United States International Trade Commission

Foundry Products:

Competitive Conditions in the U.S. Market

Investigation No. 332-460
USITC Publication 3771
May 2005

U.S. International Trade Commission

Address all communications to
Secretary to the Commission
United States International Trade Commission
Washington, DC 20436

U.S. International Trade Commission

Washington, DC 20436
www.usitc.gov

Foundry Products: Competitive Conditions in the U.S. Market

Investigation No. 332-460

Publication 3771

May 2005

This report was prepared principally by the Office of Industries

Project Leaders

Judith-Anne Webster
judith-anne.webster@usitc.gov; (202) 205-3489

Deborah A. McNay
deborah.mcnay@usitc.gov; (202) 205-3425

David Lundy
david.lundy@usitc.gov; (202) 205-3439

Primary Reviewers

John Benedetto
Laura Bloodgood

Contributing Authors

Vincent DeSapio, Queena Fan, Dennis Fravel, Gerald Houck, Harry Lenchitz, Christopher Mapes, Heather Sykes, Craig Thomsen, Alan Treat, Karl Tsuji, Norman VanToai, and Linda White

With special assistance from

John Ascienzo, Diane Bennett, Joanna Bonarriva, Phyillis Boone, Robert Carr, John Fry, Sharon Greenfield, John Kitzmiller, Kenneth Kozel, Ruben Mata, Seamus O'Connor, Cynthia O. Payne, Joyce Prue, Frederick Ruggles, Tracy Quilter, Monica Reed, and Janice Wayne

Under the direction of

Larry Brookhart, Chief
Natural Resources and Metals Division

ABSTRACT

This investigation provides an overview of the global foundry industry and U.S. market during 1999-2003, including principal metals and casting methods, production steps, technology, and factors of competition affecting the industry's performance and competitiveness. A profile of the U.S. foundry industry examines business trends and practices, financial performance, factors of production, and policies that affect domestic producers. Purchasing patterns and practices of downstream industries are addressed and the principal metal foundry industries are examined together with analysis of 10 selected iron-, steel-, aluminum-, and copper-based foundry products used by downstream industries. Significant foreign industries in Brazil, Canada, China, India, Korea, Mexico, and Taiwan are also examined.

The economic slowdown in 2000 and 2001 adversely affected the domestic foundry industry. Additionally, many high-volume commodity-type castings are increasingly sourced from foreign suppliers. Moreover, U.S. import statistics show increasing imports of downstream products containing the foundry product groups during 1999-2003, which suggests that purchases of downstream products containing foreign metal castings replaced use of U.S. foundry products.

Demand for metal castings is largely influenced by trends in the automotive industry, which accounts for more than one-third of reported total U.S. castings shipments. Despite an 8-percent decline in motor vehicle production during the period, a shift from iron to aluminum castings for certain automotive applications favorably affected U.S. foundry producers in these markets. Markets for ductile iron soil and pressure pipe were also reported as strong. Steel castings principally used in the railway equipment, construction, and power generation industries benefitted from an upturn in domestic manufacturing, but faced an overall decline in shipments because U.S.-based castings producers have expanded foreign operations to supply major customers that have moved manufacturing offshore. Copper castings lost market share to lower-cost PVC for valves and fittings.

U.S. purchasers of foundry products responding to the Commission questionnaire principally represented the motor vehicle, industrial machinery, mining and oil/gas field machinery and equipment, valve and pipe fittings, and construction machinery and equipment industries. In addition to quality, price is considered a significant factor in purchasing decisions, with nearly one-half of responding purchasers indicating that they usually buy castings at the lowest price. Although U.S. purchasers indicated that domestic castings producers have lowered prices, improved product quality, and shortened lead times to improve competitiveness, about one-third of reporting U.S. purchasers significantly increased their purchases of foreign castings at the expense of U.S. castings, primarily because of lower foreign pricing.

Aside from intense global competition, the foremost problem of domestic producers is their inability to adequately increase prices to compensate for significantly rising business costs, in part because purchasers can source castings from lower-cost foreign producers and often have pricing leverage in the market. Further, U.S. foundries are less able to absorb low product prices because they have higher costs relative to the foundries in developing countries. Of all metal types, the aluminum and copper foundries have a more favorable financial picture, whereas gray iron foundries face the most difficult financial condition. Despite the overall profitability of rough metal casting operations, the number of establishments experiencing operating losses doubled or tripled for gray iron, ductile iron, and steel foundries, and increased by over one-third for aluminum and copper foundries.

CONTENTS

CONTENTS–*Continued*

Page

Chapter 2: Industry overview and factors of competition—*Continued*

CONTENTS–*Continued*

CONTENTS–*Continued*

Page

Chapter 5: U.S. iron foundry industry—*Continued*

CONTENTS–*Continued*

Page

Chapter 5: U.S. iron foundry industry—*Continued*

Chapter 6: U.S. steel foundry industry 6-1

CONTENTS–*Continued*

Page

Chapter 6: U.S. steel foundry industry—*Continued*

CONTENTS–*Continued*

Page

Chapter 7: U.S. aluminum foundry industry—*Continued*

Chapter 8: U.S. copper foundry industry 8-1

CONTENTS–*Continued*

Page

Chapter 9: Profiles of the foundry industry in selected foreign countries 9-1

CONTENTS–*Continued*

Page

Chapter 9: Profiles of the foundry industry in selected foreign countries—*Continued*

CONTENTS–*Continued*

Page

Chapter 9: Profiles of the foundry industry in selected foreign countries—*Continued*

CONTENTS–*Continued*

Page

Chapter 9: Profiles of the foundry industry in selected foreign countries—*Continued*

Chapter 10: Competitive conditions in the U.S. foundry market

Appendixes

Figures

CONTENTS–*Continued*

Page

Figures—*Continued*

Tables

CONTENTS–*Continued*

Page

Tables—*Continued*

CONTENTS–*Continued*

Page

Tables—*Continued*

CONTENTS–*Continued*

Page

Tables—*Continued*

CONTENTS–*Continued*

Page

Tables—*Continued*

CONTENTS–*Continued*

Page

Tables—*Continued*

CONTENTS–*Continued*

Page

Tables—*Continued*

CONTENTS–*Continued*

Page

Tables—*Continued*

CONTENTS–*Continued*

Page

Tables—*Continued*

CONTENTS–*Continued*

Page

Tables—*Continued*

CONTENTS–*Continued*

Page

Tables—*Continued*

CONTENTS–*Continued*

Page

Tables—*Continued*

ITC READER SATISFACTION SURVEY
Foundry Products: Competitive Conditions in the U.S. Market

The U.S. International Trade Commission (USITC) is interested in your voluntary comments (burden less than 10 minutes) to help assess the value and quality of our reports, and to assist in improving future products. Please **return survey by facsimile (202-205-2217) or by mail** to the USITC, or visit the USITC Internet home page (*http://reportweb.usitc.gov/reader_survey/readersurvey.html*) to electronically submit a Web version of the survey.

(Please print; *responses below not for attribution):*

Your name and title: ____________________

Organization (if applicable): ____________________

Which format is most useful to you? ❑ CD-ROM ❑ Hardcopy ❑ USITC Internet site

Circle your assessment of each factor below: **SA** = strongly agree, **A** = agree, **N** = no opinion, **D** = disagree, or **SD** = strongly disagree.

Value of this report:					
▶ Statistical data are useful	SA	A	N	D	SD
▶ Other non-numerical facts are useful	SA	A	N	D	SD
▶ Analysis augments statistical data/other facts	SA	A	N	D	SD
▶ Relevant topic(s)/subject matter	SA	A	N	D	SD
▶ Primary or leading source of information on this subject	SA	A	N	D	SD
Quality of this report:					
▶ Clearly written	SA	A	N	D	SD
▶ Key issues are addressed	SA	A	N	D	SD
▶ Charts and graphs aid understanding	SA	A	N	D	SD
▶ References cite pertinent sources	SA	A	N	D	SD

Other preferred source of information on this subject: ____________________

Specify chapters, sections, or topics in report that are most useful: ____________________

____

____

Identify any type of additional information that should have been included in report: ____________________

____

____

Suggestions for improving report: ____________________

____

____

Please update your mailing and electronic addresses below (voluntary)-

Mailing address: ____________________

City, state, and zip code: ____________________

E-mail address: ____________________

OMB No.: 3117–0188

FOLD

UNITED STATES
INTERNATIONAL TRADE COMMISSION
WASHINGTON, DC 20436

OFFICIAL BUSINESS
PENALTY FOR PRIVATE, USE $300

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 12840 WASHINGTON, DC

POSTAGE WILL BE PAID BY ADDRESSEE

U.S INTERNATIONAL TRADE COMMISSION
500 E STREET, SW.
WASHINGTON, DC 20277-2840

ATTN:
OFFICE OF INDUSTRIES
Foundry Products: Competitive Conditions in
the U.S. Market

EXECUTIVE SUMMARY

Introduction

Following receipt on May 4, 2004, of a request from the Committee on Ways and Means of the U.S. House of Representatives (Committee), the U.S. International Trade Commission (Commission) instituted investigation No. 332-460, *Foundry Products: Competitive Conditions in the U.S. Market,* under section 332(g) of the Tariff Act of 1930. The purpose of this investigation is to provide a report analyzing competitive conditions facing the U.S. foundry industry in the U.S. market during the most recent 5-year period, including an overview of the industry together with a detailed analysis of selected key iron-, steel-, aluminum-, and copper-based foundry products which are representative of major segments of the foundry industry.

Specifically, the Committee requested the Commission to provide:

1. A profile of the U.S. foundry industry.

2. Trends in U.S. production, shipments, capacity, consumption, and trade in foundry products, as well as financial conditions of domestic producers.

3. A profile of major foreign industries including, but not necessarily limited to, Brazil and China.

4. A description of relevant U.S. and foreign government policies and regulations affecting U.S. and foreign producers as identified during the investigation by the producers and consumers of foundry products, including appropriate investment, tax, and export policies; environmental regulations; and worker health and safety regulations.

5. A comparison of various factors affecting competition between U.S. and foreign producers–such as the availability and cost of raw materials, energy, and labor; level of technology and changes in the manufacturing process; pricing practices; transportation costs; technical advice and service; and an analysis of how these factors affect the industry.

6. An analysis of the purchasing patterns and practices of downstream industries.

The primary sources of information for this study were responses to the Commission's producer and purchaser questionnaires. Responses to the producer questionnaire represented 75 percent of total 2003 castings production, as reported by the American Foundry Society. These responses were supplemented by information collected through Commission hearing testimony, fieldwork interviews with domestic producers and foreign competitors, telephone discussions with domestic and foreign industry sources, literature review, and information obtained by the Commission from other sources, including U.S. and foreign embassies and consulates and the U.S. and Foreign Commercial Service.

Competitive Conditions in the U.S. Foundry Market

The information gathered during the course of this investigation indicates the difficulties faced by the U.S. foundry industry. Most foundries remain profitable, but the number of foundries reporting losses has increased substantially for all metal types. In general, aluminum foundries are in the best competitive condition and have a more favorable financial position relative to the other metal segments, whereas gray iron foundries face the most difficult financial and competitive conditions.

U.S. producers responding to the Commission questionnaire overwhelmingly rate developing countries such as China, Brazil, and India as having an advantage in overall competitiveness in the U.S. market, citing low prices as the major reason. U.S. purchaser respondents agree for the most part that developing countries have a major price advantage in the U.S. market. This advantage derives in part from the lower production costs of these countries, mostly the result of a wide disparity in foundry wage rates between U.S. and foreign foundries.

The key production cost advantage in foreign countries is lower labor rates. This advantage is further compounded by other costs, including health benefits and pension costs, that are often higher for U.S. foundries than for their foreign competitors. Additionally, lower energy costs and lax enforcement of worker health and safety and environmental laws provide foreign foundries in China, India, and Brazil with a competitive advantage in these areas.

Raw material costs, generally the largest component of total production costs, are comparable among all countries in most cases. Product quality, labor availability, technological advancement, and exchange rates remain competitive concerns for foundries worldwide and key competitor countries do not have a clear advantage in these areas.

Competitive advantages which U.S. foundries currently maintain include strengths in complex castings, lead times, transportation, and technical advice and services. Additionally, U.S. producers have responded to competition with a broad array of initiatives, such as implementing lean manufacturing, improving customer service, and increasing automation.

U.S. Foundry Industry

The economic slowdown of 2000 and 2001, the shift from iron to aluminum castings in certain automotive applications, rising competition with polyvinyl chloride (PVC) for copper valves in household applications, and the downturn in the trucking industry starting in late 2000 significantly affected the U.S. foundry industry during 1999-2003. Additionally, there was reduced demand for domestic castings because of competition from lower-cost producing countries, particularly China. The overall loss of sales resulting from these market conditions was compounded by higher regulatory, worker benefit, and raw material costs, which reduced cash flow for the U.S. foundry industry. The financial condition of the U.S. foundry industry deteriorated from 1999 to 2003, as operating income declined for both rough and machined castings operations.

Purchasing Patterns and Practices

Price is a significant factor in purchasing decisions, with nearly one-half of responding purchasers indicating that they usually buy castings at the lowest possible price. Although U.S. purchasers indicated that domestic castings producers have lowered prices, improved product quality, and shortened lead times to improve their competitiveness, about one-third of reporting U.S. purchasers significantly increased their purchases of foreign-produced castings at the expense of U.S.-produced castings, primarily because of lower foreign pricing.

U.S. purchasers of foundry products responding to the Commission questionnaire principally represented the motor vehicle, industrial machinery, mining and oil/gas field machinery and equipment, valve and pipe fitting, and construction machinery and equipment industries. U.S. purchasers largely share similar purchasing practices for castings, despite differences in the customers and markets that they serve.

U.S. Iron Foundry Industry

Iron is the most commonly cast metal because of its relatively low cost, ease of casting into complex shapes, ease of machining, and desired physical properties. Hence, iron foundries are highly integrated into the supply chain for a wide range of downstream products, particularly the automotive, various machinery and equipment, and pipe and valve industries. However, wide dissemination of production technology renders iron foundries particularly vulnerable to foreign price competition.

Pressure to meet demands for lower prices and loss of some downstream markets from decades of material substitution efforts and more recent shifting to offshore production by certain customers have squeezed profit margins for iron foundries in recent years. This situation has been exacerbated by escalating costs for raw materials, energy, and employee benefits.

Foundries producing rough castings in the more specialized ductile-iron segment are in somewhat better financial condition than those in the more competitive gray-iron industry. Operating income for ductile-iron respondents declined by 67 percent during 1999-2003, but remained positive. Declining operating income for gray-iron respondents, however, deteriorated into losses by 2002.

Although ductile iron crankshaft/camshaft castings are generally less expensive to produce than forged steel crankshafts, they have been increasingly replaced by forged steel crankshafts in engine applications because of steel's perceived superior attributes regarding noise, vibration, and harshness (NVH) as well as longevity, strength, resistance, and smaller size. Operating income for the sector declined by one-half during 1999-2003, and two leading producers of these products recently filed for Chapter 11 bankruptcy reorganization.

U.S. producers of gray iron motor vehicle gear box castings principally produce housings for transmissions used primarily on trucks and agricultural and construction machinery. U.S. producers' shipments have been subject to price pressures from end-users, competition from imported machined castings, a shift from gray iron to aluminum and ductile iron by end-users, and imports of finished transmissions. However, reporting producers of gray iron motor vehicle gear box castings generally posted positive financial results during 1999-2003.

During 1999-2003, a drop in demand from U.S. motor vehicle manufacturers (the dominant consumers) combined with increased import competition resulted in significant decreases in production and employment in the domestic ductile iron bearing housings industry, particularly among producers of machined castings. Although many performance indicators for the industry rebounded in 2003, financial performance declined throughout the period, with operating income showing a loss in 2003. Forty percent of reporting firms operated at a loss in 2003.

U.S. producers of gray iron compressor housing castings reported steady declines in net sales quantities, net sales values, and operating income during 1999-2003, which are largely attributed to a decrease in production of products incorporating compressor housings in the United States.

U.S. foundries maintain a competitive advantage in specialized gray iron pump castings due to relative difficulties in sourcing these castings overseas. For high volume, price-sensitive, commodity-type castings, China has made competitive inroads because of labor cost advantages. Operating income for responding foundries declined 65 percent during the period, and by 2003, 18 of the 29 producers reporting financial data had operating losses.

U.S. producers of gray iron non-motor vehicle castings primarily produce housings for transmissions, construction machinery, material-handling machinery, and stationary applications at steel mills, paper mills, mines, power plants, and other industrial plants. U.S. gear box producers have in some instances used foreign-produced castings, but have not shifted to imports to a significant degree. Some U.S. producers of these castings have noted a decline for their product, in part because of imports of finished products incorporating gear boxes. Operating income for this industry declined by one-half from its 2000 level and over 40 percent from its 1999 level.

U.S. Steel Foundry Industry

Railway equipment, which dominates industry shipments, and construction, industrial, and mining and oil/gas field machinery and equipment account for approximately 90 percent of domestic steel foundry shipments, by quantity. Typical products made from steel castings include compressors, mechanical components, pumps, tools, and valves.

Operating income for reporting producers' rough steel castings operations decreased by 54 percent as the ratio of costs to net sales for raw materials, direct labor, and energy increased. Energy costs, in particular, affected this sector, with an average increase of 39 percent per ton during 1999-2003. Steel foundries also reportedly face an overall contraction in domestic demand partly because an increasing share of global manufacturing is performed outside the United States resulting in expanded foreign steel casting operations by U.S.-based producers.

Foreign producers of both rough and machined *steel valve castings* increased U.S. market presence through consistently lower prices and high quality that matched U.S.-produced castings during 1999-2003. The domestic industry has consolidated, with a few U.S. producers accounting for a majority of domestic production. In response to competitive pressures from foreign producers, U.S. producers have increasingly focused on higher value-added machined castings. In light of this competition, U.S. firms will likely focus on productivity gains and innovation, as well as on niche markets for machined steel valve castings to maintain a competitive position.

U.S. Aluminum Foundry Industry

Production, capacity, and shipments of aluminum castings by questionnaire respondents increased during 1999-2003 (by 15 percent, 35 percent, and 20 percent, respectively), reflecting growing worldwide demand for aluminum products, particularly in automotive applications. Consequently, reported aluminum foundry profitability recovered from lows in 2001, as operating income rebounded in 2003 to surpass 1999 levels by 12 percent. The impact of the 2001 economic downturn is reflected in the sharp increase in firms reporting operating losses, which increased from 25 percent of reporting firms in 2000 to 36 percent in 2001. Responding foundries that also machined aluminum castings exhibited stronger financial performance than those with solely rough casting operations.

The U.S. market for aluminum castings used as engine components is primarily influenced by trends in the motor-vehicle industry, particularly North American motor-vehicle production levels and Corporate Average Fuel Efficiency (CAFE) and emissions standards. Aluminum engine components are increasingly used in motor-vehicle engine applications because of their light weight, relative strength, and good recycling characteristics. Despite price pressures in the motor vehicle industry, responding U.S. producers of rough and machined castings recorded profits throughout the period.

U.S. foundries maintain a competitive edge in aluminum castings for use in automobile suspension and steering systems because of U.S. superiority in the design and manufacture of these castings. This design and manufacturing expertise is a result of longer U.S. experience in manufacturing aluminum castings for automobiles, largely attributable to greater use of aluminum by U.S. automakers compared with foreign manufacturers. Operating income for reporting producers of rough castings rebounded from a loss in 2001, but declined irregularly for foundries reporting on machined castings operations.

U.S. Copper Foundry Industry

The copper castings industry was negatively affected by the economic downturn during 2000 and 2001 and the rise in interest rates that slowed housing starts in 2000. The rough copper foundry industry recovered in 2002 and 2003 from lows in 2001. Operating income rebounded just short of 1999 levels in 2002 as firms found process efficiencies through automation, began to offer fully machined and finished products, took on niche product lines, and shortened lead times.

Operating income for the machining operations declined at a faster rate than for rough casting operations. Operating income for rough copper castings remained high (11 percent of net sales in 2003), whereas machined castings operations posted an operating margin about one-half of that of the rough castings producers. Ease of casting and wide dissemination of production technology make copper foundries vulnerable to foreign price competition.

Demand for copper valves is dependent upon investment in new capital goods, replacement of valves in existing piping systems, and the residential construction industry. Copper valves compete with PVC for many household and low-pressure applications, and the market share of copper has been declining because of advantages of PVC in cost and ease of installation. Purchases of U.S.-produced machined copper valve castings fell by 56 percent during 1999-2003, whereas purchases of imported castings rose by 70 percent, with China accounting for most of the increase. Although operating income on sales of rough copper valves decreased while operating income increased on sales of machined castings during the period, the positive return on net sales for each operation remained virtually unchanged.

Country Profiles

Brazil

The resurgent Brazilian economy has generated increased demand for foundry products from leading markets, such as the motor-vehicle industry. Despite concerns about high interest rates, an overburdened transportation infrastructure, and the ability to hire and retain skilled employees, the Brazilian industry anticipates that domestic demand for foundry products will continue to increase as major end-use markets benefit from the improved economy, greater consumer spending, and infrastructure investments. Brazilian foundries are characterized by extensive use of domestically produced raw materials, which accounts for the dominance of cast iron in its product mix, and output of labor-intensive cast products. An estimated 70 percent of Brazil’s exports are destined for the United States. Engine blocks and cylinder heads of gray iron (for diesel engines) and aluminum are among the leading Brazilian foundry exports to the United States.

Additional investment in the Brazilian foundry industry is needed to meet projected increased demand and maintain its position as a net exporter of foundry products. By 2009, Brazilian castings demand is expected to outstrip installed capacity. The significant deficit in projected domestic supply may result in increased imports into the Brazilian market, particularly for the growing motor vehicle industry.

Canada

Canadian metal casting is a small but well established industry that is responding to an increasingly competitive global market with value-added products and customer support services. The industry responded to rising production costs and a tighter labor market with education and advanced technology, thus increasing the average annual output value per production worker by almost $16,000 in 2002.

Despite relatively constant shipment values, Canada recorded growing exports whereas increased imports supported domestic demand for lower-priced, commodity-type castings. The United States has long been Canada's major export market, accounting for 87 percent of total exports in 2003.

China

China is now the world's largest producer of foundry products (surpassing the United States in 2002), with total output of 20 million metric tons and employment of over 1.2 million people in 2004. The industry includes up to 25,000 producers, although 20,000 of these are small-scale enterprises. Industry concentration is high, with the 1,400 members of the Chinese Foundry Association accounting for 70 percent of total production by weight.

China's rapidly expanding foundry industry reflects burgeoning demand from the country's fast-growing manufacturing sector and foreign direct investment (FDI), which has increased the number of joint ventures with foreign partners and, to a lesser extent, wholly foreign-owned foundry operations. Foreign investment is also a source of technological and management advancement for the industry.

Chinese foundries typically produce low-quality castings, use older equipment, are inefficient, and cause significant harmful environmental effects. The Chinese industry's proportion of high-value castings is less than for developed countries, its overall level of technology and productivity are low, and energy consumption is high. Chinese foundries also produce a large amount of basic, low-value castings of relatively simple metallurgy. Moreover, management skill and technical expertise overall are average by world standards. However, certain operations are among the most advanced in the world, producing high quality castings using state-of-the-art machinery and modern management techniques.

India

India's metal foundry industry is expected to grow steadily, as its exports amounted to only 1 percent of total global consumption in 2003. India's ability to produce almost any type of casting at any quality level, at a competitive price, together with its annual capacity of 7.5 million metric tons, makes it a world leading outsourcing destination for casting products. In 2003, India was the sixth-largest metal casting producer in the world with total output of 4.0 million metric tons, employing 500,000 in 5,000 foundries. Approximately 500 foundries (10 percent of the total) account for 70 percent of India's total production. These are large, modern, and globally competitive metal foundries.

Gray iron is currently the predominant metal type cast in India. However, faced with intense and growing competition from China, the Indian foundry industry has shifted from its low-wage competitive strategy to the higher value-added and more capital-intensive segments of the industry. India's metal casting industry has benefitted from government support and export-oriented industrial policies since the 1991 trade reforms.

Korea

Despite an economic downturn, the Korean foundry industry has gradually increased metal castings production during 1999-2003. Expansion can be attributable to a number of factors, such as the presence of large domestic consumers, particularly the Korean automobile industry. In 2003, almost 86 percent of production was concentrated in iron castings. Primary export markets for Korean castings in 2003 were Japan and the United States.

The foundry industry faces many government regulations in Korea that are similar to those in the United States. However, the Korean Government has some general industrial policies that benefit the foundry industry, particularly lower energy prices for the industrial sector.

Mexico

Metal foundries are well established in Mexico, having benefitted from extensive FDI during the 1970s and 1980s, particularly by U.S., European, and Japanese automobile and automotive parts manufacturers that sought out Mexico as an export platform for production-sharing operations. Despite being well integrated in the North American production chain, with the automotive sector consuming roughly three-fifths of all Mexican-produced castings, Mexican foundries have been overshadowed since the late 1990s-early 2000s by rising production in China and India.

Mexican foundries cast mostly gray iron and aluminum. The industry consists of both Mexican and foreign-owned firms, with most being small and medium-size operations. Top-end foundries are tier-1 automotive parts producers or casters of other engineered components. Mid-range foundries tend to be job shops that produce less-sophisticated products for both automotive and non-automotive applications. The low-end foundries cast simple shapes in large-volume runs, which renders them vulnerable to rising competition from lower-cost, foreign competitors with similar capabilities.

Considered high-tech by North American standards, Mexican foundries are highly regarded for their casting technologies and capabilities, along with highly skilled pattern-making and lost-foam molding. Labor costs are low but rising. Other factors driving up production costs for Mexican foundries are an unevenly developed transportation network; shortage of technically skilled labor, technicians, engineers, and managers; high import dependency for ferrous scrap and aluminum; high-cost electricity and natural gas; and limited and expensive domestic bank credit.

Taiwan

The foundry industry in Taiwan has experienced fluctuations in production levels during 1999-2003. The number of foundries has declined significantly in the past decades, which can be attributed to the shift to overseas production of many downstream consuming industries. Production of iron castings accounted for nearly 71 percent of the industry's total output in 2003.

CHAPTER 1
INTRODUCTION

Purpose and Scope of the Report

On May 4, 2004, the U.S. International Trade Commission (USITC or Commission) received a letter from the Committee on Ways and Means of the U.S. House of Representatives (Committee), requesting that the Commission conduct an investigation, under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)), of the current competitive conditions facing producers in the U.S. foundry industry with respect to the U.S. market.[1] In response, the Commission instituted investigation No. 332-460, *Foundry Products: Competitive Conditions in the U.S. Market* on June 3, 2004. The Committee asked the Commission to provide its report within 12 months of the receipt of the request, or by May 4, 2005.

The Committee requested that the Commission provide an overview of the industry, together with a detailed analysis of selected key iron-, steel-, aluminum-, and copper-based foundry products which are representative of the major segments of the foundry industry. The Committee requested that the Commission's report provide information for the most recent 5-year period, to the extent possible, regarding:

1. A profile of the U.S. foundry industry.

2. Trends in U.S. production, shipments, capacity, consumption, and trade in foundry products, as well as financial conditions of domestic producers.

3. A profile of major foreign industries including, but not necessarily limited to, Brazil and China.

4. A description of relevant U.S. and foreign government policies and regulations affecting U.S. and foreign producers as identified during the investigation by the producers and consumers of foundry products, including appropriate investment, tax, and export policies; environmental regulations; and worker health and safety regulations.

5. A comparison of various factors affecting competition between U.S. and foreign producers–such as the availability and cost of raw materials, energy, and labor; level of technology and changes in the manufacturing process; pricing practices; transportation costs; technical advice and service; and an analysis of how these factors affect the industry.

6. An analysis of the purchasing patterns and practices of downstream industries.

Public notice of this investigation was posted in the Office of the Secretary, U.S. International Trade Commission, Washington, DC 20436, and published in the *Federal Register* (69 F.R. 33402).[2] A public hearing, in which all interested parties were permitted to present testimony regarding this investigation, was held on October 14, 2004, in Washington, DC.[3] A copy of the transcript of the hearing, as well as written statements submitted in conjunction with this investigation, may be found at the Commission's Internet site *http://www.usitc.gov* under the dockets section.

[1] A copy of the request letter is included in app. A.
[2] This notice is included in app. B.
[3] A list of hearing participants is included in app. C.

Product and Industry Coverage

Foundry products are near net shape (i.e., close to final dimension) cast parts (or simply castings) of various metal types and their alloys. To produce a casting, molten metal is poured or injected into a mold. When released from the mold, the resulting product is a *rough* casting.[4] Typically, these castings are further processed by *machining*, which entails smoothing surfaces, drilling holes, cutting threads for fasteners, and other steps necessary for incorporation into an assembly.[5]

For the purposes of this investigation, the Commission considers the foundry industry to be composed of establishments that produce rough castings of the specified metal types. These establishments, in some cases, also produce machined castings and assembled products that incorporate castings. Machining and assembly operations that are not performed at foundry establishments are not included in the scope of this investigation.

Virtually every piece of machinery and equipment contains a cast metal part. Typical castings include engine blocks, ship propellers, faucet valves, and differential housings. Applications include motor vehicles of all types; agricultural, construction, mining, refrigeration, and railway equipment; pipes and valves; and aircraft parts.

Organization

The report is divided into 10 chapters. Chapter 1 sets forth the scope of analysis on foundry products by defining the industry, products, and time period under study, and describes the data-gathering efforts for this study. Chapter 2 identifies the metal types, casting methods, and manufacturing process, and explains casting technology and the factors of competition affecting the foundry products industry. The last part of this chapter explains the analytical framework of the investigation. Chapter 3 provides a profile of the U.S. foundry industry, including trends in business indicators, trade, factors of production, and financial performance, and discusses government programs and policies that affect domestic producers. Chapter 4 describes purchasing practices in the U.S. market. Chapters 5-8 examine the four metal types of castings together with analysis of selected key iron-, steel-, aluminum-, and copper-based foundry products used in downstream industries. Chapter 9 provides information on the foundry products industry in countries that were identified during the course of the investigation as significant competitors in the U.S. market. This chapter includes separate industry profiles and a discussion of business trends, factors of production, and government policies and regulations affecting foreign producers in Brazil, Canada, China, India, Korea, Mexico, and Taiwan. Finally, chapter 10 summarizes the condition of the U.S. foundry industry and assesses factors affecting competition between U.S. and foreign producers in the U.S. market.

Study Approach

This report assesses competitive conditions faced by the U.S. foundry products industry, and compares it to selected foreign industries that supply the U.S. market. The foreign countries selected were identified during the course of the investigation as the major competitors in the U.S. market and include Brazil, China, India, Korea, Mexico, and Taiwan. Canada also was included because its industry is integrated to a significant extent with the U.S. industry. Most of the data presented in this investigation cover 1999-2003, but the report also includes additional information for 2004 and part of 2005, as available.

---

[4] A grinding step is usually necessary to remove filling passages and other excess metal adhering to the rough casting.

[5] For some products, such as manhole covers, only a minor amount of machining is necessary.

The Commission determined that detailed data on U.S. producers and purchasers were not available at the level of detail necessary to evaluate competitive conditions in the U.S. market. Therefore, the Commission developed both producer and purchaser questionnaires that served as the principal data source for the investigation. The aggregated data for the 1999-2003 time period provided the basis for a trend analysis of U.S. producer and market conditions.[6] Publicly available data from trade journals and the U.S. Department of Commerce and other government agencies were also used as data sources.

There are more than 2,000 foundry establishments producing all metal types in the United States, according to information provided by the American Foundry Society (AFS), a U.S. trade association representing the foundry industry. AFS maintains a database listing all U.S. foundries known to them. USITC staff used this database, supplemented by an additional list of foundries identified using other company directories and Internet searches, to compile a mailing list for the producer questionnaire. AFS indicated that small foundries would have difficulty completing the questionnaire because they lack resources or data systems to retrieve the necessary information. Therefore, USITC staff sent producer questionnaires only to the 1,250 establishments with 50 or more employees.[7] Questionnaires were also available on the Commission's website to allow firms to voluntarily participate in the information gathering activities, if they so desired.

Purchasers of foreign foundry products in the United States likely number in the tens of thousands because the use of metal castings is so common in manufacturing industries. Sending a questionnaire to all purchasers to gather data necessary for an examination of U.S. purchases of foreign foundry products was not feasible within the 1-year time frame of this investigation. Therefore, the Commission, in consultation with the Committee and AFS, selected 10 product groups, believed to be representative, for a detailed competitive evaluation.[8] The Commission identified the Harmonized Tariff Schedule of the United States (HTS) classifications for all the items in these 10 product groups,[9] and compiled a list of the importers of such products from U.S. Customs and Border Protection records. A list of purchasing companies was also gathered by requesting producers to provide customer lists.[10] USITC staff developed a sample of nearly 1,600 purchasers of both domestic- and foreign-origin castings using these two sources. These purchasers were requested to provide data regarding their purchases of castings classified in the product groups and, in addition, their total purchases of all iron-, steel-, aluminum-, and copper-based castings.

Questionnaire Responses

Questionnaire responses provided the Commission detailed information on shipments, domestic and foreign purchases, exports, employment and wages, financial performance, investment, and U.S. market conditions for 1999-2003. Producer questionnaire responses were received from 680 establishments out of

---

[6] Questionnaires requested data for 1999-2003 from U.S. producers and purchasers. Because questionnaires were mailed during late summer/early fall of 2004, the latest year that data could be gathered was 2003.

[7] The only available information indicating the size of individual establishments was employment data from AFS. Based on these data, those establishments with 50 or more employees represent over 90 percent of the total employment of the U.S. industry, suggesting that industry coverage, with respect to total output, was high.

[8] The 10 groups include cast products used in the following downstream products: ductile iron crankshafts/camshafts; aluminum engine components; aluminum suspension/steering systems; gray iron motor vehicle gear boxes; copper valves; steel valves; ductile iron bearing housings; gray iron compressor housings; gray iron pump parts; and gray iron non-motor vehicle gear boxes.

[9] Foundry products are not specifically provided for in the HTS in most cases, and are typically classified in a category that includes finished assemblies or parts of finished assemblies. Therefore, U.S. import classifications provide aggregate data that do not specifically identify castings. Consequently, questionnaires had to be used to gather trade data.

[10] The producer and purchaser questionnaires were issued sequentially so that information gathered from the producer questionnaires could be used in the purchaser questionnaire phase.

1,246 mailed (55 percent response rate).[11] Most non-respondents are believed to be small producers, based on information from the AFS database. Of the 680 establishments responding, 422 reported production of iron-, steel-, aluminum-, or copper-based castings. Although the Commission extended the cutoff date for questionnaire receipt by over 5 months, questionnaire responses were not provided by several large establishments. Purchaser questionnaire responses were received from 651 companies of 1,591 mailed (41 percent response rate), with 470 firms indicating they purchased the castings specified within the scope of the investigation.

A significant number of questionnaires were returned bearing incomplete or internally inconsistent data. Most of these questionnaires were completed or corrected through the efforts of Commission staff by telephone and e-mail follow-up. A small number remained incomplete, and any data provided were used to the extent possible. The information compiled from the producer questionnaires is likely representative of the foundry industry as a whole; aggregate shipments from the producer questionnaire represent almost 75 percent of total shipments in 2003, as reported by AFS. There was no similar basis of comparison for information from the purchaser questionnaire, so it is not possible to determine the extent to which these data are representative of total purchases of the specified product groups.

Supplemental Information

The data in the questionnaire responses were supplemented by testimony presented at the Commission's public hearing and by written submissions filed with the Commission by interested parties. Information also was obtained from field interviews, trade associations, contacts with industry representatives (producers, suppliers, and purchasers), trade literature, and Internet sites. Domestic fieldwork included interviews and plant visits in Alabama, Maryland, Michigan, Pennsylvania, and Ohio. For information on the foundry industries of other countries, interviews and plant visits were conducted with government and trade association representatives, producers, and purchasers in Brazil, China, and India.

Many foundries ceased operating during 1999-2003 and did not complete a producer questionnaire. Therefore, aggregate data from the producer questionnaire, although believed to be representative, may not fully reflect trends in the foundry industry. To compensate for missing data and to account for trends since 2003, USITC staff relied on interviews with domestic and foreign producers and purchasers, and secondary sources as available.

Previous Commission Investigations

In 1984, the Commission, at the request of the U.S. Trade Representative, conducted an investigation to examine the competitive position of the U.S. foundry industry in domestic and world markets. In September 1984, the Commission issued its report, covering the period 1979-83.[12] Since that time, there have been key changes in the industry and markets including the emergence of less-developed countries as leading world producers. Another notable trend is the growth in global foundry production since the early 1980s, from 52 million short tons in 1982 to over 73 million short tons in 2003.[13]

[11] Thirty-nine questionnaires were returned by the U.S. Postal Service as undeliverable, which may indicate that these firms have gone out of business.

[12] USITC, *Competitive Assessment of the U.S. Foundry Industry*, investigation No. 332-176, USITC publication 1582, Sept. 1984.

[13] The 1982 production amount is from the Commission's 1984 report. The 2003 production amount is from "38th Census of World Casting Production–2003,' *Modern Casting*, Dec. 2004, p. 25.

CHAPTER 2
INDUSTRY OVERVIEW AND FACTORS OF COMPETITION

Overview of the Castings Industry

The metal castings industry is diverse, ranging from small operations that specialize in low-volume specialty products to large establishments producing thousands of tons of castings per year. Individual castings range from less than one ounce to many tons. Each establishment has specialized equipment that is suited to a particular metal, casting size, and order volume for its target market. In many cases, foundries are categorized as either job shops or captive operations. Job shops tend to produce short runs for a broad range of customers, and typically accrue the higher costs that are associated with changing production lines and maintaining large inventories of patterns for their many customers. Although job shops have the flexibility to adapt to changing market needs, they typically lack the capital resources of a captive operation to invest in plant modernization.[1] Captive shops are internal units of companies that supply castings for their affiliated manufacturing operations. Because these foundries generally supply one customer, their success largely reflects the performance of their affiliated manufacturing facility and its market. Captive operations typically have access to financial resources of the affiliated manufacturing operations to carry them through difficult operating periods, and often have a guaranteed line of business.[2] In addition to these categories, foundries are also grouped by those that offer a broad range of products to a small customer base and those that produce a limited number of products for a large group of customers. Foundries with a small customer base are often more vulnerable to cyclical industry declines.

The global market is increasingly segmented into commodity and specialized castings. Commodity castings are generally less sophisticated, simpler castings that can be produced by most producers because limited technical skill and technology levels are required. Specialized castings, however, generally require more complex designs and manufacturing technologies, and may be proprietary in nature. They generally must meet higher standards, such as closer tolerances and tighter material specifications, than commodity-type castings. As a result, these castings typically command a higher price and are often sourced from more sophisticated foundry operations.

Metal Types

Cast iron, steel, aluminum, and copper accounted for 92 percent, by value, of metal castings produced in the United States in 2002, with cast iron alone, in its several variations, accounting for about 38 percent; steel for 17 percent; aluminum for 32 percent; and copper for 5 percent.[3]

[1] U.S. industry official, telephone interview with USITC staff, Mar. 2005.
[2] Ibid.
[3] U.S. Census Bureau, Economic Census 2002. Other metals commonly produced as castings include zinc, magnesium, lead, and nickel.

Iron

Cast iron and steel are alloys of the metallic element iron, but they differ in important ways. Cast iron contains over 2 percent by weight of carbon, and as a result has a lower melting temperature and requires less refining than does steel, which has a typical carbon content of 0.5 percent. Iron castings can therefore be produced with less costly and less specialized equipment than steel castings. Because cast iron shrinks less when solidifying than does steel, it can be cast into more complex shapes; however, iron castings do not have sufficient ductility to be rolled or forged (table 2-1).[4]

Iron is the most commonly cast metal in the foundry industry, being not only relatively less costly to produce than cast steel, but also easily cast, readily machinable, and suitable for a wide range of cast metal products that do not require the superior strength and malleability of steel.[5] The iron foundry industry comprises establishments that produce both rough and machined iron castings. Metal foundries produce molten iron by melting scrap iron, pig iron, and scrap steel in a traditional coke-fired cupola furnace, or in electric-induction or electric-arc furnaces. Molten iron is refined by adding alloying metals into either the furnace or a ladle. It is then moved to a pouring station for pouring into molds. Molten iron is cast by most molding processes, but is less suited for permanent molding and injection molding (die casting) because its high melting temperature increases wear on the casting surfaces of cast-iron permanent molds and steel dies.

There are several important types of cast iron, each of which has physical properties that make it suitable for specific applications.

Gray iron.[6]—Gray iron is the most widely cast metal and is easier to cast and less costly to produce than other types of cast iron because it does not require special alloy additions necessary to produce ductile iron or compacted-graphite iron nor does it require annealing (heat treatment) of the rough castings as is necessary to produce malleable iron.[7]

The largest end use for gray iron castings is the motor vehicle industry. Gray iron is ideal for engine blocks because it can be cast into complex shapes at relatively low cost. Gray iron also is preferred for engine blocks because of its high strength-to-weight ratio, ability to withstand high pressures and temperatures, corrosion resistance, and greater wear resistance compared to aluminum. Gray iron is suitable for brake drums and disks because of its dimensional stability under differential heating. It is suitable for internal-combustion engine cylinders because of its low level of surface-friction resistance. It is suitable for gear boxes, differential housings, power-transmission housings, and speed changers in both automotive and non-automotive applications because of its high vibration-dampening capability. Other casting applications for gray iron include compressor housings for appliances and other equipment; construction castings and fittings (e.g., man-hole covers, storm grates and drains, grating, fire hydrants, lamp posts, etc.); utility meter box covers; soil pipe and fittings; parts for pumps for liquids; and rolls for rolling mills, among other cast products.

---

[4] "Understanding Cast Irons," *Engineered Casting Solutions*, summer 2000, pp. 28-29, found at *http://www.castingsource.com/tech_art_understanding.asp*, retrieved July 22, 2004.

[5] C.R. Loper, "Foundry Practice and Equipment," *Mark's Standard Handbook for Mechanical Engineers* (New York: McGraw Hill, 1985).

[6] Compiled from "Mechanical Properties of Gray Iron," *Engineered Casting Solutions*, summer 2000, pp. 30-33, found at *http://www.castingsource.com/tech_art_grayiron.asp*, retrieved July 22, 2004; and D.E. Krause, The Gray Iron Research Institute, Inc., "Gray Iron, a Unique Engineering Material," Iron Casting Research Institute, found at *http//www.ironcasting.org/Gray%20Iron%20A%20Unique%20Material.htm*, retrieved July 22, 2004.

[7] The physical properties of gray iron are reflected in its microstructure with carbon occurring in the form of a network of graphite flakes throughout the silicon-iron matrix.

Table 2-1
A comparison of the characteristics of casting irons with casting steel[1]

Characteristic	Gray iron	Ductile iron	Malleable iron	Carbon steel[2]
Carbon content (*percent*)	2.5 - 4.0	3.0 - 4.4	2.0 - 2.7	0 - 2.1
Silicon content (*percent*)	1.0 - 3.0	1.5 - 2.8	1.1 - 1.6	0 - 2.0
	Ranking			
Castability	4	4	3	1
Ease of machining	4	3	3	1
Vibration damping	4	3	3	1
Surface hardenability	4	4	4	1
Elasticity modulus (stiffness)	1	4	3	4
Impact resistance	1	3	2	4
Corrosion resistance	4	4	3	1
Strength to weight	1	4	2	3
Wear resistance	3	4	2	1
Production cost	4	3	2	1

[1] Characteristics are ranked from 4 (best) to 1 (least/worst) as comparisons among various types of casting irons and a selected casting steel, and should not be interpreted relative to all types of ferrous and non-ferrous (e.g., aluminum and copper alloys, among others) casting metals.

[2] Carbon and silicon ranges reflect all types of casting steels. In contrast, for ranking purposes, characteristics of casting irons are compared to those of a 0.3-percent carbon steel. Castings produced from alloy steel may have higher strength relative to ductile iron.

Source: Ductile Iron Society, "Ductile Iron Data for Design Engineers," figure 2.7: Comparison of the engineering characteristics of Ductile iron versus competitive ferrous cast metals, found at *http://www.ductile.org/didata/Section2/figures/pfig2_7.htm*; and figure 2.3: Approximate ranges of carbon and silicon for steel and various cast irons, found at *http://www.ductile.org/didata/Section2/figures/pfig2_3.htm*, retrieved July 22, 2004.

***Ductile iron.*[8]—**Ductile iron (also called "nodular iron") combines many of the engineering qualities of steel with the processing capabilities of iron. To produce ductile iron, magnesium is added to molten iron, which increases the ductility, stiffness, impact resistance, and tensile strength of the resulting castings. Ductile iron also offers flexibility in casting a wide range of sizes, with sections ranging from very thin to very thick. Ductile iron is a growth metal in the casting industry to the point of approaching gray-iron production levels. Ductile iron is primarily used for pipes, tubes, and fittings, and for automotive parts. Pressure pipe and fittings are cast with ductile iron primarily to resist fracturing from ground movement, shocks, and soil corrosion;[9] these products are common in municipal water and sewage systems. For the automotive industry, ductile iron is cast into camshafts and crankshafts for internal-combustion engines. Other end uses for ductile iron castings are bearing housings, machinery components, construction and utility applications, and electric and electronic equipment components.

[8] Compiled from "Mechanical Properties of Ductile Iron," *Engineered Casting Solutions*, pp. 34-35, found at *http://www.castingsource.com/tech_art_ductile.asp*, retrieved July 22, 2004; "Introduction," *Ductile Iron Data for Design Engineers*, Ductile Iron Society, found at *http://www.ductile.org/didata/Section2/2intro.htm*, retrieved July 22, 2004; and "Designing with Ductile Iron," *Ductile Iron Data for Design Engineers*, Ductile Iron Society, found at *http://www.ductile.org/didata/Section10//10intro.htm*, retrieved July 22, 2004.

[9] The chemicals contained in soil react with variables such as moisture and level of aeration to corrode metals. Corrosion in Soils, found at *http://www.corrosion-doctors.org/SoilCorrosion/Frames.htm*, retrieved Apr. 26, 2005.

Malleable iron.[10]**—**Malleable iron is cast iron with properties similar to those of ductile iron, however, malleable iron castings are produced by a method that requires a lengthy period of annealing in a special furnace to induce characteristics of increased strength, durability, and ductility; ease of machining; and high resistance to atmospheric corrosion. The lengthy annealing period increases the relative cost of producing castings of malleable iron compared to those of gray or ductile irons. In addition, technical requirements limit the thickness of a casting that can practically be produced of malleable iron. Malleable iron use declined, particularly for automotive parts, after widespread adoption of the ductile-iron process in the early 1970s. A major use for malleable iron is pipe fittings, particularly for applications that require resistance to shock and vibration or rapid temperature changes.

Compacted graphite iron.[11]**—**Compacted graphite iron (CGI) exhibits properties that are intermediate between those of gray and ductile iron, and results from the addition of certain rare-earth elements and titanium to molten iron. Recent growth in CGI use was made possible by the development of advanced sensors and controls for the precise metallurgical additions to molten iron. CGI exhibits unique properties of medium to high strength, good thermal conductivity, low shrinkage, and medium dampening capacity while retaining much of the castability of gray iron to produce complex shapes and intricately cored passages. CGI also provides a better machined finish than gray iron. CGI exhibits slightly higher thermal conductivity, more dampening capacity, and better machinability than is possible with ductile iron. A drawback of CGI castings is the close metallurgical control necessary to obtain successive castings with consistent properties. The largest end use for CGI is internal-combustion engine blocks for both motor vehicles and other applications.

Steel

Steel castings are produced in a wide range of chemical compositions and physical properties. Steel castings are, in general, of higher strength and ductility than cast iron. Castings of alloy steel have high strength, and those of stainless steel are highly resistant to corrosion.

Steel castings are used extensively in the agricultural, construction, manufacturing, power generation, processing, and transportation industries. Typical products made from steel castings include bridge and building supports, compressors, mechanical components, pumps, tools, and valves. The railway rolling-stock industry is the largest consumer of steel castings in the United States, by volume. Because of their high strength and low cost, highly engineered lightweight steel castings are increasingly used in high-volume automotive chassis and drive-train applications.

Aluminum

Cast aluminum and aluminum-based alloys dominate the nonferrous castings market, accounting for 74 percent ($6.0 billion) of total U.S. nonferrous casting shipments in 2002.[12] Aluminum-alloy castings contain varying amounts of silicon, copper, magnesium, tin, and zinc.

The strength-to-weight ratio of aluminum is among the highest of all metals, which has enabled lighter-weight aluminum to find a niche in almost every segment of the transportation industry—particularly in aerospace where aluminum castings are used for such applications as engine and airframe parts. Motor vehicle use of aluminum has tripled to 250 pounds per vehicle in the past three decades, with the major cast

[10] Compiled from "Mechanical Properties of Malleable Iron," *Engineered Casting Solutions*, summer 2000, pp. 40-41, found at *http://www.castingsource.com/tech_art_malleable.asp*, retrieved July 22, 2004.

[11] Compiled from "Mechanical Properties of Compacted Graphite Iron," *Engineered Casting Solutions*, summer 2000, pp. 38-39, found at *http://www.castingsource.com/tech_art_graphite.asp*, retrieved July 22, 2004.

[12] "Nonferrous Castings: 2002," U.S. Census Bureau, July 2003, table 2.

components (200 pounds per vehicle) being cylinder heads, intake manifolds, engine blocks, wheels, shock towers, and front knuckles.[13] Other automotive applications for aluminum castings are pistons and connecting rods, die-cast electrical-switch boxes,[14] and power heads.

Copper

Copper castings include those of copper-based alloys, such as brass (copper with zinc as the primary alloying metal) and bronze (a large family of copper alloys with tin, aluminum, manganese, or another metal as the primary alloying metal). Copper castings have high corrosion resistance, good electrical and thermal conductivity (especially pure or near pure copper castings), and good tensile and compressive strength (certain alloys are nearly as strong as many stainless steel alloys), are non-sparking, and exhibit low friction and good wear resistance when in contact with other metals and materials. In addition, they maintain these properties at extremely low temperatures. Copper castings are especially amenable to post-casting operations such as machining, brazing, soldering, polishing, and plating.

Typical applications for copper castings include valves that control the flow of liquids and gases; plumbing fixtures such as faucets; power plant water impellers; architectural applications (e.g., door hardware); ship propellers; bearing sleeves; and electrical circuit parts (e.g., circuit breakers).

Casting Methods

Sand Casting

Sand casting is the most common method of metal casting, accounting for approximately 75 percent of all metal cast. It consists of forming a cavity in sand with a pattern,[15] filling the cavity with molten metal, allowing it to cool and solidify, and then releasing the casting by breaking away the sand. Patterns are full-size models having the shape of the exterior of the casting to be produced and may be made of wood, brass, aluminum, or other material. The choice of material for a pattern depends on the expected number of times it will be used and the cost of producing it. If the casting has features such as a hollow interior or internal holes, inserts ("cores") made of sand (with resin binder) are placed in the impression before the two parts of the mold are joined.

Shell-Mold Casting

Shell-mold casting is a variation of sand casting in which sand containing a resin binder is cured by heat. The pattern is heated and impressed into sand. The sand cures in contact with the hot pattern, after which excess sand is removed, leaving a shell mold. Shell molding castings can be used for any metal, and the process generally produces castings of greater dimensional accuracy at a higher rate of production than green- or dry-sand casting. Typical parts produced by shell casting include connecting rods, gear housings, and lever arms.

---

[13] Ducker Research, from presentation by Andrew M. Sherman, "Trends in Automotive Applications for Aluminum," Manufacturing and Vehicle Design Research Laboratory, Ford Motor Company, 7th International Conference on Aluminum Alloys, Charlottesville, Virginia, Apr. 10, 2000, found at *http://www.cs.virginia.edu/icaa7/trends.pdf*, retrieved Aug. 2, 2004.

[14] NEMA 4X-rated electronic enclosures by Bud Industries, found at *http://www.automationtechies.com/store/pid11710.php*, retrieved Aug. 2, 2004.

[15] Sand molds may be either "green sand" in which the sand is moistened with a water-based binder, or "dry-sand" in which the sand is treated with an organic binder and then baked hard to remove moisture and increase strength.

Investment Casting

Investment casting is a process also known as the "lost-wax" process, or "precision" casting. The process is suitable only for small castings and is capable of producing castings of very-close dimensional tolerance, with excellent surface finish and detail. Typical parts made by the investment casting process include golf-club heads, orthopedic implants, costume jewelry, dentures, and turbine-engine blades.

In this process, an expendable wax pattern is made for each casting to be produced by using a special wax that is melted and injected, under pressure, into a metal mold. The patterns are assembled onto wax pieces that will form runners and channels for molten metal to enter the mold cavity. The wax pattern assembly is dipped into a slurry of a refractory coating material that will produce a uniform coating after drying. The precoated assembly is placed in a flask and a fluid aggregate containing an inorganic binder is poured around it. The molds are allowed to air set. After setting, the flasks are heated in an oven, at which time the wax is melted out and may be reclaimed and reused. The heating process completely eliminates the wax and gas-forming material from the mold. When the mold is at a suitable temperature, molten metal is poured into the mold. After cooling and solidifying, the mold material is broken away from the castings. The individual castings, each an exact metal replica of the wax pattern, are broken or cut from the central runners, and, because of the precision of the process, often require very little finishing.

Lost-Foam Casting

Lost-foam casting is a technique similar to investment casting in that it uses an expendable pattern, one made of polystyrene foam rather than wax. The pattern is coated with a refractory material and then encased with sand, forming a one-piece sand mold. As molten metal is poured into the mold, the foam vaporizes and metal takes its place. This process can produce complex shaped castings without any parting-line flash. However, the cost of the expendable patterns adds to the processing cost. Such parts as pump housings, manifolds, and auto brake components may be produced by this method.

Permanent-Mold Casting

The permanent mold process involves the pouring of molten metal into reusable metal molds of a higher melting temperature than the metal being cast. The process is used primarily for nonferrous (e.g., aluminum or copper) castings. The advantage of permanent mold casting is that rather than making a new, expendable mold for each casting, the mold can be used many, often thousands, of times. Shapes and sizes are limited in this method, however, and initial tooling costs are high. The process is economical only for high-volume production. Typical products of this process include gears, splines, wheels, and auto engine pistons.

Centrifugal Casting

Centrifugal casting involves the pouring of molten metal into a rotating cylindrical mold. Centrifugal force causes the metal to flow to the outer wall of the mold, where it is held until it solidifies. Typical products produced by centrifugal casting include cast-iron pipe, propeller shafts and mill rolls. (Cast-iron pipe is one of the most significant applications of metal castings, accounting for about 25 percent, by weight, of all cast-iron production.)

Die Casting

Die-casting is similar to permanent mold casting except that the molten metal is injected into the mold under high pressure, resulting in very uniform parts with good surface finish and dimensional accuracy. Die casting molds, which are called “dies” in the industry, are costly because they are made from hardened steel and often require a long cycle time and technical expertise for their production. Die casting is limited to the nonferrous metals; harder, higher-melting-point metals (e.g., iron and steel) would destroy the dies.

Production Steps

Design

The customer or user of a casting is normally responsible for its design. The foundry may provide assistance in the design, through its practical knowledge of casting limitations and requirements, and often through application of computer simulation of metal flow and solidification characteristics.

Pattern Making

Once a design has been received, the casting producer must design and build the necessary tooling to produce the casting. For a sand casting, the tooling consists of dies for any required cores and patterns to make sand molds. The patterns incorporate placement of cores and include shapes forming channels in the mold through which molten metal flows to completely fill every cavity of the finished mold. The size, shape, and location of these channels, called sprues, gates, and risers, are essential parts of the pattern design process. The design process is aided by computer simulation programs that are used to predict the flow of metal in the mold. Separate patterns (these are usually called molds) are manufactured to produce cores. Some casting producers have in-house pattern-making capabilities, while others outsource such services. The production of patterns requires significant capital investment and skilled labor.

Mold Making

The mold-making process is one of the key production steps in a sand foundry, usually occurring in the area where molten metal is poured. The extent of automation of mold making depends upon the size, complexity, and number of castings to be produced. For U.S. and foreign foundries producing high-volume production runs, molding machines are fully automated. These machines feed sand into a flask around a pattern, automatically remove the pattern, position the mold for insertion of cores, close the mold, and convey it to the metal-pouring station.

Metal Melting and Pouring

Another key production step is metal melting. The type of melting furnace depends upon the type of metal to be cast and the volume of molten metal required. Raw materials, consisting of scrap, including significant amounts of internal scrap; virgin materials such as pig iron (in iron or steel foundries) or ingot (for copper or aluminum foundries); and alloy materials are placed in a melting furnace. Any necessary refining, such as oxidizing unwanted contaminants in the metallic charge, or dissolving such contaminants through the use of slags, is done in the melting furnace. Molten metal is then poured from the melting furnace into a ladle and moved to a pouring station, where it is poured into molds.

Shake-out

After the casting has solidified, the mold is broken away and the casting is removed. At this point, various cleaning methods, such as shaking or shot blasting, may be used to remove all of the sand or other molding material, including that which was in the cores and the internal parts of the casting. Metal that has solidified in the sprues, gates, and risers is broken or cut off of the castings and returned to the melting area for remelt. Sand is recovered and processed for reuse.

Final Processing of Rough Castings

Unwanted protrusions, such as those where the casting was broken away from the gates and risers, and thin flash, where separate parts of the mold abutted, are cut or ground away. After such limited processing, a rough casting is ready for shipment or further processing. If a large number of a single casting are to be produced, the producer may invest in special tooling, e.g., a die, to cut off the flash, thereby automating the process and reducing the direct-labor input while also increasing the uniformity of the rough castings.

Machining of Castings

Some castings are used as rough castings and require no further processing. However, many castings are extensively machined or ground. Such machining may include drilling of holes and machining of surfaces to closer dimensional tolerance or smoother surface finish than can be achieved in a rough casting. Some foundries perform these finishing operations in-house while others may outsource the finishing. In many cases, however, rough castings are shipped to customers who perform the finishing operations.

Technology

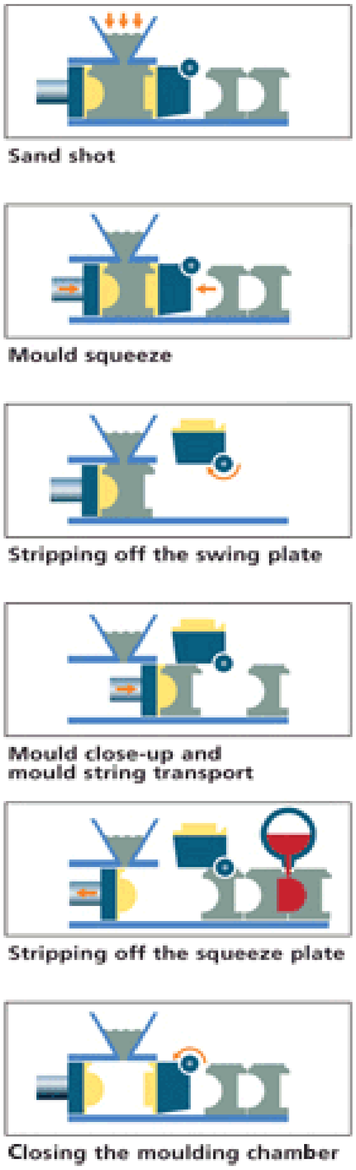
Melting

A variety of technologies are available to produce molten metal. Iron foundries often use cupola furnaces, which are fueled with coke, as their primary melting facility. Cupola melting is an old technology, but one that has seen incremental improvements over the years. Cupolas are most suited to high-production, continuous operations. Other iron foundries, as well as steel foundries, choose either electric-arc or electric-induction furnaces, which are more suited to batch-type and intermittent operations. Nonferrous foundries may use electric-induction furnaces and, due to the lower melting temperature of the metals, have additional options in gas- or oil-fired reverberatory (open-flame) furnaces. Typically, a foundry will also use an electrically heated holding furnace to maintain temperature in molten metal, transferring large amounts of molten metal from the melting furnace to the holding furnace, then taking smaller amounts to the pouring location as needed so that a constant pouring temperature can be maintained for all similar castings.

Molding

In the sand-casting-molding process, there are many opportunities for application of automation and robotic technology. Since the production of molds can be very labor-intensive, foundries, especially those in the developed world, invest heavily in mold-making technology to remain competitive, particularly for the production of high-quantity orders, such as those for automotive applications. An example of recently developed molding technology is the Disamatic molding machine, which produces machine-made molds in which the plane separating the two halves of the mold are vertical, rather than horizontal (figure 2-1). Each

Figure 2-1
The Disa molding principle



Source: Disa Group, found at *www.disagroup.com*

mold has an impression on each side, and two molds together form a mold cavity. The molds are pushed along a conveyor with the back of each mold and the front of its following mold forming a mold cavity. Metal is poured into the molds almost immediately after forming the molds. Thus, the entire casting process is simplified and automated, and production is increased.

Computer Technology

The greatest technological advances occurring in the castings industry are those associated with electronic computing advances.[16] The application of process control to the industry has revolutionized everything from predictive design to process sensing and control to on-line quality testing. Computers play a major role in reducing the time needed to produce castings and increasing the efficiency with which foundries interact with their customers. An increasing number of customers are sending part geometry to foundries via the exchange of computer-aided design (CAD) files, whereas traditionally, casting geometry was obtained from blueprint drawings.[17] Technologies such as rapid prototyping allow foundries to make 3-D models and patterns directly from CAD data, reducing both time and costs, as well as increasing dimensional consistency.[18] Several computer modeling and software design programs predict metal shrinkage, cooling rate, and resulting physical metallurgy properties without the need to cast a test model. These advancements can transform what could have been an 18-month design process that included multiple drawings and mold models into a few weeks, and help reduce the cost of actual pattern-making and molding. Further, new software versions allow users to "tune" the predictive program to actual results, thus allowing the effects of natural process inconsistencies, hindrances, impurities, or other unknowns to be factored in. The installation of sensors and controls linked to computer monitors and analysis tools, which can improve metal casting productivity and quality by continuously monitoring output, is another use of computers in castings facilities.[19] Similar modeling power is enabling cupola production to become

[16] Listed as number one by multiple industry sources. U.S. industry officials, telephone interviews with USITC staff, Aug.-Sept. 2004.

[17] "SFSA: Overview of the Casting Process," Steel Founders' Society Of America, May 2001, found at *http://www.sfsa.org/sfsa/cstintcp.html#prcint2.1*, retrieved Sept. 25, 2003.

[18] A computer analyzes a CAD model to determine what needs to be made and then slices the model into thin cross-sections, which are reproduced to form a 3-dimensional object. Terry Wohlers, "Rapid Prototyping," Foundry Management & Technology, Jan. 2002, Vol. 130, no. 1, pp. 92-95; and "Foundry Execs Share Viewpoints on Casting Technology Trends," Modern Casting, Dec. 2002, found at *http://www.moderncasting.com/archive/WebOnly/1202/Essay_1202.asp*, retrieved Apr. 30, 2003.

[19] The Cast Metals Coalition, found at *http://cmc.aticorp.org/products.html*, retrieved Sept. 23, 2003.

predictable. Models that incorporate both the chemistry and physics of the process[20] have allowed average waste rates of cupola melts to decrease by as much as half.[21]

Much of the computer-related research that is being done in the metal casting industry is occurring at universities rather than at the foundries themselves.[22] Working through the Cast Metals Coalition,[23] the U.S. metal casting industry is able to attract public and private investment in technology development. The U.S. Department of Energy is a key cosponsor of this research, through its Office of Energy Efficiency and Renewable Energy. Technologies that are developed in the United States are available to anyone in the world that has the capital to invest in them.[24]

Other Advanced Technologies

An important use of technology in some foundries is x-ray spectrography during the testing phase to determine strengths and weaknesses of castings. Automated machines also are playing an increasing role in performing repetitive tasks, which can reduce the cost of labor.

Another example of advanced technology is the SinterCast process for the production of compacted-graphite iron castings. Real-time thermal analysis determines the solidification behavior of each small amount of molten iron to be treated. The results enable the control system to calculate proper addition rates of magnesium and other additives prior to the casting. The key was development of patented thermal analysis Sampling Cups which quickly and automatically determine the required additions, practically eliminating casting process variation, and delivering consistent product.[25]

Factors of Competition

Labor, raw materials, and energy are key production factors of the global foundry industry, with labor and raw materials typically the leading production cost factors. *Labor* accounts for a large share of manufacturing costs. Direct labor cost and availability are of particular concern to the industry, as well as the cost of worker benefits such as health care and pensions. Hourly labor rate differentials between work forces in developed and developing countries are large, and contribute to the competitive advantage of developing countries. Attracting and retaining skilled technical and managerial labor in the industry is a task reportedly made more difficult by the "dirty" image of the industry. This issue is more prevalent in developed countries and urban areas where the foundry industry must compete for workers with industries offering higher wages and more attractive work environments.

---

[20] Kevin L. Moore et al, "Feedback Control of a Cupola – Concepts and Experimental Results," 1998 AFS Cupola Conference, Cincinnati, OH, Oct. 1998, found at *http://www.csois.usu.edu/publications/pdf/pub013.pdf,* retrieved Aug. 17, 2004.

[21] Based on early results of the U.S. Department of Energy's Office of Industrial Technology's primary application of the integrated I3PSC system, found at *http://www.oit.doe.gov/sens_cont/factsheets/fact-cupola.pdf,* retrieved Aug. 17, 2004.

[22] "AMT Market Forecast," *Technical Insights' Advanced Manufacturing Technology*, Vol. 24, No. 9, 2003, p. 11.

[23] The Cast Metals Coalition comprises the three leading technical societies of the foundry industry: American Foundry Society, North American Die Casting Association, and Steel Founders' Society of America.

[24] "Foundry Execs Share Viewpoints on Casting Technology Trends," Modern Casting.

[25] Sintercast Supermetal CGI, found at *http://www.sintercast.com/default.asp?groupid=20043514927705&firstlevelid=200435133835739,* retrieved Aug. 18, 2004.

The availability and price of foundry *raw materials* are major concerns of the global industry. Because most raw materials are sold on the global market, foundries throughout the world generally pay comparable prices for their raw materials, with an allowance for transportation cost differentials. Significant increases in these costs in recent years, driven in large part by global supply and demand forces, have led foundries to pursue cost-reduction activities such as material substitution and increased recycling.

Metal casting is an extremely energy-intensive process. As such, *energy* expenditures can account for a large portion of the cost of a casting. Foundries take great care in selecting which type of furnace to install for their individual casting needs, since the purchase of a furnace is a long-term commitment that requires a significant capital investment. With increasing energy costs, many foundries have put more effort into mitigating these costs through hedging energy costs in financial markets; utilizing curtailment programs, in which foundries consume the most energy during lower-priced, off-peak hours to reduce energy costs; forming cooperative buying groups to leverage purchasing power to obtain lower energy prices; and self-supplying energy via energy co-generation.

The way in which *technology* is applied in the production process is critical to global competitiveness as a means to maintain product quality and consistency. The use of technology may also be influenced by the type of castings produced and relative wage rates. Low-value, low-quality castings, for example, generally require a lower level of technology and relatively more semi-skilled labor than foundries producing more complex castings. To lower labor costs, foundries in developed countries with higher wage rates may install more automation and technological improvements, whereas foundries in developing countries with relatively lower wage rates may substitute labor for relatively high-cost capital investments. *Capital availability* and profitability play crucial roles in determining the amount and type of technology and equipment that can be purchased to upgrade the manufacturing process, the introduction of new products, investment in research and development, and the size and extent of capacity expansions. The *interest rate* available to foundries is also an important determinant of what projects can be undertaken. Higher interest rates raise the costs of projects, and thus may reduce profitability and/or extend the time frame for recovering investment expenditures.

Technical services are another aspect to manufacturing that may confer competitive advantage. These services include casting design and selection, material specifications, manufacturing simulation, product testing, machining, and assembly. The number of services offered by foundries largely reflects the type of castings manufactured (i.e., commodity castings or more specialized castings) and the size of the foundry operation. Larger firms, and foundries in developed countries, are more likely to have a unit dedicated to providing technical services to customers.[26] Although technical services are being added by a number of foundries in developing countries, their capabilities in this area are reportedly more limited.[27]

Certification to certain global standards is often required of foundries by their customers to ensure that tasks are being performed in a way that makes the development, manufacture, and supply of products and services more efficient, safer, and cleaner. A number of domestic and foreign foundries, typically the larger, modern facilities, are certified by the International Organization of Standardization (ISO). The ISO 9000 standards family, for example, is a worldwide series of quality management and assurance standards for inspecting production processes, updating records, maintaining equipment, training employees, and handling customer relations.[28] The QS-9000 standard was developed by Ford, GM, and Chrysler to establish consistent

---

[26] U.S. industry official, telephone interview with USITC staff, Mar. 2005.

[27] Ibid.

[28] ISO 9000 and ISO 14000 - in brief, International Organization for Standardization, found at *http://www.iso.org/iso/en/iso9000-14000/index.html*, retrieved Apr. 5, 2005.

quality standards for their suppliers, and is based on ISO 9001:1994 standards.[29] ISO 14000 certifications provide a systematic approach to addressing environmental concerns and performance that offer additional benefits, such as cost control, customer assurance, reduced insurance premiums, increased employee efficiency and involvement, and an improved public image.[30] However, foundries often incur recurring costs in the form of audits and compliance inspections to maintain certification.

Lean manufacturing and Six Sigma are *manufacturing* philosophies that have been adopted by many foundries in both developed and developing countries. The goal of lean manufacturing is to cut costs by reducing waste, shortening lead times, and improving employee performance, satisfaction, and skills.[31] The "Six Sigma" manufacturing technique strives for near perfection by reducing product variation to no more than 3.4 defects per million.[32] Very tight process controls limit defects by reducing errors and waste, which can, in turn, increase profits.

The ability of foundries to deliver their cast products to customers on schedule and at a competitive price is another important competitive factor. Largely at the request of their customers, many foundries work from a *just-in-time inventory* system to reduce the costs of storage. Because proximity to purchasers and end users facilitates this inventory management system, foundries located at a distance from their customers may maintain just-in-time deliveries by warehousing castings in nearby storage or providing reliable scheduled supplies by means of established transportation routes. Shipments from developing countries may require longer *lead times* than those from developed countries, as the *transportation* infrastructure in many developing countries is reportedly inadequate.[33] Moreover, foundries that are closer to their purchasers are generally able to give more competitive final delivered prices than those that are located farther away because of reduced transportation costs.

A variety of federal and regional government programs and policies affect the foundry industry. A country's tax structure, rates, and provisions, for example, may influence a foundry's investment decisions. *Tax and investment* policies may attract new foundry operations by offering favorable financing and tax deferments or deter new investment by increasing corporate tax rates or enacting new tax provisions. Tax treatment of research and development expenses and equipment purchases, such as depreciation schedules, allowances, and tax credits, may also influence decisions in these areas. Taxes on production inputs, such as energy, also have an effect on foundry operations, as do more indirect policies such as the amount of regulation of the electricity utility sector. Governments may also offer grants to firms, for example, to ease the financial burden of establishing a new manufacturing site or provide employee training.

Because foundry manufacturing processes produce a significant amount of waste, both hazardous and non-hazardous, many countries and regions have established *environmental regulations* that typically set limits on air, water, and soil contaminants, and/or encourage sustainable development policies. Although

---

[29] QS-9000 is a much more difficult standard to implement than ISO 9001, and is imposed mainly on Tier 1 suppliers, who can also require it of their suppliers. "What is QS-9000?," found at *http://www.iso9000system.com/qs9000.html*, retrieved Sept. 8, 2004.

[30] "ISO 14001: Why It's Important to Die Casting," North American Die Casting Association, found at *http://www.diecasting.org/environment/iso14000.htm*, retrieved Sept. 8, 2004.

[31] "Cost Management in Lean Manufacturing Enterprises and the Effects upon Small and Medium Enterprises," Proceedings of the Fourth SMESME International Conference, found at *http://iprod.auc.dk/sme2001/paper/creese.pdf*, retrieved Aug. 31, 2004; and "Nonprofit Group Helps Manufacturers to Go 'Lean'," Snohomish County Business Journal, May 2004, found at *http://www.wamfg.org/pages/press_scbj_thomas.html*, retrieved Aug. 31, 2004.

[32] Six Sigma Definition, found at *http://www.sixsigmasurvival.com/SixSigmaDefinition.html*, retrieved Mar. 30, 2005.

[33] See discussions of transportation infrastructure for selected countries in Ch. 9, Profiles of the Foundry Industry in Selected Foreign Countries.

most developed and developing countries have enacted strict environmental standards, enforcement of these regulations is often variable and may be lax, particularly within many developing countries. Although many foundries, especially the most modern ones, recycle a number of the resources used in making castings, the casting process still generates byproducts that must be reduced or eliminated. To achieve these standards, many foundries have invested in costly cleansing and purifying systems that are often incorporated into the manufacturing process, as well as recycling programs that recover reusable materials, such as sand and water.

Foundries' working environment subjects workers to a variety of hazardous conditions, such as extremely high temperatures, chemical additives, and repetitive motion, that can result in harmful, if not lethal, accidents and exposure. Consequently, federal and regional agencies in most countries regulate *worker health and safety* and impose industry standards to protect the labor force, although enforcement is variable and may be relatively weaker in certain developing countries. These standards may require the installation of exposure-control technologies such as ventilation fans, and require workers to wear full environmental suits or fire-resistant clothing and use air-purifying respirators.

Exchange rates can play a role in determining international competitiveness in terms of both costs and revenue, as castings markets are becoming increasingly global. A fixed exchange rate pegs a country's currency to one or more foreign currencies, such as the Chinese yuan to the U.S. dollar, so that the relative value between the two is constant. With a floating exchange rate, two currencies are free to be traded for any amount relative to each other, based on each country's currency's supply and demand in the market. Most currencies trade under this regime.

CHAPTER 3
U.S. FOUNDRY INDUSTRY

This chapter provides a general overview of the U.S. metal foundry industry as a whole, based on responses to the USITC producer and purchaser questionnaires, fieldwork, and interviews with leading industry participants. The chapter begins with a discussion of the structure of the industry and factors driving demand. Next, various business trends, production factors, and domestic policies are presented, with emphasis on their relevance to U.S. metal casters. The chapter concludes with a discussion of purchasing trends. Subsequent chapters provide similar analysis for 4 segments of the foundry industry and for foreign foundry industries.

In the course of the investigation, the Commission collected information from 465 foundries operating in the United States during 1999-2003. Of 465 producer questionnaire responses, 250 firms reported producing iron castings, 195 made aluminum castings, 87 manufactured steel castings, and 49 produced copper castings during 1999-2003, with a substantial number reporting that they produce more than one type of metal casting.[1] The American Foundry Society also collects information on the foundry industry by metal types. Data collected by the USITC account for 82 percent of iron, 75 percent of aluminum, 65 percent of steel, and 32 percent of copper production, as reported by the AFS in 2003.[2]

Industry Profile

Industry Structure

The U.S. foundry industry is characterized by a high degree of concentration and a large proportion of small producers. The top 10 responding producers collectively accounted for 32 percent, by quantity, of the industry's total production in 2003. Approximately 50 percent of responding producers have 100 or fewer production workers. An average responding firm produced about 24,000 short tons of castings and employed 184 production workers in 2003.

A majority of foundries indicated that they were job shops producing a broad number of products in low quantity runs. Sand casting was the predominant method of casting (352 foundries), whereas 120 foundries were die casters.[3]

Historically, metal casting establishments generally have been located close to raw materials, energy sources, and waterways.[4] Most firms are located around the Great Lakes, with a high concentration in states such as Ohio, Michigan, Pennsylvania, and Illinois.[5] However, the geographic concentration of the industry is shifting, as facilities are built where scrap metal and electricity are available at a reasonable cost or a local

[1] As some foundries pour multiple metal types, the total does not add to 465 respondents.
[2] AFS, "38th Annual Census of World Casting Production–2003," *Modern Casting*, Dec. 2004, p. 26.
[3] Establishments may use more than one type of process, so the casting methods exceed the aggregate of reporting foundries.
[4] U.S. industry officials, various fieldwork by USITC staff, and U.S. Environmental Protection Agency (EPA), Office of Compliance, "Sector Notebook Project: Profile of the Metal Casting Industry," Feb. 1998, found at *http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/metcstsnapt1.pdf*, retrieved Oct. 14, 2003.
[5] "Foundries Industry Report," *Harris Infosource,* p. 4, found at *http://www.harrisinfo.com/purdue/Foundries.pdf*, retrieved Feb. 7, 2005.

market for the cast products exists.[6] The Southern states, for example, are becoming a production center for aluminum castings because of nearby automotive manufacturers.[7]

The number of foundries in the United States has declined since 1999 as firms consolidated and closed. Although the USITC was unable to compile comprehensive information on the number of firms that have gone out of business since 1999, this was a continuing trend, according to domestic producers, as 25 known foundries closed during the period. One industry source estimates that approximately 50 foundries close in the United States each year. Information on key firms that have closed since 2000 is presented in table 3-1. However, new plants have also been added. For example, a new Ross Aluminum Foundries plant began operations in 2004 in Piqua, OH.[8] North Vernon Industry Corporation, a division of Toyota Motor Co., plans to build a new gray-iron casting operation in Cullman, AL to begin production by the end of 2005.[9]

Table 3-1
U.S. foundry industry: U.S. foundries that closed operations, 2001-2005

Date of closure	Name	Location
January 2001	PrimeCast, Inc.	Beloit, WI and South Beloit, IL
April 2001	Hayes-Lemmerz	Howell, MI
September 2001	Empire Steel Castings	Reading, PA
October 2001	American Racing Equipment	Warsaw, KY
February 2002	Wheland Foundry	Chattanooga, TN and Warrenton, GA
June 2002	Hayes-Albion Corp.	Albion, MI and Jackson, MS
September 2002	Buckeye Steel Castings Co.	Columbus, OH
October 2002	Kingsport Foundry	Kingsport, TN
June 2003	U.S. Pipe & Foundry Co.	Anniston, AL
June 2003	Tecumseh Products Co.	Sheboygan Falls, WI
August 2003	Excelsior Foundry	Belleville, IL
September 2003	Pemco Die Casting Corp.	Bridgeman, MI
December 2003	Intermet Corp.	Radford, VA
January 2004	Campbell Foundry	Harrison, NJ
July 2004	Intermet Corp.	Havana, IL
November 2004	Lester Precision Die Castings	Bedford Heights, OH
December 2004	Kurdziel Industries	Sparta, MI
December 2004	Production Pattern & Foundry	San Leandro, CA
May 2005	General Aluminum	Cedarburg, WI
December 2005	Dana Corp.	Muskegon, MI
2005	Lexington Die Casting	Lakewood, NY
2005	Intermet Corp.	Sturtevant, WI and Decatur, IL

Note.–This list is not exhaustive. Buckeye Steel reopened as Columbus Steel Castings in March 2003. Production Pattern & Foundry reopened in Carson City, NV.

Source: Compiled by the Commission from various industry sources.

[6] U.S. Environmental Protection Agency, Office of Compliance, "Sector Notebook Project: Profile of the Metal Casting Industry," Feb. 1998, found at *http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/metcstsnapt1.pdf*, retrieved Oct. 14, 2003.

[7] "Bemco Spends $1-Mil on Expansion," *Platts Metals Week*, May 19, 2003.

[8] "Ross Al Expands Casting Operations," *Platts Metals Week*, Dec. 8, 2003.

[9] "Gray Iron Foundry Planned in Alabama," *Foundry Management & Technology*, found at *http://www.foundrymag.com*, retrieved Jan. 3, 2005.

Demand Characteristics

In general, the foundry products industry was affected by the U.S. economic slowdown beginning in the summer of 2000 and continuing into 2001.[10] The decline in economic activity became a recession by March 2001 and the downturn lasted until November 2001.[11] According to responding producers, the slowdown reduced demand for foundry products and negatively affected sales. The economic recovery starting in 2002[12] spurred demand in certain markets, particularly for aluminum foundry products, leading to higher forecasted production for many foundries through 2008.[13]

Principal markets for cast products in 2003[14] include motor vehicles (47 percent) and soil/pressure pipe (20 percent), according to respondents to the USITC producer questionnaire. Thirty-six percent of metal castings are shipped to the automotive market, and an additional 11 percent of U.S. producers' shipments went to the truck market, specifically large highway trucks (Class 8 trucks). U.S. foundry producers supply key motor vehicle components such as camshafts and crankshafts, steering systems, transmissions, and engine blocks, and demand for these and other components is a key factor affecting castings shipments for responding foundries within the United States.

An 8 percent decline in motor vehicle production during 1999-2003, to 16.2 million vehicles, adversely affected demand for metal castings. The period low was reached in 2001, when vehicle output totaled 15.8 million units.[15] A significant reduction in Class 8 truck production in 2001[16] following the 1999 peak also directly affected casting producers,[17] as build rates fell by at least one-half because of high prices for fuel and an oversupply of used trucks in the market.[18] Another demand change has been the shift from iron to aluminum castings for automotive applications.[19] Additionally, rising demand for certain vehicles, such as sport utility vehicles and pickups, favorably affected aluminum castings producers as automotive manufacturers designed and launched vehicles for this market segment.

Soil and pressure pipe, specifically pipe made of cast iron used in water and sewer systems for commercial buildings, is also a leading market for metal castings (20 percent market share). According to producers, the market for soil and pressure pipe remained strong from 1999-2003 because of suburban growth.

---

[10] Multiple producer and purchaser questionnaire responses; various staff interviews of industry officials; and Economic Report of the President, Transmitted to the Congress Feb. 2002, found at *www.gpoaccess.gov/usbudget/fy03/pdf/2002_erp.pdf*, p. 42, retrieved Mar. 17, 2005.

[11] "The NBERs Recession Dating Procedure," Business Cycle Dating Committee, National Bureau of Economic Research, Oct. 23, 2003, found at *http://www.nber.org/cycles/recessions.html*, retrieved Mar. 17, 2005. According to NBER, "a recession is a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales."

[12] Economic Report of the President, Transmitted to the Congress Feb. 2003, found at *www.gpoaccess.gov/usbudget/fy04/pdf/2003_erp.pdf*, p. 27, retrieved May 2, 2005.

[13] Alfred Spada, Marketing Director, AFS, cited in Tony Reid, "Auto Supply Company Announces Closure of Decatur, Ill., Foundry" *Herald & Review*, Decatur, IL, Mar. 30, 2005, p. A1.

[14] End market determined by share of 2003 shipments of castings by quantity.

[15] "North American Car & Truck Production, 1954-2003," *2004 Ward's Automotive Yearbook*, p. 117.

[16] David Hare, "TRUCKIN'," *Las Vegas Business Press*, Jan. 14, 2002, Vol. 19, Issue 2, p. 2, and Gail Kachadourian, "Class 8 Sales Plunge in '01,"*Automotive News*, Jan. 28, 2002.

[17] Multiple producer questionnaire responses, and U.S. industry official, telephone interview with USITC staff, Feb. 2, 2004.

[18] Hare, p. 2, and Kachadourian, p. 1.

[19] See chapter 7: U.S. Aluminum Foundry Industry for more detailed information.

Producer Trends

Capacity, Production, and Shipments

Both total production and shipments of U.S. foundry products reported by U.S. foundries declined during 1999-2003 (table 3-2). According to multiple responses to producer questionnaires, site visits, and company interviews, this decline was attributable to an 8 percent decline in domestic motor vehicle production (including the reduction in demand in the Class 8 truck market in 2001), the economic downturn in 2001, and reduced demand for domestic castings because of competition from low-cost producing countries, particularly China. The ferrous metals segment, the industry's largest, was the most negatively affected by these trends, as production and shipments declined by over 10 percent.[20] However, production and shipments of aluminum foundry products grew along with demand for cast aluminum products, particularly for automotive applications.[21] Total U.S. foundry capacity rose by 3 percent during 1999-2003 to 13.1 million short tons, largely attributable to a rise in aluminum casting capacity that increased by 35 percent.

Table 3-2
All foundries: Responding U.S. producers' capacity, production, and shipments for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Capacity:					
Iron	9,687,985	9,722,389	9,620,048	9,744,415	9,360,928
Steel	928,834	938,160	936,923	927,816	928,614
Aluminum	1,984,306	2,059,350	2,168,378	2,460,681	2,676,496
Copper	158,790	159,123	165,372	176,483	175,313
Total	12,759,159	12,876,046	12,886,373	13,305,001	13,136,989
Production:					
Iron	8,320,927	8,323,187	7,407,860	7,554,569	7,461,348
Steel	713,175	611,943	558,926	534,006	618,815
Aluminum	1,271,861	1,448,825	1,241,855	1,409,842	1,458,699
Copper	99,016	98,291	88,874	89,628	87,223
Total	10,404,979	10,482,246	9,297,515	9,588,045	9,626,085
	Value (*1,000 dollars*)				
Domestic shipments:					
Iron	8,026,920	7,748,331	6,819,025	6,678,797	6,599,966
Steel	1,325,710	1,346,992	1,248,566	1,109,013	1,191,829
Aluminum	4,821,176	5,340,710	5,096,981	5,658,193	5,797,773
Copper	325,628	331,703	317,985	348,807	333,407
Total	14,499,434	14,767,736	13,482,557	13,794,810	13,922,975

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[20] For more details on the iron and steel foundry industries, see chs. 5 and 6, respectively.
[21] For more details, see chapter 7: U.S. Aluminum Foundry Industry.

Employment

Total employment by respondents in the U.S. foundry industry declined by 12 percent during 1999-2003 to 89,230 workers (table 3-3); all types of foundries operated with fewer employees by the end of the 5-year period.[22] Iron foundries experienced the greatest absolute loss in employment at close to 9,000 employees. However, the greatest percentage drop occurred in steel foundries, which lost 21 percent of their workforce.

Overall wages paid decreased along with the decline in employment. However, hourly wages for U.S. foundry workers grew by almost $2 per hour and, at $17.57 per hour, ranked among the highest foundry wage rates in the world.[23] To some degree, the decline in workforce was offset by an increase in productivity. Productivity increased over the period as U.S. foundries automated facilities to use less labor to help contain labor costs.[24]

Table 3-3
All metal foundries: Responding U.S. producers' employees and related information for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Average number of employees	101,169	101,653	94,413	91,158	89,230
Production and related workers:					
Average number	85,134	85,505	78,738	76,025	74,048
Hours worked (*1,000 hours*)	178,996	181,099	164,669	159,087	157,113
Wages paid (*1,000 dollars*)	2,782,103	2,848,880	2,711,048	2,743,512	2,742,297
Average hourly wages (*dollars per hour*)	15.58	15.78	16.58	17.35	17.57
Productivity (*short tons per 1,000 hours*)	58	58	57	61	62

Note.–Average hourly wages based on establishments that were able to provide both hours worked and wages paid data. Productivity based on establishments that were able to provide both production quantity and hours worked data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Respondents to the producer questionnaire indicated that they experienced difficulty in hiring and retaining workers. Thirty-six percent of respondents said that there was an overall labor shortage for foundry workers, while 73 percent of questionnaire respondents said that they experienced problems filling higher-skilled positions. They attributed the hiring difficulties to the difficult, repetitive nature of foundry work, low wages compared with other manufacturing positions, and the image of foundries as "dirty."

To maintain a skilled workforce, particularly in rural areas, many foundries offer apprentice programs or pair up with local technical schools in an effort to find and train skilled workers (such as patternmakers and welders). Additionally, many foundries offer continuous training for workers, often on-site, including apprenticeship programs for more high-skilled jobs, such as pattern making.[25]

---

[22] Based on questionnaire responses. For details on trends in each foundry industry, see chs. 5-8.

[23] *See*, e.g., "Metal Casting Industry Profile," The Cast Metals Coalition, found at *http://cmc.aticorp.org/industryprofile.html*, retrieved Aug. 30, 2004, and AFS Metalcasting Forecast & Trends 2004, p. 34.

[24] Multiple producer questionnaire respondents; Albert Lucchetti, President, Cumberland Foundry, hearing transcript, p. 33; and Larry Comunale, Vice President and General Manager, Doncaster Southern Tool, hearing transcript, p. 49.

[25] U.S. industry officials, interview with USITC staff, June 2004; and Randall Lawton, President, Bay Engineered Castings, hearing transcript, p. 45.

Financial Condition

The financial condition of the U.S. foundry industry deteriorated during 1999-2003, as operating income declined for both rough and machined castings operations (tables 3-4 and 3-5). Rough casting operations were the most profoundly affected by this trend, as operating income dropped by almost $1 billion during the period and operating margins declined from 10 percent of net sales to 3 percent. Operating margins for machined operations declined as well (by 5 percentage points), but remained fairly strong at 8 percent of sales. The most significant indication of the deteriorating financial climate was the increase in the number of firms producing rough castings that reported operating losses, which nearly doubled during 1999-2003; 38 percent of U.S. foundries reported operating losses in 2003, up from 21 percent in 1999. Since 2001, numerous foundries, including over one-half of the top 10 foundries in the United States, have filed for bankruptcy protection (table 3-6).[26]

Producers cited numerous instances of lost sales as customers sourced castings from foreign sources. Producers who lost customers to overseas suppliers most frequently cited China as the foreign country where their former customers were now purchasing castings, particularly those made of iron. According to respondents, Brazil, India, and Mexico were also supplying products which domestic firms used to furnish. To compensate for lost business, several industry representatives indicated that they are focusing on production of more complex, low volume castings because high-volume orders are going overseas to countries such as China.[27] In addition to foreign competition, castings producers mentioned experiencing more intense domestic competition from foundries facing financial difficulties, as these foundries tend to move into niche products that may already be produced by other firms or may lower prices in an attempt to remain competitive.[28]

While reported producer sales values of rough castings declined by 2 percent and sales of machined castings grew by 5 percent, profitability was affected significantly by an increase in cost of goods sold, particularly for energy and raw materials costs and employee compensation. Additionally, implementation of a more stringent U.S. regulatory environment prior to the study period led to higher initial spending to meet new mandates for both environmental protection and worker health and safety. Updates to these regulations have occurred throughout the period. According to one producer, "external costs from taxes, health and pension benefits, tort litigation, regulation and rising energy prices add approximately 22 percent to U.S. manufacturers' unit labor costs, nearly $5 per hour worked, relative to their major foreign competitors."[29]

---

[26] Multiple producer questionnaire responses; and "Economic Recovery Bypasses U.S. Foundry Industry," *Manufacturing & Technology News*, Nov. 4, 2004, found at *http://www.manufacturingnews.com/news/04/1104/art1.html*, retrieved Feb. 7, 2005.

[27] "Economic Recovery Bypasses U.S. Foundry Industry," *Manufacturing & Technology News*, Nov. 4, 2004, found at *http://www.manufacturingnews.com/news/04/1104/art1.html*, retrieved Feb. 7, 2005; and U.S. industry officials, interview with USITC staff, June 2004.

[28] U.S. industry officials, interview with USITC staff, June 2004.

[29] James Mallory, Executive Director, Non-Ferrous Founders' Society, hearing transcript, p. 10.

Table 3-4
All metal foundries: Responding U.S. producers' financial results for their rough casting operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
Net sales *(short tons)*	9,853,876	9,935,643	8,913,411	9,065,311	9,099,913
	Value (*1,000 dollars*)				
Net sales	13,930,587	14,415,274	13,217,612	13,520,790	13,655,176
Cost of goods sold:					
Raw materials	3,944,353	4,208,142	3,787,996	4,117,107	4,267,961
Direct labor	2,654,631	2,731,731	2,565,274	2,583,277	2,622,699
Energy	702,790	840,143	900,856	824,616	870,236
Other factory cost	4,412,869	4,767,425	4,578,677	4,534,858	4,644,012
Total cost of goods sold	11,714,643	12,547,441	11,832,803	12,059,858	12,404,908
Gross profit	2,215,944	1,867,833	1,384,809	1,460,932	1,250,268
Selling, general, and administrative	810,574	872,360	853,263	809,766	832,874
Operating income	1,405,370	995,473	531,546	651,166	417,394
Other income and expenses:					
Interest expense	181,242	193,971	173,127	128,802	148,152
All other expenses and income	186,716	86,570	204,387	48,161	100,165
Net income before taxes	1,037,412	714,932	154,032	474,203	169,077
Depreciation/amortization	582,094	620,064	653,607	716,208	717,716
	Ratio to net sales (*percent*)				
Raw materials	28	29	29	30	31
Direct labor	19	19	19	19	19
Energy	5	6	7	6	6
Other factory cost	32	33	35	34	34
Cost of goods sold	84	87	90	89	91
Gross profit	16	13	10	11	9
Selling, general, and administrative	6	6	6	6	6
Operating income	10	7	4	5	3
	Number of establishments reporting:				
Operating losses	95	118	167	168	183
Financial results data	447	465	472	477	477

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and cost data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 3-5
All metal foundries: Responding U.S. producers' financial results for their machining operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
Net sales (*short tons*)	1,558,756	1,439,563	1,346,137	1,408,701	1,482,936
	Value (*1,000 dollars*)				
Net sales	4,488,405	4,732,866	4,386,197	4,645,413	4,715,872
Cost of goods sold:					
Rough castings produced	2,485,604	2,615,647	2,374,424	2,489,269	2,610,135
Rough castings purchased from other companies	38,812	52,648	107,789	135,442	136,002
In-house machining costs	1,071,856	1,158,886	1,060,455	1,178,910	1,179,224
Subcontracted machining costs	45,327	51,609	52,536	55,279	62,353
Other machining costs	60,975	63,398	74,689	105,726	119,660
Total costs of goods sold	3,702,574	3,942,188	3,669,893	3,964,626	4,107,374
Gross profit	785,831	790,678	716,304	680,787	608,498
Selling, general, and administrative	220,466	284,848	277,394	227,347	225,398
Operating income	565,365	505,830	438,910	453,440	383,100
	Ratio to net sales (*percent*)				
Cost of goods sold	82	83	84	85	87
Gross profit	18	17	16	15	13
Selling, general, and administrative	5	6	6	5	5
Operating income	13	11	10	10	8
	Number of establishments reporting:				
Operating losses	39	49	50	55	65
Financial results data	199	209	215	217	222

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and cost data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 3-6
U.S. foundry industry: U.S. foundries that filed for Chapter 11 bankruptcy protection, 1999-2005

Date	Name	Location
December 2000	LTV Corp.	Cleveland, OH
October 2001	Federal-Mogul Powertrain Systems	Malden, MO
November 2001	Wheland Foundry	Chattanooga, TN and Warrenton, GA
December 2001	Hayes Lemmerz	22 locations in United States
December 2001	Heick Die Casting	Chicago, IL
January 2002	Hayes-Albion Corp.	Albion, MI
January 2002	Fansteel, Inc.	Creston, IA
August 2002	Kingsport Foundry	Kingsport, TN
April 2003	Golden Castings Corp.	The Dalles, OR
June 2003	Lionheart Industries	Foundries throughout United States
August 2003	Atchison Casting Corp.	Foundries throughout United States
September 2003	Neenah Foundry Co.	Neenah, WI
September 2003	Advanced Cast Products, Inc.	Meadville, PA
September 2003	Dalton Corp.	Kendallville, IN and Stryker, OH
September 2003	Deeter Foundry, Inc.	Lincoln, NE
September 2003	Gregg Industries, Inc.	El Monte, CA
February 2004	Auburn Foundry	Auburn, IN
September 2004	Citation Corp.	17 foundries
September 2004	Intermet Corp.	17 foundries
January 2005	Lee Brass	Anniston, AL

Note.–This list is not exhaustive.

Source: Compiled from various industry sources.

When considering the leading issues affecting their firms' financial condition, producers cited healthcare costs as having the greatest effect, followed by raw material and labor costs (table 3-7). Although the cost of energy did not rank as the leading issue, it was the second most frequently cited factor overall. Government regulations are also important to the viability of an establishment's operations, and was the third most cited issue.

Table 3-7
U.S. foundry industry: Internal issues impacting viability of establishment's operations and ranking in terms of importance
(*Number of responses*)

Issues	Ranking 1	2	3	4	5	Total responses
Healthcare costs	111	142	85	35	18	391
Raw material costs	98	51	41	43	38	271
Labor	93	58	47	46	36	280
Government regulations	38	44	75	63	68	288
Skilled labor availability	29	23	24	34	49	159
Energy costs	28	58	62	87	72	307
Other issues	16	2	2	7	10	37
Cost of capital	12	7	19	20	28	86
Insurance costs	11	13	35	26	28	113
Employment taxes	4	12	19	24	27	86
Raw materials availability	4	15	17	26	26	88
Transportation costs	1	7	8	9	18	43
Training costs	0	4	8	5	5	22

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Raw Materials

During 1999-2003, global raw material costs for foundry inputs, such as ingot, scrap, coke, and alloys, rose significantly (table 3-8). One of the key reasons was China's increased demand for raw materials to supply its expanding industrial sector.[30] Chinese demand is particularly significant in the scrap market; it became the first country to import more than $1 billion annually in U.S. scrap. U.S. foundries report that the price of steel scrap has more than doubled; some foundries have reported four-fold increases in steel scrap prices. Reportedly, demand from China has been so great that it sometimes has led to limited scrap availability.[31] For example, one foundry reported that its supply has been rationed by its raw material suppliers because of scrap shortages. This shortage of raw materials has led foundries to alter their mix of alloys in order to meet customer needs.[32]

Ninety-seven percent of questionnaire respondents indicated that foundry product purchasers share metal cost increases with foundries, which usually get passed along in the form of a surcharge.[33] According to producers, aluminum cost increases are easier to pass through than those for iron or steel inputs, such as

[30] David Sax, "A Hungry Dragon," Dec. 27, 2004, found at *http://www.canadianbusiness.com/managing/article.jsp?content=20041227_64453_64453*, retrieved Feb. 18, 2005; "China's Need for Metal Keeps U.S. Scrap Dealers Scrounging," *New York Times*, Mar. 13, 2004; and "China Effect Convulses Commodity Markets," *Financial Times*, Nov. 15, 2003.
[31] Roy Hanks, Marketing Manager, Waupaca, hearing transcript, p. 39.
[32] U.S. industry official, interview with USITC staff, Mar. 8, 2005.
[33] Producer questionnaires; USITC staff interviews with U.S. industry officials; and George Boyd, President and CEO, Goldens' Foundry and Machine, hearing transcript, p. 24.

