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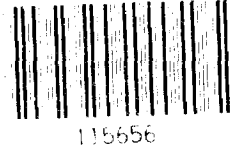
General Accounting Office

Materials Shortages And Industrial Bottlenecks: Causes, Trends, Prospects

When the Nation's capacity to produce basic materials--such as steel, aluminum, cement, and chemicals--is exceeded by demand, the result can create production bottlenecks which adversely affect industries that rely on those basic materials. This can breed inflation. Reasons for insufficient basic materials capacity seem to be overlooked or poorly understood.

The materials shortages of 1973-1974 were the most severe since the Korean War. GAO believes they were caused mainly by underinvestment in prior years. Although Government intervention--environmental and price controls--has been cited as the cause of underinvestment, forces within the private market played an equal if not larger role in reducing investment incentives.

Looking ahead, some current trends could also inhibit future capacity growth. These trends include uncertain energy costs, extended lead-times for capacity creation, and greater sensitivity to investment risks. GAO believes these trends provide a further basis for concern over the supply side of the Nation's economy.



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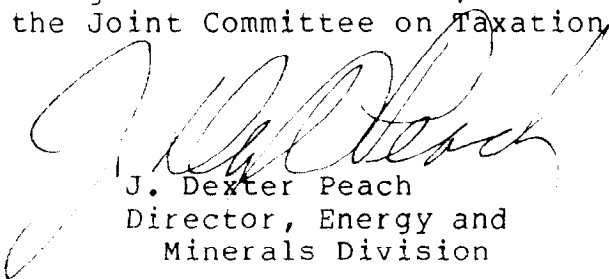
P R E F A C E

The availability of industrial materials (steel, paper, cement, etc.) to the manufacturing sector and the economy at large is essential to supporting growth without accelerating inflation. Access to critical raw materials (e.g., mineral, energy, and wood resources) is important in ensuring that the industrial materials are available. Less appreciated, but equally important, is the capacity of manufacturing industries to process the raw materials into industrial materials.

This study is intended as a primer on the meaning and importance of having adequate capacity to make industrial materials. In it, we define adequate capacity, review its relationship to the economy, analyze the causes of the severe capacity shortages of 1973 and 1974, review current trends in capacity growth, and identify some relationships to Government activities.

Business statistics and industry reports form the basic data in the report. We have gone beyond a basic compilation of data to analyze how economic trends affect the growth of materials capacity. While there are different viewpoints and analytical techniques, we believe this analysis is as reasonable an explanation of how capacity grows as the data would support.

Copies of this report are being provided to the House Committee on Banking, Finance and Urban Affairs, the Senate Committee on Banking, Housing and Urban Affairs, the Joint Economic Committee, and the Joint Committee on Taxation.



J. Dexter Peach
Director, Energy and
Minerals Division

D I G E S T

It is clear that the health and growth of the American economy depends on its access to the materials of production. Materials availability is in turn related to the abundance and distribution of the resources--minerals, hydrocarbons, and wood fibers--from which they come. What is less obvious is that materials availability also depends on sufficient processing capacity to turn resources into usable items. Unless there is enough industrial capacity (e.g., nonferrous smelters, chemical plants, petroleum refineries, and paper mills) the economy's needs for materials cannot be met because of bottlenecks in the production process.

GAO reviewed the topic of industrial capacity to learn how it grows to meet the demands of the economy and to understand the shortages which take place when it does not. For the materials industries that GAO studied, capacity represents the maximum output of the industry under continuous, round-the-clock, every day operations. When demand exceeds capacity, as can happen in a growing economy, shortages can arise. These shortages are accompanied by unfulfilled needs, disruptions to consumer industries, and, invariably, rapidly rising prices. (See pp. 5-8.) The more shortages, the greater the inflationary pressure.

Capacity may fail to grow as fast as demand for several reasons. Among those identified by GAO are (1) prior periods of depressed prices, and (2) Government intervention which lowers the economics of expansion or an industry's ability to finance the proper amount of capacity in time. (See pp. 8-10.) Capacity expansion is an expensive process, frequently costing hundreds of millions of dollars. As the decision-making environment for business grows more complex and uncertain, the cost and lead times for capacity growth are likely to grow. (See pp. 30-31 and 33.)