Table 3-8
U.S. foundry industry: Average annual prices for metallic raw materials, 1999-2003
(***Cents per pound***)

Metal	1999	2000	2001	2002	2003
Aluminum:					
Scrap	46.41	45.17	42.84	46.79	49.53
Ingot	65.7	74.6	68.8	64.9	68.1
Copper:					
Scrap	67.55	75.55	66.55	66.88	76.45
Ingot	72.09	83.97	72.65	71.62	80.99
Pig iron[1]	106.43	120.97	107.5	112.35	144.71
Ferrous scrap (composite)[2]	80.56	79.3	64.14	73.82	116.34

[1] Average unit values, U.S. imports for consumption from Brazil, the major foreign supplier.
[2] Composite average for broker shredded auto bundles, #1 dealer scrap bundles, and #1 dealer heavy melting scrap.

Source: Statistics of *American Metal Market* and official statistics of the U.S. Department of Commerce.

pig iron.[34] Many suppliers to the automotive industry were locked into long-term contracts with automakers that made it difficult to pass on cost increases. Some producers felt that this business environment may be changing as Chapter 11 bankruptcies persuade automakers to provide suppliers relief for raw material price increases.[35]

Energy

U.S. foundries use electricity, natural gas, and metallurgical coke for their energy needs. Since 1999, natural gas prices in the United States have risen considerably. In 1999, the average monthly industrial price of natural gas was $3.12 per 1,000 cubic feet. It increased irregularly to $5.78 per 1,000 cubic feet in 2003, roughly twice the price during the 1990s.[36] Though electricity prices vary by state, industrial electricity prices in general were higher in 2003 than in 1999 (table 3-9).[37]

Table 3-9
U.S. foundry industry: Average annual prices for energy, 1999-2003

Energy source	1999	2000	2001	2002	2003
Electricity (*cents per kW-hr*)[1]	4.43	4.64	5.04	4.88	4.95
Natural gas (*dollars per 1,000 cu. ft.*)[1]	3.12	4.45	5.24	4.02	5.78
Metallurgical coal (*dollars per short ton*)[2]	32.63	32.70	35.12	39.10	38.09

[1] Average prices to industrial sector customers.
[2] U.S. market price not available. Average export price for U.S. shipments of metallurgical coal to North American destinations used as a proxy.

Source: U.S. Department of Energy (USDOE), Energy Information Administration (EIA), *Annual Energy Review 2003*, table 6.8 (natural gas prices by sector), 1967-2003, and table 8.10 (average retail prices of electricity), 1960-2003; and USDOE, EIA, *Quarterly Coal Report*, (various tables) average price of U.S. metallurgical coal exports, various issues.

[34] Historically, aluminum prices have fluctuated more sharply than prices for iron or steel, so purchasers have been more accepting of surcharges for aluminum than other metals.
[35] U.S. industry officials, telephone interviews with USITC staff, Mar. 8, 9, 11, and 17, 2005.
[36] U.S. Department of Energy, Energy Information Administration, *Natural Gas Monthly*, Aug. 2004, table 4.
[37] U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2002*, table 8.6; and Electric Power Monthly, table 5.6.B, found at *http://www.eia.doe.gov/emeu/aer/txt/ptb0806.html* and *http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_b.html*, retrieved Sept. 2, 2004.

In 1999, when natural gas was relatively inexpensive compared to electricity, many foundries invested in furnaces fueled by natural gas.[38] When gas prices began to rise, these producers were unable to revert to electricity as a fuel source. Owing to rising costs, foundries have begun to use various mechanisms to manage energy inputs. For example, some foundries have attempted to buy futures contracts to hedge against price increases in natural gas, whereas others have arranged long-term contracts with energy companies or paired with other foundries to buy energy in bulk. Several foundries mentioned that they schedule melting operations at off hours to get the lowest price.[39] Only 22 percent of respondents to the questionnaire stated that energy cost increases could be passed on to customers.

Labor

Despite the decline in employment, total employee costs rose by about $317 million (6 percent) to $5.2 billion during 1999-2003 (table 3-10). On a per employee basis, costs grew over $10,000 per employee during the period to $58,568 in 2003. Significant growth in health and pension costs accounted for most of this increase, as salaries rose by less than 1 percent during the period. Health benefits, for example, increased by 28 percent ($2,244 per employee) during the period and pension costs grew by 39 percent ($1,041 per employee). Additionally, producers cited workers' compensation costs as an area in which high costs affect their competitiveness.[40] One producer, for example, reported that workers' compensation costs for the facility had suddenly risen by $15,000, even though there have been no recent accidents.[41]

Table 3-10
All metal foundries: Responding U.S. producers' employee costs and capital expenditures for their rough casting operations, fiscal years 1999-2003

(***1,000 dollars***)

Item	1999	2000	2001	2002	2003
Employee costs:					
Salaries and wages (including overtime)	3,771,733	4,047,346	3,814,982	3,796,364	3,791,209
Health benefits	504,677	575,089	574,614	604,711	645,329
Pension and profit sharing	183,872	184,831	183,586	198,149	255,017
Other costs	410,127	489,692	483,279	478,315	503,950
Employee training	39,047	38,679	30,667	29,966	30,497
Total employee costs	4,909,456	5,335,637	5,087,128	5,107,505	5,226,002
Capital expenditures:					
Machinery, equipment, and fixtures:					
Environmentally related	98,772	58,578	44,423	61,891	31,509
Other	759,886	768,044	702,863	590,796	469,535
Land, building, and related improvements	96,667	161,002	138,131	80,555	89,292
Total capital expenditures	955,326	987,624	885,417	733,242	590,336

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[38] Multiple responses to USITC producer questionnaires and "Energy and Environmental Profile of the U.S. Metalcasting Industry," prepared by Energetics, Inc., for the U.S. Department of Energy, Sept. 1999, p. 14.
[39] U.S. industry officials, interview with USITC staff, June 2004.
[40] Multiple USITC producer questionnaire responses; and Dave Bumbar, President, Aurora Metals, hearing transcript, p. 65.
[41] U.S. industry official, interview with USITC staff, United States, June 2004.

Investment

Reflecting the impact of declining operating incomes, capital expenditures declined by 38 percent to $590 million during 1999-2003 (see table 3-10). According to producer questionnaire responses, more than 70 percent of foundries reduced, delayed, or terminated planned capital investments. Despite the decline, firms were able to embark upon some capital spending, averaging about $1 million per facility. Most firms (53 percent) indicated they automated their facilities to improve lead times and save on labor costs. Several firms indicated that they were able to upgrade equipment via auctions and liquidations of foundries that had gone out of business. To make capital improvements, 94 percent of questionnaire respondents reported that their establishments used internal cash flow for funding. Secured debt was also a prevalent source of funding and was used by 52 percent of U.S. foundries during 1999-2003.

Business Practices

To remain competitive, U.S. foundries adapted and improved many of their business practices during the 5-year period. According to responses to the producer questionnaire, a majority of firms reported that they upgraded customer service, introduced value-added services (such as engineering and design), improved flexibility, and provided faster production times. More than 75 percent of foundries reported that their lead times decreased. On average, reported lead times declined from 6 weeks to 4 weeks for products with a pattern and from 14 weeks to 12 weeks for products without a pattern. This reduction was attributed to productivity improvements accomplished through computer design and logistics management, along with adoption of lean-manufacturing principles. However, 56 percent of firms attributed the shorter lead time to declining order levels.

U.S. foundries also reported assisting customers with technical services, indicating that during 1999-2003 customers asked for help in these areas more often than in the past. Seventy percent of foundries reported that they were involved with product design and development. According to producers, providing technical services can be a competitive selling advantage.[42] The level of technical services provided can vary. Some foundries provide basic information on the various types of castings available and appropriate application, whereas others assist in component design, selection, and processing. According to producers, technical services are more of a selling feature for automotive components than other castings, as automotive customers need to know that the structural casting is designed and processed to meet required specifications before incorporation into a motor vehicle.[43] However, while foundries are willing to use their expertise to provide value-added services to their customers, producers express concern that their product design and development suggestions may be used by customers to manufacture castings offshore.[44]

In addition to changes that producers implemented to maintain competitiveness, business practices have changed as purchasers dictate production terms more often than in the past. In response to purchaser demands, 55 percent of producers indicated that delivery times have become less flexible, and 33 percent reported less flexibility in product specifications.

The vast majority (94 percent) of responding U.S. foundries claim that certification is necessary to compete in the market; 71 percent of questionnaire respondents named ISO 9000 and 19 percent cited ISO 14000 as required certifications. Other customer-specified certifications, noted by 47 percent of producer respondents, include TS 16949 and various other standards specific to the end-use industry.[45]

[42] U.S. industry officials, telephone interviews with USITC staff, Mar. 8-10, 2005.
[43] Ibid.
[44] Multiple USITC producer questionnaire responses.
[45] For more details on certifications, see chapter 2.

Pricing

The price of metal castings sold by U.S. foundries is determined by a variety of methods. Respondents to the USITC producer questionnaire noted that the most common method of determining price is through negotiating each job (table 3-11). Negotiating prices with the customer for short-term or long-term contracts is also a typical method to set prices on foundry products. Sales contracts are common in the foundry industry, with 29 percent of questionnaire respondents reporting that contracts of one year or less represent the bulk (76 percent or more) of their sales. Another 15 percent noted the same share for contracts of more than 1 year. Approximately 22 percent of respondents cited spot sales as their principal sales channel.

Many foundries indicated that their profitability was affected by price concessions made to prevent customers from moving offshore (table 3-12).[46] Forty-two percent of responding producers indicated that prices had decreased during 1999-2003 and 21 percent indicated that prices stayed the same over the period.

Table 3-11
U.S. foundry industry: Pricing methods identified by producers

Method used to determine price	Number of responses
Negotiated between producer and customer for each individual job	250
Negotiated between producer and customer on a contract of 1 year or less	124
Negotiated between producer and customer on a contract of more than 1 year	96
Price set by producer	91
Price set by customer	35
Price set based on imported product price or by imported product offer price	30

Note.–A total of 403 establishments responded. Many indicated more than one price determination method.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 3-12
U.S. foundry industry: Domestic producers' comparison of relative price changes of domestic castings in the U.S. market, 1999-2003

Price change in U.S. market	Number of responses
Increased:	
By 0-10 percent	59
By 11-20 percent	42
By 21-30 percent	9
By 31 percent or more	1
Unspecified amount	3
Total responses	114
Stayed the same	63
Decreased:	
By 0-10 percent	74
By 11-20 percent	36
By 21-30 percent	14
By 31 percent or more	3
Total responses	127

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[46] However, there was a significant disparity between the producer and purchaser responses regarding changes in castings prices over the period. See chs. 4 and 10 for more details.

Producers also stated that they gave their customers other concessions that were not reflected in the price of the casting. For example, 71 percent of producer respondents extended customer payment terms, 54 percent provided discounts to customers, and 37 percent provided rebates. Forty-three percent of producers indicated that they accepted smaller minimum orders and 39 percent offered more discounts than they had in the past. One producer indicated that customers demand rebates of 3 percent, on average.[47] Foundries also reported that they stored inventory for customers, offered lower prices to customers placing larger orders, and absorbed tooling costs.

Domestic Policies

The cost of compliance with government regulations decreased profits and made companies less competitive compared to foundry operations in countries with less stringent regulations, according to questionnaire respondents. When asked what government policies have the greatest impact on operations, environmental regulations were cited by 86 percent of responding producers as one of the top three factors affecting business performance. Nearly three-quarters of respondents placed U.S. Occupation Health and Safety Administration (OSHA) regulations in the top three, followed by trade policies (63 percent).

Environment

Environmentally-related expenditures spending peaked in 1999, when firms spent over $98 million on environmentally related capital expenditures. While environmental expenditures declined since then, spending on environmental issues accounted for approximately 5 percent of capital expenditures in 2003. According to producers, environmental regulations and enforcement constitute a major problem in maintaining international competitiveness, especially for smaller firms. Producers allege that leading competitor countries have less stringent regulations or enforcement than in the United States.[48] According to one U.S. producer, some U.S. foundries have shut down because of compliance costs for environmental protection. Another foundry estimates that it takes more than 0.5 workyears to handle all environment-related paperwork.[49]

Although producers express concerns with a number of U.S. environmental regulations, they specifically cite the 1990 Clean Air Act, particularly maximum achievable control technology (MACT) and Title V regulations (as many components of these regulations came into effect from 1999-2003), as having a significant impact (table 3-13).[50] For example, one U.S. producer indicated that it does not expect to see a new foundry built in the United States, in part because of Title V.[51] An economic impact study performed by the U.S. Environmental Protection Agency estimates that total annualized cost for foundries to comply with Title V to be $21.7 million.[52] However, the American Foundry Society disputes this figure, and has noted that its estimated cost is closer to $300 million.[53]

---

[47] U.S. industry official, interview with USITC staff, United States, June 2004.

[48] U.S. industry officials, interviews with USITC staff, various dates; foreign fieldwork by USITC staff; multiple producer questionnaire responses; and Thomas Piwonka, “Employment, Environment, and Energy Issues,” found at *http://www.wtec.org/loyola/casting/09_01.htm*, retrieved Oct. 14, 2003.

[49] U.S. industry official, interview with USITC staff, United States, June 2004.

[50] Multiple producer questionnaire responses; George Boyd, President and CEO, Goldens’ Foundry and Machine, hearing transcript, p. 23; and U.S. industry officials, interviews with USITC staff, Aug. 2004.

[51] U.S. industry official, interview with USITC staff, United States, June 2004.

[52] U.S. Environmental Protection Agency, “Economic Impact Analysis of Proposed Iron and Steel Foundries NESHAP: Final Report,” p. 4-2.

[53] “EPA Iron & Steel MACT Rule Endangers U.S. Metalcasting Industry,” American Foundry Society, found at *http://www.afsinc.org/Govn/EPAIronSteelMACTRule.h*, retrieved Aug. 30, 2004.

Table 3-13
U.S. foundry industry: Environmental legislation cited by U.S. foundry producers as affecting their business performance

Environmental Legislation	Main requirements
Clean Air Act Amendments (CAAA):	
Title III of CAAA -Maximum Achievable Control Technology (MACT)	For existing hazardous air pollutant sources, standards must be "at least as stringent as the average emissions limitations achieved by the top 12 percent of the existing sources in categories with over 30 sources and the top five of the existing sources in categories with fewer than 30 sources."
	For new hazardous air pollutant sources, standards must be "no less stringent than the emission control achieved in practice for the best-controlled similar source."
Title V of CAAA	Major hazardous air polluting sources are subject to a national operating permit program administered by the EPA.
Clean Water Act	A National Pollutant Discharge Elimination System (NPDES) permit must be obtained from the EPA or state environmental agency to discharge pollutants into the water. Permits contain discharge limits.
	Facilities must meet pretreatment standards if discharging to a publicly owned treatment facility.
California Proposition 65: Safe Drinking Water and Toxic Enforcement Act of 1986 (updated in 2003)	Businesses are not permitted to discharge chemicals known to cause cancer or reproductive toxicity into water or onto land where chemicals could find their way into the water supply.
	Clear warnings must be given to anyone that could be exposed to a chemical known to cause cancer or reproductive toxicity.

Sources: "Iron and Steel Foundry MACT Bulletin Revised," RMT Integrated Environmental Solutions, Mar. 2001, found at *http://www.rmtinc.com/public/docs/i&smact_final.pdf*, retrieved Aug. 30, 2004; "What is Title V?" AQMD, found at *http://www.aqmd.gov/titlev/WhatIsTV.html*, retrieved July 7, 2004; California Office of Environmental Health Hazard Assessment, found at *http://www.oehha.ca.gov/prop65/law/P65law72003.html*, retrieved Feb. 17, 2005; EPA, Office of Compliance Sector Notebook Project: Profile of the Metal Casting Industry, Feb. 1998, found at *http://www.epa.gov/Compliance/resources/publications/assistance/sectors/notebooks/metcstsnapt1.pdf*, retrieved Feb. 17, 2005; and responses to the USITC producer questionnaires.

Worker Health and Safety

Producers noted that worker safety regulations can be burdensome for the foundry industry, particularly when leading competitor countries appear to have less stringent regulations or less rigorous enforcement of worker health and safety regulations.[54] Although OSHA regulations have many facets, depending on the type of metal poured and the process, the most significant component of OSHA requirements is related to indoor air quality, i.e., managing levels of airborne contaminants, such as asbestos, carbon monoxide, metal fumes, and silica dust. Both personal air respirators and collectors are often necessary to maintain compliance with OSHA mandates, along with fire resistant clothing, boots, and gloves. Representatives of the American Foundrymen's Society estimated that OSHA regulations cost $6,590 per employee per year.[55]

[54] Michael Kerwin, Consultant, Georgetown Economic Services, hearing transcript, p. 69; and responses to USITC multiple producer questionnaires.
[55] U.S. industry officials, telephone interview with USITC staff, Mar. 8, 2005.

According to producers, the safety measures can also be burdensome. For example, one firm noted that changes to required measures were made on 16 separate occasions between 1999 and 2004.[56] Another foundry reported that the state health inspector is required by law to visit the plant following each complaint from the local community, which is about every 2 weeks.[57] To manage costs, some firms agree to participate in a voluntary OSHA protection program, which eliminates surprise OSHA inspections.

Trade and Monetary Policies

Producers that listed trade policies among their leading concerns suggested that U.S. trade policy, in general, benefits foreign competitors, particularly those from China and Mexico, more than domestic producers. Specifically, producers expressed concern that some foreign countries that benefit from preferential trade treatment[58] do not impose on companies the same environmental and worker health and safety standards and companies operating in some foreign countries do not offer the same benefits and wages[59] as the United States.[60] A few producers indicated that other countries provide incentives for firms that export castings. Additionally, a few producers said that NAFTA caused production to move to Mexico where labor was less expensive.

Finally, many producers that cited trade policies as a leading concern indicated that allowing China to openly trade with the United States while maintaining a currency that is fixed to the U.S. dollar is unfair to U.S. foundries.[61] During 1999-2001, a strong U.S. dollar gave U.S. residents enhanced buying power, as foreign goods became less expensive in the U.S. market. However, a strong currency has a downside for manufacturers, as U.S.-produced goods are more expensive to economies with weaker currencies.[62] In particular, there is considerable concern in the foundry industry regarding the fixed Chinese currency exchange rate. According to some producers, the Chinese currency is undervalued by up to 40 percent and producers feel that this gives the Chinese an unfair selling advantage in the U.S. marketplace.[63]

Federal/State Programs

Among responding foundries, 141 indicated that they had utilized a government program. The programs most often cited by producers are training grants provided to firms by various states (table 3-14). Other significant programs available to firms aim to improve casting technologies or reduce environmental impacts.

---

[56] Response to the USITC producer questionnaire.
[57] U.S. industry official, interview with USITC staff, June 2004.
[58] E.g., extending WTO membership to China and NAFTA to Mexico.
[59] E.g., workers compensation, leave, and pensions.
[60] Responses from multiple producer questionnaires.
[61] James Mallory, Executive Director, Non-Ferrous Founders' Society, hearing transcript, p. 13
[62] Eugene Muratore, “A Review of the North American Foundry Industry,” *Ductile Iron News,* Issue 2, 2003, found at *http://www.ductile.org/magazine/2003_2/north-american-foundry-industry.htm*.
[63] Multiple producer questionnaire responses. For more detail, see Chapter 10.

Table 3-14
U.S. foundry industry: Government programs received by the U.S. foundry industry

Program name	Provider	Benefits provided
Business and Industry Guaranteed Loans	U.S. Department of Agriculture	Loan guarantee program in which loans are made through private lenders and guaranteed by the USDA. This program is targeted specifically at non-agricultural sector firms to help create jobs and stimulate rural economies.
Trade Adjustment Assistance (TAA)	U.S. Department of Commerce	The program's primary goal is to assist domestic manufacturers and producers injured by increased imports.
Manufacturing Extension Partnership (MEP)	U.S. Department of Commerce	A nationwide network of non-profit centers whose primary goal is to assist small and medium-sized U.S. manufacturers improve their operations.
OSHA Training Grants	U.S. Department of Labor	Grants awarded to non-profit organizations to develop training and educational programs in regards to safety and health hazards in workplaces.
Various types of loan guarantees	U.S. Small Business Administration	Loan guarantees for small businesses.
Various state education and training grants	Various state governments	Types of assistance provided by different states include items such as matching training funds, education grants, and state apprenticeship programs.
Various tax incentives and loan guarantees	Various state and local governments	Different types of tax incentives provided include items such as state tax credits and local property tax abatements.
Employment Training Panel (ETP)	State of California	Provides training funds to businesses that need to train or retrain workers that face technological advancements or foreign and domestic competition.
Enterprise Zones	State of California	This program is aimed at assisting economically distressed areas of the state by offering incentives to encourage business investment and the creation of new jobs through tax incentives.
Skills Enhancement Fund	State of Indiana	Financial assistance to companies in the form of grants for training employees that are residents of the state, with reimbursements of up to $200,000 or up to 50 percent of eligible training costs.
Training 2000 Grant	State of Indiana	Training grants awarded to companies to assist in the costs of training employees in skills needed with capital-investment projects the company has undertaken.
Community Economic Betterment Account (CEBA)	State of Iowa	Financial assistance of up to $1 million for businesses to create or retain employment opportunities.
Kansas Industrial Retraining (KIR) Program	State of Kansas	Funds provided to companies that need to retrain their employees, companies must show that employees are likely to be displaced owing to obsolete or inadequate skills and knowledge. Companies also must show that they are restructuring their business operations along with the ability to financially complete the project.

See source at end of table.

Table 3-14–*Continued*
U.S. foundry industry: Government programs received by the U.S. foundry industry

Program name	Provider	Benefits provided
Kentucky Economic Development Finance Authority	State of Kentucky	A number of financial and tax incentive programs offered to businesses to encourage economic development, business expansion, and job creation.
Economic Development Job Training Program (EDJT)	State of Michigan	Various types of loan guarantees for small businesses.
Michigan Economic Growth Authority (MEGA) Grant	State of Michigan	Companies in manufacturing are eligible to receive a tax credit against the Michigan Single Business Tax, providing they meet all the requirements.
Customized Training Program	State of Missouri	Assistance to companies for the training and retraining of employees.
Power for Jobs Program	State of New York	Under this program, the state provides a legislatively set amount of megawatts of economical electricity for businesses that have a commitment to create or retain jobs in the state.
Skilled Manufacturing Resource Training Grants (SMART)	State of New York	Grants available to companies for the advancement of worker skills.
Strategic Alliance Training Program	State of New York	Assistance to support worker training.
Industrial Training Program	State of Ohio	Provides up to 50 percent of funding for training and materials for workers, to be used with a project that creates or retains jobs.
Training for Industry Program	State of Oklahoma	Free customized training to new and expanding companies in the state that qualify. Types of training include technical skills, safety training, ISO 9000 training, and various other skills.
Ben Franklin Technology Development Authority Programs	State of Pennsylvania	Various types of financing opportunities, technical assistance, and development grants to companies and entrepreneurs.
Workforce and Economic Development Network of Pennsylvania (WEDnetPA)	State of Pennsylvania	Offers companies that qualify free job training for employees on basic entry-level and advanced technology skills through an educational alliance of state universities, community colleges, and other technical schools.
Customized Job Training Program (CJT)	State of Pennsylvania	Provides grant funds for specialized job training for new and existing employees.
Wisconsin Department of Commerce Technology Zone tax credit	State of Wisconsin	Eight designated zones in the state that can provide up to $5 million in tax credits for high-tech companies locating or expanding business in the technology zone.
Extraterritorial Income Tax	U.S. Government	Tax benefit offered to ensure competitiveness of products exported and to assist U.S. exporters in dealing with double taxation.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission and various government agency websites.

Purchases

Total reported purchases of domestic and foreign castings by responding U.S. purchasers[64] increased by 26 percent in value during 1999-2003 (table 3-15). Foreign purchases by these firms accounted for 28 percent of total casting purchases, and were mainly concentrated in machined products. Purchases of rough castings from foreign sources grew the most of any category during 1999-2003 (by 59 percent), although such purchases accounted for the smallest share (6 percent) of total castings purchases. Purchases of foreign-origin machined castings increased by 25 percent, and represented 22 percent of total purchases. Purchasers indicated that their leading reason for increased purchases of foreign castings was price.[65] Certain purchasers noted that machined castings could be purchased from foreign sources for about the same price as domestically-produced rough castings. Multiple purchasers indicated that lower pattern and tooling costs made foreign castings more competitive than domestic castings and influenced their purchasing decision. Finally, a few purchasers noted a limited or non-existent domestic supply of certain cast products, forcing them to purchase these products from off-shore suppliers.

While purchases of foreign-sourced rough castings exhibited the highest growth rate during the period, purchases of domestic castings, particularly rough castings, increased the most in value terms (up by $1.2 billion). According to multiple purchaser questionnaire responses, domestic producers' shorter lead times, lower transportation costs, engineering support, and stocking arrangements contributed to increased purchases of domestic castings.

Another purchasing trend is that producers are increasingly supplementing production at their domestic establishment by purchasing foundry products offshore, particularly machined castings. According to producer questionnaire responses, imports of castings by U.S. foundries increased by $233 million between 1999 and 2003, particularly from Japan (table 3-16). Approximately 72 percent of respondents indicated that their reason for offshore purchases was to obtain a lower cost than their own production cost.

Table 3-15
All metal types: Total reported U.S. purchases of domestic and foreign castings, 1999-2003
(*1,000 dollars*)

Type	1999	2000	2001	2002	2003
Rough castings:					
Domestic	2,850,808	3,360,345	3,515,710	3,463,996	3,511,293
Foreign	345,297	549,147	552,896	577,870	547,648
Unknown	9,468	13,500	14,397	17,023	22,637
Total	3,205,573	3,922,992	4,083,003	4,058,889	4,081,578
Machined castings:					
Domestic	2,288,757	2,427,903	2,403,019	2,615,098	2,865,352
Foreign	1,594,912	1,693,496	1,879,500	1,923,846	1,996,157
Unknown	2,942	316	569	228	87
Total	3,886,611	4,121,715	4,283,088	4,539,172	4,861,596

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

[64] Information reported for total U.S. purchases of all metal types is based on data received from purchasers of the 10 selected product groups.
[65] For more details on factors affecting purchasing decisions, see Chapter 4: Purchasing Patterns and Practices.

Table 3-16
All metal foundries: Responding U.S. producers' imports of rough and machined castings, 1999-2003
(*1,000 dollars*)

Country or country group	1999	2000	2001	2002	2003
Rough:					
China	([1])	5,311	12,916	12,715	11,110
All other[2]	([1])	20,656	18,125	28,265	32,674
Total	10,652	25,967	31,041	40,980	43,784
Machined:					
Japan	42,985	45,233	45,275	68,429	123,136
China	5,727	6,471	11,506	15,938	18,108
India	([1])	4,885	3,506	5,830	6,208
Taiwan	([1])	1,737	1,912	1,510	2,120
All other[2]	63,656	74,650	75,956	126,129	163,604
Total	112,368	132,976	138,155	217,836	313,176

[1] Data withheld to avoid disclosure of confidential business information.
[2] Individual country detail included in “all other” to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

CHAPTER 4
PURCHASING PRACTICES OF U.S. PURCHASERS AND DOWNSTREAM INDUSTRIES

Overview

Despite operating in diverse industries and markets, U.S. purchasers reported that they largely share similar purchasing practices for castings. U.S. purchasers report that they are fairly knowledgeable about their castings sources, both foreign and domestic; infrequently or never change castings suppliers; and overwhelmingly require the same high product standards of their U.S. and foreign castings. Price is a significant factor in purchasing decisions, with nearly one-half of responding purchasers indicating that they usually buy castings at the lowest price. Although U.S. purchasers indicated that domestic castings producers have lowered prices, improved product quality, and shortened lead times to maintain or gain sales during the period, about one-third of reporting U.S. purchasers significantly increased their purchases of foreign-produced castings at the expense of U.S.-produced castings, primarily because of lower foreign pricing.

Purchaser Characteristics

The three largest U.S. purchasers of foundry products are the automotive, machinery and equipment, and other transportation industries.[1] Purchasers include original equipment manufacturers (OEMs), machine shops and other fabricators, distributors, and other types of customers, such as municipalities,[2] and may be the castings end user or serve as a middleman/supplier for downstream industries. Although domestic purchasers often have the flexibility to determine their castings source, those that supply downstream industries may be directed by their end-use customers to source castings from specified foundries, for example, because of an existing relationship. U.S. purchasers responding to the USITC questionnaire generally mirrored this composition, with 61 percent of respondents indicating end uses in the motor vehicle, industrial machinery, mining and oil/gas field machinery and equipment, valve and pipe fittings, and construction machinery and equipment sectors.[3] According to U.S. producers, their customers are increasingly smaller niche manufacturers rather than larger firms that place high-volume orders; the latter provide greater financial rewards for castings producers.[4]

U.S. purchasers (or their final customers) generally own the patterns and tooling used to manufacture castings, but they are nearly always stored at the supplying foundry. If switching sources, purchasers will likely develop new tooling, patterns, or dies with their new supplier rather than move these items, according to questionnaire responses.

[1] Hearing submission, American Foundry Society, Sept. 30, 2004, p. 2.

[2] Ibid.

[3] Purchasers were asked to identify all final markets that they supply; consequently, those purchasers with multiple end markets appear more than once.

[4] U.S. industry officials, interviews with USITC staff, United States, June 2004.

Nearly 19 percent of responding U.S. purchasers noted that they have related foreign firms that produce rough or machined castings and export to the U.S. market. These castings are often destined for the U.S.-based purchaser's operation. Thirteen percent of domestic purchasers indicated that they currently produce rough metal castings in the United States as well as purchase castings.

The most often cited reasons for production changes were cost competition, material substitution, decreased demand, sourcing from foreign foundries, and manufacturing offshore, either by the castings purchaser or its final customer. One industry official attributed declining domestic foundry shipments to bankruptcies and closures within downstream industries.[5] For example, 34 purchasers of castings for motor vehicles that responded to the purchaser questionnaire indicated that they had reduced or eliminated U.S. production of 46 product lines during the period. This industry reported the largest number of manufacturers that adjusted their production volumes as a result of U.S. market shifts. One U.S. purchaser noted that as ". . . OEM's look for greater and greater cost savings, it is only a matter of time before [castings] manufacturers . . . are asked to locate their plant locations in closer proximity."[6] Industry sources indicate that the valve industry has also largely moved offshore.[7] According to questionnaire responses, eight purchasers reduced output levels or closed U.S. production of 17 valve and pipe fittings lines during 1999-2003.

Contract Process

When considering the purchase of castings, 386 of 418 responding U.S. purchasers reported that they typically initiate contact with their suppliers, whether domestic or foreign (table 4-1). According to purchaser questionnaire responses, U.S. foundries are more likely to initiate direct contact with U.S. purchasers than are foreign foundries, who appear to work more often through brokers to gain access to U.S. purchasers than do U.S. foundries. Foreign foundries likely use brokers more frequently because of brokers' greater familiarity with U.S. purchasers and U.S. business practices. Customer-directed sourcing is also fairly common for U.S. purchasers, according to purchaser questionnaire responses. Customers may provide a list of approved U.S. or foreign vendors or foundries from which the purchasers can select their castings source. U.S. purchasers may also be directed by a parent company, either domestic or foreign, to purchase castings from the parent's in-house operation or a related supplier under the parent's umbrella of companies. Purchaser questionnaire respondents indicated that specifying casting sources reduces costs as customers gain uniform quality and specifications, and eliminate duplication of tooling, pattern making, dies, and administrative activities. These responses were consistent across downstream industries.

Questionnaire responses indicate that U.S. purchasers in all downstream industries typically contact 3 or fewer foundries before making a castings purchase, with 51 percent of responding purchasers contacting 3 foundries. Nearly all U.S. purchasers also reported never or infrequently (less often than annually) changing castings suppliers. Supplier loyalty reflects, in part, customer-directed sourcing decisions, satisfaction with the existing supplier relationship and product, and cost avoidance. Purchaser respondents indicated that once suppliers are set up and producing castings, switching sources is generally not cost effective. Changes in casting specifications or product design or customer-directed sourcing shifts, however, may trigger re-sourcing of castings.

[5] U.S. industry official, interview with USITC staff, United States, June 2004, and Roy Hanks, Marketing Manager, ThyssenKrupp-Waupaca, hearing transcript, p. 38.

[6] Hearing submission, ASC Industries, Oct. 12, 2004, p. 10.

[7] Larry A. Comunale, Vice President and General Manager, Doncaster Southern Tool, hearing transcript, p. 219.

Table 4-1
U.S. purchasers of foundry products: Purchase method for domestic and foreign castings
(*Number of responses*)

Purchase method	Domestic castings[1]	Foreign castings[2]
Contacted producer directly	386	237
Contacted by broker or sales agent	101	169
Contacted by producer	162	97
Purchase/transfer castings	27	74
U.S. producer sources foreign castings at purchaser request	([3])	20
U.S. producer sources foreign castings at its initiative	([3])	26

[1] A total of 418 firms responded. Many indicated more than one purchasing method.
[2] A total of 344 firms responded. Many indicated more than one purchasing method.
[3] Not applicable.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

According to one U.S. foundry that supplies the largest end market, the motor-vehicle industry, Japanese transplant automakers are reportedly more loyal customers and provide better opportunities for repeat business than U.S. automakers. They also have clearer quality standards that are easier to meet and maintain. Moreover, the transplant operations work with their suppliers to reduce costs. The Big Three U.S. producers[8] are not considered to be as loyal to their suppliers; for example, contracts with the Big Three are easy to break, as many have provisions that can void parts of the contract with just 30-days notice.[9] These claims are supported by a recent study that found that many U.S. suppliers prefer working with the Japanese transplant automakers rather than the Big Three because they "are treated as partners rather than adversaries and stand a better chance of making an acceptable financial return."[10] Consequently, domestic suppliers are less willing to share technological innovations with the Big Three automakers and are less trusting of their methods.[11]

Contracts between foundries and their customers may include quality clauses that allow a purchaser to drop a supplier if product specifications are not met.[12] Purchaser questionnaire respondents note that the principal changes in contract terms during the period are largely focused on extended payment terms and, to a lesser extent, longer contracts.

Castings Origin Issues

Nearly 80 percent of all responding U.S. purchasers indicated that they always know the producer(s) of the domestic castings they purchase, whereas 53 percent of respondents indicated the same level of knowledge about the producer(s) of their foreign casting purchases. The better knowledge of U.S. foundries likely reflects familiarity with the U.S. market and its domestic suppliers.

In contrast, end-use customers are less familiar with the origin of the castings in the products acquired from U.S. purchasers that serve as their suppliers, according to questionnaire responses. U.S. castings

[8] DaimlerChrysler, Ford, and General Motors.
[9] U.S. industry official, interview with USITC staff, United States, June 2004.
[10] "U.S. Parts Makers Prefer Honda, Toyota," Reuters, Aug. 1, 2004, found at *http://asia.search.news.yahoo.com...*, retrieved Aug. 2, 2005.
[11] Lindsay Chappell, "Gulf widens between Big 3, suppliers," Automotive News, Aug. 2, 2004, found at *http://www.autonews.com...*, retrieved Aug. 2, 2004.
[12] U.S. purchaser official, interview with USITC staff, United States, Oct. 2004.

purchasers indicated that 36 percent of their downstream customers are always aware of or interested in the country of origin of the castings in their products, with another 17 percent of purchasers noting that customers are usually aware of their origin. This relative lack of awareness of castings origin likely occurs more often with end-use customers that are further removed from the manufacturing process and that have less need to specify castings sources. In this case, the only end-use customers reported by U.S. purchasers to exceed the 50-percent level for always knowing the origin of their castings were those in the motor-vehicle industry. The extensive globalization, certification requirements, and safety-oriented parts production of this industry likely contribute to the greater focus on castings origin by U.S. motor-vehicle parts end-users.

Insurance, Standards, and Trademark Issues

Proof of insurance for product liability is not required by most U.S. purchasers for either domestic or foreign castings suppliers. However, domestic purchasers always require proof from U.S. suppliers more often than their foreign sources (32 percent compared to 22 percent, respectively). Product liability insurance covers such issues as product failure resulting from metallurgical or material problems, and is not available in all countries, most notably China.[13]

Industries that produce more safety- and performance-related products with the potential for large liability claims, such as transportation industries, more often demand product liability insurance coverage of their castings producers. Of 133 responding U.S. purchasers in the motor-vehicle industry, for example, 43 percent reported always requiring insurance from domestic producers, the highest response of all downstream industries.

Despite claims by U.S. producers that purchasers require less restrictive standards of their foreign suppliers, nearly 99 percent of responding U.S. purchasers indicated that they require the same (or higher) quality standards for purchases of foreign castings as for U.S. castings, with no differences among downstream industries.

Tracking parts throughout the manufacturing process has become an important element of quality control for the foundry industry, and is often required by sales contracts.[14] The information available from traceability documentation is critical to establishing material and manufacturing integrity in case of failure. This documentation, or a trademark,[15] has become an essential requirement for U.S. foundries, according to 55 percent of purchaser questionnaire respondents. About 48 percent of U.S. purchasers reported making similar demands of their foreign castings producers. Another 21-24 percent of purchasers noted that trademarks/documentation were usually or sometimes required.

Traceability documentation is important to purchasers as it provides documentation throughout the supply chain for criteria such as heat dates, purchase order numbers, product descriptions, chemical content, and physical, dimensional, quantity, grade, and type information.[16] According to one domestic producer,

---

[13] "Product Liability Coverage, Offshore Solutions: Your Global Sourcing Partner," found at *http://www.offshoresolutions.com/solutions/liabilityInsurance.htm*, retrieved Feb. 1, 2005.

[14] Ken Maisch, "3-D Traceability in the Foundry," *Foundry Management & Technology*, Sept. 2000, p. 78.

[15] A trademark is a word, name, symbol or device which is used to indicate the source of goods and to distinguish them from merchandise produced or sold by others. Trademark rights may be used to prevent the use of a confusingly similar mark, but not to prevent the manufacture of the same goods or the sale of the same goods or services under a clearly different mark. "What Are Patents, Trademarks, Servicemarks, and Copyrights?," *General Information Concerning Patents*, United States Patent and Trademark Office, found at *http://www.uspto.gov/web/offices/pac/doc/general/whatis.htm*, retrieved Feb. 5, 2005.

[16] "Bulk Metals Qualified Suppliers List for Distributors (QSLD) Home Page with Criteria and Provisions," Defense Logistics Agency, Defense Supply Center, Philadelphia, found at

(continued...)

traceability documentation is essential to its business relationships. This foundry must develop and document the processes and material that will be used and allow the customer to audit this information. This is an expensive and lengthy process that usually lasts at least six months to a year before any sales can be made.[17]

Downstream industries that most often reported requiring trademarks or documentation included the mining, motor vehicle, railway, valve, aircraft, and ship industries. Most of these are transportation industries subject to certification requirements and high liability potential. Motor vehicle producers require of their foundries a Production Part Approval Record (PPAR), which is a paperwork trail from casting design through production. Foundries must keep a hard copy of this record as motor-vehicle producers conduct audits of these suppliers.[18] The water works industry also requires casting traceability documentation for product liability issues such as failure.[19]

Purchasing Decision Factors

Domestic purchasers were asked to rank the leading factors used to evaluate potential purchases from domestic and foreign castings suppliers. Purchaser responses indicate that they prioritize the same factors when considering purchases from both domestic and foreign castings sources, with castings quality and price the key determinants (table 4-2). Castings quality was the highest ranked factor affecting purchase decisions for nearly 60 percent of responding U.S. purchasers, for both domestic- and foreign-origin castings; price (delivered) was ranked highest the second-most frequently. Delivery time was also ranked as an important factor for purchasing from both U.S. and foreign suppliers. Transportation costs are a more significant factor for foreign-made castings than for U.S. castings. Technical services were a more significant purchase factor for domestic castings; its relatively lower importance may reflect a flow of technology and expertise to purchasers that now have the capability to design their components and outsource tooling requirements.[20]

Certain purchasing factors favor U.S. foundries. "Buy American" practices are still evident. As noted in questionnaire responses, certain purchasers are committed to buying solely U.S.-made castings. One U.S. foundry official noted that if downstream customers require castings to be made in the United States, then U.S. foundries are guaranteed that business.[21] This situation often occurs when foundries supply castings for federally funded operations, such as construction projects. Certain purchasers noted that when inventory management and complex manufacturing skills are required, U.S. foundries excel. U.S. foundries were also cited by responding U.S. purchasers as manufacturing with a low defect (rejection) rate. Moreover, U.S. foundries were reported by some U.S. purchasers to have advantages in lead time, low volume manufacturing, proximity to their customers, product variability, technical expertise, engineering support, and stocking agreements.

[16] (...continued)
http://www.dscp.dla.mil/gi/prod_services/metals.htm, retrieved Feb. 1, 2005.

[17] U.S. industry official, interview with USITC staff, United States, June 2004. Costs associated with traceability increase with the growth in documentation. Ken Maisch, "3-D Traceability in the Foundry," p. 78.

[18] U.S. industry official, interview with USITC staff, United States, June 2004.

[19] Jim Keffer, President, EBAA Iron Sales, Inc., hearing transcript, p. 166 and p. 175.

[20] William T. Blackerby, Jr., Chief Operating Officer, ASC Industries, Inc., hearing transcript, pp. 146-148.

[21] U.S. industry official, interview with USITC staff, United States, Oct. 2004.

Table 4-2
U.S. purchasers of foundry products: Ranking of factors when purchasing domestic and foreign castings
(*Number of responses*)

	Domestic castings ranking[1]					Foreign castings ranking[2]				
Factor	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Price (delivered)	113	175	94	17	3	102	151	67	9	3
Delivery time	26	66	200	74	15	13	51	153	75	24
Quality of castings	241	117	31	9	3	97	93	30	10	2
Transportation cost	4	6	13	75	84	5	13	25	86	61
Technical services	11	11	24	89	86	9	9	16	47	75
Financing terms	3	1	5	24	35	1	1	6	24	37
Warranty terms	4	2	7	10	27	2	5	5	10	21
Historic supplier relationship	15	16	19	53	92	12	10	14	28	55
Standards certification	25	13	22	32	55	23	12	17	33	45

[1] A total of 404 firms responded.
[2] A total of 335 firms responded.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

However, gaps in product coverage and capacity constraints of U.S. producers have led U.S. purchasers to source offshore, according to responding U.S. purchasers. Aluminum engine blocks and heads, iron exhaust manifolds, and specialty plumbing items, for example, were cited as products for which there is limited or no U.S. casting production. One purchaser stated that domestic foundries have been "unwilling to utilize foreign tooling . . . this has definitely been a factor for companies like ASC in their move off-shore."[22] This purchaser also cited experience with the inflexibility and long lead times of the U.S. industry, claiming these factors have influenced domestic purchasers to source from offshore.[23] A number of respondents also claimed that the U.S. industry has a longer lead time for new products than offshore sources, in contrast to the reported experience of other U.S. purchasers.

Additional factors also convey advantages to foreign foundries, according to responding domestic purchasers. Questionnaire respondents reported that foreign producers usually offer lower cost pattern making[24] and tooling[25] than their U.S. counterparts, which greatly enhances the competitiveness of foreign foundries. This factor by itself does not determine a contract award, but is a significant element of the overall business proposal. A large number of U.S. purchasers cited lower machining costs as another advantage for certain foreign producers, such as those in China.[26] Several purchasers reported that they were able to buy foreign-origin machined castings for less than the cost of a rough casting produced in the United States, resulting in increased purchases from foreign sources. Other respondents source from foreign producers to take advantage of currency differentials.[27]

U.S. producers have claimed that U.S. purchasers and their downstream customers are increasingly moving production offshore. U.S. purchasers that supply global industries find an advantage in sourcing from offshore foundries since it allows them to service their overseas customers, such as the automakers, from a local base. Just as proximity and its related advantages are important factors when supplying automakers and

[22] Hearing submission, ASC Industries, p. 11.
[23] Ibid.
[24] One purchaser noted that U.S. pattern-making costs were up to 90 percent higher than foreign sources.
[25] Foreign tooling costs were estimated to be 50 to 70 percent lower than comparable U.S. tooling, according to one U.S. purchaser.
[26] A U.S. purchaser indicated that machined castings are 30 to 50 percent cheaper from all foreign sources than from U.S. producers.
[27] See chapter 10 for more detail on the competitive effect of currency valuations.

equipment manufacturers producing in the United States, local sourcing is also important to U.S. companies manufacturing overseas.

Moreover, as more competitors source castings from less expensive offshore suppliers to supply their U.S. operations, U.S. castings producers and purchasers feel pressure to follow the same course to stay competitive in their market. For example, one domestic foundry indicated that a number of large vehicle and off-road machinery manufacturers with in-house foundries are buying from offshore sources because of the intense competition in their industries.[28]

A few purchasers expressed concerns that they are being asked by their customers to shift operations offshore to take advantage of lower casting and machining costs. For many companies, establishing a foreign operation is a costly endeavor with numerous risks that may not withstand a thorough cost-benefit analysis. Other purchasers noted the risk inherent in long supply lines from foreign sources, as well as concerns about product quality and piracy.

Pricing and Cost Issues

The price of metal castings purchased by U.S. purchasers is determined by a variety of methods. The most common pricing method reported is to negotiate prices with the supplier for each individual job, as indicated by 163 of 452 responding purchasers (table 4-3). Absent price negotiations, purchasers report little leverage with their suppliers; 88 purchasers stated that the castings price was set by the producer, whereas only 7 purchasers reported that they were able to set prices. The majority of downstream industries negotiate prices for each individual job, but a few industries (e.g., refrigeration, plumbing, and pumps/compressors) indicated that their prices are established with short-term contracts. The pump and compressor industry also noted that its prices were largely set by the castings producer.

Table 4-3
U.S. purchasers of foundry products: Pricing methods

Method used to determine price	Number of responses
Negotiated between producer and customer for each individual job	163
Negotiated between producer and customer on a contract of 1 year or less	122
Negotiated between producer and customer on a contract of more than 1 year	104
Price set by producer	88
Price set by customer	7
Price set based on imported product price or by imported product offer price	15

Note.–A total of 452 firms responded. Many indicated more than one price determination method.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Domestic purchasers were asked to evaluate changes in casting prices during the period. Of 407 responding purchasers, 66 percent indicated that domestic castings prices had generally increased during 1999-2003. About one-half of purchasers reporting increases estimated the price increase to be no greater than 10 percent (table 4-4). A significantly smaller number of U.S. purchasers (13 percent) reported that domestic casting prices had decreased, with most of this group reporting price declines of less than 10 percent. U.S. purchasers were fairly evenly split when indicating the price change of foreign castings, with 45 percent reporting an increase and 40 percent indicating that the price of foreign castings remained the same. For purchasers reporting a price increase for foreign castings, this increase typically did not exceed 10 percent.

[28] U.S. industry official, interview with USITC staff, United States, Aug. 2003.

Table 4-4
U.S. purchasers of foundry products: Comparison of relative price changes of domestic and foreign castings in the U.S. market, 1999-2003

(***Number of responses***)

Price change in U.S. market	Domestic castings price[1]	Foreign castings price[2]
Increased:	270	151
By 0-10 percent	137	94
By 11-20 percent	78	38
By 21-30 percent	27	9
By 31 percent or more	11	1
Unspecified amount	17	9
Stayed the same	84	134
Decreased:	53	48
By 0-10 percent	40	35
By 11-20 percent	6	10
By 21-30 percent	2	1
By 31 percent or more	2	1
Unspecified amount	3	1

[1] A total of 407 firms responded.
[2] A total of 343 firms responded.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Of 440 responding purchasers, less than 4 percent indicated that they always purchase castings at the lowest price offered. Nonetheless, 49 percent indicated that they usually purchase castings at the lowest price, and another 36 percent note that they sometimes purchase at the lowest price. This emphasis on lowest price continues to pressure the foundry industry and likely contributes to deteriorating financial conditions. One purchaser noted the importance of monitoring suppliers' financial conditions to avoid unexpected plant closures and disruptions in castings supply.[29]

To lower their purchasing costs of U.S. castings, respondents have asked domestic casting producers to lower their prices to maintain the business and set target prices for U.S. foundries (table 4-5). Casting suppliers have reportedly been asked to meet target prices based on prices for castings quoted by Chinese foundries.[30] Forty-one percent of U.S. purchasers reported that they shifted purchases to foreign foundries to lower their purchasing costs. The threat of going offshore is reportedly often used against U.S. foundries by their customers.[31] U.S. producers have also commented on the leverage larger customers have over castings suppliers, in some cases having the market power to demand 3 to 5 percent annual price reductions. Similar practices are used to lower purchasing costs of foreign-origin castings, with the imposition of periodic price reductions emerging as the third leading method for lowering costs of foreign castings purchases.

[29] U.S. purchaser official, interview with USITC staff, United States, Oct. 2004.
[30] U.S. industry official, interview with USITC staff, United States, June 2004.
[31] Ibid.; and George G. Boyd, President and CEO, Goldens' Foundry and Machine, hearing transcript, p. 21.

Table 4-5
U.S. purchasers of foundry products: Methods to lower purchasing costs of domestic and foreign castings
(*Number of responses*)

Methods to lower purchasing costs of castings	Domestic castings[1]	Foreign castings[2]
Request casting producers to reduce price to maintain business	221	147
Shift purchases to foreign-origin castings	139	([3])
Request casting producers to meet target prices	105	69
Change method to calculate pass-on costs (i.e., surcharges)	63	32
Impose periodic price reductions	43	37
Use online reverse auctions	25	17
Require rebates	25	19
Shift purchases to domestic-origin castings	([3])	22

[1] A total of 339 firms responded.
[2] A total of 241 firms responded.
[3] Not applicable.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Import Competition and Industry Responses

Nearly one-third of reporting U.S. purchasers increased their purchases of foreign-produced castings by more than 5 percent (by quantity) at the expense of U.S.-produced castings during 1999-2003. Despite the higher ranking given to the significance of quality as the leading purchase factor, lower price was the principal reason given for these increased purchases by 142 of 154 respondents (table 4-6). Only 27 purchasers indicated that better casting quality was an inducement for increased purchases from foreign sources. U.S. purchasers identified China as the leading major foreign supplier of both rough and machined castings. Similar reasons for increased purchases of foreign castings were evident in all downstream industries, with lower price the principal factor in this growth.

To maintain or increase their sales, U.S. purchasers indicated that domestic castings producers have lowered prices and increased efforts to improve product quality, shorten lead times, offer more flexible delivery times, and obtain certifications (table 4-7). Other foundry industry initiatives cited by U.S. purchasers include the implementation of lean manufacturing, adapting to customer inventory requirements, and offering favorable payment terms.

Table 4-6
U.S. purchasers of foundry products: Reasons for significantly increased purchases of foreign castings

Reasons	Number of responses
Lower price	142
Closure of domestic castings producers	29
Better quality	27
Smaller minimum orders	17
Shorter lead times	15
More flexible delivery times	11
Shorter contract period	5
More flexibility in product specification	4

Note.–A total of 154 firms responded. Many indicated more than one reason.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Table 4-7
U.S. purchasers of foundry products: Reported changes in domestic producers' business practices

Business practice	Number of responses
Lowered price	100
Improved quality	87
Shortened lead times	85
Increased flexibility in delivery times	68
Adopted ISO or similar quality standards	67
Added value to their products	48
Reduced size of minimum orders	35
Increased flexibility in product specification	16

Note.–A total of 167 firms responded. Many indicated more than one business practice.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Downstream respondents noted various business practice adaptations by U.S. castings producers. For U.S. purchasers associated with the motor-vehicle industry, lower prices was the primary response of domestic producers over the period. U.S. suppliers to the motor-vehicle industry are under considerable pressure to continually reduce prices to their customers despite increased raw material prices and greater manufacturing and product development responsibilities. Shortened lead times was the leading change in business practices for domestic suppliers to purchasers of castings for the farm/garden machinery, industrial machinery, pumps/compressors, aircraft, and ships/boat industries. The mining industry indicated that improved product quality was the principal change in business practices for its domestic suppliers. Finally, more flexible delivery times was the lead response for suppliers to the construction machinery and valve industries.

CHAPTER 5
U.S. IRON FOUNDRY INDUSTRY

This chapter provides an overview of the U.S. iron foundry industry, based on responses to the USITC producer and purchaser questionnaires, fieldwork, and interviews with leading industry participants. The chapter begins with a discussion of the structure of the industry and leading demand characteristics. Analyses of various business trends, production factors, and domestic policies follow, and the chapter concludes with a discussion of purchasing trends.

Iron is the most commonly cast metal because of its relatively low cost, ease of casting into complex shapes, ease of machining, and desired physical properties.[1] Hence, iron castings are integrated into the production chain for a wide range of downstream products, with shipments predominantly to the automotive, various machinery and equipment, and pipe and valve industries. However, low production costs and widespread technology dissemination render iron foundries particularly vulnerable to foreign price competition. Moreover, iron castings have also lost market share to other metals, particularly to lighter-weight aluminum and higher-strength steel, especially in automotive applications. Pressure to meet customer prices and loss of downstream markets, coupled with escalating costs for raw materials, energy, and employee benefits, have squeezed profit margins for iron foundries in recent years. Foundries producing rough castings in the more specialized ductile iron industry are in somewhat better financial condition, despite declining operating income, than those in the more competitive gray iron industry where declining operating income deteriorated into losses during 2002-2003.

Of the 465 respondents to the foundry questionnaire, 169 reported producing iron castings in the United States during 1999-2003.[2] Given that most cast gray iron (116) or ductile iron (109), data for these two iron industries are presented separately where the similarities and differences can be highlighted.[3] The American Foundry Society (AFS) also collects information on the foundry industry based on metal types. Questionnaire data collected by the USITC account for 82 percent of iron foundry production in 2003 as reported by the AFS.[4] Of the 463 U.S. purchasers responding to the purchaser questionnaire, 271 reported purchasing iron castings. Results from the producer and purchaser questionnaires are discussed in this chapter to provide not only an overview of the iron foundry industry, but also more product-specific analysis of ductile iron crankshaft and camshaft castings, gray iron motor vehicle gear-box castings, ductile iron bearing castings, gray iron compressor housing castings, gray iron pump castings, and gray iron non-motor vehicle gear-box castings.[5]

---

[1] C.R. Loper, "Foundry Practice and Equipment," *Mark's Standard Handbook for Mechanical Engineers* (New York: McGraw Hill, 1985); and "Understanding Cast Irons," *Engineered Casting Solutions*, summer 2000, pp. 28-29, found at *http://www.castingsource.com/tech_art_understanding.asp*, retrieved July 22, 2004. See also "Iron" in ch. 2.

[2] Of these respondents, 140 cast only various types of iron. Others cast both iron and other metals, including steel (16), aluminum (15), copper alloys (7), or various combinations of these metals. These figures do not sum to total number of responding establishments, as the categories are not mutually exclusive.

[3] Respondents that cast all other types of iron (e.g., malleable, compacted-graphite iron, etc.) (21) or did not specify the types of iron cast in their facilities (7) are not analyzed further for they represent less than 5 percent of all reported production of rough iron castings. However, these respondents are included in the database where all types of iron are specified, i.e., where not otherwise specifically broken out between gray and ductile iron.

[4] AFS, "38th Annual Census of World Casting Production–2003," *Modern Casting*, Dec. 2004, p. 26.

[5] Of the169 establishments reporting production of iron castings, 11 respondents reported information on ductile iron crankshafts/camshafts; 20 for gray iron motor-vehicle gear boxes; 18 for ductile iron bearing housings; 37 for gray iron compressor housings; 31 for gray iron pump castings; and 21 for gray iron non-motor vehicle gear box

(continued...)

Industry Profile

Industry Structure

Iron foundries are highly concentrated, with the top-10 responding gray iron casters accounting for 54 percent of all reported gray iron production volumes and the top-10 responding ductile iron casters accounted for 62 percent of all reported ductile iron production volumes in 2003. Hence, most iron foundries are small operations, with more than one-half employing fewer than 100 production and related workers (PRWs).[6] Conversely, only a few respondents that cast gray iron (8 of 108) or ductile iron (8 of 100) employed 500 or more PRWs.

Responding establishments that cast gray or ductile iron are concentrated primarily in the industrialized areas of the upper Midwestern states (i.e., Wisconsin, Indiana, Pennsylvania, Ohio, Michigan, and Iowa), as are their downstream customers (especially the automobile industry), for whom iron foundries are an integral part of the supply chain. Respondents that cast ductile iron are also clustered in Alabama for production of soil pipe/pressure pipe and components for various other downstream industries.

Foundries that produce rough iron castings largely consider themselves to be job shops. The majority of these job shops report significantly higher production of broad numbers of products in low-quantity runs[7] than do those that consider themselves to be captive operations. However, larger foundries, whether job-shop or captive operations, tend to specialize in casting a fewer number of products than do smaller operations.

The most common production-related activities cited by both gray and ductile iron foundries are building of expended-type molds, followed by pattern-making, and rough-castings design (table 5-1). Approximately one-third of respondents also report machining their rough iron castings. Only the building of expended-type molds is performed entirely in-house.[8] Expendable sand molds and cores are most commonly relied upon by responding establishments for their relatively low cost and high suitability for casting complex shapes in either gray or ductile irons.[9] More specialized casting alternatives reported by several respondents for each type of iron include lost-foam and centrifugal casting.

---

[5] (...continued)
castings. Of the 271 purchasers reporting information on iron castings, 13 respondents reported information on ductile iron crankshafts/camshafts; 43 for gray iron motor-vehicle gear boxes; 24 for gray iron bearing housings; 20 for gray iron compressor housings; 59 for gray iron pump castings; and 32 for gray iron non-motor vehicle gear box castings.

[6] Sixty-three (58 percent) of the 108 gray iron casters and 55 (55 percent) of the 100 ductile iron casters reported employing fewer than 100 PRWs.

[7] For example, as a job shop, Golden's Foundry and Machine Co., of Columbus, GA, casts some 15 to 20 different products in a typical day, in either gray iron or ductile iron with the same green sand molding process on the same casting equipment. Testimony of George G. Boyd, President and Chief Executive Officer, Golden's Foundry & Machine, hearing transcript, p. 19. Another job shop, Cumberland Foundry Co. Inc., of Cumberland, RI, produces between 40 to 50 different types of castings a day, with average weights ranging from a few ounces to 800 pounds and quantity runs averaging less than 50 pieces each, with most in 1- or 2-piece quantities. Testimony of Albert T. Lucchetti, President, Cumberland Foundry Co. Inc., hearing transcript, pp. 32-33.

[8] The extent to which other activities are contracted out reflects both cost differences and degree of technical sophistication. U.S. industry source, telephone interview with USITC staff, Feb. 5, 2005.

[9] See also "Sand casting" in ch. 2.

Table 5-1
Gray and ductile iron foundries: Establishment activities of responding producers, 2004

Activity	Number responding that performed activity	Average percentage performed in-house
Gray iron:		
Total establishments reporting = 95		
Design of rough castings	44	45
Pattern making	53	52
Mold making, expended type	74	100
Mold/die making, permanent type	6	91
Machining of rough castings	36	65
Downstream manufacture	11	60
Ductile iron:		
Total establishments reporting = 85		
Design of rough castings	36	53
Pattern making	49	51
Mold making, expended type	59	99
Mold/die making, permanent type	4	94
Machining of rough castings	30	55
Downstream manufacture	11	51

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Rough castings accounted for about three-quarters of average net sales during 1999-2003 for respondents that cast either gray or ductile irons (table 5-2). Gray iron casters derived slightly more of their sales from machined castings than did ductile iron casters, although both increasingly shifted their sales toward machined castings over the 5-year period. Some respondents shifted sales, in part, as downstream customers have increasingly subcontracted or sought to reduce their own in-house machining costs.[10]

Table 5-2
Gray and ductile iron foundries: Responding U.S. producers' average net sales shares, fiscal years 1999-2003
(*Percent of total sales*)

Item	1999	2000	2001	2002	2003
Gray iron:					
Rough castings	75	74	73	74	73
Machined castings	13	13	14	14	14
Downstream products containing in-house castings	11	11	11	11	11
Other	1	1	1	1	1
Total	100	100	100	100	100
Ductile iron:					
Rough castings	77	76	75	75	75
Machined castings	9	9	10	10	11
Downstream products containing in-house castings	12	12	12	12	12
Other	2	2	2	2	2
Total	100	100	100	100	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[10] U.S. industry official, telephone interview with USITC staff, Feb. 5, 2005.

Demand Characteristics

The predominant end markets for gray iron cast components are automobiles, trucks, and other motor vehicles, which together accounted for 59 percent of all shipments by responding foundries in 2003 (table 5-3), despite a long-term trend dating back to the 1970s of material substitution by the automotive industry.[11] Motor vehicles have remained the predominant end-use market because of the desired physical properties, relatively low cost, and ease of casting gray iron[12] into engine blocks, cylinder sleeves, brake drums and discs, and drive-train component housings. Other notable end uses for gray iron include refrigeration, air conditioning, and heating equipment; construction and municipal castings; and valves and pipe fittings that do not require the specialized properties of more costly ductile or other irons, or steel.

Table 5-3
Gray iron foundries: End market for responding U.S. producers' shipments, 2003
(*Percent*)

End market	Share of 2003 shipments of castings by quantity
Motor vehicles:	
Automobiles (including light duty trucks, SUVs, vans, etc.)	39
Trucks	18
Other (buses, motor homes, etc.)	2
Farm and garden machinery and equipment	4
Mining and oil/gas field machinery and equipment	1
Construction machinery and equipment	3
Refrigeration, air conditioning, and heating equipment	8
Industrial machinery	2
Soil pipe/pressure pipe	1
Valve and pipe fittings	7
Pumps and compressors	2
Household appliances	1
Construction/municipal castings	8
Other/unknown	4
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

By contrast, the predominant end use market for ductile iron castings is soil pipe/pressure pipe (table 5-4), as ductile iron offers flexibility in casting a wide range of sizes and section-thicknesses, along with fracture and corrosion resistance. The other major end use markets cited are automobiles and trucks, because the stiffness, impact resistance, and tensile strength make ductile iron suitable for camshafts and crankshafts.

[11] A recent example occurred in 1996 when General Motors Corp. redesigned parts for its 90-degree, V-6 and V-8 cast-iron engines with aluminum or reinforced plastic-composite intake manifolds, aluminum water pump, and aluminum cylinder head to replace gray iron components. Testimony of William T. Blackerby, Jr., Chief Operating Officer, ASC Industries, Inc., hearing transcript, pp. 77-78. See also Al Wrigley, "Big Three Engine Program to Drive Demand," *American Metal Market*, May 10, 2002; Al Wrigley, "DaimlerChrysler Switching to Aluminum," *American Metal Market*, Sept. 21, 2000; Al Wrigley, "Iron Yields to Aluminum in GM Engines," *American Metal Market*, Aug. 18, 2000; and Al Wrigley, "Ford Converts Engines to Aluminum," *American Metal Market*, Jan. 31, 2000.

[12] Loper, "Foundry Practice and Equipment."

Table 5-4
Ductile iron foundries: End market for responding U.S. producers' shipments, 2003
(*Percent*)

End market	Share of 2003 shipments of castings by quantity
Motor vehicles:	
Automobiles (including light duty trucks, SUVs, vans, etc.)	26
Trucks	9
Farm and garden machinery and equipment	2
Construction machinery and equipment	1
Plumbing	2
Industrial machinery	1
Soil pipe/pressure pipe	48
Valve and pipe fittings	4
Other/unknown	7
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Channels of distribution for rough castings largely reflect the supply-chain structures of the major downstream consuming sectors for each type of iron. Rough gray iron castings (table 5-5) are mostly shipped to machine shops/other fabricators and original equipment manufacturers (OEMs) (together 62 percent), as gray iron foundries are an integral part of the tiered OEM supply structure for the automobile, heavy-truck, machinery, and equipment industries. However, smaller shares of such rough castings are also either retained for in-house machining or subcontracted to outside machine shops. By contrast, distributors are the predominant channels for shipping machined castings produced by responding establishments that cast gray iron components.

Table 5-5
Gray iron foundries: Responding U.S. producers' shipments, by channel of distribution, 2003
(*Percent*)

Channel of distribution	Share of 2003 shipments of by quantity
Rough castings:	
In-house machining	17
Machining subcontractor	10
Machine shop/other fabricators	31
Distributors	8
Original equipment manufacturers (OEM)	31
Other	4
Total	100
Machined castings:	
Distributors	49
Original equipment manufacturers (OEM)	18
In-house for use in downstream products	13
Other	20
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Distribution channels are less concentrated for rough ductile iron castings (table 5-6). Although machine shops/other fabricators and OEMs received a combined 40 percent of such castings, predominantly as automotive and truck components, a combined 52 percent were shipped through other channels (i.e., contractors, end-use customers, etc.) and distributors, particularly as soil pipe/pressure pipe, and valve and pipe fittings. As with machined gray iron castings, distributors are also the predominant channels for shipping machined castings produced by respondents that cast ductile iron components. However, other channels are also significant customers for a wide range of machined ductile iron castings.

Table 5-6
Ductile iron foundries: Responding U.S. producers' shipments, by channel of distribution, 2003
(*Percent*)

Channel of distribution	Share of 2003 shipments of by quantity
Rough castings:	
In-house machining	5
Machining subcontractor	2
Machine shop/other fabricators	22
Distributors	24
Original equipment manufacturers (OEM)	18
Other	30
Total	100
Machined castings:	
Distributors	43
Original equipment manufacturers (OEM)	11
In-house for use in downstream products	9
Other	36
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Producer Trends[13]

Capacity, Production, Inventories, and Shipments

Reported production capacity for all types of rough iron castings (table 5-7) fluctuated around 9.7 million short tons during 1999-2002 before declining by 4 percent in 2003 as responding establishments shutdown about 383,000 short tons of production capacity owing to declining downstream market shares, rising import competition, and continued financial losses.[14] Entry of several producers since 2000 was not

[13] Certain data have been withheld to avoid disclosure of business confidential information. These data include rough castings purchased from other companies and other machining costs.

[14] For example, Anvil International found itself burdened with "excess" foundry capacity for casting malleable-, non-malleable, and ductile iron pipe fittings, that the company president attributed to loss of market share to lower-priced fittings from China. To reduce both the "excess" capacity and production costs, Anvil International spent approximately $20 million to shut down its Statesboro, GA foundry and combine iron casting operations at its Columbia, PA foundry in 2001. Testimony of Thomas Fish, President, Anvil International, hearing transcript, Departments of Commerce, Justice, and State; the Judiciary; and Related Agencies Subcommittee of the House (continued...)

sufficient to maintain previous production levels of rough iron castings as production in subsequent years declined to a level 10 percent below the 8.3-million short tons levels of 1999-2000. Capacity utilization slightly improved in 2003 as production capacity was reduced, whereas annual inventory levels tracked downward after 2000 and inventories as a share of production remained relatively steady thereafter. However, respondents that cast ductile iron reported higher inventory shares (33 percent) than did those that cast gray iron (6 percent). Certain ductile iron castings, particularly soil pipe/pressure pipe and valves and pipe fittings, are seasonal products with demand driven by the cycle of construction activity and extent of public works projects; hence, producers typically build up inventories throughout the year to maintain a wide range of sizes in stock to meet customer order requests in a timely manner, particularly during the peak sales months during the summer.[15]

Table 5-7
All iron foundries: Responding U.S. producers' capacity, production, and inventories for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Capacity (short tons)	9,687,985	9,722,389	9,620,048	9,744,415	9,360,928
Production (short tons)	8,320,927	8,323,187	7,407,860	7,554,569	7,461,348
Capacity utilization (*percent*)	86	86	77	78	80
Inventory:					
Total (short tons)	1,307,444	1,548,935	1,535,070	1,478,815	1,478,237
Share of production (*percent*)	16	19	21	20	20

Note.–Figures may not add to totals because of rounding. Capacity utilization based on establishments that were able to provide both capacity and production amounts. Inventory share of production based on establishments that were able to provide both inventory and production amounts.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Gray Iron

Domestic shipments, internal consumption, and total shipments of rough gray iron castings (table 5-8) declined, in both quantity and value terms, in almost every year during 1999-2003. Impacts on the foundry industry from weaker demand by downstream customers were particularly noticeable in 2001. However, domestic and export shipments did not recover in 2003 as customer demand started improving, a situation that U.S. industry sources attribute to rising competition and aggressive pricing by foreign iron casters dating back to 2000[16] and to downstream customers moving, or threatening to move, production offshore.[17]

[14] (...continued)
Appropriations Committee, Washington DC, May 22, 2003, p. 14.
[15] U.S. industry official, telephone interview with USITC staff, Feb. 7, 2005.
[16] Testimony of Randall W. Lawton, President and Chief Executive Officer, Bay Engineered Castings, hearing transcript, p. 42.
[17] Testimony of George G. Boyd, President and Chief Executive Officer, Golden's Foundry & Machine, pp. 20-21.

Table 5-8
Gray iron foundries: Responding U.S. producers' domestic shipments and exports for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Domestic shipments:					
Commercial	2,323,846	2,226,627	1,935,334	1,955,464	1,918,109
Internal consumption and transfers	1,609,770	1,518,037	1,319,633	1,325,863	1,308,876
Exports	43,675	59,622	49,539	51,414	50,828
Total	3,977,291	3,804,286	3,304,506	3,332,741	3,277,813
	Value (*1,000 dollars*)				
Domestic shipments:					
Commercial	1,896,944	1,860,464	1,601,200	1,569,667	1,558,985
Internal consumption and transfers	1,982,805	1,720,332	1,483,362	1,433,360	1,368,361
Exports	47,811	59,835	51,458	50,443	50,691
Total	3,927,560	3,640,631	3,136,020	3,053,470	2,978,037

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Ductile Iron

By contrast, domestic shipments, internal consumption, and total shipments of rough ductile iron castings (table 5-9) peaked in 2000, in both quantity and value terms, but dropped the following year as demand by downstream customers declined with the slowdown of U.S. manufacturing activity. These shipments improved only slightly during 2002-03 as customer demand improved, but increased domestic shipments in 2002 and 2003 remained below the 2000 level. However, quantities exported rebounded strongly as the depreciation of the U.S. dollar enhanced the price competitiveness of U.S.-produced ductile iron castings in foreign markets, enabling several U.S. foundries to sell significantly more abroad with the upturn of foreign demand.[18]

Table 5-9
Ductile iron foundries: Responding U.S. producers' domestic shipments and exports for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Domestic shipments:					
Commercial	3,256,997	3,408,571	3,150,315	3,173,773	3,165,871
Internal consumption and transfers	551,267	574,878	506,345	487,514	486,104
Exports	119,810	136,639	117,644	176,797	215,252
Total	3,928,074	4,120,088	3,774,304	3,838,084	3,867,227
	Value (*1,000 dollars*)				
Domestic shipments:					
Commercial	2,826,391	2,962,444	2,742,013	2,713,756	2,731,532
Internal consumption and transfers	808,239	743,591	602,885	619,136	592,210
Exports	114,684	135,664	117,747	166,287	197,381
Total	3,749,314	3,841,699	3,462,645	3,499,179	3,521,123

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[18] U.S. industry official, telephone interview with USITC staff, Feb. 10, 2005.

Employment

Employment in responding establishments that produce rough gray iron or ductile iron castings (table 5-10) declined during 1999-2003 for all workers and for PRWs. Job losses were particularly noticeable beginning in 2001 concurrent with both declining domestic shipments and weaker downstream customer demand.[19] However, employment levels, much like shipments, did not recover even as demand began to rebound in 2003, which U.S. industry sources attributed to loss of markets owing to price and import competition along with movement of downstream customers offshore.[20] Likewise, hours worked by PRWs at responding gray iron foundries fell each year during the 5-year period, unlike at ductile iron foundries, to mirror the declining trends in both PRW employment and shipment quantities, owing to the weaker financial condition of firms in the more competitive gray iron industry. Productivity generally rose during 1999-2003 at responding establishments, albeit slightly more at those that cast gray iron (by 9 percent) than at those that cast ductile iron (by 7 percent), a reflection of industry efforts to reduce the labor intensity and enhance production efficiency of foundry operations.[21]

Table 5-10
Gray and ductile iron foundries: Responding U.S. producers' employees and related information for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Gray iron:					
Average number of employees	26,201	25,397	22,760	21,508	20,615
Production and related workers:					
Average number	21,557	20,820	18,372	17,322	16,480
Hours worked (*1,000 hours*)	45,089	43,760	37,858	34,645	34,318
Wages paid (*1,000 dollars*)	737,987	715,035	642,310	627,945	617,723
Average hourly wages (*dollars per hour*)	16.42	16.39	17.03	18.20	18.08
Productivity (*short tons per 1,000 hours*)	89	88	88	98	97
Ductile iron:					
Average number of employees	20,363	20,297	19,039	18,751	18,635
Production and related workers:					
Average number	17,355	17,256	16,116	15,864	15,690
Hours worked (*1,000 hours*)	39,993	40,952	36,549	36,931	36,298
Wages paid (*1,000 dollars*)	548,622	564,527	531,447	533,467	543,480
Average hourly wages (*dollars per hour*)	13.87	13.96	14.81	14.77	15.34
Productivity (*short tons per 1,000 hours*)	99	100	103	106	106

Note.–Figures may not add to totals because of rounding. Average hourly wages based on establishments that were able to provide both hours worked and wages paid data. Productivity based on establishments that were able to provide both production quantity and hours worked data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[19] When Anvil International shut down its Statesboro, GA foundry and combined casting of malleable-, non-malleable, and ductile iron pipe fittings at its Columbia, PA foundry in 2001, 350 jobs were lost at Statesboro. However, rather than the anticipated addition of 200 jobs, another 100 were lost at Columbia, which the president attributed to loss of market share to cheaper Chinese castings. Testimony of Thomas Fish, President, Anvil International, pp. 14-15.

[20] Testimony of Randall W. Lawton, President and Chief Executive Officer, Bay Engineered Castings, p. 42; and testimony of George G. Boyd, President and Chief Executive Officer, Golden's Foundry & Machine, pp. 20-21.

[21] Testimony of Albert T. Lucchetti, President, Cumberland Foundry Co., Inc., p. 33.

Financial Condition

Rough Iron Castings

Gray iron.–Responding foundries that produced rough gray iron castings reported sharply deteriorating operating incomes, which declined by $506 million (148 percent) during 1999-2003, and turned into losses by 2002 (table 5-11). Similarly, a growing share of responding establishments reported operating losses in each successive year since 1999, to exceed one-half by 2003. Moreover, respondents' total net sales declined in both quantity and value terms throughout the 5-year period,[22] despite rebounding customer demand in 2002-03. These declining financial trends reflect the highly competitive nature of gray iron casting, concurrent with the loss of downstream customers that transferred production offshore,[23] as evident in their declining sales unit values (table 5-12). Although the cost of goods sold (COGS) irregularly declined throughout the 5-year period, respondents reported that each cost component, particularly raw materials, direct labor, and other factory costs, generally rose as shares of net sales through 2003 (see table 5-11). These cost escalations drove down gross profits, in terms of both value and unit value, and as a share of total net sales, with net sales-to-costs margins being particularly squeezed in 2003. Moreover, gray iron foundries were generally unable to pass along the cost increases for raw materials and energy.[24] Gray iron foundries that consider themselves to be job shops or producers of a broad number of products fared better with declining but positive operating incomes through 1999-2003 (table 5-13), as job shops were apparently better able to moderate the cost-price squeeze by diversifying among multiple products and downstream markets. By contrast, captive producers and those producing a limited number of products have experienced operating losses since 2000 because of ongoing price pressures[25] and constraints of servicing specific downstream markets.

Ductile iron.–By contrast, responding foundries that produced rough ductile iron castings experienced less severe financial deterioration than did those that produced rough gray iron castings. Ductile iron casters' operating incomes declined less, by $417 million (67 percent), and remained positive throughout the 5-year period (table 5-14). Although a rising share of responding ductile iron establishments also reported operating losses during the period, this share was lower than for gray iron establishments, reaching 43 percent in 2003. Similarly, casters of ductile iron indicated that their total net sales declined, but to a lesser degree than for those that cast gray iron, in both quantity and value terms during 1999-2003.[26] Net sales rebounded in 2003 as ductile iron foundries experienced somewhat less pricing pressures as producers of a

---

[22] Net sales declined, despite four additional establishments that reported sales of rough gray iron castings over the 5-year period.

[23] Testimony of Randall W. Lawton, President and Chief Executive Officer, Bay Engineered Castings, p. 42; testimony of Roy Hanks, Marketing Manager, ThyssenKrupp-Waupaca, hearing transcript, p. 38; and testimony of George G. Boyd, President and Chief Executive Officer, Golden's Foundry & Machine, pp. 20-21.

[24] A notable exception is the case of Intermet Corp., which was able to reach agreement with its automotive-sector customers in January 2005, to amend purchase orders and supply contracts with more favorable cost recovery terms for ferrous scrap and other raw materials. "Intermet Reaches Agreements with Customers to Amend Contracts," *Modern Casting*, Jan. 3, 2005, found at *http://www.moderncasting.com*, retrieved Jan. 21, 2005.

[25] According to one U.S. industry source, even captive foundries must successfully bid for gray iron castings orders as the parent company shops around for lowest-cost bids and wants its foundries to be as competitive as outside domestic and foreign sources. U.S. industry source, interview with USITC staff, June 24, 2004.

[26] Net sales declined, despite three additional establishments that reported sales of rough ductile iron castings over the 5-year period.

Table 5-11
Gray iron foundries: Responding U.S. producers' financial results for their rough casting operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Net sales:					
Commercial domestic and export sales	2,480,884	2,398,884	2,119,128	2,158,369	2,141,496
Internal consumption for production of machined castings	1,242,293	1,166,498	968,770	926,169	872,986
Other internal consumption or transfers to related firms	187,373	211,807	190,814	217,331	228,147
Total net sales quantities	3,910,550	3,777,189	3,278,712	3,301,869	3,242,629
	Value (*1,000 dollars*)				
Net sales:					
Commercial domestic and export sales	2,091,325	2,066,958	1,774,565	1,746,496	1,730,096
Internal consumption for production of machined castings	1,181,603	966,732	805,489	763,214	745,986
Other internal consumption or transfers to related firms	627,385	593,701	557,215	550,129	497,787
Total net sales values	3,900,313	3,627,391	3,137,269	3,059,839	2,973,869
Cost of goods sold:					
Raw materials	938,502	949,914	758,568	760,199	783,766
Direct labor	894,900	895,313	794,971	785,145	792,823
Energy	200,797	237,074	236,341	213,687	220,575
Other factory cost	1,329,097	1,299,623	1,154,291	1,128,782	1,154,056
Total cost of goods sold	3,363,296	3,381,924	2,944,171	2,887,813	2,951,220
Gross profit	537,017	245,467	193,098	172,026	22,649
Selling, general, and administrative	194,420	191,313	187,981	173,329	185,591
Operating income	342,597	54,154	5,117	-1,303	-162,942
Other income and expenses:					
Interest expense	46,296	46,464	48,474	46,116	50,571
All other expenses and income	109,181	58,647	84,125	47,103	51,232
Net income before taxes	187,120	-50,957	-127,482	-94,522	-264,745
Depreciation/amortization	170,972	181,969	172,239	197,810	180,004
	Ratio to net sales (*percent*)				
Raw materials	24	26	24	25	26
Direct labor	23	25	25	26	27
Energy	5	7	8	7	7
Other factory cost	34	36	37	37	39
Cost of goods sold	86	93	94	94	99
Gross profit	14	7	6	6	1
Selling, general, and administrative	5	5	6	6	6
Operating income	9	1	([1])	([1])	-5
	Number of establishments reporting:				
Operating losses	20	27	41	47	51
Financial results data	97	98	100	102	101

[1]Less than 0.5 percent.

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and cost data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-12
Gray iron foundries: Selected financial unit values for responding U.S. producers' rough casting operations, fiscal years 1999-2003

(***Dollars per short ton***)

Item	1999	2000	2001	2002	2003
Total sales unit value	997	960	957	927	917
Raw material cost	240	251	231	230	242
Direct labor cost	229	237	242	238	245
Energy cost	51	63	72	65	68
Other factory cost	340	344	352	342	356
Total cost of goods sold	860	895	898	875	910
Gross profit	137	65	59	52	7

Note.–Figures may not add to totals because of rounding. For each of the above items, unit values calculated only where establishment provided both value and quantity data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-13
Gray iron foundries: Selected financial information for U.S. producers' rough casting operations for specified classes, fiscal years 1999-2003

(***1,000 dollars***)

Class/item	1999	2000	2001	2002	2003
Job shops:					
Total net sales	1,270,942	1,250,116	1,083,234	1,030,046	1,004,933
Operating income	99,672	89,065	38,196	46,299	23,914
Net income	47,636	49,775	2,439	10,303	-16,960
Captive producers:					
Total net sales	1,960,602	1,708,676	1,451,346	1,419,763	1,339,163
Operating income	141,075	-99,898	-76,352	-93,009	-200,510
Net income	35,525	-163,527	-169,953	-146,297	-260,503
Limited number of products:					
Total net sales	2,275,193	2,000,422	1,667,907	1,680,035	1,572,376
Operating income	167,397	-97,457	-86,415	-73,599	-212,154
Net income	50,029	-170,180	-190,266	-131,061	-273,289
Broad number of products:					
Total net sales	1,029,618	1,046,683	950,703	874,457	883,150
Operating income	117,963	98,451	56,131	25,076	12,892
Net income	89,004	73,340	35,065	-2,015	-19,594

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-14
Ductile iron foundries: Responding U.S. producers' financial results for their rough casting operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Net sales:					
Commercial domestic and export sales	3,356,317	3,518,879	3,251,975	3,329,489	3,350,682
Internal consumption for production of machined castings	208,680	190,297	174,899	175,641	173,051
Other internal consumption or transfers to related firms	312,596	345,813	302,531	278,444	294,911
Total net sales quantities	3,877,593	4,054,989	3,729,405	3,783,574	3,818,644
	Value (*1,000 dollars*)				
Net sales:					
Commercial domestic and export sales	2,990,055	3,136,954	2,899,401	2,881,185	2,919,063
Internal consumption for production of machined castings	330,599	319,940	305,335	316,214	305,568
Other internal consumption or transfers to related firms	540,225	482,062	372,268	368,362	361,501
Total net sales values	3,860,879	3,938,956	3,577,004	3,565,761	3,586,132
Cost of goods sold:					
Raw materials	1,014,628	1,052,364	938,446	967,090	1,006,653
Direct labor	512,211	522,912	489,514	487,198	487,508
Energy	254,527	294,727	311,213	292,543	307,235
Other factory cost	1,234,907	1,314,542	1,247,975	1,237,137	1,345,944
Total cost of goods sold	3,016,273	3,184,545	2,987,148	2,983,968	3,147,340
Gross profit	844,606	754,411	589,856	581,793	438,792
Selling, general, and administrative	222,660	234,150	224,415	219,533	233,720
Operating income	621,946	520,261	365,441	362,260	205,072
Other income and expenses:					
Interest expense	38,615	46,609	41,268	33,847	28,905
All other expenses and income	24,507	1,139	16,621	30,397	32,927
Net income before taxes	558,824	472,513	307,552	298,016	143,240
Depreciation/amortization	126,309	134,256	141,190	164,706	173,116
	Ratio to net sales (*percent*)				
Raw materials	26	27	26	27	28
Direct labor	13	13	14	14	14
Energy	7	7	9	8	9
Other factory cost	32	33	35	35	38
Cost of goods sold	78	81	84	84	88
Gross profit	22	19	16	16	12
Selling, general, and administrative	6	6	6	6	7
Operating income	16	13	10	10	6
	Number of establishments reporting:				
Operating losses	10	20	27	31	37
Financial results data	84	85	85	87	87

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and cost data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

more specialized product than gray iron,[27] particularly in the most recent years when unit sales values declined less during 2002-03 (table 5-15). Each COGS cost component, but particularly other factory costs, rose as shares of net sales through 2003 (see table 5-14). These cost escalations drove down gross profits, in terms of both value and unit value and as a share of total net sales, and hence, operating income over the 5-year period. Unlike the foundries that cast gray iron, ductile iron job shops experienced greater declines in operating income (nearly 100 percent) than captive producers (64 percent) throughout 1999-2003 (table 5-16). However, financial performance was less affected by product diversity as respondents that cast a limited number of products experienced only a somewhat marginally larger decline (65 percent) in operating income than did those that cast a broader number of products (62 percent).

Machined Iron Castings

Gray iron.–Unlike the rough gray iron castings sector, foundries that also machined gray iron castings enjoyed positive operating income that rebounded in 2003, after three consecutive years of decline (table 5-17), as downstream demand revived. Net sales also rebounded from the low level of 2000, to exceed the 1999 level throughout 2001-03.[28] Total COGS rose over the 5-year period, but not as a share of net sales in 2003, which eased the squeeze on net sales-to-costs margins in that year. However, the share of establishments reporting operating losses increased in each successive year since 1999 to 30 percent by 2003.

Ductile iron.–Unlike the rough ductile iron castings sector, foundries that also machined ductile iron castings reported operating income that peaked in 2001 (table 5-18). Although net sales and total COGS rose at roughly the same pace (27 percent and 28 percent, respectively) during 1999-2003,[29] COGS rose as a share of net sales since 2001 which squeezed net sales-to-costs margins in successive years. Responding establishments appeared able to hold down the costs of in-house machining, which declined as a share of COGS since 2000. However, controlling various machining costs was not sufficient to offset the rising cost share of rough castings produced. The share of establishments reporting operating losses increased since 2001 to reach 29 percent by 2003.

Table 5-15
Ductile iron foundries: Selected financial unit values for responding U.S. producers' rough casting operations, fiscal years 1999-2003

(*Dollars per short ton*)

Item	1999	2000	2001	2002	2003
Total sales unit value	996	971	959	942	939
Raw material cost	262	260	252	256	264
Direct labor cost	132	129	131	129	128
Energy cost	66	73	83	77	80
Other factory cost	318	324	335	327	352
Total cost of goods sold	778	785	801	789	824
Gross profit	218	186	158	154	115

Note.–Figures may not add to totals because of rounding. For each of the above items, unit values calculated only where establishment provided both value and quantity data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[27] U.S. industry official, telephone interview with USITC staff, Feb. 4, 2005.

[28] Increased net sales also reflected, in part, five additional establishments reporting sales of machined gray iron castings over the period.

[29] Increased net sales also reflected, in part, four additional establishments that reported sales of machined ductile iron castings over the period.

Table 5-16
Ductile iron foundries: Selected financial information for U.S. producers' rough casting operations for specified classes, fiscal years 1999-2003
(*1,000 dollars*)

Class/item	1999	2000	2001	2002	2003
Job shops:					
Total net sales	1,921,815	2,067,490	1,853,505	1,775,024	1,795,917
Operating income	165,824	154,249	106,139	68,666	118
Net income	137,068	120,914	78,214	34,822	-31,530
Captive producers:					
Total net sales	1,127,571	1,043,630	895,705	899,743	897,178
Operating income	344,131	242,707	156,141	167,097	123,452
Net income	337,439	231,562	149,307	160,309	114,835
Limited number of products:					
Total net sales	2,060,538	2,050,765	1,790,963	1,821,601	1,806,685
Operating income	448,670	351,569	252,211	256,750	158,439
Net income	416,364	329,984	217,665	225,230	129,441
Broad number of products:					
Total net sales	872,866	891,953	836,015	821,468	816,940
Operating income	94,051	90,678	71,198	61,202	36,093
Net income	68,291	68,548	53,259	39,167	17,612

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Raw Materials and Energy

As the primary furnace input for producing molten iron,[30] ferrous scrap accounts for the predominant raw-materials cost share for both gray and ductile iron foundries (table 5-19). Despite escalating scrap prices in recent years,[31] substitution among scrap types is less feasible for iron foundries than for steelmakers because of their tighter composition specifications and size requirements.[32] Iron foundries that sought pig iron to offset some ferrous scrap cost increases also encountered escalating prices and limited availability.[33] Nevertheless, shifts were slight for the cost shares among these raw materials over 1999-2003, despite a certain degree of substitution among raw materials possible (between scrap and pig iron, rather than alloys) with the installed melting technologies.[34]

[30] See also "Iron" in ch. 2.

[31] Price escalations for ferrous scrap are attributed to rising U.S. scrap exports as the weaker dollar provided lower prices for foreign buyers, export restrictions by Russia and Ukraine, rising Chinese demand, resumed demand by U.S. steelmakers, and fewer scrap generators as U.S. manufacturing moves offshore, among other factors dating back to 2002. Alfred T. Spada, "Ferrous Scrap Pricing, a Case of Supply and Demand," *Modern Casting*, Apr. 2004, pp. 18-20; Kyle Bauer, "Surviving the Scrap Crisis, What Can You Do?," *Modern Casting*, Apr. 2004, pp. 21-23; and Kevin O'Shaughnessy, "Don't Scrap the Issue, the Points and Counterpoints of Government Intervention," *Modern Casting*, Apr. 2004, pp. 24-26. For more details on ferrous-scrap price trends, see "Raw materials" in ch. 3.

[32] David Borsuk, Sadoff Iron and Metal, cited in Gene Muratore and Joe Ward, "Gaining Insight into Ferrous Raw Material Trends," *Modern Casting*, Nov. 2002, pp. 30-32.

[33] Price escalations and supply limitations for pig iron are attributed to forward selling, production problems at a major Russian producer, limited shipments from Brazil, rising Chinese demand, and reduced production by U.S. integrated steel mills in favor of higher value-added steel mill products. Spada, "Ferrous Scrap Pricing." For more details on pig-iron price trends, see "Raw materials" in ch. 3.

[34] U.S. industry official, telephone interview with USITC staff, Feb. 11, 2005.

Table 5-17
Gray iron foundries: Responding U.S. producers' financial results for their machining operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
Net sales (*short tons*)	271,260	269,005	264,058	273,272	282,995
	Value (*1,000 dollars*)				
Net sales	471,463	469,747	488,220	489,695	520,112
Cost of goods sold:					
Rough castings produced	271,416	266,393	277,361	273,167	278,424
Rough castings purchased from other companies	21,162	25,856	35,734	43,677	50,790
In-house machining costs	77,513	77,901	77,104	84,465	86,506
Subcontracted machining costs	([1])	([1])	2,532	1,891	2,141
Other machining costs	([1])	([1])	7,360	8,850	8,670
Total costs of goods sold	374,081	374,961	400,091	412,050	426,531
Gross profit	97,382	94,786	88,129	77,645	93,581
Selling, general, and administrative	28,122	30,969	30,279	30,072	29,187
Operating income	69,260	63,817	57,850	47,573	64,394
	Ratio to net sales (*percent*)				
Cost of goods sold	79	80	82	84	82
Gross profit	21	20	18	16	18
Selling, general, and administrative	6	7	6	6	6
Operating income	15	14	12	10	12
	Number of establishments reporting:				
Operating losses	5	7	8	9	10
Financial results data	28	28	30	31	33

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and cost data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Prices have also risen for electricity, natural gas, and metallurgical coke,[35] but not to the same degree as those for ferrous scrap and pig iron. Electricity accounts for the largest share of energy costs for iron foundries (table 5-20), both for melting iron in electromagnetic-induction and electric-arc furnaces, and for powering the mold-making, casting, grinding, and other production equipment. Differing price escalations were reflected somewhat in slight shifts for the respective cost shares among these energy sources during 1999-2003. Both respondents that cast gray iron and those that cast ductile iron report slight natural gas cost share increases, for which the price increased the most among these fuels. Respondents that cast ductile iron also have higher reliance on natural gas to control the cooling and annealing of ductile iron castings. Hence, switching among fuels at iron foundries is constrained by the installed melting and casting technologies.[36]

[35] Prices rose for electricity because of escalating domestic demand, for natural gas from constrained global supplies, and for metallurgical coke attributable to export cut-backs by China to meet rising domestic consumption, and growing consumption in India and other countries, after a prolonged period of coke oven capacity closures with far fewer additions worldwide. Nancy E. Kelly, "US, EU Protest Chinese Coke Export Controls," *American Metal Market*, May 28, 2004; and Scott Robertson, "Summit Speakers Warn of Crisis in the Coke Market," *American Metal Market*, Oct. 8, 2003. For more details about energy price trends, see "Energy" in ch. 3.

[36] Ibid.

Table 5-18
Ductile iron foundries: Responding U.S. producers' financial results for their machining operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
Net sales (*short tons*)	144,018	143,920	152,152	150,186	157,440
	Value (*1,000 dollars*)				
Net sales	269,900	284,516	320,613	320,450	343,040
Cost of goods sold:					
Rough castings produced	151,668	147,135	152,703	164,748	201,716
Rough castings purchased from other companies	([1])	([1])	([1])	([1])	([1])
In-house machining costs	67,747	79,604	83,054	75,640	69,174
Subcontracted machining costs	7,859	6,396	6,974	7,811	9,644
Other machining costs	([1])	([1])	([1])	([1])	([1])
Total costs of goods sold	234,392	241,250	258,748	268,180	300,074
Gross profit	35,508	43,266	61,865	52,270	42,966
Selling, general, and administrative	17,934	20,560	21,952	22,659	23,610
Operating income	17,574	22,706	39,913	29,611	19,356
	Ratio to net sales (*percent*)				
Cost of goods sold	87	85	81	84	87
Gross profit	13	15	19	16	13
Selling, general, and administrative	7	7	7	7	7
Operating income	7	8	12	9	6
	Number of establishments reporting:				
Operating losses	3	5	2	6	7
Financial results data	20	21	22	23	24

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and cost data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-19
Gray and ductile iron foundries: Share of total metal raw material costs for responding U.S. producers' rough casting operations, fiscal years 1999-2003

(*Percent*)

Item	1999	2000	2001	2002	2003
Gray iron:					
Primary metals in scrap form	75	72	72	73	73
Primary metals in other forms	16	16	16	17	17
Other metal	9	11	12	10	10
Total	100	100	100	100	100
Ductile iron:					
Primary metals in scrap form	68	69	68	70	70
Primary metals in other forms	13	12	12	12	12
Other metal	19	18	19	18	18
Total	100	100	100	100	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-20
Gray and ductile iron foundries: Share of total energy costs for responding U.S. producers' rough casting operations, fiscal years 1999-2003

(***Percent***)

Item	1999	2000	2001	2002	2003
Gray iron:					
Electricity	52	52	50	52	51
Natural gas	13	16	20	16	20
Metallurgical coke	32	29	27	28	27
Other	3	3	3	4	3
Total	100	100	100	100	100
Ductile iron:					
Electricity	58	54	52	57	53
Natural gas	18	24	27	21	25
Metallurgical coke	17	17	15	16	16
Other	7	5	5	7	6
Total	100	100	100	100	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Labor

Aggregate salaries and wages, including overtime, for all employees at responding establishments generally fell from their 2000 peak and leveled off thereafter (table 5-21) because of the declining number of employees (see table 5-10). At least one industry official attributed higher wages at least in part to the limited availability of foundry labor.[37] Average hourly wages for PRWs rose more at ductile iron foundries (up by 11 percent) than at gray iron foundries (up by 10 percent) over the 5-year period (see table 5-10). At responding establishments that cast ductile iron, average hourly wages were approximately 84 percent of those that cast gray iron, a reflection of a higher portion of the ductile iron respondents' employees located in lower-wage areas outside the industrialized portions of the upper Midwest.[38]

Health benefits, pensions, and other non-salary and wage costs (excluding employee training) borne by iron foundries continued to rise in nearly each successive year after 2000. Among these non-salary and wage costs, pension expenses rose the most during 2001-03 for both casters of gray iron (by 47 percent) and ductile iron (by 94 percent).

Industry officials cite the importance of employee training to maintain a highly skilled workforce to remain competitive, particularly to replace talented foundry employees leaving the industry.[39] However, increases in various non-salary and wage costs appear to have left shrinking amounts that responding establishments could expend for employee training, which fell during 1999-2003. Hence, respondents that cast ductile iron spent more on training than those that cast gray iron, reflecting this group's somewhat better financial condition.

[37] Testimony of Albert T. Lucchetti, President, Cumberland Foundry Co., Inc., p. 33.

[38] Regional variations in prevailing wage rates is more relevant than degree of labor organization since the workforce in the foundry industry tends to be highly unionized across the United States. U.S. industry source, telephone interview with USITC staff, Feb. 4, 2005.

[39] See e.g., testimony of Randall W. Lawton, President and Chief Executive Officer, Bay Engineered Castings, p. 45.

Table 5-21
Gray and ductile iron foundries: Responding U.S. producers' employment costs for their rough casting operations, fiscal years 1999-2003

(*1,000 dollars*)

Item	1999	2000	2001	2002	2003
Gray iron:					
Salaries and wages (including overtime)	1,005,758	1,166,894	997,806	970,403	960,359
Health benefits	147,857	178,840	163,378	169,288	179,561
Pension and profit sharing	63,214	69,113	65,787	76,283	96,525
Other costs	107,948	162,477	152,073	152,239	158,297
Employee training	10,752	10,262	6,795	6,781	6,328
Total employee costs	1,335,529	1,587,586	1,385,839	1,374,994	1,401,070
Ductile iron:					
Salaries and wages (including overtime)	921,524	965,351	925,750	905,127	902,639
Health benefits	121,357	137,529	141,523	152,431	162,798
Pension and profit sharing	32,980	30,114	28,843	38,288	56,062
Other costs	112,274	123,937	119,314	116,544	124,608
Employee training	16,465	16,369	13,927	13,499	14,455
Total employee costs	1,204,600	1,273,300	1,229,357	1,225,889	1,260,562

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Both the availability and skill level of labor are of concern to U.S. foundries that produce iron castings. Of particular concern is the exodus of technically skilled workers from the industry as foundries shutdown.[40] Moreover, some respondents reported concerns regarding the quality (especially the skill levels and work ethics) of applicants. Reasons for the difficulties mentioned by respondents in retaining existing employees and attracting new ones include the difficult work environment and physical labor required, and also the deteriorating financial condition of many iron foundry operations.

Investment

Capital investments to enhance future competitiveness were either limited or put on hold at iron foundries owing to lower production levels in 2001 and shrinking profit margins as a result of foreign price competition, pressure to meet customer-specified prices, and market losses as customers moved production offshore.[41] Hence, deteriorating financial conditions generally limited respondent to investing less in each successive year after 2000 for machinery, equipment, and fixtures (table 5-22). Exceptional aggregate increases in certain years reflected a small number of respondents that were financially capable of significant investments.[42] Generally, iron foundries reported funding capital expenditures from corporate cash flows and secured debt rather than unsecured debt or issuance of equity. Most capital investments were for incremental enhancements, automation, or energy savings with existing production equipment rather than purchases of

[40] Randall W. Lawton, President and Chief Executive Officer, Bay Engineered Castings, pp. 43-44.

[41] Testimony of Randall W. Lawton, President and Chief Executive Officer, Bay Engineered Castings, p. 42; testimony of Roy Hanks, Marketing Manager, ThyssenKrupp-Waupaca, p. 38; testimony of George G. Boyd, President and Chief Executive Officer, Golden’s Foundry & Machine, pp. 20-22; and testimony of Albert T. Lucchetti, President, Cumberland Foundry Co., Inc., p. 33.

[42] An illustration of the time-frame, size, and risks of capital investment for iron foundries is one operation that was able to obtain financing from a local bank to adopt the latest technology for large green-sand molding, as part of a multi-year plan to upgrade the core-making equipment and iron-melting furnaces. This $4-million investment was undertaken, largely based on indications by an established large-OEM customer that the foundry could anticipate receiving a significant increase in sales ranging from $3 million to $6 million. However, this investment came on-line in 2001as the U.S. economy turned down. Testimony of George G. Boyd, President and Chief Executive Officer, Golden’s Foundry & Machine, p. 21.

Table 5-22
Gray and ductile iron foundries: Responding U.S. producers' capital and R&D expenditures for their rough casting operations, fiscal years 1999-2003
(***1,000 dollars***)

Item	1999	2000	2001	2002	2003
Gray iron:					
Capital expenditures:					
Machinery, equipment, and fixtures:					
Environmentally related	59,216	21,304	13,670	10,425	5,500
Other	170,765	154,601	168,251	99,880	81,360
Land, building, and related improvements	13,059	32,899	26,761	11,412	11,852
Total	243,040	208,804	208,682	121,717	98,712
Research and development expenditures	726	712	1,213	1,691	2,685
Ductile iron:					
Capital expenditures:					
Machinery, equipment, and fixtures:					
Environmentally related	20,196	20,710	17,987	38,056	17,622
Other	147,344	201,463	169,305	163,262	85,111
Land, building, and related improvements	21,752	22,617	23,326	27,352	14,697
Total	189,292	244,790	210,618	228,670	117,430
Research and development expenditures	7,453	6,544	8,107	9,357	7,268

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

new equipment. By contrast, research and development (R&D) expenditures generally rose in each successive year for gray iron foundries. Such investments reflected both production process improvements and cost-cutting measures, not only for enhanced competitiveness, but also in an attempt to survive financial downturns.[43]

Debt

Responding iron foundries generally accumulated rising total debt loads over the 5-year period (table 5-23), although they were able to reduce their indebtedness by cutting back on capital investments in 2003. Increased debt reflects collateralized borrowing to finance new capital investment in production assets (property, plant, and equipment) owing to the deteriorating financial condition of many iron foundries. Respondents that cast gray iron were increasingly less financially able to invest in future production capabilities, as reflected by their original cost of property, plant, and equipment rising during 1999-2001 but subsequently falling by $194 million (6 percent) over the next 2 years to slightly below the 1999 level. Likewise, the book value of these assets declined by $183 million (13 percent) over the 5-year period. Respondents that cast ductile iron were in better financial shape to augment the original cost of their property, plant, and equipment by approximately $734 million (about one-third) from 1999 to 2003. However, the book value of these assets only increased by about $254 million (26 percent) over this same period. For both gray iron and ductile iron foundries, these trends indicate that their production assets were depreciating faster than they were being replaced. Hence, consistent with limited and declining capital spending previously discussed, the production assets were likely closer to the end of their expected useful lives in 2003 than in 1999.

[43] U.S. industry official, telephone interview with USITC staff, Feb. 11, 2005.

Table 5-23
Gray and ductile iron foundries: Other financial information for responding U.S. producers' rough casting operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
Gray iron:					
Total debt (*1,000 dollars*)	668,904	680,831	690,135	736,725	682,431
Property, plant, and equipment:					
Original cost (*1,000 dollars*)	3,338,303	3,525,474	3,532,085	3,391,183	3,337,774
Book value (*1,000 dollars*)	1,376,462	1,457,927	1,432,322	1,304,778	1,193,499
Ductile iron:					
Total debt (*1,000 dollars*)	599,922	645,764	588,757	670,124	636,573
Property, plant, and equipment:					
Original cost (*1,000 dollars*)	2,242,068	2,366,793	2,560,239	2,833,974	2,975,851
Book value (*1,000 dollars*)	959,463	1,012,007	1,058,473	1,259,197	1,213,578

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Purchaser Trends

U.S. downstream customers that responded to the USITC purchaser questionnaire reported that their purchases of rough iron castings recovered as downstream demand rebounded after 2001, for a net gain of $439 million (24 percent) over the 5-year period (table 5-24). Although domestic foundries are the predominant source of rough iron castings, their share of the total declined from 87 percent to 83 percent over the 5-year period, which is consistent with concerns expressed by domestic foundry industry representatives about rising import competition and loss of domestic customers.[44] By contrast, downstream customers reported wider sourcing of machined iron castings, with domestic sources providing from 52 percent to 57 percent of all machined castings purchased annually during this 5-year period. As purchasers sought less expensive sources of machined iron castings, domestic iron foundries appeared somewhat successful at meeting price competition from foreign castings during 2003 compared to the previous year, as the market share for foreign sources fell from 48 percent to 45 percent.

According to data of foreign purchases aggregated across the six specific cast iron products and further analyzed in this chapter, Mexico was the predominant foreign source for rough iron castings throughout the 5-year period (table 5-25), reflecting the Mexican foundry industry's lower production costs and integration into the North American supply chain for cast components purchased by the automotive, machinery, and equipment industries.[45] However, Mexico's share of total foreign purchases declined significantly during the period, reflecting increased penetration from competing foreign sources. By contrast, foreign-origin machined iron castings were increasingly purchased from China, as imports rose in each

[44] Testimony of Randall W. Lawton, President and Chief Executive Officer, Bay Engineered Castings, p. 42; testimony of Roy Hanks, Marketing Manager, ThyssenKrupp-Waupaca, p. 38; and testimony of George G. Boyd, President and Chief Executive Officer, Golden's Foundry & Machine, pp. 20-21.

[45] See also "Mexico" in ch. 9.

Table 5-24
All iron castings: Total reported U.S. purchases of domestic and foreign castings, 1999-2003
(*1,000 dollars*)

Type	1999	2000	2001	2002	2003
Rough castings:					
Domestic	1,606,325	1,786,201	1,757,761	1,789,459	1,880,352
Foreign	225,168	329,707	293,389	327,916	375,757
Unknown	8,466	12,494	13,386	17,023	22,636
Total	1,839,959	2,128,402	2,064,536	2,134,398	2,278,745
Machined castings:					
Domestic[1]	1,156,680	1,194,433	1,131,999	1,166,700	1,308,409
Foreign	933,255	914,925	991,981	1,063,460	1,070,935
Total	2,089,935	2,109,358	2,123,980	2,230,160	2,379,344

[1] Includes data for purchases of castings from unknown sources to avoid disclosure of confidential business information.

Note.–These data do not indicate all purchases of castings in the United States. See ch. 1 for additional information on data coverage.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

successive year, by nearly 3-fold over the 5-year period to $59 million, to account for 49 percent of all imports in 2003. A hearing witness noted increased price competitiveness for machined iron castings from China and other developing countries since 2001. According to one industry source, more large-volume castings are being imported from China, whereas many U.S. iron foundries are concentrating on more specialized, smaller-production volume castings that are less susceptible to relocating production abroad or sourcing from foreign competitors.[46]

[46] Testimony of Randall Lawton, President, Bay Engineered Castings, pp. 42-44; see also “China” in ch. 9.

Table 5-25
All iron product groups: Total reported U.S. purchases of domestic and foreign castings, 1999-2003
(*1,000 dollars*)

Country or region[1]	1999	2000	2001	2002	2003
Rough castings:					
Domestic	423,557	453,394	426,994	427,478	418,256
Foreign:					
Mexico	([2])	([2])	([2])	([2])	([2])
Japan	([2])	([2])	([2])	([2])	([2])
EU15	1,103	1,347	1,563	3,777	3,770
Canada	492	1,544	2,117	2,975	2,948
China	844	985	1,355	2,276	2,544
All other	2,080	2,082	2,661	2,824	3,528
Total, foreign purchases	13,902	17,870	19,708	29,171	30,725
Machined castings:					
Domestic	181,227	187,576	192,975	220,648	223,661
Foreign:					
China	11,956	27,192	37,792	43,067	59,187
Canada	([2])	([2])	([2])	([2])	([2])
Mexico	10,864	14,110	15,085	14,950	14,887
Japan	([2])	([2])	([2])	([2])	([2])
India	7,152	6,588	7,332	6,240	3,301
EU15	11,404	2,121	1,897	2,732	2,719
All other	6,001	7,919	6,654	6,449	8,641
Total, foreign purchases	81,109	80,667	93,899	96,883	121,445

[1] Countries and regions are mutually exclusive.
[2] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. Includes purchases of ductile iron crankshafts/camshafts, gray iron motor vehicle gear boxes, ductile iron bearing housings, gray iron compressor housings, gray iron pumps, and gray iron non-motor vehicle gear boxes. Product group data combined to avoid disclosure of confidential business information.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Product Profiles

Ductile Iron Crankshaft/Camshaft Castings[47]

Industry Profile

***Industry structure*.—**Eleven U.S. manufacturers reported production of ductile iron castings for camshafts and crankshafts, one of which dominated production for the period. These plants are largely located in the Midwest near their leading customers, the automakers, to facilitate just-in-time inventory and delivery. Several of these foundries are large captive operations manufacturing camshaft and crankshaft castings for their vehicle-making parent. Many of these manufacturers concentrate in only one metal type – iron – although two companies also reported producing one other metal type (either aluminum or steel). Sand casting is the leading method used to produce these products because of its low overall cost and ability to produce large iron castings. Most of these foundries are large, multi-product companies, nearly all of which manufacture their own molds but perform significantly fewer additional activities related to the production of these castings. The majority of reporting producers indicated that their customers required certification of their establishments, with ISO9000/14000 the most common certifications.

Product Description and Uses

Camshafts and crankshafts are integral components of internal combustion spark-ignition and compression-ignition (diesel) engines, most notably for motor vehicle applications. The basic function of the camshaft is to push on valve lifters to open and close the engine valves by means of the cam lobes incorporated into the camshaft. This movement provides for the intake of air and fuel into the cylinder and the release of exhaust gases from the cylinder through the opened valves. An engine may have one or two camshafts, depending on its design. The camshaft is driven by gears, a belt, or a chain from the crankshaft, and turns at one-half of the speed of the crankshaft. The crankshaft is the main rotating shaft running the length of the engine to which connecting rods from the pistons are attached. The crankshaft is usually counterweighted to take into account the weight of the pistons, connecting rods, and crankpin. The connecting rods, which link the engine pistons to the offset, but interconnected, segments of the crankshaft, convert the up-and-down movement of the pistons into crankshaft rotation. This motion is transmitted to the transmission and eventually to the driving wheels.

***Demand characteristics*.—**U.S. producers' shipments of ductile iron crankshafts and camshafts are used almost exclusively in the manufacture of motor vehicles, which accounted for 95 percent of shipments (table 5-26). These products are largely shipped directly from U.S. producers to original equipment manufacturers (i.e., motor vehicle producers) for further processing and incorporation into motor-vehicle engines (table 5-27).

Forged steel crankshafts have increasingly replaced cast ductile iron crankshafts in engine applications[48] because of their perceived superior attributes regarding noise, vibration, and harshness (NVH)[49]

[47] The description and uses for this section was largely gathered from the Dictionary of Automotive Terms, found at *http://100megsfree4.com/dictionary/* and How Stuff Works, found at *http://auto.howstuffworks.com*.

[48] Crankshafts manufactured from bar steel were expected to account for 60 percent of the market by mid-2002 because of the material's capability to improve engine performance and reduce weight. The growth would largely be at the expense of cast iron, which accounted for 60 percent of the crankshaft market in 2000. "Steel to Gain Market Share in Engine Crankshaft Applications, Reports American Iron and Steel Institute," Oct. 10, 2000, found at *http://www.amm.com.*

[49] Alan P. Druschitz et al, "Influence of Crankshaft Material and Design on the NVH Characteristics of a Modern, Aluminum Bock, V-6 Engine," SAE Technical Paper Series, 1999-01-1225, 1999.

as well as longevity, strength, resistance,[50] and smaller size.[51] Ductile iron crankshafts, however, are generally less expensive to produce than forged steel crankshafts. Japanese and European transplant automakers have traditionally used forged steel crankshafts in their engines, whereas the so-called "Big Three" U.S. automakers (Ford, General Motors, and DaimlerChrysler) have generally incorporated ductile iron crankshafts in their engines.[52] General Motors, however, decided in 2002-03 to shift to forged steel crankshafts for several of its new engine programs, such as its global V-6 engines.[53]

Table 5-26
Ductile iron crankshaft/camshaft castings: End market for responding U.S. producers' shipments, 2003
(*Percent*)

End market	Share of 2003 shipments of castings castings by quantity
Motor vehicles:	
Automobiles (including light duty trucks, SUVs, vans, etc.)	92
Trucks	3
Farm and garden machinery and equipment	3
Construction machinery and equipment	1
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-27
Ductile iron crankshaft/camshaft castings: Responding U.S. producers' shipments, by channel of distribution, 2003
(*Percent*)

Channel of distribution	Share of 2003 shipments of castings by quantity
Rough castings:	
Machine shop/other fabricators	5
Original equipment manufacturers	94
Other	([1])
Total	100

[1] Less than 0.5 percent.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[50] Al Wrigley, "New GM engines will use imported steel," American Metal Market, Feb. 7, 2003, found at *http://www.amm.com*, retrieved Jan. 12, 2005.
[51] David Anderson, "Growth seen in power train, suspension systems," American Metal Market, Nov. 15, 1999, found at *http://www.amm.com*, retrieved Jan. 12, 2005.
[52] Al Wrigley, "New GM engines will use imported steel."
[53] Al Wrigley, "GM picks forged steel crankshaft for global V-6," American Metal Market, Jan. 17, 2003, found at *http://www.amm.com*, retrieved Jan. 12, 2005.

Engines are also being developed that incorporate multiple camshafts, such as dual overhead camshaft engines (DOHC), which directly affects the volume of camshafts demanded in the market.[54] However, alternative metals, particularly steel, are also commonly found in camshaft applications. Camshafts produced from steel tubing rather than steel bar, for example, have become increasingly popular.[55] Moreover, a large number of automakers[56] incorporate assembled camshafts into their engines. These camshafts are manufactured from steel or powdered metal lobes that are heated and then mounted on a ground, hollow steel tube. These camshafts reportedly have advantages of greater stiffness, lower weight, near net shape, and overall lower cost.

Demand for these products reflects not only the number of motor vehicles produced,[57] which directly impacts the level of demand for engines that incorporate crankshafts and camshafts, but also reflects the engine characteristics desired by the automaker, which determines the metal and manufacturing process required. Trends in engine production closely correspond to those of motor vehicle output, with a resulting upstream effect on the demand for camshafts and crankshafts as inputs for their manufacture. Since the Big Three are the principal consumers of ductile iron crankshafts, their recent loss of U.S. market share also may reduce demand for North American-produced engines and components, including crankshafts. One U.S. producer indicated that at least one customer was shutting down production and/or sourcing its requirements from foreign sources. Another U.S. foundry noted the emergence of new suppliers in the marketplace, including Yasunaga (Japan), Abromex (Mexico), and Teksid (Poland).

Producer Trends[58]

Production and inventories –Because of material substitution, most respondents reported declines in production over the period, which fell by 36 percent to 221,679 short tons in 2003 (table 5-28). Although data on inventory levels are confidential, these levels remained low during the period, reflecting the shift to just-in-time inventories adopted by most motor-vehicle manufacturers and their suppliers.

***Employment*.—**Reflecting the decline in U.S. production, reported average annual employment by U.S. producers of these castings fell by 40 percent during 1999-2003 to 1,232 workers (table 5-29). As a result, most other employment indicators exhibited commensurate declines. Productivity, however, peaked in 2002 before declining by 5 percent in 2003 to 102 short tons per hour. The 5-percent overall increase in

---

[54] John E. Sacco, "Universal completes upgrade," American Metal Market, Jan. 10, 1997, found at *http://www.amm.com,* retrieved Jan. 12, 2005.

[55] Al Wrigley, "Tougher competition seen in auto mart," American Metal Market, Apr. 14, 2000, found at *http://www.amm.com*, retrieved Jan. 12, 2005.

[56] Ford, DaimlerChrysler, Subaru, Mazda, Porsche, and Volkswagen report using assembled camshafts in their engines. "2004 Light Vehicle Engines," *Ward's Engine & Vehicle Technology Update*.

[57] Motor vehicle production declined by 8 percent overall during 1999-2003, to 16.2 million vehicles. The period low was reached in 2001, when vehicle output totaled 15.8 million units. "North American Car & Truck Production, 1954-2003," *2004 Ward's Automotive Yearbook*, p. 117.

[58] Certain data have been withheld to avoid disclosure of business confidential information. These data include inventories, exports, breakouts of domestic shipments and net sales by commercial vs. internal, operating income and related ratios, and imports.

Table 5-28
Ductile iron crankshaft/camshaft castings: Responding U.S. producers' production and inventories for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Production (short tons)	345,903	307,151	236,771	244,839	221,679
Inventory:					
Total (short tons)	([1])	([1])	([1])	([1])	([1])
Share of production (percent)	([1])	([1])	([1])	([1])	([1])

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. Inventory share of production based on establishments that were able to provide both inventory and production amounts.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-29
Ductile iron crankshaft/camshaft castings: Responding U.S. producers' employees and related information for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Average number of employees	2,048	1,742	1,343	1,322	1,232
Production and related workers:					
Number	1,845	1,541	1,164	1,143	1,038
Hours worked (*1,000 hours*)	3,611	3,361	2,284	2,298	2,231
Wages paid (*1,000 dollars*)	59,402	55,932	42,841	44,249	43,278
Average hourly wages (*dollars per hour*)	16.46	16.65	18.77	19.27	19.42
Productivity (*short tons per 1,000 hours*)	97	92	104	107	102

Note.–Figures may not add to totals because of rounding. Average hourly wages based on establishments that were able to provide both hours worked and wages paid. Productivity based on establishments that were able to provide both production quantity and hours worked.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

productivity during 1999-2003 trails slightly the same index for the overall iron foundry industry, which rose by 7 percent during 1999-2003. Reported average hourly wages increased steadily during 1999-2003 to $19.42 in 2003. This average hourly wage exceeds the reported ductile iron industry average of $15.34 in 2003,[59] which may reflect the influence of the higher-wage motor-vehicle industry on this product's producers.

***Producers' shipments and exports*.—**Because of the increased use of alternative metals in camshaft/crankshaft applications, responding U.S. producers' shipments of these products fell by 36 percent during 1999-2003 to 220,367 short tons (table 5-30). Shipment value declined by a slightly larger margin, totaling $341.7 million in 2003. The decline occurred largely in commercial shipments. U.S. exports declined throughout the period and accounted for a small share of reported domestic shipments. Such exports are believed to be largely directed to NAFTA partners Canada and Mexico for use in the regional motor vehicle market.

***Financial condition*.–**Because of confidentiality considerations, much of this sector's financial results cannot be disclosed. However, as total net sales quantities and net sales values declined, sector operating income also fell by more than 50 percent during 1999-2003 (table 5-31). Two of eight responding

[59] See table 5-10, Gray and ductile iron castings: Responding U.S. producers' employees and related information for their rough castings operations, 1999-2003, p. 5-12.

Table 5-30
Ductile iron crankshaft/camshaft castings: Responding U.S. producers' domestic shipments and exports for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Domestic shipments:					
Commercial	([1])	([1])	([1])	([1])	([1])
Internal consumption and transfers	([1])	([1])	([1])	([1])	([1])
Exports	([1])	([1])	([1])	([1])	([1])
Total	346,610	305,439	236,331	244,121	220,367
	Value (*1,000 dollars*)				
Domestic shipments:					
Commercial	([1])	([1])	([1])	([1])	([1])
Internal consumption and transfers	([1])	([1])	([1])	([1])	([1])
Exports	([1])	([1])	([1])	([1])	([1])
Total	592,673	487,258	317,879	352,473	341,699

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-31
Ductile iron crankshaft/camshaft castings: Responding U.S. producers' financial results for their rough casting operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Rough castings:					
Net sales:					
Commercial domestic and export sales	196,197	156,364	103,205	97,739	82,687
Internal consumption for production of machined castings	([1])	([1])	([1])	([1])	([1])
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales quantities	346,522	305,341	236,248	244,074	219,994
	Value (*1,000 dollars*)				
Net sales:					
Commercial domestic and export sales	190,739	164,688	96,282	94,768	93,052
Internal consumption for production of machined castings	([1])	([1])	([1])	([1])	([1])
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales values	584,911	483,471	318,590	353,531	342,463
Operating income	([1])	([1])	([1])	([1])	([1])
	Ratio to net sales (*percent*)				
Operating income	([1])	([1])	([1])	([1])	([1])
	Number of establishments reporting:				
Operating losses	0	1	1	1	2
Financial results data	7	8	8	8	8

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

producers reported operating losses in 2003. Two large U.S. foundries, Intermet and Citation, produce ductile iron crankshafts and camshafts, and both are currently in bankruptcy. Most financial indicators for this sector display significant declines.

***Investment*.—**Capital expenditures in this sector fell by 67 percent during 1999-2002 to an estimated $3.4 million, in step with the decline in operating income (table 5-32). Capital expenditures nearly tripled in 2003, however, to $9.1 million. No expenditures for research and development were reported during the period. According to one U.S. foundry, many U.S. companies have reduced or eliminated R&D expenditures to save money.[60]

Purchaser Trends

Respondents' purchases of both rough and machined ductile iron crankshaft and camshaft castings more than doubled during 1999-2003, with purchases fairly evenly split between the two categories during most years of the period (table 5-33). The U.S. industry maintained its dominance of the rough castings sector after inroads by U.S. imports during 2000-2001, and increased its hold of the machined castings sector by the end of the period. Because limited purchasing data were provided by U.S. purchasers of these castings, specific country details cannot be provided to protect business confidentiality. However, imports from Japan dominated the rough castings sector, and were also a significant source of machined castings for U.S. purchasers. The Japanese vehicle component sector retains significant links with the large base of Japanese transplant automakers and parts producers manufacturing in the United States. Mexico was the leading source of machined castings during the period, in large part because of the closer integration of the Mexican industry into the North American motor-vehicle industry since the implementation of NAFTA.

Imports of finished engines, which incorporate ductile iron cast crankshafts and camshafts as well as other types of crankshafts and camshafts, rose by 18 percent during 1999-2004 to $7.1 billion (table 5-34). Canada and Mexico remained the leading suppliers of engines to the U.S. market because of their extensive integration into the U.S. motor vehicle industry, whereas Japan was surpassed by Germany in 2004 as the

Table 5-32
Ductile iron crankshaft/camshaft castings: Responding U.S. producers' capital and R&D expenditures for their rough casting operations, fiscal years 1999-2003
(*1,000 dollars*)

Item	1999	2000	2001	2002	2003
Machinery, equipment, and fixtures	10,157	5,517	3,586	3,354	9,145
Research and development expenditures	0	0	0	0	0

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

[60] U.S. industry official, interview with USITC staff, United States, June 2004.

Table 5-33
Ductile iron crankshaft/camshaft castings: Purchases of domestic and foreign castings by responding U.S. purchasers, 1999-2003

(***1,000 dollars***)

Year	Total
Rough castings:	
1999	19,302
2000	23,983
2001	21,540
2002	38,365
2003	46,185
Machined castings:	
1999	19,036
2000	8,246
2001	15,084
2002	33,939
2003	41,426

Note.–Domestic and foreign purchases not shown separately to prevent disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-34
Ductile iron crankshaft/camshaft castings: U.S. imports for consumption of downstream products, 1999-2004

(***1,000 dollars***)

Country	1999	2000	2001	2002	2003	2004
Canada	2,780,661	2,708,311	2,081,575	2,133,041	2,379,929	2,869,822
Mexico	1,471,621	1,416,037	1,254,197	1,197,325	1,328,201	1,806,325
Germany	390,574	908,114	855,169	1,003,626	1,104,624	990,703
Japan	1,212,129	1,424,922	1,463,912	1,511,961	1,178,639	939,439
Brazil	27,572	25,500	16,791	179,928	268,809	180,147
Sweden	54,975	64,861	49,182	50,324	89,719	174,416
Italy	4,147	3,648	27,005	48,619	65,945	90,776
United Kingdom	69,548	79,200	101,335	257,796	183,778	45,369
Singapore	5,187	483	1,203	9,252	9,766	7,580
Korea	2,256	1,783	2,828	5,329	9,441	7,213
All other	16,535	16,120	16,376	9,886	21,470	15,357
Total	6,035,205	6,648,981	5,869,572	6,407,083	6,640,320	7,127,149

Note.–Downstream products include spark-ignition and compression-ignition engines for motor vehicles (HTS classifications 8407.34.18, 8407.34.48, and 8408.20.20). Figures may not add to totals because of rounding.

Source: Compiled from official statistics of the U.S. Department of Commerce.

third largest supplier of these products to the U.S. market. In addition to Mexico and Germany, Brazil, Sweden, and Italy recorded the most significant gains during the period. Other notable increases occurred in imports of engines from Korea. Firms from many of the countries have corporate links with motor-vehicle manufacturers located in the United States.

Table 5-35
Ductile iron crankshaft/camshaft castings: Price comparison by responding U.S. producers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Brazil	Lower	1	30
China	Lower	4	35
India	Lower	1	15
Korea	Lower	1	20
Mexico	Lower	1	10
Other	Lower	1	5
Machined castings:			
Japan	About the same	1	([1])

[1]Not applicable.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Competitive Assessment of Price- and Product-related Factors

***Price and non-price factors*.—**Based on questionnaire responses, U.S. producers consider China the leading competitive concern for this sector. The price of imports of rough ductile iron castings for camshafts and crankshafts from China is believed by responding U.S. producers to be on average 35 percent lower than the U.S. price for comparable goods (table 5-35). Other countries identified as competitive concerns for rough castings include Korea, Mexico, and Brazil, all of which reportedly supply castings at prices less than those of the U.S. industry. Japan was cited by U.S. producers as the only competitive concern for machined castings, which are estimated to be comparably priced to U.S. products.

In contrast, U.S. purchasers' price experience is largely with machined castings. They report that foreign-produced machined castings are comparably priced or priced lower than U.S. ductile iron camshafts and crankshafts (table 5-36). In particular, China and India are believed to supply these products at prices 30 percent below the U.S.-origin casting. Only castings from Japan were noted as being priced higher, with a 20-percent premium, according to one purchaser.

When asked for the leading countries from which they have increased imports, responding U.S. purchasers cited China, Japan, and India. Of these three countries, Japan is the only source cited by responding domestic purchasers as improving its U.S. delivered price. Both U.S. purchasers reporting on Japan indicated that all other competitive factors were as important as price in their purchase decisions. Increased metal castings purchases from China and India were largely attributable to the same factors — better availability, design, range of products, warranty terms, and packaging, and lower transportation costs — rather than a better price.

***Producers' response to import competition.*—**Cost/price adjustments were the leading response to import competition by U.S. producers responding to this question (table 5-37). These foundries indicated that they lowered prices or suppressed price increases and implemented cost-reduction efforts to improve their competitive position vis-à-vis their foreign competitors. Responding U.S. producers of ductile iron camshaft and crankshaft castings largely agreed that their prices for these products remained the same or dropped during the period, with price declines ranging up to 10 percent. Five firms reacted by improving product quality. Cost-reduction and quality improvement programs such as lean manufacturing, Six Sigma, and total quality management have been widely adopted by automakers and their suppliers to reduce waste and product defects and improve product quality.

Table 5-36
Ductile iron crankshaft/camshaft castings: Price comparison by responding U.S. purchasers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Brazil	Lower	1	15
Japan	Lower	1	5
Machined castings:			
Canada	About the same	1	([1])
China	Lower	1	30
EU-15	Lower	2	16
EU-15	About the same	1	([1])
Eastern Europe[2]	About the same	1	([1])
India	Lower	1	30
Japan	Higher	1	20
Japan	About the same	1	([1])
Korea	Lower	2	10
Mexico	Lower	3	11
Taiwan	Lower	1	20
Thailand	About the same	1	([1])
Turkey	Lower	1	10

[1] Not applicable.
[2] Includes Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Poland, Romania, Slovakia, Slovenia, and Yugoslavia (Serbia and Montenegro).

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Table 5-37
Ductile iron crankshaft/camshaft castings: Responding U.S. producers' responses to import competition

Nature of response	Number of responses
Total number of establishments responding	10
Took no or few actions because:	
Had already shifted production to other lines of castings	1
Lacked capital funds to counter foreign competition	1
Other	1
Took the following actions:	
Lowered prices or suppressed price increases	8
Reduced or dropped plans to expand capacity	3
Cut back or eliminated production	4
Shifted to other cast products	3
Implemented cost-reduction efforts	8
Improved product quality	6
Opened a plant in a foreign country	1
Other	1

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

To a lesser extent, responding producers indicated that they cut back or eliminated production, which is clearly demonstrated in the industry data presented. Four firms indicated that they took no action against import competition because they lacked the capital to implement such activities. Raising capital for investments is particularly difficult in the U.S. motor vehicle parts industry because of the unfavorable financial condition of many firms in the industry. Suppliers to the U.S. motor-vehicle industry are largely unable to raise prices to their customers to cover significantly higher raw material prices, and many firms are consequently experiencing financial difficulties.

Gray Iron Motor Vehicle Gear Box Castings

Industry Profile

> ***Product Description and Uses***
>
> Gray iron motor vehicle gear box castings are primarily housings or other internal parts of transmissions, differentials, transfer cases, and power take-off units (auxiliary gear boxes that transfer power from the transmission through a gear box to an output shaft to power non-motive applications) found on medium- and heavy-duty trucks and agricultural tractors. Transfer cases are auxiliary gear boxes that may be or are located adjacent to the transmission or one of the axles. Housings for automatic transmissions include elaborate passageways, cast into one of the housing halves, that route the automatic transmission fluid to control the operation of the transmission. Gray iron castings principally are used in transmissions for trucks, particularly medium- and heavy-duty trucks, tractors, and construction machinery. Traditionally, gray iron has been used for such gear boxes because of its strength, machinability, ability to handle heat and dampen noise and vibration, and low cost.

Industry structure.–Based upon questionnaire responses, the U.S. foundry industry producing gray iron motor vehicle gear box castings had 20 firms in 2003, operating 25 foundries. The industry is dominated by two firms that accounted for 86 percent of the quantity of production in 2003. Three firms produce over 20,000 tons annually, and the remainder produce less than 2,000 tons annually. Two firms have captive foundries. Since 1999, one medium-size producer has entered and exited bankruptcy and one captive foundry was closed and demolished. In May 2004, CNH Global N.V., closed its foundry at Racine, WI, where CNH, a large producer of agricultural and construction machinery, had produced housing, drive train component, axle, and other castings.[61] One firm opened a foundry during this period. In 2001, a major U.S. foundry ceased operations, and one of its foundries was purchased and restarted operations in early 2002.

The foundries producing gray iron motor vehicle gear box castings principally are located in the Midwest. The majority of producers indicated that they produce both gray and ductile iron castings. Two reported producing other iron castings, and one also reported producing aluminum castings. Sand molding was the method of production reported. Less than one-half of the firms reported that they design castings or produce patterns, with most indicating that they produce molds, and only a handful performing machining. Slightly over one-half of the larger foundries produce a high volume of gear box parts primarily for the truck and off-highway market. Smaller foundries produce in limited volume production runs. For this industry, production of gray iron motor vehicle gear box castings represented only 2 percent to 3 percent of production, as these foundries make other products. Both U.S. producers and purchasers indicated that certification by purchasers is required, and most foundries are certified to ISO9000 or higher, or to automotive standards.

Demand characteristics.**—**U.S. foundries reported that approximately 71 percent of shipments in 2003 were to machine shops or fabricators in which they had no ownership interest (table 5-38). A small percentage of gray iron gear box castings were machined by the foundries themselves. An even smaller percentage of shipments were to OEMs. During 1999-2003, the trend has been for foundries and OEMs not to invest in machining of gray iron castings for gear boxes. No U.S. producer reported shipping machined castings. The general trend is for OEMs to seek foundries that can reduce their costs. This has resulted in OEMs asking vendors to perform more operations so that the OEMs do not have to use funds to invest in and maintain machining, assembly, and related operations and therefore not be burdened by corresponding labor costs. As discussed later, OEMs are purchasing foreign machined castings.

[61] CNH Global N.V., "CNH Announces Tentative Decision to Close Foundry," press release, found at *http://www.cnh.com/media/detail.asp?id=1452362132003,* retrieved Jan. 13, 2005. The foundry and adjacent assembly factory were demolished for housing developments. CNH Global N.V., "CNH to Recycle Shuttered Racine Tractor Plant, Clearing the Way for Development of 100 Acre Lakefront Property," press release, July 27, 2004, found at *http://www.cnh.com,* retrieved Jan. 21, 2005.

Table 5-38
Gray iron motor vehicle gear box castings: Responding U.S. producers' shipments, by channel of distribution, 2003
(***Percent***)

Channel of distribution	Share of 2003 shipments of castings by quantity
Rough castings:	
In-house machining	19
Machining subcontractor	1
Machine shop/other fabricators	71
Original equipment manufacturers	6
Other	2
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

The principal end-use markets for gray iron motor vehicle gear box castings were automobiles, principally light duty trucks, SUVs, and vans, that accounted for 46 percent of the market and trucks that accounted for 38 percent (table 5-39). Farm, garden, and construction machinery accounted for most of the remainder. Some automobile and agricultural tractor and construction machinery producers have captive foundries and therefore may produce parts to their needs. The industry producing transmissions for heavy vehicles is dominated by a handful of companies[62] that sell to major automobile, truck, and agricultural and construction machinery OEMs. Other agricultural or construction OEMs, particularly those related to foreign parent companies, may import finished transmissions.[63]

Table 5-39
Gray iron motor vehicle gear box castings: End market for responding U.S. producers' shipments, 2003
(***Percent***)

End market	Share of 2003 shipments of castings by quantity
Motor vehicles:	
Automobiles (including light duty trucks, SUVs, vans, etc.)	46
Trucks	38
Other (buses, motor homes, etc.)	2
Farm and garden machinery and equipment	5
Construction machinery and equipment	2
Refrigeration, air conditioning, and heating equipment	1
Industrial machinery	2
Construction/municipal castings	1
Other/unknown	2
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[62] This industry includes Allison Transmissions, a subsidiary of General Motors; Arvin-Meritor, Inc.; Eaton Corp.; Roadranger (a joint venture between Eaton Corp. and Dana Corp.), Transmission Technologies Corp., and ZF Transmissions.
[63] U.S. industry official, telephone interview with USITC staff, Feb. 18, 2005.

As a result of regulatory demands and market expectations for improved fuel economy stemming from vehicle weight reductions, end-users have sought to reduce weight in transmissions and therefore have increased their use of metals besides gray iron. Gray iron motor vehicle gear box castings have been replaced by aluminum castings and powder metal components. For example, in 2001 it was announced that for 2002, General Motors Co., including Allison Transmissions, was replacing gray iron with aluminum on a number of applications, including transmissions for trucks.[64] Most producers of transmissions for medium- and heavy-duty trucks offer transmissions with aluminum housings. According to one large U.S. automobile producer, many U.S. producers of gray iron motor vehicle gear box castings increasingly have moved to producing certain transmission components in ductile iron because it is more profitable.[65] Gray iron castings continue to be used in older model transmissions that are used on vehicles currently being produced.[66] However, newer model transmissions and transmission components are almost entirely being produced from aluminum, ductile iron, or other materials.[67] Gray iron castings are still used in applications where properties such as tensile strength or machined surface qualities are required.

Producer Trends[68] [69]

***Production and inventories*.—**U.S. production of gray iron motor vehicle gear box castings increased by approximately 3 percent during the period (table 5-40). However, the volume of production fell by almost 13 percent in 2001 from its peak in 2000, but rebounded by 17 percent by 2003. Several responding producers reported that their production peaked in 1999 or 2000, and subsequently fell, by as much as 73 percent in one instance. For those responding foundries that reported decreases in consumption of their production, seven cited material substitution, three noted that customers had shut down production, seven noted reduced demand for the final product, and seven noted increased imports of the downstream product. These declines were offset by other foundries increasing production for the agricultural and truck markets.

Table 5-40
Gray iron motor vehicle gear box castings: Responding U.S. producers' production and inventories for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Production (short tons)	1,071,096	1,086,250	945,872	1,072,903	1,107,964
Inventory:					
Total (short tons)	26,688	27,486	24,781	25,335	28,957
Share of production (percent)	2	3	3	2	3

Note.–Figures may not add to totals because of rounding. Inventory share of production based on establishments that were able to provide both inventory and production amounts.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[64] The Aluminum Association, Inc., "Aluminum Revving Up for More Auto Gains," press release, July 30, 2001, found at *http://www.aluminum.org*, retrieved Feb. 15, 2005.

[65] U.S. industry official, telephone interview with USITC staff, Jan. 21, 2005.

[66] Ibid.

[67] Ibid., and U.S. industry official, email to USITC staff, Mar. 31, 2005.

[68] Certain data have been withheld to avoid disclosure of business confidential information. These data include certain shipments, sales, capital expenditures, and purchases of foreign-produced castings.

[69] Data provided U.S. producers for gray iron castings for motor vehicle gear boxes include some figures for brake parts, as U.S. producers were not able to breakout data solely for gear box castings.

Employment.—During 1999-2003, employment in this industry declined by 7 percent, as did the number of production workers, by almost 13 percent (table 5-41). Average hourly wages for production workers producing gray iron motor vehicle gear box castings rose by 5 percent compared with average hourly earnings of production workers for the overall U.S. gray iron foundry industry which rose by 10 percent, from \$16.42 to \$18.08.[70] Worker productivity rose from 225 short tons per thousand hours in 1999 to 281 short tons per hour in 2003, or by 25 percent, and corresponds to the decline in the number of production workers and also continual capital investments at these foundries.

Table 5-41
Gray iron motor vehicle gear box castings: Responding U.S. producers' employees and related information for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Average number of employees	3,121	2,969	2,703	2,825	2,888
Production and related workers:					
Number	2,107	1,944	1,696	1,772	1,837
Hours worked (*1,000 hours*)	4,768	4,368	3,372	3,726	3,936
Wages paid (*1,000 dollars*)	72,862	65,456	51,552	61,620	63,248
Average hourly wages (*dollars per hour*)	15.28	14.99	15.29	16.54	16.07
Productivity (*short tons per 1,000 hours*)	225	249	281	288	281

Note.–Figures may not add to totals shown because of rounding. Average hourly wages based on establishments that were able to provide both hours worked and wages paid. Productivity based on establishments that were able to provide both production quantity and hours worked.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Producers' shipments and exports.—Reported U.S. producers' shipments of gray iron motor vehicle gear box castings generally followed the automobile and truck markets, which in turn moved with the overall economy, declining from 1999 through 2001and then recovering into 2003.[71] The trend in agricultural equipment, however, was different with a continual rise in sales during 2000-2003.[72] Several U.S. producers noted in their questionnaire responses that the war in Iraq resulted in increased consumption of heavy-duty transmissions and differentials over the last 18 months.

Reporting U. S. producers' total shipments fell by 17 percent by quantity from 1999 to 2001, and then rebounded by 17 percent by 2003 (table 5-42). Total shipments by value declined by 18 percent between 1999 and 2001, and then rebounded by 17 percent by 2003. For two mid-sized producers and a small number of other producers, the value of shipments declined by up to 46 percent between 1999 and 2000. The decline in shipment value was attributable to price pressure, import competition, and a shift from gray iron to aluminum or ductile iron for certain applications. Other producers, however, had shipment values that were approximately equal to or slightly above their 1999 levels.

Some responding U.S. producers indicated that prices have for their product have declined by up to 10 percent. In contrast, about 60 percent of U.S. purchasers reported that prices have risen, with purchasers reporting almost equal price increases of 0 to 10 percent, 11 to 20 percent, and 21 to 30 percent. Most of the remainder of purchasers surveyed stated that prices have remained the same. A few purchasers reported declines in prices paid, most less than 10 percent.

[70] See table 5-10, Gray and ductile iron castings: Responding U.S. producers' employees and related information for their rough castings operations, 1999-2003, p. 5-12.
[71] Eaton Corp. closed a heavy-duty transmission plant in Shelbyville, TN, because of "depressed conditions in the truck industry during 2002 and 2001," and the company's efforts to rationalize manufacturing operations. Eaton Corp., Form 10-K, March 2004, found at *http://www.sec.gov*, retrieved Feb. 23, 2005.
[72] Association of Equipment Manufacturers, *U.S. Ag Flash Reports*, various issues.

Table 5-42
Gray iron motor vehicle gear box castings: Responding U.S. producers' domestic shipments and exports for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Domestic shipments:					
Commercial	([1])	([1])	([1])	([1])	([1])
Internal consumption and transfers	([1])	([1])	([1])	([1])	([1])
Exports	([1])	([1])	([1])	([1])	([1])
Total	1,057,179	1,006,029	877,644	996,751	1,026,098
	Value (*1,000 dollars*)				
Domestic shipments:					
Commercial	([1])	([1])	([1])	([1])	([1])
Internal consumption and transfers	([1])	([1])	([1])	([1])	([1])
Exports	([1])	([1])	([1])	([1])	([1])
Total	601,228	593,607	490,160	548,885	572,183

[1] Data withheld to avoid disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

***Financial condition*.—**The generally positive financial results reported by producers of gray iron motor vehicle box castings from 1999 to 2003 were nonetheless affected by declining net sales and operating income (table 5-43). Net sales quantities and values for the rough castings segment both declined from 1999 to 2001 but then rebounded, and by 2003 they were not far below their 1999 levels. The vast majority of operating income, which was positive, was accounted for by three firms. For the industry as a whole, operating income fell by 33 percent between a peak in 2000 to a bottom in 2001, before rising again in 2002 and declining in 2003. Overall, the industry's operating income declined by 31 percent between 1999 and 2003. The number of firms reporting operating losses doubled from 4 in 1999 to 8 in 2003 and, whereas the operating income margin never dipped below double digits, it did decline from 14 percent to 10 percent. Reported data on machined castings for this industry were minimal.

***Investment*.—**Capital expenditures for machinery, equipment, and fixtures declined by over 60 percent during 1999-2003 (table 5-44). The types of capital expenditures included multi-million dollar expenditures on furnaces and new casting lines. For example, Deere & Co., a major producer of agricultural and construction machinery, reportedly installed induction melting furnaces to replace 30-year old arc melting furnaces in 2000 for approximately $20 million.[73] Responding U.S. producers noted some expenditures for robotics. The high level of capital expenditures in 1999 and 2000, along with other improvements to manufacturing processes, have resulted in increased productivity as noted above. No foundries reported any expenditures on research and development.

[73] Pat Kinney, "John Deere Foundry Wins Award," WCFCourier.com, found at *http://www.wcfcourier.com,* retrieved Feb. 10, 2005.

Table 5-43
Gray iron motor vehicle gear box castings: Responding U.S. producers' financial results for their rough casting operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Rough castings:					
Net sales:					
Commercial domestic and export sales	([1])	([1])	([1])	([1])	([1])
Internal consumption for production of machined castings	([1])	([1])	([1])	([1])	([1])
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales quantities	1,057,320	1,006,156	882,536	996,661	1,026,449
	Value (*1,000 dollars*)				
Net sales:					
Commercial domestic and export sales	([1])	([1])	([1])	([1])	([1])
Internal consumption for production of machined castings	([1])	([1])	([1])	([1])	([1])
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales values	601,452	593,990	488,242	548,670	572,243
Operating income	86,010	87,960	([1])	([1])	([1])
	Ratio to net sales (*percent*)				
Operating income	14	15	([1])	([1])	([1])
	Number of establishments reporting:				
Operating losses	4	3	7	9	8
Financial results data	18	19	19	21	21

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and operating income data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-44
Gray iron motor vehicle gear box castings: Responding U.S. producers' capital and R&D expenditures for their rough casting operations, fiscal years 1999-2003
(*1,000 dollars*)

Item	1999	2000	2001	2002	2003
Machinery, equipment, and fixtures	22,267	19,219	([1])	12,047	([1])
Research and development expenditures	0	0	0	0	0

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Purchaser Trends

A small majority of foreign-produced castings purchased by U.S. purchasers are machined castings (table 5-45).[74] Because of the limited number of responses from purchasers of these castings, volume and value data cannot be published without revealing the operations of the firms supplying the data. Canada was the leading source of purchased foreign-produced machined castings, followed by Mexico. Machined castings from China rose by over 1,800 percent from a small base, with most of the increase occurring in 2002, becoming a significant source of supply. Purchases from Eastern Europe and Brazil also rose. Purchases of rough castings from Korea entered the U.S. market in 2002.

Table 5-45
Gray iron motor vehicle gear box castings: Purchases of domestic and foreign castings by responding U.S. purchasers, 1999-2003
(*1,000 dollars*)

Year	Total
Rough castings:	
1999	147,108
2000	171,886
2001	190,431
2002	188,295
2003	173,098
Machined castings:	
1999	189,861
2000	193,122
2001	196,227
2002	212,026
2003	213,847

Note.–Domestic and foreign purchases not shown separately to prevent disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Imports of motor vehicle gear boxes, which include transmissions, that incorporate gray iron castings as well as those of aluminum and other metals, rose by 68 percent during 1999-2004 to $5.1 billion (table 5-46). Japan was the leading supplier, with Canada and France being a distant second and third leading suppliers, respectively. Imports from Japan, France, and Germany showed the largest gains during the period.

[74] For machined castings, reported quantities and values may not correspond because some purchasers did not report quantities.

Table 5-46
Gray iron motor vehicle gear boxes castings: U.S. imports for consumption of downstream products, by leading suppliers, 1999-2004

(***1,000 dollars***)

Country	1999	2000	2001	2002	2003	2004
Japan	1,164,158	1,454,083	1,262,582	1,647,949	2,029,531	2,849,247
Canada	935,784	1,002,929	923,093	988,948	813,785	861,371
France	442,918	500,873	650,934	716,347	753,348	807,287
Mexico	155,484	142,510	113,713	128,516	119,374	202,544
Germany	67,786	96,774	94,769	87,972	137,131	173,683
Brazil	69,661	50,756	40,988	44,089	41,245	65,722
Italy	16,419	16,684	21,786	38,570	55,801	47,895
Hungary	19	489	2,102	50,328	145,525	18,475
United Kingdom	136,956	122,181	55,264	7,584	10,050	14,170
Sweden	18,614	10,960	3,977	3,019	1,662	9,764
All other	16,504	17,068	20,223	25,288	32,902	27,792
Total	3,024,303	3,415,307	3,189,431	3,738,610	4,140,354	5,077,950

Note.–Downstream products include transmissions and other gearboxes for motor vehicles, and may include those where the housings and other castings are aluminum and other metals (HTS classifications 8708.40.10, 8708.40.20, 8708.40.30, 8708.50.10, 8708.50.50, and 8708.50.80). Figures may not add to totals because of rounding.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Competitive Assessment of Price- and Product-related Factors

Price and non-price factors.–For both rough and machined castings, U.S. producers reported that foreign prices were significantly below those reported by U.S. purchasers; this was particularly so with regard to machined castings (tables 5-47 and 5-48). Responding U.S. producer and purchaser perceptions of price differentials were almost the same with regard to castings supplied by China and India. Rough Chinese castings were priced approximately 27 percent to 30 percent below the price of U.S. castings, and machined castings were 28 percent to 38 percent lower. Castings from India also commanded low prices. As noted earlier, the majority of imports were from Canada and Mexico, where the price differential ranges from 18 percent below the U.S. price to 10 percent above the U.S. price. The difference in the prices for machined castings is largely the result of high U.S. labor costs for programming and operating the machining of a part, as the cost of a machine tool and tooling are relatively the same in both countries.[75]

U.S. purchasers reported that factors such as improved product availability and lead times, rather than price improvements, influenced their decisions to increase purchases from China. Similarly, purchasers rated other factors as more important than price for increased purchases from other leading sources, including Canada, Korea, and Mexico.

[75] Chinese industry official, interview with USITC staff, China, Nov. 2004.

Table 5-47
Gray iron motor vehicle gear box castings: Price comparison by responding U.S. producers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Brazil	Lower	4	14
Brazil	Higher	1	8
China	Lower	9	26
EU-15	Lower	1	10
Germany	Lower	1	10
India	Lower	3	18
Mexico	Lower	1	15
Machined castings:			
Brazil	Lower	2	18
China	Lower	4	38
France	Lower	1	30
Germany	Lower	1	20
India	Lower	2	40
Korea	Lower	1	20
Mexico	Lower	2	23

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

***Producers' response to import competition*.—**In response to U.S. import competition, most U.S. producers reported that they have lacked the funds to counter such competition, whereas two reported that they had shifted to production of more advanced types of castings (table 5-49). The lack of funds to respond corresponds to the deteriorating financial condition of this industry as noted earlier. U.S. producers also reported implementing cost-reduction efforts and lowering prices, raising product quality, and scaling back on production or capacity expansions. Other producers closed production lines or shifted to other cast products.

Table 5-48
Gray iron motor vehicle gear box castings: Price comparison by responding U.S. purchasers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Canada	Lower	3	18
Canada	Higher	1	10
China	Lower	1	30
EU-15	Lower	1	5
EU-15	Higher	1	10
Korea	Lower	3	7
Machined castings:			
Brazil	Lower	3	8
Canada	Lower	1	3
China	Lower	8	28
China	About the same	1	([1])
EU-15	Lower	2	5
EU-15	About the same	1	([1])
Eastern Europe[2]	Lower	2	11
India	Lower	1	30
Japan	Higher	1	10
Korea	Lower	1	10
Mexico	Lower	3	8
Mexico	About the same	1	([1])
Taiwan	About the same	1	([1])
Turkey	Lower	1	10

[1] Not applicable.
[2] Includes Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Poland, Romania, Slovakia, Slovenia, and Yugoslavia (Serbia and Montenegro).

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Table 5-49
Gray iron motor vehicle gear box castings: Responding U.S. producers' responses to import competition

Nature of response	Number of responses
Total number of establishments responding	22
Took no or few actions because:	
Had already shifted production to more advanced types of castings	1
Had already shifted production to other lines of castings	2
Lacked capital funds to counter foreign competition	7
Other	2
Took the following actions:	
Lowered prices or suppressed price increases	19
Reduced or dropped plans to expand capacity	10
Cut back or eliminated production	14
Closed production lines	4
Shifted to other cast products	9
Implemented cost-reduction efforts	20
Improved product quality	14
Imported product instead	1
Other	4

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission

Ductile Iron Bearing Housing Castings[76]

Industry Profile

> **Product Description and Uses**
>
> A bearing housing consists of a frame or block designed to house a complete bearing. The main purpose of a bearing housing is to hold the bearing and to provide support to the load that is transferred to the bearing from the shaft. Many general purpose types of bearing housings are constructed as a single piece, primarily consisting of ductile iron, and are a part of a bearing mounting, surrounding the bearing. The use of metals such as ductile iron provide benefits such as strength, increased machinability of the casting, and improved shock resistance.
>
> Primary types of bearing housings include the pillow block and the flange type. In the case of the pillow block housing, it is mounted to a surface that is parallel to a shaft axis. The flange bearing housing can come in many different types, such as the two-bolt, three-bolt, and four-bolt flange. The number of bolts varies depending on the use of the housing, and the shape and fastening support needed for the bearing. Shapes of the flange housing can differ from square (four-bolt) to elliptical (two-bolt). Different shapes and sizes of bearing housings contribute to their use in a wide variety of items, from clamp mixers to automobiles.

Industry structure.—Eighteen companies reported U.S. production of ductile iron bearing housings. Collectively, the top five respondents accounted for the majority of the reported U.S. production. U.S. bearing housing producers tend to be located in the midwestern and eastern United States, providing access to major customers, particularly motor vehicle manufacturers. With the exception of one company, all of the large producers identified themselves as job shops. Respondents that produced only ductile iron castings accounted for the bulk of bearing housing production. Those companies that produced other castings, in addition to ductile iron castings, tended to produce gray iron castings. Essentially all reporting producers reported sand casting as the method of choice. All of the large foundries reported making their own molds, and in particular the expended variety.

Demand characteristics.– The primary end-use market for bearing housings is the bearing industry. In turn, bearings are found in a wide array of products, including motor vehicles, industrial equipment and tools, and aerospace industry parts. Reportedly, motor vehicles is the dominant bearing-consuming industry worldwide.[77] Questionnaire responses from producers indicate that the domestic motor vehicle industry consumes approximately 85 percent of U.S. bearing housing shipments (table 5-50).

[76] The description and uses for this section were largely gathered from the following sources: U.S. Customs Ruling NY I87872, Oct. 22, 2002, found at *http://rulings.customs.gov*, retrieved Aug. 3, 2004; "Bearings," *Motion System Design*, Dec. 2000, p. A55; e-mail correspondence from U.S. industry official to USITC staff, Nov. 23, 2004; "The Bearing Housing," NTN Bearing Corporation of America, found at *http://www.ntnamerica.com/Knowledge/Mounted_Units/Housing.htm*, retrieved Aug. 13, 2004; "About Pillow Block Bearings," GlobalSpec.com, found at *http://bearings.globalspec.com/LearnMore/Mechanical_Components/Bearings_Bushings/Pillow_Block_Bearings/*, retrieved Aug. 13, 2004; and "Heavy Duty C-Clamp Mixer, Model 400-500-DD-VARI," Grovhac, Inc., found at *http://www.globalspec.com/FeaturedProducts/Detail?ExhibitID=17996*, retrieved Jan. 11, 2005.

[77] International Organization for Standardization (ISO), "Business Plan ISO/TC 4, Rolling Bearings," found at *http://isotc.iso.ch/livelink/livelink/fetch/2000/2122/687806/ISO_TC_004__Rolling_bearings_.pdf?nodeid=852512&vernum=0*, retrieved Jan. 20, 2005.

Table 5-50
Ductile iron bearing housing castings: End market for responding U.S. producers' shipments, 2003
(*Percent*)

End market	Share of 2003 shipments of castings by quantity
Motor vehicles:	
Automobiles (including light duty trucks, SUVs, vans, etc.)	41
Trucks	44
Farm and garden machinery and equipment	1
Construction machinery and equipment	1
Railway equipment	4
Industrial machinery	3
Valve and pipe fittings	2
Pumps and compressors	1
Construction/municipal castings	1
Other/unknown	2
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

During 1999-2003, there were mixed trends in many industries that are bearing consumers. Some industries that use bearings in their final products, such as the railway equipment industry, experienced improved industrial and manufacturing activity, which led to an overall increase in new railcar orders industry-wide in 2003 after "several years of decline."[78] Meanwhile, the motor vehicle sector realized an 8-percent decrease in U.S. production of cars and trucks during 1999-2003.[79] Overall demand for bearings decreased over the period, partially attributed to mixed automotive demand in the United States.[80]

Questionnaire respondents indicated that they performed very little machining in-house. As such, the vast majority of rough castings were first shipped to machining subcontractors or machine shops (table 5-51).

Table 5-51
Ductile iron bearing housing castings: Responding U.S. producers' shipments, by channel of distribution, 2003
(*Percent*)

Channel of distribution	Share of 2003 shipments of castings by quantity
Rough castings:	
Machining subcontractor	28
Machine shop/other fabricators	53
Original equipment manufacturers	13
Other	6
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[78] "FY 2003 10-K Report," Trinity Industries Inc., p. 12, Dec. 31, 2003, found at *http://www.trin.net/invsrela/finance.html*, retrieved Dec. 17, 2004.
[79] "North American Car & Truck Production, 1954-2003," 2004 Ward's Automotive Yearbook.
[80] Elena Murphy, "Mixed automotive demand slows recovery," *Purchasing*, vol. 132 issue 2, p. 41, Feb. 6, 2003.

Producer Trends[81]

Production and inventories.—Responses to the Commission's questionnaire indicate that U.S. production of ductile iron bearing housings decreased significantly between 1999 and 2003; production was at its lowest level of the period in 2002, and then rose in 2003 (table 5-52). Production in 2003 was approximately 29 percent lower by quantity, than in 1999. Meanwhile, reported total inventory levels, by quantity, declined more than 35 percent between 1999 and 2003. One industry official indicates that production in the bearing industry, the main customer for bearing housings, has gradually declined in the past few years, but increased in late 2003. According to the industry official, the bearing industry lags behind growth trends experienced by its customers, and often will increase production only after its customers have nearly used up producer inventories, thus accounting for a production increase in 2003 after an economic upswing and a draw down in inventories during 2002.[82]

Table 5-52
Ductile iron bearing housing castings: Responding U.S. producers' production and inventories for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Production (short tons)	25,834	25,347	15,705	14,120	18,334
Inventory:					
Total (short tons)	1,390	([1])	([1])	440	898
Share of production (percent)	5	([1])	([1])	3	5

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. Inventory share of production based on establishments that were able to provide both inventory and production amounts.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Employment.—Employment indicators have followed a trend similar to that for bearing housing production, declining through 2002 before increasing in 2003. The average number of employees declined from 1999-2002 by approximately 34 percent to 372 workers (table 5-53). From 2002 to 2003, however, employment in the industry rose by 21 percent, coinciding with the increase in production. The number of hours worked by production and related workers decreased by 41 percent from 1999-2002, only to rise in 2003 to approximately 295,000 hours, an increase of 21 percent from 2002. Productivity levels declined by 21 percent during 1999-2002 before increasing by 7 percent to 62 short tons per 1,000 hours in 2003, largely reflecting production growth in that year. The reported average hourly wage rose by nearly $2.00 during 1999-2003, to $16.32 per hour. This increase in hourly wages was greater than that reported for the overall U.S. ductile iron foundry industry, which rose from $13.87 in 1999 to $15.34 in 2003.[83]

[81] Certain data have been withheld to avoid disclosure of business confidential information. These data include U.S. imports, U.S. exports, inventory, internal consumption, operating income, and equipment expenditures.
[82] U.S. industry official, telephone interview with USITC staff, Jan. 21, 2005.
[83] See table 5-10, Gray and ductile iron castings: Responding U.S. producers' employees and related information for their rough castings operations, 1999-2003, p. 5-12.

Table 5-53
Ductile iron bearing housing castings: Responding U.S. producers' employees and related information for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Average number of employees	470	419	348	308	372
Production and related workers:					
Number	389	343	280	244	296
Hours worked (*1,000 hours*)	412	379	276	244	295
Wages paid (*1,000 dollars*)	5,929	5,631	4,204	3,874	4,824
Average hourly wages (*dollars per hour*)	14.38	14.84	15.22	15.87	16.32
Productivity (*short tons per 1,000 hours*)	73	67	57	58	62

Note.–Figures may not add to totals because of rounding. Average hourly wages based on establishments that were able to provide both hours worked and wages paid. Productivity based on establishments that were able to provide both production quantity and hours worked.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Producers' shipments and exports.–Between 1999 and 2003, U.S. producers' total shipments of bearing housings decreased by more than 26 percent, to 17,649 short tons in 2003 (table 5-54). A significant decline in shipments occurred between 1999 and 2002; thereafter, commercial shipments increased by more than 65 percent (by quantity), largely reflecting improved market conditions in 2003 in downstream industries.

Table 5-54
Ductile iron bearing housing castings: Responding U.S. producers' domestic shipments and exports for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Domestic shipments:					
Commercial	19,330	18,576	9,950	10,151	16,762
Internal consumption and transfers	([1])	([1])	([1])	([1])	([1])
Exports	([1])	([1])	([1])	([1])	([1])
Total	23,923	23,728	14,427	13,925	17,649
	Value (*1,000 dollars*)				
Domestic shipments:					
Commercial	27,492	31,486	18,514	17,717	30,441
Internal consumption and transfers	([1])	([1])	([1])	([1])	([1])
Exports	([1])	([1])	([1])	([1])	([1])
Total	38,609	44,213	29,536	27,089	35,589

[1] Data withheld to avoid disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Financial condition.[84]–Despite reporting increased net sales value during 1999-2003, the ductile bearing housing industry reported an overall decrease in total net sales quantities. Net sales quantities declined slightly to 7,387 short tons in 2003 (table 5-55), with the largest relative decrease from 2000-2001

[84] No responding producers to the Commission's questionnaire reported machining operations for this product group.

Table 5-55
Ductile iron bearing housing castings: Responding U.S. producers' financial results for their rough casting operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Rough castings:					
Net sales:					
Commercial domestic and export sales	7,629	13,050	8,232	9,244	7,387
Internal consumption for production of machined castings	0	0	0	0	0
Other internal consumption or transfers to related firms	0	0	0	0	0
Total net sales quantities	7,629	13,050	8,232	9,244	7,387
	Value (*1,000 dollars*)				
Net sales:					
Commercial domestic and export sales	10,596	18,061	12,939	15,341	12,196
Internal consumption for production of machined castings	0	0	0	0	0
Other internal consumption or transfers to related firms	0	0	0	0	0
Total net sales values	10,596	18,061	12,939	15,341	12,196
Operating income	([1])	([1])	122	437	-2
	Ratio to net sales (*percent*)				
Operating income	([1])	([1])	1	3	([2])
	Number of establishments reporting:				
Operating losses	2	1	1	2	4
Financial results data	9	10	10	10	10

[1] Data withheld to avoid disclosure of confidential business information.
[2] Less than 0.5 percent.

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and operating income data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

(a decrease of nearly 37 percent).[85] Operating income reported by firms on their sales of ductile bearing housings declined irregularly over the period, and showed a loss in 2003. Forty percent of reporting firms operated at a loss in 2003, compared to the range of 10-22 percent in prior years in the period examined.

The declining financial results of producers of ductile iron bearing housings may be due in part to restructuring of operations by bearing manufacturers, their primary customers. For example, an article in the trade press noted efforts by bearing manufacturers such as Timken Industrial Group to restructure operations to increase profitability. In the article, Timken noted that many of its bearing customers (equipment manufacturers) have moved production overseas and that bearing manufacturers are unable to profitably gain new contracts.[86]

[85] The reported figures for the financial information in this product group differ from figures in production and shipments because many establishments were unable to report financial results.
[86] John Sacco, "Timkin revamping Ohio bearing unit to cut costs," American Metal Market, Sept. 4, 2003, found at *http://www.amm.com*, retrieved Jan. 20, 2005.

Investment.—Questionnaire respondents in this product category indicated no expenditures for research and development from 1999-2003. Several establishments reporting data for ductile iron bearing housings also indicated they manufactured other products, possibly resulting in no breakouts of research and development expenditures just for this product group. Further, producers reported a decline in investment for equipment of 22 percent from 1999-2003, after reaching a high in equipment expenditures in 2001(table 5-56).

Table 5-56
Ductile iron bearing housing castings: Responding U.S. producers' capital and R&D expenditures for their rough casting operations, fiscal years 1999-2003
(*1,000 dollars*)

Item	1999	2000	2001	2002	2003
Machinery, equipment, and fixtures	768	491	([1])	([1])	602
Research and development expenditures	0	0	0	0	0

[1] Data withheld to avoid disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Purchaser Trends[87]

Respondents' purchases of rough castings declined by 31 percent whereas purchases of machined castings increased by 35 percent during 1999-2003 (table 5-57). Despite decreases in purchases of U.S.-produced rough bearing housing castings, purchasers continued to source such products domestically, with foreign sources accounting for a small fraction of the market. However, U.S. purchasers increased purchases of machined bearing housing castings from foreign sources, whereas purchases of U.S. machined castings declined. Because limited purchasing data were provided by U.S. purchasers of these castings, specific country details cannot be published without revealing the operations of the firms that furnished the information. However, U.S. purchasers of ductile iron bearing housings indicated in the Commission's questionnaire that China and Brazil were the primary foreign sources from which they purchased rough and machined castings.

The decline in purchases of U.S.-produced rough castings may be attributable to an increase in imports of intermediate and finished goods incorporating bearing housings. Over the period, U.S. imports of downstream products increased by 59 percent to $438 million in 2004 (table 5-58).

[87] Certain data have been withheld to avoid disclosure of business confidential information. These data include purchases of rough castings and machined castings of U.S. and foreign producers by U.S. purchasers.

Table 5-57
Ductile iron bearing housing castings: Purchases of domestic and foreign castings by responding U.S. purchasers, 1999-2003

(***1,000 dollars***)

Year	Total
Rough castings:	
1999	19,397
2000	18,430
2001	13,850
2002	15,424
2003	13,375
Machined castings:	
1999	3,926
2000	4,668
2001	4,427
2002	5,384
2003	5,314

Note.–Domestic and foreign purchases not shown separately to avoid disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-58
Ductile iron bearing housings: U.S. imports for consumption of downstream products, by leading suppliers, 1999-2004

(***1,000 dollars***)

Country	1999	2000	2001	2002	2003	2004
Japan	65,275	79,617	73,219	80,579	81,933	107,026
Germany	33,518	30,360	30,944	36,944	43,583	55,529
Canada	21,350	25,728	26,826	29,226	36,500	44,790
Mexico	34,426	44,469	37,156	33,886	32,053	43,911
Brazil	20,706	22,840	20,595	25,457	26,549	34,552
United Kingdom	27,013	27,254	23,435	27,429	25,634	30,976
China	12,538	14,707	14,587	14,931	16,927	29,896
France	12,032	13,525	11,439	14,435	18,523	18,566
Taiwan	4,138	7,438	8,200	7,216	8,395	9,713
Austria	5,575	8,057	7,117	6,790	6,598	9,029
All other	39,677	42,787	37,419	42,948	41,352	54,438
Total	276,251	316,782	290,937	319,841	338,047	438,426

Note.–Downstream products include bearings and housed bearings (HTS classifications 8483.30.40 and 8483.30.80). Figures may not add to totals because of rounding.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Competitive Assessment of Price- and Product-related Factors

Price and non-price factors.–Responses to the Commission's producer questionnaire showed China, Brazil, and India to be the leading foreign sources of rough and machined castings. They also identified China, Brazil, and India as the leading competitors. U.S. producers identified China[88] as the primary foreign competitor, with an average rough castings price 36 percent lower (table 5-59) than comparable U.S. products. Further, China was identified by U.S. producers as the foreign competitor for machined castings with the lowest price, approximately 43 percent below prices for comparable U.S. products.

U.S. purchasers also identified China, Brazil, and India as the primary foreign competitors of U.S. producers. These three countries provided U.S. purchasers with rough castings priced from 20-34 percent lower than comparable U.S. products (table 5-60). For machined castings, one responding U.S. purchaser indicated that India was the primary competitor, with prices averaging 40 percent lower than comparable U.S. products. However, more respondents identified China as the primary competitor, with prices averaging 30 percent lower.

Responding U.S. purchasers identified China, Brazil, Taiwan, Finland, and Germany as likely sources from which to increase foreign purchases. By far, China was the country that was cited most frequently. With few exceptions (price, availability, and lead time), China was perceived by the majority of respondents as having improved in nearly all competitive factors. In particular, all respondents noted improvements in delivery times and declines in transportation costs.

Table 5-59
Ductile iron bearing housing castings: Price comparison by responding U.S. producers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Australia	Lower	1	15
Brazil	Lower	4	35
China	Lower	7	36
France	Lower	1	10
India	Lower	4	31
Korea	Lower	1	20
Mexico	Lower	1	50
South America	Lower	1	35
Turkey	Lower	1	40
Machined castings:			
Brazil	Lower	3	28
China	Lower	3	43
France	Lower	1	30
Germany	Lower	1	20
India	Lower	3	35
Korea	Lower	1	20
Mexico	Lower	3	27

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[88] More respondents indicated that China was the leading country with the largest average price difference than Mexico or Turkey.

Table 5-60
Ductile iron bearing housing castings: Price comparison by responding U.S. purchasers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Brazil	Lower	1	34
China	Lower	3	32
India	Lower	1	20
Machined castings:			
Brazil	About the same	1	([1])
China	Lower	7	30
EU-15	Lower	1	20
EU-15	About the same	1	([1])
India	Lower	1	40
Japan	Higher	1	10
Mexico	Lower	1	20
Taiwan	Lower	4	19

[1]Not applicable.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

***Producers' response to import competition*.–**Responses to the Commission's questionnaire showed that leading actions taken by U.S. producers to deal with import competition included lowering prices or suppressing price increases, implementing cost-reduction efforts, and improving product quality (table 5-61). For example, one firm stated that it looked further into methods to obtain higher mold quality. Another firm indicated that it did not increase prices during 2001-2003. Several producers stated that they took fewer or no actions due in part to a lack of funds or because they had already shifted production toward more advanced types of castings.

Table 5-61
Ductile iron bearing housing castings: Responding U.S. producers' responses to import competition

Nature of response	Number of responses
Total number of establishments responding	15
Took no or few actions because:	
Had already shifted production to more advanced types of castings	2
Had already shifted production to other lines of castings	1
Lacked capital funds to counter foreign competition	2
Other	2
Took the following actions:	
Lowered prices or suppressed price increases	11
Reduced or dropped plans to expand capacity	8
Cut back or eliminated production	8
Closed production lines	3
Shifted to other cast products	4
Implemented cost-reduction efforts	11
Improved product quality	10
Other	1

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Gray Iron Compressor Housing Castings[89]

Industry Profile

***Industry structure.*—**Based on responses to the Commission's producer questionnaire, 37 companies reported production of gray iron compressor housings. The majority of respondents identified themselves as job shops, with four identifying their companies as captive foundries. Further, responses indicate the expended type of the sand casting method as the most often used production method.

Collectively, the top five reporting companies accounted for a large portion of U.S. production. The majority of the respondents are located in the midwestern and eastern sections of the United States, primarily in Indiana, Pennsylvania, and Wisconsin. This provides access to manufacturing facilities of several large corporations that use compressor housings in their products on the East Coast. For example, Whirlpool, one of the world's leading manufacturers of home appliances, has all of its U.S. manufacturing facilities located in the eastern part of the United States.[90] A number of corporations have either captive foundries or subsidiaries dedicated to producing compressors and compressor parts such as housings, which ultimately are placed into their products.

Product Description and Uses

The primary function of a compressor is to aid the movement and compression of fluid, gas or vapors between internal portions of a machine. Compressor housings are generally made out of gray iron, and are an integral part of a compressor. The use of metals such as gray iron provide benefits such as the dampening or controlling of vibration, increasing the machinability of the casting, dimensional stability and/or high strength to weight ratios. The size of a compressor housing can vary, depending on the final product, whether it is a supermarket refrigerator, a commercial air-conditioning unit, or a pneumatic tool. Compressor housings are found in various types of items, ranging from refrigeration products and air conditioners to turbochargers used in vehicles.

While the purpose of the compressor varies depending on the product, the compressor housing's purpose remains the same, to house and aid the function of the compressor. In refrigerators and air conditioners, the compressor works by moving liquid refrigerant around in a pipe. In the air conditioner of an automobile, the compressor housing is assembled with seals that assist in controlling leakage of the refrigerant from the compressor. In the case of turbochargers, the function of the compressor housing is to convert the speed-energy of air coming from a compressor turbine into pressure-energy that can be used by the engine. The compressor housing "contains the impeller wheel used to compress the flow of air into the manifold." The size of the housing determines the volume of air that can flow through.

***Demand characteristics.*—**The primary downstream market for compressor housings is the refrigeration, air conditioning, and heating industry (table 5-62).[91] Responses to the Commission's

---

[89] Aluminum is another type of metal often used to cast compressor housings. The description and uses for this section were largely gathered from the following sources: "Gray Iron Casting FAQs,"Atlas Foundry Company, found at *http://www.atlasfdry.com/grayironfaqs.htm*, retrieved Dec. 17, 2004; "AC Compressor Function," *Autoswalks*, found at *http://www.autoswalk.com/accomfun.html*, retrieved Aug. 13, 2004; "Mobile Air Conditioning System Technology Assessment," California Air Resources Board, Apr. 2004, found at *http://www.arb.ca.gov/cc/042004workshop/appendix-c-1.pdf*, retrieved Aug. 13, 2004; "What is a Turbo charger?," TurboNation, found at *http://www.turbonation.com/turbo.htm*, retrieved Aug. 13, 2004; "Powerstroke Turbine," Free Auto Advice, found at *http://www.freeautoadvice.com/diesel/psdturbo.html*, retrieved Dec. 15, 2004; and "Wide World of Turbo," Super Street, found at *http://www.superstreetonline.com/techarticles/36542/index.html*, retrieved Sept. 16, 2004.

[90] "Facility Finder," Whirlpool, found at *http://www.whirlpoolcorp.com/about/facilityfinder/region_detail.asp?region=na*, retrieved Jan. 19, 2005.

[91] From 2002-2003, consumer disposable income drove demand for the household goods that contain most gray iron compressor housings. Standard and Poors indicates that "lower mortgage rates supported housing demand and left consumers with cash to spend on furnishing or decorating their homes. In addition, lower interest rates made the (continued...)

questionnaire indicate that the vast majority of rough castings are sold directly to the OEM (table 5-63). According to the Association of Home Appliance Manufacturers, U.S. shipments of refrigerators increased 2.8 percent from 2002 to 2003 and room air conditioners increased 33.5 percent during the same time period.[92] Despite increasing demand for downstream products that incorporate compressor housings, U.S. production of compressor housings declined each year between 1999 and 2003. This can be attributed at least in part to the decline of U.S. production of air conditioners and other products that incorporate compressor housings.[93]

Table 5-62
Gray iron compressor housing castings: End market for responding U.S. producers' shipments, 2003
(*Percent*)

End market	Share of 2003 shipments of castings by quantity
Motor vehicles:	
Trucks	2
Refrigeration, air conditioning, and heating equipment	91
Industrial machinery	1
Pumps and compressors	6
Other/unknown	1
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Producer Trends[94]

Production and inventories.—Despite steady increases in sales by many major end-use markets for compressor housings during the period, U.S. production of gray iron compressor housings decreased by approximately 26 percent to 116,051 short tons in 2003 (table 5-64). This can be partially attributed to the increasing trend of end-use manufacturers moving production overseas. For example, between 2001 to 2004, many large corporations such as Matsushita, GE, Whirlpool, and Electrolux closed U.S. production facilities for products that consume compressor housings.

[91] (...continued)
financing of consumer durables purchases more affordable." Standard and Poor's Industry Surveys, "Household Durables," May 6, 2004, found at *http://www.netadvantage.standardandpoors.com/*, retrieved Oct. 13, 2004.

[92] Standard and Poor's Industry Surveys, "Household Durables," May 6, 2004., found at *http://www.netadvantage.standardandpoors.com/*, retrieved Oct. 13, 2004. The figures from the table are from the Association of Home Appliance Manufacturers, found at *http://www.aham.org*. Please note that this number includes all shipments to the U.S. market, imported or domestically produced, and excludes export shipments.

[93] Based on responses to the Commission's questionnaire, the refrigeration industry is the largest end market for gray iron compressor housings. A number of major downstream product manufacturers such as Electrolux and Matsushita have closed U.S. production in the past years.

[94] Certain data have been withheld to avoid disclosure of business confidential information. These data include U.S. imports, U.S. exports, internal consumption, and commercial domestic and export sales.

Table 5-63
Gray iron compressor housing castings: Responding U.S. producers' shipments, by channel of distribution, 2003
(*Percent*)

Channel of distribution	Share of 2003 shipments of castings by quantity
Rough castings:	
In-house machining	([1])
Machining subcontractor	10
Machine shop/other fabricators	6
Original equipment manufacturers	84
Total	100

[1]Less than 0.5 percent.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-64
Gray iron compressor housing castings: Responding U.S. producers' production and inventories for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Production (short tons)	156,860	153,196	144,454	116,178	116,051
Inventory:					
Total (short tons)	([1])	([1])	([1])	([1])	([1])
Share of production (percent)	([1])	([1])	([1])	([1])	([1])

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. Inventory share of production based on establishments that were able to provide both inventory and production amounts.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

A number of multinational manufacturers of compressors or end products using compressors either closed down production in the United States, decreased production, or are planning to reduce production. At least one industry official attributes this to severe competition in the end market for compressors, which in turn has affected component producers.[95] In 2001, Matsushita Electric Industrial Company closed its air conditioner compressor factory in North Carolina, citing declining production in the United States by U.S. home air conditioner manufacturers.[96] Additionally, Matsushita closed its refrigerator compressor company in the United States in 2002, citing "intensified price competition in the U.S. refrigerator compressor market."[97] Further, Matsushita indicated that it restructured its refrigerator compressor production operations in light of its global operations, and shifted production from the United States to many facilities in Asia.[98] Others, such as Whirlpool and Electrolux, expanded operations in Mexico by relocating some or all of their

[95] U.S. industry official, telephone interview with USITC staff, Feb. 11, 2005.
[96] "Matsushita Discontinues Operations At Its U.S. Air Conditioner Compressor Factory," Panasonic Press Releases, Jan. 13, 2001, found at *http://ir-site.panasonic.com/relevant/en010113-1/en010113-1.html*, retrieved Jan. 18, 2005.
[97] "Matsushita Closes Refrigerator Compressor Company in the U.S.," Panasonic Press Releases, Jan. 30, 2002, found at *http://ir-site.panasonic.com/relevant/en020130-2/en020130-2-1.pdf*, retrieved Jan. 18, 2005.
[98] Ibid.

production of appliances.[99] Electrolux, a Swedish appliance maker, plans to discontinue production of refrigerators at its Michigan facility in 2005.[100] GE announced job cuts in 2004 at its U.S. refrigerator plant in Indiana, citing competitiveness issues.[101] Additionally, one U.S. producer indicated that foreign competitors of the compressor end markets are gaining market share, impacting the volume of compressors produced in the United States.[102] According to an industry trade publication, China supplies "two-thirds of the world's air-conditioners and 47 percent of its compressors."[103]

Employment.**—**Employment reported by producers of gray iron compressor housing castings showed a 17-percent decrease in the average number of employees between 1999 and 2003, with wages paid declining around 13 percent (table 5-65). The average number of employees fell each year between 1999 and 2002, and then increased slightly in 2003. A few establishments that reported increases in production from 2002-2003 hired additional workers that year. Generally, productivity levels fluctuated during the period, mostly due to overall decreasing production levels, but were 9 percent lower in 2003 than in 1999.

The increase from 2002-2003 in the number of employees was reflected in an increase in the number of hours worked and wages paid to employees during the year. Average hourly wages reported rose from $13.65 per hour in 1999 to $14.64 per hour in 2003. These wage levels were lower than those reported for the overall U.S. gray iron foundry industry, which ranged from $16.42 per hour in 1999 to $18.08 per hour in 2003.[104]

Producers' shipments and exports.**—**During 1999-2003, U.S. producers' reported total shipments of compressor housings, as measured in quantity, decreased each year and were 26 percent lower in 2003 than in 1999 (table 5-66). Meanwhile, U.S. exports fluctuated from 1999 to 2003, with a total overall

Table 5-65
Gray iron compressor housing castings: Responding U.S. producers' employees and related information for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Average number of employees	1,956	1,923	1,834	1,575	1,623
Production and related workers:					
Number	1,376	1,348	1,272	1,044	1,089
Hours worked (*1,000 hours*)	2,915	2,875	2,522	2,142	2,363
Wages paid (*1,000 dollars*)	39,796	40,898	37,440	32,581	34,600
Average hourly wages (*dollars per hour*)	13.65	14.23	14.85	15.21	14.64
Productivity (*short tons per 1,000 hours*)	54	53	57	54	49

Note.–Figures may not add to totals because of rounding. Average hourly wages based on establishments that were able to provide both hours worked and wages paid. Productivity based on establishments that were able to provide both production quantity and hours worked.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[99] Jack Lyne, "Whirlpool Eyeing Mexico after $100M Investment in U.S. Manufacturing," Conway Data Inc., Dec. 1, 2003, found at *http://www.conway.com/ssinsider/pwatch/pw-031201.htm*, retrieved Jan. 18, 2005.
[100] "Electrolux Closing U.S. Refrigerator Factory," *Appliance Magazine*, found at *http://www.appliancemagazine.com/news.php?article=5813&zone=0&first=1*, retrieved Jan. 18, 2005.
[101] "GE Announces Job Cuts at U.S. Refrigerator Plant," *Appliance Magazine*, found at *http://www.appliancemagazine.com/latin/news.php?article=7202&zone=32&first=1*, retrieved Jan. 18, 2005.
[102] U.S. industry official, telephone interview with USITC staff, Feb. 11, 2005.
[103] "Suppliers stifle air-conditioner firms Industry turns to India as compressor producers fall behind," Global Manufacture.net, Nov. 2, 2004, found at *http://www.globalmanufacture.net/home/communities/production/compresor.cfm*, retrieved Jan. 17, 2005.
[104] See table 5-10, Gray and ductile iron castings: Responding U.S. producers' employees and related information for their rough castings operations, 1999-2003, p. 5-12.

Table 5-66
Gray iron compressor housing castings: Responding U.S. producers' domestic shipments and exports for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Domestic shipments:					
Commercial	154,152	150,818	135,881	117,289	113,375
Internal consumption and transfers	([1])	([1])	([1])	([1])	([1])
Exports	([1])	([1])	([1])	([1])	([1])
Total	154,705	151,786	137,001	118,192	113,852
	Value (*1,000 dollars*)				
Domestic shipments:					
Commercial	150,494	151,054	135,875	117,978	116,847
Internal consumption and transfers	([1])	([1])	([1])	([1])	([1])
Exports	([1])	([1])	([1])	([1])	([1])
Total	151,048	152,188	137,244	119,004	117,416

[1] Data withheld to avoid disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

decrease of 8 percent by volume in the 5-year period. However, U.S. exports were small relative to production throughout the period. Responses to the Commission's questionnaire also show that exports of gray iron compressor housings account for a small share of shipments, with the majority of shipments destined for the U.S. commercial market.

Financial condition.[105]**—**U.S. producers of rough compressor housing castings reported steady declines in net sales quantities, net sales values, and operating income during 1999-2003. Total net sales quantities decreased each year during the period and were 26 percent lower in 2003 than in 1999. Total net sales values declined in all but one year, and fell by 22 percent between 1999 and 2003 (table 5-67). Operating income reported by responding firms has decreased each year since 2000, from $9.1 million in 1999 and $9.7 million in 2000 to $152,000 in 2003. The number of establishments reporting operating losses rose throughout the period. The declining profitability and sales of the industry during the period is reflected by a 98 percent decline in operating income. At the end of the reporting period almost one-half of the companies had operating losses.

Investment.**—**Questionnaire responses for this product category showed a decline in investment in machinery and equipment in each year of the period, for a decline of 79 percent between 1999 and 2003. Respondents reported little or no research and development expenditures (table 5-68).

[105] No responding producers to the Commission's producer questionnaire reported machining operations for this product group.

Table 5-67
Gray iron compressor housing castings: Responding U.S. producers' financial results for their rough casting operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Rough castings:					
Net sales:					
Commercial domestic and export sales	([1])	([1])	([1])	([1])	([1])
Internal consumption for production of machined castings	0	0	0	0	0
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales quantities	154,240	151,225	136,875	118,408	113,405
	Value (*1,000 dollars*)				
Net sales:					
Commercial domestic and export sales	([1])	([1])	([1])	([1])	([1])
Internal consumption for production of machined castings	0	0	0	0	0
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales values	150,746	151,590	137,348	119,167	117,636
Operating income	9,101	9,699	3,798	419	152
	Ratio to net sales (*percent*)				
Operating income	6	6	3	([2])	([2])
	Number of establishments reporting:				
Operating losses	5	5	9	12	12
Financial results data	25	26	26	26	25

[1] Data withheld to avoid disclosure of confidential business information.
[2] Less than 0.5 percent.

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and operating income data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-68
Gray iron compressor housing castings: Responding U.S. producers' capital and R&D expenditures for their rough casting operations, fiscal years 1999-2003
(*1,000 dollars*)

Item	1999	2000	2001	2002	2003
Machinery, equipment, and fixtures	5,479	4,124	3,421	2,597	1,132
Research and development expenditures	0	0	0	([1])	0

[1] Data withheld to avoid disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Purchaser Trends[106]

U.S. purchasers indicated that Taiwan was the leading source of imports of rough gray iron compressor castings whereas China was identified as the leading source of machined compressor housing purchases throughout 1999-2003. Taiwan is home to large consumers of compressor housings, with manufacturers such as TCL-Rechi Refrigeration Equipment Company. TCL-Rechi is also Taiwan's largest manufacturer of refrigeration compressors, and along with its parent company TCL, is one of China's top-five manufacturers of air conditioners. TCL-Rechi plans on adding a compressor production line in Taiwan which would increase annual output of compressors in 2005, thus becoming one of the world's top-three manufacturers of the product with around 10 million units.[107]

In response to the Commission's questionnaire, U.S. purchasers indicated that they purchased machined compressor housings from both U.S. producers and foreign producers. U.S. purchasers opted to import significant quantities of machined castings, whereas a majority of rough castings purchases were produced domestically. Overall, U.S. purchasers responding to the Commission's questionnaire decreased total purchases of rough castings by almost 26 percent and increased purchases of machined castings by 492 percent during 1999-2003 (table 5-69).

U.S.-produced rough compressor housing castings accounted for the majority of such purchases, with foreign-produced castings gaining ground, particularly after 2000. In regards to machined castings, foreign-produced castings continually increased from 1999-2003, eventually accounting for a large share of total machined castings purchases.

Table 5-69
Gray iron compressor housing castings: Purchases of domestic and foreign castings by responding U.S. purchasers, 1999-2003

(***1,000 dollars***)

Year	Total
Rough castings:	
1999	74,817
2000	64,954
2001	57,934
2002	58,615
2003	55,539
Machined castings:	
1999	2,465
2000	6,273
2001	7,778
2002	9,541
2003	14,592

Note.–Domestic and foreign purchases not shown separately to prevent disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[106] Certain data have been withheld to avoid disclosure of business confidential information. These data include purchases of rough castings and machined castings of U.S. and foreign producers by U.S. purchasers.

[107] " TCL-Rechi fully loaded with orders for compressors to be filled in 2005," Manufacturing.net, Dec. 24, 2004, found at *http://www.manufacturing.net/article/NEa1222460.4iw.html?vertical=News&verticalid=486&industry=Top+Stories&industryid=1922*, retrieved Jan. 18, 2005.

Over the past few years, an increasing number of manufacturers have increased production of compressors and components overseas, then shipped fully assembled components back into the United States.[108] U.S. imports of downstream products increased by 120 percent from 1999-2004 (table 5-70), as imports from Japan, Mexico, China, and Canada increased significantly. The greatest increase in imports were compressors for refrigerating equipment, various types of air compressors, and parts.

Table 5-70
Gray iron compressor housings: U.S. imports for consumption of downstream products, by leading suppliers, 1999-2004

(*1,000 dollars*)

Country	1999	2000	2001	2002	2003	2004
Japan	241,262	325,160	316,206	546,327	658,545	708,349
Mexico	226,414	267,806	271,233	433,697	502,395	607,089
Brazil	217,435	220,265	211,203	291,157	286,195	298,679
China	48,135	64,022	59,722	97,860	143,561	221,841
Canada	16,506	35,724	52,770	145,528	123,059	172,651
Germany	85,286	86,025	79,155	91,884	102,133	133,127
United Kingdom	67,648	40,792	33,057	69,533	92,238	105,892
Korea	131,279	141,046	130,313	99,510	108,479	85,963
Belgium	67,481	94,856	76,068	60,067	63,271	71,841
Singapore	15,848	24,214	18,603	68,001	53,477	65,855
All other	215,397	236,380	262,484	330,158	357,818	466,248
Total	1,332,691	1,536,290	1,510,814	2,233,722	2,491,171	2,937,535

Note.–Downstream products include compressors (HTS classifications 8414.30.40, 8414.30.80, 8414.40.00, 8414.80.05, 8414.80.15, 8414.80.16, and 8414.80.20). Figures may not add to totals because of rounding.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Competitive Assessment of Price- and Product-related Factors

Price and non-price factors.—Responding U.S. producers indicated that China, Brazil, and India provided lower prices for rough and machined castings of compressor housings. On average, U.S. producers reported that rough castings from China were priced 35 percent lower than similar castings from U.S. sources, those from Brazil were priced 26 percent lower, and those from India were priced 25 percent lower (table 5-71).

U.S. purchasers reported similar price differences between U.S. and foreign machined castings. U.S. purchasers indicated that machined castings from China were priced 38 percent lower than similar castings from U.S. sources, those from India were priced 31 percent lower, and those from Taiwan were priced 25 percent lower (table 5-72). One respondent indicated that the average price difference for a comparable product from Korea was approximately 40 percent, while another respondent stated that castings from Eastern Europe were priced 40 percent lower than a similar casting from U.S. sources.

[108] U.S. industry official, telephone interview with USITC staff, Feb. 11, 2005.

Table 5-71
Gray iron compressor housing castings: Price comparison by responding U.S. producers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Brazil	Lower	8	26
China	Lower	14	35
India	Lower	6	25
Korea	Lower	1	25
Mexico	Lower	4	13
South America	Lower	1	35
Taiwan	Lower	1	32
Machined castings:			
Brazil	Lower	5	29
China	Lower	11	35
France	Lower	1	30
Germany	Lower	1	20
India	Lower	5	32
Korea	Lower	2	23
Mexico	Lower	4	19
Singapore	About the same	2	([1])
Taiwan	About the same	1	([1])

[1]Not applicable.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-72
Gray iron compressor housing castings: Price comparison by responding U.S. purchasers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Brazil	Lower	1	25
China	Lower	1	20
China	Higher	1	10
EU-15	Higher	1	5
Mexico	Lower	3	20
Machined castings:			
Brazil	Lower	1	20
China	Lower	6	38
Eastern Europe[1]	Lower	1	40
India	Lower	4	31
Korea	Lower	1	40
Mexico	Lower	1	25
Taiwan	Lower	2	25

[1] Includes Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Poland, Romania, Slovakia, Slovenia, and Yugoslavia (Serbia and Montenegro).

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

However, U.S. purchasers' responses regarding price comparisons of U.S.- and foreign-produced rough compressor housing castings were somewhat different than producers' responses. U.S. purchasers reported that rough castings from Mexico were priced approximately 20 percent lower than those from comparable U.S. sources. Respondents differed regarding China's pricing. One purchaser indicated that Brazil's prices for rough castings are 25 percent lower than those of U.S. producers, which is similar to estimates provided by U.S. producers.

U.S. purchasers that provided responses to the Commission's questionnaire cited China, India, France, Taiwan, and Mexico as sources from which they increased foreign purchases. With the exception of U.S. delivered price, most U.S. purchasers indicated that improvements in all competitive factors influenced their decisions to increase purchases from these foreign countries.

Producers' response to import competition.–A majority of firms reported that they responded to import competition by reducing prices or suppressing price increases of their castings (table 5-73). Firms did this in several ways. One firm stated that it paid for the tooling costs while another firm said that it absorbed the price increases. Other establishments said they shifted production to more types of castings. Many firms said that they improved product quality, or implemented cost-reduction efforts. Others changed their product mix or reduced or eliminated production entirely. The industry's decline in sales and production is reflected in a high number of firms that said they took little or no action to respond to import competition because of insufficient capital.

Table 5-73
Gray iron compressor housing castings: Responding U.S. producers' responses to import competition

Nature of response	Number of responses
Total number of establishments responding	30
Took no or few actions because:	
Had already shifted production to more advanced types of castings	2
Had already shifted production to other lines of castings	3
Lacked capital funds to counter foreign competition	7
Other	2
Took the following actions:	
Lowered prices or suppressed price increases	22
Reduced or dropped plans to expand capacity	8
Cut back or eliminated production	17
Closed production lines	8
Shifted to other cast products	17
Implemented cost-reduction efforts	21
Improved product quality	15
Imported product instead	1
Opened a plant in a foreign country	1
Other	3

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Gray Iron Pump Castings

Industry Profile

Product Description and Uses

A pump is a device used to raise or transfer fluids, typically at a constant flowrate or at constant pressure. The two main categories of pumps are *positive displacement pumps* and *dynamic pumps*. A *positive displacement pump* has an expanding cavity, or area, on the suction side and a decreasing cavity on the discharge side. Liquid flows into the pump as the cavity on the suction side expands and the liquid flows from the pump on the discharge side as the cavity decreases. A positive displacement pump will produce the same flow at a given speed, regardless of discharge pressure. A dynamic pump operates by developing a high liquid velocity and converting the velocity to pressure in a diffusing flow passage. The most popular type of dynamic pump is a centrifugal pump which consists of an impeller and an intake at its center. When the impeller rotates, liquid is discharged by centrifugal force into a casing surrounding the impeller. A dynamic pump will produce varying flowrates at a given speed. The centrifugal pump accounts for at least 80 percent of the world's pump production because its is more suitable than positive-displacement pumps for handling large capacities of liquid. Principal pump components using gray iron castings may include the pump casing, cover, impeller, bearing housing, seal plate, flanges, and volute castings.

***Industry structure*.—**A total of 33 firms responded indicating that they produced gray iron pump castings. Most foundries producing castings for the pump industry are presently located in the Midwest United States, where most foundries were located originally to take advantage of proximity to raw materials such as lake sands and proximity to industrial customers.[109] Newer foundries have been established in regions of the country that offer inexpensive access to supplies of electrical energy and in states that offer savings in the form of tax incentives.[110] According to industry contacts, foundries producing pump castings for industrial uses tend to specialize in a narrow range of products serving a limited number of end-users because such foundries are limited in the type of castings they produce by the type of molding equipment that the foundry possesses.[111] Other foundries that produce for the residential sump pump market tend to produce multiple cast components that make up the pump because it is more economical for the customer to have all pump items produced, and possibly assembled, in the same location rather than dispersed among multiple locations and assembled in a single location.[112]

***Demand characteristics*.—-**U.S. demand for gray iron castings for use in pumps is dependent on demand for pumps by both the industrial and residential U.S. markets. Demand for pump castings for the industrial market is highly dependent on the construction, agricultural mining, petrochemical, and municipal markets. Another important demand factor for pumps are natural disasters such as hurricanes and floods which create a demand for pumps to evacuate standing water. The substitution of alternative materials, such as plastics and ceramics, is more common in the market for residential pump casting components, where price competitive factors are more likely to dictate the use of materials used in the pump.[113]

The leading outlet for rough gray iron castings in 2003 was OEMs who machined 62 percent of these rough castings shipped by U.S. foundries (table 5-74). Nearly 27 percent of the subject rough castings shipped were machined by other machine shops or subcontractors whereas 10 percent were machined in-house in 2003. Nearly 94 percent of machined gray iron pump castings were sold directly to OEMs in 2003. Foundries producing gray iron castings for the pump market are increasingly being asked by customers to

[109] U.S. industry officials, telephone interviews with USITC staff, Jan. 27-Feb. 8, 2005.
[110] Ibid.
[111] Ibid.
[112] Ibid.
[113] Ibid.

Table 5-74
Gray iron pump castings: Responding U.S. producers' shipments, by channel of distribution, 2003
(*Percent*)

Channel of distribution	Share of 2003 shipments of castings by quantity
Rough castings:	
In-house machining	10
Machining subcontractor	5
Machine shop/other fabricators	22
Distributors	1
Original equipment manufacturers	62
Other	1
Total	100
Machined castings:	
Distributors	6
Original equipment manufacturers	94
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

machine the rough castings they produce and even to do some final assembly of the final product. Customers increasingly find it more economical to have the casting, machining, and some assembly done at a single location rather than being dispersed among multiple locations.

The major end-use market for gray iron pump castings in 2003 was manufacturers of pumps and compressors, which accounted for 54 percent of all such shipments by these foundries, followed by manufacturers of construction machinery and equipment (14 percent) and manufacturers of farm and garden machinery and equipment (9 percent) (table 5-75). A number of respondents have indicated efforts to broaden their product mix by selling to a wider range of end-users to avoid dependance on a single end-use industry.

Within the broad market for pump castings, it appears that two separate markets have emerged. Commodity-type castings are simpler in design, are less highly engineered, tend to be more labor-intensive to produce, and are less subject to delivery schedules that place a premium on timely delivery of the product. As a result, commodity-type castings tend to be more vulnerable to imports from low-wage countries with abundant supplies of less-expensive labor and sufficient engineering skills to produce simple castings. For such castings, price is the principal competitive factor. According to industry responses, an estimated 90 percent of gray iron pump castings tend to be commodity-type castings.[114]

[114] U.S. industry official, telephone interview with USITC staff, Feb. 8, 2005.

Table 5-75
Gray iron pump castings: End market for responding U.S. producers' shipments, 2003
(*Percent*)

End market	Share of 2003 shipments of castings by quantity
Motor vehicles:	
Automobiles (including light duty trucks, SUVs, vans, etc.)	5
Trucks	2
Farm and garden machinery and equipment	9
Mining and oil/gas field machinery and equipment	4
Construction machinery and equipment	14
Refrigeration, air conditioning, and heating equipment	1
Plumbing	3
Industrial machinery	3
Valve and pipe fittings	2
Pumps and compressors	54
Other/unknown	4
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

More specialized pump castings tend to be sourced domestically because these castings require a higher value-added technical and engineering component.[115] Specialized castings contain more intricate cores, are more detailed in their shape and size, are produced to closer tolerances, and require tighter material specifications. In specialized applications, liability considerations alone often preclude the use of cheaper castings.[116] In addition, many specialized castings are made using proprietary designs supplied by the customer. Many of these customers are reluctant to share these designs with foreign foundries who may, in turn, sell the design to a third party.[117] Specialized castings often serve markets operating with tighter delivery schedules, and imported castings, according to purchasers, generally have more difficulty reaching customers on time.[118] The greater need for product feedback between the customer and the foundry while the part is being cast also limits the amount of imported specialized castings in the U.S. market.[119] Larger pump castings are typically not sourced from overseas because of their complex design and because it is often not cost-efficient to ship these items over long distances.