Capacity shortages plagued the American economy in the 1970s, most notably in 1973 and 1974 when virtually all materials were hard to get. (See chapter 3.) Prevailing opinion--notably the National Commission on Supplies and Shortages--holds that these shortages were created by Government intervention. Demand was raised too high while supply was limited by price controls and environmental regulations. GAO reexamined the event and found that instabilities in the private market played a commensurate if not greater role in the capacity shortages. Supply in 1973 and 1974 was not enough to meet demand of even a normal business cycle peak. Despite price controls, industry was producing virtually all it could from the capacity it had. Clearly, industrial capacity was deficient--most plausibly because the profitability of making materials hit post-war lows in the 1970-1971 recession. This was a result, in part, of the temporary shift in industry financing and competitive behavior in the 1960s. The experience suggests that capacity shortages can arise irrespective of Government intervention. (See pp. 13 to 20.)

Some capacity problems reappeared in the late 1970s as well, and shortages of major materials (e.g., steel, aluminum, and ethylene) have been forecast for the 1980s. (See pp. 25-28.) Current Government policies dealing with, for instance, environmental controls, energy prices, or foreign trade, have the potential for exacerbating supply problems of specific industries. (See pp. 28-29.)

Looking ahead, the problem of ensuring adequate materials capacity is necessarily linked with the challenge of revitalizing American industry and rebuilding the strategic industrial base, and GAO believes it should be given due consideration in evaluating appropriate policies to meet this challenge. (See pp. 5-7 and 30-34.)

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ABBREVIATIONS

BTU	British Thermal Unit
COWPS	Council On Wage and Price Stability
GAO	General Accounting Office
NCSS	National Commission on Supplies and Shortages

CHAPTER 1

INTRODUCTION AND OVERVIEW

. . . a far more serious problem than any recession-induced cutbacks in small projects is worrying businessmen and economists alike. They fear that a continued reluctance to embark on big, brand-new plants to make basic materials, such as steel, aluminum, paper and chemicals, will bring shortages in the 1980s, a surge in prices and greater dependence on imports."

Wall Street Journal, (June 11, 1979, p. 13)

This report is about the importance of industrial capacity in the materials-producing sector of our economy. Ever since the severe and widespread materials shortages of 1973-1974, there has been a latent concern over the possibility of repeating those shortages in the future. This is understandable given the fact that, as we pointed out in a previous report 1/, nothing was ever done to remedy the 1973-1974 shortage situation. It was largely "solved" by a worldwide recession and by the fact that global recovery from that recession has generally been slow and uneven. Sporadic shortages of a number of materials since that time, and predictions of shortages to come for still other materials, have probably acted to reinforce those concerns.

GAO issued a number of other reports 2/ dealing with the problems caused by the 1973-1974 shortages and the circumstances surrounding them. This was motivated by the severity of the shortages and the considerable concern and activity that they generated in the Congress. As the Permanent Subcommittee on

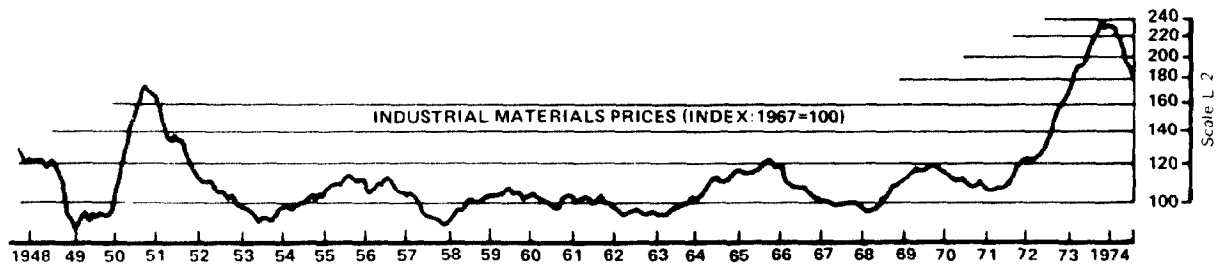
1/"Learning To Look Ahead: The Need For a National Materials Policy and Planning Process" (EMD-79-30, Apr. 19, 1979).