Producer Trends

Production and inventories.—U.S. production of rough gray iron pump castings by responding foundries declined 11 percent during 1999-2003 (table 5-76) because of a combination of factors. The pump industry was affected by the worldwide economic downturn and subsequent declining demand by a number of the major end-users of pumps beginning in 2001. Sectors of the U.S. market for pumps particularly affected were the construction, chemical, machine tool, and machinery markets. A number of questionnaire

[115] Specialized castings include larger castings for use in municipal applications and certain high-pressure castings for the petrochemical industry.
[116] U.S. industry official, telephone interview with USITC staff, Feb. 8, 2005.
[117] U.S. industry officials, telephone interviews with USITC staff, Feb. 15, 2005.
[118] U.S. industry officials, telephone interviews with USITC staff, Feb. 8, 2005.
[119] U.S. industry officials, telephone interviews with USITC staff, Feb. 15, 2005.

Table 5-76
Gray iron pump castings: Responding U.S. producers' production and inventories for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Production (short tons)	65,816	76,717	64,058	60,062	58,751
Inventory:					
Total (short tons)	1,617	1,753	1,532	1,601	1,823
Share of production (percent)	2	2	2	3	3

Note.–Figures may not add to totals because of rounding. Inventory share of production based on establishments that were able to provide both inventory and production amounts.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

respondents have indicated that the decline in demand by end-users bottomed out in 2003 and that producers have begun to experience rising demand and production since then.[120]

Other factors reported as adversely affecting production during 2001-2003 include the role of both imported castings and imported pumps. A number of pump castings formerly sourced from U.S. companies are now being replaced by less-expensive "commodity" castings from foreign sources.[121] Production of pump castings has also been adversely affected by U.S. pump customers' movement of their production facilities from U.S. to foreign locations, and the subsequent replacement of their U.S. casting suppliers with foreign suppliers.[122] These foreign produced pumps are then either sold to foreign customers or are exported to the U.S. market. U.S. production appears to have also been negatively affected by imports of less-expensive foreign pumps. A number of questionnaire respondents have alleged that the price of certain assembled foreign pumps sold in the U.S. market is less than the cost of the pump castings produced in the United States.[123] In addition, producers of gray iron castings for use in many consumer-oriented pumps cite increased substitution of plastic components for gray cast iron components as a reason for their decreased production.

Employment.—The average number of production and related workers for responding rough gray iron pump castings foundries declined 24 percent during 1999-2003 (table 5-77), reflecting declining production of castings beginning in 2001 and efforts to increase productivity of foundry operations. Total number of hours worked declined 23 percent and total wages paid declined 13 percent. Average hourly wages for the industry rose to $13.92/hour in 2003 from $12.38/hour in 1999. Productivity in the industry rose from 27 short tons per 1,000 hours in 1999 to 30 short tons per 1,000 hours in 2003. Productivity increased as foundries sought to increase the automation of their facilities, particularly in material handling and finishing operations where the labor content is high, through the use of robotic technology. In addition, questionnaire respondents have indicated that productivity has been improved through product redesign to permit reduced labor content of certain castings.[124]

[120] U.S. industry officials, telephone interviews with USITC staff, Jan. 27-Feb. 8, 2005.
[121] U.S. industry officials, telephone interviews with USITC staff, Jan. 27-Feb. 8, 2005.
[122] According to producer questionnaire respondents, between 1999-2003 four U.S. customers moved pump production facilities from the United States to China and India, representing a loss in sales of domestically-produced castings to these pump producers.
[123] U.S. industry officials, telephone interviews with USITC staff, Jan. 27-Feb. 8, 2005.
[124] Ibid.

Table 5-77
Gray iron pump castings: Responding U.S. producers' employees and related information for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Average number of employees	1,945	1,962	1,807	1,661	1,556
Production and related workers:					
Number	1,396	1,409	1,284	1,154	1,067
Hours worked (*1,000 hours*)	2,531	2,702	2,262	2,079	1,953
Wages paid (*1,000 dollars*)	31,329	34,682	29,368	28,180	27,183
Average hourly wages (*dollars per hour*)	12.38	12.84	12.98	13.55	13.92
Productivity (*short tons per 1,000 hours*)	27	28	28	29	30

Note.–Figures may not add to totals because of rounding. Average hourly wages based on establishments that were able to provide both hours worked and wages paid. Productivity based on establishments that were able to provide both production quantity and hours worked.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Producers' shipments and exports.—Total U.S. producers' commercial shipments (by quantity) by responding foundries producing rough gray iron pump castings declined 12 percent during 1999-2003 (table 5-78) because of declining demand for both cast iron pumps and pump castings beginning in 2001 and increased substitution of imported pumps and pump castings for domestically produced products. U.S. exports of the subject rough castings were small (3 percent or less of total U.S. shipments) throughout the period.

Table 5-78
Gray iron pump castings: Responding U.S. producers' domestic shipments and exports for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Domestic shipments:					
Commercial	61,767	71,107	59,609	56,314	54,424
Internal consumption and transfers	4,005	4,031	3,480	2,700	([1])
Exports	960	1,471	1,254	1,015	([1])
Total	66,732	76,609	64,343	60,029	58,507
	Value (*1,000 dollars*)				
Domestic shipments:					
Commercial	86,991	95,826	79,294	72,300	72,633
Internal consumption and transfers	6,868	10,794	8,751	([1])	([1])
Exports	1,330	2,149	1,936	([1])	([1])
Total	95,189	108,769	89,981	82,381	83,409

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Some responding foundries indicate that U.S. production dedicated for the export market during 1999-2003 was adversely affected by the weakness in Asian agricultural and construction markets during this period. These Asian markets suffered lingering effects of the Asian currency crises of 1997 which negatively affected the ability of these nations to import pumps from the United States.

***Financial condition*.–**The financial results of responding gray iron pump castings foundries deteriorated during 1999-2003 as net sales quantities and value and operating income for all gray iron castings declined during 1999-2003 (table 5-79). At the same time, operating income as a percentage of net sales also declined for rough and machined castings during this period, reflecting higher expenses beginning in 2001 because of rising raw material costs. Operating income for responding foundries declined 65 percent during this period with operating income as a percent of sales declining to 2 percent in 2003. By 2003, 18 of the 29 producers reporting data had operating losses. Both sales and operating income have been negatively affected by a decline in shipments to traditional end-users beginning in 2001 and by a rise in prices paid for certain key raw materials, principally pig iron, steel scrap, and coke.[125] According to one industry officials, raw material costs increased by an average of nearly 10-15 percent between 2001-2003, and foundries found it difficult to pass these cost increases on to customers because of price competition in end-use markets.[126] Operating income for producers of machined gray iron castings, which represent a small share of responding producers' total castings shipments, returned to profitability in 2003 after three consecutive years of losses.

***Investment*.—**Capital expenditures on machinery, equipment, and fixtures by responding gray iron pump castings producers declined 71 percent during 1999-2003 (table 5-80) with declines beginning in 2001 due principally to declining sales and profits. As industry sales declined, profits and cash generation declined, and capital projects were postponed.[127] Other factors affecting changes in capital expenditures include limited access to capital, anticipated demand by customers for castings, and normal replacement of capital equipment because of wear and tear.[128] Research and development expenditures by the reporting foundries during this period were nil or negligible and showed no discernible trend. According to one industry official, research and development expenses tend to be low because many of these markets are mature, the technology is often well-established, and there is less product innovation relative to other industries.[129] Most research and development expenditures appear to be oriented toward the use of automation in the casting finishing process.[130]

Purchaser Trends

U.S. purchases of domestic- and foreign-produced rough gray iron pump castings by responding purchasers increased 16 percent in quantity during 1999-2003 (table 5-81). The U.S. industry's share of the rough gray iron pump castings market declined during 1999-2003 reflecting rising imports from China, whereas the U.S. industry's share of the machined castings market rose during the same period. Imports from China and Canada provided most of the import increase during this period. U.S. imports from Mexico and India declined during 1999-2003. Machined gray iron pump castings increased by quantity during 1999-2003 with imports from China and Brazil increasing during this period whereas imports from India declined.

[125] U.S. industry officials, telephone interviews with USITC staff, Jan. 27-Feb. 3, 2005.
[126] U.S. industry official, telephone interview with USITC staff, Jan. 27, 2005.
[127] U.S. industry officials, telephone interview with USITC staff, Jan. 27-Feb. 3, 2005.
[128] U.S. industry official, telephone interview with USITC staff, Jan. 27, 2005.
[129] Ibid.
[130] Ibid.

Table 5-79
Gray iron pump castings: Responding U.S. producers' financial results for their rough casting and machining operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Rough castings:					
Net sales:					
Commercial domestic and export sales	60,265	69,799	59,535	56,406	53,852
Internal consumption for production of machined castings	([1])	([1])	([1])	([1])	([1])
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales quantities	64,534	73,366	62,957	59,582	56,084
	Value (*1,000 dollars*)				
Net sales:					
Commercial domestic and export sales	86,711	96,106	78,603	72,565	70,610
Internal consumption for production of machined castings	([1])	([1])	([1])	([1])	([1])
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales values	98,108	110,800	92,397	85,299	82,191
Operating income	4,407	4,244	2,163	2,201	1,527
	Ratio to net sales (*percent*)				
Operating income	4	4	2	3	2
	Number of establishments reporting:				
Operating losses	8	7	13	15	18
Financial results data	29	30	30	31	29
Machined castings:					
Net sales (*short tons*)	([1])	([1])	([1])	([1])	([1])
	Value (*1,000 dollars*)				
Net sales	([1])	([1])	([1])	([1])	([1])
Operating income	([1])	([1])	([1])	([1])	([1])
	Ratio to net sales (*percent*)				
Operating income	([1])	([1])	([1])	([1])	([1])
	Number of establishments reporting:				
Operating losses	0	1	1	1	0
Financial results data	1	1	1	1	1

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and operating income data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-80
Gray iron pump castings: Responding U.S. producers' capital and R&D expenditures for their rough casting operations, fiscal years 1999-2003

(***1,000 dollars***)

Item	1999	2000	2001	2002	2003
Machinery, equipment, and fixtures	5,967	7,981	5,565	2,667	1,711
Research and development expenditures	([1])	([1])	0	([1])	([1])

[1] Data withheld to avoid disclosure of business confidential information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-81
Gray iron pump castings: Purchases of domestic and foreign castings by responding U.S. purchasers, 1999-2003

(***1,000 dollars***)

Year	Total
Rough castings:	
1999	71,225
2000	87,771
2001	83,784
2002	79,331
2003	82,913
Machined castings:	
1999	15,669
2000	31,273
2001	41,687
2002	40,834
2003	54,238

Note.–Domestic and foreign purchases not shown separately to prevent disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

China was the leading foreign supplier of rough and machined gray iron pump castings, as reported by U.S. purchasers in 2003. Imports from China generally consist of highly price-sensitive commodity-type castings where Chinese castings often have a competitive advantage because of low labor costs in China. For commodity-type castings, China's distance from the U.S. market is a less important competitive factor as timely delivery of the product and feedback between the foundry and the customer are not as critical as for specialized castings.

Mexico was the second leading supplier in 2003 of rough gray iron pump castings. Since the implementation of NAFTA, Mexico has played an important role as a supplier of basic commodity type castings because of lower labor costs relative to the United States and close geographical proximity to the U.S. market.

U.S. imports of downstream products produced using gray iron pump castings increased 59 percent during 1999-2004 (table 5-82). Mexico accounted for the largest absolute import increase during this period whereas Germany, Canada, and Japan were the largest suppliers of these imports to the United States in 2004, accounting for 18 percent, 15 percent, and 12 percent, respectively, of imports.

Table 5-82
Gray iron pump castings: U.S. imports for consumption of downstream products, by leading suppliers, 1999-2004

(*1,000 dollars*)

Country	1999	2000	2001	2002	2003	2004
Germany	548,734	578,074	499,827	483,243	535,758	687,550
Canada	368,543	415,906	444,189	475,986	494,494	566,525
Japan	363,587	397,938	356,536	335,307	383,115	467,494
Mexico	187,377	218,961	250,276	353,714	417,321	462,338
China	100,194	133,266	140,463	177,358	222,567	328,668
Italy	158,022	160,143	148,338	176,951	249,044	285,217
United Kingdom	180,597	184,470	167,368	182,372	182,753	198,125
Taiwan	44,385	58,348	60,459	63,600	79,871	101,535
Brazil	41,702	43,978	38,973	37,942	44,725	74,935
France	70,452	62,082	64,500	62,920	69,044	72,634
All other	350,146	415,277	415,183	441,736	488,512	597,555
Total	2,413,741	2,668,443	2,586,109	2,791,126	3,167,203	3,842,578

Note.–Downstream products includes various pumps for liquids (HTS classifications 8413.11.00, 8413.19.00, 8413.20.00, 8413.30.10, 8413.30.90, 8413.40.00, 8413.50.00, 8413.60.00, 8413.70.10, 8413.70.20, 8413.81.00, 8413.91.10, 8413.91.20, and 8413.91.90). Figures may not add to totals because of rounding.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Competitive Assessment of Price- and Product-related Factors

***Price and non-price factors*.–**According to foundry respondents, U.S. producers consider China to be the leading foreign competitor in the U.S. market in terms of price for both rough and machined pump castings (table 5-83). Questionnaire respondents reported that prices of imported rough and machined gray iron pump castings from China are on average 26 percent and 42 percent lower, respectively, than the price for the same castings from U.S. producers. Other countries identified as competitive in both rough and machined castings include Brazil and India, with prices, on average, ranging from 21 percent to 34 percent lower than U.S. prices.

U.S. purchasers of gray iron pump castings also list China as a leading foreign competitive source for both rough and machined castings (table 5-84). According to purchasers, Chinese rough castings are 33 percent lower in price, on average, and Chinese machined castings are 39 percent lower in price, on average, than comparable U.S. produced castings. Commodity-type castings tend to be more vulnerable to imports from China.

When asked for the leading countries from which they have increased imports, U.S. purchasers largely selected China. The 24 respondents that increased purchases from China cited improvements in non-price factors, such as design, technical support, and packaging, as leading factors influencing their purchase decisions. Similar response patterns were cited for India, Mexico, and Taiwan, with service, support, and other non-price factors noted as the leading purchase determinants.

Table 5-83
Gray iron pump castings: Price comparison by responding U.S. producers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Australia	Lower	1	15
Brazil	Lower	9	25
Canada	Lower	1	25
Chile	Lower	1	15
China	Lower	17	26
France	Lower	1	10
India	Lower	7	21
Korea	Lower	2	20
Mexico	Lower	3	17
Machined castings:			
Brazil	Lower	6	26
China	Lower	18	42
France	Lower	1	30
Germany	Lower	1	20
India	Lower	4	34
Korea	Lower	1	20
Mexico	Lower	3	15
Taiwan	Lower	3	28

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Producers' response to import competition.—According to foundry respondents, cost/price adjustments were the leading response to import competition offered by U.S. producers responding to this question (table 5-85). These foundries indicated that they lowered prices or suppressed price increases and implemented cost-reduction efforts to improve their competitive position relative to foreign competitors. Cost-reduction efforts consisted primarily of automating their production operations, principally the materials handling and finishing operations, in order to lower labor costs.

A significant number of respondents indicated that in the market for commodity-type castings there is very little that U.S. foundries can do to respond to low prices offered by low-value imports from low-wage nations like China. According to these producers, no amount of productivity improvements would allow their castings to compete on a price basis with low value imports when the prices of such imports are priced lower than the U.S. cost to produce the castings. A number of such foundries shifted production to other, more specialized cast products, including castings for the air conditioning compressors, motor vehicle (particularly trucking) and pipe fitting and coupling markets.[131] These cast products are similar in shape and material requirements to castings used in pumps.

Finally, a significant number of respondents indicated that they took no or few actions to respond to import competition because they lacked the capital funds to counter foreign competition. Many firms have found it difficult to raise capital funds through borrowing because of the unfavorable outlook for certain segments of the pump casting industry.[132]

[131] U.S. industry official, telephone interview with USITC staff, Feb. 8, 2005.
[132] Ibid.

Table 5-84
Gray iron pump castings: Price comparison by responding U.S. purchasers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Canada	Lower	1	15
Canada	Higher	1	10
China	Lower	5	33
EU-15	Lower	2	7
India	Lower	1	50
Japan	Higher	1	20
Mexico	Lower	1	15
Mexico	Higher	1	5
Taiwan	Lower	4	34
Turkey	Lower	1	15
Machined castings:			
Brazil	Lower	1	50
Canada	About the same	1	([1])
China	Lower	14	39
China	About the same	1	([1])
EU-15	Lower	1	20
EU-15	About the same	2	([1])
India	Lower	5	37
India	Higher	1	5
Japan	Lower	1	10
Korea	Lower	2	28
Korea	About the same	1	([1])
Mexico	Lower	2	23
Mexico	About the same	1	([1])
Taiwan	Lower	3	20
Taiwan	Higher	1	12
Turkey	Lower	1	10

[1] Not applicable.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Table 5-85
Gray iron pump castings: Responding U.S. producers' responses to import competition

Nature of response	Number of responses
Total number of establishments responding	33
Took no or few actions because:	
Had already shifted production to more advanced types of castings	4
Had already shifted production to other lines of castings	6
Lacked capital funds to counter foreign competition	9
Other	3
Took the following actions:	
Lowered prices or suppressed price increases	21
Reduced or dropped plans to expand capacity	11
Cut back or eliminated production	16
Closed production lines	9
Shifted to other cast products	17
Implemented cost-reduction efforts	24
Improved product quality	17
Imported product instead	1
Opened a plant in a foreign country	2
Other	3

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Gray Iron Non-Motor Vehicle Gear Box Castings

Industry Profile

Product Description and Uses

Gray iron non-motor vehicle gear box castings are primarily used in the housings of transmissions, differentials, transfer cases, and power-take off units (auxiliary gear boxes that transfer power from the transmission through a gear box to an output shaft for applications other than propelling the vehicle) found on construction equipment and stationary gear boxes. The stationary gear boxes are used in a variety of industries such as mining, paper-making, petroleum and natural gas extraction and pumping, power generation, and other industrial applications. Gray iron castings, however, are not used in drive axles for non-motor vehicles, such as construction machinery. Traditionally, gray iron has been used for the gear box housings because of its strength, ability to handle heat, machinability, noise dampening characteristics, and low cost.

Industry structure.–Twenty-one firms reported production of gray iron non-motor vehicle gear box castings.[133] Another 8 firms indicated that they produced such castings, but were unable to report production data. For the firms that reported data, this industry is dominated by 2 large producers that accounted for 75 percent of production in 2003, by quantity. Another four foundries, with annual production of approximately 3,600 tons to 8,300 tons each in 2003 accounted for another 19 percent, and the remaining foundries, each of which produced 1,200 tons or less, accounted for almost 7 percent. One producer exited the industry in 2003. Reporting producers were located in Alabama, California, Indiana, Iowa, Illinois, Kansas, Minnesota, Pennsylvania, Texas, and Wisconsin.

All but one firm that reported production are job shops that also produce other types of castings for other industries; the one exception is a captive producer. Most of these firms produce both gray and ductile or other iron castings. Two reported also producing aluminum castings, and one also reported producing copper castings. Sand casting was the method used to produce these products, with two firms reporting that they also used the lost foam method of casting. Most producers reported making their own molds, with many also fabricating their own patterns, but foundries were less involved in casting design and machining. The majority of producers reported that purchasers required certification of their establishment, typically an ISO 9000 certificate or higher.

Demand characteristics.–A large portion of U.S. producers' shipments were to machine shops or other fabricators (table 5-86). These fabricators are likely to be gear box producers that manufacture either standard or custom gear box products, that in turn are sold to end-users or to OEMs. The foundries supplying gear boxes typically do not perform machining; in general, gear box producers tend to have their own machining operations.[134]

In 2003, the end-use markets for gray iron non-motor vehicle gear box castings were principally for motor-vehicles,[135] farm and garden, mining, oil/gas field machinery, and construction machinery, as well as refrigeration, air-conditioning, and heating equipment (table 5-87). Each of these industries has different economic and technical drivers.

---

[133] Several large producers of gray iron non-motor vehicle gear box castings for construction machinery were unable to separate their castings production for agricultural machinery, including tractors. Therefore, data for these producers' responses have been included in the section on gray iron motor vehicle castings.

[134] American Gear Manufacturers Association official, telephone interview with USITC staff, Feb. 17, 2005.

[135] Some producers that were not able to separate data for gray iron non-motor vehicle castings from gray iron motor vehicle castings, however, were able to identify end-use markets for their shipments.

Table 5-86
Gray iron non-motor vehicle gear box castings: Responding U.S. producers' shipments, by channel of distribution, 2003
(*Percent*)

Channel of distribution	Share of 2003 shipments of castings by quantity
Rough castings:	
In-house machining	1
Machining subcontractor	1
Machine shop/other fabricators	61
Original equipment manufacturers	23
Other	15
Total	100
Machined castings:	
Original equipment manufacturers	100
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-87
Gray iron non-motor vehicle gear box castings: End market for responding U.S. producers' shipments, 2003
(*Percent*)

End market	Share of 2003 shipments of castings by quantity
Motor vehicles:	
Automobiles (including light duty trucks, SUVs, vans, etc.)	17
Trucks	8
Other (buses, motor homes, etc.)	13
Farm and garden machinery and equipment	13
Mining and oil/gas field machinery and equipment	13
Construction machinery and equipment	10
Refrigeration, air conditioning, and heating equipment	4
Industrial machinery	9
Pumps and compressors	1
Construction/municipal castings	1
Other/unknown	10
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Small gear boxes frequently have aluminum castings for the housing, rather than gray iron. Housings for large, custom-made gear boxes are typically fabrications made from steel plate, particularly if the order size is small (less than 6 units), because the cost of the tooling to make such castings tends to exceed the cost of producing the fabrications, even though for engineering reasons castings would likely be preferable for structure and noise dampening.[136]

[136] U.S. industry official, telephone interview with USITC staff, Feb. 23, 2005.

Responding U.S. producers and purchasers reported that foreign foundries have entered the U.S. market, but most were not able to identify these competitors. However, Thyssen Krupp Funicoes Ltd., of Brazil, was identified as a new competitor.

Producer Trends[137] [138]

Production and inventories.–Reported U.S. production[139] of gray iron non-motor vehicle gear box castings in short tons fluctuated during the period, but was lower in 2003 than in 1999; between 1999 and 2003, production declined by 9 percent (table 5-88). Production for particular downstream industries, such as the oil and gas equipment industry, were particularly robust in 2000 and 2001; production peaked in 2001. Most producers indicated that the trend in consumption had increased or remained the same. However, five responding producers reported that market demand declined because of reduced demand for downstream final products, increased imports of downstream products, instances of material substitution, and a factory closing by a downstream U.S. customer. For foundries in this industry, inventories as a share of production accounted for 2 to 3 percent of their total production.

A major consumer of gray iron non-motor vehicle gear box castings is the gear box industry, which purchased $56.6 million of iron and steel rough and semifinished castings in 2002.[140] Since 2002, the gear-making and gear box industry has grown at about 4 percent to 5 percent annually, as a result of rising demand, particularly from the mining equipment industry.[141] Gear box producers have also been subject to price competition, as customers have demanded world class prices for this intermediate product.[142]

Table 5-88
Gray iron non-motor vehicle gear box castings: Responding U.S. producers' production and inventories for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Production (short tons)	115,731	114,025	116,601	102,936	105,568
Inventory:					
Total (short tons)	3,200	2,917	2,563	2,782	2,621
Share of production (percent)	3	3	2	3	3

Note.–Figures may not add to totals because of rounding. Inventory share of production based on establishments that were able to provide both inventory and production amounts.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

---

[137] Certain data have been withheld to avoid disclosure of business confidential information. These data include shipments and sales for internal consumption, net sales of machined castings and related data, research and development expenditures, and purchases of rough castings.

[138] Data for gray iron non-motor vehicle gear box castings provided by responding U.S. producers include data for other products, such as counterweights for forklift trucks.

[139] Data for U.S. production, shipments, and other indicators are likely to be understated as certain producers did not supply numerical data and other producers categorized their production as gray iron motor vehicle gear box castings.

[140] This compares with $80.9 million purchased in 1997. U.S. Census Bureau, 2002 Economic Census, *Speed Changer, Industrial High-Speed Drive, and Gear Manufacturing: 2002,* EC02-311-333612 (RV), Dec. 2004.

[141] U.S. industry official, telephone interview with USITC staff, Feb. 17, 2005.

[142] Ibid.

Employment.–Based on questionnaire responses, the average number of employees involved in producing gray iron non-motor vehicle gear box castings decreased by 271 persons, or 20 percent, between 1999 and 2003 (table 5-89). Average hourly wages reportedly rose by 12 percent over the period, from $13.58 to $15.20. This compares with average hourly wages for production workers at all gray iron foundries, which rose by 10 percent, from $16.42 to $18.08.[143] Productivity fell in 2000, but has risen each year since, with the largest increases occurring during 2001 and 2002. The increase in productivity since 2000 reflects reductions by responding U.S. producers in the average number of employees by 22 percent, of production workers by 24 percent, and of hours worked by 28 percent, and a smaller decline in production (7 percent).

Table 5-89
Gray iron non-motor vehicle gear box castings: Responding U.S. producers' employees and related information for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Average number of employees	1,364	1,396	1,296	1,150	1,093
Production and related workers:					
Number	1,044	1,084	986	872	826
Hours worked (*1,000 hours*)	2,081	2,336	2,090	1,648	1,695
Wages paid (*1,000 dollars*)	28,256	31,629	28,654	25,181	25,760
Average hourly wages (*dollars per hour*)	13.58	13.54	13.71	15.28	15.20
Productivity (*short tons per 1,000 hours*)	56	49	56	62	62

Note.–Figures may not add to totals because of rounding. Average hourly wages based on establishments that were able to provide both hours worked and wages paid. Productivity based on establishments that were able to provide both production quantity and hours worked.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Producers' shipments and exports.–Based on questionnaire responses, the quantity and value of total net sales for this industry fluctuated during 1999-2003. Both indicators were lower in 2003 as compared with 1999–the value of shipments was 8 percent lower, whereas tons shipped were 9 percent lower (table 5-90). According to one industry official, the large decline in commercial shipments was caused in part by a loss of business to Chinese imports based largely on price considerations.[144] However, U.S. exports, although small relative to total shipments throughout the period (less than 4 percent) rose each year during the period.

Reporting U.S. producers that accounted for the majority of U.S. shipments stated that prices in the U.S. market fell by up to 10 percent during 1999-2003. Several other producers asserted that prices declined by up to 20 percent. However, other producers reported that prices generally remained the same. Most reporting U.S. purchasers noted prices increased in the U.S. market by up to 10 percent for both U.S.- and foreign-produced castings. A few purchasers reported price increases ranging from 11 to 30 percent. Very few purchasers reported price declines.

[143] See table 5-10, Gray and ductile iron castings: Responding U.S. producers' employees and related information for their rough castings operations, 1999-2003, p. 5-12.
[144] U.S. industry official, telephone interview with USITC staff, Feb. 23, 2005.

Table 5-90
Gray iron non-motor vehicle gear box castings: Responding U.S. producers' domestic shipments and exports for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Domestic shipments:					
Commercial	108,512	105,951	90,123	86,882	85,211
Internal consumption and transfers	([1])	([1])	([1])	([1])	([1])
Exports	([1])	([1])	([1])	([1])	([1])
Total	112,539	121,724	113,784	100,112	102,455
	Value (*1,000 dollars*)				
Domestic shipments:					
Commercial	104,211	103,883	88,167	81,409	80,249
Internal consumption and transfers	([1])	([1])	([1])	([1])	([1])
Exports	([1])	([1])	([1])	([1])	([1])
Total	109,329	120,212	111,437	94,476	98,627

[1] Data withheld to avoid disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

***Financial condition*.—**The financial results of operations reported by gray iron non-motor vehicle gear box producers declined from 1999 to 2003 (table 5-91). Net sales values and operating income for the rough castings segment both peaked in 2000 and then declined irregularly. By 2003, net sales values were down close to 20 percent from their 2000 highs (and down close to 10 percent from their 1999 level) whereas operating income was down by one-half from its 2000 level and over 40 percent from its 1999 level. Operating income margins fell from 5 percent in 1999 to 3 percent in 2003, and the number of firms reporting operating losses doubled from 6 to 13 (and in 2003 accounted for over one-half of industry establishments). Whereas the firms that reported losses were small- to medium-sized producers, even large producers reported declining profitability over the period. A few firms reported losses throughout the period, with some of the losses becoming more severe and some becoming smaller.

With respect to the machined castings segment, net sales and operating income peaked in 2001 and 2000, respectively, before declining precipitously. By 2003, both had lost about two-thirds of their 1999 values. The operating income margin increased from 2 percent in 1999 to 12 percent in 2000 before settling back in at the 2 percent level for the remainder of the reporting period.

***Investment*.—**Capital expenditures were made by a handful of firms, and declined by 73 percent over the period (table 5-92). Such expenditures peaked in 2000, but fell each of the following years. The high level of expenditures in 2000 and 2001 is attributable to one firm replacing major production machinery. One firm also conducted a small amount of research and development.

Table 5-91
Gray iron non-motor vehicle gear box castings: Responding U.S. producers' financial results for their rough casting and machined operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Rough castings:					
Net sales:					
Commercial domestic and export sales	109,487	108,667	93,081	91,403	89,061
Internal consumption for production of machined castings	([1])	([1])	([1])	([1])	([1])
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales quantities	113,091	122,808	114,529	100,960	102,864
	Value (*1,000 dollars*)				
Net sales:					
Commercial domestic and export sales	99,830	101,225	87,660	82,456	80,054
Internal consumption for production of machined castings	([1])	([1])	([1])	([1])	([1])
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales values	103,653	115,375	108,638	92,342	94,912
Operating income	5,388	6,618	3,504	([1])	3,176
	Ratio to net sales (*percent*)				
Operating income	5	6	3	([1])	3
	Number of establishments reporting:				
Operating losses	6	5	10	10	13
Financial results data	23	22	23	23	23
Machined castings:					
Net sales (*short tons*)	([1])	([1])	([1])	([1])	([1])
	Value (*1,000 dollars*)				
Net sales	([1])	([1])	([1])	([1])	([1])
Operating income	([1])	([1])	([1])	([1])	([1])
	Ratio to net sales (*percent*)				
Operating income	([1])	([1])	([1])	([1])	([1])
	Number of establishments reporting:				
Operating losses	0	0	0	0	1
Financial results data	2	2	2	2	3

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and operating income data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 5-92
Gray iron non-motor vehicle gear box castings: Responding U.S. producers' capital and R&D expenditures for their rough casting operations, fiscal years 1999-2003
(*1,000 dollars*)

Item	1999	2000	2001	2002	2003
Machinery, equipment, and fixtures	6,834	8,803	7,966	3,896	1,822
Research and development expenditures	([1])	([1])	([1])	0	0

[1] Data withheld to avoid disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Purchaser Trends

The value of U.S. purchases of foreign-produced rough castings rose by 72 percent and the quantity purchased declined by 8 percent during 1999-2003. Because of limited data from U.S. purchasers, specific country details cannot be provided so as to maintain business confidentiality. U.S. purchases of foreign-produced machined castings declined in both quantity and value. The leading source of purchases of rough castings was Mexico, followed by Brazil and the EU15, with minor amounts from China and Canada. In contrast, the leading source of machined castings was China, followed by Brazil, Mexico, India, Korea, and a number of other countries. Responding purchasers cited lower costs for machined castings from China, Brazil, and Mexico as compared with U.S. costs.

During 1999-2003, responding purchasers reported a declining trend in purchases of both rough and machined castings (table 5-93). Purchases of foreign-produced rough castings rose to account for 20 percent of reported purchases in 2003, whereas foreign-produced machined castings as a share of purchases fell to 47 percent. The decline in both rough and machined purchases corresponds with U.S. foundry reports that imports of finished downstream products have been supplanting gear boxes produced or assembled from imported components in the United States. Further, imports of downstream products that incorporate a gear box may also have risen.

Table 5-93
Gray iron non-motor vehicle gear box castings: Purchases of domestic and foreign castings by responding U.S. purchasers, 1999-2003
(*1,000 dollars*)

Year	Total
Rough castings:	
1999	105,610
2000	104,240
2001	79,163
2002	76,619
2003	77,871
Machined castings:	
1999	31,379
2000	24,661
2001	21,671
2002	15,807
2003	15,689

Note.–Domestic and foreign purchases not shown separately to prevent disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

U.S. imports of downstream products (finished gear boxes) rose by 10 percent to $618.4 million during 1999-2004 (table 5-94). In 2004, Germany was the leading supplier, followed by Italy, Japan, and the United Kingdom. Imports from Spain rose dramatically in 2004. Imports from China have risen continually during 1999-2004. Several large European gear box companies produce gear boxes in the United States, and are likely to import certain products from Europe. Further, European gear box producers are known for their high quality gear box products and have a reputation for making sophisticated gear boxes. Significant skill is required in producing the gearing that is incorporated in gear boxes.

Table 5-94
Gray iron non-motor vehicle gear box castings: U.S. imports for consumption of downstream products, by leading suppliers, 1999-2004
(***1,000 dollars***)

Country	1999	2000	2001	2002	2003	2004
Germany	123,421	118,157	120,329	96,882	123,177	132,310
Italy	99,685	110,468	123,812	137,739	123,222	116,505
Japan	102,986	116,132	93,637	73,555	88,567	97,503
United Kingdom	58,101	68,799	65,915	31,114	38,531	90,490
Canada	26,743	26,569	33,861	30,501	24,852	24,582
Spain	5,942	6,725	5,479	5,915	5,414	23,222
France	21,510	16,575	26,027	17,799	24,669	22,253
China	8,692	12,761	10,769	14,246	17,725	21,763
Belgium	49,630	30,339	14,026	11,501	12,894	19,305
Mexico	19,132	17,800	13,430	13,104	11,925	14,697
All other	45,167	46,816	45,542	39,362	44,477	55,736
Total	561,009	571,141	552,827	471,718	515,453	618,366

Note.–Downstream products includes gear boxes for stationary applications such as in factories, mills, oil and gas fields, as well as gear boxes, including transmissions, differentials, and transfer cases for construction and material handling machinery, and marine applications (HTS classifications 8483.40.30, 8483.40.50, and 8483.40.70). Figures may not add to totals because of rounding.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Competitive Assessment of Price- and Product-related Factors

Price and non-price factors.–U.S. producers reported lower prices for foreign-produced gray iron non-motor vehicle gear box castings, on average ranging from 10 percent to 50 percent below their own prices (table 5-95). Producers reported much lower prices for foreign machined castings compared with rough castings. U.S. purchasers reported average prices for foreign-produced castings compared with U.S. castings, with similarly low prices from most foreign sources (table 5-96). Both U.S. producers and purchasers reported that the prices of rough and machined castings from China ranged from 30 percent to 39 percent lower than U.S. prices. Prices for Mexican-produced castings were 15 percent to 20 percent below U.S. prices. However, U.S. producers reported much lower prices for castings from Brazil (17 percent to 33 percent lower) compared with U.S. purchasers reporting only a 10-percent lower price.

Table 5-95
Gray iron non-motor vehicle gear box castings: Price comparison by responding U.S. producers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Australia	Lower	1	15
Brazil	Lower	7	17
China	Lower	9	36
France	Lower	1	10
India	Lower	3	20
Korea	Lower	2	23
Mexico	Lower	2	15
Machined castings:			
Brazil	Lower	2	33
China	Lower	11	38
France	Lower	1	30
Germany	Lower	1	20
India	Lower	4	31
Korea	Lower	1	25
Mexico	Lower	3	20
Taiwan	Lower	1	50

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

For U.S. purchasers, other factors were also important in influencing their decisions to increase purchases of foreign-produced castings. For imports from Canada, purchasers cited factors such as better delivery times, lower order size, and better design. For Chinese castings, purchasers noted better product availability, better delivery times, improved product quality and design as some of the reasons they increased purchases of Chinese castings.

Producers' response to import competition.–Many responding U.S. producers indicated that they lacked capital funds with which to counter foreign competition (table 5-97). This corresponds to the deteriorating financial health of this industry as noted above. Because of foreign competition, the majority of U.S. producers have lowered prices or limited price increases, implemented cost-reduction efforts, and improved product quality. Producers have also responded by reducing or eliminating production, closing production, as well as reducing or eliminating plans to expand capacity in this product. Some producers have shifted to the production of other cast products.

Table 5-96
Gray iron non-motor vehicle gear box castings: Price comparison by responding U.S. purchasers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Brazil	Lower	1	10
Canada	Higher	1	8
China	Lower	1	30
EU-15	Lower	2	8
EU-15	Higher	1	20
Korea	Lower	1	4
Mexico	Lower	2	30
Machined castings:			
Brazil	Lower	2	10
Canada	Lower	1	3
China	Lower	6	39
EU-15	Lower	2	5
EU-15	About the same	1	([1])
India	Lower	2	50
India	About the same	1	([1])
Korea	Lower	2	15
Mexico	Lower	1	20
Taiwan	Lower	3	23

[1]Not applicable.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Table 5-97
Gray iron non-motor vehicle gear box castings: Responding U.S. producers' responses to import competition

Nature of response	Number of responses
Total number of establishments responding	24
Took no or few actions because:	
Had already shifted production to more advanced types of castings	3
Had already shifted production to other lines of castings	4
Lacked capital funds to counter foreign competition	8
Other	1
Took the following actions:	
Lowered prices or suppressed price increases	21
Reduced or dropped plans to expand capacity	10
Cut back or eliminated production	14
Closed production lines	3
Shifted to other cast products	9
Implemented cost-reduction efforts	19
Improved product quality	14
Imported product instead	1
Other	2

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

CHAPTER 6
U.S. STEEL FOUNDRY INDUSTRY

This chapter provides a general overview of the U.S. steel foundry industry as a whole, based on responses to the USITC producer and purchaser questionnaires, fieldwork, and interviews with leading industry participants. The chapter begins with a discussion of the structure of the industry and leading demand characteristics. Next, producer trends are presented, with emphasis on the financial condition of respondents to the producer questionnaire, concluding with a discussion of purchaser trends.

Steel castings are used in the agricultural, construction, manufacturing, power generation, processing, and transportation industries. Typical products made from steel castings include compressors, mechanical components, pumps, tools, and valves. Steel castings vary significantly in size, chemical and physical composition, and end-use requirements. Almost two-thirds of rough steel castings are machined in-house, with a significant portion of the remainder shipped directly to original equipment manufacturers (OEMs). In 2003, 18 percent of respondents' purchases of rough steel castings were from foreign producers, compared with 15 percent in 1999. By contrast, 35 percent of respondents' purchases of machined steel castings in 2003 were from foreign producers, compared with 48 percent in 1999.

Of the 465 respondents to the foundry questionnaire, 87 reported producing steel castings[1] in the United States during 1999-2003. The American Foundry Society (AFS) collects information on the foundry industry based on metal types. Questionnaire data collected by the USITC account for 65 percent of steel foundry production in 2003 as reported by the AFS.[2] Of the 463 U.S. firms responding to the purchaser questionnaire, 154 respondents reported purchasing steel castings. Results from the producer and purchaser questionnaires are discussed in this chapter to provide an overview of the steel foundry industry, and to perform more product-specific analysis of steel valves.[3]

Industry Profile

Industry Structure

The U.S. steel foundry industry is concentrated in the Midwest, comprising 40 foundries - a legacy of the historic aggregation of manufacturing firms along the shores of the Great Lakes. Steel foundry operations range from fewer than 10 employees to more than 500 at a single plant, with the majority employing fewer than 100 workers.[4] One-third of the volume of steel castings shipped in 2003 accounted for 80 percent of total shipment value.[5] The majority of responding foundries were job shops, with fewer than 20 percent identified as captive producers. Typically, both captive producers and job shops produce a broad

[1] Of the 87 identified steel foundries, 55 produce steel castings exclusively. Sixteen foundries produce both steel- and iron-based castings, with 4 of these firms also producing non-ferrous castings. The remaining 16 foundries produce both non-ferrous castings and steel-based castings only.

[2] AFS, "38th Annual Census of World Casting Production–2003," *Modern Casting*, Dec. 2004, p. 26.

[3] Of the 87 establishments reporting production of steel castings, 12 respondents reported information on steel valves. Of the 154 purchasers reporting purchases of steel castings, 46 reported information on steel valves.

[4] In 2003, the median number of employees for domestic steel foundry operations was 76, with one-third of reporting firms employing 50 or fewer employees in steel foundry operations.

[5] Steel castings with values of $2,000 per ton or less accounted for two-thirds of steel castings shipments by volume, but only 20 percent by value in 2003. By comparison, steel castings with values greater than $2,000 per ton accounted for only one-third of steel castings shipments by volume, but 80 percent by value in 2003.

number of products in low quantity runs, with only 14 responding foundries producing a limited number of products in high quantity runs. In addition to castings operations, steel foundries perform a range of other production-related activities, including pattern and mold making (table 6-1). Steel castings are usually component parts of larger finished products so downstream manufacture is not a major activity for most steel foundries. Steel foundry products are increasingly cast to precise shapes that require little or no machining after casting. Largely owing to their relatively high value, rough castings account for a large proportion of total sales (table 6-2).

Demand Characteristics

Steel castings are used in the agricultural, construction, manufacturing, power generation, processing, and transportation industries. Typical products made from steel castings include compressors, mechanical components, pumps, tools, and valves. Steel castings vary significantly in size, chemical and physical composition, and end-use requirements.[6] By quantity, railway equipment dominates steel castings shipments (table 6-3). Such equipment, together with construction, industrial, and mining and oil/gas field machinery and equipment, accounts for 86 percent of domestic steel castings shipments. Almost two-thirds of rough

Table 6-1
Steel foundries: Establishment activities of responding producers

Activity	Number responding that performed activity	Average percentage performed in-house
Total establishments reporting = 77		
Design of rough castings	42	75
Pattern making	39	63
Mold making, expended type	55	94
Mold/die making, permanent type	19	43
Machining of rough castings	49	66
Downstream manufacture	18	60

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 6-2
Steel foundries: Responding U.S. producers' average net sales shares, fiscal years 1999-2003
(*Percent of total sales*)

Item	1999	2000	2001	2002	2003
Rough castings	55	56	56	57	56
Machined castings	29	28	28	28	28
Downstream products containing in-house castings	14	13	13	13	13
Other	0	2	2	2	2
Total	100	100	100	100	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[6] Unit values for steel castings shipped by responding domestic producers in 2003 ranged from slightly more than $200 to more than $100,000 per ton.

Table 6-3
Steel foundries: End market for responding U.S. producers' shipments, 2003
(*Percent*)

End market	Share of 2003 shipments of castings by quantity
Motor vehicles:	
Automobiles (including light duty trucks, SUVs, vans, etc.)	1
Trucks	2
Mining and oil/gas field machinery and equipment	8
Construction machinery and equipment	9
Railway equipment	61
Industrial machinery	8
Valve and pipe fittings	2
Pumps and compressors	1
Aircraft (including related engines)	1
Other/unknown	6
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

steel castings are machined in-house, with a significant portion of the remainder shipped directly to OEMs (table 6-4). More than 90 percent of machined castings are shipped to either distributors or OEMs.

Demand for steel castings is to a certain extent dependent on the U.S. railway equipment industry. According to industry sources, production of railway freight cars and locomotives reached a 20-year high in 1998 when 75,000 cars were produced. Due to railcar surpluses and the economic downturn, production declined steadily to 18,000 by 2002. Additionally, longer wheel life cycles, owing to improvements in wheel production process and metallurgy, have also affected demand for rail wheels as wheels are replaced less frequently.[7] The demand for steel valve castings, another major market, is largely influenced by oil and natural gas prices, which increased during 1999-2003 and resulted in more U.S. oil and gas development and production activity.[8]

[7] Marybeth Luczak, "Reinventing the Wheel," *Railway Age*, Jun. 2004, Vol. 205, Iss. 6, p. 22; Robert E. Paaswell, "Building Railcars in New York," Five Borough Institute, found at *http://www.fiveborough.org/5boroughreport/railcars_paaswell.html*; John E Carroll, Jr., "Deja vu All Over Again," *Railway Age*, July 2002; Dan Sandoval, "Foundry Business to Come Back Down to Earth," June 26, 2001; and Kenneth H. Kirgin, "Metal Supply and Demand Trends, U.S. Casting Industry Snapshot - 2002," found at *http://www.castsolutions.com/archive/08.2_01_feature_article.html*, retrieved Apr. 22, 2005.

[8] Based on the number of rotary rigs in operation. U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review*, Feb. 2005, p. 83.

Table 6-4
Steel foundries: Responding U.S. producers' shipments, by channel of distribution, 2003
(*Percent*)

Channel of distribution	Share of 2003 shipments of by quantity
Rough castings:	
In-house machining	65
Machining subcontractor	3
Machine shop/other fabricators	3
Distributors	5
Original equipment manufacturers (OEM)	21
Other	2
Total	100
Machined castings:	
Distributors	56
Original equipment manufacturers (OEM)	36
In-house for use in downstream products	4
Other	5
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Producer Trends[9]

Capacity, Production, Inventories, and Shipments

Following a drop in demand during 2000-2002, respondents' production volume increased by 16 percent in 2003 in response to improved conditions in downstream domestic manufacturing (table 6-5). Responding foundries produced approximately 619,000 tons of steel castings in 2003, with shipments valued at more than $1.3 billion. Despite year-to-year changes in production, production capacity largely remained constant during 1999-2003. This is because relatively high fixed-cost capitalization requirements mitigate against rapid reductions in production capacity during periods of decreased demand.[10] Instead, variable inputs, such as labor and raw materials, are adjusted downward, resulting in relatively low capacity utilization rates during these periods.

[9] Certain data have been withheld to avoid disclosure of business confidential information. These data include certain internal consumption and transfer quantities of rough steel castings, net sales quantities of machined steel castings, and certain production costs of machined steel castings.

[10] See table 6-15 for additional information on steel castings capitalization.

Export shipments for rough steel castings grew during 1999-2003 as domestic consumption contracted, especially during 2001-2002 (table 6-6). During 1999-2003, exports averaged approximately 5 percent of total respondents' shipments by quantity, and they averaged 9 percent of total shipments by value. Despite a drop during 2001-2002, the value of export shipments increased by 19 percent during 1999-2003, while the value of domestic shipments contracted by slightly more than 10 percent. The contraction in the value of domestic shipments coincides with an expansion of U.S.-based producers' foreign steel castings operations during this period. According to domestic producers, foreign operations are essential for firms that intend to continue to produce steel castings for the global market, as an increasing share of manufacturing is performed outside the United States in locations where U.S.- produced castings are not competitive due to their relatively higher transportation and production costs.[11]

Table 6-5
Steel foundries: Responding U.S. producers' capacity, production, and inventories for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Capacity (short tons)	928,834	938,160	936,923	927,816	928,614
Production (short tons)	713,175	611,943	558,926	534,006	618,815
Capacity utilization (*percent*)	80	68	62	60	69
Inventory:					
Total (short tons)	39,645	36,186	35,655	35,614	38,325
Share of production (*percent*)	12	13	14	14	13

Note.–Figures may not add to totals because of rounding. Capacity utilization based on establishments that were able to provide both capacity and production amounts. Inventory share of production based on establishments that were able to provide both inventory and production amounts.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 6-6
Steel foundries: Responding U.S. producers' domestic shipments and exports for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Domestic shipments:					
Commercial	221,976	214,739	176,463	151,950	163,399
Internal consumption and transfers	([1])	([1])	([1])	([1])	([1])
Exports	([1])	([1])	([1])	([1])	([1])
Total	709,321	609,280	556,421	530,870	613,420
	Value (*1,000 dollars*)				
Domestic shipments:					
Commercial	909,063	944,605	884,625	745,393	760,570
Internal consumption and transfers	416,647	402,387	363,941	363,620	431,259
Exports	111,004	123,193	131,914	119,871	131,759
Total	1,436,714	1,470,185	1,380,480	1,228,884	1,323,588

[1]Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[11] U.S. industry officials, telephone interviews with USITC staff, Feb. 7 and 10, 2005. Officials represent steel castings suppliers to a range of industries, and include a Tier 1 automotive supplier.

Table 6-7
Steel foundries: Responding U.S. producers' employees and related information for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Average number of employees	13,303	13,089	12,272	10,894	10,490
Production and related workers:					
Average number	11,240	11,038	10,286	9,028	8,756
Hours worked (*1,000 hours*)	22,612	22,571	20,647	18,018	17,901
Wages paid (*1,000 dollars*)	293,422	306,489	292,319	266,338	272,188
Average hourly wages (*dollars per hour*)	12.98	13.58	14.16	14.78	15.21
Productivity (*short tons per 1,000 hours*)	31	27	27	30	35

Note.–Figures may not add to totals because of rounding. Average hourly wages based on establishments that were able to provide both hours worked and wages paid data. Productivity based on establishments that were able to provide both production quantity and hours worked data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Employment

During 2000-2003, responding domestic producers trimmed employment rolls, largely in response to decreasing demand during 2000-2002 (table 6-7). Despite a 22-percent decline in the number of production and related workers during 1999-2003, productivity increased by 13 percent. The productivity increase is largely attributable to efficiency gains as a result of investment in new technology and the development of employee incentive programs on the part of some firms. One major domestic steel foundry instituted a 2-tier pay structure, where new hires receive a decreased base wage but are eligible for annual performance bonuses based on production output. According to management, the results of this incentive system have exceeded expectations in terms of increased productivity.[12]

Financial Condition

Rough Castings

During 1999-2003, respondents' net sales values of rough steel castings decreased by less than 9 percent, while operating income for rough steel castings operations decreased by 54 percent as the costs for raw materials and energy increased (table 6-8). As a percentage of net sales, operating income declined from 9 percent in 1999 to 4 percent in 2003. The most significant factor in the reduction of operating income in percentage terms was energy costs, which increased by almost 39 percent on a per ton basis during 1999-2003 (table 6-9). Among responding firms reporting operating losses, unit energy cost increases (as high as 50 percent during 1999-2003) were the most significant drain on operations. Less drastic increases in unit costs for raw materials also contributed to the decline in operating income.

Captive producers increased both their operating and net income margins during 1999-2003 (table 6-10). By contrast, job shop operating margins fell from 11 percent to 5 percent during the same period, while net income margins declined from 6 percent in 1999 to 1 percent in 2003. Although respondents with a limited number of products typically reported higher operating margins than those producing a broad number of products, both sets of respondents reported similar net income margins, decreasing from 6 percent in 1999 to 1-2 percent in 2003.

[12] U.S. industry official, telephone interview with USITC staff, Feb. 7, 2005.

Table 6-8
Steel foundries: Responding U.S. producers' financial results for their rough casting operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Net sales:					
Commercial domestic and export sales	231,629	228,982	189,532	165,753	192,143
Internal consumption for production of machined castings	([1])	([1])	([1])	([1])	([1])
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales quantities	587,586	517,856	495,544	463,078	503,118
	Value (*1,000 dollars*)				
Net sales:					
Commercial domestic and export sales	938,832	986,455	929,983	798,703	843,179
Internal consumption for production of machined castings	309,533	306,605	284,856	274,820	305,951
Other internal consumption or transfers to related firms	53,264	59,279	55,208	45,803	37,185
Total net sales values	1,301,629	1,352,339	1,270,047	1,119,326	1,186,315
Cost of goods sold:					
Raw materials	260,212	270,117	254,999	224,932	261,365
Direct labor	294,862	309,437	298,926	264,094	276,030
Energy	64,290	70,376	77,834	68,648	75,851
Other factory cost	436,854	451,605	451,591	403,808	399,361
Total cost of goods sold	1,056,218	1,101,535	1,083,350	961,482	1,012,607
Gross profit	245,411	250,804	186,697	157,844	173,708
Selling, general, and administrative	129,185	140,475	137,538	123,856	120,554
Operating income	116,226	110,329	49,159	33,988	53,154
Other income and expenses:					
Interest expense	39,685	39,848	25,964	5,508	32,086
All other expenses and income	-1,396	673	-759	450	964
Net income before taxes	77,937	69,808	23,954	28,030	20,104
Depreciation/amortization	52,559	53,947	57,025	57,753	52,835
	Ratio to net sales (*percent*)				
Raw materials	20	20	20	20	22
Direct labor	23	23	24	24	23
Energy	5	5	6	6	6
Other factory cost	34	33	36	36	34
Cost of goods sold	81	81	85	86	85
Gross profit	19	19	15	14	15
Selling, general, and administrative	10	10	11	11	10
Operating income	9	8	4	3	4
	Number of establishments reporting:				
Operating losses	14	16	20	21	25
Financial results data	67	71	72	71	71

[1]Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and cost data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 6-9
Steel foundries: Selected financial unit values for responding U.S. producers' rough casting operations, fiscal years 1999-2003

(*Dollars per short ton*)

Item	1999	2000	2001	2002	2003
Total sales unit value	2,215	2,611	2,563	2,417	2,358
Raw material cost	443	522	515	486	519
Direct labor cost	502	598	603	570	549
Energy cost	109	136	157	148	151
Other factory cost	743	872	911	872	794
Total cost of goods sold	1,798	2,127	2,186	2,076	2,013
Gross profit	418	484	377	341	345

Note.–Figures may not add to totals because of rounding. For each of the above items, unit values calculated only where establishment provided both value and quantity data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 6-10
Steel foundries: Selected financial information for U.S. producers' rough casting operations for specified classes, fiscal years 1999-2003

(*1,000 dollars*)

Class/item	1999	2000	2001	2002	2003
Job shops:					
Total net sales	885,542	929,238	881,085	757,497	789,776
Operating income	94,792	88,529	45,815	28,969	38,933
Net income	57,511	52,679	20,997	26,274	7,826
Captive producers:					
Total net sales	174,566	181,072	169,497	170,222	186,661
Operating income	8,099	7,226	8,088	10,875	14,612
Net income	5,911	5,052	6,799	10,240	14,131
Limited number of products:					
Total net sales	340,257	320,083	267,101	229,617	287,386
Operating income	48,045	33,048	-3,931	6,552	28,538
Net income	20,845	5,556	-16,890	11,773	5,883
Broad number of products:					
Total net sales	935,622	1,003,923	970,412	876,667	884,360
Operating income	65,911	73,463	49,317	28,576	25,435
Net income	54,414	59,656	36,567	15,205	12,949

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Machined Castings

During 1999-2003, respondents' net sales values of machined steel castings decreased by a total of about 4 percent, while operating income for machined steel castings operations decreased by a total of 29 percent (table 6-11). As a percentage of sales value, operating income declined from 15 percent in 1999 to 11 percent in 2003. The most significant factor in the decline in operating income was machining costs, which increased by more than 27 percent on a per ton basis during 1999-2003. Machined steel castings producers cite increasing labor costs as another factor in the decline in operating income for machined castings operations.[13]

Raw Materials and Energy

Responding steel foundries purchase scrap steel, primary steel, and alloying metals, in varying amounts depending on the products manufactured (table 6-12). Although respondents do have some ability to adjust their relative consumption of scrap steel and primary steel by substituting one for the other, prices for the grades of scrap required by steel foundries typically move in tandem with prices for primary steel. Some foundries, particularly those which produce proprietary products for sale directly to end users, are able to pass raw materials cost increases along to their customers.[14] Many foundries, however, are not positioned to do so. In particular, steel foundries producing commodity products for sale to OEMs are more likely to be caught in a "cost squeeze" where they are not be able to pass raw materials cost increases along to their customers. Increasing scrap costs have also led to creative cost-saving arrangements, such as some foundries purchasing steel scrap directly from their scrap-producing downstream customers.[15]

Electricity and natural gas are not directly substitutable in the steel foundry process. Although the decreasing energy share of electricity costs for responding steel foundries during 1999-2003 is in part a result of relatively flat electricity prices, the increasing share of natural gas costs during the same period is the result of price increases (table 6-13). The cost of natural gas is a growing concern to foundry industry officials, many of whom believe that natural gas prices will increase even further because it is not assured that both the supply and the delivery system for natural gas will grow as quickly as required by increasing demand.[16] On the other hand, Energy Information Administration estimates suggest relatively constant natural gas prices, with the probability of only modest price increases in the future.[17]

Labor

Although respondents' total employment costs decreased as the workforce downsized (table 6-14 and see table 6-7), per employee costs increased by 22 percent during 1999-2003. Most of the increase was driven by salaries and wages, which increased by 19 percent on a per employee basis during this period. However, health benefits, which averaged 11 percent of total employment costs during 1999-2003, increased by more than 35 percent on a per employee basis to an annual average of more than $5,000 per employee in 2003. Other costs (including unemployment insurance and worker's compensation), which averaged 9 percent of total employment costs during 1999-2003, increased by 39 percent on a per employee basis, to an annual average of $4,400 per employee in 2003. Responding producers' questionnaire data consistently ranked these cost trends as serious issues impacting the viability of their operations. Industry officials

[13] U.S. industry officials, telephone interviews with USITC staff, Feb. 7 and 8, 2005.
[14] Ibid.
[15] Ibid.
[16] U.S. industry officials, telephone interviews with USITC staff, Feb. 7, 8, and 9, 2005.
[17] Energy Information Administration, *Annual Energy Outlook 2005 with Projections to 2025*, DOE/EIA-0383 (Washington, DC: U.S. Department of Energy, 2005), pp. 95-99.

Table 6-11
Steel foundries: Responding U.S. producers' financial results for their machining operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
Net sales (*short tons*)	([1])	([1])	([1])	([1])	([1])
	Value (*1,000 dollars*)				
Net sales	822,876	761,990	696,892	668,391	786,256
Cost of goods sold:					
Rough castings produced	403,671	373,722	343,694	339,610	390,446
Rough castings purchased from other companies	([1])	([1])	([1])	([1])	([1])
In-house machining costs	212,014	222,048	207,798	182,898	237,087
Subcontracted machining costs	13,817	17,148	15,822	15,216	15,527
Other machining costs	([1])	([1])	([1])	([1])	([1])
Total costs of goods sold	639,941	622,007	577,599	546,447	653,660
Gross profit	182,935	139,983	119,293	121,944	132,596
Selling, general, and administrative	59,221	58,866	53,112	44,671	45,033
Operating income	123,714	81,117	66,181	77,273	87,563
	Ratio to net sales (*percent*)				
Cost of goods sold	78	82	83	82	83
Gross profit	22	18	17	18	17
Selling, general, and administrative	7	8	8	7	6
Operating income	15	11	9	12	11
	Number of establishments reporting:				
Operating losses	9	12	12	12	14
Financial results data	36	39	40	40	41

[1]Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and cost data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 6-12
Steel foundries: Share of total metal raw material costs for responding U.S. producers' rough casting operations, fiscal years 1999-2003

(*Percent*)

Item	1999	2000	2001	2002	2003
Primary metals in scrap form	61	58	56	59	60
Primary metals in other forms	23	26	28	24	23
Other metal	16	16	16	17	18
Total	100	100	100	100	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 6-13
Steel foundries: Share of total energy costs for responding U.S. producers' rough casting operations, fiscal years 1999-2003

(***Percent***)

Item	1999	2000	2001	2002	2003
Electricity	73	69	66	72	68
Natural gas	24	30	33	27	31
Metallurgical coke	([1])	([1])	([1])	([1])	([1])
Other	2	1	1	([1])	([1])
Total	100	100	100	100	100

[1]Less than 0.5 percent.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 6-14
Steel foundries: Responding U.S. producers' employment costs for their rough casting operations, fiscal years 1999-2003

(***1,000 dollars***)

Item	1999	2000	2001	2002	2003
Salaries and wages (including overtime)	395,018	418,981	389,939	353,490	371,427
Health benefits	50,212	54,873	59,252	53,597	53,507
Pension and profit sharing	17,277	19,295	15,962	12,827	14,577
Other costs	42,159	47,409	47,365	44,565	46,081
Employee training	1,085	1,218	1,031	915	873
Total employee costs	505,751	541,776	513,549	465,394	486,465

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

explained that employment costs are the most difficult manufacturing input to control because the prevailing costs of labor, health benefits, and other employment costs are set by local markets, and cannot be influenced by management techniques.[18]

Investment

Respondents' fixed-cost capital expenditures decreased from $77 per ton of annual capacity to $62 per ton reflecting the declining financial position of for the steel castings industry (table 6-15). Fixed capital investments for individual firms range from several million dollars to tens of millions of dollars, with an industry average of $14 million for steel foundries responding to the producer questionnaire. Increases in environmentally-related expenditures, especially during 2000-2002, were a particular concern among responding producers. Responding steel castings producers overwhelmingly cited environmental regulations

[18] U.S. industry officials, telephone interviews with USITC staff, Feb. 7 and 8, 2005. Industry officials cited the unique labor demands of the steel foundry industry as an inherent constraint. Because the work is relatively arduous, and working conditions are dirtier and more dangerous than in some other industries, steel foundries have difficulty attracting a sufficient number of suitable entry-level workers. Also, since steel foundry skills are necessarily acquired on-the-job, industry officials cited high labor turnover and low retention as a constraint to labor force development. Finally, the costs of unemployment insurance and worker's compensation are typically higher for the steel foundry industry than for other industries because premiums are affected by workforce layoffs and workplace accidents, which, despite diligent avoidance efforts, have occurred within the industry.

Table 6-15
Steel foundries: Responding U.S. producers' capital and R&D expenditures for their rough casting operations, fiscal years 1999-2003

(***1,000 dollars***)

Item	1999	2000	2001	2002	2003
Capital expenditures:					
Machinery, equipment, and fixtures:					
Environmentally related	2,128	3,460	7,906	6,031	2,194
Other	60,557	44,196	44,624	37,665	48,374
Land, building, and related improvements	8,824	13,690	11,152	2,779	7,116
Total	71,509	61,346	63,682	46,475	57,684
Research and development expenditures	5,118	5,266	5,725	6,883	8,017

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

as the government policy having the greatest impact on their castings business. Producers also stressed the significance of research and development (R&D) expenditures to their continued competitiveness. During 1999-2003, respondents' R&D expenditures increased by almost 57 percent, from 4 percent to 15 percent of their rough casting operating income.

Debt

The ratio of book value to original cost for property, plant, and equipment decreased from 42 percent to 32 percent during 1999-2003, reflecting the additional investments made by responding producers of steel castings during that period (table 6-16).

Purchaser Trends

Respondents to the Commission's purchaser questionnaire sourced 80 percent of their rough steel castings, by value, from domestic producers during 1999-2003 (table 6-17). However, purchases of rough steel castings of foreign origin increased by 25 percent during this period. In 2003, 18 percent of respondents' purchases of rough steel castings were from foreign producers, compared with 15 percent in 1999. By contrast, respondents' purchases of machined steel castings of foreign origin were relatively flat during 1999-2003 (with the exception of 2000), even as purchases of machined steel castings of domestic origin increased by almost 65 percent in value. In 2003, 65 percent of respondents' purchases of machined steel castings were from domestic producers, compared with 52 percent in 1999.

Table 6-16
Steel foundries: Other financial information for responding U.S. producers' rough casting operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
Total debt (*1,000 dollars*)	246,132	242,064	240,652	268,868	275,676
Property, plant, and equipment:					
Original cost (*1,000 dollars*)	974,690	1,029,380	1,078,468	1,068,540	1,111,132
Book value (*1,000 dollars*)	413,707	417,134	406,513	358,187	356,202

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 6-17
All steel castings: Total reported U.S. purchases of domestic and foreign castings, 1999-2003
(*1,000 dollars*)

Type	1999	2000	2001	2002	2003
Rough castings:					
Domestic[1]	256,554	488,405	566,879	356,085	260,707
Foreign	45,251	106,791	134,947	137,976	56,492
Total	301,805	595,196	701,826	494,061	317,199
Machined castings:					
Domestic[1]	119,815	117,285	141,929	164,964	197,591
Foreign	109,471	175,705	107,512	92,344	106,333
Total	229,286	292,990	249,441	257,308	303,924

[1] Includes data for purchases of castings from unknown sources to prevent disclosure of business confidential information.

Note.–Figures may not add to totals because of rounding. These data do not indicate all purchases of castings in the United States. See ch. 1 for additional information on data coverage.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Product Profile

Steel Valve Castings

Industry Profile

Industry structure.—In response to the Commission's questionnaire, 12 foundries in the United States reported producing steel valve castings. Three foundries located in Wisconsin, Alabama, and Nebraska account for approximately 55 percent of the quantity of steel valve castings reported, and 73 percent of the production value. Most foundries are multi-product job shops that produce in low quantity for various industries, including, for example, the pump, energy, and transportation industries. Sand casting and investment casting are the leading methods used to produce steel valve castings. Most foundries that produce steel valve castings manufacture their own molds and patterns, as well as machine rough castings. Establishments that produce steel valve castings have increased automation to increase efficiency, as well as to reduce lead times and operating costs.[19] Most U.S. producer respondents reported that being qualified as an Approved Manufacturer was an important factor in the marketing of castings. U.S. producers cited ISO 9000/14000 as the most common certifications.

U.S. producers of steel valve castings vary in the channels by which they distribute their products. In response to the Commission's questionnaire, U.S. producers of steel valve castings reported that OEMs are the most important channel of distribution, with approximately 80 percent of shipments of rough castings and 75 percent of machined castings going to OEMs (table 6-18).

Product Description and Uses

Taps, cocks, valves and similar devices are used to control the flow of liquids, gases, and solids through pipes and piping systems. Flow control is attained by moving a disc, plug, or other flow-controlling element within the valve assembly to open, close, or partially obstruct the passageway. Valves come in a range of sizes and are used with a variety of pressures; a check valve permits the material in a system to flow in only one direction. These generally have no external means of control, but are opened by the pressure in the system and are closed automatically when the pressure drops below the level for which the valves were designed. A hand-operated valve generally contains a mechanism that is used to open and close the valve. A tap is a type of valve that regulates delivery at the end of the pipe, and is used in household faucets and in controls on stem and gas lines. A cock consists of rotating devices that regulate the flow of a liquid. It is a type of valve within a valve that controls the flow of material within a piping system rather than at the terminal end of the system. Valves are generally produced according to standards and specifications determined by a number of U.S. organizations, including the American Society for Testing and Materials (ASTM), the American Petroleum Institute (API), and the American National Standards Institute (ANSI). Comparable foreign organizations have also developed standard specifications for valves. Valves manufactured for pipes with outside diameters of more than 2 inches are usually produced from castings; valves made for smaller pipes are made from forgings. Steel valves are generally made from steel scrap.

[19] U.S. industry official, telephone interview with USITC staff, Dec. 17, 2004.

Table 6-18
Steel valve castings: Responding U.S. producers' shipments, by channel of distribution, 2003
(*Percent*)

Channel of distribution	Share of 2003 shipments of castings by quantity
Rough castings:	
In-house machining	12
Machining subcontractor	1
Machine shop/other fabricators	7
Original equipment manufacturers	80
Total	100
Machined castings:	
Original equipment manufacturers	75
In-house for use in downstream products	25
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Demand characteristics.—Demand for steel valve castings is concentrated in the valve and pipe-fittings segment (41 percent), as well as the construction machinery and mining equipment segment (19 percent) (table 6-19). In the construction and mining segments, increased demand for natural resources such as copper ore has affected demand for steel valve castings by companies that supply large equipment and trucks.[20] The energy sector is another key consumer of steel valves. According to one industry representative, oilfield services companies are a major purchaser of steel valve castings within the valve and pipe-fittings market.[21] As oil prices rise, the activities of oilfield services companies increase, as well as the demand for steel valve castings. The demand for steel valve castings is largely influenced by the price of oil. Steel hand-operated and check-type taps, cocks, and valves are used in piping systems in the petroleum refining, oil and gas production, and chemical processing industries. These are also used in waste water treatment, and pulp and paper manufacturing, as well as by utility companies.[22]

[20] Ibid.

[21] U.S. industry official, telephone interview with USITC staff, Feb. 4, 2005.

[22] Crane Valves, found at *http://www.cranevalve.com/crane1.htm*, retrieved July 13, 2004; and “Valve Standards in the Petrochemicals and Refining Industry,” *Valve Magazine*, Vol. 8, No. 3, Summer 1996, p. 10.

Table 6-19
Steel valve castings: End market for responding U.S. producers' shipments, 2003
(*Percent*)

End market	Share of 2003 shipments of castings by quantity
Motor vehicles:	
Trucks	1
Other (buses, motor homes, etc.)	6
Farm and garden machinery and equipment	2
Mining and oil/gas field machinery and equipment	3
Construction machinery and equipment	19
Railway equipment	1
Industrial machinery	6
Valve and pipe fittings	41
Pumps and compressors	6
Ships and boats	1
Other/unknown	14
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Producer Trends[23]

***Production and inventories*.—**Questionnaire respondents reported fluctuating production levels between 1999 and 2003 (table 6-20) that correspond to establishments' business cycles and the general state of the economy,[24] as well as to fluctuating oil prices throughout the 5-year period. Between 1999 and 2003, there was a strong correlation between the price of oil and demand for steel valve castings, which spurred production levels. The production of steel valve castings increased 15 percent from 1999 to 2000, while West Texas Intermediate (WTI) spot prices more than doubled over the same period.[25] According to one industry representative, higher oil prices during the period created greater demand for steel valve castings for both upstream and downstream activities of oilfield services companies.[26] However, between 1999 and 2003, operating costs for producers of steel valve castings rose approximately 11 percent because of increasing materials costs and energy costs from electricity and natural gas usage.

Total inventory levels remained constant at approximately 10 to 11 percent of total production during the 5-year period, indicating that establishments adjusted production levels to match sales and maintained adequate inventory levels.

[23] Certain data have been withheld to avoid disclosure of business confidential information. These data include internal consumption, operating income, and research and development expenditures.

[24] U.S. industry official, E-mail correspondence with USITC staff, Jan. 18, 2005.

[25] Spot prices are measured FOB. For historical data, see the Energy Information Administration, Department of Energy, *http://tonto.eia.doe.gov/oog/ftparea/wogirs/xls/psw13vdcr.xls,* retrieved Feb. 4, 2005.

[26] Upstream activities include extraction and production. Downstream activities include refining. U.S. industry official, telephone interview with USITC staff, Feb. 4, 2005.

Table 6-20
Steel valve castings: Responding U.S. producers' production and inventories for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Production (short tons)	17,929	20,629	18,994	16,721	17,265
Inventory:					
Total (short tons)	1,398	1,746	1,637	1,376	1,562
Share of production (percent)	10	11	11	11	12

Note.–Figures may not add to totals because of rounding. Inventory share of production calculations do not total because they are based on establishments that were able to provide both inventory and production amounts.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

***Employment*.—**The average number of employees decreased by 16 percent, and production and related workers decreased by 24 percent over the five-year period (table 6-21). U.S. producers reported strong growth in employment in the period leading up to 2001. According to several industry representatives, the number of hours worked increased 24 percent from 1999 to 2000 owing to the strong state of the economy. From 2000 to 2003, employment levels, hours worked, and wages paid all declined because of a decrease in demand for steel valve castings, although hours worked and wages paid picked up slightly in 2003. One industry representative said that during this time, more U.S. purchasers were purchasing from overseas.[27]

Compared to 1999, the average number of hours worked annually per production and related worker increased by 24 percent to 1,908 hours per worker in 2003, indicating that employees were working longer hours annually. One U.S. producer reported that when demand and production increased, companies were hesitant to hire additional workers, and instead waited to see if the upward trend would continue.[28] In the meantime, existing employees worked more hours. On the other hand, when demand decreased and production declined, the same U.S. producer reported a reduction of the work week to 32 hours as a substitute for lay offs, citing the difficulty of finding quality workers and training inexperienced workers as the main drawbacks to reducing the skilled labor force.[29] Productivity measured in short tons per hour experienced no change throughout the period, which is reflected by the marginal increase in hourly wages from $11.50 to $12.60 per hour.

***Producers' shipments and exports*.—**Between 1999 and 2003, the level of domestic shipments and exports tended to mirror the pattern of production levels. U.S. producer respondents reported that domestic shipments and exports increased 14 percent from 1999 to 2000 (table 6-22), attributable to rising oil prices that positively affected the demand for steel valve castings during this time.[30] The quantity of domestic commercial shipments of rough steel valve castings fluctuated downward after 2000 to below 1999 levels, whereas the downward trend of internal consumption and transfers after 2000 was reversed by a 32-percent gain from 2002 to 2003 to 2,237 short tons. Much of the recent year's increase in internal consumption is attributable to one establishment's added capacity in 2002 to produce machined castings.[31] Export quantities increased overall by 15 percent during the period, accounting for 7 percent of shipments.

[27] U.S. industry official, telephone interview with USITC staff, Feb. 7, 2005.
[28] U.S. industry official, telephone interview with USITC staff, Feb. 4, 2005.
[29] Ibid.
[30] U.S. industry official, E-mail correspondence with USITC staff, Jan. 18, 2005.
[31] U.S. industry official, E-mail correspondence with USITC staff, Jan. 21, 2005.

Table 6-21
Steel valve castings: Responding U.S. producers' employees and related information for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Average number of employees[1]	1,723	1,807	1,622	1,480	1,453
Production and related workers:					
Number	1,729	1,861	1,687	1,470	1,312
Hours worked (*1,000 hours*)	2,668	3,107	2,861	2,452	2,504
Wages paid (*1,000 dollars*)	30,679	35,309	33,874	30,057	31,556
Average hourly wages (*dollars per hour*)	11.50	11.36	11.84	12.26	12.60
Productivity (*short tons per 1,000 hours*)	7	7	7	7	7

[1] One producer was only able to provide the number of production and related workers for their establishment, therefore, this figure understates the actual average number of employees for the responding producers.

Note.–Figures may not add to totals because of rounding. Average hourly wages based on establishments that were able to provide both hours worked and wages paid. Productivity based on establishments that were able to provide both production quantity and hours worked.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 6-22
Steel valve castings: Responding U.S. producers' domestic shipments and exports for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Domestic shipments:					
Commercial	14,794	16,511	15,249	13,445	13,835
Internal consumption and transfers	2,284	2,719	2,114	1,694	2,237
Exports	1,041	1,405	1,489	1,073	1,195
Total	18,119	20,635	18,852	16,212	17,267
	Value (*1,000 dollars*)				
Domestic shipments:					
Commercial	116,301	129,333	122,722	117,158	120,428
Internal consumption and transfers	17,517	24,187	21,824	26,071	26,429
Exports	5,401	6,670	7,288	6,131	6,673
Total	139,219	160,190	151,834	149,360	153,530

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

In terms of dollar value, domestic shipments peaked in 2000, then decreased by 7 percent to approximately $120 million by 2003. During this period, one establishment reported a change in product mix from smaller valve castings to larger valve product lines,[32] which is reflected in higher unit values.

***Financial condition*.—**U.S. producers reported irregularly decreasing net sales quantities and irregularly increasing net sales values during 1999-2003 (table 6-23). Throughout the period, and despite decreasing or increasing sales, operating income remained at approximate break-even levels. Ten U.S. producers of rough steel valve castings reported a 14-percent increase in net sales from 1999 to 2000. From this peak, when operating income for the rough castings sector reached $4.6 million in 2000 because of heightened demand, operating income decreased to $3.0 million in 2003. Over the five-year period,

[32] U.S. industry official, E-mail correspondence with USITC staff, Jan. 18, 2005.

Table 6-23
Steel valve castings: Responding U.S. producers' financial results for their rough casting and machining operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Rough castings:					
Net sales:					
Commercial domestic and export sales	16,179	([1])	16,192	14,772	15,423
Internal consumption for production of machined castings	2,247	([1])	2,069	2,073	2,297
Other internal consumption or transfers to related firms	0	0	0	0	0
Total net sales quantities	18,426	20,911	18,261	16,845	17,720
	Value (*1,000 dollars*)				
Net sales:					
Commercial domestic and export sales	([1])	([1])	([1])	([1])	([1])
Internal consumption for production of machined castings	([1])	([1])	([1])	([1])	([1])
Other internal consumption or transfers to related firms	0	0	0	0	0
Total net sales values	151,613	171,818	154,797	154,034	158,718
Operating income	2,226	4,600	3,443	([1])	3,011
	Ratio to net sales (*percent*)				
Operating income	1	3	2	([1])	2
	Number of establishments reporting:				
Operating losses	2	1	1	3	2
Financial results data	9	9	9	9	9
Machined castings:					
Net sales (*short tons*)	2,906	3,424	2,854	3,052	3,346
	Value (*1,000 dollars*)				
Net sales	44,758	53,404	49,107	55,482	([1])
Operating income	([1])	([1])	([1])	([1])	([1])
	Ratio to net sales (*percent*)				
Operating income	([1])	([1])	([1])	([1])	([1])
	Number of establishments reporting:				
Operating losses	0	1	0	0	0
Financial results data	6	6	6	6	6

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and operating income data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

operating margins for rough castings ranged between one and three percent. Of the ten establishments reporting, between one and three reported operating losses during the period under study.

U.S. producers reported higher margins for their sales of machined castings. Operating margins for producers of machined steel valve castings were substantially higher than those of producers of rough steel valve castings, reflecting the higher value-added component of machined steel valve castings versus rough steel valve castings and the expansion and growth of one establishment.[33] Total net sales in short tons of machined castings increased 15 percent between 1999 and 2003 despite declines in sales in 2001 and 2002. In dollar terms, total net sales increased 28 percent over the five-year period. Two establishments reported operating losses in 1999 and 2000.

***Investment*.—**Questionnaire responses show that capital and research and development expenditures fluctuated widely from year to year. U.S. producer questionnaire respondents reported a large increase in capital expenditures from 1999 to 2000, which was mainly because of the expansion of one establishment (table 6-24).[34] Capital expenditures fell in 2001, fell sharply in 2002, and then rose in 2003. One company official cited eroding profitability as a result of increased foreign competition as the cause of the decline in capital expenditures during this period.[35] Another industry official cited a reluctance on the part of U.S. producers to maintain or increase capital expenditures based on projected demand and production levels.[36] U.S. industry representatives reported that the increase in capital expenditures in 2003 was mostly attributable to increases in business gained from closed foundries in the United States. Subsequent increases in profits were channeled into new capital investments.[37] Although some high production shops have increased capital investments and automation to increase efficiency and productivity, industry officials state that capital improvements for labor-intensive job shops are not as cost effective.[38] Research and development expenditures followed a similar pattern as capital expenditures.

Purchaser Trends

Respondents' purchases of both foreign-produced rough and machined steel valve castings more than tripled during 1999-2003, with slightly more purchases of rough steel valve castings than purchases of machined castings during the period. During 1999-2003, the U.S. industry experienced a steady decline in the purchases of rough steel valve castings, but increased its hold of the machined castings sector by the end of the period (table 6-25). Because limited purchasing data were provided by the U.S. purchasers of these castings, specific country details cannot be provided to protect business confidentiality. However, imports from Korea and India dominated the rough castings sector, and were also significant sources of machined castings for U.S. producers. China, however, surpassed both Korea and India as the largest source of U.S. imports of machined castings.

[33] U.S. industry official, E-mail correspondence with USITC staff, Jan. 21, 2005.
[34] Ibid.
[35] Ibid.
[36] U.S. industry official, telephone interview with USITC staff, Feb. 7, 2005.
[37] U.S. industry officials, telephone interviews with USITC staff, Jan. 21, 2005.
[38] Ibid.

Table 6-24
Steel valve castings: Responding U.S. producers' capital and R&D expenditures for their rough casting operations, fiscal years 1999-2003
(*1,000 dollars*)

Item	1999	2000	2001	2002	2003
Machinery, equipment, and fixtures	5,639	11,882	9,062	1,286	2,530
Research and development expenditures	([1])	([1])	([1])	([1])	([1])

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 6-25
Steel valve castings: Purchases of domestic and foreign castings by responding U.S. purchasers, 1999-2003
(*1,000 dollars*)

Year	Total
Rough castings:	
1999	135,890
2000	221,687
2001	271,313
2002	140,109
2003	87,021
Machined castings:	
1999	4,816
2000	10,501
2001	19,710
2002	21,852
2003	21,866

Note.–Domestic and foreign purchases not shown separately to prevent disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Overall U.S. imports for consumption of downstream products of steel valve castings exhibited an upward trend during 1999-2004, increasing approximately 28 percent to over $600 million in 2004 (table 6-26). Downstream products from Canada continued to dominate U.S. imports for consumption, posting a 38-percent gain between 1999 and 2004, despite a decline in demand in 2001 and 2002 because of the U.S. economic downturn. During the same time that Canada and Mexico were experiencing declines in exports to the U.S. market, Chinese exports of downstream products of steel valve castings to the U.S. market more than doubled, while Korea and Taiwan exhibited consistent export growth of 37 percent and 10 percent, respectively, during 1999-2004

Competitive Assessment of Price- and Product-related Factors

***Price and non-price factors*.—**U.S. producer questionnaire respondents reported that the prices of rough castings produced in Brazil, China, India, and Mexico ranged between 34 percent and 57 percent lower than the price of similar castings produced in the United States (table 6-27). Four U.S. producer respondents cited China as having the lowest priced rough castings. U.S. producers reported that machined castings produced in Brazil, China, India, Korea, and Mexico ranged between 40 percent and 65 percent lower than similar machined castings produced in the United States. U.S. producers cited Brazil and China

Table 6-26
Steel valve castings: U.S. imports for consumption of downstream products, by leading suppliers, 1999-2004

(***1,000 dollars***)

Country	1999	2000	2001	2002	2003	2004
Canada	78,960	96,324	106,460	88,007	97,656	108,666
China	40,706	45,319	51,538	53,728	64,567	99,685
Korea	44,344	50,086	52,732	53,083	62,288	61,067
Taiwan	52,557	62,911	59,074	53,813	56,117	57,702
Italy	37,779	40,380	45,228	51,169	41,172	44,434
Mexico	49,436	64,302	61,481	40,321	33,217	38,554
India	10,866	15,448	24,019	23,788	25,431	32,119
Romania	6,754	11,722	18,945	9,252	15,974	24,461
Japan	32,285	30,230	28,963	23,802	19,666	22,944
Germany	28,593	21,943	22,045	18,454	17,575	19,692
All other	93,480	114,930	104,703	106,538	89,986	98,293
Total	475,760	553,595	575,188	521,955	523,649	607,617

Note.–Downstream products include steel taps, cocks, and valves, and steel parts for these products (HTS classifications 8481.30.20 and 8481.80.30). Figures may not add to totals because of rounding.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 6-27
Steel valve castings: Price comparison by responding U.S. producers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Brazil	Lower	2	39
China	Lower	4	57
India	Lower	3	54
Mexico	Lower	2	34
Machined castings:			
Brazil	Lower	2	65
Canada	About the same	1	([1])
China	Lower	3	66
India	Lower	3	57
Korea	Lower	1	60
Mexico	Lower	1	40
Other	About the same	1	([1])

[1]Not applicable.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

as the lowest priced producers. Based on price comparisons, U.S. producers of machined castings are at more of a competitive disadvantage vis-à-vis foreign producers than are U.S. producers of rough castings.

U.S. purchasers questionnaire respondents reported smaller price differentials for rough steel valve castings from most suppliers than did U.S. producers, indicating significant differences between perceived and actual prices (table 6-28). Purchasers reported that prices of foreign-produced rough castings were between 15 percent and 33 percent lower than similar machined castings purchased in the United States. U.S. purchasers reported that rough castings purchased in China had the largest price differential (33 percent) compared to domestic U.S. prices.

Table 6-28
Steel valve castings: Price comparison by responding U.S. purchasers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
China	Lower	4	33
Eastern Europe[1]	Lower	1	25
India	Lower	3	35
Korea	Lower	4	25
Mexico	Lower	2	15
Taiwan	Lower	2	23
Machined castings:			
Canada	About the same	1	([2])
China	Lower	12	39
China	About the same	1	([2])
EU-15	Lower	1	20
EU-15	About the same	2	([2])
Eastern Europe	Lower	1	50
India	Lower	6	42
Korea	Lower	2	18
Taiwan	Lower	5	29
Thailand	Lower	1	15

[1] Includes Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Poland, Romania, Slovakia, Slovenia, and Yugoslavia (Serbia and Montenegro).
[2] Not applicable.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

U.S. purchaser respondents reported that China is in the best competitive position vis-à-vis India, Korea, Taiwan, and the EU-15 to influence purchaser decisions to expand purchases from foreign suppliers. Out of 39 responses, approximately one-third cited better delivery times, better range or variety of products, better reliability of supply, better warranty terms, better technical support, and lower transportation costs as the main competitive factors in China that influence purchaser decisions. Competitive positioning of each country relative to one another does not appear to be based on price, as better U.S. delivered price as a decisive competitive factor only drew minimal responses.

***Producers' response to import competition*.—**In response to the Commission's questionnaire, nine establishments noted that they had implemented cost-reduction efforts, including plant consolidations, reductions in capital expenditures, and lean manufacturing processes (table 6-29) .[39] Eight establishments had lowered prices or suppressed price increases for steel valve castings, and seven establishments had cut back or eliminated production. Six establishments reported reducing or eliminating plans to expand existing capacity. One industry representative expressed concern that continued downward pricing pressure because of foreign competition would result in further reduction of capacity and a deterioration of the industry.[40]

[39] U.S. industry officials, telephone interviews by USITC staff, Jan. 21, 2005.
[40] Ibid.

Table 6-29
Steel valve castings: Responding U.S. producers' responses to import competition

Nature of response	Number of responses
Total number of establishments responding	10
Took no or few actions because:	
Had already shifted production to more advanced types of castings	3
Had already shifted production to other lines of castings	2
Lacked capital funds to counter foreign competition	1
Took the following actions:	
Lowered prices or suppressed price increases	8
Reduced or dropped plans to expand capacity	6
Cut back or eliminated production	7
Closed production lines	3
Shifted to other cast products	4
Implemented cost-reduction efforts	9
Improved product quality	7
Imported product instead	1
Other	1

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

CHAPTER 7
U.S. ALUMINUM FOUNDRY INDUSTRY

This chapter provides an overview of the U.S. aluminum foundry industry, based on responses to the USITC producer and purchaser questionnaires, fieldwork, and interviews with leading industry participants. The chapter begins with a discussion of the structure of the industry and leading demand characteristics, followed by an analysis of various business trends, production factors, and domestic policies, and concluding with a discussion of purchasing trends.

The U.S. aluminum foundry industry provides notable contrasts to other metal-type foundry industries. Responding foundries vary widely in size but with none large enough to dominate production. The firms are mostly job shops, and a high portion are die casters. Unlike other metal-type castings, aluminum castings are sold predominantly as components for the automotive industry, as U.S. aluminum foundries are integrated into the automotive components supply chain. Moreover, aluminum foundries have benefitted at the expense of iron from material substitution by the automotive industry's efforts to reduce overall vehicle weight and improve fuel efficiency. Responding foundries that also machined aluminum castings exhibited stronger financial performance than those with solely rough casting operations. Unlike other metal-type segments, the aluminum foundry industry is also noted for maintaining significant levels of capital investment not only to convert facilities from iron to aluminum casting, but also to take advantage of advances in aluminum casting technology.

Of the 465 establishments responding to the foundry questionnaire, 195 establishments reported producing aluminum castings in the United States during 1999-2003. The American Foundry Society (AFS) also collects information on the foundry industry based on metal types. Questionnaire data collected by the USITC account for 75 percent of aluminum foundry production in 2003 as reported by the AFS.[1] Of 463 U.S. purchasers responding to the foundry questionnaire, 197 firms reported purchasing aluminum-based castings. Results from the producer and purchaser questionnaires are discussed in this chapter to provide not only an overview of the aluminum foundry industry, but also more product-specific analysis of aluminum and aluminum alloy engine parts and aluminum suspension and steering parts castings.[2]

Industry Profile

Industry Structure

Aluminum foundry firms are diverse in size. There are no firms that account for a significant percentage of production and the size of firms predominately ranges from less than 100 to fewer than 300 employees. Most of the 35 firms with employment over 300 are captive foundries or dedicated Tier 1 suppliers to the automotive industry. Responding foundries that cast aluminum are concentrated primarily in Pennsylvania and Indiana.

[1] AFS, "38th Annual Census of World Casting Production–2003," *Modern Casting*, Dec. 2004, p. 26.

[2] Of the 195 establishments reporting production of aluminum castings, 39 respondents reported information on aluminum engine component castings and 28 reported information on aluminum suspension/steering component castings. Of the 184 purchasers reporting information on aluminum castings, 45 respondents reported purchases of aluminum engine component castings and 24 respondents reported purchases of aluminum suspension/steering component castings.

Establishments reporting production of aluminum rough castings refer to themselves as job shops, and production is split between those producing a limited number of products in high quantities and a broad number of products in low quantity runs. Leading products produced are automotive components, such as engine blocks, wheels, cylinder heads, and manifolds. Production related activities performed at reporting establishments are not as diverse as those of foundries that cast other metals. Much of the pattern and mold-making is performed off-site (table 7-1). Over one-half of the establishments reported that they are die casters whose castings are predominately for the automotive industry, of which over 50 percent are used in power trains.[3]

Table 7-1
Aluminum foundries: Establishment activities of responding producers

Activity	Number responding that performed activity	Average percentage performed in-house
Total establishments reporting = 172		
Design of rough castings	74	59
Pattern making	35	59
Mold making, expended type	43	86
Mold/die making, permanent type	60	47
Machining of rough castings	136	71
Downstream manufacture	42	68

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Demand Characteristics

About 73 percent of aluminum castings are intended for the automotive industry (table 7-2), which is the largest market for aluminum castings and cast products make up more than one-half of the aluminum used in automobiles.[4] Aluminum's light weight is attractive to auto manufacturers seeking to reduce vehicle weight to improve fuel efficiency and reduce emissions.[5] According to responses to the USITC producer questionnaire and staff interviews, the trend toward lighter materials is driving the aluminum casting industry.[6]

While there is increased demand for aluminum components in automobiles, producers indicate that the automotive market is a highly competitive, low-margin segment.[7] If producers can maintain high-volume, then they can be competitive. However, in times of economic downturn such as 2001, when sales and demand declined, producers are immediately affected by the shift. For example, the market for large highway trucks declined in 2001,[8] negatively affecting producers for that market segment.[9]

---

[3] "Die Castings End Users - 2003," Leggett and Platt Aluminum Group, found at *http://www.legaluminum.com/graphics/faq_intro_04.jpg*, retrieved Mar. 9, 2005.

[4] Aluminum Association, found at *http://www.aluminum.org/Content/NavigationMenu/The_Industry/-Castings/Castings.htm*, retrieved Jan. 12, 2005.

[5] Christina A. Stutovich, Counter Intelligence: Engine Parts, *Aftermarket Business*, Aug. 25, 2003.

[6] U.S. industry officials, interview by USITC staff, United States, June 23 and 24, 2004; and multiple responses to the producer questionnaire.

[7] Multiple producers questionnaires; and U.S. industry officials, telephone interview with USITC staff, Feb. 7, 2005 and Feb. 8, 2005.

[8] For more detail, see Chapter 3: U.S. Foundry Industry.

[9] Multiple producer questionnaires; and U.S. industry official, telephone interview with USITC staff, Feb. 2, 2005.

Table 7-2
Aluminum foundries: End market for responding U.S. producers' shipments, 2003
(*Percent*)

End market	Share of 2003 shipments of castings by quantity
Motor vehicles:	
Automobiles (including light duty trucks, SUVs, vans, etc.)	73
Trucks	5
Other (buses, motor homes, etc.)	2
Farm and garden machinery and equipment	7
Refrigeration, air conditioning, and heating equipment	1
Industrial machinery	1
Household appliances	3
Construction/municipal castings	1
Ships and boats	2
Other/unknown	5
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Only 46 percent of aluminum foundries indicated that they machine castings in-house (table 7-3), of which 80 percent are sold to OEMs for incorporation into downstream products. Few aluminum foundries finish and assemble final products for sale. The share of sales of rough castings to machined castings by respondents has remained stable over the past five years.

Producer Trends

Capacity, Production, Inventories, and Shipments

Production, capacity, and shipments of aluminum castings increased during 1999-2003 (by 15 percent, 35 percent, and 20 percent, respectively), reflecting growing worldwide demand for aluminum products, particularly in automotive applications (tables 7-4 and 7-5). Specifically, producers indicated that shifts made by the Big Three auto manufacturers (General Motors, Ford, and the Chrysler division of DaimlerChrysler) directly affected their operations, as production lines were expanded or modified to accommodate new business. For example, from 1999-2003, Ford reconfigured the F-150 to include more aluminum components. For a few firms, an increase in the diameter of wheels for Ford and GM vehicles, from 15 inches to 18 inches over the period,[10] led to increased production and shipments. In addition, components such as knuckles and control arms were converted from ductile iron to aluminum. In anticipation of growing demand, producers increased capacity faster than shipments grew, so capacity utilization dropped over the period.

Growth also occurred in the value of internal consumption and transfers as many firms, such as Ford, set up captive foundries to accommodate new product lines. Additionally, a number of mergers and acquisitions took place as firms shifted towards aluminum, which expanded pouring capabilities for

[10] U.S. industry officials, telephone interviews by USITC staff, Jan. 12, 2005 and Feb. 7, 2005.

Table 7-3
Aluminum foundries: Responding U.S. producers' shipments, by channel of distribution, 2003
(*Percent*)

Channel of distribution	Share of 2003 shipments of by quantity
Rough castings:	
In-house machining	46
Machining subcontractor	8
Machine shop/other fabricators	5
Distributors	([1])
Original equipment manufacturers (OEM)	39
Other	3
Total	100
Machined castings:	
Distributors	4
Original equipment manufacturers (OEM)	80
In-house for use in downstream products	15
Other	1
Total	100

[1]Less than 0.5 percent.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-4
Aluminum foundries: Responding U.S. producers' capacity, production, and inventories for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Capacity (short tons)	1,984,306	2,059,350	2,168,378	2,460,681	2,676,496
Production (short tons)	1,271,861	1,448,825	1,241,855	1,409,842	1,458,699
Capacity utilization (*percent*)	73	73	59	59	56
Inventory:					
Total (short tons)	67,358	80,183	72,550	78,604	77,851
Share of production (*percent*)	6	6	7	6	6

Note.–Figures may not add to totals because of rounding. Capacity utilization based on establishments that were able to provide both capacity and production amounts. Inventory share of production based on establishments that were able to provide both inventory and production amounts.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

downstream producers of products using aluminum castings. For example, Budd, a subsidiary of ThyssenKrupp, acquired Stahl Specialty and merged it into Waupaca Foundry (ThyssenKrupp's U.S. division), one of the largest cast-iron foundry companies in the country. This deal expanded Waupaca's aluminum pouring capabilities by over 45 million pounds per year.[11]

[11] Al Wrigley, "Budd Buy Seen Proof of New Merger Wave," *American Metal Market*, June 28, 2000, Vol. 108, Issue 124, p. 16.

Employment

During 1999-2003, employment and hours worked within the aluminum castings industry fluctuated and was slightly lower in 2003 than in 1999 (table 7-6). The growth in productivity was pronounced from 2001 through 2003, increasing by 4 percentage points to 24 short tons/1,000 hours. At $19.57 per hour, wages in 2003 were $2 per hour more than the average for all metal types. As many aluminum foundries are leading Tier 1 suppliers, wages in the industry tend to positively correlate to wages for the automotive industry, which are commonly union shops. Additionally, wholly owned suppliers for foreign automotive firms, such as Nissan and Toyota, have stable, long-term arrangements with their parent and can afford to pay higher salaries than foundries for other metal types.[12]

Table 7-5
Aluminum foundries: Responding U.S. producers' domestic shipments and exports for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Domestic shipments:					
Commercial	512,837	516,986	497,412	570,947	572,656
Internal consumption and transfers	677,497	748,046	632,263	721,600	724,003
Exports	59,730	65,654	61,394	63,128	65,127
Total	1,250,064	1,330,686	1,191,069	1,355,675	1,361,786
	Value (*1,000 dollars*)				
Domestic shipments:					
Commercial	2,416,678	2,382,009	2,332,086	2,537,722	2,599,531
Internal consumption and transfers	2,404,498	2,958,701	2,764,895	3,120,471	3,198,242
Exports	234,840	281,569	265,302	264,136	275,527
Total	5,056,016	5,622,279	5,362,283	5,922,329	6,073,300

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-6
Aluminum foundries: Responding U.S. producers' employees and related information for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Average number of employees	34,122	35,863	33,755	34,057	33,643
Production and related workers:					
Average number	28,968	30,528	28,518	28,874	28,338
Hours worked (*1,000 hours*)	59,182	61,886	58,815	59,781	59,029
Wages paid (*1,000 dollars*)	1,008,065	1,072,406	1,076,861	1,160,001	1,153,172
Average hourly wages (*dollars per hour*)	17.04	17.33	18.46	19.43	19.57
Productivity (*short tons per 1,000 hours*)	20	22	20	23	24

Note.–Figures may not add to totals because of rounding. Average hourly wages based on establishments that were able to provide both hours worked and wages paid data. Productivity based on establishments that were able to provide both production quantity and hours worked data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[12] U.S. industry official, telephone interview with USITC staff, Nov. 2, 2005.

Financial Condition

Rough Castings

The aluminum foundry industry recovered from period lows for many financial indicators in 2001, as operating income rebounded in 2003 to surpass 1999 levels by 12 percent (table 7-7). The impact of the 2001 downturn is reflected in the sharp increase in firms reporting operating losses, which increased from 25 percent of reporting firms in 2000 to 36 percent in 2001. While total net sales quantities increased marginally, the overall value increased significantly, by $1.2 billion between 1999 and 2003, as many firms produced more complex, higher-priced castings for automotive applications.

Raw materials costs grew significantly throughout the period, and the ratio of raw materials costs to net sales was comparatively higher than that for other metals (by at least 5-percentage points). This correlates to the higher relative costs for aluminum than inputs for foundries of other metal types. One component in the increase of raw materials cost was an increase in the cost of secondary aluminum in 2002, which one company estimated cost an additional $1.2 million in the second quarter of 2002 compared to the first.[13]

Energy costs peaked in 2001, before declining by 2003, yet still grew 65 percent between 1999 and 2003 (see table 7-7). Average unit values for energy followed similar trends, reflecting the fluctuating costs of natural gas and electricity over the period (table 7-8). Labor costs for rough aluminum castings remained fairly stable through the period, reflecting the high, but more stable union driven wages for aluminum foundry workers.

Producers making a limited number of products were the most affected by the 2001 downturn, shifting from profits to a $113 million loss in 2001 (table 7-9). These companies are highly dependent on their customer, and if the customer has a change in demand, it is reflected in the profits of the foundry. Many of these firms are captive producers, and, due to company restructuring throughout the captive producer class, these firms showed a profit by 2002.

Machined Castings

Responding foundries that also machined aluminum castings exhibited stronger financial conditions than those with solely rough casting operations (table 7-10). While operating income for machined aluminum castings declined over the period, it did not experience the same fluctuations as operating income for rough castings. Further, operating income as a percentage of net sales for machined castings was significantly higher than that for rough operations.

[13] "Intermet Sees Surge in Raw Materials Prices," June 24, 2002, found at *http://www.intermet.com/latest/2002/rawmat.html*, retrieved Feb. 2, 2004.

Table 7-7
Aluminum foundries: Responding U.S. producers' financial results for their rough casting operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Net sales:					
Commercial domestic and export sales	443,488	460,058	457,442	527,481	535,864
Internal consumption for production of machined castings	524,316	594,552	496,329	572,818	575,017
Other internal consumption or transfers to related firms	70,058	101,941	86,056	100,882	109,235
Total net sales quantities	1,037,862	1,156,551	1,039,827	1,201,181	1,220,116
	Value (*1,000 dollars*)				
Net sales:					
Commercial domestic and export sales	2,014,474	2,124,063	2,117,750	2,365,809	2,408,721
Internal consumption for production of machined castings	1,663,512	2,015,184	1,911,239	2,146,721	2,207,483
Other internal consumption or transfers to related firms	321,499	511,902	461,868	519,307	570,905
Total net sales values	3,999,485	4,651,149	4,490,857	5,031,837	5,187,109
Cost of goods sold:					
Raw materials	1,479,085	1,686,039	1,617,444	1,947,748	1,994,908
Direct labor	724,937	789,619	795,516	870,095	887,931
Energy	130,715	185,160	222,273	201,406	215,938
Other factory cost	1,206,744	1,480,284	1,534,793	1,569,428	1,566,872
Total cost of goods sold	3,541,481	4,141,102	4,170,026	4,588,677	4,665,649
Gross profit	458,004	510,047	320,831	443,160	521,460
Selling, general, and administrative	202,192	242,940	243,221	231,579	234,539
Operating income	255,812	267,107	77,610	211,581	286,921
Other income and expenses:					
Interest expense	51,095	53,002	50,587	37,437	32,045
All other expenses and income	41,129	53,518	97,761	-2,637	31,684
Net income before taxes	163,588	160,587	-70,738	176,781	223,192
Depreciation/amortization	206,112	222,078	254,808	268,358	284,390
	Ratio to net sales (*percent*)				
Raw materials	37	36	36	39	38
Direct labor	18	17	18	17	17
Energy	3	4	5	4	4
Other factory cost	30	32	34	31	30
Cost of goods sold	89	89	93	91	90
Gross profit	11	11	7	9	10
Selling, general, and administrative	5	5	5	5	5
Operating income	6	6	2	4	6
	Number of establishments reporting:				
Operating losses	35	38	56	47	48
Financial results data	139	150	154	155	156

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and cost data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-8
Aluminum foundries: Selected financial unit values for responding U.S. producers' rough casting operations, fiscal years 1999-2003

(***Dollars per short ton***)

Item	1999	2000	2001	2002	2003
Total sales unit value	3,854	4,022	4,319	4,189	4,251
Raw material cost	1,425	1,458	1,555	1,622	1,635
Direct labor cost	698	683	765	724	728
Energy cost	126	160	214	168	177
Other factory cost	1,163	1,280	1,476	1,307	1,284
Total cost of goods sold	3,412	3,581	4,010	3,820	3,824
Gross profit	441	441	309	369	427

Note.–Figures may not add to totals because of rounding. For each of the above items, unit values calculated only where establishment provided both value and quantity data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-9
Aluminum foundries: Selected financial information for U.S. producers' rough casting operations for specified classes, fiscal years 1999-2003

(***1,000 dollars***)

Class/item	1999	2000	2001	2002	2003
Job shops:					
Total net sales	2,097,337	2,342,145	2,096,384	2,238,331	2,245,729
Operating income	169,809	187,315	127,453	178,064	190,718
Net income	113,492	155,307	102,899	154,467	172,047
Captive producers:					
Total net sales	1,459,993	1,614,687	1,742,561	2,106,476	2,189,277
Operating income	5,810	11,167	-20,750	13,029	53,103
Net income	-24,733	-46,797	-127,324	17,661	34,994
Limited number of products:					
Total net sales	2,623,673	2,984,566	2,979,150	3,500,518	3,639,238
Operating income	155,733	155,743	17,136	114,758	189,637
Net income	75,370	62,710	-113,410	99,804	139,333
Broad number of products:					
Total net sales	882,245	948,024	862,140	853,135	861,263
Operating income	43,543	58,511	26,647	43,337	65,799
Net income	34,513	54,823	19,290	34,161	58,494
Die casters:					
Total net sales	2,875,479	3,221,402	2,987,273	3,284,961	3,470,216
Operating income	209,107	238,045	125,127	181,050	212,697
Net income	148,769	193,565	92,950	152,201	184,085

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-10
Aluminum foundries: Responding U.S. producers' financial results for their machining operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
Net sales (*short tons*)	499,515	509,627	429,278	495,533	486,760
	Value (*1,000 dollars*)				
Net sales	2,397,938	2,684,394	2,378,836	2,687,200	2,588,568
Cost of goods sold:					
Rough castings produced	1,393,645	1,549,642	1,348,347	1,454,488	1,486,657
Rough castings purchased from other companies	2,441	11,597	52,702	68,169	66,510
In-house machining costs	580,349	647,816	566,187	713,577	661,235
Subcontracted machining costs	17,121	20,934	22,517	26,141	30,212
Other machining costs	36,463	39,836	38,826	72,898	77,584
Total costs of goods sold	2,030,019	2,269,825	2,028,579	2,335,273	2,322,198
Gross profit	367,919	414,569	350,257	351,927	266,370
Selling, general, and administrative	69,264	128,975	125,866	86,668	85,602
Operating income	298,655	285,594	224,391	265,259	180,768
	Ratio to net sales (*percent*)				
Cost of goods sold	85	85	85	87	90
Gross profit	15	15	15	13	10
Selling, general, and administrative	3	5	5	3	3
Operating income	12	11	9	10	7
	Number of establishments reporting:				
Operating losses	18	19	19	22	22
Financial results data	86	90	92	92	93

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and cost data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Raw Materials and Energy

Between 1999 and 2003 the share of scrap to primary aluminum as inputs to the casting process remained fairly stable (table 7-11). The drop in the cost share of aluminum scrap in 2000 corresponds to an increase in aluminum ingot prices during that year. In late 2003 and early 2004, however, firms reported shifting back to primary aluminum. According to producers, the market for aluminum scrap has tightened considerably, and it is hard to obtain.[14] Further, the industry may shift from scrap because melting aluminum scrap causes foundries to surpass acceptable pollution limits dictated by the EPA.[15] To meet these new standards, aluminum scrap must be free of paint, coating, and lubricants, or measures need to be taken to prevent release of dioxin and furan, which can cause cancer and other illnesses.[16] By 2000, many aluminum foundries had converted to natural gas furnaces in response to the relatively low cost of natural gas at the time (table 7-12). However, natural gas costs rose by 2003, accounting for a higher percentage of total energy costs.[17]

[14] U.S. industry official, telephone interview with USITC staff, Feb. 8, 2005, and for more information, see Chapter 3: U.S. Foundry Industry.

[15] U.S. industry official, telephone interview with USITC staff, Feb. 8, 2005.

[16] Paul Schaffer, “Conn. Foundry Faces $65,750 EPA Penalty,” *American Metal Market*, Sept. 20, 2004, Vol. 112, Iss. 38, p. 14.

[17] U.S. industry officials, telephone interviews with USITC staff, Feb. 2 and 7, 2005.

Labor

During 1999-2003 employment costs increased by 17 percent despite the decline in employees and hours worked during 1999-2003 (table 7-13 and see table 7-6). These shifts were in line with shifts occurring throughout the manufacturing industry. The cost of health benefits grew 41 percent, slightly higher than the increase for metal foundries as a group.[18] Employee training costs were relatively high compared with other metal castings mainly owing to training for new aluminum castings processes.[19]

Table 7-11
Aluminum foundries: Share of total metal raw material costs for responding U.S. producers' rough casting operations, fiscal years 1999-2003

(***Percent***)

Item	1999	2000	2001	2002	2003
Primary metals in scrap form	18	15	18	18	18
Primary metals in other forms	68	72	71	72	73
Other metal	13	12	11	10	9
Total	100	100	100	100	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-12
Aluminum foundries: Share of total energy costs for responding U.S. producers' rough casting operations, fiscal years 1999-2003

(***Percent***)

Item	1999	2000	2001	2002	2003
Electricity	51	46	42	46	43
Natural gas	47	52	57	52	56
Other	2	2	1	1	1
Total	100	100	100	100	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-13
Aluminum foundries: Responding U.S. producers' employment costs for their rough casting operations, fiscal years 1999-2003

(***1,000 dollars***)

Item	1999	2000	2001	2002	2003
Salaries and wages (including overtime)	1,188,737	1,252,618	1,279,031	1,353,239	1,343,493
Health benefits	154,382	172,289	182,062	199,158	218,304
Pension and profit sharing	52,917	54,950	61,716	58,367	74,052
Other costs	119,079	128,196	138,409	139,104	146,906
Employee training	8,861	9,014	7,877	7,642	7,627
Total employee costs	1,523,976	1,617,067	1,669,095	1,757,510	1,790,382

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[18] For more details, see Chapter 3: U.S. Foundry Industry.
[19] U.S. industry official, telephone interview with USITC staff, Feb. 3, 2005.

Investment and Debt

Aluminum foundries maintained significant levels of capital investment and research and development expenditures throughout the 5-year period, spending over $1.8 billion in total capital expenditures and $339 million for research and development (table 7-14). Original costs grew over the period as companies maintained purchases of capital, averaging $303 million in capital spending each year (table 7-15). This reflects the expenditures necessary to convert facilities from iron castings to aluminum castings to meet automotive demand, along with significant advances in aluminum casting technology over the period.

Purchaser Trends

Reflecting increasing demand for aluminum foundry products, purchases of aluminum-based castings by downstream industries increased from 1999 to 2003 (table 7-16). While purchases of domestic castings remained significantly higher than foreign origin castings throughout the period, growth in purchases of foreign origin castings outpaced domestic castings for both the rough and machined segments. Purchases of Japanese machined aluminum castings increased the most (table 7-17), reflecting an increased presence of production facilities for Japanese automobiles in the United States.

Table 7-14
Aluminum foundries: Responding U.S. producers' capital and R&D expenditures for their rough casting operations, fiscal years 1999-2003

(***1,000 dollars***)

Item	1999	2000	2001	2002	2003
Capital expenditures:					
Machinery, equipment, and fixtures:					
Environmentally related	11,147	8,290	2,406	5,037	1,969
Other	350,345	325,167	300,265	269,236	241,898
Land, building, and related improvements	47,575	83,222	74,944	37,130	52,195
Total	409,067	416,679	377,615	311,403	296,062
Research and development expenditures	48,509	117,184	83,554	40,638	48,843

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-15
Aluminum foundries: Other financial information for responding U.S. producers' rough casting operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
Total debt (*1,000 dollars*)	806,416	829,960	731,468	985,860	870,201
Property, plant, and equipment:					
Original cost (*1,000 dollars*)	3,444,618	3,984,358	4,425,582	4,672,910	5,167,086
Book value (*1,000 dollars*)	1,888,055	2,118,506	2,214,315	2,190,809	2,211,000

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-16
All aluminum castings: Total reported U.S. purchases of domestic and foreign castings, 1999-2003
(*1,000 dollars*)

Type	1999	2000	2001	2002	2003
Rough castings:					
Domestic	896,510	1,000,727	950,540	1,191,412	1,213,916
Foreign	74,104	111,531	122,376	110,545	113,253
Total	970,614	1,112,258	1,072,916	1,301,957	1,327,169
Machined castings:					
Domestic	[1] 949,185	1,046,396	1,080,347	1,227,970	1,304,567
Foreign	500,809	547,296	720,464	686,330	726,742
Total	1,449,994	1,593,692	1,800,811	1,914,300	2,031,309

[1] Domestic castings purchases for 1999 include purchases of castings from unknown sources to prevent disclosure of confidential business information.

Note.–These data do not indicate all purchases of castings in the United States. See ch. 1 for additional information on data coverage.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Table 7-17
All aluminum product groups: Total reported U.S. purchases of domestic and foreign castings, 1999-2003
(*1,000 dollars*)

Country or region[1]	1999	2000	2001	2002	2003
Rough castings:					
Domestic	181,387	238,716	211,814	270,159	295,278
Foreign:					
Korea	([2])	([2])	([2])	([2])	([2])
Japan	([2])	([2])	([2])	([2])	([2])
All other	13,733	16,030	16,606	19.984	19,035
Total, foreign purchases	27,118	37,505	41,675	44,500	43,837
Machined castings:					
Domestic	560,701	555,543	584,496	646,414	770,810
Foreign:					
Japan	20,596	40,588	81,732	90,098	79,560
Brazil	30,114	56,986	39,821	40,520	45,644
EU15	([2])	([2])	([2])	([2])	([2])
China	([2])	([2])	([2])	([2])	([2])
All other	11,443	14,112	19,563	36.704	20,258
Total, foreign purchases	66,448	115,373	144,368	171,859	154,110

[1] Countries and regions are mutually exclusive
[2] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. Includes purchases of aluminum engine components and aluminum suspension parts. Product group data combined to prevent disclosure of confidential business information.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Product Profiles

Aluminum Engine Component Castings

Industry Profile

Product Description and Uses

Motor-vehicle engines (rotary internal combustion and spark-ignition) are comprised of a number of parts, including such principal components as intake manifolds, exhaust manifolds, pistons, and connecting rods. These parts are often manufactured from aluminum alloys because of their light weight and relative strength. These parts all serve distinct functions within an engine. The intake manifold supplies the air-fuel mixture to the cylinders by means of pipes connecting the carburetor of fuel injection system and intake valves. The exhaust manifold performs a similar function, connecting the exhaust valves with the exhaust pipe to release engine exhaust. Pistons are cylindrical pieces of metal, closed at one end, that move up and down inside the cylinders. They are connected to the crankshaft by connecting rods, which can rotate at both ends to adjust to the change in piston and crankshaft positions and movements.

Industry structure. **–**Thirty-nine manufacturers responding to the USITC questionnaire reported production of aluminum engine components, many of which are leading suppliers of automotive subassemblies and modules in addition to cast aluminum components. These firms are largely located in the Midwest and Mid-Atlantic regions near motor-vehicle production centers to provide responsive service to their customers. Most of these manufacturers are large, multi-product companies that principally use sand or die casting to manufacture aluminum engine components. A few foundries cast these products using the permanent mold process. In addition to casting, most responding foundries largely perform some machining. Less than one-half of respondents, however, perform any other casting-related operations, such as mold making, casting design, or pattern making. The majority of reporting producers indicated that their customers required certification of their establishments, with ISO9000/14000 the most common certifications.

Demand characteristics.**—**U.S. foundries reporting for this industry indicated that 49 percent of rough castings were retained for in-house machining to supply OEMs (i.e., automakers), which accounted for three-fourths of the machined castings shipped for use in vehicle engines (table 7-18). By retaining these castings in house for machining, these foundries provide a higher-valued product. Overall, the motor vehicle industry accounted for 71 percent of U.S. producers' castings shipments used as aluminum or aluminum alloy engine components (table 7-19), while 29 percent of these castings shipments were destined for machinery and equipment for use in engines to power lawn mowers and tractors, for example.

The U.S. market for aluminum castings used as engine components is primarily influenced by trends in the motor-vehicle industry, particularly North American motor-vehicle production levels asa well as efforts to reduce motor-vehicle engine weight to improve fuel economy and reduce emissions. Moreover, aluminum engine components are seeing increased use in motor-vehicle engine applications because of their relative strength and good recycling characteristics,[20]despite a few manufacturing difficulties associated with the use of aluminum (e.g., joining of components) and its higher cost than steel. For example, General Motors (GM) switched from cast iron to aluminum for the cylinder heads and to aluminum or composite plastic for the intake manifolds of its V6 and V8 engines.[21] GM's Vortec V-8, to be installed on 2006 model Monte Carlos and Impalas, includes aluminum oil pans, chain cases, water pumps, and pistons.

[20] Anna Kochan, "Higher Volume Cars to Test Aluminum," *Automotive News*, Jan. 29, 2002.
[21] Hearing submission of ASC Industries, Inc., Foundry White Paper, p. 4.

Table 7-18
Aluminum engine component castings: Responding U.S. producers' shipments, by channel of distribution, 2003
(*Percent*)

Channel of distribution	**Share of 2003 shipments of castings by quantity**
Rough castings:	
In-house machining	49
Machining subcontractor	17
Machine shop/other fabricators	14
Distributors	3
Original equipment manufacturers	17
Other	([1])
Total	100
Machined castings:	
Distributors	9
Original equipment manufacturers	75
In-house for use in downstream products	18
Total	100

[1]Less than 0.5 percent.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-19
Aluminum engine component castings: End market for responding U.S. producers' shipments, 2003
(*Percent*)

End market	**Share of 2003 shipments of castings by quantity**
Motor vehicles:	
Automobiles (including light duty trucks, SUVs, vans, etc.)	66
Trucks	5
Farm and garden machinery and equipment	25
Household appliances	1
Other/unknown	3
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

The trend to parts commonality and interchangeability in vehicle platforms has also improved aluminum penetration in the engine sector.[22] General Motors announced that about 75 percent of its Vortec I-5 and I-4 truck engine components would be shared with the Vortec 4200 I-6 engine, and that 89 percent of components would be shared between the 3.5 liter I-5 and 2.8 liter I-4 engines.[23]

[22] Al Wrigley, "GM retools for new aluminum engine family," *American Metal Market*, Oct 29, 2001.
[23] "General Motors engines will share components," *American Metal Market*, Oct. 4, 2002, found at *http://www.amm.com*, retrieved Feb. 17, 2005.

Producer Trends[24]

Production and inventories.—Despite a decline in U.S. motor vehicle production during the period,[25] reported U.S. production of aluminum engine component castings fluctuated during the 1999-2003 but posted a 41-percent total increase to 240,936 short tons in during 1999-2003, in part a response to greater emphasis on reducing motor-vehicle engine weight to improve fuel economy and reduce emissions (table 7-20). Inventory levels declined slightly during the period to 4 percent of production volume in 2003, driven in part by the continued shift to just-in-time delivery by the motor vehicle industry to reduce warehouse and storage costs incurred with large inventories.

Employment.—Based on questionnaire responses, productivity in the aluminum engine component sector rose by a total of 33 percent during 1999-2003 to 20 short tons per hour (table 7-21), which exceeds the overall aluminum foundry industry reported productivity increase of 20 percent. This improvement was achieved in part through greater application of automation and computer-controlled equipment, as well as employment cutbacks. Despite a 5-percent decline in total employment, the average number of production and related workers in the industry remained relatively constant, indicating greater reductions in non-production related employment. As a result of these cutbacks, the number of hours worked and the amount of wages paid also experienced slight declines. The average hourly wage remained relatively constant between $13.00 to $14.00, reflecting in part U.S. producers' ongoing efforts to control labor costs at a time of increased price pressure and competition from low-cost producers. The 2003 hourly wage was 25 percent less than that earned by U.S. workers employed by the overall aluminum foundry industry ($17.57).[26]

Table 7-20
Aluminum engine component castings: Responding U.S. producers' production and inventories for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Production (short tons)	170,453	223,862	189,005	219,624	240,936
Inventory:					
Total (short tons)	8,611	11,400	10,783	11,855	10,724
Share of production (percent)	6	6	6	6	5

Note.–Figures may not add to totals because of rounding. Inventory share of production based on establishments that were able to provide both inventory and production amounts.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[24] Certain data have been withheld to avoid disclosure of business confidential information. These data include export quantity, breakouts of internal net sales quantities, operating income and related ratios, and research and development.

[25] Motor vehicle production declined by 8 percent overall during 1999-2003, to 16.2 million vehicles. The period low was reached during the economic downturn of 2001, when vehicle output totaled 15.8 million units. "North American Car & Truck Production, 1954-2003," *2004 Ward's Automotive Yearbook*, p. 117.

[26] See table 7-6, Aluminum castings: Responding U.S. producers' employees and related information for their rough castings operations, 1999-2003, p. 7-7.

Producers' shipments and exports.—During the period under study, the value of overall shipment levels experienced significant growth, up 46 percent to $1.2 billion in 2003 (table 7-22). The increase occurred principally in shipments for internal consumption, as a larger share of expanded industry output was retained in-house for machining, reflecting in part the trend in the motor vehicle industry for component manufacturers to shoulder greater manufacturing responsibility and add value to their output by producing subassemblies or modules. The value of U.S. exports by reporting producers of rough castings used as aluminum engine components nearly tripled by value during the period and accounted for a small but increasing share of U.S. producers' shipments. U.S. exports are principally directed to NAFTA partners Canada and Mexico, which serve as production bases for U.S. and foreign vehicle makers.

Table 7-21
Aluminum engine component castings: Responding U.S. producers' employees and related information for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Average number of employees	6,839	7,371	6,693	6,614	6,478
Production and related workers:					
Number	4,804	5,136	4,603	4,678	4,615
Hours worked (*1,000 hours*)	11,347	12,322	10,796	11,221	11,249
Wages paid (*1,000 dollars*)	157,228	165,914	143,462	155,890	148,557
Average hourly wages (*dollars per hour*)	13.86	13.46	13.29	13.89	13.21
Productivity (*short tons per 1,000 hours*)	15	17	17	19	20

Note.–Figures may not add to totals because of rounding. Average hourly wages based on establishments that were able to provide both hours worked and wages paid. Productivity based on establishments that were able to provide both production quantity and hours worked.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-22
Aluminum engine component castings: Responding U.S. producers' domestic shipments and exports for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Domestic shipments:					
Commercial	78,979	77,972	73,550	86,840	88,021
Internal consumption and transfers	([1])	([1])	([1])	([1])	([1])
Exports	([1])	([1])	([1])	([1])	([1])
Total	163,029	213,317	182,407	212,518	232,269
	Value (*1,000 dollars*)				
Domestic shipments:					
Commercial	332,584	334,318	309,246	357,799	357,132
Internal consumption and transfers	443,683	740,936	585,166	681,348	749,746
Exports	19,448	36,666	32,277	40,978	52,615
Total	795,715	1,111,920	926,689	1,080,125	1,159,493

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Financial condition.—Despite price pressures in the motor vehicle industry, U.S. producers reporting sales of rough aluminum engine castings posted the highest operating income level of the period in 2003 on sales of 226,984 short tons. Operating income as a share of net sales value was relatively high in 2003, but down slightly from the period high recorded in 1999 (table 7-23). Of the 38 firms reporting financial data, 8 foundries reported operating losses in 2003, up from 3 firms in 1999. For the machined casting sector, estimated operating income fluctuated by a wider margin, as operating income fell during the first 3 years of the period before recovering to a reported period high in 2003. Reported net sales during the period rose by 31 percent overall to $533.4 million in 2003 on net sales of 60,321 short tons. As a share of net sales, the sector's operating income returned to double digits in 2003. One responding firm accounted for a large share of the increase in net sales and operating income, however, as its parent company expanded its U.S. operations and boosted sales. Despite the improved financial condition of this industry reported during 2002-03, 4 of the 19 firms reporting financial data recorded operating losses in 2003.

Investment.—Capital expenditures in the rough aluminum or aluminum alloy engine component castings industry fluctuated during the period, ranging between $32.9 million and $55.4 million (table 7-24). Research and development expenditures in this sector were considerably lower.

Purchaser Trends

Total purchases of rough and machined aluminum engine castings rose by 57 and 43 percent, respectively, during 1999-2003, with machined castings accounting for more than three-fourths of purchases in 2003 (table 7-25). U.S.-produced castings accounted for the bulk of rough castings purchases during 1999-2003, ranging between 80 and 85 percent of the total. U.S.-produced castings accounted for the bulk of machined castings purchases as well, although purchases of foreign-produced machined castings made slight inroads during the period.

Because limited purchasing data were provided by U.S. purchasers of these castings, specific country details cannot be provided to protect business confidentiality. However, Korea was the leading foreign source of rough aluminum engine component castings reported by U.S. purchasers during the period, and Japan was by far the leading foreign source of machined castings used for aluminum engine components imported by U.S. purchasers. Japanese transplant vehicle and parts producers maintain close ties to Japan-based suppliers and are believed to account for a large share of these purchases. Several questionnaire respondents also indicated that there were new suppliers of these products to the U.S. market, most of which were reported to be foreign suppliers.

The level of direct imports of these products reported by U.S. producers fails to capture those cast aluminum engine components that are also imported indirectly to the U.S. market as parts of finished engines and parts. Imports of finished engines and engine parts, which incorporate aluminum engine castings as well as other types of engine parts, increased by 19 percent during 1999-2004 to $9.1 billion (table 7-26). Canada, Mexico, and Japan remain the leading suppliers of engines to the U.S. market because of their extensive integration into the U.S. motor vehicle industry. In addition to Canada Japan, and Mexico, however, Germany, Korea, and Italy posted large gains during the period. Other notable increases occurred in imports of engines and related parts from Brazil, China, and Taiwan.

Table 7-23
Aluminum engine component castings: Responding U.S. producers' financial results for their rough casting and machining operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Rough castings:					
Net sales:					
Commercial domestic and export sales	88,868	90,372	83,325	96,661	97,754
Internal consumption for production of machined castings	([1])	([1])	([1])	([1])	([1])
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales quantities	157,093	209,896	178,359	205,740	226,984
	Value (*1,000 dollars*)				
Net sales:					
Commercial domestic and export sales	371,480	420,189	359,996	410,674	412,212
Internal consumption for production of machined castings	([1])	([1])	([1])	([1])	([1])
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales values	744,355	1,031,054	849,784	994,923	1,055,376
Operating income	110,160	128,371	76,616	134,341	150,953
	Ratio to net sales (*percent*)				
Operating income	15	12	9	14	14
	Number of establishments reporting:				
Operating losses	3	4	8	9	8
Financial results data	27	35	35	37	38
Machined castings:					
Net sales (*short tons*)	53,726	58,242	49,657	55,775	60,321
	Value (*1,000 dollars*)				
Net sales	408,255	483,938	420,850	500,737	533,414
Operating income	([1])	36,090	18,383	25,413	([1])
	Ratio to net sales (*percent*)				
Operating income	([1])	7	4	5	([1])
	Number of establishments reporting:				
Operating losses	2	4	4	5	4
Financial results data	17	18	18	19	19

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and operating income data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-24
Aluminum engine component castings: Responding U.S. producers' capital and R&D expenditures for their rough casting operations, fiscal years 1999-2003

(***1,000 dollars***)

Item	1999	2000	2001	2002	2003
Machinery, equipment, and fixtures	34,470	55,375	42,649	46,545	32,939
Research and development expenditures	([1])	([1])	([1])	([1])	([1])

[1] Data withheld to avoid disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-25
Aluminum engine component castings: Purchases of domestic and foreign castings by responding U.S. purchasers, 1999-2003

(***1,000 dollars***)

Year	Total
Rough castings:	
1999	160,360
2000	218,919
2001	184,949
2002	231,444
2003	251,912
Machined castings:	
1999	611,282
2000	648,667
2001	702,043
2002	782,553
2003	875,099

Note.–Domestic and foreign purchases not shown separately to prevent disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-26
Aluminum engine part castings: U.S. imports for consumption of downstream products, by leading suppliers, 1999-2004

(***1,000 dollars***)

Country	1999	2000	2001	2002	2003	2004
Canada	3,398,328	3,512,828	2,773,274	2,821,348	3,131,331	3,645,162
Mexico	1,707,221	1,684,604	1,514,641	1,513,832	1,674,504	2,286,756
Japan	1,854,205	2,222,129	2,179,555	2,305,800	2,056,653	1,886,708
Germany	465,114	953,047	912,218	1,042,630	1,080,783	915,780
United Kingdom	95,332	127,038	129,290	293,947	226,011	96,303
Brazil	46,431	54,581	64,883	71,920	72,132	62,726
Korea	7,695	7,612	11,369	16,343	30,167	39,330
China	15,186	14,872	17,579	24,781	29,029	30,259
Italy	6,053	4,061	4,664	8,677	14,285	29,244
Taiwan	15,232	14,176	17,030	18,273	22,289	25,187
All other	43,384	63,464	68,780	70,971	79,148	78,584
Total	7,654,182	8,658,411	7,693,278	8,188,532	8,416,333	9,096,040

Note.–Downstream products include spark-ignition engines for motor vehicles and parts of these engines (HTS classifications 8407.34.18, 8407.34.48, and 8409.91.50). Figures may not add to totals because of rounding.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Competitive Assessment of Price- and Product-related Factors

Price and non-price factors.—China and Brazil were identified by U.S. producers of castings for aluminum or aluminum alloy engine components as the leading competitive concerns for this industry (table 7-27). Although one producer indicated that the price of castings from China was higher than the U.S. price, 18 U.S. producers reported that Chinese prices were an average of 26 percent lower than the U.S. price for comparable products. Castings from Brazil were estimated by 7 producers to average 18 percent lower in price than U.S. castings. A few U.S. producers indicated that rough castings from Germany, India, and Taiwan were higher priced than the comparable U.S. product.

U.S. producers largely found China to be the lowest priced supplier to the U.S. market for machined aluminum engine castings, with prices averaging 33 percent lower than the U.S. price. Prices of castings from Brazil averaged 17 percent below U.S. prices. Other low-priced suppliers of machined castings reported by U.S. producers include Korea and Mexico.

U.S. purchasers largely noted that imports of rough castings were priced lower than similar U.S. products, except for those castings from Japan (table 7-28). Imports of machined castings were generally reported by U.S. purchasers to be comparably priced or lower priced than U.S. imports. Imports of Chinese castings were cited as averaging 18 percent below U.S. prices, the lowest of all reported foreign sources. Three U.S. purchasers indicated that machined castings from the EU-15 averaged 11 percent higher than U.S. products.

Table 7-27
Aluminum engine component castings: Price comparison by responding U.S. producers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Brazil	Lower	7	18
China	Lower	18	26
China	Higher	1	30
Germany	Higher	2	8
India	Lower	2	30
India	Higher	1	30
Mexico	Lower	2	30
Taiwan	Higher	1	25
Machined castings:			
Brazil	Lower	8	17
China	Lower	11	33
China	Higher	1	30
China	About the same	1	([1])
EU-15	Lower	1	10
India	Lower	1	30
India	Higher	1	30
Japan	Higher	1	10
Korea	Lower	2	23
Mexico	Lower	3	27
Taiwan	Higher	1	25

[1]Not applicable.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-28
Aluminum engine component castings: Price comparison by responding U.S. purchasers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Brazil	Lower	1	15
China	Lower	3	18
Japan	Higher	1	5
Korea	Lower	2	5
Mexico	Lower	1	2
Taiwan	Lower	1	20
Machined castings:			
Brazil	Lower	5	11
Canada	Lower	1	5
Canada	About the same	3	([1])
China	Lower	7	18
China	About the same	1	([1])
EU-15	Higher	3	11
EU-15	About the same	3	([1])
Eastern Europe [2]	Lower	2	7
India	Lower	3	13
Japan	Lower	1	5
Japan	Higher	2	18
Japan	About the same	4	([1])
Korea	Lower	7	15
Korea	About the same	2	([1])
Mexico	Lower	3	10
Mexico	About the same	2	([1])
Taiwan	Lower	3	4
Taiwan	About the same	1	([1])
Thailand	Lower	2	13
Turkey	Lower	1	10

[1] Not applicable.
[2] Includes Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Poland, Romania, Slovakia, Slovenia, and Yugoslavia (Serbia and Montenegro).

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

When asked for the leading countries from which they have increased imports, U.S. purchasers most often cited China, Japan, Korea, Mexico, and Brazil. Of particular note is Japan, which was the only country noted by most responding domestic purchasers as improving on its U.S. delivered price. Non-price factors, such as better packaging and more flexible payment terms, were the most commonly cited reasons for increased purchases from most countries. Although these countries demonstrated strengths in many of these areas, Korea reportedly lagged in providing better product quality and Brazil was less competitive in range of products offered, reliability of supply, and technical support and service.

Producers' response to import competition.**—**The 33 responding producers indicated that the principal actions undertaken in response to import competition were related to price/cost and quality issues (table 7-29). The majority of firms (28) lowered or suppressed prices in an effort to counter foreign competition. Responding U.S. producers of castings for aluminum engine components largely agreed that prices for these products remained the same or dropped during the period, with price declines generally ranging up to 10 percent. Another 27 respondents implemented cost reduction efforts, and 22 firms improved product quality. Cost-reduction and quality improvement efforts often focus on the implementation of lean manufacturing, Six Sigma, and total quality management programs that emphasize reductions in waste and product defects and quality improvements. Less common responses to import competition were corporate decisions to shift to other cast products and cut back or eliminate production. Four foundries reported that they lacked the capital funds to respond to their import competition. Foundries reporting operating losses are less likely to be able to internally fund capital investments, and may find access to external financial sources somewhat limited because of the relatively unfavorable financial situation and credit rating of the motor vehicle industry.

Table 7-29
Aluminum engine component castings: Responding U.S. producers' responses to import competition

Nature of response	Number of responses
Total number of establishments responding	33
Took no or few actions because:	
Had already shifted production to more advanced types of castings	4
Had already shifted production to other lines of castings	5
Lacked capital funds to counter foreign competition	4
Other	3
Took the following actions:	
Lowered prices or suppressed price increases	28
Reduced or dropped plans to expand capacity	7
Cut back or eliminated production	8
Closed production lines	5
Shifted to other cast products	8
Implemented cost-reduction efforts	27
Improved product quality	22
Imported product instead	5
Opened a plant in a foreign country	1
Other	1

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Aluminum Suspension/Steering Part Castings

Industry Profile

***Industry structure*.—**A total of 28 firms responded indicating that they produced aluminum alloy castings used in suspension/ steering systems for on-highway trucks, buses, passenger vehicles and light-duty trucks. An estimated 5 firms account for nearly 75 percent of aluminum alloy castings used for suspension/steering applications.[27] Most automotive foundries are located near automotive production facilities (whether OEM or Tier 1 suppliers), largely in the Midwest. However, a number of newer aluminum foundries have chosen to locate near sources of inexpensive electrical energy[28] (such as in the U.S. Southeast) and sources of stable, skilled, and less expensive labor. The degree of specialization in this industry is largely determined by the quantity and variety of equipment a particular foundry possesses. Larger, more highly-capitalized foundries tend to have a wider volume and variety of equipment, allowing them to produce a wider range of products in order to serve a larger number of end-users. Smaller aluminum foundries tend to specialize in the production of products related to a single end-user with producers of automotive-related aluminum castings producing solely for the automotive industry.[29]

Product Description and Uses

The *steering system* in automobiles includes the steering wheel, various gears and linkages to connect the steering wheel to position the front tires and other components used to control the direction of a vehicle's motion. The steering system may also contain a power-steering assist system to supply the force needed to assist the driver in turning the steering wheel. Principal automotive steering system components include the steering wheel and column, a manual gearbox and pitman arm or a rack and pinion assembly, and linkages (including tie rod, tie rod end, and idler arm). Major automotive steering components made of cast aluminum include steering column components, power steering pump components, and the housing for the rack and pinion unit. The role of the automobile *suspension system* is to keep the car's wheels in firm contact with the road surface, as well as, to provide a comfortable ride for passengers by absorbing road shock that would otherwise be directly transmitted to the steering wheel and to the automotive chassis. Major suspension system components include the steering knuckle assembly (steering knuckle, control arm, and caliper), engine cradle, differential carrier, coil springs, shock absorber and/or strut, sway bar, rotor, wheel bearing, and wheel rim.

***Demand characteristics.*—**U.S. demand for aluminum part castings is heavily dependent on the level of automotive production in the United States,[30] on the continuation of federal legislation to require that automobiles sold in the United States reach certain average mileage standards,[31] and the substitution of lighter-weight aluminum components for iron and steel components in order to comply with these standards. During the past 5 years, a number of automakers in the United States have announced projects to manufacture suspension/steering parts made from aluminum alloy 356. In part, automakers decided to increase aluminum use to compensate for weight increases caused by upsizing of new vehicles.[32]

---

[27] U.S. industry official, telephone interview with USITC staff, Jan. 10, 2005.

[28] Electrical energy costs often account for nearly 50 percent of total manufacturing cost.

[29] U.S. industry official, telephone interview with USITC staff, Jan. 10, 2005.

[30] Officials of aluminum foundries indicate that little distinction is being made between production in the United States by U.S.-owned firms or by foreign transplants, which are increasingly open to sourcing their castings needs from U.S. foundries if the quality and price of these castings are competitive.

[31] The most notable example is the Corporate Average Fuel Economy (CAFÉ) standards developed by the Federal Government.

[32] Auto manufacturers announcing new aluminum use were DaimlerChrysler AG's adoption of aluminum steering knuckles made of A356 in the 2004 Dodge Durango SUV; Ford Motor Co.'s use of aluminum steering knuckles in the 2001 Explorer and Mountaineer SUVs, and use of aluminum cast crossmembers for the 2003 Mercury Grand Marquis and Marauder sedans and for the 2003 Lincoln Town Cars; General Motors' use of aluminum engine cradles in its 2004 Pontiac Grand Prix and 2005 Buick Regal cars, and use of aluminum steering knuckles, control

(continued...)

Increasingly, the trend in the industry has been for foundries to supply customers (typically OEMs and Tier 1 producers) with machined castings rather than rough castings for economic reasons. Customers realize savings from having an entire component cast, machined, and possibly assembled at a single site than having various stages of production occurring at multiple sites.[33]

Aluminum castings compete with iron and steel castings for use in automotive components. Aluminum gained market share at the expense of iron and steel as automakers sought to reduce weight by substituting aluminum. However, the higher price of aluminum components relative to iron and steel has forced automakers to evaluate the benefits associated with weight savings versus cost increases. As a result, a number of automakers still use components made of iron and steel for reasons of economy.

The use of aluminum suspension/steering components is a relatively recent development, occurring during the last 10 years, and most of the design of such components was first developed by U.S. manufacturers. Much of the design work is performed for OEMs by U.S. foundries. As a result, the U.S. foundry industry has developed a technological lead relative to the rest of the world in the design and manufacture of these castings. Because these components are structural in nature, automakers require that foundries meet certain minimum certification and testing requirements, including use of X-ray and non-destructive analysis, in order to qualify as a supplier. Thus far, most of the qualified automotive suppliers have tended to be U.S. foundries.[34] The U.S. industry's greater experience in process control has allowed production of castings that more easily meet the automobile industry's rigid quality requirements than foreign castings, with fewer costly rejects. U.S. foundries produce aluminum castings for the automotive industry in comparatively large volumes, owing to the higher percentage use of aluminum automotive castings in the United States than in Europe and Japan as well as greater U.S. automotive production volumes. As a result, U.S. foundries are able to take advantage of economies of scale to produce individual castings more inexpensively than foundries producing the same castings, but in smaller volumes, overseas.[35]

The leading outlet for rough aluminum suspension/steering part castings in 2003 was OEMs, which machined nearly 42 percent of the rough castings shipped by U.S. foundries (table 7-30). Nearly 15 percent of the subject rough castings shipped were machined by other machine shops while nearly 34 percent were machined in-house in 2003. Nearly 55 percent of total machined aluminum suspension/steering part castings in 2003 were shipped directly to OEMs and 41 percent were shipped in-house for use in the manufacture of the finished downstream product. It is expected that in time, increasing percentages of castings will arrive at the OEM fully machined and ready to be assembled.[36]

The major end-use market for aluminum suspension/steering part castings in 2003 was the motor vehicle (automobiles and trucks) market, which accounted for 98 percent of all subject shipments by foundries producing such castings (table 7-31). Automobiles (including light-duty trucks, SUVs, and vans) were responsible for 85 percent of these castings shipments.

---

[32] (...continued)
arms, and differential carriers on the 2004 Cadillac SRX sports wagon; and Mitsubishi's use of aluminum castings in crossmembers in V-6 versions of its U.S.-built Eclipse, Galant, and Eclipse Spyder cars. In each case, the aluminum casting will replace a comparable steel part.

[33] U.S. industry official, telephone interview with USITC staff, Jan. 10, 2005.

[34] U.S. industry official, telephone interview with USITC staff, Feb. 2, 2005.

[35] Ibid.

[36] U.S. industry official, telephone interview with USITC staff, Jan. 10, 2005.

Table 7-30
Aluminum suspension/steering part castings: Responding U.S. producers' shipments, by channel of distribution, 2003

(***Percent***)

Channel of distribution	Share of 2003 shipments of castings by quantity
Rough castings:	
In-house machining	34
Machining subcontractor	1
Machine shop/other fabricators	15
Distributors	([1])
Original equipment manufacturers	42
Other	8
Total	100
Machined castings:	
Distributors	2
Original equipment manufacturers	55
In-house for use in downstream products	41
Other	2
Total	100

[1]Less than 0.5 percent.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 7-31
Aluminum suspension/steering part castings: End market for responding U.S. producers' shipments, 2003

(***Percent***)

End market	Share of 2003 shipments of castings by quantity
Motor vehicles:	
Automobiles (including light duty trucks, SUVs, vans, etc.)	85
Trucks	13
Other/unknown	2
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Producer Trends

Production and inventories.—U.S. production of rough aluminum suspension/steering part castings by responding foundries increased 16 percent during 1999-2003 (table 7-32), reflecting increasing percentages of aluminum use in automotive applications as automakers continue to substitute light-weight aluminum for iron and steel components, despite the higher cost of aluminum. Lowering the weight (both sprung and unsprung) of the vehicle has been a primary objective for automakers seeking to achieve fuel economy savings and to improve vehicle ride and handling capabilities.

Table 7-32
Aluminum suspension/steering part castings: Responding U.S. producers' production and inventories for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Production (short tons)	191,453	211,632	194,689	228,007	221,330
Inventory:					
Total (short tons)	8,103	9,682	9,912	12,145	11,405
Share of production (percent)	4	5	5	5	5

Note.–Figures may not add to totals because of rounding. Inventory share of production based on establishments that were able to provide both inventory and production amounts.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

For such critical components as control arms and steering knuckles used in cars and light-duty trucks, the percentage of such components made of aluminum castings has almost doubled during the last 5 years to 20 percent.[37] Nearly 5 percent of engine cradles and differential carriers are made of cast aluminum and this figure has nearly doubled during the last 5 years. The percentage use of aluminum castings has increased particularly in cars, light-duty trucks and SUV platforms.

***Employment*.—**The number of production and related workers reported by responding foundries engaged in the production of rough aluminum suspension/steering part castings declined 11 percent during 1999-2003, with total number of hours worked declining 12 percent and total wages paid rising 11 percent to $146 million (table 7-33). Average hourly wages for this industry rose to $18.08/hour in 2003 compared with $14.32/hour in 1999. Industry productivity rose from 19 short tons of castings per 1,000 hours in 1999 to 27 short tons per 1,000 hours in 2003. Industry sources attribute the increase in productivity to increased capital investment in foundry facilities to include greater use of automated equipment. The industry has been able to achieve significant cost savings and productivity improvements in materials handling and in finishing operations, the principal labor-intensive areas of production, through the use of robotic technology.[38]

Table 7-33
Aluminum suspension/steering part castings: Responding U.S. producers' employees and related information for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Average number of employees	5,050	5,032	4,867	5,196	4,676
Production and related workers:					
Number	4,170	4,121	4,069	4,288	3,720
Hours worked (*1,000 hours*)	9,147	8,476	8,795	9,120	8,064
Wages paid (*1,000 dollars*)	131,023	126,322	142,927	158,937	145,763
Average hourly wages (*dollars per hour*)	14.32	14.90	16.25	17.43	18.08
Productivity (*short tons per 1,000 hours*)	19	23	21	24	27

Note.–Figures may not add to totals because of rounding. Average hourly wages based on establishments that were able to provide both hours worked and wages paid. Productivity based on establishments that were able to provide both production quantity and hours worked.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[37] U.S. industry official, telephone interview with USITC staff, Jan. 14, 2005.
[38] U.S. industry consultant, telephone interview by USITC staff, Jan. 10, 2005.

***Producers' shipments and exports*.—**Total U.S. producers' shipments by quantity of rough aluminum suspension/steering part castings by responding foundries increased 17 percent during 1999-2003 (table 7-34). U.S. domestic commercial shipments of rough aluminum castings increased 7 percent during this period. U.S. exports of the subject rough castings increased 77 percent during 1999-2003 and accounted for 6 percent of total U.S. shipments in 2003. U.S. exports increased primarily to Canada and Mexico, because of increased production of cars and light-duty trucks by OEMs in these countries, as well as increasing percentages of cast aluminum cross members and control arms used by OEMs and Tier 1 suppliers in these nations.[39]

Table 7-34
Aluminum suspension/steering part castings: Responding U.S. producers' domestic shipments and exports for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Domestic shipments:					
Commercial	124,953	125,489	118,497	137,023	133,534
Internal consumption and transfers	55,033	72,702	56,163	140,575	71,700
Exports	7,523	7,446	[15,271	10,023]	13,253
Total	187,509	205,637	189,931	287,621	218,487
	Value (*1,000 dollars*)				
Domestic shipments:					
Commercial	498,074	510,541	502,931	538,080	559,652
Internal consumption and transfers	202,427	256,290	219,333	286,734	276,061
Exports	40,422	[74,516	52,441	47,698]	54,076
Total	740,923	841,347	774,705	872,512	889,789

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission

***Financial condition*.—**Total net sales value reported by responding foundries producing rough aluminum suspension/steering part castings increased 32 percent during 1999-2003 (table 7-35). Operating profits fluctuated during this period, declining from $76 million (12 percent of sales) in 1999 to a negative $5 million in 2001 (a negative 1 percent of sales) before rebounding to $83 million (10 percent of sales) in 2003. The industry returned to profitability during this period as a result of strong sales increases, as demand conditions in the automotive vehicle market improved. Additionally, producers placed continued emphasis on annual reductions in operating costs. The cost reductions were achieved through both process improvements on the production floor to reduce labor costs by automating certain manufacturing steps and working with customers to redesign products to reduce the labor component of manufacturing particular castings.[40]

At the same time, net sales values for foundries producing machined aluminum alloy castings increased 33 percent while operating income declined. The decline in operating income was largely attributable to highly competitive conditions in the industry which have led foundries to enter into agreements with their larger automotive customers to reduce the non-raw material portion of their manufacturing costs charged to customers by 3-5 percent annually, putting pressure on the ability of foundries to pass their costs on to their customers.[41] In order to protect themselves from future competition, a number of foundries have entered into long-term agreements with automotive customers to reduce the costs of their finished castings by 3-5 percent annually for both current product platforms and future replacement programs.

[39] U.S. industry official, telephone interview with USITC staff, Jan. 13, 2005.
[40] Ibid.
[41] U.S. industry officials, telephone interviews with USITC staff, Feb. 7-11, 2005.

Table 7-35
Aluminum suspension/steering part castings: Responding U.S. producers' financial results for their rough casting and machining operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Rough castings:					
Net sales:					
Commercial domestic and export sales	101,540	110,123	114,351	133,277	130,871
Internal consumption for production of machined castings	([1])	([1])	([1])	([1])	([1])
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales quantities	166,035	192,529	181,534	220,180	213,147
	Value (*1,000 dollars*)				
Net sales:					
Commercial domestic and export sales	419,838	456,721	482,748	552,344	525,897
Internal consumption for production of machined castings	([1])	([1])	([1])	([1])	([1])
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales values	643,483	722,869	737,651	878,692	848,961
Operating income	75,729	66,961	-4,624	79,744	82,804
	Ratio to net sales (*percent*)				
Operating income	12	9	-1	9	10
	Number of establishments reporting:				
Operating losses	4	5	10	5	6
Financial results data	23	24	27	26	27
Machined castings:					
Net sales (*short tons*)	67,975	80,797	65,683	88,036	81,302
	Value (*1,000 dollars*)				
Net sales	373,008	446,136	377,808	527,941	495,119
Operating income	63,766	64,487	([1])	57,649	([1])
	Ratio to net sales (*percent*)				
Operating income	17	14	([1])	11	([1])
	Number of establishments reporting:				
Operating losses	1	2	4	4	5
Financial results data	12	13	15	15	14

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and operating income data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

***Investment*.—**Capital expenditures on machinery, equipment, and fixtures by responding foundries producing aluminum suspension/steering part castings declined 72 percent during 1999-2003 (table 7-36). Capital expenditures in this industry are usually budgeted in advance of anticipated use of the component in a new motor vehicle platform. An automotive OEM may announce a projected use of aluminum when it announces a new product launch and 18-24 months may elapse before the vehicle platform is built and the parts ordered. Capital expenditures for the parts suppliers generally follow a cycle. Expenditures for machinery and equipment will ramp up in advance of the actual construction of the vehicle to assure that the parts will be produced and available to OEMs when they are needed. The automotive industry greatly expanded the use of aluminum in a number of new product models during 1999-2003; however, capital expenditures among aluminum foundries tended to occur during the prior 5-year period. According to industry sources, capital expenditures during the 1999-2003 period declined dramatically because of anticipated winding down of a number of product platforms using aluminum components and consequent lowered demand for components. Capital expenditures in the sector are expected to increase again with the announcement by OEMs of new product platforms.[42]

Table 7-36
Aluminum suspension/steering part castings: Responding U.S. producers' capital and R&D expenditures for their rough casting operations, fiscal years 1999-2003
(*1,000 dollars*)

Item	1999	2000	2001	2002	2003
Machinery, equipment, and fixtures	215,907	73,011	82,239	47,206	60,016
Research and development expenditures	([1])	([1])	([1])	([1])	([1])

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Research and development expenditures increased 36 percent during 1999-2003. Such expenditures in this industry tend to be low, relative to capital expenditures for machinery and equipment, as most of the components produced for the automotive industry are based on existing technology. Automotive customers tend to be reluctant to adopt new, unproven technologies for use in safety-critical components.[43] At the same time, some large foundries with multiple product operations indicated that research and development expenditures are not strictly product related and such expenditures may be included in a separate operational budget elsewhere in the corporate structure.[44] One such foundry had a separate research facility devoted to aluminum product development.

Purchaser Trends

U.S. purchases of domestic- and foreign-produced rough aluminum suspension/steering part castings by responding purchasers increased 81 percent in value during 1999-2003 (table 7-37) with imports from China, Japan, Mexico, and Canada contributing to the increase. U.S. purchases of machined aluminum part castings more than doubled during 1999-2003 with imports from Japan providing most of the increase.

[42] U.S. industry official, telephone interview with USITC staff, Jan. 17, 2005.
[43] U.S. industry official, telephone interviews with USITC staff, Jan. 13 and Jan. 21, 2005.
[44] Ibid.

Table 7-37
Aluminum suspension/steering part castings: Purchases of domestic and foreign castings by responding U.S. purchasers, 1999-2003

(***1,000 dollars***)

Year	Total
Rough castings:	
1999	48,145
2000	57,302
2001	68,540
2002	83,215
2003	87,203
Machined castings:	
1999	15,867
2000	22,249
2001	26,821
2002	35,720
2003	49,821

Note.–Domestic and foreign purchases not shown separately to prevent disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

According to U.S. purchasers, foreign purchases accounted for a growing share of total purchases of rough castings but a declining share of purchases of machined castings. Despite the increase in imports during this period, imports of rough aluminum suspension/steering part castings as a percentage of U.S. apparent consumption totaled 1 percent in 2003.

Beginning in 2002, China became the leading foreign source of rough aluminum suspension/steering part castings, as reported by U.S. purchasers. Rough castings from China are composed principally of simpler, easier to cast parts, and their use appears to be primarily confined to specific non-structural components of the automobile. The presence of Chinese machined castings in the U.S. market appears to be limited at this point.

Japan was the second leading supplier to the United States of rough aluminum castings and the leading supplier of machined castings to the United States. The Japanese presence in the U.S. market is related to the advanced nature of the Japanese aluminum foundry industry and the strong relationship Japanese foundries have established with Japanese automobile transplant manufacturers in the United States.

Thus far, imported aluminum castings for use in structural suspension components such as steering knuckles and control arms do not appear to be a significant competitive factor in the U.S. automotive market. Foundries producing aluminum castings for rack-and-pinion steering units have indicated that increasing percentages of these components are being sourced from Asian nations. The housing for these units are relatively simple one-piece, two-piece, or three-piece designs that are increasingly within the ability of producers in Japan and China to cast.[45]

U.S. imports of downstream products produced using aluminum suspension/steering part castings increased 66 percent during 1999-2004 (table 7-38). Mexico accounted for the largest import increase during this period while Canada, Mexico, and Japan were the largest suppliers of these imports to the United States in 2004, accounting for 27 percent, 24 percent, and 22 percent, respectively of imports.

[45] U.S. industry official, telephone interview with USITC staff, Feb. 9, 2005.

Competitive Assessment of Price- and Product-related Factors

Price and non-price factors.—According to foundry respondents, most U.S. producers regard China as the principal low-cost foreign competitor in the U.S. market for aluminum suspension/steering part castings. Chinese rough casting prices were, on average, 28 percent lower than U.S. prices, and machined castings prices were, on average, 26 percent lower than U.S. prices for comparable components (table 7-39).

Table 7-38
Aluminum suspension/steering part castings: U.S. imports for consumption of downstream products, by leading suppliers, 1999-2004
(*1,000 dollars*)

Country	1999	2000	2001	2002	2003	2004
Canada	681,640	649,339	568,567	707,577	766,588	841,317
Mexico	402,867	427,722	418,093	547,464	595,284	743,631
Japan	378,180	471,948	519,820	574,888	584,341	665,908
Germany	121,293	114,513	117,602	157,285	230,908	250,989
Liechtenstein	109,723	109,741	99,126	106,899	120,321	134,259
Korea	9,535	18,474	20,570	37,854	46,564	84,889
India	5,650	7,530	8,904	27,893	36,967	58,189
Taiwan	16,163	17,239	14,804	20,976	26,461	48,120
Brazil	8,062	18,894	17,109	16,885	17,527	40,223
Spain	6,826	8,983	20,410	24,129	32,795	33,881
All other	110,865	105,541	92,220	123,861	135,748	171,990
Total	1,850,804	1,949,924	1,897,225	2,345,711	2,593,504	3,073,396

Note.–Downstream products includes steering wheel, steering columns, and steering boxes (HTS classifications 8708.94.50, 8708.99.43, and 8708.99.46). Figures may not add to totals because of rounding.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 7-39
Aluminum suspension/steering part castings: Price comparison by responding U.S. producers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Brazil	Lower	4	15
Canada	Lower	1	10
China	Lower	11	28
Germany	Lower	1	15
India	Lower	3	22
Japan	Lower	1	15
Mexico	Lower	5	16
Mexico	Higher	1	40
Machined castings:			
Brazil	Lower	4	18
Canada	Lower	1	10
China	Lower	14	26
India	Lower	2	20
Korea	Lower	5	20
Mexico	Lower	10	12

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

U.S. purchasers reported price experience principally with machined castings. According to purchasers, there appeared to be no general consensus on the leading foreign suppliers of these castings to the United States. A narrow majority of purchasers listed China and Japan as the leading foreign suppliers, with Chinese castings, on average, 20 percent lower than U.S. prices and purchasers divided over whether Japanese castings for comparable components were priced lower or nearly the same as U.S. prices (table 7-40).

Although the sample of responses was relatively small, U.S. purchasers indicated that purchases from Canada have increased because of improvements in all non-price factors, such as product quality and reliability of supply. Purchases from China and Japan were also largely influenced by similar determinants. U.S. purchasers generally indicated that U.S. delivered prices from the noted foreign sources had not improved sufficiently to influence their purchasing decisions.

Producers' response to import competition.— Cost/price adjustments were the leading response to import competition by U.S. producers responding to import competition (table 7-41). These foundries indicated that they lowered prices or suppressed price increases and implemented cost-reduction efforts to improve their competitive position relative to their foreign competitors. Since labor costs are the principal manufacturing cost component, a significant number of firms have attempted to automate their operations, principally the materials handling and finishing operations, in order to lower labor costs. Over one-half of responding producers indicated that they have sought to improve product quality in order to compete more effectively while a significant number reduced or dropped plans to expand capacity because of import competition. Very few respondents indicated that they have responded to foreign competition by importing the product directly or by opening a plant in a foreign country.

Over one-half of responding producers indicated that no or few actions were taken as a result of import competition because they had already shifted production to more advanced types of castings or to other lines of castings. A number of these producers have sought to broaden their product range to non-automotive aluminum applications, citing aluminum castings for use in helicopters, farm tractors, and heavy trucks as examples. These end-uses are viewed as a supplement to the main automotive business of these producers rather than a replacement because of the small volumes involved. Some producers are exploring the use of aluminum castings in the telecommunications market (use in satellites and fiber optics), an end-use market with potentially high volumes.[46]

[46] U.S. industry official, telephone interview with USITC staff, Feb. 10, 2005.

Table 7-40
Aluminum suspension/steering part castings: Price comparison by responding U.S. purchasers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
China	Lower	1	5
EU-15	Lower	1	5
EU-15	Higher	1	20
Japan	Higher	1	20
Korea	Lower	1	4
Machined castings:			
Brazil	Lower	2	13
Canada	About the same	2	([1])
China	Lower	4	20
EU-15	Lower	1	5
Eastern Europe[2]	Lower	1	20
India	Lower	1	20
Japan	Lower	1	10
Japan	About the same	2	([1])
Korea	Lower	1	25
Mexico	Lower	1	10
Mexico	About the same	1	([1])
Taiwan	Lower	2	18
Thailand	Lower	1	10
Turkey	Lower	1	20

[1] Not applicable.
[2] Includes Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Poland, Romania, Slovakia, Slovenia, and Yugoslavia (Serbia and Montenegro).

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Table 7-41
Aluminum suspension/steering part castings: Responding U.S. producers' responses to import competition

Nature of response	Number of responses
Total number of establishments responding	28
Took no or few actions because:	
Had already shifted production to more advanced types of castings	13
Had already shifted production to other lines of castings	5
Lacked capital funds to counter foreign competition	1
Other	1
Took the following actions:	
Lowered prices or suppressed price increases	22
Reduced or dropped plans to expand capacity	12
Cut back or eliminated production	8
Closed production lines	7
Shifted to other cast products	3
Implemented cost-reduction efforts	23
Improved product quality	15
Imported product instead	3
Opened a plant in a foreign country	2
Other	2

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

CHAPTER 8
U.S. COPPER FOUNDRY INDUSTRY

This chapter provides an overview of the U.S. copper foundry industry, based on responses to the USITC producer and purchaser questionnaires, fieldwork, and interviews with leading industry participants. The various business trends and production factors that affect copper-based foundries are identified, including the principal purchasing trends influencing industry performance. The chapter examines the structure of the industry and leading demand characteristics. Most copper foundries machine their castings in-house and sell directly to end-users, primarily the valve and pipe, and plumbing industries; hence, sales are highly dependent on residential construction trends. Ease of casting and widespread technology dissemination renders copper foundries particularly vulnerable to foreign price competition. Additionally, copper castings have lost market share to lower-cost PVC for valves and pipe fittings. Operating incomes from production of rough copper castings remain robust, but foundries that machine copper castings are barely breaking even.

Of the 465 establishments responding to the foundry questionnaire, 49 establishments reported producing copper castings in the United States during 1999-2003.[1] The American Foundry Society (AFS) also collects information on the foundry industry based on metal types. Questionnaire data collected by the USITC account for 32 percent of copper foundry production in 2003, as reported by the AFS.[2] Of 463 U.S. purchasers responding to the foundry questionnaire, 88 firms reported purchasing copper-based castings. Results from the producer and purchaser questionnaires are discussed in this chapter and provide an overview of the copper foundry industry as well as more product-specific analysis of copper-alloy hand-operated and check-type taps, cocks, and valves.

Industry Profile

Industry Structure

The copper foundry industry is highly concentrated as the ten largest responding establishments produced more than 126,000 tons of copper castings in 2003, accounting for 72 percent of production. Responding foundries that cast copper are concentrated primarily in Pennsylvania and Indiana.[3] These firms are primarily small businesses – 34 companies have less than 100 employees.

Establishments reporting production of rough copper castings largely consider themselves job shops that produce a large variety of small-run products. Leading products produced are pump components, such as impellers, and a variety of valves. Establishments are primarily sand casting facilities. Production related activities performed at reporting establishments are diverse, with most companies indicating that they perform all activities through the casting production process (table 8-1).

[1] Of the 49 establishments reporting production of copper castings, 12 respondents reported information on copper valve castings. Of the 84 respondents reporting purchases of copper castings, 38 purchasers reported information on copper valve castings.

[2] AFS, "38th Annual Census of World Casting Production–2003," *Modern Casting,* Dec. 2004, p. 26.

[3] For more details on the reasons for locating firms in specific states, see Chapter 3: U.S. Foundry Industry.

Table 8-1
Copper foundries: Establishment activities of responding producers

Activity	Number responding that performed activity	Average percentage performed in-house
Total establishments reporting = 40		
Design of rough castings	25	72
Pattern making	27	74
Mold making, expended type	28	91
Mold/die making, permanent type	10	47
Machining of rough castings	31	68
Downstream manufacture	15	71

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Demand Characteristics

The copper castings industry was negatively impacted by the economic downturn during 2000 and 2001 and the rise in interest rates that slowed housing starts in 2000.[4] Housing starts are a significant component of demand for the copper foundry products industry as a majority of copper castings are intended for the plumbing and valve and pipe fittings industries (table 8-2). Copper is the only metal casting type with a significant military component, as 5 percent of sales are purchased by the Department of Defense. Sixteen firms reported that their products have military applications, primarily as propellers and valves for Navy ships.

Copper foundries indicated that 73 percent of rough castings were further machined in-house to make downstream products, such as valves and pipe fittings. As these goods need little further processing to be used in the final product, most foundries can sell the valve and pipe fittings direct to the end-user (table 8-3).

Table 8-2
Copper foundries: End market for responding U.S. producers' shipments, 2003
(*Percent*)

End market	Share of 2003 shipments of castings by quantity
Mining and oil/gas field machinery and equipment	3
Construction machinery and equipment	1
Refrigeration, air conditioning, and heating equipment	3
Plumbing	27
Industrial machinery	1
Valve and pipe fittings	41
Pumps and compressors	2
Construction/municipal castings	2
Ships and boats	4
Other/unknown	15
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[4] U.S. industry official, interview with USITC staff, Jan. 18, 2005.

Table 8-3
Copper foundries: Responding U.S. producers' shipments, by channel of distribution, 2003
(*Percent*)

Channel of distribution	Share of 2003 shipments of by quantity
Rough castings:	
In-house machining	73
Machining subcontractor	7
Machine shop/other fabricators	1
Distributors	1
Original equipment manufacturers (OEM)	15
Other	3
Total	100
Machined castings:	
Distributors	9
Original equipment manufacturers (OEM)	27
In-house for use in downstream products	59
Other	5
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Producer Trends

Capacity, Production, Inventories, and Shipments

Copper foundries responding to the questionnaire expanded capacity each year during 1999-2003. Reported capacity was 10 percent higher in 2003 than in 1999 (table 8-4). Production fluctuated during the period, but declined by 11,793 short tons overall leading to a 12-percentage point decrease in capacity utilization from 1999-2003 dropping from 62 percent to 50 percent. Most of the additional capacity is accounted for by mergers in the industry in 2001, which expanded pouring capabilities for a few large firms. Further, some foundries went forward with expansion projects planned prior to the decline in demand.[5] Some of the expanded capacity is also to meet Navy contracts for new ships. The Navy[6] plans to build 10 new ships a year in order to maintain its goal of a 300-vessel fleet.[7]

Owing to declining demand, the quantity of shipments fell by over 8,000 short tons during the period (table 8-5). However, the value of the shipments of copper castings increased slightly, largely attributable to an increase in the value of internal consumption and transfers to related firms (up 16 percent to $255.6 million). This shift resulted from acquisitions within the industry that expanded high-value product lines for a few large firms.[8]

[5] U.S. industry official, interview with USITC staff, Jan. 26, 2005.
[6] U.S. industry official, interview with USITC staff, Jan. 27, 2005.
[7] Roxana Tiron, "Lack of Specificity in Navy Shipbuilding Plans Irks the Industry," July 2004, found at *http://nationaldefense.ndia.org/issues/2004/Jul/Lack_of_Specificity.htm*, retrieved Mar. 18, 2005.
[8] Based on responses to the USITC producer questionnaire.

Table 8-4
Copper foundries: Responding U.S. producers' capacity, production, and inventories for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Capacity (short tons)	158,790	159,123	165,372	176,483	175,313
Production (short tons)	99,016	98,291	88,874	89,628	87,223
Capacity utilization (*percent*)	62	62	54	51	50
Inventory:					
Total (short tons)	6,716	6,072	5,488	5,479	6,240
Share of production (*percent*)	6	6	7	7	8

Note.–Figures may not add to totals because of rounding. Capacity utilization based on establishments that were able to provide both capacity and production amounts. Inventory share of production based on establishments that were able to provide both inventory and production amounts.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 8-5
Copper foundries: Responding U.S. producers' domestic shipments and exports for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Domestic shipments:					
Commercial	21,547	21,036	17,345	17,185	14,732
Internal consumption and transfers	65,973	67,652	62,407	64,268	64,135
Exports	375	430	352	294	453
Total	87,895	89,118	80,104	81,747	79,320
	Value (*1,000 dollars*)				
Domestic shipments:					
Commercial	105,905	101,944	87,772	84,737	77,795
Internal consumption and transfers	219,723	229,759	230,213	264,070	255,612
Exports	2,312	2,950	2,403	1,763	2,405
Total	327,940	334,653	320,388	350,570	335,812

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Employment

With the decline in copper casting production, the number of workers employed by copper foundries decreased by 10 percent (table 8-6). Productivity remained fairly stable at about 20 short tons per hour. Producers indicated that the decline in demand for copper products resulted in few capital investments and improvements to productivity. Firms indicated that productivity improvements were limited to process improvements such as reclamation of excess metal from the casting process, training, and automation. As hours worked dropped, so did total wages paid to those workers. At $15.04 per hour, the hourly wage paid to copper production workers in 2002 and 2003 is $2.53 less than the wage paid to production workers for all metal types.

Table 8-6
Copper foundries: Responding U.S. producers' employees and related information for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Average number of employees	2,916	2,961	3,002	2,844	2,632
Production and related workers:					
Average number	2,381	2,424	2,430	2,333	2,149
Hours worked (*1,000 hours*)	4,892	4,954	4,898	4,652	4,367
Wages paid (*1,000 dollars*)	67,958	68,596	68,337	67,614	65,683
Average hourly wages (*dollars per hour*)	13.89	13.85	13.95	14.53	15.04
Productivity (*short tons per 1,000 hours*)	20	20	18	19	20

Note.–Figures may not add to totals because of rounding. Average hourly wages based on establishments that were able to provide both hours worked and wages paid data. Productivity based on establishments that were able to provide both production quantity and hours worked data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Financial Condition

Rough Castings

Respondents report that the rough copper foundry industry recovered in 2002 and 2003 from lows in 2001 (table 8-7). According to industry officials, operating income rebounded just short of 1999 levels in 2002 as firms found process efficiencies through automation, offered fully machined and finished products, took on niche product lines, and shortened lead times.[9]

Total net sales quantities fluctuated through the period and were 9 percent lower in 2003 than in 1999. According to responses to producer questionnaires, sales declined as customers began to buy offshore. This trend is most apparent when the customer "owns" the pattern for the product and can easily move production offshore where they reportedly can get a lower price.[10] Despite the quantity decrease, the value of sales of rough copper castings increased slightly (2 percent); this increase resulted from a sharp increase in the total sales unit value of the copper cast by foundries that moved into more complex castings over the period.

However, the overall financial results for this industry reflect the dominance of a few large firms. When these firms are removed from the aggregate data, operating income for the remaining firms over the period is negligible, and reflected a loss during 2001. Even the economic recovery did not substantially affect small firms – operating income recovered slightly, but still held at less than 1 percent.

These firms were the most affected by the peak in the cost of goods sold in 2001 (represented by a growth in the COGS ratio to net sales), particularly the increase in raw materials costs. Overall, raw material costs for producing rough copper castings were a large component of net sales and remained a relatively

[9] U.S. industry officials, E-mail correspondence with USITC staff, Jan. 18, 2005; and various producer questionnaire responses.
[10] U.S. industry officials, E-mail correspondence with USITC staff, Jan. 18, 2005.

Table 8-7
Copper foundries: Responding U.S. producers' financial results for their rough casting operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Net sales:					
Commercial domestic and export sales	18,862	18,350	15,636	15,421	13,503
Internal consumption for production of machined castings	61,413	62,338	58,372	60,050	59,375
Other internal consumption or transfers to related firms	750	791	784	809	657
Total net sales quantities	81,025	81,479	74,792	76,280	73,535
	Value (*1,000 dollars*)				
Net sales:					
Commercial domestic and export sales	94,771	91,310	77,585	78,077	69,410
Internal consumption for production of machined castings	270,733	284,721	283,927	313,847	304,607
Other internal consumption or transfers to related firms	2,528	2,391	2,800	3,033	2,694
Total net sales values	368,032	378,422	364,312	394,957	376,711
Cost of goods sold:					
Raw materials	129,239	133,034	132,002	135,487	131,207
Direct labor	65,216	64,825	64,664	67,076	65,373
Energy	11,237	12,835	15,411	13,359	14,051
Other factory cost	77,435	90,806	84,797	94,188	85,764
Total cost of goods sold	283,127	301,500	296,874	310,110	296,395
Gross profit	84,905	76,922	67,438	84,847	80,316
Selling, general, and administrative	39,528	39,485	38,482	40,912	37,339
Operating income	45,377	37,437	28,956	43,935	42,977
Other income and expenses:					
Interest expense	3,593	6,173	5,355	4,674	3,566
All other expenses and income	-520	-22,064	521	378	260
Net income before taxes	42,304	53,328	23,080	38,883	39,151
Depreciation/amortization	11,831	13,150	14,581	14,692	14,503
	Ratio to net sales (*percent*)				
Raw materials	35	35	36	34	35
Direct labor	18	17	18	17	17
Energy	3	3	4	3	4
Other factory cost	21	24	23	24	23
Cost of goods sold	77	80	81	79	79
Gross profit	23	20	19	21	21
Selling, general, and administrative	11	10	11	10	10
Operating income	12	10	8	11	11
	Number of establishments reporting:				
Operating losses	9	11	15	12	13
Financial results data	39	39	39	39	39

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and cost data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

consistent share throughout the period despite copper prices that grew measurably from 1999-2003 (table 8-8).[11] However, the average unit value for raw materials costs grew the most between 2000 and 2001. During 2000, firms converted to no- or low-lead copper alloys, which are more expensive than leaded ones.[12]

Machined Castings

For responding foundries that also machined copper castings, operating income for the machining operations declined at a faster rate than operating income for rough casting operations (table 8-9). This decrease was primarily attributable to a decrease in net sales over the period. According to producers, sales declined as high-volume products, such as connectors and clamps, moved offshore, particularly to China and India.[13] Additionally, the number of firms reporting operating losses increased by 8 firms.

Raw Materials and Energy

Raw material costs as a share of metals costs shifted over the period along with prices for scrap and ingot (table 8-10). Overall, there has been a shift away from scrap as an input because copper scrap has become more expensive and difficult to obtain, as China has been purchasing large amounts of the world scrap supply.[14] According to one U.S. producer, Chinese demand for scrap copper is so high that the Chinese even purchase scrap copper wire coated in plastic; U.S. firms do not recycle this product as it is too labor-intensive to strip off the plastic coating.[15] Additionally, U. S. firms find it difficult to use some scrap materials because many include lead, and remelting creates concerns with air quality standards that foundries are required to meet. According to industry representatives, the problems with raw material costs were compounded significantly during 2004 when copper prices rose 60 percent over 2003.[16]

According to industry representatives, although energy costs account for a consistent share of net sales, energy costs have a significant impact on the copper foundry industry as copper requires the highest remelt temperature (over 22,000 degrees Fahrenheit) of all foundry products (table 8-11).[17] Establishments producing rough copper castings use electricity as their predominant form of energy. As a percentage of total energy costs, electricity costs declined 3 percentage points during 1999-2003 because of the higher cost of natural gas, which now accounts for a greater percentage of energy costs.

---

[11] Minerals and Metals, *Shifts in U.S. Merchandise Trade 2001*, July 2002, Publication No. 3525, U.S. International Trade Commission, p . 9-1.

[12] Lisa Swenson, “Converting to Low-Lead Copper Casting: Three Foundries' Experiences,” *Modern Casting*, Oct. 1, 2001, vol. 91, p. 40.

[13] Multiple producer questionnaire responses, and U.S. industry official, telephone interview with USITC staff, Mar. 18, 2005.

[14] Testimony by James Mallory, Executive Director, Non-Ferrous Founder Society, hearing transcript, p. 12.

[15] U.S. industry official, interview with USITC staff, June 24, 2005.

[16] U.S. industry official, interview with USITC staff, Jan. 27, 2005.

[17] U.S. industry officials, interviews with USITC staff, United States, June 24, 2005 and Jan. 26, 2005.

Table 8-8
Copper foundries: Selected financial unit values for responding U.S. producers' rough casting operations, fiscal years 1999-2003

(*Dollars per short ton*)

Item	1999	2000	2001	2002	2003
Total sales unit value	4,542	4,644	4,871	5,178	5,123
Raw material cost	1,595	1,633	1,765	1,776	1,784
Direct labor cost	805	796	865	879	889
Energy cost	139	158	206	175	191
Other factory cost	956	1,114	1,134	1,235	1,166
Total cost of goods sold	3,494	3,700	3,969	4,065	4,031
Gross profit	1,048	944	902	1,112	1,092

Note.–Figures may not add to totals because of rounding. For each of the above items, unit values calculated only where establishment provided both value and quantity data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 8-9
Copper foundries: Responding U.S. producers' financial results for their machining operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
Net sales (*short tons*)	39,874	39,659	37,459	35,222	35,546
	Value (*1,000 dollars*)				
Net sales	313,478	323,364	309,271	303,858	304,902
Cost of goods sold:					
Rough castings produced	170,371	181,154	167,551	177,523	174,650
Rough castings purchased from other companies	([1])	([1])	([1])	([1])	([1])
In-house machining costs	73,363	74,690	71,517	70,630	71,384
Subcontracted machining costs	([1])	([1])	([1])	([1])	([1])
Other machining costs	11,100	10,571	12,583	8,156	15,067
Total costs of goods sold	258,967	270,664	255,905	260,237	264,924
Gross profit	54,511	52,700	53,366	43,621	39,978
Selling, general, and administrative	24,587	23,208	24,154	22,318	21,982
Operating income	29,924	29,492	29,212	21,303	17,996
	Ratio to net sales (*percent*)				
Cost of goods sold	83	84	83	86	87
Gross profit	17	16	17	14	13
Selling, general, and administrative	8	7	8	7	7
Operating income	10	9	9	7	6
	Number of establishments reporting:				
Operating losses	2	4	7	4	10
Financial results data	23	24	24	24	24

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and cost data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 8-10
Copper foundries: Share of total metal raw material costs for responding U.S. producers' rough casting operations, fiscal years 1999-2003

(***Percent***)

Item	1999	2000	2001	2002	2003
Primary metals in scrap form	25	16	16	20	21
Primary metals in other forms	58	68	68	65	64
Other metal	16	16	16	15	15
Total	99	100	100	100	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 8-11
Copper foundries: Share of total energy costs for responding U.S. producers' rough casting operations, fiscal years 1999-2003

(***Percent***)

Item	1999	2000	2001	2002	2003
Electricity	87	84	82	87	84
Natural gas	12	16	18	13	16
Other	1	([1])	([1])	([1])	([1])
Total	100	100	100	100	100

[1] Less than 0.5 percent.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Labor

In spite of a decline in the workforce, employment costs for the copper castings industry were 11 percent higher in 2003 than in 1999 (table 8-12 and see table 8-6). Most of the increase was driven by a rise in salaries and wages, which increased by 15 percent (to $33,651) on a per employee basis from 1999-2003. Health benefits increased by more than 75 percent to $5,239 per employee, following trends for the foundry industry as a whole. Associated costs per employee increased by 32 percent, mainly as a result of an increase in worker compensation costs. According to industry representatives, worker compensation costs in the copper foundry industry have grown in part because of the concern over exposure to lead.[18] Lead is an important alloying element, particularly for plumbing products as lead is easily machined, maintains its shape under pressure, and can be recycled.[19] However, exposure of foundry workers to lead can lead to long term damage of the muscles and internal organs.[20]

[18] U.S. industry official, telephone interview with USITC staff, Jan. 26, 2005.
[19] Plumbing Alloys In The Scrap Stream, Copper Development Association, found at *http://www.copper.org/environment/trends/plumbing_alloys.html*, retrieved Jan. 26, 2004.
[20] Illinois Department of Public Health, Lead in Industry, found at *http://www.idph.state.il.us/about/epi/getpbout.htm*, retrieved Jan. 26, 2005.

Table 8-12
Copper foundries: Responding U.S. producers' employment costs for their rough casting operations, fiscal years 1999-2003

(***1,000 dollars***)

Item	1999	2000	2001	2002	2003
Salaries and wages (including overtime)	85,241	86,913	86,930	91,811	88,570
Health benefits	9,451	9,950	11,340	14,023	14,985
Pension and profit sharing	3,312	3,342	2,569	3,487	4,485
Other costs	11,618	11,191	11,462	12,789	13,788
Employee training	241	248	202	213	241
Total employee costs	109,863	111,644	112,503	122,323	122,069

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Investment

According to producers, capital expenditures for rough castings were greatly restricted during the period, but particularly during the economic slowdown in 2000 and 2001 (table 8-13). Many foundries indicated that owing to their financial situation even routine upgrades/improvements were delayed.[21] Research and development related expenditures decreased during the period for these reasons. Despite the decrease, capital expenditures were still 10 percent of gross profits in 2003. As firms looked to maintain competitiveness and manage labor costs, many copper foundries indicated that they automated production lines. Environmentally-related expenditures peaked in 1999 and 2000 as firms implemented OSHA mandated improvements to limit lead exposure.

Table 8-13
Copper foundries: Responding U.S. producers' capital and R&D expenditures for their rough casting operations, fiscal years 1999-2003

(***1,000 dollars***)

Item	1999	2000	2001	2002	2003
Capital expenditures:					
Machinery, equipment, and fixtures:					
Environmentally related	2,468	1,768	345	596	360
Other	16,118	22,416	10,556	8,533	6,109
Land, building, and related improvements	4,292	7,507	926	1,090	1,956
Total	22,878	31,691	11,827	10,219	8,425
Research and development expenditures	([1])	([1])	([1])	([1])	([1])

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

[21] Multiple responses to the USITC producer questionnaire; and U.S. industry official, telephone interview with USITC staff, Jan. 27, 2005.

Debt

Original costs rose 18 percent though firms spent fairly little on capital investments from 1999-2003 (table 8-14). However, most of the growth was between 1999-2000 before the industry was negatively affected by the economy. Industry debt increased sharply until 2001 when it declined dramatically. This fluctuation is because of insurance payouts after damage from fires and floods at several firms which eliminated debt.

Purchaser Trends

Purchases of copper-based castings increased steadily throughout the period. Purchases of rough copper castings of domestic origin exhibited the greatest growth in value, increasing 67 percent throughout the period (table 8-15). However, purchases of domestic machined copper castings decreased, as purchasers increasingly sourced machined castings from foreign suppliers. Almost all purchasers who reported purchases of copper castings indicated that they bought foreign copper castings because of their lower price.

Table 8-14
Copper foundries: Other financial information for responding U.S. producers' rough casting operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
Total debt (*1,000 dollars*)	73,920	89,097	90,423	65,178	54,513
Property, plant, and equipment:					
Original cost (*1,000 dollars*)	214,669	239,223	247,536	253,572	252,352
Book value (*1,000 dollars*)	82,817	98,803	95,919	90,753	85,795

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 8-15
All copper castings: Total reported U.S. purchases of domestic and foreign castings, 1999-2003
(*1,000 dollars*)

Type	1999	2000	2001	2002	2003
Rough castings:					
Domestic	96,597	89,090	241,541	130,777	160,960
Foreign	790	1,158	2,406	2,504	2,434
Total	97,387	90,248	243,947	133,281	163,394
Machined castings:					
Domestic[1]	86,191	80,135	60,572	62,670	59,959
Foreign	51,509	66,006	59,844	82,410	92,315
Total	137,700	146,141	120,416	145,080	152,274

[1] Includes data for purchases of castings from unknown sources to prevent disclosure of business confidential information.

Note.–These data do not indicate all purchases of castings in the United States. See ch. 1 for additional information on data coverage.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Product Profiles

Copper Valve Castings

Industry Profile

Product Description and Uses

Valves are used to control the flow of liquids, gases, and solids through pipes and piping systems. Control is achieved by moving a disc, plug, or other flow-controlling element within the valve assembly to open, close, or partially obstruct the passageway. Valves are produced in a range of sizes and are used with a variety of pressures. A check valve permits the material in a system to flow in only one direction. These generally have no external means of control, but are opened by the pressure in the system and are closed automatically when the pressure drops below the level for which the valves were designed. A hand-operated valve contains a mechanism that is used to open and close the valve. Valves are generally produced according to standards and specifications established by standards-setting organizations such as the American Society for Testing and Materials (ASTM), the American Petroleum Institute (API), and the American National Standards Institute (ANSI). For valves used in other countries, other standards may apply.

Copper valves are those made of metal in which the copper content is, by weight, less than 99.3 percent, but not less than any other metallic element. Copper scrap is generally used as raw material.

Industry structure.—Twelve establishments reported producing copper-alloy hand-operated and check-type taps, cocks, and valve ("copper valve") castings in the United States during 1999-2003. The three largest establishments accounted for 64 percent of all reported copper valve castings production in 2003. Three of the 12 are located in Pennsylvania; 11 of these foundries use sand casting and one uses investment casting. Many of these producers are producers of finished copper valves, rather than job shops; however, most perform design, pattern making, and mold making, as well as machining and downstream manufacturing. The majority of these firms produce castings only for copper valves, although some produce other cast copper-alloy products or cast products of other metals.

Demand characteristics.—According to questionnaire responses, 93 percent of rough copper valve castings were produced for in-house machining; and 72 percent of machined castings were intended for in-house use in downstream products, indicating that the majority of copper valve castings currently being produced in the United States are being produced by valve manufacturers rather than by job shops (table 8-16). The remainder represent direct sales of castings to valve manufacturers. Questionnaire responses indicate that the leading end use applications for copper valve castings are plumbing and valves and pipe fittings, accounting for 37 and 54 percent, respectively, of total sales (table 8-17).

Demand for valves is dependent upon investment in new capital goods, such as for water and sewage treatment systems, replacement of valves in existing piping systems,[22] and the residential construction industry. Housing starts have been a stable source of demand for copper valves.[23] Housing starts increased 13 percent during 1999-2003, to 1.8 million in 2003.[24] Copper valves compete directly with polyvinyl chloride (PVC) for many household and low pressure applications, and the market share of copper has been declining due to advantages of PVC in cost and ease of installation.

[22] U.S. industry official, telephone interview with USITC staff, Feb. 18, 2005.

[23] Vanguard Economic Week in Review, Feb. 19, 2005.

[24] National Association of Home Builders, *Annual Housing Starts (1978-2003),* found at *http://www.nahb.org/generic.aspx?genericContentID=554*, retrieved Dec. 16, 2003.

Table 8-16
Copper valve castings: Responding U.S. producers' shipments, by channel of distribution, 2003
(*Percent*)

Channel of distribution	**Share of 2003 shipments of castings by quantity**
Rough castings:	
In-house machining	93
Original equipment manufacturers	7
Total	100
Machined castings:	
Original equipment manufacturers	([1])
In-house for use in downstream products	72
Other	28
Total	100

[1]Less than 0.5 percent.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 8-17
Copper valve castings: End market for responding U.S. producers' shipments, 2003
(*Percent*)

End market	**Share of 2003 shipments of castings by quantity**
Mining and oil/gas field machinery and equipment	1
Refrigeration, air conditioning, and heating equipment	4
Plumbing	37
Valve and pipe fittings	54
Pumps and compressors	2
Ships and boats	1
Other/unknown	1
Total	100

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Producer Trends

***Production and inventories*.—**According to questionnaire responses, the quantity of U.S. production of rough copper valve castings fluctuated during 1999-2003 and was 6 percent lower in 2003 than 1999. The decline reflected the combined effect of material substitution and increased import penetration. Inventories were little changed, with an increase of 2 percent by weight but less than 1 percentage point as a share of production (table 8-18).[25]

[25] Certain data have been withheld to avoid disclosure of business confidential information. These data include commercial shipments, export shipments, commercial domestic and export sales, sales for internal consumption or transfer to related firms other than for production of machined castings, and operating income for rough castings; net (continued...)

Table 8-18
Copper valve castings: Responding U.S. producers' production and inventories for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Production (short tons)	54,133	56,199	51,761	51,856	50,966
Inventory:					
Total (short tons)	4,401	3,962	3,748	3,676	4,511
Share of production (percent)	8	7	7	7	9

Note.–Figures may not add to totals because of rounding. Inventory share of production based on establishments that were able to provide both inventory and production amounts.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Employment.—Questionnaire responses indicate that the number of persons employed in the production of copper valve castings decreased each year during 1999-2003, and the number in 2003 was 14 percent below the level of 1999. The number of hours worked by PRWs declined 17 percent between 1999 and 2003 and wages paid fell about 7 percent, while average hourly wages and productivity both increased, by 13 percent and 15 percent, respectively. According to questionnaire respondents, productivity increased as a result of such actions as utilizing automatic molding machines and introducing the use of trim dies, which also improve quality (table 8-19).

Table 8-19
Copper valve castings: Responding U.S. producers' employees and related information for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
Average number of employees	1,111	1,067	1,023	1,013	954
Production and related workers:					
Number	934	890	852	844	805
Hours worked (*1,000 hours*)	1,973	1,933	1,726	1,667	1,632
Wages paid (*1,000 dollars*)	31,654	30,361	29,340	29,682	29,570
Average hourly wages (*dollars per hour*)	16.04	15.71	17.00	17.81	18.12
Productivity (*short tons per 1,000 hours*)	27	29	30	31	31

Note.–Figures may not add to totals because of rounding. Average hourly wages based on establishments that were able to provide both hours worked and wages paid. Productivity based on establishments that were able to provide both production quantity and hours worked.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Producers' shipments and exports.—According to questionnaire responses, U.S. producers' domestic shipments, as measured in both quantity and value, fluctuated during 1999-2003. Both indicators were lower in 2003 than 1999. Export shipments, which were less than one percent of total shipments throughout the period, were also lower in both quantity and value in 2003 as compared to 1999. The bulk of domestic shipments (over 85 percent) have been in the form of shipments for internal consumption or transfer by captive foundries, as opposed to commercial shipments. The quantity and value of commercial shipments

[25] (...continued)
sales and operating income for machined castings; and expenditures for machinery, equipment, fixtures, research, and development.

Table 8-20
Copper valve castings: Responding U.S. producers' domestic shipments and exports for their rough casting operations, 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Domestic shipments:					
Commercial	([1])	([1])	([1])	([1])	([1])
Internal consumption and transfers	48,105	49,918	46,473	47,185	46,520
Exports	([1])	([1])	([1])	([1])	([1])
Total	53,848	55,895	51,039	51,187	49,819
	Value (*1,000 dollars*)				
Domestic shipments:					
Commercial	([1])	([1])	([1])	([1])	([1])
Internal consumption and transfers	119,507	119,895	116,875	131,229	123,142
Exports	([1])	([1])	([1])	([1])	([1])
Total	146,183	145,314	136,723	149,421	137,924

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

declined significantly during the period (by over 40 percent) while the quantity of shipments for internal consumption and transfer fell 3 percent and the value increased 3 percent (table 8-20).

Financial condition.—U.S. producers of rough copper valve castings reported declining but generally stable sales and profitability during 1999-2003. Net sales quantities fell by 7 percent between 1999 and 2003 and net sales values decreased about 1 percent (table 8-21). Operating income in 2001 was about one-half of its 1999 amount, and recovered to 94 percent of the 1999 amount in 2003. Although two of 10 reporting firms reported operating losses in 2003 (up from 1 of 9 reporting firms in 1999), the operating margin recovered in 2002-2003 after a poor year in 2001.

With respect to machined copper valve castings, questionnaire responses indicate that net sales quantities decreased 3 percent during 1999-2003, while net sales values rose 5 percent. Operating income increased 38 percent and the operating margin for the industry increased, but remained at less than one-half that for rough castings. As was the case with rough copper valve castings, 2001 was the worst year financially for the machined copper valve castings industry (see table 8-21).

Investment.—Questionnaire responses indicate that capital expenditures on machinery, equipment, and fixtures decreased each year during 1999-2003, and that the 2003 level was 45 percent below the 1999 level (table 8-22). The data reflect the fact that one major producer invested heavily in a new foundry and machining center during 1999-2001, but reduced capital spending based on reduced sales outlook in 2002-2003.[26]

[26] U.S. industry official, telephone interview with USITC staff, Feb. 22, 2005.

Table 8-21
Copper valve castings: Responding U.S. producers' financial results for their rough casting and machining operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
	Quantity (*short tons*)				
Rough castings:					
Net sales:					
Commercial domestic and export sales	([1])	([1])	([1])	([1])	([1])
Internal consumption for production of machined castings	41,153	42,149	39,723	40,287	38,731
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales quantities	49,292	50,663	46,994	47,584	45,624
	Value (*1,000 dollars*)				
Net sales:					
Commercial domestic and export sales	([1])	([1])	([1])	([1])	([1])
Internal consumption for production of machined castings	165,060	167,937	162,611	173,908	166,976
Other internal consumption or transfers to related firms	([1])	([1])	([1])	([1])	([1])
Total net sales values	197,629	202,355	192,918	205,162	195,694
Operating income	22,552	19,678	11,960	19,177	21,283
	Ratio to net sales (*percent*)				
Operating income	11	10	6	9	11
	Number of establishments reporting:				
Operating losses	1	1	3	1	2
Financial results data	9	9	10	10	10
Machined castings:					
Net sales (*short tons*)	24,225	24,717	24,020	23,568	23,436
	Value (*1,000 dollars*)				
Net sales	212,183	219,741	211,482	217,592	223,535
Operating income	([1])	([1])	([1])	([1])	([1])
	Ratio to net sales (*percent*)				
Operating income	([1])	([1])	([1])	([1])	([1])
	Number of establishments reporting:				
Operating losses	1	1	1	1	1
Financial results data	4	5	5	5	5

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding. The figures above reflect only those establishments that were able to provide quantity, value, and operating income data.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 8-22
Copper valve castings: Responding U.S. producers' capital and R&D expenditures for their rough casting operations, fiscal years 1999-2003

(***1,000 dollars***)

Item	1999	2000	2001	2002	2003
Machinery, equipment, and fixtures	11,976	7,827	6,561	3,823	3,224
Research and development expenditures	([1])	([1])	([1])	([1])	([1])

[1] Data withheld to avoid disclosure of confidential business information.

Note.–Figures may not add to totals because of rounding.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Purchaser Trends

U.S. firms produced almost 100 percent of rough copper valve castings purchased in the United States throughout the 5-year period, according to questionnaire responses. For machined castings, however, U.S. producers lost ground to foreign suppliers (table 8-23). Purchases of U.S.-produced machined castings declined by 56 percent during 1999-2003 while purchases of foreign-produced machined castings increased by a comparable amount. Overall, purchases of U.S.-produced copper valve castings have declined by 23 percent, while purchases of imported castings have increased by 57 percent. The share of total purchases represented by U.S.-produced castings declined to 30 percent from 54 percent.

Imports were an important and growing source of machined copper valve castings. To protect business confidentiality, specific country detail cannot be provided. By value, 31 percent of all imports of machined copper valve castings in 2003 came from China, according to questionnaire responses. Imports from the rapidly growing Asian countries China, Thailand, Taiwan , and India accounted for 57 percent of total imports of machined copper valve castings in 2003, up from 24 percent in 1999.

According to questionnaire responses by purchasers of machined castings, the quantity of purchases of imported castings increased by more than 400 percent during 1999-2003. China, in particular, increased from being only a nominal source to become the leading source of such castings, accounting for 58 percent of imports in 2003. Imports from Thailand, the European Union, and Taiwan also increased by notable amounts.

An industry source indicates that U.S. imports of copper-alloy valves and fittings are expected to reach 30,000 tons in 2005.[27] However, most of these are imported as finished products and would not be reported in official statistics.[28] Import penetration statistics indicate that imports of copper-based valves account for a quarter of all valve consumption in the United States.[29]

The value of imports of downstream product containing copper valves and copper parts for valves increased 34 percent during 1999-2004. Imports from China, which increased 277 percent and now account for over one-third of all such imports, and Italy, which increased 50 percent, were partially offset by a major decrease in imports from Mexico (table 8-24).

[27] Kenneth H. Kirgin, “Casting Imports to U.S. Reach 3 Million Tons,” *Modern Casting,* Sept. 2004, p. 2.
[28] Ibid.
[29] Ibid.

Table 8-23
Copper valve castings: Purchases of domestic and foreign castings by responding U.S. purchasers, 1999-2003

(***1,000 dollars***)

Year	Total
Rough castings:	
1999	38,089
2000	40,980
2001	39,667
2002	43,608
2003	43,969
Machined castings:	
1999	155,579
2000	151,120
2001	125,593
2002	161,216
2003	129,500

Note.–Domestic and foreign purchases not shown separately to prevent disclosure of confidential business information.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 8-24
Copper valve castings: U.S. imports for consumption of downstream products, by leading suppliers, 1999-2004

***(1,000 dollars*)**

Country	1999	2000	2001	2002	2003	2004
China	98,162	117,111	138,010	235,652	265,954	370,033
Taiwan	150,413	153,024	128,510	131,037	151,785	164,607
Mexico	239,099	265,292	266,369	237,383	186,305	141,404
Italy	78,848	90,542	87,228	87,333	108,307	118,039
Germany	61,160	70,026	72,371	45,100	48,495	71,758
Canada	39,864	45,649	42,960	40,854	43,623	48,478
Korea	13,036	23,882	19,379	22,908	15,181	20,358
Turkey	18,835	27,388	20,902	21,905	18,393	19,385
Portugal	13,655	15,920	15,851	15,500	14,069	16,353
Thailand	6,783	8,474	6,635	10,157	10,510	15,209
All other	76,173	75,164	63,986	79,943	73,105	83,875
Total	796,028	892,472	862,201	927,772	935,727	1,069,499

Note.–Downstream products includes copper valves and copper parts for valves (HTS classifications 8481.30.10 and 8481.80.10). Figures may not add to totals because of rounding.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Competitive Assessment of Price- and Product-related Factors

Price and non-price factors.—U.S. producers, in questionnaire responses, indicated that prices from all countries mentioned are lower than those of U.S. copper valve castings producers. China was the country most often mentioned by producers; Chinese castings were estimated to be priced 36 percent lower than comparable U.S.-produced castings (table 8-25). Castings purchasers, in the main, also reported lower prices for imported castings. For the following countries, the average of the estimated price differentials reported by purchasers were: China (33 percent), Thailand (26 percent) and Taiwan (24 percent). A few purchasers

Table 8-25
Copper valve castings: Price comparison by responding U.S. producers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Brazil	Lower	1	30
Canada	Lower	2	13
China	Lower	4	36
EU-15	Lower	1	15
India	Lower	2	28
Mexico	Lower	1	35
Taiwan	Lower	1	10
Machined castings:			
Brazil	Lower	1	75
Canada	Lower	1	5
China	Lower	5	37
Taiwan	Lower	2	30

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

responded that the prices from those 3 sources were "about the same" as those in the United States and one respondent stated that prices from China were 10 percent higher than those in the United States (table 8-26).

Purchasers of imported copper valve castings indicated that their decisions to increase purchases of imported product were influenced by advantages in every competitive factor identified. For imports from China, 13 (100 percent) of those who responded indicated that Chinese product incorporated better design, better range or variety of product, better warranty terms, better technical support and service, lower transportation costs, and better packaging. Only 5 of the respondents noted better U.S. delivered price as an advantage, although 11 noted more discounts as a Chinese advantage. Respondents also noted Chinese advantages in lead times, minimum order size, design, quality, and flexible payment terms. Similar responses were noted by purchasers of castings from Taiwan, Canada, and Germany, with imported castings being preferred by purchasers on the basis of every competitive factor; not on the basis of price alone.

Producers' response to import competition.—Actions taken by producers in response to import competition were primarily to reduce prices or suppress price increases, to implement cost-reduction efforts, and to improve product quality. One of the nine producers that responded indicated that it had changed to imported product and one indicated that it had opened a plant in a foreign country (table 8-27).

Table 8-26
Copper valve castings: Price comparison by responding U.S. purchasers of domestic and foreign castings in the U.S. market

Country	Price relative to U.S. castings	Number of responses	Average percent difference
Rough castings:			
Canada	Lower	1	10
Canada	Higher	1	20
China	Lower	1	10
EU-15	Lower	1	10
India	Lower	1	16
Mexico	Lower	2	17
Machined castings:			
Brazil	Lower	2	28
Brazil	Higher	1	10
Brazil	About the same	1	([1])
Canada	About the same	3	([1])
China	Lower	10	33
China	Higher	1	10
China	About the same	2	([1])
EU-15	Lower	2	15
India	Lower	1	20
India	Higher	1	40
Japan	About the same	1	([1])
Mexico	Lower	1	10
Mexico	Higher	1	20
Portugal	Lower	1	20
Taiwan	Lower	8	24
Taiwan	About the same	2	([1])
Thailand	Lower	7	26
Thailand	About the same	1	([1])
Turkey	Lower	1	25

[1]Not applicable.

Source: Compiled from data submitted in response to purchaser questionnaires of the U.S. International Trade Commission.

Table 8-27
Copper valve castings: Responding U.S. producers' responses to import competition

Nature of response	Number of responses
Total number of establishments responding	9
Took no or few actions because:	
Had already shifted production to more advanced types of castings	1
Had already shifted production to other lines of castings	1
Lacked capital funds to counter foreign competition	1
Took the following actions:	
Lowered prices or suppressed price increases	8
Reduced or dropped plans to expand capacity	2
Cut back or eliminated production	2
Shifted to other cast products	2
Implemented cost-reduction efforts	8
Improved product quality	7
Imported product instead	1
Opened a plant in a foreign country	1

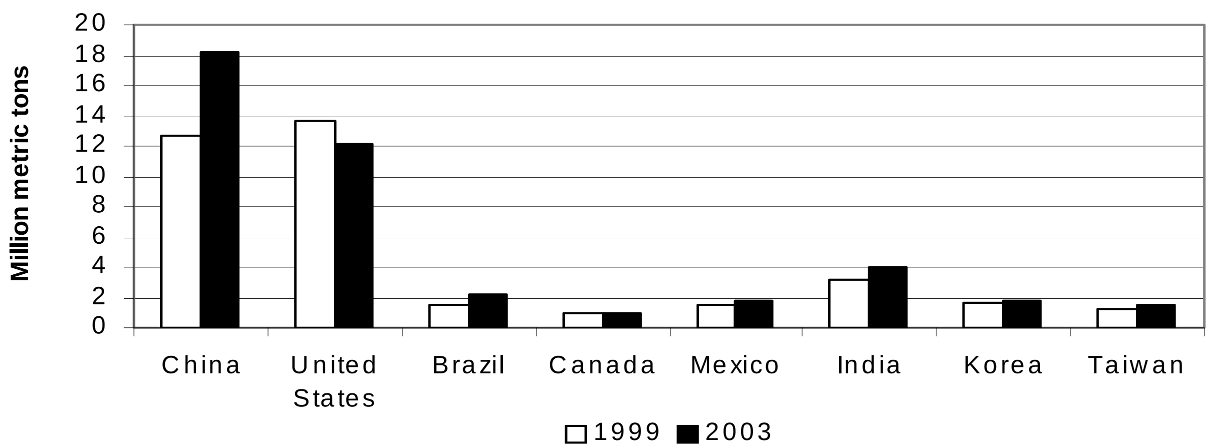
Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

CHAPTER 9
PROFILES OF THE FOUNDRY INDUSTRY IN SELECTED FOREIGN COUNTRIES

Introduction

Many industrialized economies have developed large foundry industries to support their manufacturing sectors. Moreover, the availability of abundant raw material resources in certain producing countries also furthered foundry industry development. Global production of foundry products totaled approximately 74 million metric tons in 2003, with the top-10 producing countries accounting for 82 percent (60.3 million metric tons) of output.[1] Seven countries, which accounted for 41 percent (30.4 million metric tons) of estimated 2003 global production, are the focus of this chapter (figure 9-1). China is the world's largest producer of foundry products and a leading competitive concern of the U.S. industry, according to hearing testimony and questionnaire responses. In addition to China, Latin America's largest castings producer, Brazil, was specifically cited in the request letter as a focus of this study. Other countries, such as Korea, India, Mexico, and Taiwan, were frequently mentioned by the U.S. industry and questionnaire respondents as principal competitors in the U.S. market. They also rank among the world's 12 leading castings manufacturers. The Canadian industry is included here because of its role in the larger North

Figure 9-1
Production of foundry products in selected countries, 1999 and 2003



Source: 34th and 38th Census of World Casting Production, 1999 and 2003, *Modern Casting*, Dec. 2000 and 2004.

[1] Production of 32 countries is represented in these data. Data are typically collected from the individual country's foundry association. "38th Census of World Casting Production – 2003," *Modern Casting*, Dec. 2004, pp. 25-27.

American industry and North American Free Trade Agreement (NAFTA) membership. The foundry industries in more developed countries, such as Japan and those in Western Europe, are generally comparable to the U.S. industry in terms of production cost structure, infrastructure development, and government policies and regulations. Based on questionnaire responses, U.S. producers did not indicate that these countries are competitive concerns in the U.S. market. Consequently, this chapter focuses on the previously cited countries of competitive concern to the U.S. industry and provides information on industry conditions, factors of production, and government policies, to the extent possible.

Brazil

Industry Profile

Industry statistics (2003):
- World rank – 9th
- Production – 2.2 million metric tons
- Employment – 47,198 workers
- No. of firms – 1,231

Industry characteristics:
- Net exporter of foundry products
- Industry is largely Brazilian-owned
- Small and medium firms account for 95 percent of industry

The resurgent Brazilian economy has generated increased demand for foundry products from leading markets, such as the motor-vehicle industry. Despite concerns with high interest rates, an overburdened transportation infrastructure, and hiring and retaining skilled employees, the Brazilian industry expects domestic demand for foundry products to continue to increase as major end-use markets benefit from the improved economy, greater consumer spending, and infrastructure investments.

Although Brazil is one of world's top 10 foundry products manufacturers, the value of its output is considered to be relatively low because iron castings dominate its product mix, relative to higher-valued aluminum and other non-ferrous production.[2] The industry is characterized by its extensive use of domestically produced raw materials and production of labor-intensive foundry products, a specialty of the Brazilian industry.[3] Brazilian foundries use a wide array of casting methods in their production processes, including die, investment, and shell (sand) casting, and many perform some machining of castings.[4]

Brazil accounted for 3 percent of global ferrous casting production and 1 percent of nonferrous production in 2003.[5] Industry revenue totaled $2.9 billion in that year, up 26 percent from the 1999 level,[6] reflecting the notable upturn in the Brazilian economy (table 9-1). The Brazilian foundry industry accounted for 0.58 percent of Brazilian GDP in 2003.[7] Despite its position as one of the largest Latin American markets for foundry products, foreign competition is limited, with most foreign castings entering the country incorporated into parts or finished goods.[8]

Following two years of continuous decline in the number of foundries operating in Brazil, the industry added foundries during 2002-03, reaching a period high of 1,231 foundries.[9] Although most foundries are Brazilian owned,[10] and 95 percent are small- to medium-sized businesses,[11] several U.S. and other foreign companies are represented in the Brazilian industry. These include General Motors (United States), Teksid (Italy), Gibbs Die Casting (United States), and Magal (Germany). A few U.S. foundries have

[2] Joe Scarry, "Shifts In Global Casting In 1999," CastingTrade.com, found at *http://www.castingtrade.com/html/world/worldchange.html*, retrieved Mar. 18, 2005.

[3] Brazilian industry official, interview with USITC staff, Brazil, Nov. 2004.

[4] ABIFA Foundry Guide 2004. The Associação Brasileira de Fundição (ABIFA) is the Brazilian foundry industry association.

[5] "38th Census of World Casting Production – 2003," *Modern Casting*, Dec. 2004, p. 26.

[6] ABIFA presentation.

[7] Ibid.

[8] Brazilian industry official, interview with USITC staff, Brazil, Nov. 2004. Brazilian tariffs on castings range from 0-20 percent.

[9] ABIFA presentation to USITC staff, Brazil, Nov. 2004.

[10] David P. Kanicki, "Global Casting Report: Past, Present & Future," *Modern Casting*, Dec. 2000, p. 24.

[11] Brazilian industry association official, interview with USITC staff, Brazil, Nov. 2004.

Table 9-1
Brazilian foundry industry: Number of firms and industry revenue, 1999-2003

Item	1999	2000	2001	2002	2003
Number of firms	1,050	1,015	1,007	1,177	1,231
Revenue (billion dollars)	2.3	2.7	2.3	2.5	2.9

Source: ABIFA presentation.

reportedly partnered with Brazilian foundries to gain access to low-cost castings to supply U.S. customers that might otherwise purchase castings from China.[12]

The Sao Paolo region is the largest producing area in Brazil, accounting for 34 percent of Brazilian foundry production in 2003. Other leading producing areas are the state of Minas Gerais and the South, which accounted for 29 percent and 28 percent, respectively, of Brazilian foundry output.[13] Brazilian output is concentrated in 10 foundries, which accounted for 47 percent (930,034 metric tons) of production in 2003.[14] Many of these same firms are the largest employers in the Brazilian foundry industry, with employment in excess of 1,000 workers.

The automotive market purchases nearly 57 percent of foundry output in Brazil.[15] The growth of the Brazilian motor vehicle industry, with a reported investment of $20 billion, has spurred development of the Brazilian foundry industry. The capital goods and railroad sectors are also exhibiting signs of recovery, which is reportedly lifting demand for foundry products.[16]

Tupy SA, an independent Brazilian foundry with operations worldwide, is the largest foundry in Latin America. Tupy's Brazilian operations are located in Joinville and Mauá, with total foundry capacity of 500,000 metric tons. Production is focused on cylinder blocks and heads for medium- and heavy-duty engine applications. Tupy (Mauá) is one of the few foundries that casts compacted graphite iron (CGI), which is used to produce V-6 engine blocks for Ford.[17] Tupy also pours gray iron and nodular (ductile) iron at its Brazilian foundries. Another large international player in the Brazilian industry is Teksid do Brasil, an Italian-based foundry company. Teksid produces gray and nodular iron castings primarily for motor vehicle applications at its Betim, Brazil facility, which has a production capacity of approximately 250,000 metric tons per year.[18]

---

[12] Ted Evanoff, "Chinese imports hurting iron trade: Low-cost suppliers help fuel Hoosier plants' woes," *Indianapolis Star*, Jan. 17, 2003, found at *http://www.incma.org*, retrieved Sept. 26, 2003.

[13] ABIFA presentation.

[14] Four Brazilian foundries – General Motor Ferro, Minas Zinco, Teksid Iron, and Tupy (Joinville) – are known to have a production capacity in excess of 100,000 metric tons, and another six foundries have capacities ranging between 50,000-100,000 metric tons, ABIFA Foundry Guide 2004.

[15] In addition, exports account for 16 percent of output; capital goods, 14 percent; steelmakers and other consumers, 5 percent each; and infrastructure applications, 3 percent. ABIFA Foundry Guide 2004, p. 24, and ABIFA presentation.

[16] Brazilian industry official, interview with USITC staff, Brazil, Nov. 2004; "Foundries see 20% increase in sales in 2004," BNAmericas.com, June 25, 2004, found at *http://itc.newsedge-web.com*, retrieved June 29, 2004; and "Brazilian Economy Growing After Recession," Associated Press, found at *http://itc.newsedge-web.com*, retrieved June 30, 2004.

[17] Information from Tupy website, found at *http://www.tupy.com.br/ing.htm*.

[18] Information from Teksid website, found at *http://www.teksid.com.*

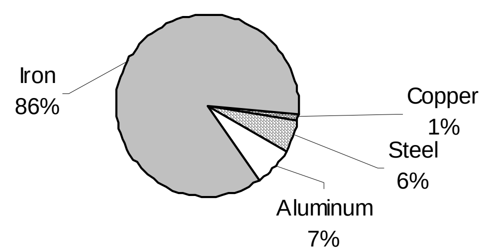
Business Trends

Production

Following the 2001 recession and electricity shortage, Brazilian foundry production rose by 28 percent to 2.2 million metric tons in 2003 in response to the rapid growth of the Brazilian economy (table 9-2). Total projected production of metal castings in 2004 is 2.8 million metric tons, about 25 percent higher than the 2003 average total of 2.2 million metric tons.[19] The daily pour rate has risen by 22 percent to 12.3 metric tons per day in November 2004, compared with 10 metric tons during the comparable period in 2003.[20]

Despite growth in the aluminum casting sector, the Brazilian foundry industry remains largely focused on lower-valued gray and ductile iron production, which accounted for about 86 percent of industry output in 2003 (figure 9-2). Although iron accounted for the largest portion of 2003 sales by quantity, nonferrous and steel castings accounted for a greater share by value (30 percent and 13 percent, respectively).[21] The aluminum sector, in particular, has been cited as a major beneficiary of the upturn in the transportation industries.[22] Increased investment in the automotive sector and greater motor vehicle production are generating demand for foundry products. The privatization of the railway sector has also spurred demand for castings, as has growth in the agricultural equipment industry.[23] Demand from the capital goods sector is also rebounding as the Brazilian economy recovers.[24]

Figure 9-2
Brazilian foundry industry: 2003 production, by metal type (based on weight)



Source: *Modern Casting*.

According to industry sources, installed capacity and production are expected to increase through 2009, although not at the same pace. By 2009, Brazilian demand for castings is expected to outstrip installed capacity by 510,000 metric tons, creating a significant deficit in projected supply (table 9-3). According to Brazilian industry sources, the Brazilian government must reduce interest rates to enable the industry to invest in expansions and facility upgrades to meet projected demand.[25] According to the Brazilian foundry association, the projected shortfall in domestic production may result in increased imports to the Brazilian market, particularly to the growing motor vehicle industry.[26]

---

[19] Table entitled "Produção de Fundidos," ABIFA, found at *http://www.abifa.org.br/mercado/mercado_prod_fun.asp,* retrieved Jan. 3, 2005.

[20] Ibid.

[21] ABIFA presentation.

[22] "Abal/Aluminum consumption to grow 7.9% in 2004," BNAmericas, Aug. 19, 2004, found at *http://itc.newsedge-web.com,* retrieved Aug. 20, 2004.

[23] "Foundries see 20% increase in sales in 2004."

[24] "Brazilian Economy Growing After Recession."

[25] Brazilian industry association officials, interview with USITC staff, Brazil, Nov. 2004.

[26] Ibid.

Table 9-2
Brazilian foundry industry: Casting production, by metal, 1999-2003
(*1,000 metric tons*)

Type of metal casting	1999	2000	2001	2002	2003
Gray iron	971	1,168	1,114	1,219	[1]1,949
Ductile iron	361	379	387	494	([2])
Aluminum	98	108	119	122	150
Steel	76	89	83	87	124
Malleable iron	32	33	27	23	([2])
Copper-base	16	15	14	14	16
Zinc	12	12	10	8	6
Magnesium	6	6	6	4	5
Other nonferrous	0	0	0	0	0
Total	1,574	1,810	1,760	1,970	2,249

[1] Includes production of malleable and ductile iron.
[2] Production included with gray iron.

Note.–Figures may not add to totals because of rounding.

Source: Annual Census of World Casting Production from several issues of *Modern Casting* .

Table 9-3
Brazilian foundry industry: Actual and projected production and installed capacity, 2003-2009
(*1,000 metric tons*)

	Actual	Projected					
Item	2003	2004	2005	2006	2007	2008	2009
Production	2,249	2,800	3,130	3,400	3,580	3,770	3,910
Installed capacity	3,000	3,100	3,400	3,400	3,400	3,400	3,400

Source: ABIFA presentation.

Employment

The Brazilian industry is adjusting to new market conditions as tariffs decline and globalization continues, with a focus on improving labor productivity to retain its share of the global market.[27] Brazilian foundries have emphasized greater mechanization and increased investment in employee training to achieve these improvements. As a result, productivity has improved significantly over the period, with metric tons per worker increasing 19 percent and hours/per ton declining by 16 percent (table 9-4). Recent favorable economic conditions that have attracted new industry entrants and boosted production have had a corollary effect on employment, which rose by 11 percent since 2001 to 47,198 workers in 2003. Brazilian government policies that restrict a firm's staffing flexibility likely limited worker reductions during the 2001 recession.

Table 9-4
Brazilian foundry industry: Employment and productivity, 1999-2003

Item	1999	2000	2001	2002	2003
Employment (*number of workers at year-end*)	38,202	41,407	42,409	43,918	47,198
Productivity (*metric tons per worker*)	41.2	44.6	41.0	45.4	49.0
Productivity (*hours per metric ton*)	48.6	44.8	48.7	44.0	40.8

Source: ABIFA presentation.

[27] Kanicki, "Global Casting Report: Past, Present & Future."

Investment

Industry sources have indicated that investment in the Brazilian foundry industry is needed to meet future demand and maintain its position as a net exporter of foundry products.[28] However, capital investment is hampered by high interest rates.[29] The investment necessary to meet projected 2009 demand for Brazilian castings is estimated by industry sources at $560 million.[30] With the recent improvements in the Brazilian economy and foundry industry fundamentals, local foundries anticipated increasing their investment in capacity expansions by $100 million to reach $450 million in 2004.[31]

Exports

Brazil is a net exporter of foundry products, with 14 to 16 percent of Brazilian castings output exported. Exports grew by 14 percent a year by value during the period, and were expected to reach $750 million in 2004.[32] The volume of exports rose at a lower rate (10 percent), reaching 361,395 metric tons in 2003 (table 9-5). Iron castings accounted for about 88 percent of these exports, reflecting the dominance of iron in Brazilian foundry production. Exports of nonferrous castings, in particular components for the automotive industry, rose by 53 percent during the period and accounted for 6 percent of total exports in 2003. Exports were reportedly adversely affected in 1999 because of high pig iron prices that reduced cost competitiveness,[33] and in 2001 by the global economic slowdown.

Table 9-5
Brazilian foundry industry: Exports by metal type, 1999-2003

Metal type	1999	2000	2001	2002	2003
	Quantity (*metric tons*)				
Iron	219,850	232,658	204,172	265,152	317,276
Steel	15,035	21,649	19,865	21,145	22,475
Non-ferrous	14,143	19,247	14,443	17,714	21,644
Total	249,028	273,554	238,480	304,011	361,395
	Value (*million dollars*)				
Total value	355.8	398.1	337.1	446.9	564.6

Source: ABIFA presentation and ABIFA Foundry Guide 2004, ABIFA, p. 25.

[28] "Metalurgia 2002," Business Network Switzerland, found at *http://212.23.235.40/~0xac10400b_0x000a7dde/metalbrazil.doc*, retrieved Jan. 21, 2005.

[29] Brazilian industry association officials, interview with USITC staff, Brazil, Nov. 2004.

[30] Ibid.

[31] "Foundries see 20% increase in sales in 2004," Bnamericas.com.

[32] Brazilian industry association officials, interview with USITC staff, Brazil, Nov. 2004.

[33] ABIFA filed an antitrust case against Brazilian pig iron producers in December 1998 charging them with establishing a cartel and jointly raising pig iron prices. "Brazil foundry group presses for ruling on pig iron price complaint," *American Metal Market*, Mar. 27, 2000, found at *http://www.findarticles.com/*, retrieved Oct. 8, 2003.

Brazil is one of the top 10 suppliers of castings to the U.S. market. An estimated 70 percent of Brazil's exports are destined for the United States. Engine blocks and heads of gray iron (for diesel engines) and aluminum are among the leading Brazilian foundry exports to the United States.[34] Another 20 percent of its castings exports reportedly are shipped to Europe (primarily Germany).[35]

Factors of Production

Brazil is considered a low-cost producer of foundry products because of certain natural advantages (low-cost hydroelectric power and abundant supplies of pig iron and aluminum) as well as relatively low-cost labor. However, the Brazilian industry is hampered by an inadequate transportation infrastructure and concerned about the availability of trained workers.

Raw Materials and Energy

The Brazilian foundry industry is a large consumer of electricity, most of which is generated by hydroelectric power.[36] Despite these resources, Brazil's energy supply remains vulnerable to disruption because of dependence on sufficient rainfall to power hydroelectric facilities and the lack of needed investment in power generation and distribution systems.[37] Additional demands on the Brazilian energy sector resulting from improved industrial and export growth may strain supply limits and cause shortages in certain regions.

The Brazilian energy sector has been largely controlled by state-owned energy companies, most notably Petrobrás, the leader in oil and natural gas exploration and production,[38] but government control of the production sector ended in 1999.[39] Power generation is largely controlled by the federal government, but distribution is, for the most part, state- or privately held.[40] Currently, an estimated 80 percent of Brazil's electricity generation is government-held.[41] State-generated energy has generally been cheaper than that provided by private entities.[42]

Brazil's hydroelectricity prices, believed to be the world's lowest,[43] declined by 5 percent during the period. Hydroelectric power accounts for about 95 percent of Brazil's electricity output, with less than 25

---

[34] Kenneth H. Kirgin, "Casting Imports: What to Expect in 2003," *Modern Casting*, Sept. 2002, found at *http://moderncasting.com*, retrieved June 10, 2004.

[35] "Foundries see 20% increase in sales in 2004," Bnamericas.com.

[36] ABIFA Foundry Guide.

[37] U.S. Department of Energy, Office of Fossil Energy, *An Energy Overview of Brazil*, Oct. 20, 2003, pp. 2-3, found at *http://www.fe.doe.gov/international...*, retrieved July 20, 2004; and U.S. Department of Energy, Energy Information Administration (EIA), *Country Analysis Briefs: Brazil*, July 2003, pp. 9-10, found at *http://www.eia.doe.gov....*, retrieved July 20, 2004.

[38] Petrobrás has been partly privatized. "Latin American Reforms May Scare Investors," Petroleum Intelligence Weekly, found at *http://itc.newsedge-web.com*, retrieved Aug. 10, 2004.

[39] U.S. Department of the Interior, U.S. Geological Survey, "The Mineral Industry of Brazil – 2001," *U.S. Geological Survey Minerals Yearbook – 2001*, found at *http://minerals.usgs.gov/minerals/pubs/country/2001/brmyb01r.pdf*, p. 5.1.

[40] "The structure of the Brazilian Economy," *Doing Business With Brazil*, Nov. 26, 2001, found at *http://www.cni.org.br/produtos/com_ext/src/doing02.pdf*, retrieved Jan. 3, 2005.

[41] *Country Analysis Briefs: Brazil*, U.S. Department of Energy.

[42] "A dark future ahead if investors don't switch-on to energy funding," *American Metal Market*, July 28, 2003, p. 7.

[43] Brazilian industry official, interview with USITC staff, Brazil, Nov. 2004.

percent of its hydroelectric potential utilized.[44] The 2001 supply shortage[45] led the government to focus on expansion of hydroelectric generating capacity and the creation of a competitive marketplace, as well as the development of its natural gas reserves[46] to reduce dependence on hydroelectric power.[47] Since 1999, natural gas production has increased by 31 percent in contrast to the 3-percent decline in hydroelectricity production (table 9-6). The average price of natural gas reached period highs during the hydroelectricity supply shortage, but increased overall by only 3 percent (table 9-7).

Table 9-6
Brazilian energy production by selected sources, 1999-2002

Energy source	1999	2000	2001	2002
Natural gas (*million cubic meters*)	11,898	13,283	13,998	15,568
Hydroelectric energy (*gigawatt hours*)	293,000	304,403	267,876	284,944

Source: *Brazilian Energy Balance 2003*, Ministry of Mines and Energy, Secretariat for Energy, found at *http://www.mme.gov.br/paginasInternas.asp?url=../ben/,* retrieved July 21, 2004.

Table 9-7
Average prices of selected Brazilian energy sources, 1999-2002[1]

Energy source	1999	2000	2001	2002
Natural gas (US dollars per cubic meter)[2]	83.4	103.2	101.7	86.3
Industrial electricity (US dollars per megawatt hour)[3] . . .	42.6	47.6	43.3	40.6

[1] Brazilian reals converted to current U.S. dollars; price to consumer with taxes.
[2] Petrobrás selling prices to industrial consumers.
[3] Brazilian average prices.

Source: *Brazilian Energy Balance 2003*, Ministry of Mines and Energy, Secretariat for Energy, found at *http://www.mme.gov.br/paginasInternas.asp?url=../ben/,* retrieved July 21, 2004.

Consumers of energy resources in Brazil are grouped by type of end-user (e..g, residential, industrial), and Brazilian foundries are designated as industrial power consumers that purchase from designated suppliers and negotiate with the power source for this supply. Foundries may pay a premium for energy consumed during peak hours (e.g., 10 times more than the standard rate). Some foundries are able to reduce their energy costs because they purchase molten metal from a local source rather than melt their own metal, which requires maintaining and operating furnaces.[48]

Brazil is the world’s second largest producer of pig iron,[49] a principal input in gray iron castings. This contributes to the dominance of gray iron castings in the Brazilian foundry industry’s product mix. Brazil exports 62 percent of its pig iron, which is considered to be low cost and of good quality because of

[44] “Brazil to announce electric sector regulations,” AP Worldstream English, July 27, 2004, found at *http://itc.newsedge-web.com,* retrieved July 29, 2004.

[45] The 2001 electricity shortage resulted from inadequate rainfall levels and insufficient investment in the hydroelectric power industry. *Country Analysis Briefs: Brazil*, U.S. Department of Energy.

[46] Brazilian natural gas reserves totaled 237 billion cubic meters in 2002. *Brazilian Energy Balance 2003*, Ministry of Mines and Energy, Secretariat for Energy, *http://www.mme.gov.br/paginasInternas.asp?url=../ben/,* retrieved July 21, 2004.

[47] *Country Analysis Briefs: Brazil*, U.S. Department of Energy.

[48] Brazilian industry official, interview with USITC staff, Brazil, Nov. 2004.

[49] ABIFA Foundry Guide 2004, p. 21.

its low sulfur and phosphorous content. Although Brazilian foundries pay the world price for pig iron, their transportation costs are much lower because they only pay for internal shipping.[50] Brazil is also a leading world producer of aluminum because of the high quality of its local bauxite ore and the low cost of hydroelectricity used to power energy-intensive aluminum smelters.

Labor

The training and availability of skilled, technical workers is a leading concern of the Brazilian foundry industry. Larger companies operate in-house training to maintain and improve skill levels, and have developed educational institutions to address specific needs. Industry officials noted that Brazil lacks sufficient educational opportunities in metallurgy, and is encouraging schools to offer more metallurgical courses.[51]

Although wage rates are relatively low compared to those in the United States, benefits to employees are quite extensive. Hourly wage rates for Brazilian foundry workers averaged $4.60 an hour (in U.S. dollars)[52] for foundry workers in 2003,[53] but these rates are considerably higher than those paid in China. To offset this wage differential and to better retain its share of the international market, the Brazilian foundry industry has focused on increased mechanization and investment in employee training. The Brazilian Constitution limits the workweek to 44 hours and stipulates a weekly rest period of 24 consecutive hours, preferably on Sundays.[54]

Brazilian foundries subsidize a range of employee benefits, many of which are government mandated.[55] The benefits vary by company, but often include a basket of food or restaurant coupons; transportation to and from work;[56] free or subsidized meals; uniforms and safety equipment; and healthcare. In addition, employees receive generous paid vacations[57] and a government-mandated "13th" salary.[58] Some

---

[50] Brazilian industry official, interview with USITC staff, Brazil, Nov. 2004.

[51] Ibid.

[52] "Worldwide Labor Rates–Foundry Industry," *AFS 2003 Metalcasting Forecast & Trends*, p. 31.

[53] The minimum wage currently stands at 260 reals (around $95) a month. "Brazil wants to hike wages again," United Press International, Dec. 15, 2004, found at *http://washingtontimes.com/upi-breaking/20041215-052924-1544r.htm*, retrieved Feb. 17, 2005.

[54] U.S. Department of State, Bureau of Democracy, Human Rights, and Labor, "Brazil - Country Reports on Human Rights Practices 2003," Feb. 25, 2004, found at *http://www.state.gov/g/drl/rls/hrrpt/2003/27888.htm*, retrieved Feb. 8, 2005.

[55] Employers are mandated by the federal government to provide commuting expenses; risk premiums and health hazard allowances; family, birth, and maternity allowances; social contributions equivalent to 15 percent of payroll; social security contributions equivalent to 20 percent of payroll; on-job accident insurance; and contributions to third parties, such as SENAI. *Doing Business in Latin America - Brazil*, found at *http://www.onlinelearning.net/instructors/smurr/LatAm/sam/brazil.html#lablaw*, retrieved Jan. 3, 2005.

[56] The employer pays for commuting expenses that exceed 6 percent of an employee's base wage or compensation. *Doing Business in Latin America - Brazil*.

[57] Every employee, upon completing one year's service with the same company, is entitled to 30 calendar days vacation as long as the employee has not accrued more than five unjustified absences from work during the period. Workers receive a one-third bonus in addition to the normal wage for annual vacations. *Doing Business in Latin America - Brazil*.

[58] In December of each year, an employer pays a salary bonus, known as the Christmas bonus, to each employee. The bonus corresponds to 1/12th of the overall wage paid to the employee. *Doing Business in Latin America - Brazil*.

foundries also offer profit-sharing[59] and additional bonuses based on company and employee performance. Larger foundries also provide extensive social support to their employees, including such services as recreational programs, maternity and child care counseling, and volunteer activities.[60]

Brazilian firms, including foundries, must also comply with federal regulations that govern the hiring and dismissal of employees. These stipulations may influence employment and scheduling decisions by firms seeking to maintain balanced staffing through periods of fluctuating production.[61] Firing a permanent employee "without good cause" is considered difficult and incurs a financial penalty. Employees contribute 8 percent of their monthly salary to the Unemployment Guarantee Fund (FGTS), with matching funds provided by the employer. If an employee is dismissed, the employer must contribute an additional 40 percent of the amount accrued in the FGTS fund as a severance for the fired employee.[62] A maximum three-month (90 days) probation contract allows firms to employ workers without permanently hiring them.[63]

Two government-funded educational programs target technical workers – Serviço Nacional de Aprendizagem Industrial (SENAI) and Escola Technica Tupy (ETT). SENAI, a vocational training center, is one of four major sector-based vocational training corporations that operate throughout Brazil. SENAI, which is privately managed and financed from payroll taxes levied on employers, provides a wide range of short-term training and upgrading programs for adult workers.[64] ETT, which began as Tupy's in-house educational program to train foundry technical workers, has expanded its course offerings and is currently under the supervision of the Sociedade Educacional De Santa Catarina.[65]

Technology

Industry investment in various types of production technology is considered important for manufacturing and product quality consistency, as well as lower costs that improve competitiveness in global markets.[66] Industry observers note that the technology level in the global foundry industry is not high, and that the same technologies are available worldwide and are evenly distributed.[67] The technology level of the Brazilian foundry industry is generally comparable to that of the U.S. industry. Larger foundries are capital intensive, making extensive use of automated mold- and core-making equipment and employing sophisticated machining equipment.[68] These foundries also operate an array of laboratories to measure the physical and chemical properties of castings. Smaller foundries are more likely to employ manufacturing methods that are more labor intensive, such as manual mold- and core-making.

---

[59] Brazilian industry officials, interviews with USITC staff, Brazil, Nov. 2004. Provisional Measure 794 of December 29, 1994 established the basis for profit sharing as a production incentive. *Doing Business in Latin America - Brazil*.

[60] Brazilian industry officials, interviews with USITC staff, Brazil, Nov. 2004.

[61] Ibid.

[62] *Doing Business in Latin America - Brazil*.

[63] Ibid.

[64] "Asian Development Bank: Skills Promotion Funds," found at *http://www-ilo-mirror.cornell.edu/public/english/employment/skills/recomm/publ/003.htm*, retrieved Jan. 3, 2005.

[65] "An Educational Exchange Between Piedmont Virginia Community College and Escola Technica Tupy," found at *http://www.vccaedu.org/inquiry/vcca-journal/priddy.html*, retrieved Jan. 3, 2005.

[66] Brazilian industry official, interview with USITC staff, Brazil, Nov. 2004.

[67] Brazilian industry officials, interviews with USITC staff, Brazil, Nov. 2004.

[68] Of the 453 firms reporting to ABIFA, 305 foundries employ manual molding systems, 201 firms employ mechanized systems, and 73 foundries operate automated molding systems. Many foundries utilize more than one type of molding system. ABIFA Foundry Guide 2004.

Brazilian industry officials note that investment in technology is hampered by Brazil's high interest rates and by the government prohibition on the purchase of used equipment from foreign sources.[69] In addition, the federal government reportedly offers incentives to firms to purchase Brazilian-made equipment and penalizes (with taxes) those that purchase foreign-made equipment.[70]

Of the 453 firms reporting to ABIFA, 130 foundries reported receiving ISO 9000 and 14000, TS 16949,[71] or QS 9000 certification. The majority of those certified are in compliance with ISO 9000.

Transportation

The Brazilian transportation infrastructure has numerous infrastructure deficiencies, resulting in high costs, long delays, and bottlenecks for business, particularly with respect to road and port systems.[72] As a result, transportation has been problematic for some foundries. Because of the lack of containers and ships at ports, some foundry shipments have been air freighted at a significant cost to the foundry to meet customer delivery requirements.[73]

Investment in transportation infrastructure has increased, but continued funding may depend on the success of the public-private partnerships pending approval in the Brazilian Congress.[74] These partnerships are considered to be critical because the Brazilian government reportedly has limited funding to solely support such improvements.[75] More than $8.6 billion is necessary to fund identified rail and port improvements; an estimated $10 billion is necessary to fund 18 targeted transportation projects.[76]

After decades of state-ownership, the federal railroad system has been transferred to the private sector.[77] Rail transportation is limited, but ongoing upgrades in rolling stock and other equipment by the newly privatized railroad is expected to improve rail performance. The quality of most roads is still poor,[78] with the state of São Paulo and the south the only regions with world-class highways. Since over 60 percent of Brazilian domestic freight is moved over the road system,[79] the inadequate state of this system is a further drag on the economy. Moreover, gasoline is expensive, contributing to higher trucking costs.

The Law of Port Modernization of 1993 (law 8630) provided for reforms of Brazilian port operations, but high costs, long turnaround times, container shortages, and organized labor are standing concerns for

---

[69] Brazilian industry official, interview with USITC staff, Brazil, Nov. 2004.

[70] Ibid.

[71] TS 16949 is a technical specification for facilities that produce OEM or service parts for the automotive industry to improve product and process quality.

[72] U.S. & Foreign Commercial Service and U.S. Department of State, *Brazil Country Commercial Guide FY 2003*, Dec. 13, 2002, p. 4; and "Brazil has worse infrastructure than half of Latin America," EFE News Service, Sept. 27, 2004, found at *http://itc.newsedge-web.com*, retrieved Sept, 28, 2004..

[73] Brazilian industry official, interview with USITC staff, Brazil, Nov. 2004.

[74] "Brazil economy: Aiming for growth minus inflation," Economist Intelligence Unit, Aug. 4, 2004, found at *http://itc.newsedge-web.com,* retrieved Aug. 6, 2004.

[75] Brazilian industry official, interview with USITC staff, Brazil, Nov. 2004.

[76] "The Structure of the Brazilian Economy," *Doing Business With Brazil*, Confederação Nacional da Indústria, Nov. 26, 2001, found at *http://www.cni.org.br/produtos/com_ext/src/doing02.pdf*,retrieved Jan. 3, 2005.

[77] "Brazil in Brief," Embassy of Brazil, found at *http://www.brasilemb.org*, retrieved Aug. 10, 2004.

[78] Only 9 percent of federal, state, and municipal roads totaling about 1.7 million kilometers are paved. "The Structure of the Brazilian Economy," *Doing Business With Brazil*.

[79] "Brazil economy: Aiming for growth minus inflation," Economist Intelligence Unit, Aug. 4, 2004, found at *http://itc.newsedge-wen.com,* retrieved Aug. 6, 2004.

industry. Port privatization is promised.[80] To stimulate investment in port improvements, the Government recently exempted purchases of terminal equipment from certain taxes.[81]

Domestic Policies

High interest rates are a leading concern of the Brazilian foundry industry, as they impact the industry's ability to obtain favorable financing to fund expansions and equipment upgrades. The industry is also subject to the highest taxes in South America. The depreciation of the Brazilian real relative to the U.S. dollar, however, may enhance the industry's export opportunities to the U.S. market.

Federal/Regional Programs

Although no known Brazilian government programs are specifically directed at the foundry industry, the industry likely benefits indirectly from ongoing government programs that provide financial support or incentives. Brazil is developing an industrial support program to help modernize industrial equipment, support technological innovation, and expand export levels. This program is bolstered by subsidized loan programs and the establishment of a new industrial development agency.[82] One of the sectors to benefit from these initiatives is the capital goods sector, a principal end-use market for foundry products. Two programs have been announced. The Modermaq program provides low-interest loans for purchasers of modern industrial equipment.[83] Another program for industrial exporters is designed to encourage innovation and competitiveness in small and medium businesses.[84]

Brazil also offers credit assistance to its exports under two programs. The Export Financing Program known as PROEX, which was established in 1991, is intended to equalize Brazilian and international interest rates for export financing and to fund the manufacture of goods for trade.[85] In addition, the National Bank for Economic and Social Development (BNDES) manages the BNDES-Exim Program, which funds the manufacture and foreign sale of domestically produced goods.[86] BNDES also offers a credit line for purchases of agricultural machinery and equipment known as Moderfrota.[87] However, BNDES reportedly requires compliance with an extensive list of regulations to gain financing at favorable rates, and Brazilian companies that export have better access to its credit program.[88] Moreover, the Forum for Competitiveness

---

[80] U.S. & Foreign Commercial Service and U.S. Department of State, *Brazil Country Commercial Guide FY 2004*, July 15, 2003, found at *http://www.exporthotline.com/chamber....*, retrieved Feb. 16, 2005.

[81] "Brazil economy/Tax breaks for growth," Economist Intelligence Unit, Aug. 11, 2004, found at *http://itc.newsedge-web.com*, retrieved Aug. 13, 2004.

[82] U.S. Department of State telegram, "GOB Further Defines Industrial Policy," message reference No. 00661, prepared by the U.S. Embassy, Brasilia, Mar. 2004.

[83] The BNDES has allocated 2.5 billion reals ($824 million) for this program and will finance 90 percent of the equipment purchase, to be repaid in no more than 60 installments at an interest rate not to exceed 15 percent a year. "BNDES approves US$824mn in loans for machinery," BNAmericas, Aug. 11, 2004, found at *http://itc.newsedge-web.com*, retrieved Aug. 13, 2004.

[84] "GOB Further Defines Industrial Policy.

[85] *2004 National Trade Estimate Report on Foreign Trade Barriers*, United States Trade Representative, p. 22.

[86] "Foreign Trade," *Doing Business with Brazil*, Confederação Nacional da Indústria, Nov. 26, 2001, found at *http://www.cni.org.br/*.

[87] "Capital goods sector is "reviving," says Furian," Oct. 10, 2003, found at *http://www.radiobras.gov.br*, retrieved Aug. 3, 2004.

[88] One industry official estimated that only 5 percent of Brazilian firms meet the BNDES terms. Brazilian industry official, interview with USITC staff, Brazil, Nov. 2004.

in the Capital Goods Productive Chain has been created at BNDES with the aim of supporting industrial sustainability through government investments and purchases, and infrastructure improvements.[89]

Monetary/Tax Policies

Exchange rates.--The Brazilian real steadily depreciated against the dollar during 1999-2003, losing 69 percent of its value, as shown in the following tabulation (reals per U.S. dollar):[90]

Year	Rate
1999	1.82
2000	1.83
2001	2.36
2002	2.92
2003	3.08

This depreciation follows the independent floating of the real with respect to the U.S. dollar since January 15, 1999. Although numerous economic factors influence Brazil's overall competitive condition, such as its relatively high inflation rate, the lower value of the Brazilian real relative to the U.S. dollar may improve the cost competitiveness of Brazilian foundry exports to the U.S. market as well as the export of finished goods that incorporate foundry products.

Tax structure.[91]***--***The tax level in Brazil on imported and locally manufactured goods is the heaviest in Latin America and higher than that in the United States.[92] These taxes reportedly hinder the international competitiveness of Brazilian products and investment levels. Brazilian companies are reportedly subject to as many as 61 different taxes,[93] with a corporate tax rate in 2003 of 34 percent. Total tax collections accounted for nearly 36 percent of Brazilian gross domestic product in 2003.[94] Although these taxes are considered burdensome, they do not discriminate between foreign and domestic firms.[95] Tax reform is widely discussed, but the projected reduction in the level of overall tax collection has reportedly thwarted reform efforts. In August 2004 the Government of Brazil announced its intention to reduce tax rates on capital gains and capital goods, as well as personal income. These measures are designed to streamline the Brazilian tax system and ease the tax burden for the agricultural and industrial sectors, thereby spurring investment in these sectors and improving productivity.[96] The most notable taxes in the manufacturing sector include the

[89] "Capital goods sector is "reviving," says Furian.."

[90] International Financial Statistics Browser, International Monetary Fund, found at *http://ifs.apdi.net/imf/ifsbrowser.aspx?branch=ROOT*, retrieved Feb. 8, 2005.

[91] Except where noted, information for this section collected from "How to Understand Corporate Taxes in Brazil," American Chamber of Commerce – Sao Paulo by PriceWaterhouseCoopers; and "Taxes and Taxing Powers," found at *http://www.receita.fazenda.gov.br*, retrieved Oct. 15, 2003.

[92] *Brazil County Commercial Guide FY 2004.*

[93] Raymond Colitt, "Brazilian industry angry at tax rise plan," *Financial Times*, July 20, 2004, found at *http://financialtimes.printthis.clickability.com*, retrieved July 21, 2004.

[94] "Brazil's Lula to decree income tax cuts Wednesday," Reuters, July 19, 2004, found at *http://biz.yahoo.com*, retrieved Aug. 3, 2004.

[95] U.S. Department of State, *Brazil - 2005 Investment Climate Statement*, found at *http://www.state.gov/e/eb/ifd/2005/41988.htm*, retrieved Apr. 1, 2005.

[96] "Brazil economy: Tax break package aims to boost Brazilian growth."

Industrialized Product Tax (IPI), the Merchandise and Service Circulation Tax (ICMS), the Corporate Income Tax (IRPJ), and the Social Contribution on Net Income Tax (CSLL).[97]

Interest rates.--The cost of money has been cited by industry officials as one of the leading impediments to investment in and the improved competitiveness of the Brazilian foundry industry. According to Brazilian industry sources, Brazilian interest rates must be reduced to improve the industry's ability to finance necessary investments in expansions, equipment, and other facility improvements.[98] Although the bank commercial lending rate fluctuated during 1999-2003, it remained consistently higher than that in the United States, as shown in the following tabulation (percent):[99]

Year	Rate
1999	80.44
2000	56.83
2001	57.62
2002	62.88
2003	67.08

The government has maintained high interest rates to protect the Brazilian real and to guard against inflation.[100]

Environment

Despite extensive environmental laws that are reportedly as stringent as those of developed countries, enforcement of these regulations in Brazil has reportedly been lax. Environmental agencies lack the financial resources, personnel, training, and political support to pursue regulatory compliance.[101] Certain local governments have reportedly enacted regulations specific to local industries, and enforced stricter environmental standards than those enacted at the federal level.[102] However, several Brazilian foundries have environmental programs that meet or exceed existing environmental standards.[103] Teksid and Tupy, for

[97] The IPI is a federal excise tax, generally ranging between 10 and 15 percent, assessed on most domestic and imported manufactured products. The IPI rate has been lowered to 2 percent for a broad range of capital goods to encourage investment in machinery and equipment. "Brazil economy/Tax breaks for growth," Economist Intelligence Unit, Aug. 11, 2004, found at *http://itc.newsedge-web.com,* retrieved Aug. 13, 2004. Brazilian exports are exempt from the IPI tax. The ICMS is a value-added tax assessed by state governments on both imports and domestic goods. The rate ranges between 7 and 18 percent among the different Brazilian states, depending on the type of transaction. The Corporate Income Tax (IRPJ) is an assessment of 15 percent on taxable income, as well as a surcharge of 10 percent on annual taxable income greater than R$240,000 (about US$120,000). The Social Contribution on Net Income (CSLL) tax was 9 percent on taxable corporate income in 2002.

[98] Brazilian industry official, interview with USITC staff, Brazil, Nov. 2004.

[99] International Financial Statistics Browser, International Monetary Fund, found at *http://ifs.apdi.net/imf/ifsbrowser.aspx?branch=ROOT*, retrieved Feb. 8, 2005.

[100] Jonathan Wheatley, "Brazil moving to a calmer rhythm: Borrowing overseas is no longer always the best option for Latin firms," *Financial Times USA*, July 12, 2004, found at *http://itc.newsedge-web.com,* retrieved July 22, 2004.

[101] David Shaman, "Brazil's Pollution Regulatory Structure and Background," Sept. 9, 1996, found at *http://www.worldbank.org,* retrieved July 28, 2004, and "Comparing environmental laws in Latin America," Inter-American Development Bank, Nov. 25, 2003, found at *http://iadb.org,* retrieved July 28, 2004.

[102] Brazilian industry official, interview with USITC staff, Brazil, Nov. 2004.

[103] Brazilian industry officials, plant visits and interviews with USITC staff, Brazil, Nov. 2004. Ten ABIFA member foundries have received ISO14000 certification for environmental management and methods to improve

(continued...)

example, pursue sustainable development policies.[104] These foundries also recycle sand and employ sophisticated air and water treatment systems. Tupy, for example, installed sleeve filters in its furnaces that reduce CO_2, NOx, and SOx emissions by 95 percent.[105]

The Federal Constitution of 1988 provides the basis for Brazil's environmental program for the conservation of biodiversity and its sustainable use.[106] The Environmental Crimes Act, No. 9,605, approved on February 13, 1998, improves upon many aspects of the previous environmental legislation. The new law streamlines sentences, addresses the criminal responsibility of companies that infringe environmental laws, and strengthens other provisions.[107] The federal government, the states, the Federal District, and municipalities are authorized under Article 23 of the Federal Constitution to protect the environment, to take action against any type of pollution, and to protect Brazilian wildlife. One of the most important items in the Constitution is the requirement of an environmental impact study prior to any activities "which may potentially cause significant degradation of the environment."[108]

In addition, Brazil ratified the Kyoto Treaty in August 2003, but is exempt from reducing its carbon emissions because of its status as a developing country. Brazil is eligible to receive financial aid from foreign sources under the Kyoto Treaty's Clean Development Mechanism to promote the use of cleaner energy technologies.[109]

Worker Health and Safety

The Ministry of Labor establishes regulations outlining occupational, health, and safety standards applicable to Brazilian industries and their workers. This regulatory framework is consistent with internationally accepted standards, but as with other aspects of Brazilian government regulations, application and enforcement are considered lax. The responsible government authorities reportedly lack sufficient funding to fulfill their enforcement and inspection mandates.[110] Brazilian legislation governing worker health

---

[103] (...continued)
environmental performance.

[104] "Policy for Environment and Safety," Teksid, found at *http://www.teksidaluminum.com/pdf/Pieghevole-UK.pdf,* retrieved Feb. 16, 2005, and Sustainability Balance Sheet 2001, Tupy.

[105] Sustainability Balance Sheet, Tupy, p. 15.

[106] Environmental quality issues are within the purview of the agencies that comprise the National Environmental System (SISNAMA), which includes agencies from the national, state, and local levels. The Ministry of Environment (MMA) is the central body of the System and the Brazilian Institute of Environment and Natural Renewable Resources (IBAMA) is the federal executive body. IBAMA is charged with monitoring and enforcing environmental regulations, as well as assisting state agencies with technical advice. Mandatory approval of any project that may cause adverse environmental effects is required by IBAMA. The Brazilian states as well as local governments have established individual agencies that serve to improve environmental quality. "An Energy Overview of Brazil," U.S. Department of Energy, found at *http://www.fe.doe.gov*, retrieved July 20, 2004, p. 25.

[107] *The Environmental Crimes Act of 1998*, Embassy of Brazil, found at *http://lawvianet.com/lawsregs.html,* retrieved Apr. 5, 2005.

[108] *The Federal Constitution of 1988*, Embassy of Brazil, found at *http://lawvianet.com/lawsregs.html,* retrieved Apr. 5, 2005.

[109] U.S. Department of Energy, *An Energy Overview of Brazil*, found at *http://www.fe.doe.gov,* retrieved July 20, 2004, p. 25.

[110] U.S. Department of State, Bureau of Democracy, Human Rights, and Labor, "Country Reports on Human Rights Practices," Mar. 31, 2003, found at *http://www.state.gov*, retrieved Aug. 10, 2004.

and safety is covered by Portaria 3.214, which outlines labor safety guidelines. The three principal elements of this legislation – safety, health, and ergonomics[111] – are included in the Environmental Risks Prevention Program (PPRA),[112] the Workers Health and Medical Program (PCMSO), and NR 17.

---

[111] The Brazilian government mandates an ergonomically correct workplace, which requires jobs to be adapted to an individual. Brazilian industry official, interview with USITC staff, Brazil, Nov. 2004.

[112] International Occupational Safety and Health Information Centre, International Labour Organization, found at *http://www.ilo.org/public/english/protection/safework/cis/managmnt/ioha/app_c03.htm*, retrieved Apr. 5, 2005.

Canada

Industry Profile

Industry statistics:
- World rank (2001): 17th
- Production (2001): 912,000 metric tons
- Employment (2002): 14,900 production workers
- No. of establishments (2002): 260

Industry characteristics:
- An increase in nonferrous metal production over the past decade.
- Primarily small establishments.
- Net exporter if indirect exports are included; otherwise, net importer.

Canadian metal casting is a relatively small but well established industry in transition from traditional products to value-added services and products. In terms of weight, Canada ranked 17th among reporting countries with an estimated casting production of 912,000 metric tons or 1 percent of world output in 2001 (latest year available).[113]

Like the U.S. industry, the Canadian casting industry comprises three basic kinds of operations: job shops, production shops, and captive shops. Traditionally, job shops tended to supply castings to local markets, production shops supplied original equipment manufacturers (OEMs), and captive shops were embedded within the manufacturing system of the end-use product.[114] However, these distinctions have become somewhat blurred. With the advent of e-commerce and customer partnerships, some job shops sell beyond their local borders and some production shops have teamed up with their customers to provide a smoother production system. Casting methods used in Canada include die, sand, centrifugal, permanent mold, semi-solid, lost foam, and investment castings.[115]

Also like the U.S. industry, over the past decade, some members of the Canadian casting industry have evolved from product provider to customer partner by incorporating supportive services in their product base. These customer relationships embody a range of product bundling, including cast design support, modeling, and prototyping; metallurgical research and development; pattern making; machining; testing; partial assembly with the end product; and warehousing to support the customer's just-in-time inventory system. One casting operation serving the automotive industry reported assigning a resident engineer to each customers' design centers as a key member of the design team. Another caster reduced lead time by forecasting its customers' needs and putting their cast components on open order or consignment, resulting in doubled sales to these same customers. The formation of partnerships by casters has not been limited to the larger production shops. Some job shops have also developed long term customer relationships.[116] Although price has been reported to be a criteria customers used to select a casting partner, other factors considered by customers include casting quality (equally important as price[117]), delivery time, and customer loyalty.[118]

---

[113] American Foundry Society (AFS), "The Global Metalcasting Market," ch. in *AFS 2003 Metalcasting Forecast and Trends*, p. 30.

[114] Industry Canada, "Industry Structure and Overview," ch. in *Canadian Metalcasting Technology Roadmap*, rev. Oct. 2003, p. 2, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/rm00065e.html*, retrieved June 14, 2004.

[115] Ibid, pp. 1-2.

[116] Industry Canada, "Partnerships," ch. in *Canadian Metalcasting Technology Roadmap*, rev. Oct. 2003, pp. 1-2, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/rm00065e.html*, retrieved June 14, 2004.

[117] U.S. industry representative, interview by USITC staff, United States, Oct. 21, 2004.

[118] Industry Canada, "Partnerships," ch. in *Canadian Metalcasting Technology Roadmap*, rev. Oct. 2003, p. 2, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/rm00065e.html*, retrieved June 14, 2004.

In 2002, Canada had about 260 active principal casting establishments,[119] of which nearly 80 percent were small operations with fewer than 100 employees.[120] About 47 percent of all active principal casting establishments are located in the Province of Ontario, with those in the southern region serving primarily OEMs for both the Canadian and U.S. automotive industry. In addition, the Province of Quebec hosts about 26 percent of the establishments and British Columbia about 13 percent.[121] Although casting establishments in the coastal, northern, and prairie regions[122] have experienced declining traditional local markets such as maritime, forestry, mining, and agriculture sectors, some have reportedly remained viable by developing new products, geographically diverse marketing campaigns, and customer partnerships.[123]

Despite the decline in many traditional casting markets, the number of Canadian foundry establishments has actually increased over the past decade, with a growing trend towards more production of nonferrous castings (table 9-8).

Table 9-8
Canadian foundry industry: Foundry establishments, by metal type, 1993 and 1999-2002
(*Number*)

Year	Total establishments	Establishments by metal type: Iron	Steel	Nonferrous
1993[1]	154	79	34	41
1999	189	70	35	84
2000	264	102	44	118
2001	261	100	47	114
2002	260	98	46	116

[1] This year included to provide an historical perspective.

Note.–Making data correlations between 1999 and 2000 is problematic because the Government of Canada made conceptual and methodology changes to the data set collection in 2000. As a result of these collection changes, nearly 24,000 principal establishments were added to the overall manufacturing sector in 2000. The magnitude of the effect from these changes is not readily available and differs by industry. With the exception of trade data, problematic correlations apply to all data sets between 1999 and 2000 in the Canadian section of this report. See Canadian Industry Statistics, establishments, foundries (NAICS 3315) found at *http://strategis.ic.gc.ca/canadian_industry_statistics/cis.nsf/IDE/cis3...*, retrieved Jan. 13, 2005

Source: Compiled by the Commission from official Canadian Industry Statistics for all foundry establishments (NAICS 3315), iron foundries (NAICS 331511), steel foundries (NAICS 331514), and nonferrous foundries (NAICS 33152), found at *http://strategis.ic.gc.ca/canadian_industry_statistics/cis.nsf/IDE/cis3...*, retrieved Jan. 13, 2005.

---

[119] Canadian Industry Statistics defines principal establishments as those that are incorporated, have employees that are primarily engaged in manufacturing, and have annual sales of manufactured goods of $30,000 or more.

[120] Canadian Industry Statistics, Establishments, Foundries (NAICS 3315), found at *http://strategis.ic.gc.ca/canadian_industry_statistics/cis.nsf/IDE/cis3...*, retrieved Jan. 13, 2005.

[121] There are no foundries reported in the Northwest Territories, Nunavet, nor Yukon. *Canadian Industry Statistics, Establishments, Foundries (NAICS 3315).*

[122] Canada's prairie region spans the provinces of Alberta, Saskatchewan, and Manitoba.

[123] Industry Canada, "Marketing," ch. in *Canadian Metalcasting Technology Roadmap,* rev. Oct 2003, p. 1, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/rm00065e.html*, retrieved June 14, 2004.

To provide some perspective on size and location, Canada has four large casting establishments (500 plus employees), of which two are nonferrous and two are iron, all of which are located in Ontario.[124] Of another 48 medium-sized casting establishments (100-499 employees), approximately one-half are nonferrous, with the majority also located in Ontario.[125] Canadian nonferrous castings are used primarily for the transportation industry.[126] Based on reported annual sales of $50 million or more, a combination of domestic- and foreign-owned companies are among Canada's leading foundry producers and represent a variety of cast metal products for end users (table 9-9).

Table 9-9
Canadian foundry industry: Leading foundry producers, country of ownership, and major products

Company	Country of ownership	Products
Norcast	Canada	Iron and steel grinding mill liners
Atlas Steels Inc.	Canada	Steel, stainless steel, carbon, and alloy steel bar, plate, and tube products
Haley Industries	Canada	Aluminum and magnesium castings for the international aerospace industry
Exco Technologies Inc.	Canada	Large die castings for the automotive industry
Gerdau Ameristeel Inc.	Brazil	Steel equipment blades (e.g., bulldozer blades)
Ispat Sidbec Inc. (subsidiary of Ispat International)	Netherlands	Steel and alloy steel wire, bars, sheets, pipes, and tubes for the construction industry
Kubota Metal Corp.	Japan	Variety of steel and alloy steel products including centrifugal tubes, steel processing equipment, and assemblies for the refining and chemical industries
Canada Pipe Co. Ltd.	United States	Iron pipe for sewers
Brake Parts Canada Inc.	United States	Engine parts, rotors, disk brakes, flywheels, crankshafts, and steering parts for motor vehicles

Source: Canadian Industry Statistics, Company Directories, Foundries (NAICS 3315) found at *http://strategis.ic.gc.ca/canadian_industry_statistics/cis.nsf/IDE/cis 3...*, retrieved Jan. 13, 2005.

Business Trends

Despite relatively constant shipment values during 1999-2002, Canada reported growing exports of high value castings while increased imports supported domestic demand for lower priced commodity type castings.

[124] Canadian Industry Statistics, Establishments, Nonferrous Foundries (NAICS 33152) and Iron Foundries (NAICS 331511), found at *http://strategis.ic.gc.ca/canadian_industry_statistics/cis.nsf/IDE/cis3...*, retrieved Jan. 13, 2005.

[125] Canadian Industry Statistics, Establishments, Nonferrous Foundries (NAICS 33152).

[126] Comparable data for specific nonferrous metal castings are not readily available. However, the Aluminum Association reported that in 2002 and 2003, Canadian aluminum castings were used predominantly for passenger cars and light trucks, including wheels. The Aluminum Association Incorporated, "Aluminum Casting Statistics, Canadian Shipments of Aluminum Castings," *Fourth Quarter 2003 Report* (Washington, D.C., Mar. 19, 2004), p. 1.

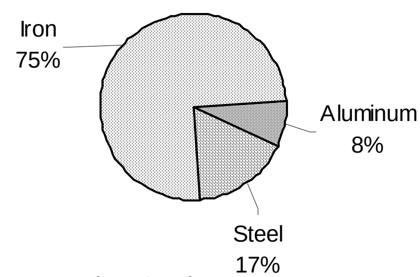
Production

The value of Canadian foundry shipments remained fairly constant at $2.1 billion during 1999-2002 (latest year available), as shown in the following tabulation (in million U.S. dollars):[127]

Year	Value
1999	2,100
2000	2,200
2001	2,000
2002	2,100

Of the metals cast in 2002, nonferrous metals accounted for $1.2 billion (57 percent) of total shipment value,[128] and included primarily aluminum, copper, and zinc as well as some magnesium and nickel.[129] That same year, gray and ductile iron together accounted for $698 million (33 percent of total shipments in 2002), and steel accounted for $162 million (8 percent).[130] This mix of metal types has changed over time. During 1993-1995, iron castings accounted for the majority of the value of shipments, followed by nonferrous castings and steel.[131] For a breakout of metal types by weight in 2001 (latest year available), see figure 9-3.

Figure 9-3
Canadian foundry industry: 2001 production, by metal type (based on weight)



Source: *Modern Casting*.

Employment

The employment trend during 1999-2002 reflects increased use of automated production processes. During the period, the number of production workers decreased by 11 percent to 14,900 in 2002 (table 9-10).[132] Commensurate with the reduction in production workers, total wages and salaries decreased by 6 percent to $436 million in 2002. Within the same time frame, the average annual salary per production worker increased from about $28,000 in 1999 to just over $29,000 during 2000-2002.[133] Although salaries remained fairly constant over the four years, the average output value per production worker grew by an estimated $15,940 to approximately $140,940 in 2002. One report indicates that the Canadian casting industry has made capital improvements during this time frame,[134] which may explain the increase in worker productivity.

---

[127] Canadian Industry Statistics, data tables, Foundries (NAICS 3315) found at *http://strategis.ic.gc.ca/canadian_industry_statistics/cis.nsf/IDE/cis3...*, retrieved Jan. 13, 2005.

[128] Ibid.

[129] Industry Canada, Appendix A in *Canadian Metalcasting Technology Roadmap,* 2000, pp. 44-51, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/h* rm 00051e.html, retrieved Jul.. 28, 2004.

[130] Canadian Industry Statistics, data tables, Foundries (NAICS 3315).

[131] Ibid.

[132] Despite the increased number of establishments because of changes in data collection in 2000, the number of production workers decreased from 1999 to 2000.

[133] Calculated by Commission staff using Canadian dollar average annual salary per production worker for foundries (NAICS 3315), found at *http://strategis.ic.gc.ca/canadian_industry_statistics/cis.nsf/IDE/cis3...* , and the Bank of Canada's inflation calculator, found at *http://www.bankofcanada.ca/en/inflation_calc.htm.* The calculator uses monthly consumer price index (CPI) for which June 1992 CPI=100.

[134] Industry Canada, "Technology," Human Resources," and "Investment," chs. in *Canadian Metalcasting Technology Roadmap,* rev. Oct. 2003, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/h*rm 00051e.html, retrieved July 28, 2004.

Table 9-10
Canadian foundry industry: Number of employees and production and related workers, 1999-2002

Item	1999	2000	2001	2002
All employees	19,400	19,700	18,100	17,500
Production and related workers	16,800	16,600	15,300	14,900
Man-hours worked (*1,000 hours*)	34	([1])	([1])	([1])
Wages paid to production workers (*U.S. million dollars*)	464	487	439	436

[1] Not available.

Note.–As of 2000, Canada Industry Statistics no longer included data on hours worked.

Source: Canadian Industry Statistics, Foundries (NAICS 3315), Data Tables, found at *http://strategis.ic.gc.ca/canadian_industry_statistics/cis.nsf/IDE/cis3...*, retrieved Jan. 13, 2005

Trade

During 1999-2002, demand for Canadian foundry products outpaced production, resulting in a shortfall in Canadian producer shipments versus domestic demand of $21 million in 2002 (latest year available).[135] As a result, imports increased by 5 percent to $247 million in 2003 (table 9-11). Although the United States has long accounted for a disproportionate share of Canada's casting imports, that share has started to erode in recent years with the growth in imports from Asia, primarily China. This is explained in part by the availability of lower-priced, off-the-shelf commodity-type castings such as municipal-use castings from China.[136] With a narrowing of discernible qualitative differences between domestic- and Chinese-produced products,[137] some casters are reportedly importing commodity-type castings to fill their product line while focusing their own production on more complex, value-added products.[138]

Table 9-11
Canada: Imports, by principal sources, 1999-2003
(*1,000 U.S. dollars*)

Country	1999	2000	2001	2002	2003
United States	177,400	201,653	197,644	175,419	169,143
China	14,802	16,653	20,136	24,562	31,671
Germany	2,931	2,669	3,680	4,203	7,625
India	2,976	2,748	4,940	3,432	5,284
All other countries	37,170	35,851	34,816	36,684	33,520
Total	235,279	259,574	261,216	244,300	247,243

Source: Canadian Industry Statistics, Canadian Trade by Industry, Foundries (NAICS 3315), found at *http://strategis.ic.gc.ca/sc_mrkti/tdst/tdo/tdo.php#tag,* retrieved Jan. 13, 2005.

[135] Canadian manufacturing shipments and Canadian apparent domestic market, found at *http://strategis.ic.gc.ca/sc_mrkti/tdst/tdo/tdo.php#tax,* retrieved Jul. 30, 2004.

[136] Industry Canada, "Competitiveness," ch. in *Canadian Metalcasting Technology Roadmap,* rev. Oct. 2003, p. 1, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/*hrm 00051e.html, retrieved July 28, 2004.

[137] Industry Canada, "Markets," ch. in *Canadian Metalcasting Technology Roadmap,* rev. Oct. 2003, p. 3, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/*hrm 00051e.html, retrieved July 28, 2004.

[138] Industry Canada, "Competitiveness," ch. in *Canadian Metalcasting Technology Roadmap,* rev. Oct. 2003, p. 1, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/*hrm 00051e.html, retrieved July 28, 2004.

During 1999-2003, Canadian exports of castings increased by 19 percent to $224.4 million (table 9-12), and accounted for 9 percent to 11 percent of its casting shipments through 2002.[139] An estimated 70 percent of the industry's shipments are reportedly exported through indirect means,[140] primarily to the U.S. market.[141] During 1999-2003, nonferrous castings accounted for 70-74 percent of exports (table 9-13), followed by iron castings (13-19 percent), and steel castings (11-14 percent).[142] The United States has long been Canada's major export market, receiving $194.3 million (87 percent) of export shipments in 2003.[143]

Table 9-12
Canada: Exports, by principal markets, 1999-2003
(*1,000 U.S. dollars*)

Country	1999	2000	2001	2002	2003
United States	167,769	189,315	189,043	188,015	194,283
Germany	1,959	2,058	2,746	2,209	4,390
Italy	3,652	2,620	2,980	2,679	4,084
South Africa	28	58	113	1,250	2,510
All other countries	15,357	14,011	16,877	19,492	19,121
Total	188,765	208,062	211,759	213,645	224,388

Source: Canadian Industry Statistics, Canadian Trade by Industry, Foundries (NAICS 3315), found at *http://strategis.ic.gc.ca/sc_mrkti/tdst/tdo/tdo.php#tag,* retrieved Jan. 13, 2005.

Table 9-13
Canada: Exports, by principal products, 1999-2003
(*1,000 U.S. dollars*)

Item	1999	2000	2001	2002	2003
Iron cast products	36,327	33,413	32,345	27,698	32,991
Steel cast products	20,730	25,299	26,976	29,673	26,372
Non-ferrous die-cast products	86,607	93,265	90,740	95,427	103,215
Non-ferrous other than die-cast products	45,101	56,085	61,699	60,846	61,811
Total	188,765	208,062	211,759	213,645	224,388

Note.–Figures may not add to totals because of rounding.

Source: Canadian Trade by Industry, Foundries, (NAICS 3315) found at *http://strategis.ic.gc.ca/scmrkti/tdst/tdo/tdo.php#tag*, retrieved Jan. 13, 2005.

Factors of Production

As with the U.S. industry, rising costs for input materials and energy have put a strain on the Canadian casting industry's profit margin. At the same time, a tighter labor market has challenged management's ability to adapt. However, education and implementation of advanced technology are two methods being used to help mitigate these problems.

---

[139] Shipment data for 2003 are not available to make an export to shipment comparison. Canadian Trade by Industry, foundry (NAICS 3315), found at *http://strategis.gc.ca/sc_mrkti/tdst/tdo/tdo.php#tag*, retrieved July 30, 2004.

[140] "Indirect" meaning that the casting is already assembled in the customer's product when exported.

[141] E-mail correspondence from Canadian industry official to USITC staff, Mar. 2, 2005.

[142] Canadian Trade by Industry, Foundry (NAICS 3315), found at *http://strategis.gc.ca/sc_mrkti/tdst/tdo/tdo.php#tag*, retrieved July 30, 2004.

[143] Ibid.

Raw Materials and Energy

From 1999 to 2002 (latest year available), the cost of materials and supplies for the manufacturing of cast products in Canada increased by $20 million to about $828 million, and accounted for an estimated 39 percent of the industry's shipment value in 2002.[144] The primary raw material for the industry is recycled metal.[145] Virgin metal is used for a small fraction of specialty formulations, including some aluminum and brass castings.[146] During this time period, energy costs increased by about $27 million (34 percent) to approximately $107 million[147] and accounted for approximately 5 percent of the industry's 2002 shipment value.[148] The primary reasons for rising energy costs were higher natural gas prices and deregulation of the electricity market in 2000.[149]

Labor[150]

The lack of skilled and unskilled labor has been a problem for the industry, according to some foundry representatives. The shortage is felt throughout the provinces in rural and urban areas, and covers the full range of the production process, including metallurgists, computer/electronic specialists, engineers, and people who can operate and repair the new technology/equipment. Part of the problem is a "dirty, dull, and dangerous" image of the industry.[151] Traditionally, Canadian foundries hired skilled labor from Europe, but this source has reportedly diminished with improved job opportunities in Eastern Europe. Other causal factors include low wages and a lack of industry promotion within the education system and communities in general.

Some labor issues are being addressed through a variety of education programs. The joint Education Committee of the Canadian Foundry Association (CFA) and the Ontario Chapter of the American Foundry Society (AFS) have produced a video and education package for foundries to use as a presentation tool to help develop student and public awareness of the industry. On a larger scale, the joint CFA/AFS-Ontario Education Committee, with contributions from the Government of Ontario, and industry members and suppliers, established the Modern Technologies Institute at Mohawk College in Hamilton, Ontario; classes started in September 2000. In addition, the University of Windsor, in Ontario, has a very strong education apprentice program with many corporate partners, including Windsor Mold Group, Fleetwood Metal Industry Inc., and three automotive companies that have plants in Canada: Daimler Chrysler, Ford, and General Motors.[152] One foundry reportedly recruited permanent employees through its participation in engineering apprenticeship programs in Manitoba and Nova Scotia Provinces. Another foundry, with its own onsite

---

[144] Canadian Industry Statistics, data tables, Foundries (NAICS 3315), "Cost of Materials and Supplies," found at *http://strategis.ic.gc.ca/canadian_industry_statistics/cis.nsf/IDE/cis3...*, retrieved Jan. 13, 2005.

[145] Office of Energy Efficiency, *Profile of the Canadian Foundry Industry*, found at *http://oee.nrcan.gc.ca/cipec/ieep/newscentre/foundry*, retrieved Jan. 18, 2005.

[146] Ibid.

[147] Canadian Industry Statistics, data tables, Foundries (NAICS 3315).

[148] Calculated by USITC staff.

[149] Office of Energy Efficiency, *Profile of the Canadian Foundry Industry*, found at *http://oee.nrcan.gc.ca/cipec/ieep/newscentre/foundry*, retrieved Jan. 18, 2005.

[150] Information for Labor was derived principally from Industry Canada, "Human Resources and Education," ch. in *Canadian Metalcasting Technology Roadmap*, rev. Oct. 2003, pp. 1-3, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/rm*00079e.html, retrieved June 14, 2004.

[151] Industry Canada, "Industry Structure and Overview," ch. in *Canadian Metalcasting Technology Roadmap*, rev. Oct. 2003, p. 3, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/rm*00069e.html, retrieved June 14, 2004.

[152] University of Windsor, Ontario, Canada, An Employers' Guide Contact Information, found at *http://www.google.com/u/uofwindsor?query=co*-op+programs&sa.x=0&sa.y=0, retrieved Feb. 8, 2005.

training facility, established an apprenticeship program with its local community college. However, these educational arrangements are the exception. Most foundries use on-the-job training and/or continuing education course work offered by the American Foundry Society's Cast Metals Institute (CMI). CMI course work is available over the Internet as well as in Canada and the United States.[153]

Technology[154]

The adoption of advanced technology by the Canadian industry has helped to mitigate labor concerns, as well as some environmental issues. One important change made by most Canadian cast iron operations during the past two decades is the shift from coke-using cupolas to electric induction furnaces, which increased compliance with pollution standards for carbon dioxide emissions.[155] Near net shaping has been adopted by some of the major foundries. This is an important advancement because it produces castings with such close precision to the customer's required dimensions that little or no machining is needed, thereby reducing or eliminating waste and a major step in the production process. More recently, the adoption of process sensors and controls have made it easier to shift from skilled manual labor to an automated operation, which has the advantage of increased product consistency and quality, particularly for long production runs. Long production runs may, in turn, provide economies of scale that contribute to lower unit cost. Process sensors and controls also provide data for computer-created models of the casting process, the benefits of which include reduced product turnaround time,[156] reduced energy use, and reduced scrap waste. Modeling is available through some Canadian public institutions (notably Industrial Materials Institute of Boucherville, and the Industrial Technology Centre in Manitoba), and independent design consultants.

Domestic Policies

Exchange rates between the Canadian and U.S. dollar were not highly correlated with the value of bilateral trade for castings. Industry sources noted that other factors affecting bilateral trade include market proximity, open markets, and common language. In terms of environment and worker health and safety issues, Canada reportedly has extensive laws and enforcement programs.

Federal/Regional Programs

As of 2003, some Canadian foundry representatives reportedly expressed concern that the Government of Canada does not assist the industry in the form of no-fault loans, tax credits, and accelerated two-year writeoffs for capital investments, particularly those for pollution control.[157] Also, possible government-based solutions for competing with increasing imports were suggested, including tariffs,

---

[153] Cast Metals Institute, About CMI, found at *http://www.castmetals.com/aboutcmi.html*, retrieved Feb. 8, 2005.

[154] Information for Technology was derived principally from Industry Canada, "Technology," ch. in *Canadian Metalcasting Technology Roadmap*, rev. Oct. 2003, pp. 1-3, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/rm*00078e.html, retrieved June 14, 2004.

[155] Office of Energy Efficiency, *Environmental Considerations*, found at *http://oee.nrcan.gc.ca/cipec/ieep/newscentre/foundry*, retrieved Jan. 18, 2005.

[156] Some casters using computer-based modeling reported turnaround time of less than two weeks from the customer's initial request to product delivery. Computer-based modeling reduces product turnaround time by allowing customer and caster to share drawings and specs electronically. It also reportedly reduces product design time and facilitates a more efficient casting process. See "Casting Process Modeling Ensures Design Accuracy for ATM Housing," found at *http://www.castsolutions.com/archive/CastingSucesses/LCS0300_8.html*, retrieved Apr. 1, 2005.

[157] Industry Canada, "Government," ch. in *Canadian Metalcasting Technology Roadmap*, rev. Oct. 2003, p. 1, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/rm*00078e.html, retrieved June 14, 2004.

subsidies, and Canadian content rules. However, it was reported that such solutions for imports are not likely to be implemented given the government's policies and WTO regime, of which Canada is a member.[158]

Monetary/Tax Policies

Canada has a free floating exchange rate system. During 1999-2003, the Canadian rates fluctuated somewhat against the U.S. dollar, as shown in the following tabulation (in Canadian dollars per U.S. dollar):[159]

Year	Rate
1999	1.4858
2000	1.4855
2001	1.5487
2002	1.5704
2003	1.4008

The movement in exchange rates between the Canadian and U.S. dollars was not highly correlated with the value of bilateral trade for castings. According to industry sources, other factors affecting bilateral trade in castings between Canada and the United States include the geographic closeness of the markets in both countries, market openness, common language, and the interrelationship between casters and their customers.[160]

During 1999-2003, the Canadian commercial lending interest rate fluctuated downward by 2-3 percentage points, as reflected in the following tabulation (in percent):[161]

Year	Annual rate
1999	6.44
2000	7.27
2001	5.81
2002	4.21
2003	4.69

A number of factors influence investment decisions, including relatively low interest rates.

---

[158] Industry Canada, "Competitiveness," ch. in *Canadian Metalcasting Technology Roadmap,* rev. Oct. 2003, p. 1, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/rm*00078e.html, retrieved June 14, 2004.

[159] Federal Reserve Statistical Release, Foreign Exchange Rates, found at *http://www.federalreserve.gov/releases/g5a/current*, retrieved Jan. 15, 2005.

[160] Industry Canada, "Markets," ch. in *Canadian Metalcasting Technology Roadmap*, rev. Oct. 2003, p. 2, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/rm*00078e.html, retrieved June 14, 2004.

[161] International Monetary Fund, *International Financial Statistics, Dec. 2004*, Canada, p. 232.

Environment

Canada is considered to have a rigorous national environmental protection and enforcement program, which is administered and regulated under the Ministry of Environment. In general, the Canadian Council of Ministers of the Environment (composed of environmental ministers from federal, provincial, and territorial governments) proposes nationally consistent environmental standards and objectives concerning the release of toxic substances into the air, water, and soil, after which each jurisdiction comprising the Council decides whether or not to adopt the proposal.[162] Consequently, environmental standards are administered and regulated at the federal, provincial, and territorial levels.

In addition to national and regional regulations, the Governments of Canada and the United States established the International Joint Commission in 1909, under which they share more than 30 government agreements on the environment,[163] including the 1972 Great Lakes Water Quality Agreement[164] and the 1991 U.S.-Canada Air Quality Agreement.[165] Further, Canada and the United States developed the Joint Inland Pollution Contingency Plan to coordinate reporting and response measures in the event of a chemical accident along shared inland boundaries.[166] With the United States and Mexico, Canada is also a member of the North American Commission on Environmental Cooperation, the environmental side agreement to the North American Free Trade Agreement (NAFTA).[167]

Worker Health and Safety[168]

Although some representatives of Canada's casting industry have reportedly expressed the view that occupational health and safety (OHS) programs are excessive in some Provinces,[169] it has also been noted that high OHS standards and strong controls are beneficial to the overall casting operation.[170] In Canada, OHS is primarily the responsibility of each province and territory.[171] The underlying philosophy of OHS

---

[162] Environment Canada, The Canadian Council of Ministers of the Environment (CCME), found at *http://www.ec.gc.ca/ceqg-rcqu/English/ccme/default.cfm*, retrieved Feb. 8, 2005.

[163] U.S. Environmental Protection Agency, International Affairs, *About U.S.-Canada Environmental Cooperation*, found at *http://www.epa.gov/international/regions/Canada/cooperation.html*, retrieved Feb. 2, 2005.

[164] U.S. Environmental Protection Agency, International Affairs, *Great Lakes Water Quality Agreement*, found at *http://www.epa.gov/international/regions/Canada/glwqa.html,* retrieved Feb. 2, 2005.

[165] U.S. Environmental Protection Agency, International Affairs, *US-Canada Air Quality Agreement 2004* Progress Report, found at *http://www.epa.gov/airmarkets/usca/2004report.html,* retrieved Feb. 2, 2005

[166] U.S. Environmental Protection Agency, Chemical Emergency Preparedness and Prevention, *Bi-Lateral Border Programs*, found at *http://yosemite.epa.gov/oswer/ceppoweb.nsf/content/ip-bilateral.htm*, retrieved Feb. 2, 2005.

[167] U.S. Environmental Protection Agency, International Affairs, *About the North American Commission on Environmental Cooperation (NACEC)*, found at *http://www.epa.gov/international/regions/Mexico/nacec.html,* retrieved Feb. 2, 2005.

[168] Information for Worker Health and Safety was derived principally from Canadian Centre for Occupational Health and Safety, OHS Legislation in Canada - Internal Responsibility System, found at *http://www.ccohs.ca/oshanswers/legisl/irs.html*, retrieved Feb. 3, 2005.

[169] Industry Canada, "Government," ch. in *Canadian Metalcasting Technology Roadmap*, rev. Oct. 2003, p. 2, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/rm*00078e.html, retrieved June 14, 2004.

[170] This Canadian industry representative reported that by implementing OHS standards, the facility was able to operate without lost injury time for over 800 days. See Industry Canada, "Management," ch. in *Canadian Metalcasting Technology Roadmap*, rev. Oct. 2003, p. 2, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/rm*00078e.html, retrieved June 14, 2004.

[171] Human Resources and Skills Development Canada, *Jurisdiction of the Federal Government, the Provinces*

(continued...)

legislation in all Canadian jurisdictions is the internal responsibility system, which holds both employers and employees responsible for workplace safety by establishing a responsibility sharing system, promoting safety culture, promoting best practices, developing self reliance, and ensuring compliance. Under this system, employers are free to establish and control safety procedures appropriate for their individual workplace. However, for legal defense purposes, the employer must meet the "due diligence" test, which, as applied to OHS, means "taking all reasonable precautions, under the circumstances, to prevent injuries or accidents." Conditions for establishing due diligence require having certain criteria in place before the occurrence of an accident or injury, including:

- written OHS policies, practices, and procedures;
- provision of appropriate employee training and education regarding established policies, practices, and procedures;
- training of supervisors to ensure their level of competence as defined in legislation;
- monitoring of the workplace to ensure adherence to established policies, practices, and procedures (written documentation of discipline for breaches of safety rules is considered due diligence);
- having an accident investigation and reporting system in place; and
- having written documentation of the above criteria.

In addition, employers must supply personal protective equipment as needed, immediately report all critical injuries to the jurisdiction's OHS government department, and establish a health and safety committee.[172] Legislation in the different provinces and territories generally require that the committee be composed of half management and half labor representatives (selected by the workers), meet on a regular basis, and be co-chaired by one management representative and one worker. Beyond these basic requirements, details of the OHS legislation and enforcement vary among the provinces and jurisdictions. For example, the Province of Ontario, where most foundries are located, established additional regulations relevant to industrial establishments, with certain sections applicable specifically to foundries.[173] Each jurisdiction is also responsible for worker compensation services and relevant compensation rates.[174]

---

[171] (...continued)
and the Territories in the Field of Occupational Health and Safety, found at *http://www.hrsdc.gc.ca/asp/gateway.asp?hr=/en/lp/spila/clli/ohslc/02...*, retrieved Feb. 3, 2005.

[172] Canadian Centre for Occupational Health and Safety, OHS Legislation in Canada - Basic Responsibilities, found at *http://www.ccohs.ca/oshanswers/legisl/responsi.html*, retrieved Feb. 3, 2005.

[173] Ministry of Labour, Ontario, *Occupational Health and Safety Act, R.R.O. 1990, Regulation 851, Industrial Establishments*, found at *http://www.e-laws.gov.on.ca/DBLaws/Regs/English/900851_ehtm*, retrieved Feb. 3, 2005.

[174] Canadian Centre for Occupational Health and Safety, Provincial Workers' Compensation Boards in Canada, found at *http://www.ccohs.ca/oshanswers/information/web_canada.html*, retrieved Feb. 3, 2005.

China

Industry Profile

Industry statistics (2003):
- World rank – 1st
- Production – 18 million metric tons
- Employment – 1.2 million workers
- No. of establishments – 20,000-25,000

Industry characteristics:
- Beneficiary of strong and growing demand from domestic motor vehicle producers
- Growing number of foreign-invested producers that use modern technology and produce high-quality castings
- Net exporter

China's foundry industry is expanding rapidly because of burgeoning demand from the country's fast growing manufacturing industries and, to a lesser extent, strong demand for Chinese castings in foreign markets. Structural changes resulting from foreign investment, especially the increasing number of joint ventures with foreign partners and wholly foreign-owned operations, have contributed significantly to this expansion.[175] Foreign investment is also a source of technological and managerial improvement for the industry.[176]

China's foundry industry is the largest in the world by a wide margin, surpassing the United States in 2002. China produced over 18 million metric tons of castings and employed over 1.2 million people in 2003.[177] By comparison, the United States produced 12 million metric tons in 2003, followed by Russia and Japan, each of which produced approximately 6 million metric tons.[178] The growth rate of Chinese production is also the highest in the world, averaging almost 10 percent per year during 1999-2003.[179]

Despite strong growth and foreign investment, the Chinese foundry industry generally produces low quality castings, uses old equipment, is inefficient, and causes significant deleterious environmental effects.[180] Productivity is low and energy consumption is high, as compared with foundries in developed countries.[181] Chinese foundries also produce a large amount of basic, low-valued castings of relatively simple metallurgy.[182] Moreover, management skill and technical expertise in most foundries are average by world standards.[183] However, certain operations are among the most advanced in the world, using state-of-the-art machinery and modern management techniques.[184]

The industry is composed of up to 25,000 producers, although 20,000 of these are small-scale enterprises.[185] Industry concentration is high–the 1,400 members of the Chinese Foundry Association (CFA)

---

[175] Chinese government and industry officials, interviews by USITC staff, China, Nov. 2004.

[176] Ibid.

[177] China Foundry Association (CFA), interview with USITC staff, China, Nov. 2004.

[178] American Foundry Society, AFS Metalcasting Forecast & Trends, 2004, p. 32.

[179] Based on data reported by *Modern Casting* in the 34th and 38th Annual Census of World Casting Production, found at *http://www.moderncasting.com*, retrieved Mar. 17, 2005.

[180] CFA interview.

[181] Ibid.

[182] Ibid.

[183] Ibid.

[184] Chinese industry officials, interviews with USITC staff, China, Nov. 2004; and testimony of Tim Brown, vice president, Benton Foundry Co., hearing transcript, p. 30.

[185] These are generally small, family-run enterprises that are not a competitive concern of the U.S. industry. Testimony of Tim Brown, vice president, Benton Foundry Co., hearing transcript, p. 29.

account for 70 percent of total production in terms of quantity.[186] Foundry establishments are widely distributed in the country. The eastern, southeastern, and northeastern regions account for approximately 70 percent of the enterprises. The north central and southwestern regions account for the rest. The foundries in the large eastern cities (including surrounding areas) and along coastal areas are generally more modern than those in inland and rural areas.

Prior to the 1990s, the Chinese foundry industry was primarily state-controlled, either at the national level or the township/village level. Since the early 1990s, structural changes reflecting the Chinese Government's plan to shift from a centrally-controlled economy to a market-based economy have substantially altered the Chinese foundry industry. Coupled with new laws that are designed to attract foreign investment, this has contributed to a proliferation of foundries that are foreign-invested enterprises (FIE). FIEs can take the form of joint ventures with foreign partners or wholly foreign-owned ventures (table 9-14 shows a representative sample of foundry FIEs).[187] Foreign companies are attracted to China because of the prospect of low labor costs and a strong local castings market. The creation of FIEs is further encouraged by investment and tax incentives that are available only to an FIE. Thus, there are significant inducements for foreign companies to create an FIE in China and for existing Chinese foundries to find a foreign joint-venture partner.

Chinese Foundry Industry Structure
By Ownership Type

- State-owned enterprises:
  - Centrally controlled
  - Township/village owned

- Foreign-invested enterprises:
  - Joint ventures:
    - Majority Chinese owned
    - Majority foreign owned
  - Wholly foreign owned

- Other private enterprises:
  - Privatized township/village enterprise
  - Very small producers, frequently family-run enterprises.

Privatization of state-controlled foundries also has been a part of the restructuring. In some cases, this involves the privatization of an entire enterprise. In other cases, the state-owned enterprise (SOE) remains intact and forms an FIE joint venture as a separate entity with a foreign partner; many state-controlled foundries have taken advantage of these arrangements.[188] In terms of quantity, 50 percent of production is now from SOEs and 50 percent from private-sector foundries.[189]

Privatization is typically accomplished by establishing an SOE as a share company. The shares initially may be divided between the government at either the central or township/village level and other parties that may include the managers and/or employees of the old enterprise. If enough shares are sold to a foreign company, then the company becomes a joint venture FIE. Such ventures typically involve complex negotiations involving social-goal obligations that are of paramount importance to the State. Provisions of

[186] The CFA is a Chinese Government agency that acts as a trade association. It publishes statistical and other information about the foundry industry and provides fee-based technical services to Chinese foundries. Member companies pay a reduced rate for these services. CFA has no regulatory function.

[187] To qualify as an FIE, the foreign partner must own at least 25 percent of a venture. The investment and tax incentives are discussed in the Domestic Policies section.

[188] In most cases, conversion of township/village enterprises to private companies has been accomplished. Privatization of the centrally-controlled enterprises has been a much slower process because of the huge size of these operations and concern for the disposition of State assets (e-mail correspondence from U.S. Embassy official to USITC staff, January 2005). The State-Owned Assets Supervision and Administration Commission is a powerful government agency that oversees SOEs.

[189] CFA interview.

Table 9-14
China foundry industry: Selected joint ventures and wholly foreign-owned operations

Name and location	Ownership type	Ownership nationality	Metal type
ASC Industries, Tianjin	Wholly-owned	United States	Aluminum
ASC Industries	Joint ventures (2)	United States/China	Iron, aluminum
Nanjing Teksid, Nanjing	Joint venture	Italy/China	Aluminum
Zhenjiang Teksid	Joint venture	Italy/China	([1])
Tianjin New Wei San Industrial Co., Tianjin	Wholly-owned	Taiwan	Iron
Tianjin Sanda Casting Co.	Joint venture	Japan/China	Iron, steel
Shanghai EB	Joint venture	([1])	([1])
Zhenjiang Yinfong	Joint venture	Spain/China	([1])
Kunshan Fujiwa	Joint venture	Japan/China	([1])
Kunshan Toyota	Joint venture	Japan/China	([1])
Asimco (Beijing)	Wholly-owned	United States	Iron, steel, aluminum
Shanxi International Casting Co., Shanxi Province	Joint venture	United States/China	Iron
Langfang Meiliar (Asimco)	Joint venture	United States/China	Iron

[1] Not available.

Source: Industry sources, hearing transcript, and InterChina Consulting.

the joint venture agreement will often include guaranteed support for employees and local services (e.g., hospitals, schools that were originally supported by the SOE) and other obligations such as assumption of the SOE's debt.[190]

Many of the largest foundry operations are divisions of Chinese SOEs. The FAW Group, a centrally-controlled SOE and a major Chinese automobile producer, owns FAW Foundry (FAW). FAW is based in Changchun (northeast region) and is the largest producer of automobile castings in China, employing over 6,600 people. Production in 2004 was approximately 240,000 metric tons, almost 10 percent of China's automobile casting production, with sales of $200 million. FAW produces castings of gray iron, ductile iron, nonferrous, and other metal types at 6 facilities. It has a joint venture operation producing die castings, and is actively seeking additional joint venture partners. It sells castings to FAW Group's automobile division, its joint venture partner, other domestic users (including foreign joint venture automobile producers and wholly Chinese companies), and export markets. The size of the company is a significant competitive advantage and its earnings support a large R&D center that enables research designed to improve process

[190] U.S. government official in China, e-mail correspondence with USITC staff, Jan. 28, 2005. These provisions are crucial from the State's perspective because it does not have, in many cases, the resources to immediately assume all the social responsibilities of an ex-SOE. E-mail correspondence from U.S. Embassy official to USITC staff, Jan. 2005.

technologies.[191] FAW's R&D budget is 1 percent of sales. The company's Mold and Tool plant has a reputation for high quality patterns.

Dongfeng Automobile Corporation, another SOE automobile producer, owns Dongfeng Foundry #1 and #2, employing over 5,000 workers. The company also has a joint venture foundry operation with Honda to make engine and transmission parts.

The restructuring of the Chinese foundry industry has improved China's ability to compete with producers in other countries and has also increased competition within the country, resulting in the closure of many foundries.[192] Local foundries are improving their abilities to compete with other Chinese producers by integrating downstream machining and assembly operations with their foundry operations.[193]

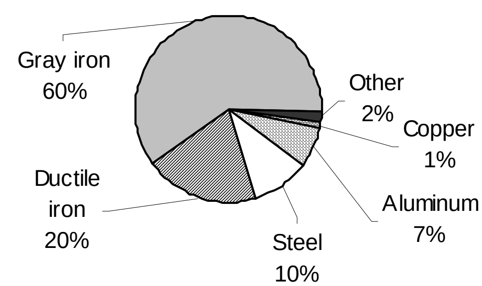
Business Trends

Production

Production of all types of castings has increased by over 50 percent since 1999 (table 9-15) and China now is the world's largest producer. Most of the production increase has come from existing facilities, but new facilities have also contributed to the increase.[194]

Chinese production of basic low-valued metal types, in comparison with developed countries, is reflected in the ratio of ductile iron castings to gray iron castings, which is 0.3 for China in 2002 versus 0.8 for the United States and 1.2 for Japan.[195] Further, China's share of aluminum castings to all castings produced is less than 7 percent, compared with 16 percent for the United States and 21 percent for Japan (figure 9-4).[196] Chinese production of specialty alloy precision castings is also lacking.[197]

Figure 9-4
China foundry industry: 2003 production, by metal type (based on weight)



Source: *Modern Casting*.

There are no comprehensive data on production trends of the FIEs. Many of these operations produce higher-valued, higher-quality castings, many of which are used by local automobile producers or exported. Several FIEs in the Beijing and Shanghai areas report production or sales increases of 50 to over 100 percent during 2002-2004.[198]

---

[191] Chinese industry official, interview with USITC staff, China, Nov. 2004.
[192] Ibid.
[193] Ibid.
[194] CFA interview.
[195] Ibid.
[196] Ibid.
[197] The rural and western foundries produce very basic castings (e.g., storm grates). Tsinghua University (Beijing, China) professor, interview with USITC staff, China, Nov. 2004.
[198] Chinese industry officials, interview with USITC staff, China, Nov. 2004.

Table 9-15
China foundry industry: Production, imports, exports, and employment, 1999-2004

Item	1999	2000	2001	2002	2003	2004
Production (*1,000 metric tons*):						
Total	12,737	13,900	14,889	16,261	18,146	20,000
Iron:						
Gray	7,912	([1])	9,002	9,840	10,800	([1])
Ductile	2,063	([1])	2,730	2,995	3,630	([1])
Other	360	([1])	428	452	400	([1])
Steel	1,353	([1])	1,590	1,692	1,770	([1])
Aluminum[2]	736	([1])	878	979	1,249	([1])
Copper	108	([1])	137	157	157	([1])
Other	115	([1])	122	146	140	([1])
Imports (*1,000 metric tons*)	([1])	([1])	([1])	20	([1])	([1])
Exports:						
Quantity (*1,000 metric tons*) . . .	([1])	([1])	([1])	1,200	1,700	([1])
Value (*1,000 dollars*)	([1])	781,241	812,013	909,613	([1])	([1])
Employment (*million*)	0.8	([1])	([1])	([1])	1.2	1.2

[1] Not available.
[2] Includes magnesium castings.

Note.–Figures may not add to the totals shown due to rounding. Data for 2004 are estimates by the China Foundry Association.

Source: *Modern Castings* and China Foundry Association.

Employment

Employment has also increased by 50 percent since 1999. Productivity for the industry as a whole is about one-fifth of U.S. productivity.[199] The SOEs have little flexibility in discharging employees because the Chinese Government at the national and local level wants to limit unemployment problems,[200] so it is difficult to improve productivity even when firms invest in new machines that can automate foundry processes.

Typically, national and local government officials influence employment levels at FIEs to a much lesser extent,[201] resulting in higher productivity at many of these individual foundries. For example, employment levels at ASIMCO, an FIE with multiple operations in China, are reportedly only 10 to 15 percent higher than comparable U.S. operations.[202] Certain wholly-owned operations have automated operations to the extent that employment levels rival any plant in the United States.

Investment

There are no comprehensive data on investment in China's foundry industry. Fieldwork in China indicates many FIEs have made substantial investments in recent years.[203] One major SOE typically invests

[199] CFA interview.
[200] Chinese industry officials, interview with USITC staff, China, Nov. 2004.
[201] Chinese and U.S. industry officials, interview by USITC staff, China, Nov. 2004.
[202] Testimony of Tim Brown, vice president, Benton Foundry Co., hearing transcript, p. 30.
[203] Chinese industry officials, interviews by USITC staff, Nov. 2004.

$12-24 million per year in its existing foundries,[204] and a U.S. company recently completed a new plant in China that required a $7 million investment. Chinese purchases of foundry equipment from both domestic and foreign sources have been substantial. Reportedly, these investments have totaled at least $120 million in recent years for modern equipment such as automatic production lines, resin sand molds and cores, centrifugal casting equipment, and die-casting equipment.[205]

Mergers and acquisitions are gaining increasing prominence in China as a result of new regulations that took effect during 2002-2003.[206] These regulations explicitly permit foreign investors to purchase traded and non-traded shares of Chinese companies. No comprehensive information exists regarding M&A activity involving foundry companies, but total M&A investments in China amounted to nearly $14 billion in 2002.[207]

Consumption

The growth of the Chinese foundry industry is directly related to increased demand from China's construction sector and manufacturing industries, especially motor-vehicle production. Consumption by end market in 2002 (latest available year) according to the China Foundry Association is shown in the following tabulation (in 1,000 metric tons):

End market	Quantity
Motor vehicles (automobiles and trucks)	2,800
Internal combustion engines (non-motor vehicle), tractors, and agricultural equipment	3,800
Cast pipe and fittings	2,500
Metallurgical and mining equipment	2,800
Machine tools	700
Construction castings	1,200
All other	2,500

The motor-vehicle sector is not the largest end-user, but it accounts for a large share of the demand for the most advanced castings. Foreign investment in the Chinese foundry industry is likely concentrated in the foundries that supply this sector.[208] Chinese automobile production has increased from 2.1 million vehicles in 2000 to 4.3 million vehicles in 2004 as demand for all motor vehicles (trucks and automobiles) has increased. However, beginning in late 2004, automobile sales started to wane and affect demand for foundry products. Reportedly, automobile production has begun to decline because of import tariff reductions (pursuant to China's WTO commitments) that have spurred car imports, infrastructure congestion that is

[204] Chinese industry official, interview by USITC staff, China, Nov. 2004.

[205] Guo Shuyan, President of the China Foundry Association, "China's Economic Development and Foundry Industry After China's Entry into the WTO," found at *http://www.moderncasting.com/MoreInfo/1202/ChinaWTO_1202.pdf*, retrieved Feb. 11, 2005. Guo phrased the investment as several billion yuan. One billion yuan is approximately $121 million.

[206] Gettman, Matthew and Decker, Stephanie, "A Guide to Doing Business in China and Information on Current Economic Conditions," U.S. Embassy in Beijing, China, Feb. 4, 2004.

[207] "Foreign Investment in China," The U.S.-China Business Council, found at *http://www.uschina.org/statistics/2003foreigninvestment.html*,retrieved Mar. 19, 2005.

[208] Chinese industry officials, interviews by USITC staff, China, Nov. 2004.

discouraging automobile purchases, and consumer anticipation of declines in vehicle prices.[209] One foundry reduced prices by almost 10 percent to maintain its volume of sales.[210]

Demand for cast pipe and fittings by the construction sector reflects extensive infrastructure projects in China. Total investment in Chinese infrastructure (roads, railways, ports, pipelines, etc.) grew by more than 29 percent in 2003, and similar growth occurred in 2004.[211]

The demand for castings from China's steel industry (included in the metallurgical and mining equipment sector) is growing rapidly, reflecting increasing Chinese steel production, which has doubled since 1999 to over 270 million metric tons in 2004.[212] China's coal mining sector is also expanding, increasing demand for cast wear parts used in mining machinery.

Trade

China is virtually self-sufficient in castings (although it likely imports a large volume of downstream products that contain castings). Imports are a very small fraction of consumption and tend to be the more sophisticated types that Chinese foundries cannot produce.[213] Exports are growing rapidly but are less than 10 percent of production.

Many export customers are located in Taiwan, Japan, Korea, the United States, and the EU (European Union).[214] Some U.S. motor vehicle manufacturers and aftermarket motor-vehicle part producers are customers of Chinese foundries. Exports in many cases are intra-company transfers from a Chinese foundry that is partially owned or wholly owned by the parent foreign company. Typically, the parent company assembles parts incorporating these Chinese castings.

Factors of Production

Raw Materials

Reportedly, prices for metal raw materials in China are equal to or greater than prices in the United States.[215] One foundry claims that aluminum alloy prices are 5 percent higher in China.[216] Price increases for metallic raw materials in China mirrored the large increases in world prices in 2004 (see U.S. overview in chapter 3 for a discussion of raw material price trends). Rural and western region foundries generally have access to lower-cost raw materials because sources are close. Inland areas also have access to more locally-generated scrap, unlike eastern foundries that must import much of their scrap requirements.[217] Some Chinese raw materials are of low quality, which is especially problematic when a foundry is making castings for

---

[209] Ibid.

[210] Chinese industry official, interview by USITC staff, China, Nov. 2004.

[211] "China's economy grows at 9.5% in 2004," *ChinaDaily*, found at *http://www.chinadaily.com.cn/english/doc/2005-01/25/content_412097.htm*, retrieved Mar. 19, 2005; and Gettman and Decker, "A Guide to Doing Business in China."

[212] International Iron and Steel Institute.

[213] Chinese government officials, interview with USITC staff, China, Nov. 2004.

[214] The information in this paragraph is based on interviews with Chinese industry officials by USITC staff, China, Nov. 2004.

[215] Chinese industry officials, interview with USITC staff, China, Nov. 2004.

[216] E-mail correspondence from Chinese industry official to USITC staff, Jan. 2005.

[217] CFA interview.

critical components such as a brake system. In these cases, imported raw materials may have to be substituted.[218] China's MFN tariffs for key raw materials are shown in the following tabulation (in percent):[219]

Item	MFN tariff
Scrap:	
Iron and steel	1.5-3
Aluminum	6
Copper	2
Ingot:	
Pig iron	1
Aluminum (including alloys)	7-9
Copper (including alloys)	1-2.5

China's domestic resources of aluminum are limited and much of the aluminum consumed by Chinese foundries must be imported.[220] A value-added tax (VAT) of 17 percent applies to raw materials that are imported, as well as to raw materials that are purchased in China. This is partially refunded if the material is contained in an exported product, effectively reducing the VAT to 4 percent (the import tariff is not refundable). A VAT also applies to foundry production activities, and it too is partially refunded if the product is exported.

Energy

Foundries report electricity costs of 5-8 cents per kilowatt hour in eastern regions of China.[221] In the Shanghai and Beijing areas, power interruptions such as rolling blackouts occasionally cause production problems. Foundries typically work with power authorities to level loads, such as planning off days during different parts of the week (such as having Sunday and Monday as the weekly off-days). Some foundries are shifting from electricity to natural gas for melting furnaces to reduce costs; reportedly, a new natural gas pipeline under construction will be transporting gas from northwestern China to Shanghai.[222] China has a large coal industry, much of it produced in the inland province of Shanxi, and foundries located here have a transportation cost advantage as compared with the eastern foundries when purchasing coal. However, the quality of some of the Chinese coal is poor and can cause environmental problems when consumed, and at least one foundry has had to purchase cleaner, higher-cost coal, to limit emissions.[223]

Labor

China's Labor Law[224] provides legal rights for workers and regulates, among other things, work hours, overtime, and wages. For example, the average number of hours worked are not to exceed 8 hours a day and 44 hours per week, overtime is limited to 36 hours per month, and overtime pay must be at a higher rate than regular pay (150-300 percent of regular pay, depending on the circumstances of the extra work). Certain

---

[218] U.S. industry official, telephone interview with USITC staff, Jan. 2005.

[219] APEC Tariff Database, found at *http://www.apectariff.org*, retrieved Feb. 11, 2004.

[220] Chinese industry officials, interview with USITC staff, China, Nov. 2004.

[221] The information is this paragraph is based on interviews with Chinese industry officials by USITC staff, China, Nov. 2004.

[222] Ibid.

[223] Ibid.

[224] See China - Labor Law, 1994. The complete text of the law may be found at *http://www.jus.uio.no/lm/china.labor.law.1994/doc.html#to2*.

Chinese foundry officials indicate that their operations are consistent with these labor regulations,[225] but comprehensive information on the whole industry is not available. The law states that there must be a minimum wage related to minimum living costs, but the actual minimum wage amount is determined by local government authorities. However, other sources indicate that enforcement of the minimum wage is lacking because localities want to attract and retain businesses with inexpensive labor.[226]

Typical wages in the eastern regions reportedly are $1.50-$2.00 per hour, but are only a tenth of this in rural and western regions.[227] This disparity can result in large differences in the price of Chinese castings.[228] Benefits usually include a yearly bonus equal to one month's wages and other provisions, such as company provided lunch and transportation to work. Companies must also make payments, usually equivalent to 50-60 percent of direct employee costs, for social-goal obligations such as health, unemployment, and pension insurance. The typical work week is 40 hours.

Foundry SOEs must provide for their employees even if these employees are no longer working, a requirement that inhibits labor cost reductions.[229] Typically, they must pay these employees until retirement age, at which point the national retirement system assumes a support obligation. SOE labor costs are also affected because of pressure from national and local governments to maintain high employment levels. The expectations for high employment levels are much lower for joint venture and foreign wholly owned operations. These entities also have much more flexibility with regard to employee dismissals without incurring cost obligations.

The rise of unions and changes in labor attitudes are beginning to reshape the labor and management relationship, and the concept of worker rights is building. Labor is increasingly mobile; in the past, a resident registration requirement made it difficult to move, but now the free flow of labor is promoted by the Government.[230] Worker expectations are increasing, especially in urban areas, as a result of the improving standard of living and material possessions.

Many Chinese foundries are finding it difficult to attract and retain workers, in part because foundry work is considered dirty and unrewarding. Technically-trained employees are also difficult to find and retain. Competition between foundries to hire this type of worker is intense, especially in urban areas where many other opportunities exist. The professor at a Beijing university with a foundry engineering program reported that most graduates take jobs in non-foundry industries. Foundries send employees to universities for non-degree-track training programs to compensate for difficulties in attracting graduates.

Technology

In many of the FIEs and the centrally-controlled SOEs, the level of technology is comparable to foundries in developed countries. Many of the major equipment producers in Japan, Taiwan, the EU, and the United States export to China. But in western and rural regions, the foundries typically use obsolete technology, and the overall technology level of the industry is low as compared with developed countries.

---

[225] Chinese industry officials, interview by USITC staff, China, Nov. 2004

[226] U.S. Department of State, Bureau of Democracy, Human Rights, and Labor, *Country Report on Human Rights Practices-2003,* Feb. 25, 2004, found at *http://www.state.gov/g/drl/rls/hrrpt/2003/27768.htm,* retrieved Mar. 18, 2005.

[227] The information in this paragraph is based primarily on interviews of Chinese government and industry officials by USITC staff, China, Nov. 2004.

[228] Tsinghua University (Beijing, China) professor, interview with USITC staff, China, Nov. 2004.

[229] The information in this paragraph is based on interviews of Chinese industry officials by USITC staff, China, Nov. 2004.

[230] Chinese government officials, interview by USITC staff, China, Nov. 2004

Transportation

China's transportation infrastructure has improved substantially since the early 1990's. In eastern areas of the country, the freeway, rail, and port facilities are well developed although congested. Despite development efforts, however, inland freeway and rail networks are not well developed.[231] Reportedly, transportation costs from foundries located in inland areas are high enough to offset much of the labor and raw material cost advantages in these regions.[232]

Management Ability

Chinese Government and industry officials cite the lack of management ability in the Chinese foundry industry.[233] Some of this is a legacy of the old, centrally-planned economy when meeting production goals was of prime importance, regardless of product quality and demand. Managers at the FIEs are generally skillful at instituting and managing quality control systems, but managers at other Chinese companies are not.[234]

Domestic Policies

There are no known Chinese government programs and policies that are specifically directed at the foundry industry. However, foundries have extensively used many programs and policies that assist industries in general.

Federal/Regional Programs

The laws that regulate the formation of FIEs and special industrial zones have been beneficial to the Chinese foundry industry.[235] Two laws that have had a significant effect on the foundry industry -- the Joint Venture Law and the Wholly Foreign Owned Enterprise Law of the People's Republic of China -- contain incentives such as reduced income tax rates and other tax-related benefits.

China has numerous industrial zones, usually referred to as special economic zones or development zones, designed to attract investment. Government authorities at the national or local level oversee these special areas and have authority to grant incentives that can include income tax exemptions, lower income tax rates, VAT exemptions, and priority access for utility services, among others. In many cases, incentives are not automatic and are subject to negotiations with the authorities.

A special VAT exemption program is available on a regional basis.[236] Reportedly, companies in the northeast region are eligible for a partial VAT exemption because the Chinese Government wants to provide incentives to revitalize the region.[237] The funds from the exemption must be used for technical improvement, e.g., new equipment, research and development. One major foundry in the region has applied for benefits under this program, but it is not clear to what extent this program aids foundries.

---

[231] Chinese government official, interview by USITC staff, China, Nov. 2004.

[232] Chinese industry officials, interviews by USITC staff, China, Nov. 2004.

[233] Chinese government and industry officials, interview by USITC staff, China, Nov. 2004.

[234] Chinese industry officials, interview with USITC staff, China, Nov. 2004.

[235] The information in this paragraph is based on interviews with Chinese industry officials, China, Nov. 2004.

[236] Chinese industry official, interview with USITC staff, Nov. 2004.

[237] This region is an old industrial area, often referred to as China's “rust belt.”

Monetary/Tax Policies

Exchange rates.--China has an exchange rate that is pegged to the U.S. dollar. This rate has varied within a narrow range around 8.28 yuan to the dollar, during 1999-2004.[238] The U.S. dollar has weakened considerably since 2002 versus the currencies of the EU and Japan, and to a lesser extent, the currency of Korea. Because Chinese foundries purchase foundry equipment from these countries, these currency value changes have likely increased the cost of imported foundry equipment in China.

Tax structure.--The nominal income tax rate is 33 percent on profits.[239] The joint venture law allows a 2 year exemption on income tax after the company is profitable, and an additional 3 years during which the tax rate is one-half of the regular rate. VAT-free importation of equipment is also available, but only as part of the original joint venture plan. Operations in special economic zones may also qualify for income tax rate reductions. For example, a provincial zone near Suzhou has an income tax rate of 24 percent; national zones have an income tax rate of 20 percent. These zones may also grant other incentives, such as a partial (up to 75 percent) income tax refund if profits are reinvested in China.[240]

The Chinese VAT, in most cases, is 17 percent, and is paid on production activities and on inputs.[241] A VAT of 17 percent applies to raw materials that are purchased in China. This is partially refunded if the material is contained in an exported product, effectively reducing the VAT to 4 percent. The VAT that applies to the value of foundry production is also partially refunded if the casting is exported.

Interest rates.--Bank commercial loan rates have varied from 5.3 to 5.8 percent during 1999-2003.[242] One Chinese foundry official claimed the normal interest rate for purchasing equipment is about 6 percent annually, but that foundries may not get the total loan requested and may have to give collateral.[243]

Environment

In general, China has extensive environmental challenges; several cities are considered to be among the most polluted in the world.[244] A 1998 World Health Organization report on air quality in 272 cities worldwide concluded that seven of the world's 10 most polluted cities were in China. Environmental protection is officially part of the duties of a ministerial-level agency called the State Environmental Protection Administration (SEPA). In recent years, China has strengthened its environmental legislation and made some progress in stemming environmental deterioration.[245]

Environmental laws are strict in urban areas in the east. Foundries in Beijing and Shanghai have particular problems with local governments that do not want polluting industries within city limits.[246] Reportedly, local government authorities monitor foundries in Shanghai, assessing fines for poor

---

[238] Based on Federal Reserve statistics, found at *http://www.federalreserve.gov*, retrieved Jan 2005.

[239] The information in this paragraph is based on interviews with Chinese industry officials by USITC staff, China, Nov. 2004.

[240] Gettman and Decker, "A Guide to Doing Business in China."

[241] The information in this paragraph is based on interviews with Chinese industry officials by USITC staff, China, Nov. 2004.

[242] International Monetary Fund International Financial Statistics Browser, found at *http://ifs.apdi.net/imf/ifsBrowser.aspx*, Feb. 3, 2005

[243] Chinese industry official, interview with USITC staff, China, Nov. 2004.

[244] Background Note: China, U.S. Department of State, Oct. 2004, found at *http://www.state.gov/r/pa/ei/bgn/18902.htm*, retrieved Jan. 31, 2005.

[245] Background Note: China, U.S. Department of State.

[246] Chinese industry officials, interviews with USITC staff, China, Nov. 2004.

performance. Foundries are strongly encouraged to move away. However, in many cases this is an opportunity to establish a new facility and purchase new machinery, because negotiations with Government officials can result in monetary incentives to move. Local governments may also assist with moving costs. The foreign-invested foundries are typically held to higher environmental standards than state-owned foundries.[247]

Worker Health and Safety

The Labor Law, Law on Work Safety, and the Law on Prevention and Control of Occupational Diseases are the main regulations that cover worker health and safety in China.[248] The State Administration of Work Safety Management and Supervision is a government agency that manages national work safety and enforces worker health and safety laws.[249] Enforcement is reportedly poor and the rate of industrial accidents is high.[250] Reportedly, foundries have made little investment in worker health and safety equipment and procedures.[251] However, FIEs tend to have fewer problems related to health and safety, and in some cases have safety procedures comparable to U.S. foundries.[252]

---

[247] Chinese industry official, interview with USITC staff, China, Nov. 2004.

[248] Opening Remarks by Ms. Christine Evans-Klock, Director of Subregional Office for East Asia, The 2nd China International Forum on Work Safety and China International Occupational Safety and Health Exhibition, found at *http://www.ilo.org/public/english/region/asro/bangkok/public/speeches/yr2004/oshchina_chris.htm,* retrieved Mar. 19, 2005.

[249] The Brief Introduction of State Administration of Work Safety, found at *http://www.cis-safety-inf.org.cn/cis_english_organizations/cis_organizations_01.htm,* retrieved Mar. 19, 2005.

[250] U.S. Department of State, Bureau of Democracy, Human Rights, and Labor, *Country Report on Human Rights Practices-2003*, Feb. 25, 2004, found at *http://www.state.gov/g/drl/rls/hrrpt/2003/27768.htm,* retrieved Mar. 18, 2005.

[251] Tsinghua University (Beijing, China) professor, interview with USITC staff, China, Nov. 2004.

[252] Chinese industry official, interview by USITC staff, China, Nov. 2004.

India

Industry Profile

Industry statistics:
- World rank (2003): 6th.
- Production (2003): 4 million metric tons
- Employment (2003): 500,000 employees
- No. of establishments (2002): 5,000

Industry characteristics:
- Major consumers: automotive and industrial equipment sectors
- Most large foundries are affiliated, captive or state-owned operations
- Exporter of iron ore and importer of energy, scrap metals, and coke
- Beneficiary of supporting government industrial policy

Metal casting is a well-established Indian industry. In 2002, over 90 percent of India's 5,000 metal foundries were traditional, small-scale, family-owned operations, accounting for 30 percent of total output.[253] The remaining 10 percent includes approximately 500 large, modern and globally competitive metal foundries that account for 70 percent of production. Most of these are captive facilities operating at near capacity. India's total annual metal foundry capacity is currently 7.5 million metric tons, with a yearly production of 4 million metric tons.[254]

The industry has grown rapidly since India's 1991 economic reform and, following a general economic slowdown in the early 2000s, the industry has begun to recover rapidly since 2003.[255] To minimize transportation costs and to serve specific regional end-use customers, Indian foundries typically are clustered near key industrial centers (table 9-16).

Most small foundries melt metals with cupolas using foundry grade coke; casting is done in standard sand molds. Since the 1991 trade reform, the foundry industry has been increasingly modernized and many large foundries are ISO-certified. In the large foundries, induction furnaces have gradually replaced cupolas, and modern casting technologies including high-pressure molding, and computer-assisted techniques in design and production have been increasingly adopted.[256] Most of the large foundries are captive or affiliated

[253] This sector is also called a cottage industry or "non-organized sector", which mostly produces nonferrous (aluminum) casting and operates at very low capacity utilization rates. Indian trade officials, correspondence with USITC staff, July 7-21, 2004; Financial Times Information, found at *http://www.nexis.com/research/* retrieved July 21, 2004; and "38th Census of World Casting Production– 2003," *Modern Casting*, Dec. 2004, pp. 25-26.

[254] India's exports currently amount to only one percent of world consumption and given its excess capacity, India can potentially become the fourth largest global metal casting producer. "Foundry Industry on the Upswing," *The Times of India*, Feb. 8, 2004, found at *http://timesofindia.indiatimes.com*, retrieved Aug. 10, 2004; and "38th Census of World Casting Production–2003," *Modern Casting*, Dec. 2004, pp. 25-26.

[255] In 1991, after many decades of economic isolation, India began implementing economic reform and trade liberalization. Since then, private economic activities have been encouraged, the government sector has been reduced through privatization, and foreign direct investment has been welcomed. Following the 1991 economic reform, the Indian economy grew at an average annual rate of about 6 percent for much of the 1990s, a higher rate than many other developing countries. However, in the early 2000's, India's economy was affected by a decrease in agricultural production caused by a drought, and a drop in demand for manufacturing exports. In 2002 and 2003, India's gross domestic product (GDP) grew by 4.3 and 8.3 percent, respectively. The U.S. Department of Energy (June 2004) expected India's 2004 economic growth to be at 6.4 percent. U.S. Department of Energy, Energy Information Agency, "Country Analysis Briefs: India," June 2004, p.1. See also "Foundry Industry on the Upswing."

[256] These applications also include DISA line, shell, hot box, and cold box core making, CAD/CAM pattern-and-die making, automatic sand plant, and advanced test facilities like spectrometer, magnetic particle testing, and ultrasonic and X-ray examination. *Foundry Forge International Newsletter*, Jan. 2004, found at *http://www.subcntractsolutions.com/Newsletter/*, retrieved Aug. 6, 2004. Indian industry officials, interview with USITC staff, India, Dec. 2004.

Table 9-16
Indian foundry industry: Foundry clusters

Cluster name	Location	Number of foundries	Products
Belgaum	Karnataka, Southern India	100	High precision, economical, and high- volume castings to the pump-set and automotive equipment makers.
Chennai (Madras)	Tamil Nadu, Southeastern India	70	Iron and steel castings for local automotive industry.
Coimbatore	Tamil Nadu, Southern India	200	Supplies pump industry (46 percent of total output) and the food processing and textile industries (14 percent);10 percent of output is exported.
Batala and Jalandhar	Punjab, Northern India	([1])	Small-scale gray iron castings for machine parts and agricultural sectors (70 percent); exports amount to 15 percent of total production.
Kolhapur	Maharashtra, Southern India	250	Supplies automotive industry; about 25 percent of production is exported.
Rajkot	Gujarat, Central India	500	Supplies diesel engine, automotive, and textile industries, mostly with gray iron castings and exports amount to 10 percent of total output.

[1] Not available.

Source: Institute of Indian Foundrymen, July 2004.

operations with annual capacities ranging from 30,000 to 60,000 metric tons and utilization rates from 85 to 90 percent.[257] Their leading customers include mass producers of engine blocks or related equipment in the automotive and agricultural equipment industries.

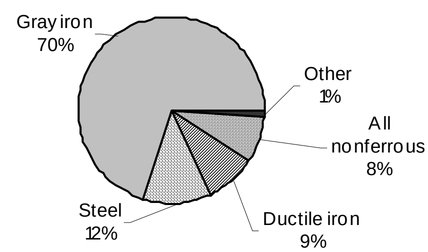
[257] *Foundry Forge International Newsletter*. Some large captive foundries remain state-owned enterprises (SOEs), including the foundry units of Bharat Heavy Electricals Ltd., Bharat Earth Movers Ltd., Hidustan Aeronautics, Scooters India, and HAL. Indian industry officials, correspondence with USITC staff, July 20 and Aug. 3, 2004.

Business Trends

Production

Indian foundries produce a wide range of castings including castings of iron, steel, and nonferrous metals.[258] Over 70 percent of castings are of gray iron while ductile iron, steel, and aluminum accounted for about 10 percent each in 2003 (figure 9-5). During 1999-2003, India's casting production grew by 25 percent from a low base (table 9-17), which was largely attributed to the strong trend of globalization in the automotive and industrial equipment industries. Gray iron castings accounted for about 55 percent of this total increase in casting production (440,000 metric tons). Production growth was concentrated in large-scale foundries which produce globally competitive castings.[259] Intense and growing competition from China in many market segments, especially in low value castings, has compelled India to focus on the higher value-added and capital-intensive segments of the industry.[260]

Figure 9-5
Indian foundry industry: 2003 production, by metal type (based on weight)



Source: *Modern Casting*.

Table 9-17
Indian foundry industry: Production by metal types, 1999-2003
(*1,000 metric tons*)

Type of metal casting	1999	2000	2001	2002	2003
Gray iron	2,400	2,300	2,300	2,370	2,840
Ductile iron	260	250	285	300	363
Malleable iron[1]	50	40	30	30	39
Steel	310	320	310	325	465
All nonferrous	220	210	230	242	331
Total	3,240	3,120	3,155	3,267	4,038

[1] Includes pipe.

Source: Several issues of *Modern Casting* providing the Annual Census of World Casting Production.

[258] Products include castings for machine tools, automobiles, tractors, factory equipment such as diesel engines, electric motors, air compressors, earth moving equipment, and railways and aircraft industries. Other casting metals include art ware, copper-based alloys, zinc-based, and magnesium-based alloys. Indian industry official, correspondence with USITC staff, Aug. 3, 2004.

[259] In the Indian foundry industry, the organized sector is the large and modern part of the industry, as compared with the "non-organized"sector or the cottage industry which includes the small, traditional and family-owned foundries. Foundry Forge International Newsletter.

[260] Indian mainly produces low-grade exports such as rough castings and municipal sanitary castings. Indian industry officials, interview with USITC staff, India, Dec. 2004.

Employment

According to an Indian industry official, as its foundry industry shifts from labor-intensive products to higher-grade castings, India has lost approximately 10 percent of total employment over the last 10 years, mostly in the non-organized sector.[261] Employment in 2003 stands at about 500,000 workers. However, the on-going trend of industrial consolidation and modernization is expected to improve productivity.[262]

Investment

In response to the 1991 trade reform, several international corporations from the EU, the United States, and East Asian countries have increased overseas operations and established foundry operations in India,[263] introducing modern production technologies and management techniques that have enhanced productivity, employee welfare,[264] and environmental standards of the industry. One industry source reportedly anticipates that India's foundry industry as of 2004 would have needed $2 billion in investment to meet the demand of a growing domestic industry and a strong export drive.[265]

Following the 1991 economic reform, the Government of India (GOI) has reduced or eliminated tariffs on imported capital goods, relaxed limitations on foreign ownership, and opened many industries to competition. As a result, the annual average amount of foreign direct investment (FDI) in India is reported to have recently increased to between $3 billion and $4 billion.[266] The reform also encourages the privatization of India's industry, enabling foreign companies to invest or form joint ventures with Indian foundry companies. FDI projects are now permitted under an automatic approval process.[267] To encourage added foreign investment, the GOI has recently declared that foreign partners in a joint venture do not have to seek permission from their Indian partners before setting up a separate operation in the same sector.[268]

---

[261] The small-scale sector includes many inefficient units employing old equipment and technology, typically with capacity utilization rates averaging 50 percent. These foundries are very sensitive to material shortage, frequent and large price increases of raw materials, and strict pollution control regulations forcing many to shut down. For example, the number of active foundries in the Coimbatore cluster has decreased to 200 from 600. Financial Times Information; and Indian industry official, correspondence with USITC staff, Aug. 3, 2004.

[262] Technology Information Forecasting and Assessment Council, "Focus on Foundry Industry," found at *http://www.tifac.org*, retrieved Aug. 6, 2004.

[263] For example, Volvo and Suzuki foundries in Madras (southern India) and New Delhi, respectively. Daewoo Motor has a foundry facility in Chennai, Sundaram. Chennai-based Sundaram Clayton has entered contracts with Cummins, Hyundai Motor, Delphi, Ford-India, Tata-Cummins, and Cummins-India. General Motors and Ford have contracts of foundry products for export with a total value of about $35 million. Suzuki Motor Corp. of Japan has formed a joint venture with Maruti Udyog Ltd. to build an aluminum casting plant at Masenar, in Haryana, to make car-related products including cylinder blocks, transmission cases, and cylinder heads. Indian industry officials, correspondence with USITC staff, Aug. 3, 2004; and Indian industry officials, interview with USITC staff, India, Dec. 2004; and Financial Times Information.

[264] Foreign direct investment is typically made in the organized segment where working conditions are generally better than those in the cottage industry segment.

[265] *Foundry Forge International Newsletter*.

[266] This level is only about one tenth of the annual FDI in China. However, since India's trade has been liberalized much later than China and other major Asian countries, this is a large increase in FDI for India. *Country Analysis Briefs: India,* U.S. Department of Energy, June 2004, p. 2.

[267] *Country Commerce: India*, The Economist Intelligence Unit, Nov. 2003, p. 15.

[268] John Larkin, "India Eases Foreign-Investment Rule," *Wall Street Journal*, Jan. 13, 2005, p. A10.

Exports

According to industry sources, overseas demand for India's castings is growing but is not large, primarily because of the lack of long-standing relationships with foreign partners and strong competition from China in several markets.[269] One source states that in Indian fiscal year (IFY) 1999-2000, India's exports of iron and steel castings were valued at $132 million and increased to $138 million in IFY 2000-2001. Export value is expected to increase to $200 million by IFY 2005-2006.[270] Even though current overseas demand for low-grade Indian castings is strong,[271] Indian exporters have increasingly focused on the high-grade products, most of which are exported to the EU and the United States. The majority of these exports are rough castings but, increasingly, customers are demanding high-precision machined castings.[272]

Factors of Production

Raw Materials and Energy

Since late 2003, supply dislocations and cost increases in raw materials and energy have reportedly caused about 500 small Indian foundries to close.[273] Overall, India is an exporter of pig iron but must import scrap metals, coke and other energy sources.

With respect to scrap metal, Indian foundries must pay a premium[274] because much of this material must be transported from the United States, which is the world's leading supplier of scrap metals. To help ease supply problems, the GOI reportedly plans to reduce tariffs on ships for demolition.[275]

---

[269] U.S. Department of State telegram, "India Foundry Industry," message reference No. 157426, prepared by U.S. Embassy, India, Oct. 1, 2004.

[270] Indian fiscal year runs from April 1through March 31. U.S. Department of State telegram, "India Foundry Industry," message reference No.157426, prepared by U.S. Embassy, India, Oct. 1, 2004.

[271] Recently, cities in the United States, the EU, and industrialized Asian countries have purchased large amounts of India's municipal sanitary castings. Even after including the transportation cost, Indian castings still typically cost only one third of those made in the United States. "Municipalities in the United States Are Buying Manhole Covers from India," *Newsday*, Jan. 20, 2004, pp. A25,30, and Roger Trap,"Import: Is Free Trade Becoming Too Costly," Factiva, found at *http://global.factiva.com*, retrieved Aug. 2, 2004.

[272] India currently produces about 450,000 metric tons of automotive castings. Over the next 5 years, this is envisioned to increase to 700,000 metric tons as India's tractor industry is expected to take off. John Deere and Massey-Ferguson both have production facilities in India. Currently, India is the second largest producer of tractors in the world. Indian industry officials, interview with USITC staff, India, Dec. 2004, p. 2.

[273] Cost recovery for material and energy is difficult, as most contracts are reportedly long-term commitments without cost-adjustment clauses. Financial Times Information, Dec. 15, 2004, found at *http://www.nexis.com/research/* retrieved July 21, 2004.

[274] The premium is for the high transportation costs from the United States to India and the small quantities purchased by Indian small-scale operations. Indian industry officials, interview with USITC staff, India, Dec. 2004.

[275] India has the world's largest ship-breaking industry. "India to Cut Import Duty on Ships to Be Scrapped," American Metal Market, July 30, 2004, found at *http://www.amm.com*, retrieved Aug. 2, 2004.

India relies on China for its foundry-grade coke needs[276] but China has recently attempted to restrict coke exports to meet its own rising demand. In response, India has built many coke oven batteries, primarily for captive facilities of major producers.[277] Molding sand is locally available in India, an advantage as compared with China and Korea which must import this raw material.[278]

Energy costs typically account for 10 to 15 percent of the total production costs in an Indian foundry and have gradually increased since the 1991 economic reform.[279] Also, as a net importer of energy, India has suffered from the recent upward trend in global energy costs and many companies have installed back-up generation, mostly in the form of relatively expensive wind power. Windmills account for 25 percent of all energy consumed by the foundry industry.[280] Energy privatization and the allowance of third-party sales of energy to ease the high cost of energy has been discussed by the GOI, but this has yet to be enacted.[281]

Labor

Labor is India's major comparative advantage over the foundry industries in industrialized countries. Indian foundry labor costs account for approximately 15 percent of total production costs[282] and typically include three components: the base wage, the cost-of-living adjustment allowance, and fringe benefits. The last item typically amounts to between 40 to 50 percent of base wages. In the organized sector, all components are typically negotiated between the local union and the management.[283] The minimum wage is currently set at a little more than a dollar a day at current exchange rates for workers in the organized sector[284] and a foundry employee typically earns from $1 to $3 for an 8-hour day.[285]

---

[276] India previously imported coke from Australia, which has recently reduced coke production due to environmental concerns, making India even more dependent on China for foundry coke. Indian coke has a very high ash content and is mostly used in small foundries. In 2003, India imported about 2.75 million metric tons of metallurgical coke (low ash content) for the production of pig iron, and 90 percent of this coke came from China. In 2004, India is expected to import between 2.5 to 3 million metric tons of coke from China. Financial Times Information.

[277] For example, Tisco, Kalyani Steel and Electro Steel Casting. Financial Times Information.

[278] Indian industry officials, interview with USITC staff, India, Dec. 2004.

[279] Indian foundries currently pay about 9 cents per kWh. In contrast, Chinese foundries pay only 4.5 cents. Indian industry officials, interview with USITC staff, India, Dec. 2004, and U.S. Department of State telegram, "India Foundry Industry."

[280] Indian industry officials, interview with USITC staff, India, Dec. 2004.

[281] Ibid.

[282] Indian industry official, correspondence with USITC staff, Aug. 3, 2004.

[283] *Country Commerce: India*, p. 55.

[284] States can also set their own minimum wage levels for local industries. India's labor legislation is a network of many inter-related pieces specifying various benefits to the workers and other aspects including strike, union formation, and management's salary. *Country Commerce: India*, p. 52.

[285] "Municipalities in the US Are Buying Manhole Covers from India," *Newsday*, Jan 20, 2003, pp. A25, A30, and A31, found at *http://www.gnp.org/india.htm*, retrieved 7-23-04. Compensation in India as estimated by the EIU is between Rs 5,000 to 9,000 with an unskilled worker earning between Rs 3,000 to 4,500 per month, depending on the states and experiences. The Factories Act of 1948 specifies that factory workers work between 43 to 48 hours during a six-day week. *Country Commerce: India*, p. 56.

FDI into India is reportedly still inhibited by a 1947 labor law restricting medium and large companies from terminating employees.[286] Indian labor is characterized by a low turn-over rate[287] and low productivity. Labor productivity in the foundry industry is among the lowest of major Asian countries because of antiquated foundry equipment and a low literacy rate, especially in the small-scale sector. Annually, India produces approximately 2.5 million college graduates including about 300,000 engineers who can provide leadership in industrial research and development and in the application of advanced technologies.[288] The English-language proficiency of both production workers and management in India makes it easier to communicate with customers worldwide.[289] However, most skilled workers are attracted to higher pay and better working conditions in sectors other than the foundry industry.[290]

Technology

To improve India's competitiveness in the high end of the global foundry market, the GOI has encouraged technology transfer through joint ventures with foreign firms, including automation and casting process simulation. Eco-friendly foundry techniques have also been introduced in India[291] and the GOI has cooperated with the private sector and the United Nations Industrial Development Organization (UNIDO) to modernize many foundry clusters.[292] According to Indian industry officials, the Indian casting industry has an advantage over China when producing highly complex machined components with precision quality standards, as engineering and machining of castings is superior in India.[293]

Transportation

Industry sources state that Indian port facilities lack the capacity to handle growing export volumes,[294] whereas road and rail systems appear to be adequate.[295] The GOI has plans to upgrade 13,146 km of India's highway network[296] and link it to 10 major ports by 4-lane roads.[297] Legislation has also been passed to help upgrade India's physical infrastructure. The 1999 National Highways Development Project, with the

---

[286] Permission for labor termination must be obtained from the government. Joanna Slater,"India's Mandate: Share the Growth," *Far Eastern Economic Review*, May 27, 2004, p. 12.

[287] Indian total workforce is estimated at 482 million in a population of over 1 billion in 2004 with 380 million being illiterate and 380 million living in poverty. With about 10 million people annually entering the workforce, the unemployment rates, ranging between 7 to 10 percent, are expected to rise mainly due to industrial consolidation and modernization in the Indian manufacturing sector. "India: Elections," *BusinessWeek*, May 31, 2004, p. 42; and *Country Commerce: India*, p. 52.

[288] India has problems at the primary education level with a low literacy rate of 62 percent, either in native language or in English, which is widely used by supervisory personnel. This rate lags behind China's 85 percent. *Country Commerce: India*, p. 52; and "India: Elections," p. 42.

[289] Indian industry officials indicated that customers have indicated that English-language proficiency provides India an advantage over countries such as China. Indian industry officials, interview with USITC staff, India, Dec. 2004.

[290] Technology Information Forecasting and Assessment Council, "Focus on Foundry Industry," found at *http://www.tifac.org*, retrieved Aug. 6, 2004.

[291] Ibid.

[292] Financial Times Information.

[293] Indian industry officials, interview with USITC staff, India, Dec. 2004.

[294] Ibid.

[295] Indian industry official, correspondence with USITC staff, Aug. 3, 2004.

[296] Government of India, Ministry of Finance, Union Budget and Economic Survey, 2003-2004, p. 185.

[297] Road transportation accounts for 70 percent of freight traffic and highways account for 40 percent of total road traffic, but represent only 2 percent of the total road system. Government of India, Ministry of Finance, Union Budget and Economic Survey, 2003-2004, p. 184.

assistance of the World Bank, sets the framework for the development of a national cross-country highway network. A tax on gasoline reportedly has been imposed to create an independent fund for road maintenance.[298] The GOI also permits full foreign ownership in physical infrastructure including power, roads, industrial towns and parks, harbors and ports.[299] Automatic approval is allowed for the purchase of ships, and cabotage laws were relaxed for container ships to facilitate transportation.

Domestic Policies

India is still an economy in transition and the central government plays a key role in the industry[300] and many large foundries remain state-owned enterprises. Since the economic reform, however, legislation has been passed to promote domestic competition, technology transfer, and foreign investment, and to enhance the global competitiveness of Indian products.[301] India's amended Monopolies and Restrictive Trade Practices Act of 1969 and the Competition Act of 2002 promote the privatization of state-owned companies, market competition, and minimize unfair trading practices, including collusion, cartel formation, and price fixing.[302] In general, Indian industry is highly-protected and the government continues to monitor virtually all aspects of business.[303] In addition, the current government may slow the privatization of profitable SOEs.[304]

Federal/Regional Aid

To promote investment and to assist weaker companies, the GOI reportedly allows tax deductible research-and-development expenditures, including capital outlays; government loans; loan guarantees; accelerated depreciation; and debt write-offs.[305] Local states can allow exemption or deferral of sales tax payable on raw material purchases.[306]

According to the Economist Intelligent Unit, the GOI offers development incentives[307] to targeted industries and lagging regions.[308] Tax and non-tax incentives are provided for establishing new industrial facilities[309] and for exported products in export-processing zones. Further incentives are also available at the state level including tax holidays, tax exemptions, income tax exemption on interest and long-term capital

---

[298] The Economist Intelligence Unit, Country Commerce: India, Nov. 2003, p. 14.

[299] Ibid., p. 15.

[300] The central government's Ministry of Industry oversees the foundry industry while the Iron and Steel Ministry supervises the iron and steel foundry industries and the Engineering Export Promotion Council is in charge of product promotions.

[301] *Country Commerce: India*, p. 14.

[302] The GOI has already undertaken key strategic measures including the sale of its 51 percent of equity in Bharat Aluminum Company to Sterlite Industries in March 2001, and its 50 percent stake in Maruti Suzuki to Suzuki of Japan, its joint-venture partner. *Country Commerce: India*, p. 35.

[303] The GOI also controls some minerals and metal scrap trading companies. In the steel industry, major state-owned enterprises include Kudremukh Iron Ore, National Mineral Development, Rashtriya Nigam, and Steel Authority of India. *Country Commerce: India*, pp. 10 and 13.

[304] The current government has recently abolished the Ministry of Disinvestment, a cabinet-level privatization agency. *Country Analysis Briefs: India*, p. 1.

[305] *Country Commerce: India*, pp 20-21 and 24; and U.S. Department of Commerce, Global Steel Trade, July 2000.

[306] The state of Maharashtra, for example. *Country Commerce: India*, p. 24,; and Global Steel Trade.

[307] *Country Commerce: India*, p. 15.

[308] Ibid., p. 24.

[309] Including tax holidays and tax exemption. *Country Commerce: India*, p. 24.

gains, and special excise duty rates for small producers.[310] The GOI eliminated the administered price control in the steel industry in 1992[311] and plans to reduce the tax on global companies' investment in Indian firms to align rates with those of comparable local companies.[312]

The GOI also helps upgrade foundry clusters. The Coimbatore cluster (producing pump-set castings) is slated to be a world-class center with the support of the GOI and the UNIDO.[314] A special government office will be created to assist local foundries in modernizing their production facilities, achieving global benchmarking standards, and acquiring quality certifications. In addition, a mobile laboratory and a "Quality Institute" will also be established to provide support to this local foundry cluster.

In the state of West Bengal, a new $3-billion cluster of 150 foundries, in the Howrah district, is scheduled to commence operations by the end of 2005.[315] The GOI will also provide important supporting operational facilities to all local foundries of the cluster.[316] The Indian Institute of Foundrymen (IIF) has proposed plans to strengthen and develop foundry clusters across India including Belgaum (pump-set and automotive castings), Kolhapur (automotive castings), Rajkot (castings for the automotive, diesel, and textile industries), and Batala/Jalandhar (castings for agricultural equipment). In addition, the clusters of Hyderabad and Chennai have also been identified for development and expansion.[317]

Monetary/Tax Policies

Indian monetary and fiscal policies work in tandem to encourage business activities. Since 1999, the Reserve Bank of India or RBI (India's Central Bank) has eased credit by lowering interest rates (table 9-18). Commercial lending rates that were around 12.5 percent have gradually been lowered since 1999 reaching 11.5 percent in 2003. Required bank cash reserves[318] also have been reduced to increase the money supply and ease credit further. To encourage investment while improving tax revenues, corporate tax rates were lowered, the tax base broadened and tax compliance enforced.[319] Excise taxes and custom duties also have been reduced and, as stated above, local and central governments provide tax incentives to encourage industrial development, foreign direct investment, and exports.

---

[310] *Country Commerce: India*, p. 14.

[311] Ibid., p. 37.

[312] Jay Solomon,"Finding the Balance," *Far Eastern Economic Review*, July 22, 2004, p. 48.

[314] Financial Times Information.

[315] "Indian Metal Casting Site to be Operational by End of 2005," Modern Casting News Release, found at *http://www.moderncasting.com/News*, retrieved Aug. 6, 2004.

[316] Supporting facilities of the industrial park include a testing facility, research and development center, sand preparation, plants truck terminals, analytical laboratory, raw material and chemical storage facilities, and related commercial facilities including banks, restaurants, hotels, and a post office. Financial Times Information, found at *http://www.nexis.com/research/*, retrieved July 21, 2004.

[317] Financial Times Information, found at *http://www.nexis.com/research/*, retrieved July 21, 2004.

[318] The cash reserve is the amount that a commercial bank must deposit in its account at the RBI. *Country Commerce: India*, p. 15; see also International Monetary Fund, "International Financial Statistics," Dec. 2004, p. 484.

[319] *Country Commerce: India*.

Table 9-18
Indian foundry industry: Financial rates, 1999-2004

Annual rates	1999	2000	2001	2002	2003	2004
Foreign exchange rate (*rupees per dollar*)	43.1	44.9	47.2	48.6	46.6	45.3
Commercial lending rate, annual average (*percent*) . . .	12.5	12.3	12.1	11.9	11.5	([1])

[1] Not available.

Source: Federal Reserve Board, Foreign Exchange Rates, 2005; IMF, International Financial Statistics, Dec. 2004.

Exchange rates.--International observers reported that the effects of the devaluation of the rupee against the dollar during 1991-1992[320] have been mostly overshadowed by the impact of various GOI's trade reform and fiscal measures taken during the 1990s.[321] The GOI governs India's exchange-control policy in conjunction with the RBI and, since 1993, exchange rates have been market-determined.[322] From 1999 to 2002, the rupee fell against the dollar by about 13 percent, but as foreign in-flows from exporters, non-resident Indians, and FDI activities increased in combination with the general weakness of the dollar, the rupee rose about 7 percent against the dollar between 2002 -2004.[323] Indian industry officials express concerns that if this trend continues, exchange rates may negatively affect Indian foundry exports by making India's exports more expensive than Chinese products. China is a key competitor in the important U.S. market.[324]

Environment[325]

The combination of urbanization, population growth and industrialization presents a major challenge to India's environment.[326] Although India's Environmental Act requires most foundries to obtain clearance for the installation, expansion or modernization of facilities, its enforcement appears uneven as economic development priorities often overshadow environmental considerations.[327] The government provides free, modern environmental technologies to medium and large enterprises[328] and 400 Indian foundries have become ISO-certified.[329] To reduce foundry pollution, which is mainly associated with coke, several units have reportedly utilized more modern techniques to enhance the metal to coke ratio.[330] Although Indian

[320] The rupee was devalued by 20 percent against the dollar in 1991, followed by a further devaluation in 1992.

[321] Petia Topalova, "Trade Liberalization and Firm Productivity: The Case of India," International Monetary Fund Working Paper, Feb. 2004, p. 6.

[322] *Country Commerce: India*, p. 37.

[323] The easing of crossborder tensions with Pakistan also played a key role in the rise in the rupee's value. See *Country Commerce: India*, p. 8.

[324] Indian industrial sources have expressed concerns regarding the exchange rate policy of China (pegging the Remimbi to the dollar) which effectively devaluates the Chinese currency relative to the Rupee. Indian industry official, correspondence with USITC staff, Aug. 3, 2004, p. 5.

[325] The Department of Environment and Forests issues the national environment guidelines which are implemented through the Central Pollution Control Board in New Delhi, as well as the pollution-control boards in each state where states' environmental authorities deal with state-specific issues. Indian industry official, correspondence with USITC staff, Technology Exchange Network, Bangalore, India, July 20, 2004.

[326] Many of India's largest cities are ranked among the world's most polluted. *Country Analysis Briefs: India*, p. 7.

[327] Ibid., pp. 7-8.

[328] *Country Commerce: India*, pp. 20-21.

[329] Indian industry official, correspondence with USITC staff, Aug. 2004.

[330] These techniques include the dry gas cleaning systems or the "divided blast systems." Suren Erkman and R. Ramaswamy, "Applied Industrial Ecology: A new Platform for Planning Sustainable Societies," Aicra Publishers,

(continued...)

environmental regulations have tightened in the past 20 years, they remain less stringent than U.S. environmental laws.[331] Indian industrial environmental conditions are expected to improve with increasing FDI.

Worker Health and Safety

Indian laws require companies with more than 100 workers to specify working conditions.[332] Although worker safety has long been stressed by authorities, enforcement is ineffective, according to industry sources. For example, in the small-scale, non-organized sector of the foundry industry, it is reported that employees carrying molten metal typically work without any safety equipment.[333] The current GOI's labor policy[334] and increasing FDI in the foundry business are expected to help improve Indian worker health and safety conditions.

[330] (...continued)
2003, p. 74.

[331] Indian industry officials, interview with USITC staff, India, Dec. 2004.

[332] These include hours worked, health insurance, sick pay, maternity leave, child labor, and termination rules. *Country Commerce: India*, pp. 53 and 55.

[333] Suren Erkman and Ramesh Ramaswamy, "Applied Industrial Ecology: A New Platform for Planning Sustainable Society,"Aicra Publishers, 2003, p. 74. However, USITC staff observed the use of safety equipment similar to that used in the United States during foundry visits in India.

[334] Indian industry official, correspondence with USITC staff Aug. 3, 2004, p. 5.

Korea[335]

Industry Profile[336]

Industry statistics (2003):
- World rank – 11th
- Production – 1.8 million metric tons
- No. of establishments – 769

Industry characteristics:
- Import market share is estimated to be only around 1 percent
- Significant focus on production for the automotive industry

Many major industries in the Korean economy, such as the automobile sector, serve as major customers for the metal foundry industry.[337] The Korean foundry market is valued at an estimated $3.5 billion.[338] It is dominated primarily by Korean manufacturers, with the import market share only around 1 percent.[339] The foundry industry is concentrated in the cities of Busan, Daegu, Incheon, and Choong Chung.[340] Each city offers different geographic benefits to the Korean foundry industry. Cities such as Busan and Incheon are major seaports in the country,[341] providing access to shipping routes, while Daegu is known as the principal commercial and manufacturing center of the south.[342] Major downstream producers such as the automobile industry and the shipbuilding industry are located in various sections of the country.

[335] For the purposes of this investigation, references to Korea in this section only include South Korea.

[336] Industry statistics are from the "38th Census of World Casting Production–2003," *Modern Casting*, Dec. 2004, pp 25-26. There are differences in data coverage for firms between Modern Casting Magazine and the Korean Foundry Cooperative Association (KFCA). Differences in data can be attributed to a number of factors, such as the number of companies that provided information and collection methods. According to the KFCA's 2003 data from its members, approximately 183 firms produced iron castings, with an average production of almost 526 tons per company. Korean Foundry Cooperative Association, "2002-2003 Total Production By Product," found at *http://www.kfca.or.kr/data/h_03.htm*, retrieved Jan. 7, 2005.

[337] "Press Release Ronneby 5 February 2004," Novacast, found at *http://www.novacast.se/Daehan_eng.pdf*, retrieved Jan. 3, 2005. The Korean automobile industry ranks fifth in the world in automobile unit production, with a total market demand for automotive parts and accessories valued at $18.5 billion in 2002. Production of motor vehicles in Korea has continually risen over the years, and now is estimated to be around 3.1 million vehicles per year. Korea's shipbuilding industry, another major consumer of castings, is first in the world in terms of order receipt and output, and accounted for 44.5 percent of all orders placed worldwide, by tonnage, in 2003. U.S. Department of Commerce (USDOC), Foreign Commercial Service (FCS), *Korea Country Commercial Guide FY 2004*, found at *http://www.stat-usa.gov*, retrieved Aug. 3, 2004; Kenneth H. Kirgin, "Casting Imports to U.S. Approach 3 Million Tons," *Modern Casting*, Sept. 2004, p. 37; and Invest in Korea, "Efficient Industrial Clusters," found at: *http://www.investinkorea.org/include/print_read.jsp?PATH=/contents/type0/2/11.html*, retrieved Jan. 6, 2005.

[338] E-mail correspondence from USFCS embassy staff with USITC staff, Sept. 9, 2004.

[339] Ibid.

[340] Korean Foundry Cooperative Association, "Third and Fourth Quarter 2004 Regional Production Trend," found at *http://www.kfca.or.kr/data/h_03.htm*, retrieved Jan. 7, 2005.

[341] "Encyclopedia Article–South Korea," MSN Encarta, found at *http://encarta.msn.com/encyclopedia_761562354_2/South_Korea.html*, retrieved Feb. 15, 2005.

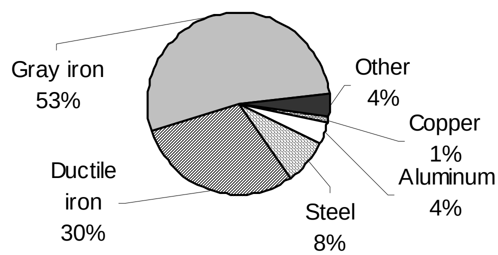
[342] Ibid.

Business Trends

Production

Despite economic slowdowns in 2000 and early 2003, Korean foundries increased production in almost every type of metal castings, with total output increasing by 10 percent from 1999-2003 to almost 1.8 million metric tons (table 9-19).[343] In 2003, almost 86 percent of production was concentrated in iron castings, with steel a distant second with slightly over 8 percent (figure 9-6). However, the greatest growth occurred in the aluminum castings sector, particularly during 2002-03, when production increased by approximately 63 percent. This increase can be largely attributed to the growing trend of automobile makers' increased demand for aluminum castings to reduce vehicle weight. The Korean foundry industry has a strong focus on automotive parts products because of the presence of major automotive makers[344] such as Hyundai and Kia. In 2003, over 503,000 metric tons of castings were sold to the automobile industry, followed by sales for engineering equipment at almost 168,000 metric tons, and for industrial machinery with over 167,000 metric tons. Castings sales to the ship industry totaled slightly over 62,000 metric tons.[345]

Figure 9-6
Korean foundry industry: 2003 production, by metal type (based on weight)



Source: *Modern Casting*.

Table 9-19
Korean foundry industry: Casting production, by metal types, 1999-2003
(*1,000 metric tons*)

Metal type	1999	2000	2001	2002	2003
Gray iron	895	905	914	925	944
Ductile iron	482	496	511	523	539
Malleable iron	38	41	43	46	48
Steel	136	139	142	145	147
Aluminum	46	46	47	48	78
Copper-base	19	20	21	22	22
Other nonferrous	5	5	5	6	6
Total	1,621	1,652	1,683	1,715	1,784

Source: Several issues of *Modern Casting*.

[343] "38th Census of World Casting Production–2003," *Modern Casting*, Dec. 2004, p. 26.

[344] Metals Industry Research and Development Center, "Metals Industry Trends & Events, The State of Asia's Foundry Industries," March-April 2002, found at *http://www.mirdc.dost.gov.ph/marapr02.htm*, retrieved Jan. 10, 2005.

[345] Korean Foundry Cooperative Association, "2002-2003 Total Production By Product," found at *http://www.kfca.or.kr/data/h_03.htm*, retrieved Jan. 7, 2005.

The city of Busan is reportedly the leading Korean production center by volume.[346] Another major production area, the city of Incheon, is a major focal point of die casting production in Korea.[347] Companies such as Daewoo Heavy Industries and Machinery have engine production facilities located in Incheon. Daewoo has a foundry shop in Incheon that has an annual capacity of 36,000 metric tons.[348]

Exports

In 2003, the Korean foundry industry exported 201,930 metric tons of castings, accounting for over $431 million.[349] The primary export markets for Korean castings in 2003 were Japan ($129 million) and the United States ($82 million).[350] Despite being a primary export market, castings from Korea account for a relatively small share of total U.S. imports. According to an industry publication, Korea's exports of all castings to the United States are anticipated to reach 180,000 metric tons in 2005.[351]

Factors of Production

Raw Materials and Energy

The Korean Government is heavily involved in setting energy prices.[352] For the industrial sector, energy prices are generally low, while prices for household and commercial sectors are considered comparatively high.[353] According to the Korea Ministry of Commerce, Industry, and Energy (MOCIE), this is done to "achieve industrial competitiveness and price stabilization in Korea." In the upcoming years, the Korean government plans to privatize many large state-owned enterprises to facilitate an open market system in the energy sector. These include the power generation assets of the state electricity utility, Korean Electric Power Corporation (KEPCO) and the natural gas monopoly Korea Gas Company (KOGAS).[354]

Korea has limited indigenous energy sources, including no oil reserves, and must import over three-quarters of its energy resource requirements.[355] According to MOCIE, on average, industrial electricity prices

---

[346] This is according to the latest available data from the KFCA as of September 2004. Further, the KFCA reports that production in the city of Busan increased by 11 percent from September 2003. Korean Foundry Cooperative Association, "Third and Fourth Quarter 2004 Regional Production Trend," found at *http://www.kfca.or.kr/data/h_03.htm*, retrieved Jan. 7, 2005; and Korean Foundry Cooperative Association, "2002-2003 Total Production By Product," found at *http://www.kfca.or.kr/data/h_03.htm*, retrieved Jan. 7, 2005.

[347] Michael J. Gallagher, "Korea," *CastingTrade.com*, 2001, found at *http://www.castingtrade.com/html/gallagher/gallagher15.html*, retrieved Aug. 2, 2004.

[348] "Introduction," Daewoo Heavy Industries & Machinery LTD., Engine & Material Div., found at *http://www.enginepark.com/eng/01_introduction.asp*, retrieved Aug. 3, 2004.

[349] U.S. Department of State telegram, "USITC Study on Foundry Products," message reference No. 157426, Mar. 2005, prepared by the U.S. Embassy, Seoul.

[350] Ibid.

[351] Kenneth H. Kirgin, "Casting Imports to U.S. Approach 3 Million Tons," *Modern Casting*, Sept. 2004, p. 37.

[352] Korea Ministry of Commerce, Industry and Energy, "Toward A 2010 Energy Policies," found at *http://www.mocie.go.kr/eng/policies/energy/energy3.asp*, retrieved Feb. 9, 2005.

[353] Ibid.

[354] U.S. Department of Energy, "South Korea Country Analysis Brief," Dec. 2003, found at *http://www.eia.doe.gov/emeu/cabs/skorea.html*, retrieved Oct. 4, 2004.

[355] "Republic of Korea, Background," World Energy, found at *http://www.worldenergy.org*, retrieved Oct. 15, 2005; and APEC, "APEC Energy Overview 2003," Jan. 2004, found at *http://www.ieej.or.jp/aperc/2003pdf/APEC_Energy_Overview_2003.pdf*, retrieved Jan. 16, 2005.

are lower in Korea compared with many other OECD countries.[356] Lower electricity prices, combined with the Korean government's energy price policies may provide cost benefits to the foundry industry in the production process. Overall, Korea ranks 12th in global capacity for electricity generation. Korea uses a combination of fossil fuel (oil, gas, and coal), nuclear, and hydroelectric capacity to meet demand. At the beginning of 2001, total power generation capacity was estimated at 54 gigawatts (GW). Most of the country's generating capacity is controlled by KEPCO. While plans for the privatization of KEPCO have stalled because of controversy from groups such as the labor union and some politicians, there are a few independent power producers in the country (approximately 2.5 GW).[357]

Overall, the Republic of Korea has limited mineral resources. In July 2003, import tariff rates on raw materials, many used by the foundry industry, such as pig iron, coal, and aluminum ingots were reduced from 13 percent to 0-3 percent.[358] The Korean Government has also intervened in the scrap metal market, a source of material for the foundry industry. Strong demand for scrap metal in Korea, combined with China's high demand and rising scrap metal prices, prompted the Korean government to impose export restrictions for six months in 2004. This action was taken to deal with the growing shortage and increased prices of these raw materials,[359] which particularly affect the foundry industry.

Labor

In 2002, the reported labor rate (hourly compensation plus benefits) in the Korean foundry industry was approximately $9 per hour.[360] However, another source states that Korean labor rates are estimated at $5.70 per hour (including fringe benefits).[361] The Economist Intelligence Unit reports that labor laws remain restrictive. The Korean foundry industry faces numerous government labor policies that affect all Korean industries, particularly the Labor Standards Act. Compliance with these regulations increases operating costs. A revision in the Labor Standards Act, which shortened the work week to 40 hours, which has been gradually implemented since July 2004.[362] The labor law also requires a mandatory 24-hour rest period each week.[363] With the new rules, many employers have attempted to implement wage reductions because of the shorter work schedule.[364] Further, under the Labor Standards Act employers must pay workers an additional 50 percent of their normal wage for overtime work.[365] An employer may not terminate a regular employee without 30 days notice or 30 days of normal wages. The employer also cannot "dismiss, layoff, suspend or

[356] Korea Ministry of Commerce, Industry, and Energy, "Toward a 2010 Energy Policies," found at *http://www.mocie.go.kr/english/policies/toward/default.asp*, retrieved Sept. 13, 2004.

[357] U.S. Department of Energy, "South Korea Country Analysis Brief," Dec. 2003, found at *http://www.eia.doe.gov/emeu/cabs/skorea.html*, retrieved Oct. 4, 2004.

[358] Pui-Kwan Tse, "The Mineral Industry of the Republic of Korea," found at *http://minerals.usgs.gov/minerals/pubs/country/2003/ksmyb03.pdf*, retrieved Mar. 31, 2005.

[359] Dan Sandoval, "Tapping the Breaks?," *Recycling Today*, Apr. 23, 2004, found at *http://www.recyclingtoday.com*, retrieved Feb. 9, 2005.

[360] American Foundry Society, *2002 Metal Forecast & Trends*, p. 30.

[361] Kenneth H. Kirgin, "Casting Imports to U.S. Approach 3 Million Tons," *Modern Casting*, Sept. 2004, p. 37.

[362] Korea Labor Institute, "A Study on the Ways to Facilitate Reducing Working Hours," found at *http://www.kli.re.kr/20_english/01_about/sub06.asp?tmp_topic=7&tmp_year=2004*, retrieved Jan. 7, 2005.

[363] U.S. Department of State, "Korea, Republic of–Country Reports on Human Rights Practices 2003," Feb. 25, 2004, found at *http://www.state.gov/g/drl/rls/hrrpt/2003/27776.htm*, retrieved Feb. 7, 2005.

[364] Economist Intelligence Unit, "South Korea-Labour market risk," found at *http://dialog.newsedge.com*, retrieved Jan. 6, 2005.

[365] Ibid. The article further notes that many companies do not observe this rule and many employees feel reluctant to report overtime. Overtime work consists of work done between 12am and 6am, on Sundays and public holidays.

transfer a worker, without reasons 'justifiable' by criminal or disorderly behavior or other misconduct on the part of the worker."[366]

Transportation[367]

The quality of Korea's transportation infrastructure is advanced compared to many nations, but lags behind many of its developed nation counterparts. Korea's rapid industrial development and an increase in the number of automobiles, prompted by a government-led attempt to promote the automobile industry, has benefitted the foundry industry in terms of creating greater customer demand for castings. However, the increase in the number of automobiles led to both bottlenecks in Korea's infrastructure and to significant levels of investment by the government to alleviate the problems.[368]

An estimated $300 billion is set aside for infrastructure projects over the next 19 years, with approximately $170 billion marked for new roads, railways, ports, and airports.[369] A multibillion dollar expansion of the highway system is planned; increased capacity in several international and domestic airports is expected; and existing port facilities are expected to benefit from the additional investments.[370] Many foundries are located near large ports such as Busan and major industrial areas such Daegu, providing access to major transportation routes. Many industrial sectors such as the foundry industry can expect to benefit from improvements to Korea's transportation infrastructure, particularly improvements to existing port facilities.

Domestic Policies

Federal/Regional Programs

Presently, there are no known government programs that are specifically directed at the Korean foundry industry. However, there are cross-industry programs that may assist the foundry industry. The Korean government established industry-based industrial clusters in its five largest regions[371] aimed at providing a beneficial corporate business environment. For example, Incheon, Ulsan, Chungnam, Jeonbuk, and Gwangju have been targeted for the development of automobile and automobile parts production. Within these industrial clusters, there are Foreign-Exclusive Investment Complexes (FEICs) which provide benefits such as tax relief and financial support toward technological development.[372]

---

[366] Ibid.

[367] With most of its borders surrounded by the sea, essentially all of Korean exported goods depend on maritime transportation. Korea has 28 international-standard ports and 22 coastal harbors and is home to the third-largest container port in the world, the port of Busan. Invest Korea, "A Strategic Location," found at *http://www.investkorea.org/templet/type0/1/read.jsp*, retrieved Aug. 16, 2004.

[368] Jaebong Ro, "Infrastructure Development in Korea," *United Nations Online Network in Public Administration and Finance*, Sept. 2002, found at *http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN008650.pdf*, retrieved Jan. 19, 2005.

[369] USDOC, FCS, *Korea Country Commercial Guide FY 2004*, found at *http://www.stat-usa.gov*, retrieved Aug. 3, 2004.

[370] Ibid.

[371] Seoul Metropolitan Area, Chungcheong, Jeolla, Gyeongsang, and Gangwon.

[372] Invest Korea, "Efficient Industrial Clusters," found at: *http://www.investinkorea.org/include/print_read.jsp?PATH=/contents/type0/2/111.html*, retrieved Jan. 6, 2005.

Monetary/Tax Policies

Exchange rates.--According to an industry source, the currency exchange rate between the U.S. dollar and the Korean won has aided the competitiveness of Korean castings exports to the United States and Europe.[373] Although the exchange rate fluctuated from 1999-2003, the 2003 rate of 1,145 won per U.S. dollar is nearly the same as the 1999 exchange rate, as shown in the following tabulation (in won per dollar).[374]

Year	Rate
1999	1,188
2000	1,130
2001	1,291
2002	1,251
2003	1,191
2004	1,145

In 2004, the dollar declined slightly against the won. These latter years provide a contrast with exchange rates in the early to mid-1990s, which averaged around 771 won per U.S. dollar in 1995.[375] In an OECD report that compared currencies in 2003, the rate of the won to the dollar was relatively stable; the won depreciated by 10 percent against the yen and 16 percent against the euro by the end of 2003.[376]

Tax structure.--A number of factors are considered when determining the effects of the country's tax structure on companies. Items such as the national corporate tax rate, local tax rates, financial incentives, and special deductions can greatly impact the effect of the tax structure on the foundry industry. Korea's corporate tax rate, at just under 30 percent,[377] is lower than rates of many countries. However, the rate is higher than some of its neighbors, such as Hong Kong, which has a corporate tax rate of 18 percent.[378] Generally, a corporation with head offices located in Korea is subject to corporate tax on its total income; the tax rate varies, depending on a corporation's taxable income.[379]

[373] Kenneth H. Kirgin, "Casting Imports to U.S. Approach 3 Million Tons," *Modern Casting*, Sept. 2004, p. 37.

[374] CIA World Factbook, "Korea," found at *http://www.cia.gov/cia/publications/factbook/geos/ks.html*, retrieved Jan. 16, 2005.

[375] United Nations Online Network in Public Administration and Finance, "Key Indicators of Developing Asian and Pacific Countries, Republic of Korea," found at *http://unpan1.un.org/intradoc/groups/public/documents/apcity/unpan012577.pdf*, retrieved Jan. 5, 2005.

[376] Organization for Economic Cooperation and Development, "Economic Surveys: Korea 2004," pp. 53-54, found at *http://www.sourceoecd.org/*, retrieved Jan. 6, 2005.

[377] In 2003, this rate was a national corporation tax of 27 percent with an additional local inhabitant surtax of 10 percent of the national tax imposed, thus leading to a top corporation tax rate of 29.7 percent. American Chamber of Commerce in Korea, "Improving Korea's business climate 2003–Taxation," found at *http://www.amchamkorea.org/publications/2003ikbc/Taxation.doc*, retrieved Jan 7, 2005.

[378] "KPMG's Corporate Tax Rate Survey–January 2003," *KPMG*, found at *http://www.us.kpmg.com/microsite/global_tax/ctr_survey/2003CorproratеTaxSurveyFINAL.pdf#search='korea%20 corporate%20tax%20rate%202003*', retrieved Feb. 7, 2005.

[379] Korea Securities Dealers Association, "Taxation," found at *http://www.ksda.or.kr/english/invest/tax_resident.cfm*, retrieved Jan. 7, 2005.

Interest rates.–Commercial lending rates in Korea declined during 1999-2003, as shown in the following tabulation (in percent): [380]

Year	Rate
1999	9.4
2000	8.5
2001	7.7
2002	6.8
2003	6.2

The decline did not increase investment spending in the country. Reports indicate that "low lending rates failed to boost bank loans to companies," despite deposit and loan rates being the lowest since January 1996.[381]

Environment

Rapid growth and industrialization of the Korean economy in the past few decades has led to many negative environmental effects. According to the United States-Asia Environmental Partnership, "Industrial emissions from factories have caused serious acid rain problems. Increased car ownership also has led to a corresponding rise in carbon emission from the country's transportation sector, contributing to Korea's air pollution problems."[382]

Like other industries, the metal casting industry in Korea must abide by environmental regulations imposed by its government, particularly the Ministry of Environment (MOE). The MOE establishes federal environmental policies and regulations. Local governments may impose their own environmental rules along with those designated by the MOE.[383] The Korean government implemented the Basic Environment Policy Act (BEPA), which was modeled after legislation in the United States. The BEPA (figure 9-7) provides basic guidelines, principles, and an administrative framework for environment preservation and remediation with a "polluter pays" principle. The legislation requires corporations to cooperate with government regulations and to take the necessary steps to prevent environmental pollution.[384] Additionally, many Korean companies adopted the ISO 14000 environment management system in 1997.[385]

---

[380] International Monetary Fund, *International Financial Statistics*.

[381] Yahoo Finance, Australia and NZ, "S. Korea's Interest Rates Fall To Record Lows in Nov," found at *http://au.biz.yahoo.com//041227/17/2lsg.html*, retrieved Jan. 16, 2005.

[382] U.S. Department of Energy, "South Korea Country Analysis Brief," Dec. 2003, found at *http://www.eia.doe.gov/emeu/cabs/skorea.html*, retrieved Oct. 4, 2004.

[383] USDOC, International Trade Administration, "Korea Environmental Technologies Export Market Plan," found at *http://www.ita.doc.gov/media/Publications/text/korea2002FINAL.txt*, retrieved Sept. 13, 2004.

[384] United States-Asia Environmental Partnership, "Korea: Regulatory Framework," found at *http://apocalypse.usaep.org/export/em-korea-rf.htm*, retrieved Sept. 13, 2004.

[385] USDOC, FCS, *Korea Country Commercial Guide FY 2004*.

Figure 9-7
Korean foundry industry: Environmental regulatory framework[386]

Atmospheric Environment	Water Environment Preservation	Noxious Chemical Substance
Regulates emission of pollutants into the air. Pollutants regulated under AEPA include sulfuric oxides, nitric oxides, carbon monoxide, and particulates.	Regulates effluents released into surface waters. Pollutants regulated under WEPA include biochemical oxygen demand, chemical oxygen demand, floating material, chrome, copper and zinc.	Regulates the manufacture and importation of virtually all chemicals. Any business that manufactures, distributes, holds, stores, or transports toxic substances must register with the MOE.

Source: United States-Asia Environmental Partnership.

Worker Health and Safety

Presently, there is no worker health and safety legislation known to be directed specifically at the foundry industry. Like many other industries, Korean foundries incur costs from worker health and safety guidelines set by the government. There are several government agencies that oversee worker health and safety in Korea. The Korean Ministry of Labor (MOL) is the primary agency responsible for occupational health policy and administration. Regional labor offices are located around the country to provide administrative and oversight support to the agency.[387] The Korea Occupational Safety and Health Agency (KOSHA) is responsible for research, accident prevention, and safety and health education. KOSHA has branch offices located in major cities to assist in occupation accident prevention activities such as providing health and safety technical guidance and training.[388]

Specific legislation in Korea that addresses worker health and safety issues includes the Labor Standards Act (1953) and the Industrial Safety and Health Act (1981 and revised in 1996). The Industrial Safety and Health Act requires corporations with 50 or more employees to employ plant physicians and health managers to oversee the occupational health and safety of workers.[389] Workers' compensation was enacted in 1963.[390]

A group occupational health service system provides occupational health services for workers in small to medium size corporations (below 1000 employees). Under this system, a monthly premium is assessed, and companies can rely on system benefits rather than having to individually hire factory doctors, nurses, or hygienists. Larger corporations hire their own physicians, nurses, and health managers. Funds are also budgeted by the Korean government to support group occupational health services, which include visits to factories by occupation health personnel to monitor activities.[391]

---

386 United States-Asia Environmental Partnership, "Korea: Regulatory Framework.,"

387 Jungsun Park and Yangho Kim, "The Present and the Future of Occupation Health in Korea," Journal of Occupational Health, found at *http://joh.med.uoeh-u.ac.jp/pdf/E41/E41_1_11.pdf*, retrieved Mar. 31, 2005; and the Korea Ministry of Labor, "About MOL," found at *http://www.molab.go.kr:8787/English/abou/sub_1.jsp*, retrieved Mar. 31, 2005.

388 Korea Occupational Safety and Health Agency, "About Kosha," found at *http://www.kosha.net/english/english.htm*, retrieved Mar. 31, 2005.

389 University of Iowa College of Nursing, "South Korea–Occupational Health," found at *http://www.occhealthnursing.net/korea03.htm*, retrieved Sept. 22, 2004.

390 Ibid.

391 Ibid.

Mexico

Industry Profile

Industry statistics:
- World rank (2003): 10th
- Production (2003): 1.8 million metric tons
- No. of establishments (2001): 1,787

Industry characteristics:
- Integrated into the North American production chain as a domestic supplier and net exporter of metal castings.
- Automotive sector consumes three-fifths of all Mexican-produced castings.
- Beneficiary of extensive foreign direct investment and ambitious growth strategies of Mexican firms.

The metal foundry industry is well established in Mexico, having benefitted from extensive foreign direct investment (FDI) during the 1970s and 1980s. Although well integrated in the North American production chain, Mexico's foundries have been overshadowed since the late 1990s-early 2000s by rising production in lower-cost countries, particularly China and India. Mexican foundries are concentrated in the country's major industrial and manufacturing centers. Roughly three-quarters of all Mexican castings are produced in the northeast region, particularly in and around the cities of Monterrey, Monclova, and Saltillo.[392]

About 1,787 foundries were operating in Mexico in 2001, of which most (1,019) were nonferrous casters; among the ferrous foundries, casters of iron (741) outnumbered those that cast steel (27).[393] Most foundries in Mexico are small- or medium-scale operations, with more than 90 percent having fewer than 100 employees.[394] There is a mix of both indigenous and foreign-owned operations among Mexican foundries. About 35 percent of Mexican foundry output is consumed domestically.[395] Details are not readily available regarding the extent to which mergers and acquisitions have affected the number of foundry operations in Mexico. However, one example is the indigenous corporation Grupo Quimmco that rose to be among one of Mexico's major casters of automotive and heavy-equipment components during a decade of ambitious growth through buyouts and pursuit of new business opportunities.[396]

The predominant end-use sector is the export-oriented automotive industry, both assemblers and original equipment manufacturers (OEMs), which consumes nearly 60 percent of all metal castings produced

---

[392] Foundries are also located in the central portion of the country in and around Mexico City (e.g., Curernavaca, Pachuca, Queretaro, and Toluca), in the north-central interior cities (e.g., Aguascalientes, Durango, Guadalajara, San Luís Potosí, and Torreón), in Veracruz on the mid-Caribbean coast, and along the U.S.-Mexico border. FundiExpo, "FundiExpo Monterrey Expects 4,000 Attendees," *Modern Casting*, a publication of the American Foundry Society (AFS), Dec. 6, 2002, found at *http://www.moderncasting.com/News/NewsReleaseRequest.asp?ReleaseID=667&MonthYear=December%202002*, retrieved July 20, 2004; "National Casting Industry Profile: Mexico. Hoy! Mexico Wants Development–Today!," *CastingTrade.com*, 2001, found at *http://castingtrade.com/html/world/mexico.html*, retrieved July 22, 2004; and Antonio E. Guerrero and Eduardo Salinas, "Mexican Metalcasting on the Move," *Foundry Management & Technology*, May 2000, p. 32.

[393] Latest year for which data are available. "36th Census of World Casting Production–2001," *Modern Casting*, Dec. 2001, pp. 22-25.

[394] "National Casting Industry Profile: Mexico," *CastingTrade.com*, retrieved Apr. 5, 2005.

[395] The Mexican Society of Foundries, cited in e-mail correspondence from Economic Section official, U.S. Embassy, Mexico City, to USITC staff, Dec. 8, 2004.

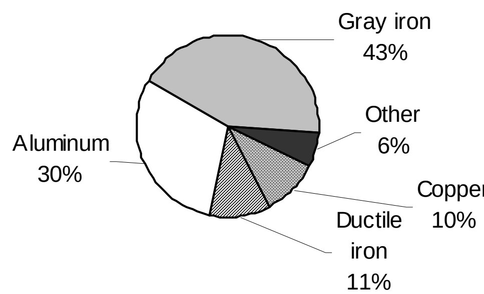
[396] As a more specific example, Grupo Quimmco purchased loss-making Macimex from bank receivership in 2001, invested more than $60 million to upgrade the operation, and turned the company into the group's fastest-growing, highest-growth potential entity. In 2003, General Motors Corp. recognized Macimex as a "Worldwide Supplier of the Year" for providing precision machined crankshafts. "Mexico Report–Iron and Aluminum Casting in Monterrey, World Leading Technology Ahead," *Wards's AutoWorld*, Jan. 2005, p. 18.

in Mexico.[397] Top-end foundries in Mexico are tier-1 automotive parts producers or casters of other engineered components. Mid-range foundries tend to be job shops that produce less-sophisticated products for both automotive and non-automotive applications. The low-end Mexican foundries cast simple shapes (e.g., valves) in large-volume runs, which renders them vulnerable to rising competition from lower-cost, foreign competitors with similar capabilities.[398]

Older foundries in Mexico primarily rely on cupola furnaces for melting iron and electric induction furnaces (EIFs)[399] for melting aluminum, copper, and other nonferrous scrap,[400] whereas newer operations utilize EIFs to melt ferrous or nonferrous metals.[401] Mexican foundries are capable of casting with all molding methods including green sand, no-bake, cold box, shell, lost-foam, semi-permanent, and permanent molding;[402] and die casting.[403] The industry is also noted for its expertise in designing and constructing lost-foam moldings[404] and in woodworking to excel at pattern building.[405]

The predominant metals cast are gray iron (43 percent) and aluminum alloys (30 percent). According to one industry analysis, Mexico has the highest-value metal mix of any country due to the high proportion of aluminum castings (figure 9-8).[406] Reports about the quality of Mexican castings vary from generally good, but with some problems in producing higher-end castings;[407] to not as good in more recent years,[408] with material-composition discrepancies and internal defects.[409] By contrast, another U.S. castings purchaser found Mexican castings cleaner (i.e., without the burnt mold-sand residue) than those from its domestic and third-country sources.[410] Iron foundries provide components primarily for the automotive sector.[411] Steel foundries produce primarily

Figure 9-8
Mexican foundry industry: 2003 production, by metal type (based on weight)



Source: *Modern Casting.*

---

[397] Virginia Cahill, "Mexican Metalcasting Makes Its Mark," *Foundry Management & Technology*, Dec. 2001, p. 30.

[398] U.S. industry publication official, telephone interview with USITC staff, Feb. 8, 2005.

[399] Less power-intensive EIFs are preferred over electric-arc furnaces due to the high cost of electricity to industrial customers in Mexico. U.S. industry-publication official, telephone interview with USITC staff, Feb. 8, 2005.

[400] The Mexican Society of Foundries, cited in e-mail correspondence from Economic Section official, U.S. Embassy, Mexico City, to USITC staff, Dec. 8, 2004.

[401] U.S. industry official, telephone interview with USITC staff, Feb. 23, 2005.

[402] Cahill, "Mexican Metalcasting Makes Its Mark," p. 32.

[403] Among the larger die casting firms are Auma (Mexico), Leggett & Platt (U.S.), and MABE (Mexico). Michael J. Gallagher, "Highlights of the Global Die Casting Industry: Mexico," *CastingTrade.com*, 2001, found at *http://castingtrade.com/html/gallagher/gallagher02.html*, retrieved July 22, 2004.

[404] U.S. industry official, interview with USITC staff, United States, June 2004.

[405] U.S. industry official, telephone interview with USITC staff, July 30, 2004.

[406] "National Casting Industry Profile: Mexico," *CastingTrade.com*.

[407] U.S. industry official, telephone interview with USITC staff, July 30, 2004.

[408] U.S. industry official, interview with USITC staff, United States, June 2004.

[409] Ibid.

[410] U.S. industry official, interview with USITC staff, United States, Oct. 2004.

[411] Top iron foundry firms serving the automotive industry include Abomex (Mexico), Autometales (Mexico),

(continued...)

valves and fittings, and miscellaneous cast parts.[412] The majority of nonferrous castings[413] are produced for various industrial equipment markets and the automotive sector.[414]

Business Trends

Production and Employment

Production of metal castings by Mexican foundries increased each year from 1999 to 2001 (table 9-20), but declined in 2002 and again in 2003. Domestic production is insufficient to meet demand, particularly in the automotive sector, which must rely on imports to round out its needs for cast metal components.[415]

Table 9-20
Mexican foundry industry: Production by metal type, 1999-2003
(*1,000 metric tons*)

Metal type	1999	2000	2001	2002	2003
Gray iron[1]	631	704	[2]888	800	790
Ductile iron	44	56	[2]62	175	200
Total, iron	675	760	950	975	990
Steel	104	143	100	300	8
Copper alloys	125	135	80	175	175
Aluminum	454	600	525	480	550
Other	118	123	225	100	100
Total, all metal types	1,474	1,761	1,880	2,030	1,823

[1] Includes malleable iron.
[2] Estimated from proportions of total cast-iron shipments.

Note.–Figures may not add to totals because of rounding.

Source: "Annual Census of World Casting Production," *Modern Casting*, Dec. (various years); and Kenneth H. Kirgin, "Casting Market Trends," *Modern Casting*, Sept. 2004, p. 38.

411 (...continued)
GIS-Cifunsa (Mexico), General Motors (U.S.), Proeza/Grede (U.S.), Hayes Lemmerz (U.S.), Nissan (Japan), Rassini (Italy), Teksid (Italy), and Volkswagen (Germany). IUSA (Mexico) and Tisa/Tismatic (Mexico) serve non-automotive markets. Cahill, "Mexican Metalcasting Makes Its Mark," p. 32; and Guerrero and Salinas, "Mexican Metalcasting on the Move," p. 34.

412 Major steel foundries include Aceros Fundios Internacional (U.S.), Acerlan (Mexico), Magoteaux (U.S.), Amsco (U.S.), Fundemex (Mexico), FWF (France), Kitz (Japan), Naco (U.S.), and Susano Solis (Mexico). Cahill, "Mexican Metalcasting Makes Its Mark," p. 32.

413 Major nonferrous foundries include GIS-Castech (Mexico), Volkswagen (U.K. and Germany), Ronald (Germany), Auma (Mexico), Levelier (France), Mahle (Germany), Montupet (France), Nemak (Mexico), Nissan (Japan), Pistones Moresa (U.S.), and Teksid (Italy). Ibid.

414 Guerrero and Salinas, "Mexican Metalcasting on the Move," p. 32.

415 "Intermet Plans New, $40-Million Ductile-Iron Foundry in Mexico, to Start in '04," *Foundry Management & Technology*, Oct. 2003, p. 6.

Table 9-21
Mexican foundry industry: Number of employees and production and related workers, 1999-2003

Item	1999	2000	2002	2002	2003
Number of establishments	77	77	76	72	([1])
Production and related workers:					
Number	9,725	9,354	7,547	6,243	5,324
Man-hours worked (*1,000 hours*)	22,802	22,457	26,203	24,285	22,237
Wages paid (*1,000 pesos*)	237,992	278,285	276,624	242,687	227,014

[1] Not available.

Note.–The number of metal foundry establishments in this table differs from the "Census of World Casting Production" survey cited previously due to a difference in industry definitions between INEGI and the AFS.

Source: Class 382200–Smelting and Molding of Metallic, Ferrous and Nonferrous Pieces. Compiled from official statistics of the National Institute of Statistics, Geography, and Information (INEGI) of Mexico.

According to Mexico's National Institute of Statistics, Geography, and Information (INEGI), both the number of employees and the man-hours worked declined in each of the past 5 years, partly as a reflection of the slight decline in the overall number of foundry establishments (table 9-21).

Investment

Numerous multinational corporations from the United States, Western Europe, and East Asia have established foundry operations in Mexico, which are credited with enhancing not only production technology, but also management, working conditions, and environmental protection in the industry.[416] During 1995-2001, more than 30 new large and medium-size foundries were established by investors from France, Germany, Japan, Mexico, and the United States.[417] The majority of new foundries established in recent years, particularly for iron and nonferrous cast parts, are in the automotive sector.[418] Recent examples of foundry operations being established or expanded in Mexico include GSC Foundries, a manufacturer of aerospace parts, that will expand its investment in its Saltillo facilities;[419] and Intermet Corp., one of the world's largest manufacturers of automotive powertrain, chassis, suspension, and structural components, which announced plans for a new ductile-iron foundry in Monterrey to cast automotive structural components, beginning in 2004.[420]

Exports

The major items exported by Mexico's foundry industry are automotive parts, especially engine blocks.[421] Other notable exports include miscellaneous castings, valves and fittings, and municipal castings. Mexican foundries export primarily to the United States, with exports of metal castings anticipated to reach

[416] "National Casting Industry Profile: Mexico," *CastingTrade.com*.

[417] Cahill, "Mexican Metalcasting Makes Its Mark," p. 30.

[418] Ibid.

[419] "GSC Foundries Invests 15 Million Dollars," *Maquilaportal.com*, Apr. 1, 2004, found at *http://www.maquilaportal.com/cgi-bin/public/hist/hist.pl?Klein-2004-04-01&Klein2=6114&Klein...*, retrieved July 23, 2004.

[420] Intermet Corp., "Intermet Announces Plans for New Foundry in Mexico," news release, Sept. 15, 2003, found at *http://www.intermet.com/latest/current/mexico.html*, retrieved July 23, 2004; and "Intermet Plans New, $40-Million Ductile-Iron Foundry in Mexico," *Foundry Management & Technology*, p. 6.

[421] "National Casting Industry Profile: Mexico," *CastingTrade.com*.

292,000 metric tons in 2005.[422] Other major export destinations include Canada and Latin America–a reflection of Mexico's extensive FDI ties and network of free-trade agreements (FTAs).

Factors of Production

Raw Materials

Currently, Mexican foundries are reportedly being adversely impacted by rising costs for raw materials and energy. Raw material costs in Mexico have escalated to the point that an industry observer noted that many small and medium-size ferrous foundries are shutting down.[423] Traditionally, the United States is the predominant source of iron and steel scrap for Mexican industries, although some ferrous scrap is also generated within Mexico.[424] However, shortages of ferrous scrap worldwide, attributed to China's rapidly expanding scrap purchases, have driven up costs of scrap steel, scrap iron, and pig iron to Mexican industries in recent years.[425] Mexico is heavily reliant on imports of aluminum ingot and scrap, thus exposing the foundry industry to increased competition with Chinese secondary-aluminum producers that are increasingly seeking more U.S. scrap, also a major source for Mexican foundries.[426] By contrast, Mexican foundries are less dependent on foreign sources of copper cathodes due to the country's sizeable mining and smelting industry,[427] but rely largely on the United States for copper scrap, where prices have been buoyed by robust domestic and foreign demand.[428]

Energy

According to the Mexican Society of Foundries (CAINTRA), the industry's energy usage can be broken out by source as shown in the following tabulation (in percent):

Energy source	Share
Electricity	35
Metallurgical coke	25
Natural gas	20
Diesel fuel	5
Total	100

422 Kenneth H. Kirgin, "Casting Imports to U.S. Approach 3 Million Tons," *Modern Casting*, Sept. 2004, p. 38.

423 Guillermo Vogel, Vice President, Mexican Chamber of the Steel Industry (CANACERO), cited in U.S. & Foreign Commercial Service (US&FCS) and U.S. Department of State, "Iron Scrap Shortage in Mexico Forces Steel Prices Up," *International Market Insight*, ID No. 124414, Apr. 19, 2004.

424 U.S. industry official, telephone interview with USITC staff, July 30, 2004.

425 Steel scrap prices in Mexico rose from an average of $100 per metric ton in 2002 to $140 per metric ton in 2003, and to $255 per metric ton by spring 2004. Since 1999, prices in Mexico for scrap iron increased by 243 percent and for pig iron by 205 percent. US&FCS and U.S. Department of State, "Iron Scrap Shortage in Mexico Forces Steel Prices Up."

426 Paul Schaffer, "Producers, Chinese Demand Jar Secondary Smelters," *American Metal Market*, Mar. 14, 2003; and U.S. industry official, telephone interview with USITC staff, July 30, 2004.

427 Major copper mines are concentrated in the northwestern state of Sonora. Ivette E. Torres, "The Mineral Industry of Mexico," *Minerals Yearbook, Vol. III, Area Reports*, U.S. Geological Survey, 2002. There are two copper refineries in Mexico, according to the Mexican Society of Foundries. E-mail correspondence from Economic Section official, U.S. Embassy, Mexico City, to USITC staff, Dec. 8, 2004.

428 Joseph McCann, "Copper Still Strong Despite Short-Term Blip," *American Metal Market*, Apr. 23, 2004; and U.S. industry official, telephone interview with USITC staff, July 30, 2004.

Higher energy costs are another concern to foundries, as electricity and natural gas account for an estimated 25 to 40 percent of production costs for iron and steel industries (including foundries) in Mexico.[429] Constrained electric-power supplies due to the country's shortage of generating capacity; transmission and distribution losses from an aging power grid, inefficient equipment, and pilferage; and discounted rates to the agricultural and residential sectors, reportedly drive-up electricity costs to industrial customers.[430] However, in December 2004, the Office of the President of Mexico announced lower state-administered energy costs to industry as part of a package of measures to check inflation and to enhance the country's economic competitiveness.[431] Prices for electricity use beyond normal threshold levels during peak hours are to be cut by 50 percent. Likewise, monthly upward adjustments to electricity rates will be at a slower rate for industrial users, because the state-run electricity corporation will purchase fuel oil at reduced prices from the state-owned petroleum company (PEMEX). Mexico has abundant natural-gas resources but FDI development interest is lacking due to legal concerns[432] and perceptions that wellhead prices in Mexico are set below those prevailing in Houston. Hence, an inadequate infrastructure for gas production, storage, and transportation forces Mexico to rely on imports of high-cost gas from the United States.[433] Natural-gas imports will also be exempted from duties as part of the package of measures announced in December 2004.[434] Finally, an additional concern for ferrous foundries that rely on coke-fired cupola furnaces is the escalating cost of metallurgical coke in Mexico[435] and worldwide as China scaled-back its exports at a time of rising global demand.[436]

[429] Alonso Ancira Elizondo, President, Mexican Iron and Steel Chamber (CANACERO), cited in US&FCS and U.S. Department of State, "Trends in Steel Consumption and Production in Mexico," *Country Commercial Guide FY 2004–Mexico*, ID No. 122909, Jan. 26, 2004.

[430] Ivan Grillo, "Energy Company to Crack Down on Power Theft," *Mexico City News*, Oct. 8, 2002; and David Shields, "Government Prepares Energy Reform," *Mexico City News*, Mar. 8, 2001. Electricity prices in Mexico rose 6 percent since the beginning of 2004. "Economic Summary," *Mexico Watch*, June 1, 2004, pp. 1-4.

[431] John Nagel, "Mexico Cuts Import Duties, Energy Costs to Curb Inflation, Boost Competitiveness," *International Trade Daily*, Dec. 21, 2004, found at *http://pubs.bna.com/ip/BNA/ITD.NFS/...*, retrieved Dec. 21, 2004.

[432] Mexico's Constitution reserves the oil and gas sectors for the state. "Pemex Courts Foreign Investment in Natural Gas, but Firms are Wary of Legal Minefield," *Mexico Watch*, July 1, 2002, p. 4.

[433] Natural-gas prices in Mexico rose by 11 percent between Jan. and May 2004. "Economic Summary," *Mexico Watch*, pp. 1-4; and George T. Baker, President, Baker & Associates, Houston, TX, cited in Philip Burgert, "Bottlenecks Disrupt Delivery of Raw Materials," *American Metal Market*, Jan. 27, 2005.

[434] Nagel, "Mexico Cuts Import Duties, Energy Costs to Curb Inflation."

[435] The price of metallurgical coke rose 335 percent in Mexico since 1999. US&FCS and U.S. Department of State, "Iron Scrap Shortage in Mexico Forces Steel Prices Up."

[436] China, the world's largest supplier of coke, scaled back its export licencing quotas in recent years to meet growing demand by its domestic industries at a time when other developing nations, particularly India, also increased demand for coke, following an extended period of coke capacity closures worldwide that far exceeded the few new additions. Nancy E. Kelly, "US, EU Protest Chinese Coke Export Controls," *American Metal Market*, May 28, 2004; and Scott Robertson, "Summit Speakers Warn of Crisis in the Coke Market," *American Metal Market*, Oct. 8, 2003.

Labor

The average hourly labor rate (wages plus benefits[437]) in the Mexican foundry industry of $1.70 in 2003 is about 9 percent of the rate in the U.S. industry ($19.00) and less than one-half that in Brazil ($3.60).[438] However, wage rates have risen in recent years for Mexico's highly unionized foundry industry,[439] thereby eroding its competitive advantage in the U.S. market compared with other low-cost foreign sources.[440] Hence, some U.S. companies that initially sought lower-cost labor by establishing foundry operations in Mexico have subsequently begun relocating to China.[441] Although Mexico has an abundance of low or unskilled workers, formal hiring is reportedly hindered by relatively high social-security contribution requirements, according to the Organization for Economic Co-operation and Development (OECD).[442] There is also a shortage of technically skilled workers, technicians, engineers, and managers in Mexico[443] and some firms reportedly have difficulty keeping experienced foundry workers.[444] Metal foundries train workers in-house and those in the border area usually import technical and managerial staff from the United States. Although these foreign workers have transferred expertise to Mexican mid-career workers, Mexican university programs[445]

---

[437] Mexico's Federal Labor Law (LFT) requires employers to pay workers double time for working overtime, and triple time for working more than 3 hours of overtime per day or for working overtime on 3 consecutive days. Employers are required by the LFT to provide employees with paid vacation time and bonuses (especially an annual end-of-year holiday bonus equivalent to at least 2-weeks pay), which amounts to an estimated additional 30 to 35 percent of salaries. U.S. Department of State, Bureau of Democracy, Human Rights, and Labor (BDHR&L), "Worker Rights," *Country Reports on Human Rights Practices 2003–Mexico*, Feb. 25, 2004; and US&FCS and U.S. Department of State, "Investment Climate," *Country Commercial Guide FY 2004 (Aug. update)–Mexico*, ID No. 126796, Aug. 12, 2004. Information was not readily available about the share of benefits in total compensation to employees of Mexico's metal foundry industry. For comparison purposes, across the manufacturing sector in 2001, benefits are estimated to account for an 11.2-percent share of total employee compensation in Mexico, compared to 20.6-percent in the United States. Official statistics of the U.S. Bureau of Labor Statistics, cited in Jeremy A. Leonard, *How Structural Costs Imposed on U.S. Manufacturers Harm Workers and Threaten Competitiveness*, Manufacturers Alliance/MAPI, for the Manufacturing Institute of the National Association of Manufacturers, 2003, p. 13.

[438] AFS, *AFS Metalcasting Forecast & Trends 2004*, Oct. 2003, p. 34.

[439] Although labor in industrial areas of the country is highly organized, the extent of unionization and wage levels in export-oriented industries vary among locales and by degree of manufacturing process. Labor unions are reportedly not considered an impediment for operators of metal foundries in Mexico. Generally, labor unions in Mexico do not have the degree of bargaining clout as do their counterparts in the United States. Moreover, wage increases in most Mexican collective bargaining agreements reportedly have kept pace with or even outpaced inflation, but not sufficiently to enable workers to recoup consumer purchasing power eroded over the past decade. U.S. Department of State, BDHR&L, "Worker Rights;" U.S. industry-publication official, telephone interview with USITC staff, Feb. 8, 2005; and U.S. industry official, telephone interview with USITC staff, Feb. 23, 2005.

[440] U.S. industry official, interview with USITC staff, United States, June 2004.

[441] Testimony of George G. Boyd, President and Chief Executive Officer, Golden's Foundry & Machine, hearing transcript, p. 132; and testimony of Roy Hanks, Marketing Manager, ThyssenKrupp-Waupaca, hearing transcript, p. 134.

[442] Cited in "The Peso Crisis, Ten Years On, Tequila Slammer, Mexico Has Still Not Fully Recovered from Its Worst Financial Crisis," *Economist*, Jan. 1, 2005, pp. 55 and 58.

[443] US&FCS and U.S. Department of State, "Investment Climate."

[444] U.S. industry official, interview with USITC staff, United States, Oct. 2004.

[445] For example, Tech de Monterrey (Instituto Technológico de Estudios Superiores de Monterrey, ITESM), centered in the northeastern industrial city of Monterrey, NL, with branch campuses throughout the country, is well regarded for providing highly trained technicians, engineers, managers, and other professionals for Mexican business and industry. See: Tech de Monterrey's English-language website at ***http://www.mty.itesm.mx/principal.html***.

and industry in-house development over the past 8 to 10 years also are producing native-Mexican technicians and managers for the foundry industry.[446]

Technology

Mexico's automotive foundries are considered "high-tech" by North American standards, with some of the newest facilities (e.g., established by Ford Motor Co. and Nissan North America Inc.) considered among the best in the world.[447] This largely reflects the extensive FDI and technology transfer by foreign multinational corporations[448] or ambitious growth strategies by Mexican-owned corporations. Automotive components producer Nemak, considered the world's largest aluminum foundry, reportedly invests some $20 million annually in cost-cutting, product quality improvements, product development, casting technology, and customer service to maintain its competitive edge not only in Mexico but also worldwide.[449] For the Mexican metal foundry industry as a whole, molding machinery and equipment are generally of U.S., Italian, or German origin,[450] although there is domestic production of foundry molding boxes.[451] Without much domestic production of tooling, dies, jigs, and fixtures, these items are sourced primarily from the United States.[452]

Transportation

Some U.S. industry officials considered transportation to be costly and inefficient, rendering Mexican foundries uncompetitive with U.S. or even Chinese foundries for hauling bulk raw materials, equipment, and cast products, particularly heavier castings.[453] Surface transportation of cargo in Mexico is dominated by commercial trucking,[454] although growth in the recently privatized rail sector is anticipated to continue; by contrast, air cargo transportation is minimal.[455] However, the prevalence of toll highways and bridges drives

---

[446] U.S. industry official, telephone interview with USITC staff, July 30, 2004.

[447] Statistics Canada, "Competitiveness," *Canadian Metalcasting Technology Roadmap*, found at *http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/rm00075e.html*, retrieved July 23, 2004.

[448] "National Casting Industry Profile: Mexico."

[449] Nemak's foundry operations in Monterrey, NL, are ISO/TS-16949 and ISO-14001 certified, with the most advanced casting technology available, and the firm has received prestigious supplier awards from the Big-Three U.S. automakers. In 1990, Nemak established its research and development center focusing on metallurgy, product engineering and design, and CAD/CAM techniques that resulted in several patents, successful launch of 35 new aluminum-cast products in 4 years, and ability to tailor its production process to readily meet customer specifications. "Mexico Report," *Wards's AutoWorld*, pp. 16-17.

[450] U.S. industry official, telephone interview with USITC staff, July 30, 2004.

[451] US&FCS and U.S. Department of State, "Manufacturing in Mexico," *Industry Sector Analysis*, ID No. 121095, Oct. 1, 2003.

[452] The United States supplied 69 percent of all tools and dies, and nearly 64 percent of all jigs and fixtures imported by Mexico in 2001. Other important sources were the European Union, Canada, and Japan. USITC, "Mexico," *Tools, Dies, and Industrial Molds: Competitive Conditions in the United States and Selected Foreign Markets*, Inv. No. 332-435, publication 3556, Oct. 2002, pp. 4-21-4-23.

[453] For example, one estimate of the cost to transport heavier products into the United States from regions beyond the U.S.-Mexico border area (e.g., from the north-central interior city of Guadalajara, JAL) is about 40-percent higher than for transporting the same product from China. Testimony of William T. Blackerby, Jr., Chief Operating Officer, ASC Industries, Inc., hearing transcript, p. 135.

[454] E-mail correspondence from US&FCS official, Mexico City, to USITC staff, Feb. 8, 2005.

[455] US&FCS and U.S. Department of State, "Federal Transportation Authority Work Plan for Railroad Transportation," *International Market Insight*, ID No. 124909, May 21, 2004; and "Plans to Increase Air Cargo Transportation Through Mexican Airports," *International Market Insight*, ID No. 124908, May 21, 2004.

up truck haulage costs along major transit routes.[456] Moreover, transportation between industrialized areas, where metal foundries are located, has been constrained by the nation's unevenly developed highway infrastructure.[457] Despite concerted efforts by the Mexican Government in recent years to coordinate and develop the country's multimodal transportation links,[458] highway upgrades have been characterized as varying from substantial to lagging among locales.[459]

Domestic Policies

Federal/Regional Programs

The Mexican Secretariat of Economy offers industrial development programs to promote output by domestic metallurgical, mechanical, and consumer products industries,[460] which would not only include metal foundries but also downstream customers for Mexican-produced metal castings. There have not been any reports of subsidies being paid by the Mexican Government to metal foundries, according to a 2002 U.S. foundry industry trade publication.[461]

Any remaining Mexican tariffs on manufacturing inputs to the metal foundry industry (and non-agricultural imports, in general) imported from its North American trade partners, were eliminated at the beginning of 2003, in accordance with the 10-year staged reductions set out in the North American Free Trade Agreement (NAFTA).[462] Metal foundry operations registered under the Maquiladora Program and the Program for Temporary Imports to Produce Exports (PITEX) tend to be foreign-owned or joint-venture, rather than indigenous firms.[463] Under these programs, metal foundries benefitted from duty exemptions on imported material inputs, capital equipment, and lubricants used in manufacturing products for export.[464] To reduce the impact of the new NAFTA-required limits to duty waivers on inputs of non-NAFTA origin for producing goods intended for export to NAFTA partners, Mexico launched the Sectoral Promotion Programs (PROSECs), at the beginning of 2001, for export-oriented manufacturers in 22 industry sectors (the minerals

---

[456] E-mail correspondence from US&FCS official, Mexico City, to USITC staff, Feb. 8, 2005.

[457] For example, Teksid de Mexico, a joint-venture between Fiat and Grupo Quimmco to cast gray-iron and aluminum engine blocks, is located in the northeastern industrial city of Monclova, COAH. Although this city is linked by an air port, rail lines, and highways with other northeastern and border cities, a heavily traveled, two-lane highway between Saltillo, COAH, and Monterrey, NL, reportedly constrains Monclova's industrial growth potential. US&FCS and U.S. Department of State, *Commercial News USA*, 1999, found at *http://www.export.gov/autosuggest.asp?docid=9166401&links=MONCLOVA&ip=&port=&imgflg=&sumflg=ContextSummary&option=showcontent*, retrieved July 21, 2004.

[458] See e.g., Ibid., "Agreement to Improve Logistic Links and Create Multimodal Corridors in Mexico," *International Market Insight*, ID No. 127350, Sept. 13, 2004; and "Federal Transportation Authority Work Plan for Railroad Transportation." The current Mexican Administration is planning for new highways to connect the Mexico City area with major ports on both the Pacific and Caribbean Basin coasts, and highway upgrades into a six-lane system from Mexico City northward to Nuevo Laredo, TAMPS-Laredo, TX. Ibid., "Economic Trends and Outlook," *Country Commercial Guide FY 2004 (Aug. update)–Mexico*, ID No. 126779, Aug. 12, 2004. In early Oct. 2004, the Mexican Government announced $1.5 billion in public financing for 22 new toll highways and 2 new toll bridges. US&FCS, "Highway Construction in Mexico," *International Market Insight*, Oct. 1, 2004.

[459] US&FCS and U.S. Department of State, "Economic Trends and Outlook."

[460] Ibid., and "Investment Climate."

[461] "Casting Imports, What to Expect in 2003," *Modern Casting*, Sept. 2002, p. 27.

[462] Office of the U.S. Trade Representative (USTR), "Mexico," *2004 National Trade Estimate Report on Foreign Trade Barriers*, 2004, p. 328.

[463] U.S. industry-publication official, telephone interview with USITC staff, Feb. 8, 2005; and U.S. industry official, telephone interview with USITC staff, Feb. 23, 2005.

[464] US&FCS and U.S. Department of State, "Investment Climate."

and metals sector includes metal foundries) that lowered or eliminated import duties on such non-NAFTA origin inputs.[465] However, such preferences were noted by one assessment as diminishing somewhat the advantages of duty-free access for U.S. suppliers under NAFTA.[466] Mexico's FTA with the European Union (EU) provides roughly similar NAFTA parity for imports of EU origin beginning in 2003. Similarly, one U.S. source noted that under Mexico's numerous other FTAs,[467] many other third-country trade competitors also enjoy or will enjoy NAFTA-type, duty-free access to the Mexican market.[468]

The 1993 Foreign Investment Law eliminated a number of non-tariff barriers to trade and investment, including export requirements (for other than export-program participants), domestic content percentages, and capital controls–thus allowing profits to be repatriated freely.[469] However, for importation of raw materials and capital equipment, Mexican customs laws for preparing and submitting entry documentation are strictly enforced to the point that, reportedly, paperwork errors can result in fines or even confiscation of goods.[470] In part, given the widespread diffusion of metal casting technology, U.S. industry officials are not aware of any reports of intellectual property (IP) piracy plaguing the Mexican foundry industry.[471] Mexico has enacted comprehensive IP rights-protection laws but official enforcement is reportedly uneven.[472]

Monetary/Tax Policies

Exchange rates–The peso is freely convertible on international exchange markets. Relative production costs at Mexican foundries rose as the value of the peso appreciated relative to that of the U.S. dollar. The Mexican economy received significant FDI in-flows during 1999-2001 which helped to render the peso among the strongest of currencies worldwide. Subsequently, Mexico's economic growth was adversely affected by declining global FDI in-flows and by the economic slowdown in the United States, its largest trade and investment partner.[473] Hence, relative production costs declined at Mexican foundries as the peso continues to depreciate relative to the dollar, as shown in the following tabulation (average annual exchange rate in pesos per dollar):[474]

---

[465] USTR, "Mexico," p. 329.

[466] US&FCS and U.S. Department of State, "Trade Regulations and Standards," *Country Commercial Guide FY 2004 (Aug. update)–Mexico*, ID No. 126784, Aug. 12, 2004.

[467] Mexico has pursued the largest network of FTAs of any country in the world, having entered into 12 agreements with Chile (agreement signed in 1992); its NAFTA partners the United States and Canada (1994); its G-3 partners Colombia and Venezuela (1995); Costa Rica (1995); Bolivia (1995); Nicaragua (1998); the European Union (2000); Israel (2000); the European Free-Trade Association members Iceland, Liechtenstein, Norway, and Switzerland (2001); its Northern Triangle partners El Salvador, Guatemala, and Honduras (2001); Uruguay (2004), and Japan (2005). Negotiations to liberalize bilateral trade are also ongoing with the Southern Cone Common Market (MERCOSUR) members Argentina, Brazil, and Paraguay, as previously with MERCOSUR member Uruguay. Mexico Secretariat of Economy, "Fechas de Publicación y Entrada en Vigor de los TLCs Suscritos por México," found at *http://www.economia-snci.gob.mx/sic_hpp/ls23al.php?s=20&p=1&l=1*, retrieved Feb. 5, 2005; Mexico Secretariat of Economy, "Agreements and Negotiations," found at *http://www.economia-snci.gob.mx/sic_php/ls23al.php?s=20&p=1&l=2*, retrieved Feb. 5, 2005; and US&FCS and U.S. Department of State, "Trade Regulations and Standards."

[468] US&FCS and U.S. Department of State, "Trade Regulations and Standards."

[469] Ibid., "Investment Climate;" and "Trade and Project Financing," *Country Commercial Guide FY 2004 (Aug. update)–Mexico*, ID No. 126789, Aug. 12, 2004.

[470] Ibid., "Trade Regulations and Standards."

[471] U.S. industry official, telephone interview with USITC staff, Feb. 23, 2005.

[472] USTR, "Mexico," p. 333.

[473] US&FCS and U.S. Department of State, "Economic Trends and Outlook."

[474] Compiled from official statistics of the International Monetary Fund, series 273..WF..ZF.

Year	Rate
1999	9.560
2000	9.456
2001	9.342
2002	9.656
2003	10.789
2004 (preliminary) . .	11.286

Similarly, depreciation of the peso from 2002 onward enhanced Mexico's competitiveness as an export platform for metal castings and downstream products.

Tax structure–Since 1986, Mexico's taxation system has undergone significant revisions to bring it in line with those of its major trade and investment partners.[475] Most direct tax incentives have been eliminated by the Mexican Government, other than the accelerated depreciation schedule.[476] Value-added taxes of 10 percent on imported products remaining in the U.S. border region and 15 percent on those entering the interior may be waived for imported material inputs, capital equipment, and lubricants to manufacturers registered with an export-manufacturing program.[477] The United States has a bilateral tax treaty with Mexico to avoid double taxation.[478]

Interest rates–Commercial lending rates are reportedly high in Mexico,[479] albeit having declined significantly in recent years as the current Mexican Administration maintained tighter fiscal and monetary policies to keep current-account deficits and inflation in check:[480] These rates are shown in the following tabulation (average annual rate in percent):[481]

Year	Rate
1999	23.743
2000	16.928
2001	12.795
2002	8.198
2003	6.905
2004 (preliminary) .	7.222

Despite infusions of foreign capital as a result of privatization efforts in the late 1990s-early 2000s,[482] and bankruptcy and lending reforms in 2000 and 2003, the Mexican banking system is still considered undercapitalized–consequently, domestic credit is limited and expensive.[483] Hence, only the larger (about 36

---

[475] Mexico Secretariat of Economy, "Doing Business in Mexico–Fiscal Policy," found at *http://www.naftaworks.org/sphp_pages/canada/invierte/doing_business/fiscal_policy.htm*, retrieved July 28, 2004.

[476] US&FCS and U.S. Department of State, "Investment Climate."

[477] Ibid., "Trade Regulations and Standards;" and "Investment Climate."

[478] Ibid., "Investment Climate."

[479] Ibid., "Economic Trends and Outlook."

[480] "The Peso Crisis," *Economist*, pp. 55 and 58.

[481] Compiled from official statistics of the International Monetary Fund, series 27360P..ZF.

[482] Since Citibank purchased Banamex in 2001, only one-fifth of Mexico's banking assets remained under Mexican ownership. US&FCS and U.S. Department of State, "Economic Trends and Outlook;" and "Investment Climate."

[483] Ibid., "Executive Summary," *Country Commercial Guide FY 2004 (Aug. update)–Mexico*, ID No. 126777,

(continued...)

percent of all) Mexican firms have direct access to domestic commercial bank financing.[484] Although credit provided by development banks has expanded in recent years, small and medium-size businesses must still rely on non-bank or foreign sources.[485]

Environment

According to the Secretariat of the Environment and Natural Resources (SEMARNAT), Mexico's larger indigenous and foreign-owned manufacturing operations (including metal foundries) generally adhere to international environmental-protection standards, particularly export-oriented standards so as not to endanger their products' market-access abroad. These larger operations are easier for Mexico's Federal Environmental Protection Agency to monitor than the more numerous, smaller and medium-size firms, many of which do not have the financial resources to adopt the necessary technological improvements or are not as strictly monitored.[486] Estimates of the cost of environmental compliance were not readily available for the Mexican foundry industry, but for comparison purposes, pollution control expenditures in the late 1990s were estimated to account for 3.1 percent of manufacturing output in Mexico, less than one-half the share in the United States (7.6 percent).[487]

Worker Health and Safety

Worker health and safety in Mexican foundries are regulated by the Federal Labor Law (LFT) that also stipulates procedures for investigating causes of and proposing remedies for on-the-job injuries and illnesses.[488] The Federal Labor Secretariat (STPS) and Social Security Institute (IMSS) jointly issue workplace health and safety standards, whereas LFT-required joint management-labor committees can set additional standards and have the first-line responsibility for workplace enforcement. Private workplaces are also subject to periodic health and safety inspections by both Federal and state labor inspectors, who exchange information on findings. Compliance with safety and health standards, according to STPS and IMSS officials, is reasonably good at most larger firms, but more difficult to monitor at the more numerous smaller firms; there are an insufficient numbers of inspectors for frequent inspections, despite additional hiring and improved Federal-state coordination. Under Mexican law, individual employees reportedly cannotbe disciplined or dismissed for removing themselves from hazardous workplace conditions. Moreover, individual employees and unions can raise grievances with inspectors, health and safety officials, or the Federal labor board.[489]

---

[483] (...continued)
Aug. 12, 2004; and "Investment Climate."

[484] Ibid., "Trade and Project Financing."

[485] Ibid., "Economic Trends and Outlook;" and "Investment Climate."

[486] SEMARNAT, "The Sustainability in the New Government," *Environmental Programs for Environmental and Natural Resources, 2001-2006*, found at *http://www.semarnat.gov.mx/dgeia/web_ingles/programa/5.shtml*, retrieved Feb. 2, 2005.

[487] Official statistics of the OECD, cited in Leonard, *How Structural Costs Imposed on U.S. Manufacturers Harm Workers and Threaten Competitiveness*, p. 20.

[488] Mexico Secretariat of Economy, "Doing Business in Mexico–Labor Law," July 8, 2004, found at *http://www.naftaworks.org/sphp_pages/canada/invierte/doing_business/labor_law.htm*, retrieved July 28, 2004.

[489] U.S. Department of State, BDHR&L, "Worker Rights."

Taiwan

Industry Profile[490]

Industry statistics:
- World rank (2003) -- 12th
- Production (2003) -- 1.47 million metric tons
- No. of establishments (2002) – 894

Industry characteristics:
- Approximately 80 percent of workers in the foundry industry are expatriates.
- Significant movement of downstream industries overseas

Despite still being a large player in the international metal casting market, Taiwan's foundry industry has experienced a significant decline in the number of firms operating on the island due primarily to the movement of downstream industries overseas.[491] In 2002, there were approximately 943 foundries operating in the country, down from 1,600 in the 1970s.[492] Approximately 84 percent of the factories are small- and-medium sized, with a concentration in the Taichung (Central Taiwan) area. A few foundries are located in Taipei, the northern region of Taiwan, and in the southern portion of Taiwan, in Kaohsiung.[493]

Taiwan is known as a producer of different types of castings, particularly die castings and investment/lost wax castings.[494] One trade press article estimates that about 20 percent of foundries in Taiwan produce gravity/pressure die castings.[495] Currently, the automotive, motorcycle and electronics companies are the industry's most important domestic customers. However, the Taiwanese die casting foundries that supply the automobile and motorcycle segments have been moving production to other countries to be closer to growth industries, such as motor vehicle production.[496]

Business Trends

Production

Due to the global economic downturn, Taiwan's economy experienced a recession in 2001; there were lower export orders in general and a migration of industrial investment to China during this time.[497]

---

490 Industry statistics are primarily from the "38th Census of World Casting Production–2003," *Modern Casting*, Dec. 2004, p. 25.

491 U.S. Department of State telegram, "Foundry Products," message reference No. 157426, prepared by the American Institute in Taiwan, retrieved Aug. 29, 2004.

492 "37th Census of World Casting Production–2002," *Modern Casting*, Dec. 2003, p. 23; and U.S. Department of State telegram, "Foundry Products," message reference No. 157426, prepared by the American Institute in Taiwan, retrieved Aug. 29, 2004.

493 U.S. Department of State telegram, "Foundry Products," message reference No. 157426, Aug. 2004, prepared by the American Institute in Taiwan.

494 "Investment Castings," Rivendell Bicycle Works, found at *http://www.rivendellbicycles.com/html/bikes_riv12.html*, retrieved Jan. 7, 2004; and Michael J. Gallagher, "Highlights of the Global Die Casting Industry, Taiwan," *CastingTrade.com*, 2001, found at *http://www.castingtrade.com*, retrieved Aug. 16, 2004.

495 Michael J. Gallagher, "Highlights of the Global Die Casting Industry, Taiwan," *CastingTrade.com*, 2001, found at *http://www.castingtrade.com*, retrieved Aug. 16, 2004.

496 Ibid.

497 CIA World Factbook, "Taiwan," found at *http://www.cia.gov/cia/publications/factbook/print/tw.html*, retrieved Jan. 5, 2005; and "Characteristics of the Taiwan Market," EMS Consulting Co., found at *http://www.emsgc.com/english/labten.htm*, retrieved Jan. 6, 2005.

Table 9-22
Taiwan foundry industry: Casting production, by metal type, 1999-2003
(*1,000 metric tons*)

Metal type	1999	2000	2001	2002	2003
Gray iron	849	1013	688	723	782
Ductile iron	171	141	224	275	257
Malleable iron	8	14	8	8	1
Steel	54	78	61	62	69
Aluminum	399	420	255	267	251
Copper-base	48	5	50	49	46
Zinc	0	0	48	50	54
Magnesium	0	0	5	5	5
Other nonferrous	([1])	([1])	([1])	([1])	2
Total	1,529	1,671	1,339	1,439	1,467

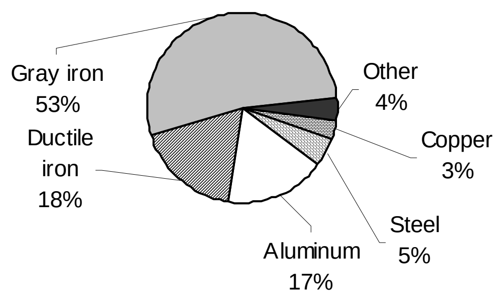
[1] Not available.

Source: Foundry Taiwan, and several years of *Modern Casting* data.

Castings production declined from almost 1.7 million metric tons in 2000 to approximately 1.3 million metric tons in 2001, which paralleled Taiwan's economic downturn (table 9-22). However, the foundry industry increased production during 2002-2003.

The majority of products made by foundries in Taiwan are gray or ductile iron, and aluminum castings. Production of cast iron products in 2003 accounted for just under 71 percent of the industry's total production and aluminum accounted for just over 17 percent of production (figure 9-9). This product mix was driven by demand for gray iron castings from the machine tool industry, and for aluminum alloy products from machine tool and vehicle manufacturers.[498] Currently, most foundries produce low-value components such as parts of machine tools, vehicles, home electrical appliances, and the outer casings of computer, communication, and consumer products. Most production supports the domestic manufacturing industry and component suppliers.[499]

Figure 9-9
Taiwan foundry industry: 2003 production, by metal type (based on weight)



Source: *Modern Casting*.

Employment

Declining interest by younger Taiwan workers in joining the foundry industry has led to a high number of expatriate workers. Taiwan industry association officials estimate that approximately 80 percent of foundry employees are expatriates, primarily from Thailand and Indonesia.[500] Further, most foundries are

[498] U.S. Department of State telegram, "Foundry Products," message reference No. 157426, Aug. 2004, prepared by the American Institute in Taiwan.

[499] Ibid.

[500] Ibid. In the overall economy, there were approximately 300,000 foreign workers in 2003, up from 3,000 in 1991. UK Trade and Investment, "Country Profile-Taiwan," found at *https://www.uktradeinvest.gov.uk/ukti/appmanager/ukti/fareast?_nfpb=true&_pageLabel=taiwan*, retrieved Jan. 7, 2005.

small-to-medium sized, with the typical foundry having an average of 20 to 30 workers.[501] Total employment for the Taiwan foundry industry is unknown.

Factors of Production

Raw Materials and Energy[502]

Energy sector liberalization, increasing energy prices, and a lack of domestic energy sources are all factors that affect the island's foundry industry. One Taiwan industry official estimates that 45 percent of production costs are from raw materials, while 35 percent of production costs are attributed to other manufacturing[503] inputs such as energy. Primary energy sources for the Taiwan foundry industry are coke and electricity. Due to its lower cost, coke has been widely used and imported mainly from China.[504] However, China's reduction of its coke export quota in early 2004 caused coke prices to quadruple.[505]

Taiwan relies heavily on energy imports, due to a lack of sufficient domestic energy sources. According to the U.S. Department of Energy, Taiwan's energy consumption is relatively high compared to other developed countries due to its heavy concentration of energy-intensive manufacturing industries[506] like the foundry industry. The Government of Taiwan is involved in many major facets of the energy industry. Reportedly, the Taiwan Government has indicated that the low cost of energy in Taiwan contributes to a lack of energy conservation measures by many.[507] The Chinese Petroleum Corporation (CPC) is Taiwan's national oil company and is the major supplier in the petroleum industry.[508] CPC also is involved in the exploration, production and imports of Taiwan's natural gas sector. The dominant supplier of electricity is the Taiwan Power Company (Taipower), a state-owned facility that the government plans to privatize by 2006. Despite privatization, the government reportedly would maintain Taipower's exclusive control over nuclear and hydropower plants.

Taiwan has limited resources of the raw materials consumed by the foundry industry.[509] There is no primary aluminum production in Taiwan, and producers depend on imports of aluminum ingot and scrap.[510]

---

[501] U.S. Department of State telegram, "Foundry Products," message reference No. 157426, prepared by the American Institute in Taiwan, retrieved Aug. 29, 2004.

[502] The majority of information in this section is from the U.S. Department of Energy, "Taiwan Country Analysis Brief," July 2004, found at *http://www.eia.doe.gov/emeu/cabs/taiwan.html*, retrieved Oct. 25, 2004.

[503] U.S. Department of State telegram, "Foundry Products," message reference No. 157426, Aug. 2004, prepared by the American Institute in Taiwan.

[504] Ibid.

[505] Ibid.

[506] U.S. Department of Energy, "Taiwan Country Analysis Brief," July 2004, found at *http://www.eia.doe.gov/emeu/cabs/taiwan.html*, retrieved Oct. 25, 2004.

[507] Yu-min Chang, "MOEA to promote energy service companies," found at *http://publish.gio.gov.tw/FCJ/past/05022531.html*, retrieved Mar. 31, 2005.

[508] Another supplier, the Formosa Petrochemical Company (FPC) owns a refinery in Mailiao, producing a full capacity of 450,000 barrels per day in 2002. Liquified natural gas (LNG) consumption in 2003 was approximately 287 billion cubic feet (Bcf), of which 257 Bcf was imported.

[509] Pui-Kwan Tse, "The Mineral Industry of Taiwan," found at *http://minerals.usgs.gov/minerals/pubs/country/2003/twmyb03.pdf*, retrieved Apr. 1, 2005.

[510] Ibid.

Labor[511]

Workers in Taiwan are offered many of the benefits provided by companies in other countries such as Brazil. There is usually a one-month bonus at the end of the year. Typical fringe benefits often include meals, transportation, and dormitory housing. Employees and family members are covered by a universal national health insurance system. Companies are required to provide a standard labor insurance program that includes items such as retirement and maternity benefits. Under the Labor Standard Law (LSL), the typical workweek in Taiwan consists of a standard eight-hour workday and a maximum of 84 hours biweekly.[512] Labor costs are estimated to account for 20 percent of the production cost of metal castings.[513]

Transportation

Taiwan's location provides a competitive advantage as a center for sea transportation and shipping in Asia.[514] Taiwan's transportation infrastructure includes five international airports, 15 domestic airports, and 6 international harbors. Many upgrades have been made to the highway system to improve traffic flow, and its overall road system is considered well-developed.[515] Further, the government has approved a 500 billion New Taiwan dollar (NT)[516] construction program for 2004-2008 that includes several freeways and subways in major cities.[517] According to the U.S. Department of Commerce, Foreign Commercial Service, "Taiwan's infrastructure construction efforts have improved traffic congestion and power shortage problems."[518]

Domestic Policies

Federal/Regional Programs

Like the United States, the government in Taiwan has established agencies dedicated to assisting business and industry in international trade. While no programs are specifically targeted for the foundry industry, some programs may provide indirect benefits. One such agency providing program assistance is the Industrial Development and Investment Center (IDIC) within the Ministry of Economic Affairs. The primary function of IDIC is to promote foreign investment in Taiwan and assist domestic companies in doing business overseas. Another important function of the IDIC is the recruitment of overseas science and technology personnel.[519] To encourage research and development (R&D) on the island, Taiwan provides duty-

[511] Except as otherwise noted, the information is primarily from the U.S. Department of Commerce, Foreign Commercial Service, *Taiwan Country Commercial Guide FY2004*, found at *http://www.stat-usa.gov/*, retrieved Oct. 8, 2004.

[512] USDOC, FCS, *Taiwan Country Commercial Guide FY2004*.

[513] U.S. Department of State telegram, "Foundry Products," message reference No. 157426, Aug. 2004, prepared by the American Institute in Taiwan.

[514] Industrial Development and Investment Center, Invest in Taiwan, "Precision Machinery, Competitive Advantages and Market Strengths," found at *http://investintaiwan.nat.gov.tw/en/opp/precision_machinery.html*, retrieved Oct. 8, 2004.

[515] USDOC, FCS, *Taiwan Country Commercial Guide FY2004*.

[516] Approximately $14.5 billion at the 2003 exchange rate.

[517] USDOC, FCS, *Taiwan Country Commercial Guide FY2004*.

[518] Ibid.

[519] Industrial Development and Investment Center (IDIC), "Functions of the IDIC," found at *http://www.idic.gov.tw/html/eintro-2.htm*, retrieved Aug. 16, 2004.

free treatment for imports of equipment for R&D purposes. Low interest loans are also available for purchases of pollution-control equipment.[520]

Other forms of government assistance that promote industrial development in the country are also available. One such program, operated by the Ministry of Economic Affairs, provides preferential lease measures for land in industrial estates. Companies that lease industrial park land are exempt from payment of lease fees for the first two years, and years three through seven include substantial discounts from the full leasing rates. If a company decides to purchase the land before the end of the lease, the money paid for the lease in the prior years can be subtracted from the final purchase price.[521] Ultimately, this results in a rent-free situation, since the money is applied to the land ownership. Further, while there are currently no foreign trade zones in Taiwan, the government plans to construct two such zones at ports in Kaohsiung and Keelung.[522]

Monetary/Tax Policies

Exchange and interest rates.– Although no official interest rate for lending was available at the Central Bank of China (CBC), interest rates are generally deemed to be fairly low for borrowers such as the foundry industry. However, despite the low interest rates, companies in all industries reportedly were hesitant to borrow, particularly due to the economic slowdown in the country during 2001.[523] In 2002, despite a slight recovery in economic conditions, companies held a cautious attitude towards borrowing from banks and increasingly turned to other methods of raising money, such as issuance of corporate bonds. Additionally, the average exchange rate between the U.S. dollar and the NT increased slightly from 1999-2003, ranging from NT 31.60 per dollar in 1999 to NT 34.42 per dollar in 2003.[524]

Tax structure.– A number of factors are considered when determining the effects of the country's tax structure on companies. Items such as the national corporate tax rate, local tax rates, financial incentives, and special deductions can greatly impact the effect of the tax structure on the foundry industry. Currently, Taiwan's highest corporate tax rate is 25 percent and the top personal income tax rate is 40 percent.[525] Taiwan's corporate tax rate is lower than some nations, which may provide a slight benefit for the Taiwan foundry industry. However, its corporate tax rate is higher than some of its neighbors, such as Hong Kong which has a corporate tax rate of 18 percent.[526] According to the Economist Intelligence Unit, "most foreign-invested firms pay corporation tax at rates of 22 percent or 25 percent." Further, there is a value-added tax that is approximately 5 percent.[527] The Taiwan government has undertaken measures to reduce taxes in the past few years. In early 2003, legislation provided the manufacturing sector with a "five-year tax holiday for new investment projects and expansion projects during a two-year period from January 2002 to December

---

520 USDOC, FCS, *Taiwan Country Commercial Guide FY2004*.

521 IDIC, "Chapter 11: Choice of Investment Locations–Industrial Estates," found at *http://www.idic.gov.tw/content/pdf/Roc_epdf_11.pdf*, retrieved Aug. 16, 2004.

522 USDOC, FCS, *Taiwan Country Commercial Guide FY2004*.

523 "Taiwan Yearbook 2004," Taipei Times, found at *http://ecommerce.taipeitimes.com/yearbook2004/P155.htm*, retrieved Mar. 31, 2005.

524 Central Intelligence Agency, "World Factbook–Taiwan," found at *http://www.cia.gov/cia/publications/factbook/print/tw.html*, retrieved Feb. 9, 2005.

525 The Heritage Foundation, "Taiwan," *2004 Index of Economic Freedom*, found at *http://cf.heritage.org/*, retrieved Jan. 7, 2005.

526 "KPMG's Corporate Tax Rate Survey–January 2003," *KPMG*, found at *http://www.us.kpmg.com/microsite/global_tax/ctr_survey/2003CorprorateTaxSurveyFINAL.pdf#search='korea%20 corporate%20tax%20rate%202003*', retrieved Feb. 7, 2005.

527 "Country ViewsWire Taiwan Factsheet," Economist Intelligence Unit, Dec. 29, 2003, found at *http://www.economist.com/*, retrieved Jan. 3, 2005.

2003." Further, tax incentives are provided for introducing new technology into Taiwan, locating companies in lesser developed areas, reducing land value increment taxes, and facilitating R&D programs.[528]

Environment

Because of rapid industrialization, pollution in Taiwan has become an increasing problem, resulting in the creation of the Environmental Protection Administration (EPA) in 1987. The foundry industry must abide by strict standards set by the EPA. One industry official indicated that EPA inspectors do not assist the foundry industry with suggestions for improvement and only inform companies as to whether or not they have passed inspection.[529]

Taiwan has established standards and specific legislation for controlling air, water, and noise pollution, as well as the treatment of solid waste. Disciplinary action is taken against companies found discharging toxic gas or polluting water. The government has also created incentives, such as providing duty-free treatment for imports of pollution abatement equipment.[530] Despite the fact that Taiwan is not a signatory to the Kyoto Protocol, the Government had indicated that it plans to observe the agreement.[531] The Council for Economic Planning and Development in Taiwan anticipates that the implementation of the Kyoto Protocol will impact many industries, such as the iron and steel industries, in efforts to reduce carbon dioxide emissions.[532]

Worker Health and Safety[533]

The foundry industry in Taiwan faces health and safety inspections similar to companies located in other countries such as the United States and Brazil. Industrial health and safety issues are under the purview of the Council of Labor Affairs. The administrative aspects fall under two departments, the Department of Labor Safety and Health and the Department of Labor Inspection. The Department of Labor Inspection's primary responsibilities are the planning and supervision of labor inspections, while local governments carry out the actual inspections. The Department of Labor Safety is responsible for the planning and guidance of labor safety and health strategies, and the promotion of training and education. The Institute of Occupational Safety and Health was created in 2002 and is responsible for research about workplace-related risk factors and how to combat them.

---

[528] USDOC, FCS, *Taiwan Country Commercial Guide FY2004*.

[529] U.S. Department of State telegram, "Foundry Products," message reference No. 157426, Aug. 2004, prepared by the American Institute in Taiwan.

[530] IDIC, "Chapter 19: Environmental Protection," found at *http://www.idic.gov.tw/content/pdf/Roc_epdf_19_20.pdf#page=01*, retrieved Aug. 16, 2004.

[531] Jia-Chen Chuo, "Proposed industrial park project offers mixed blessings," Feb. 16, 2005, found at *http://publish.gio.gov.tw/FCJ/past/05021632.html*, retrieved Mar. 21, 2005.

[532] Council for Economic Planning and Development, Executive Yuan, "Taiwan's Economic Situation and Outlook," found at *http://www.cepd.gov.tw*, retrieved Jan. 7, 2005.

[533] Industrial Safety and Health Association, Taiwan, "Administration system for occupational safety and health in Taiwan," found at *http://www.isha.org.tw/english/eng_3.htm*, retrieved Jan. 5, 2005.

CHAPTER 10
COMPETITIVE CONDITIONS IN THE U.S. FOUNDRY MARKET

This chapter provides an assessment of the competitive environment that the U.S. foundry products industry faced from 1999-2003 based on analysis in the previous chapters. This chapter provides a summary of the condition of the U.S. foundry industry, evaluates the advantages and disadvantages of the U.S. foundry industry compared with its major foreign competitors, and discusses the outlook for the U.S. industry.

The Commission received producer questionnaires from 465 establishments containing extensive quantitative and qualitative information on the U.S. foundry industry during 1999-2003. Data from the questionnaires indicate that the responding producers account for approximately 75 percent of the industry's production of castings.[1] An additional 463 questionnaires were received from companies reporting purchases of castings, of which 254 indicated purchases of the 10 product groups.[2] These questionnaires were used to identify purchaser trends in the U.S. market during 1999-2003.[3] Questionnaire responses were supplemented by information collected through a Commission hearing, fieldwork interviews with domestic producers and foreign competitors (including those in China, Brazil, and India), telephone discussions with domestic and foreign industry sources, literature review, and information obtained by the Commission from other sources, including foreign embassies and the U.S. and Foreign Commercial Service.

The U.S. foundry products industry experienced a highly competitive and changing marketplace during 1999-2003. While the U.S. economic downturn in 2001 negatively affected demand for many cast products, the industry also faced pressures from materials substitutions; for example, polyvinyl chloride increasingly replaced copper for valves and fittings, and aluminum replaced iron for many automotive applications. At the same time, many high-volume, commodity-type castings were increasingly sourced from foreign suppliers. Concerns about product pricing increased; producers indicated that their customers, particularly large automotive manufacturers, dictated prices and controlled contract terms in part because they could source certain castings at lower cost offshore.

During the 5-year period, virtually all performance indicators for the foundry products industry, including production, shipments, employment, and net sales, trended downward. Profit margins tightened as rising raw materials, energy, and labor costs cut into decreased sales. In this environment, many firms consolidated and closed. To stay competitive, remaining U.S. producers expanded customer services, shortened lead times, and shifted to more complex cast products. Information reported by producers and gathered throughout the course of this investigation suggests that the competitiveness of the industry is

[1] The coverage for each metal type varies. See ch. 1 for added detail on how the Commission's questionnaire responses are represented by metal type.

[2] The Commission, in consultation with the Committee on Ways and Means of the U.S. House of Representatives and the American Foundry Society, selected 10 product groups, believed to be representative, for a detailed competitive evaluation. See "Study Approach" section in ch. 1 for additional information on the selection process. The 10 groups include cast products used in the following downstream products: ductile iron crankshafts/camshafts; aluminum engine components; aluminum suspension/steering systems; gray iron motor vehicle gear boxes; copper valves; steel valves; ductile iron bearing housings; gray iron compressor housings; gray iron pump parts; and gray iron non-motor vehicle gear boxes.

[3] The purchaser questionnaires represent responses from companies buying domestic and foreign castings in each of the 10 product groups but there is no basis to estimate the share of total castings purchases these responses represent because benchmark data do not exist that cover the universe of purchasers.

significantly impacted by higher U.S. labor costs and a more stringent regulatory environment than its leading competitors.

Summary of U.S. Foundry Industry Condition

The production, shipment, employment and financial condition of the rough foundry products industry deteriorated during 1999-2003.[4] The decline in the financial performance of many foundries is represented by the increase in firms showing operating losses across industry segments (figure 10-1).

Information collected during the course of this investigation suggests a number of factors contributed to the decline. First, the U.S. economic slowdown during 2000 and 2001 affected the foundry industry as demand from key market segments decreased, and there was little evidence of significant improvement in the industry during subsequent years, except for aluminum foundries.[5]

Additionally, U.S. import statistics show increasing imports of downstream products containing the foundry product groups during 1999-2003,[6] which suggests that purchases of downstream products containing foreign metal castings replaced use of U.S. foundry products.[7]

Finally, downward pressure on price affected the foundry product industry's financial condition during 1999-2003 as it limited the ability of producers to raise prices to a level that covered the increase in costs over the period. More than 79 percent of producers indicated that they had either reduced prices or suppressed price increases to maintain customers. However, producers and purchasers have divergent views on how substantially the pricing pressure affected prices over the period (table 10-1). There was a significant disparity in the responses, as 42 percent of producers reported that their prices had decreased during 1999-2003, but only 13 percent of purchasers indicated that producers' domestic castings prices had decreased during the period. Additionally, producers indicated that they have offered their customers other concessions that are not reflected in the price of the castings, but that negatively affected their operating incomes, such as providing discounts and rebates, and maintaining inventories for customers.

Price and cost pressures for rough casting operations are illustrated by the comparison of sales unit values with unit costs (table 10-2). The gray and ductile iron foundries are experiencing a squeeze, as sales unit values decreased as unit costs increased. Although sales unit values increased for the steel, aluminum, and copper foundries, the rate of increase for unit costs was greater.

---

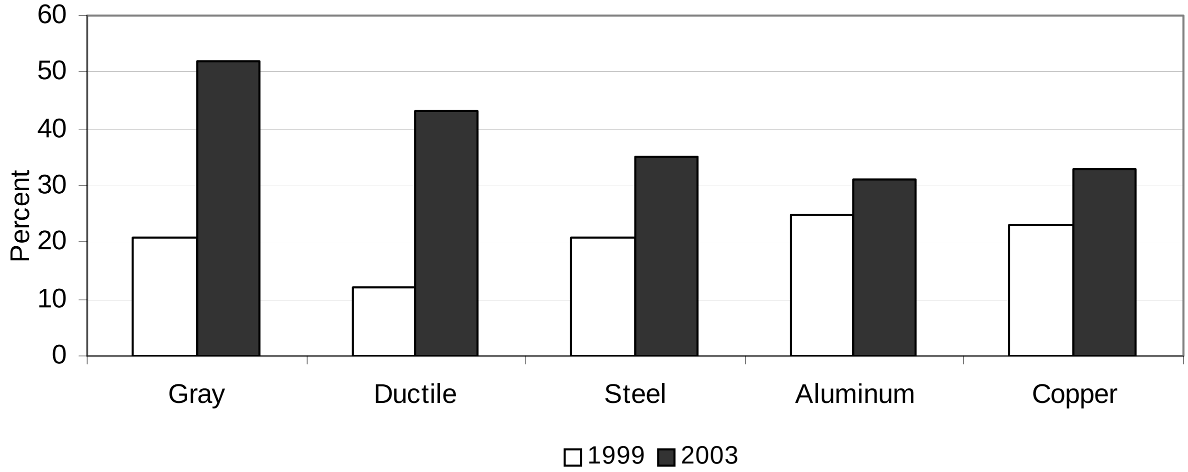
[4] For the purposes of this chapter, the iron foundry industry has been separated into gray and ductile iron industries. The information in this section is based on producer questionnaire responses and fieldwork interviews with domestic producers. Detailed data on production, shipments, financials, etc. for each type of metal foundry were presented in chs. 5-8.

[5] For more details, see chapter 7: U.S. Aluminum Foundry Industry.

[6] See the product group sections in chs. 5-9 for these data.

[7] As U.S. foundries export only 7 percent of reported shipments (based on producer questionnaire responses), cast components in these imported downstream products likely did not originate principally from U.S. suppliers.

Figure 10-1
U.S. foundries: Percent of responding establishments with operating losses, by metal type, 1999 and 2003



Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 10-1
Domestic producers' and purchasers' comparison of relative price changes for domestic and foreign castings in the U.S. market, 1999-2003

(***Number of responses***)

Price change in U.S. market	**Producer response for U.S. castings**[1]	**Purchaser response for U.S. castings**[2]	**Purchaser response for foreign castings**[3]
Increased:			
0-10 percent	59	137	94
11-20 percent	42	78	38
21-30 percent	9	27	9
31 percent or more	1	11	1
Unspecified amount	3	17	9
Stayed the same	63	84	144
Decreased:			
0-10 percent	74	40	35
11-20 percent	36	6	10
21-30 percent	14	2	1
31 percent or more	3	2	1
Unspecified amount	0	3	1

[1] The total number of responses was 304.
[2] The total number of responses was 407.
[3] The total number of responses was 343.

Source: Compiled from data submitted in response to producer and purchaser questionnaires of the U.S. International Trade Commission.

Table 10-2
All foundries: Selected financial results for responding U.S. producers by metal type, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
Gray iron foundry industry:					
Rough casting operations:					
Net sales (*1,000 dollars*)	3,900,313	3,627,391	3,137,269	3,059,839	2,973,869
Operating income (*1,000 dollars*)	342,597	54,154	5,117	-1,303	-162,942
Unit values (*dollars per short ton*):					
Net sales	997	960	957	927	917
Cost of goods sold	860	895	898	875	910
Machining operations:					
Net sales (*1,000 dollars*)	471,463	469,747	488,220	489,695	520,112
Operating income (*1,000 dollars*)	69,260	63,817	57,850	47,573	64,394
Ductile iron foundry industry:					
Rough castings operations:					
Net sales (*1,000 dollars*)	3,860,879	3,938,956	3,577,004	3,565,761	3,586,132
Operating income (*1,000 dollars*)	621,946	520,261	365,441	362,260	205,702
Unit values (*dollars per short ton*):					
Net sales	996	971	959	942	939
Cost of goods sold	778	785	801	789	824
Machining operations:					
Net sales (*1,000 dollars*)	269,900	284,516	320,613	320,450	343,040
Operating income (*1,000 dollars*)	17,574	22,706	39,913	29,611	19,356
Steel foundry industry:					
Rough casting operations:					
Net sales (*1,000 dollars*)	1,301,629	1,352,339	1,270,047	1,119,326	1,186,315
Operating income (*1,000 dollars*)	116,226	110,329	49,159	33,988	53,154
Unit values (*dollars per short ton*):					
Net sales	2,215	2,611	2,563	2,417	2,358
Cost of goods sold	1,798	2,127	2,186	2,076	2,013
Machining operations:					
Net sales (*1,000 dollars*)	822,876	761,990	696,892	668,391	786,256
Operating income (*1,000 dollars*)	123,714	81,117	66,181	77,273	87,563
Aluminum foundry industry:					
Rough casting operations:					
Net sales (*1,000 dollars*)	3,999,485	4,651,149	4,490,857	5,031,837	5,187,109
Operating income (*1,000 dollars*)	255,812	267,107	77,610	211,581	286,921
Unit value (*dollars per short ton*):					
Net sales	3,854	4,022	4,319	4,189	4,251
Cost of goods sold	3,412	3,581	4,010	3,820	3,824
Machining operations:					
Net sales (*1,000 dollars*)	2,397,938	2,684,394	2,378,836	2,687,200	2,588,568
Operating income (*1,000 dollars*)	298,655	285,594	224,391	265,259	180,768
Copper foundry industry:					
Rough casting operations:					
Net sales (*1,000 dollars*)	368,032	378,422	364,312	394,957	376,711
Operating income (*1,000 dollars*)	45,377	37,437	28,956	43,935	42,977
Unit value (*dollars per short ton*):					
Net sales	4,542	4,644	4,871	5,178	5,123
Cost of goods sold	3,494	3,700	3,969	4,065	4,031
Machining operations:					
Net sales (*1,000 dollars*)	313,478	323,364	309,271	303,858	304,902
Operating income (*1,000 dollars*)	29,924	29,492	29,212	21,303	17,996

Note.–Calculations based on unrounded data.

Source: Complied from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Gray iron experienced the greatest decline of any product segment. Financial conditions in the rough castings segment deteriorated to the extent that operating losses occurred in 2002 and 2003, although conditions improved for machining operations in 2003. Gray iron was the segment most affected by the movement of production of high-volume commodity type castings offshore as many of the key competitor countries dominate this segment of the market.[8] Additionally, gray iron was affected by the shift to aluminum in automotive applications.

The gray and ductile iron foundry industries reported increased sales of machined castings from 1999-2003, in contrast to the downward trend in rough casting sales for those metal types (see table 10-2). These foundries report that they have been expanding their machining operations to add more value to their products and improve profitability. There were no operating losses during 1999-2003 for the gray iron foundries' machining operations, in contrast to their rough casting operations.

The financial results for the 10 product groups covered in this report mirror the results for the metal type foundries (table 10-3). Sales and operating incomes have declined for most product groups. Ductile iron crankshaft/camshaft castings experienced the largest decline, mostly as a result of substitution of forged steel shafts by automobile producers. Sales for the aluminum product groups have increased substantially, largely reflecting aluminum substitution in the automobile industry. The number of establishments reporting operating income losses increased for all product groups except steel valve castings during 1999-2003.

Competitive Comparisons[9]

In assessing whether domestic or foreign producers have the advantage among various factors of competition, U.S. producer respondents overwhelmingly consider foundries in developing countries as having an advantage in overall competitiveness (table 10-4). Far fewer cited developed country producers as having an overall competitive advantage. These results also reflect the concern over competition from low-cost producers expressed by foundry industry officials and are consistent with hearing testimony and results of fieldwork and telephone interviews. According to responding U.S. producers, the producers providing the principal competition in the U.S. market are from China, Mexico, India, Korea, and Brazil. U.S. producers reported that the developing-country producers' advantage is mainly attributed to their low U.S. market prices, labor costs, level of enforcement of environmental regulations, and less onerous worker health and safety regulations. However, significant competitive advantages accruing to foreign producers in developing countries also were reported to include export, tax, import, exchange rate, and investment policies. The perceived exchange-rate advantage for China, however, was noted as a particularly significant concern by U.S. producers. In contrast, U.S. producers considered themselves as having clear advantages compared with developing country competitors in transportation costs, lead times, and technical services, although domestic purchasers considered technical support/service as only a minor advantage for U.S. producers (table 10-5).

[8] For example, production of gray iron castings in key competitor countries was 87 percent of total production in Brazil, 60 percent in China, 70 percent in India.

[9] The information in this section is based on producer and purchaser questionnaire responses.

Table 10-3
Product groups: Selected financial results for responding U.S. producers for their rough casting operations, fiscal years 1999-2003

Item	1999	2000	2001	2002	2003
Ductile iron crankshaft/camshaft castings:					
Net sales (*1,000 dollars*)	585,022	483,583	318,689	353,652	342,569
Operating income index[1]	100	74	35	46	47
Establishments reporting operating income losses (number)	0	1	1	1	2
Gray iron motor vehicle gear box castings:					
Net sales (*1,000 dollars*)	601,452	593,990	488,242	548,670	572,243
Operating income index[1]	100	102	68	75	69
Establishments reporting operating income losses (number)	4	3	7	9	8
Ductile iron bearing housing castings:					
Net sales (*1,000 dollars*)	10,596	18,061	12,939	15,341	12,196
Operating income index[1]	100	92	15	54	([2])
Establishments reporting operating income losses (number)	2	1	1	2	4
Gray iron compressor housing castings:					
Net sales (*1,000 dollars*)	150,746	151,590	137,348	119,167	117,636
Operating income index[1]	100	107	42	5	2
Establishments reporting operating income losses (number)	5	5	9	12	12
Gray iron pump castings:					
Net sales (*1,000 dollars*)	98,108	110,800	92,397	85,299	82,191
Operating income index[1]	100	96	49	50	35
Establishments reporting operating income losses (number)	8	7	13	15	18
Gray iron non-motor vehicle gear box castings:					
Net sales (*1,000 dollars*)	103,653	115,375	108,638	92,342	94,912
Operating income index[1]	100	123	65	79	59
Establishments reporting operating income losses (number)	6	5	10	10	13
Steel valve castings:					
Net sales (*1,000 dollars*)	151,613	172,818	154,797	154,034	158,718
Operating income index[1]	100	207	155	121	135
Establishments reporting operating income losses (number)	2	1	1	3	2
Aluminum engine component castings:					
Net sales (*1,000 dollars*)	744,355	1,031,054	849,784	994,923	1,055,376
Operating income index[1]	100	116	1	122	137
Establishments reporting operating income losses (number)	3	4	8	9	8
Aluminum suspension/steering part castings:					
Net sales (*1,000 dollars*)	643,483	722,869	737,651	878,692	848,961
Operating income index[1]	100	88	([2])	105	109
Establishments reporting operating income losses (number)	4	5	10	5	6
Copper valve castings:					
Net sales (*1,000 dollars*)	197,629	202,355	192,918	205,162	195,694
Operating income index[1]	100	87	53	85	94
Establishments reporting operating income losses (number)	1	1	3	1	2

[1] Operating income for product groups is expressed as an index for this table for purposes of comparison.
[2] Operating income is less than zero.

Note.–See chs. 5-8 for additional financial results.

Source: Complied from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 10-4
Domestic producers' comparison of the factors of competition
(*Number of responses*)[1]

Factor of competition	Total responses	Compared with developing countries, advantage goes to: U.S. producer	Foreign producer	Neither	Compared with developed countries, advantage goes to: U.S. producer	Foreign producer	Neither
Overall competitiveness	1,107	38	**817**	101	12	59	80
Cost of raw materials	986	154	259	435	18	18	102
Availability of materials	955	197	143	481	23	11	100
Energy costs	856	147	431	154	37	31	56
Labor costs	1,130	12	**958**	16	24	61	59
Transportation to U.S. customer	1,075	**739**	56	130	99	6	45
Level of technology	1,024	433	54	393	16	27	101
Environmental regulations	1,066	14	**886**	29	12	41	84
Investment policies	688	37	466	87	6	37	55
Tax policies	711	19	544	52	19	35	42
Loan guarantees	550	29	353	91	10	24	43
Government R&D support	651	36	425	97	8	45	40
Import policies	717	35	493	89	8	45	47
Export policies	757	19	552	90	8	44	44
Castings price in U.S. market	1,077	22	**835**	76	17	74	53
Castings quality	1,071	464	34	430	22	14	107
Lead time to serve U.S. customers	1,060	**690**	60	166	67	14	63
Exchange rates	784	49	480	133	29	62	31
Technical advice and service to U.S. customer	963	**636**	41	151	43	19	73
Worker health and safety regulations	998	46	**797**	30	9	41	75

[1]The bold underlined figures noting the number of responses, such as **817**, highlight meaningful distinctions discussed in the text for the referenced tables.

Note.–The number of establishments responding was 389. Most of these respondents rated 2 or more countries. Developing countries include China, India, Indonesia, Korea, Mexico, Taiwan, Thailand, Turkey, Vietnam, and South American and Eastern European countries. Developed countries include Australia, Canada, Japan, and Western European countries.

Source: Compiled from data submitted in response to producer questionnaires of the U.S. International Trade Commission.

Table 10-5
Domestic purchasers' assessment of factors of competition between U.S. and foreign foundry products producers

(***Number of responses***)[1]

Factor	U.S. producers have: Major advantage	U.S. producers have: Minor advantage	Neither has advantage	Foreign producers have: Minor advantage	Foreign producers have: Major advantage	Do not know
Compared with developing countries:						
Purchase price (delivered)	2	15	9	93	**315**	18
Product availability	73	120	177	25	35	20
Lead time	116	113	139	51	22	15
Delivery time	**242**	118	49	15	6	17
Discount offered	7	12	297	29	31	60
Minimum order size	52	92	208	52	19	19
Product quality	15	118	**243**	35	17	17
Product design	28	61	297	14	5	36
Range or variety of products	31	68	266	33	12	35
Reliability of supply	44	175	**173**	28	7	20
Payment terms	36	65	264	38	23	20
Warranty terms	13	44	330	8	3	40
Technical support/service	64	**182**	**156**	13	5	25
Transportation costs	**185**	**177**	43	12	5	15
Packaging	25	69	287	24	5	16
Compared with developed countries:						
Price (delivered)	6	38	59	54	37	15
Product availability	17	48	101	15	16	12
Lead time	39	53	91	10	6	12
Delivery time	83	65	41	4	5	11
Discount offered	2	6	159	8	5	25
Minimum order size	7	36	124	13	4	19
Product quality	4	13	145	20	14	11
Product design	3	12	138	23	12	18
Range or variety of products	4	30	124	19	14	17
Reliability of supply	8	55	113	17	6	10
Payment terms	10	22	137	13	9	12
Warranty terms	2	13	169	5	3	14
Technical support/service	11	52	99	18	13	12
Transportation	**83**	**84**	28	3	1	9
Packaging	14	31	141	2	1	10

[1] The bold underlined figures noting the number of responses, such as **242**, highlight meaningful distinctions discussed in the text for the referenced tables.

Note.–Developing countries include China, India, Indonesia, Korea, Mexico, Taiwan, Thailand, Turkey, Vietnam, and South American and Eastern European countries. Developed countries include Australia, Canada, Japan, and Western European countries.

Source: Compiled from data submitted in response to Commission Purchaser questionnaires.

Domestic producers ranked price, product quality, and delivery time as the three most important factors affecting their ability to compete with other domestic producers and foreign producers (table 10-6). Domestic purchasers also ranked these factors as most important when purchasing from domestic or foreign foundries. However, in contrast to domestic producers who ranked price highest, domestic purchasers ranked product quality as the most important factor in their purchasing decisions for both domestic and foreign castings. This is consistent with interviews by USITC staff with certain purchasers who indicated the importance of quality over price. However, this viewpoint likely depends on the casting application–the more critical the part (e.g., a brake component), the more important quality is relative to price. Additionally, many purchasers indicated that for simple or commodity-type castings, the quality of leading competitor countries is most often the same.

Domestic purchasers also assessed the relative advantages among domestic and foreign producers (both in developing or developed countries), reporting that none held a distinct advantage in most of the factors (see table 10-5). However, U.S. producers were considered by purchasers to have a clear major advantage among developing country competitors in delivery time, which also was ranked in the top-five factors that purchasers considered most important. The price of castings was reported by purchaser respondents as by far the major and only measurable advantage for foreign, developing-country producers, which is consistent with all other information gathered in this investigation.

Transportation costs were considered by purchasers as either a major or minor advantage of U.S. producers compared with both developing and developed country foundry competitors (see table 10-5). Although many purchasers assessed U.S. producers as having at least a minor advantage in technical support and services, reliability of supply, and product quality, more than one-half to nearly twice as many other purchasers considered neither U.S. nor foreign producers as having an advantage in any of these three competitive factors. However, based on producer questionnaire responses, telephone interviews, and fieldwork by Commission staff, producers indicated a clear U.S. advantage in each of these factors.

The following sections compare and contrast competitive advantages based on these producer and purchaser questionnaire responses, and provide supplemental information supporting the assessment conferring an existing competitive edge to foreign or domestic producers.

Competitive Advantages for Foreign Producers

Pricing

The increasing pressure by customers for lower prices has made price an overwhelming competitive factor in the foundry industry. Purchasers indicate that although quality is often a primary consideration, given a comparable level of quality (which most foundries have), price is the determining factor. Both U.S. producers and purchasers indicated that the lower purchase price was an advantage for foreign producers (see tables 10-5 and 10-6). The Commission measured relative prices by gathering pricing data for 10 product groups (table 10-7).[10] These data indicate that foreign casting price levels for the major competing countries in the U.S. market are substantially less than U.S. prices, for both rough and machined castings. Additionally, purchasers noted that in some cases machined castings could be purchased from foreign sources for about the same price as domestically-produced rough castings.

[10] Representative products covering each of the four metal types–iron, steel, aluminum, and copper–are specified in chs. 5-8.

Table 10-6
Domestic producers' assessment of factors of competition considered most important when competing against U.S. and foreign foundries, and domestic purchasers' assessment when purchasing domestic and foreign castings

(***Number of responses***)[1]

	Domestic producers' assessment[2]			Domestic purchasers' assessment[3]		
Factor	**Ranked 1**	**Ranked 2**	**Ranked 3**	**Ranked 1**	**Ranked 2**	**Ranked 3**
Competing against/purchasing from U.S. foundries:[1]						
Price	**313**	58	39	113	175	94
Delivery time	33	105	188	26	66	200
Product quality	65	213	90	**241**	117	31
Competing against/purchasing from foreign foundries:[2]						
Price	**355**	21	10	102	151	67
Delivery time	18	103	149	13	51	153
Product quality	23	173	85	**197**	93	30

[1] The bold underlined figures noting the number of responses, such as **313**, highlight meaningful distinctions discussed in the text for the referenced tables.
[2] A total of 424 establishments responded when making comparison to other U.S. foundries. A total of 396 establishments responded when making comparison to foreign foundries.
[3] A total of 404 purchasers responded in case of purchasing from U.S. foundries. A total of 404 purchasers responded in case of purchasing from foreign foundries.

Note.–A small number of respondents gave two or more factors the same ranking. Only the top 3 rankings are shown on this table. For complete ranking, see ch. 3.

Source: Compiled from data submitted in response to Commission producer and purchaser questionnaires.

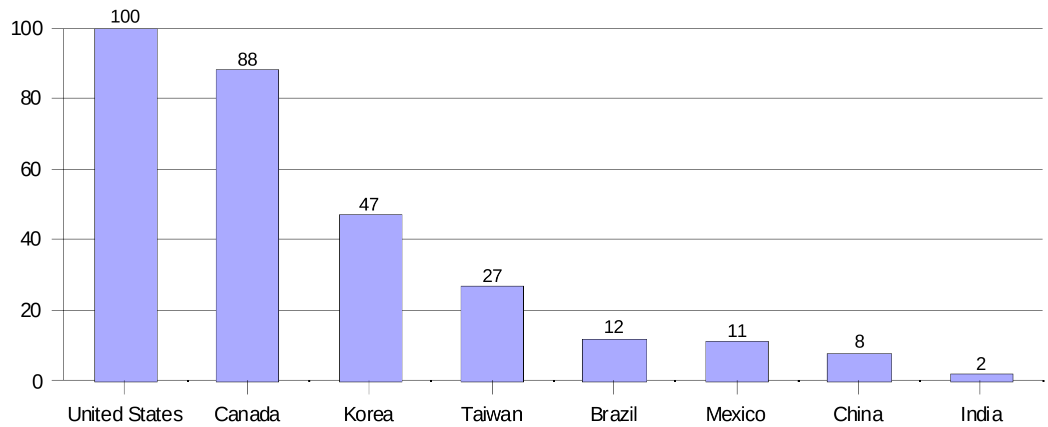
Table 10-7
Domestic producers' and purchasers' assessment of relative price levels of castings in the U.S. market for all product groups, 1999-2003[1]

Casting type/country	Price level relative to U.S. producers' price	U.S. producers' responses: Number of responses	U.S. producers' responses: Average percent difference	Domestic purchasers' responses: Number of responses	Domestic purchasers' responses: Average percent difference
Rough castings:					
China	Higher	0	(2)	1	10
	Lower	67	28	22	27
	Same	1	(2)	3	(2)
Mexico	Higher	0	(2)	1	5
	Lower	5	38	14	18
	Same	0	(2)	2	(2)
Brazil	Higher	0	(2)	0	(2)
	Lower	35	26	6	20
	Same	0	(2)	4	(2)
India	Higher	0	(2)	0	(2)
	Lower	5	32	7	32
	Same	0	(2)	0	(2)
Korea	Higher	0	(2)	0	(2)
	Lower	2	(3)	11	12
	Same	0	(2)	1	(2)
Machined castings:					
China	Higher	0	(2)	1	10
	Lower	24	34	85	33
	Same	0	(2)	6	(2)
Mexico	Higher	0	(2)	1	20
	Lower	4	17	21	14
	Same	0	(2)	5	(2)
Brazil	Higher	0	(2)	1	10
	Lower	7	25	17	15
	Same	0	(2)	2	(2)
India	Higher	0	(2)	2	23
	Lower	2	60	29	34
	Same	0	(2)	1	(2)
Korea	Higher	0	(2)	0	(2)
	Lower	1	20	20	16
	Same	0	(2)	0	(2)

[1] Table presents an aggregate compilation for the 10 product groups
[2] Not applicable.
[3] Amount not specified.

Source: Compiled from data submitted in response to producer and purchaser questionnaires of the U.S. International Trade Commission.

Figure 10-2
Indexes of hourly compensation costs for production workers in manufacturing, 2003



Source: Compiled from U.S. Bureau of Labor Statistics for all countries except China and India. Index for China and India estimated by the Commission based on reported foundry wages as compared with U.S. foundry wages.

Labor Costs

Foundries in developing countries are reported to have a substantial labor cost advantage (figure 10-2).[11] Although this factor may be mitigated slightly by lower productivity in some competitor countries,[12] the competitive advantage accruing to foreign foundries resulting from the difference in wage rates is further compounded by other costs, including health benefits and pension costs, that are often higher for U.S. foundries than for their foreign competitors.[13]

Managing labor costs, one of the largest cost component for U.S. foundries, has been problematic. For example, total employee costs for all respondents increased by 6 percent, whereas the total number of employees has declined by 12 percent during 1999-2003. Not only have wages increased by over $2 per hour, but there has been a significant rise in workers compensation costs and health benefit costs. Workers compensation costs reportedly have increased because of concern over exposure to materials detrimental to employee health, such as silica dust in the air or lead in the copper castings. Increases in health benefits costs correspond to growth in these costs for the United States as a whole.

---

[11] For U.S. foundry workers, the average wage is almost $19 per hour based on questionnaire responses. This compares, for example, with foundry workers that earn approximately $2 to $3 per hour in the eastern region of China, less than $1 per hour in the western regions of China, $4.60 an hour in Brazil, and $1 to $3 for an 8-hour day in India.

[12] For example, the Chinese Foundry Association asserts that overall Chinese foundry productivity is one-fifth of U.S. productivity (although the productivity of the foreign-invested foundries is likely better than the overall Chinese productivity). Fieldwork interviews also indicate that Indian productivity is lower than any other country with whch they compete.

[13] These costs add approximately $6 per hour to U.S. wages, $1.00-$1.50 per hour to eastern Chinese wages, and $1 per day to Indian wages. Brazil's foundry workers also receive extensive benefits, but their cost is not readily available.

National laws regarding the dismissal of employees may partially offset the disparity in total labor costs; staffing flexibility in some countries reportedly may be more regulated and impose higher costs. In China, state-owned foundries essentially cannot layoff or fire employees, according to interviews with Chinese foundry officials. Whether these employees are working or not, the foundry must continue to pay their wages until retirement age. According to fieldwork interviews, dismissing a permanent employee in Brazil unless there is a good cause is considered difficult and incurs a financial penalty.[14]

Environmental Regulations

U.S. producers reported that environmentally related capital expenditures averaged over 5 percent of operating income per year during 1999-2003, reaching a peak of 11 percent in 2003. Costs to maintain equipment, monitor factory environment, and maintain records add to operating costs, although no figures are available to document the magnitude of such costs. Fieldwork interviews in China, Brazil, and India indicated that these countries have environmental regulations that are consistent with world standards. The key difference appears to be enforcement, which reportedly is often lax. However, foundries in both China and India find it increasingly difficult to operate in certain urban and residential areas where they were originally established, due to opposition of local authorities. This is especially prevalent in the Shanghai area, which has historically been a major foundry region. Foundries in this city are closely monitored and are fined for environmental violations. Many foundries in China and India are relocating their operations outside urban areas, reflecting some level of environmental enforcement.

Worker Health and Safety Regulations

Worker safety laws in the United States are reported by producer respondents as being extensive, frequently expanded and tightened, and stringently enforced by the U.S. Occupational Health and Safety Administration. For example, dust is typically a significant problem and foundries must invest in dust collecting systems. Little comprehensive information on foundry worker safety is available for the foreign industries under study. Similar to environmental regulations, laws are in place to protect the safety of employees but enforcement is reportedly inconsistent. The U.S. Department of State reports that Brazil, China, and India have high rates of industrial accidents and death, attributable to poor enforcement of health and safety regulations.[15] In China, the level of safety in some cases depends on the ownership structure of an enterprise, according to an industry source. Foreign-invested enterprises are expected to abide by safety rules comparable to world standards, with lower expectations for state-owned foundries.[16]

Energy

Nearly two-thirds of responding U.S. producers consider foreign producers to have an advantage with regard to energy costs. Although U.S. prices can fluctuate depending on the time of day and area of the country,[17] average U.S. electricity costs were roughly 4-5 cents per kilowatt-hour (kwh) for industrial customers during 1999-2003. Most of Brazil's electrical energy is supplied by hydroelectric plants and prices

[14] Employees contribute 8 percent of their monthly salary to the Unemployment Guarantee Fund (FGTS), with matching funds provided by the employer. If an employee is dismissed, the employer must contribute an additional 40 percent of the amount accrued in the FGTS fund as a severance for the dismissed employee.

[15] U.S. Department of State, Bureau of Democracy, Human Rights, and Labor, *Country Report on Human Rights Practices-2003*, Feb. 25, 2004, found at *http://www.state.gov/g/drl/rls/hrrpt/2003*, retrieved Mar. 18, 2005.

[16] Chinese industry official, interview by USTIC staff, Jan. 2005.

[17] For example, in Alabama, peak-hour costs can be as high as 14 cents per kwh, but only 2 cents per kwh during off-hours.

are considered to be the world's lowest.[18] According to fieldwork interviews, Chinese electricity costs are 5-7 cents per kwh, slightly higher than the average U.S. cost. Based on fieldwork interviews, energy costs in India are higher than in competing nations because the industrial sector has grown faster than the ability of the Indian Government to supply energy and there are no private providers.

A current data series showing natural gas prices in domestic and foreign markets is not available. No known price series exist that compare domestic and foreign metallurgical coke prices.

The cost advantages of energy in many foreign countries may be offset by uncertainties over supply. In China, for example, electrical generating capacity is insufficient and in urban areas electricity curtailments can disrupt foundry operations. Brazil's electrical energy supply remains vulnerable to disruption because of dependence on sufficient rainfall to power hydroelectric facilities and a lack of investment in power-generation and distribution systems.

VAT Rebates

The treatment of value-added taxes (VATs) benefits the foundry industry in many key developing countries and was cited as a concern by many U.S. producers. In China and Brazil, for example, foundries are subject to payment of a VAT on the castings they produce but a portion of this tax is remitted if the product is exported. Foundries in China also are subject to payment of a VAT on imported input purchases; this tax also can be remitted when such inputs are used in downstream products that are exported. In India, foundries qualify for import tariff refunds on any imported inputs used to make castings.

Competitive Advantages for Domestic Producers

Lead Times

Lead times are an advantage for the domestic foundry industry, according to both U.S. producers and purchasers. Responses to producer questionnaires indicate that the U.S. foundry industry has reduced average lead times during 1999-2003 by more than 30 percent for castings with an existing pattern, and more than 10 percent for castings that require a pattern to be made. Comprehensive data for lead-time improvement by developing countries is not readily available. During fieldwork, several large foreign foundries indicated they have established sales and technical support operations in the United States that also help them reduce lead times. Certain foreign companies have established warehouses in the United States to decrease lead times for their U.S. customers.

The U.S. lead-time advantage is likely eroding to some extent because electronic communication of product designs and integrated computer systems can transform a design into a pattern quickly on automated, computer-controlled machines. The time to develop product designs is also improving for the same reasons, as rapid prototyping can be aided by electronic communication. Some Chinese foundries also have these capabilities.

Transportation

Transportation costs are also an advantage for U.S. producers, according to purchasers. Because many customers request specific delivery dates in a short time frame, reliability of transportation can be

[18] Brazilian industry official, interview with USITC staff, Brazil, Nov. 2004.

important in retaining customers. Freight time and cost from Asia can be prohibitive[19] whereas some suppliers in closer proximity, such as in Brazil and Mexico, often face problems associated with their inadequate transportation infrastructure. Additionally, owing to the size and weight of certain cast products, freight costs can make imports less competitive. For example, even though certain foreign producers may have a cost advantage when producing items such as cast steel railcar wheels, U.S. producers presently have a slight advantage in the domestic market for that product as they can be difficult to ship. In many cases, U.S. foundries were established near their major customers; many are in Midwestern states near motor vehicle production plants. However, as downstream customers move offshore this traditional advantage may be eroded. Conversely, transportation-related advantages can benefit foreign foundries with access to captive raw material, such as bauxite in China and pig iron in Brazil.

Technical Advice and Services

U.S. producers claim these services give them an important competitive advantage over foreign foundries.[20] The majority of U.S. purchasers considered U.S. producers to have a minor advantage at best in this factor, but only a slightly smaller number consider that neither domestic nor foreign producers have an advantage. The increasing sophistication of foreign producers, especially the foreign-invested foundries in China, is likely contributing to a declining U.S. advantage for these services. In addition, standard software that can simulate metal solidification and other computer-aided techniques to improve designs is available universally. Largely because of the to the U.S. advantage in technical design, advice and services, purchasers indicated that U.S. producers excel at complex castings.

Competitive Concerns for Both Foreign and Domestic Producers

Raw Materials

The Commission found that with few exceptions, U.S. and foreign foundries purchase similar metallic raw materials. These metals trade on world markets and tend to have equivalent prices. Robust demand by the Chinese manufacturing sector has led to significant price increases for many raw materials for foundries. Less-profitable U.S. foundries were especially impacted by these price increases. Additionally, demand from China may have reduced availability of scrap in the U.S. market.

Regional differences do exist for material costs, reflecting local market conditions and transportation costs. For example, foundries in Brazil have local access to pig iron, and although these foundries pay the world price for pig iron, their transportation costs are much lower because they only pay for internal shipping. Brazil is also a leading world producer of aluminum, because of the high quality of its local bauxite ore, giving them a similar transportation cost advantage. In contrast, much of the metallic raw materials used by Indian and Mexican foundries must be imported and transportation costs can add to the cost of the raw material. Western Chinese foundries have a raw material advantage because prices of local supplies of scrap and coal are lower than world market prices, and there are lower transportation costs because these materials are available locally. However, some of the price advantage is offset by higher inland transportation costs for their castings and lower quality raw materials.

---

[19] Producers reported shipping times from China of up to 4 weeks. One source indicated that ocean shipping costs for transporting products from China to the United States are $2,500 to $3,000 per container. They further claim that this adds $1.10 to a $12 casting, compared with only $0.30 for transporting a comparable Mexican casting to the United States. Mitchell Quint and Dermot Shorten, "The China Syndrome," found at *http://www.strategy-business.com/resiliencereport*, retrieved May 2, 2005.

[20] U.S. industry officials, interviews by USITC staff, United States, Mar. 2005.

Product Quality

According to both purchasers and producers, at one time, U.S. foundries had a clear advantage in this area, but foreign foundries have improved their product quality resulting in fewer defective products. Additionally, determining who has an advantage in product quality largely depends on the type of castings the customer requires. Purchasers indicated that the U.S. has a clear advantage in specialty castings which require more complex designs, closer tolerances, and tighter material specifications.[21] U.S. foundries were also cited by responding U.S. purchasers as manufacturing with a low defect (rejection) rate.

Concerns over product quality also depend on the castings' country of origin. Both producers and purchasers indicated that the Chinese do not produce castings at the same level of quality as those produced in the United States. However, Brazil and Mexico consistently provide castings, particularly of gray iron, that are of similar quality to those produced in the United States.

Labor Availability

Labor availability is an issue for both domestic and foreign foundries. Attracting production workers is problematic because foundries tend to be dirty, noisy places, and wages are not typically high enough to compensate. This is the situation, for example, in parts of China (especially near the major eastern cities) and in India because there are many other employment opportunities in both countries. The availability of technically trained personnel is also a problem in Brazil, China, and India because of competition with higher-paying industries. Industry officials noted that Brazil lacked sufficient educational opportunities in metallurgy, and the industry is encouraging schools to offer more metallurgical courses.

Technology

Technology transfer has tended to erode any historical U.S. technological advantage. U.S. producers' opinions are split as to the level of technology used in domestic and foreign foundries, with roughly one-half giving the U.S. an advantage and slightly less than one-half giving neither an advantage (see table 10-4). Some of this ambiguity may be related to the basis of comparison. For example, according to the Chinese Foundry Association, the Chinese industry as a whole has a low level of technology, but certain Chinese foundries have state-of-the art technology that meets or even exceeds that used in any U.S. foundry. Certain Brazilian foundries also use the latest technology.

Any improvements in foundry manufacturing processes can be quickly adopted by foundries in any country. Foundry equipment is available worldwide and countries such as China typically import machinery from Japan, Taiwan, the European Union, and the United States. Foreign direct investment in developing country industries has substantially contributed to technology adoption, especially in China. Many foreign investors operate foundries in their own countries, and transfer personnel to developing countries to bring in operating expertise.

---

[21] For example, the U.S. industry's greater experience in process control has allowed production of castings that more easily meet the automobile industry's rigid quality requirements than foreign castings, with fewer costly rejects.

Exchange Rates

Although U.S. producers cite exchange rates as an advantage for foreign producers, fluctuations in the value of the dollar make the competitive advantage unclear (figure 10-3). Divergent views exist relating to the impact of China's fixed exchange rate regime, and the economic effects of allowing the yuan to float relative to the U.S. dollar. U.S. producer questionnaire responses, hearing testimony, and interviews indicate that U.S. producers consider the fixed exchange rate an advantage for Chinese foundries selling castings in the U.S. market. Four of the representatives of the foundry industry that appeared at the Commission hearing stated that the rate at which the Chinese currency is currently pegged to the U.S. dollar has had a negative effect on the competitiveness of the domestic foundry industry, even as the dollar has weakened relative to other currencies.[22] One representative, though, testified that the view that a floating Chinese exchange rate will have a large effect is misguided because, for example, the Chinese currency cannot be used for international transactions, only domestic purchases, and Chinese manufacturers face the same currency fluctuations as domestic manufacturers when buying equipment or raw materials from third countries.[23]

Outlook for the U.S. Foundry Products Industry

With rising labor and raw material costs, greater price pressure, and declining profitability, the U.S. foundry industry faces a difficult competitive environment. The domestic industry anticipates numerous competitive challenges from factors in addition to imports during the next five years, as shown in the following tabulation:[24]

Factor cited by U.S. producers	Number of responses
Healthcare/insurance/labor costs	395
Customers moving or sourcing offshore	328
Meeting environmental/labor regulations	263
Lack of skilled labor	187
Funds to invest in new technology/equipment	187
Ability to obtain capital	115
Adoption of new technology or process improvements by domestic competitors	97

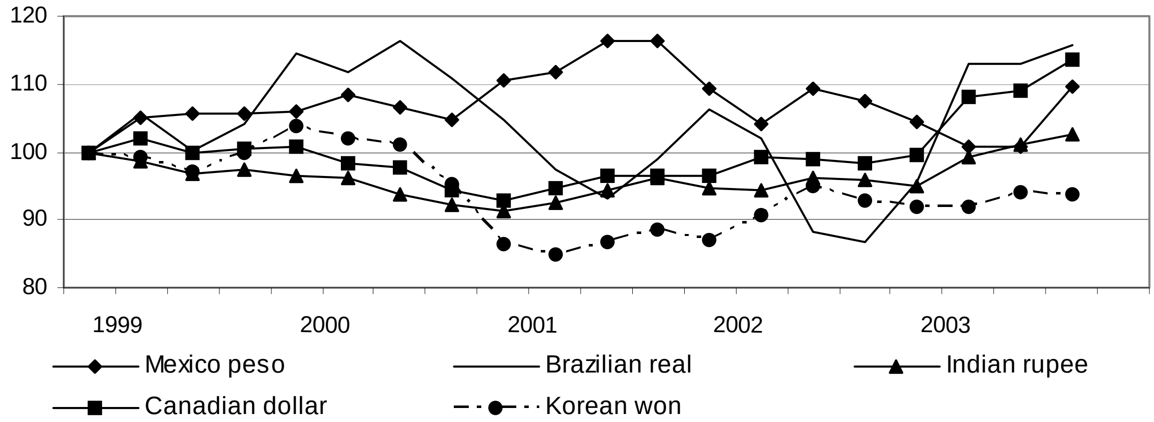
The domestic industry is under continuing pressure to reduce prices as customers confront intense competition in their own end markets. Price reductions offered by many producers, combined with higher raw material and energy costs, appear to have contributed to lower profitability. This, in turn, may have affected the level of internal funding available for capital improvements and research and development for product innovations and new technologies. The poorer financial condition of the industry also affects its ability to obtain capital from external sources on favorable terms. Any compromised ability to invest in greater automation and technological advancements, such as computer-aided design, may have implications for the future competitiveness of the industry, as technology is considered key to global competitiveness. As noted by U.S. industry respondents, the inability to adopt new technologies and equipment becomes more critical if foreign competitors are able to implement such improvements.

[22] Testimony by James Mallory, Non-Ferrous Founders' Society; George Boyd, Goldens' Foundry and Machine; Michael Kerwin, Georgetown Economic Consulting Services; and William Blackerby, ASC Industries, hearing transcript pp. 12, 24, 71, and 80, respectively.

[23] Prehearing submission of ASC Industries, Oct. 12, 2004, pp. 8-10.

[24] Based on 424 responses to the Commission's producer questionnaire.

Figure 10-3
Exchange rates: Quarterly indexes of the real values of the Brazilian real, Canadian dollar, Indian rupee, Korean won, and Mexican peso relative to the U.S. dollar, 1999-2003



Source: International Monetary Fund.

About 19 percent of producers reported that they lacked the capital funds to counter import competition and 36 percent have scaled back or dropped planned capacity expansions. Forty-six percent of responding U.S. producers reported cutting back or eliminating production or closing production lines in response to import competition. Contraction of productive capacity may reduce the industry's ability to offer the range of castings required by its customers, as well as raise the unit costs of remaining production to cover fixed overhead expenses.

Furthermore, the domestic industry's U.S. customer base appears to be shrinking. The foundry industry and its downstream customers have noted that price competition has forced many customers to increase their purchases of lower-cost castings from foreign foundries. In some cases, this shift to foreign castings has been encouraged by end-use customers trying to remain competitive in the U.S. market as their competitors pursue lower costs overseas. Competitive pressures have also driven a growing number of the industry's downstream customers to move manufacturing operations offshore to benefit in part from lower production costs. The likelihood of regaining this business becomes more remote with the actual movement of finished and semi-finished goods production from the United States to foreign locations.

Domestically, labor and environmental issues are at the forefront of industry concerns. The ability to manage or reduce healthcare, insurance, and labor costs is reported to be the paramount challenge facing the industry. Healthcare and insurance costs can be controlled to some extent by reducing coverage or shifting a greater share of the burden to employees, but neither of these actions helps to attract a skilled work force, which is a primary industry concern. The industry must not only manage increasing employee benefit costs, but also balance wages, which must be attractive enough to compete with other industries offering a more desirable work environment while remaining low enough so as not to considerably raise production costs. The U.S. foundry industry will likely continue to incur higher wage rates and benefit costs than many of its foreign competitors. It may need to intensify efforts to implement increased automation and capital improvements that will raise productivity levels and provide consistent product quality to offset a portion of this differential. This appears to be somewhat problematic, considering the financial condition of some foundries.

Increased raw material prices appear to have contributed to the industry's problems in 2004 and 2005.[25] Ferrous scrap prices doubled, pig iron prices increased 33 percent, and aluminum and copper ingot prices increased 20 and 60 percent, respectively, in 2004 compared with the prior year. Raw materials account for one-third of foundry production costs, and the most significant component is metallic raw materials. Passing on raw material cost increases to purchasers is problematic, especially for iron and steel foundries. The costs of these raw materials have historically been relatively stable, and pass-through provisions in sales contracts were not used. In addition, the large users are automobile producers who, because of their market power, resist pass-through costs. Two of the largest iron foundries, each with multiple establishments, and several other smaller producers filed for Chapter 11 bankruptcy in early 2005, citing increasing raw material costs as the reason.[26]

In recognition of the intense competitive situation facing the U.S. foundry industry, U.S. producers have responded with a broad array of initiatives that focus on improved manufacturing processes, lowering costs, and new business strategies. With respect to manufacturing processes, information derived from field work and hearing testimony indicates that U.S. producers are implementing lean manufacturing and Six Sigma programs to cut waste and product defects, improve quality, and streamline operations; increasing automation, such as adding robots to production lines; and switching to other manufacturing processes. Reverse engineering–the process of taking apart an item for duplication or enhancement–is another possible avenue to improve competitiveness. Reverse engineering cuts product development time, thus getting a competing product to market more quickly. Flexible manufacturing may also improve performance. Flexible manufacturing is a highly automated production process that uses computer-controlled machinery to produce small volumes of a broad range of products. Flexible manufacturing yields higher and more consistent product quality and improved worker productivity, but requires a large capital investment.

Nearly 80 percent of responding producers are implementing cost-reduction efforts. In addition to cutting manufacturing costs, other cost factors were identified as a source of potential improvement, with an emphasis on efficiency gains. Better utilization of the workforce may result from increased automation or reassessment of job functions and manufacturing lay-out. Greater collaboration with customers in early product design and development phases could lower costs by optimizing casting design and improving the production process, according to questionnaire respondents. Questionnaire responses indicate that formal cost evaluation programs could also reduce manufacturing costs. Respondents indicated that all products, even those with good profit margins, should be evaluated for improvement. Through this process, domestic companies may learn more about their actual costs and then make the best decisions on how to reduce such costs.

Flexible and creative business strategies play an important role in achieving operational success, according to questionnaire responses. Many U.S. producers had already shifted production from their traditional product lines prior to the current competitive climate. Niche marketing is being pursued by a number of U.S. foundries that have found demand for small runs, high-technology products, or fill-in orders, for example. Some U.S. producers have shifted their product mix to larger, more complex parts that present a manufacturing challenge to low-cost, high-volume foreign competitors, and for which production is more likely to remain in the United States. Such products include those with intricate shapes, greater core complexity, and tighter dimensional tolerances; those produced from ultra-clean iron; and parts requiring a high degree of technical collaboration with customers' engineering and manufacturing personnel, along with

[25] The Commission's producer questionnaire only requested data for 1999-2003 because of the timing of the study request.

[26] Nonferrous foundries typically include pass-through provisions in sales contracts because, historically, prices for aluminum and copper raw materials have varied to a much greater extent than those for ferrous raw materials. Reportedly, automobile producers are becoming more amenable to allowing pass-through cost increases because of increasing supplier bankruptcies.

flexible lead times. Foundries may also pour different or more alloys to broaden their product scope and customer base. To increase sales, foundries may need to expand their sales forces and marketing regions to create more sales opportunities or add a wider range of technical services to support customer needs. Foundry closures have also created opportunities for operating foundries to gain new business and expand their customer base, as well as purchase machinery and equipment at reduced prices.

As a result of these efforts, many foundries reported rebounding sales to their leading markets since the economic downturn of 2001. A number of reporting U.S. foundries are profitable and experiencing increased income. These foundries largely serve booming markets, such as that for aluminum motor-vehicle components. Captive foundries also demonstrated improved performance as they are somewhat sheltered from market forces. As the industry has contracted and the economy picks up, remaining foundries may find themselves in a better position to gain new business and increase sales.

Despite rising costs for raw materials, energy, and labor; rising pricing pressures from downstream customers and foreign metal-casting competitors; and shrinking domestic markets over the past few years, some industry observers suggest brighter prospects for the U.S. metal foundry industry. For example, the American Foundry Society (AFS) anticipates that demand for metal castings will rise significantly with expanded U.S. industrial production over the next few years. A spokesman for AFS noted that "...we're seeing year after year production gains in the foundry industry... We're actually forecasting 25-year highs for U.S. production in 2008."[27] The AFS projects continued recovery of U.S. metal castings shipments; it expects shipments to grow by 11 percent over the next 4 years to 15.27 million short tons in 2008.[28] Cast metals for which shipments are anticipated to rise the most are aluminum (by 6.4 percent in 2005 and by 18 percent over the next 4 years) and ductile iron (by 4 percent in 2005 and by 14 percent over the next 4 years). Less significant increases are anticipated for castings of steel (by 6.3 percent in 2005 and by 15.5 percent over the next 4 years) and copper alloys (by 2 percent in 2005 and by an average annual rate of 0.3 percent to 2014). The exception is gray-iron castings shipments, which reached an all-time low in 2003, for which the AFS foresees only minimal gains in 2005-08, and longer-term annual declines thereafter. An implication of more robust demand prospects is that individual domestic metal foundry establishments can benefit if they succeed at developing new customers by expanding their shipments into new end-use markets. An automotive industry analyst notes[29] that prospects could be brighter for foundries that produce ductile-iron and aluminum castings. For example, according to the analyst, automotive-parts caster Intermet Corp., which cited rising steel scrap prices as a major cause for financial losses[30] and for its decisions to shut down several production facilities[31] and to seek bankruptcy protection in 2004,[32] could favorably alter its competitive position by shifting from the highly price-competitive automotive-components market into potential new end-use markets with greater prospects for metal castings shipments–e.g., aluminum castings for household appliances.[33]

---

[27] Alfred Spada, Marketing Director, AFS, cited in Tony Reid, "Auto Supply Company Announces Closure of Decatur, Ill., Foundry" *Herald & Review*, Decatur, IL, Mar. 30, 2005, p. A1.

[28] Kenneth H. Kirgin, "11% Growth Forecast for Next 4 Years Led by Aluminum, Ductile Iron," *Modern Casting*, Jan. 2005, pp. 22-27.

[29] Jim Gillette, Auto Analyst, CSM Worldwide, cited in Reid, "Auto Supply Company Announces Closure of Decatur, Ill., Foundry."

[30] "Intermet Ties Losses to Scrap Costs," *American Metal Market*, Feb. 20, 2004.

[31] "Intermet to Close Wisconsin Aluminum Auto Parts Plant, *American Metal Market*, Dec. 15, 2005; "Intermet Closing Decatur Foundry by Year-End," *American Metal Market*, Mar. 30, 2005; and "Auto Supplier Intermet Plans to Shut Factory," *American Metal Market*, Jan. 13, 2004.

[32] "Intermet Reaches Agreements with Customers to Amend Contracts," *Modern Casting*, Jan. 3, 2005, found at *http://www.amm.com*, retrieved Apr. 6, 2005.

[33] According to the AFS, shipments for aluminum castings for household appliances are anticipated to rise by 11.4 percent over 2004-08 and by 1 percent thereafter in the longer-run (2004-14). Kirgin, "11% Growth Forecast for Next 4 Years Led by Aluminum, Ductile Iron."

APPENDIX A
REQUEST LETTER FROM THE HOUSE COMMITTEE ON WAYS AND MEANS

Congress of the United States

U.S. House of Representatives

COMMITTEE ON WAYS AND MEANS

1102 LONGWORTH HOUSE OFFICE BUILDING
(202) 225–3625

Washington, DC 20515–6348

http://waysandmeans.house.gov

May 3, 2004

The Honorable Deanna Tanner Okun
Chairman
United States International Trade Commission
500 E Street, N.W.
Washington, D.C. 20436

Dear Chairman Okun:

On behalf of the Committee on Ways and Means, and under authority of section 332(g) of the Tariff Act of 1930, 19 U.S.C. § 1332(g), I am requesting that the Commission institute a fact-finding investigation of the current competitive conditions facing producers in the U.S. foundry industry with respect to the U.S. market. Due to the impact of globalization, producers of foundry products are concerned about competitive conditions affecting their industry. Therefore, the investigation should include an overview of the industry together with a detailed analysis of selected key iron-, steel-, aluminum-, and copper-based cast products which are representative of the major segments of the foundry industry. The Commission's report on this investigation should provide information for the most recent five-year period, to the extent possible, regarding the following:

1. A profile of the U.S. foundry industry.

2. Trends in U.S. production, shipments, capacity, consumption, and trade in foundry products, as well as financial conditions of domestic producers.

3. A profile of major foreign industries including, but not necessarily limited to, Brazil and China.

4. A description of relevant U.S. and foreign government policies and regulations affecting U.S. and foreign producers as identified during the investigation by the producers and consumers of foundry products, including appropriate investment, tax and export policies; environmental regulations; and worker health and safety regulations.

5. A comparison of various factors affecting competition between U.S. and foreign producers–such as the availability and cost of raw materials, energy, and labor; level of technology and changes in the manufacturing process; pricing practices; transportation costs; technical advice and service; and an analysis of how these factors affect the industry.

6. An analysis of the purchasing patterns and practices of downstream industries.

The Commission should provide its report no later than 12 months from receipt of this request. I also request that the Commission's report be made public, consistent with the procedures set forth in section 332(g) of the Tariff Act of 1930 concerning the release of confidential business information. Thank you for your attention to this important matter.

Best regards,

Bill Thomas

Bill Thomas
Chairman

WMT/mm

APPENDIX B
FEDERAL REGISTER NOTICE

rules. All written submissions must conform with the provisions of section 201.8 of the Commission's rules; any submissions that contain BPI must also conform with the requirements of sections 201.6, 207.3, and 207.7 of the Commission's rules. The Commission's rules do not authorize filing of submissions with the Secretary by facsimile or electronic means, except to the extent permitted by section 201.8 of the Commission's rules, as amended, 67 FR 68036 (November 8, 2002).

In accordance with sections 201.16(c) and 207.3 of the Commission's rules, each document filed by a party to the investigation must be served on all other parties to the investigation (as identified by either the public or BPI service list), and a certificate of service must be timely filed. The Secretary will not accept a document for filing without a certificate of service.

Authority: This investigation is being conducted under authority of title VII of the Tariff Act of 1930; this notice is published pursuant to section 207.21 of the Commission's rules.

By order of the Commission.

Issued: June 8, 2004.

Marilyn R. Abbott,

Secretary to the Commission.

[FR Doc. 04–13359 Filed 6–14–04; 8:45 am]

BILLING CODE 7020–02–P

INTERNATIONAL TRADE COMMISSION

[Investigation No. 332–460]

Foundry Products: Competitive Conditions in the U.S. Market

AGENCY: International Trade Commission.

ACTION: Institution of investigation and scheduling of hearing.

EFFECTIVE DATE: June 8, 2004.

SUMMARY: Following receipt on May 4, 2004 of a request from the U.S. House Committee on Ways and Means under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)), the Commission instituted investigation No. 332–460, Foundry Products: Competitive Conditions in the U.S. Market.

FOR FURTHER INFORMATION CONTACT:

(1) Project Leader, Judith-Anne Webster (202–205–3489 or *judith-anne.webster@usitc.gov*)

(2) Deputy Project Leader, Deborah McNay (202–205–3425 or *deborah.mcnay@usitc.gov*)

The above persons are in the Commission's Office of Industries. For information on legal aspects of the investigation, contact William Gearhart of the Commission's Office of the General Counsel at 202–205–3091 or *william.gearhart@usitc.gov.* Media should contact Peg O'Laughlin at 202–205–1819 or *margaret.olaughlin@usitc.gov.* General information concerning the Commission may also be obtained by accessing its Internet server (*http://www.usitc.gov*).

Background: As requested by the Committee, the Commission will investigate the current competitive conditions facing producers in the U.S. foundry industry in the U.S. market. The investigation will include an overview of the industry together with a detailed analysis of selected key iron-, steel-, aluminum-, and copper-based cast products which are representative of the major segments of the foundry industry. The Commission's report will provide information for the most recent five-year period, to the extent possible, regarding the following:

1. A profile of the U.S. foundry industry.
2. Trends in U.S. production, shipments, capacity, consumption, and trade in foundry products, as well as financial conditions of domestic producers.
3. A profile of major foreign industries including, but not necessarily limited to, Brazil and China.
4. A description of relevant U.S. and foreign government policies and regulations affecting U.S. and foreign producers as identified during the investigation by the producers and consumers of foundry products, including appropriate investment, tax, and export policies; environmental regulations; and worker health and safety regulations.
5. A comparison of various factors affecting competition between U.S. and foreign producers-such as the availability and cost of raw materials, energy, and labor; level of technology and changes in the manufacturing process; pricing practices; transportation costs; technical advice and service; and an analysis of how these factors affect the industry.
6. An analysis of the purchasing patterns and practices of downstream industries. As requested by the Committee, the Commission will provide its report not later than May 4, 2005.

Public Hearing: A public hearing in connection with this investigation is scheduled to begin at 9:30 a.m. on October 14, 2004, at the U.S. International Trade Commission Building, 500 E Street, SW, Washington, DC. Requests to appear at the public hearing should be filed with the Secretary, no later than 5:15 p.m., September 24, 2004, in accordance with the requirements in the ''Submissions'' section below. In the event that, as of the close of business on September 24, 2004, no witnesses are scheduled to appear, the hearing will be canceled. Any person interested in attending the hearing as an observer or non-participant may call the Secretary (202-205–2000) after September 24, 2004, to determine whether the hearing will be held.

Statements and Briefs: In lieu of or in addition to participating in the hearing, interested parties are invited to submit written statements or briefs concerning this investigation in accordance with the requirements in the ''Submissions'' section below. Any prehearing briefs or statements should be filed not later than 5:15 p.m., September 30, 2004; the deadline for filing post-hearing briefs or statements is 5:15 p.m., October 22, 2004.

Submissions: All written submissions including requests to appear at the hearing, statements, and briefs should be addressed to the Secretary, United States International Trade Commission, 500 E Street, SW, Washington, DC 20436. All written submissions must conform with the provisions of section 201.8 of the Commission's Rules of Practice and Procedure (19 CFR 201.8); any submission that contains confidential business information must also conform with the requirements of section 201.6 of the Commission's Rules of Practice and Procedure (19 CFR 201.6). Section 201.8 of the rules require that a signed original (or a copy designated as an original) and fourteen (14) copies of each document be filed. In the event that confidential treatment of the document is requested, at least four (4) additional copies must be filed, in which the confidential information must be deleted. Section 201.6 of the rules requires that the cover of the document and the individual pages be clearly marked as to whether they are the ''confidential'' or ''nonconfidential'' version, and that the confidential business information be clearly identified by means of brackets. All written submissions, except for confidential business information, will be made available for inspection by interested parties.

In their hearing testimony and written submissions, interested parties should provide information regarding the six topics in the ''Background'' section of this notice and any other relevant information relating to competitive conditions in the U.S. foundry market.

The Commission's rules do not authorize filing submissions with the Secretary by facsimile or electronic means, except to the extent permitted by section 201.8 of the Commission's Rules of Practice and Procedure (19 CFR 201.8) (see Handbook for Electronic Filing Procedures, *ftp://ftp.usitc.gov/pub/reports/electronic_filing_handbook.pdf*). Persons with questions regarding electronic filing should contact the Secretary (202–205–2000 or *edis@usitc.gov*).

The public record for these investigations may be viewed on the Commission's electronic docket (EDIS) at *http://edis.usitc.gov.* Hearing-impaired individuals are advised that information on this matter can be obtained by contacting our TDD terminal on (202) 205–1810. Persons with mobility impairments who will need special assistance in gaining access to the Commission should contact the Secretary at 202–205–2000.

List of Subjects

Foundry, metal castings, and competition.

By order of the Commission.

Issued: June 8, 2004.

Marilyn R. Abbott,

Secretary to the Commission.

[FR Doc. 04–13358 Filed 6–14–04; 8:45 am]

BILLING CODE 7020–02–P

DEPARTMENT OF JUSTICE

[AAG/A Order No. 009–2004]

Privacy Act of 1974; Systems of Records

AGENCY: United States Trustee Program, Department of Justice.

ACTION: Notice of modifications to systems of records.

SUMMARY: Pursuant to the Privacy Act of 1974 (5 U.S.C. 552a) and Office of Management and Budget Circular No. A–130, the United States Trustee Program (''USTP''), Department of Justice, proposes to modify the following existing Privacy Act systems of record, which were last substantively revised on March 4, 2004, at 69 FR 10255:

JUSTICE/UST–001, Bankruptcy Case Files and Associated Records;
JUSTICE/UST–002, Bankruptcy Trustee Oversight Records;
JUSTICE/UST–003, U.S. Trustee Program Timekeeping Records; and
JUSTICE/UST–004, U.S. Trustee Program Case Referral System.

DATES: These actions will be effective July 26, 2004.

FOR FURTHER INFORMATION CONTACT: For information regarding these changes, and for general information regarding USTP's Privacy Act systems, contact Anthony J. Ciccone, FOIA/Privacy Counsel, Executive Office for United States Trustees, at (202) 307–1399.

SUPPLEMENTARY INFORMATION: Two new routine uses are being added to the following United States Trustee Program systems of records. They state that information from USTP systems may be disclosed in connection with investigations and/or meetings under 11 U.S.C. 341, so as to facilitate USTP civil and criminal enforcement efforts and compliance with the Bankruptcy Code and related authority.

In accordance with 5 U.S.C. 552a(e)(4) and (11), the public is given a 30-day period in which to comment; and the Office of Management and Budget (OMB), which has oversight responsibility of the Act, requires a 40-day period in which to conclude its review of the system. Therefore, please submit comments by July 15, 2004. The public, OMB, and Congress are invited to submit comments to: Mary Cahill, Management and Planning Staff, Justice Management Division, Department of Justice, 1331 Pennsylvania Ave., NW., Washington, DC 20530 (1400 National Place Building).

In accordance with 5 U.S.C. 552a(r), the Department has provided a report to OMB and Congress.

Dated: June 8, 2004.

Paul R. Corts,

Assistant Attorney General for Administration.

JUSTICE/UST–001

SYSTEM NAME:

Bankruptcy Case Files and Associated Records.

* * * * *

ROUTINE USES OF RECORDS MAINTAINED IN THE SYSTEM, INCLUDING CATEGORIES OF USERS AND THE PURPOSES OF SUCH USES:

* * * * *

(N) Release of Information related to Investigations and Proceedings:

Information from these records may be disclosed in the course of investigating the potential or actual violation of any law—whether civil, criminal, or regulatory in nature—or for the preparation of a trial or hearing for such violation. Such information may be disclosed to a federal, state, local, tribal, or foreign agency, or to an individual or organization, if there is reason to believe that such agency, individual, or organization possesses information relating to the investigation, trial, or hearing, and if the dissemination is reasonably necessary to elicit such information or to obtain the cooperation of a witness or an informant.

(O) Release of Information in connection with Section 341 Meetings:

Information from these records may be disclosed in connection with meetings held under 11 U.S.C. 341 and related proceedings, when the Department of Justice determines that the records are arguably relevant to such meetings or bankruptcy proceedings. Transcripts or other records of such meetings may also be disclosed upon request pursuant to relevant bankruptcy laws or rules.

JUSTICE/UST–002

SYSTEM NAME:

Bankruptcy Trustee Oversight Records

* * * * *

ROUTINE USES OF RECORDS MAINTAINED IN THE SYSTEM, INCLUDING CATEGORIES OF USERS AND THE PURPOSES OF SUCH USES:

* * * * *

(M) Release of Information related to Investigations and Proceedings:

Information from these records may be disclosed in the course of investigating the potential or actual violation of any law—whether civil, criminal, or regulatory in nature—or for the preparation of a trial or hearing for such violation. Such information may be disclosed to a federal, state, local, tribal, or foreign agency, or to an individual or organization, if there is reason to believe that such agency, individual, or organization possesses information relating to the investigation, trial, or hearing, and if the dissemination is reasonably necessary to elicit such information or to obtain the cooperation of a witness or an informant.

(N) Release of Information in connection with Section 341 Meetings:

Information from these records may be disclosed in connection with meetings held under 11 U.S.C. 341 and related proceedings, when the Department of Justice determines that the records are arguably relevant to such meetings or proceedings. Transcripts or other records of such meetings may also be disclosed upon request pursuant to relevant bankruptcy laws or rules.

JUSTICE/UST–003

1. SYSTEM NAME:

U.S. Trustee Program Timekeeping Records.

* * * * *

ROUTINE USES OF RECORDS MAINTAINED IN THE SYSTEM, INCLUDING CATEGORIES OF USERS AND THE PURPOSES OF SUCH USES:

* * * * *

APPENDIX C
HEARING PARTICIPANTS

CALENDAR OF PUBLIC HEARING

Those listed below appeared as witnesses at the United States International Trade Commission's hearing:

Subject: Foundry Products: Competitive Conditions in the U.S. Market

Inv. No.: 332-460

Date and Time: October 14, 2004 - 9:30 a.m.

Sessions were held in connection with this investigation in the Main Hearing Room (room 101), 500 E Street, S.W., Washington, D.C.

ORGANIZATION AND WITNESS:

Non-Ferrous Founders' Society ("NFS")
Park Ridge, IL

James L. Mallory, Executive Director, NFS

Collier Shannon Scott, PLLC
Washington, D.C.
on behalf of

American Foundry Society ("AFS")

Charles M. Kurtti, President, AFS

Albert T. Lucchetti, President, Cumberland Foundry Co., Inc.

Dave Bumbar, President, Aurora Metals Division LLC

George G. Boyd, President and CEO, Goldens' Foundry and Machine

Jim Keffer, President, EBAA Iron Sales, Inc.

ORGANIZATION AND WITNESS (continued):

Kory Brockman, Vice President, Finance,
Wisconsin Aluminum Foundry Co.

Larry A. Comunale, Vice President and General
Manager, Doncaster Southern Tool

Randall W. Lawton, President and CEO, Bay
Engineered Castings

Roy Hanks, Marketing Manager, ThyssenKrupp-Waupaca

Thomas Brown, Vice President, Benton Foundry, Inc.

Michael T. Kerwin, Consultant, Georgetown Economic
Consulting Services

Paul C. Rosenthal)
) – OF COUNSEL
Robin H. Gilbert)

ORGANIZATION AND WITNESS:

ASC Industries, Inc. ("ASC")
North Canton, OH

William T. Blackerby, Jr., Chief Operating Officer, ASC

-END -