2/"U.S. Actions Needed To Cope With Commodity Shortages" (B-114824, Apr. 29, 1974), "Stockpile Objectives of Strategic and Critical Materials Should Be Reconsidered Because of Shortages" (LCD-74-440, Mar. 11, 1975), "U.S. Dependence on Imports of Five Critical Minerals: Implications and Policy Alternatives" (ID-75-82, Jan. 29, 1976). See also the Comptroller General's letter of January 28, 1975, to the Chairman of the Senate Commerce Committee (B-114824).

Investigations of the Senate Committee on Government Operations noted in August 1974, ". . .shortages of materials have become a very important issue and a very vexing problem. Without adequate raw materials, industry cannot sustain production levels and the economy suffers." ^{3/} One of the problems the Committee was referring to was the rapid run-up in the prices of key industrial materials. As the chart below shows, this was a situation unparalleled by anything since the Korean War.

Chart 1

Industrial Materials Prices: 1948 to 1974



Source: Business Conditions Digest (December 1974),
Department of Commerce, Washington, D. C., p. 40.

As a result of these shortages, the Congress passed legislation to create the National Commission on Supplies and Shortages. ^{4/} The Commission was expected to make recommendations on the institutional adjustments needed within the Federal Government to better monitor and predict the likelihood of future shortages.

In the Commission's view the shortages were traceable to three major causes: a worldwide surge in demand; insufficient productive capacity in the materials industries; and panic buying, which the Commission ascribed to a "shortage mentality" on the part of purchasing agents.

The Commission felt that the insufficient productive capacity in materials industries was the result of several factors: an almost continual state of overcapacity in these

^{3/}Materials Shortages: Industry Perceptions of Shortages, Permanent Subcommittee on Investigations, Committee on Government Operations, U.S. Senate, Washington, D.C., August 1974, p. 1.

^{4/}Public Law 93-426, approved on September 30, 1974, and signed into law by President Ford on October 1, 1974.

industries since the Korean War, depressing the incentive to invest; over-valuation of the dollar; and further business investment uncertainty as a result of the many forms of increasing Government intervention in the market.

In our 1976 report 5/, we stated our belief that the 1973-1974 shortages were fostered by prior periods of depressed raw materials prices. This, in turn, tended to inhibit capacity investment and expansion. We did not develop this point further because, at that time, the major issues seemed to center around questions of whether the shortages were caused by a looming depletion of the world's resource base, and the possibility of cartel formation and consequent price manipulation for key minerals other than oil.

Since that time, however, there has been a continuing problem with intermittent shortages of some materials (such as cement in 1977-1978, cobalt in 1978-1979, and titanium in 1979-1980) and price problems with others (such as copper, aluminum, lumber, platinum, and gypsum board). Capacity problems in many basic materials industries are being cited increasingly as a factor in the current rate of inflation. Yet, amid growing calls for the "reindustrialization" of America in response to these and related economic issues, the processes surrounding the creation or insufficiency of basic materials capacity still seem to be overlooked and poorly understood.

Objectives, Scope and Methodology

Against this background, GAO had two basic objectives in preparing this report. The first was to provide a general primer about materials capacity and its importance in order to enhance public understanding of these issues. This is the purpose of Chapter 2, where we define "industrial capacity" in our materials producing sector, where we note some of the difficulties encountered in measuring and monitoring materials capacity, and where we describe the relationship of capacity problems to other contemporary economic concerns such as trade and productivity problems.

Our second objective was to re-examine the causes of the materials capacity shortages during 1973 and 1974, and to examine what has transpired since that time to affect the prospects of future shortages. GAO performed this work because of continued Congressional interest in materials problems, and to provide the Congress with additional information as it continues its legislative oversight activities in this area. Therefore, in Chapter 3

5/"U.S. Dependence on Imports of Five Critical Minerals: Implications and Policy Alternatives" (ID-75-82, Jan. 29, 1976, page 16).

we examine the capacity shortages of 1973-1974, and assess their significance and causes. In Chapter 4, we conclude with a summation of the relevant events in the latest business cycle peak and future capacity problems in key materials industries.

The information and analyses used to satisfy our objectives were drawn from a variety of sources. To reconstruct and evaluate the significance of the 1973-1974 shortages, we reviewed records of Congressional hearings and floor debates, testimony before the National Commission on Supplies and Shortages (NCSS), and official data prepared by Government agencies such as the Department of Commerce. We also drew upon our own previous reports, as well as the reports and case studies prepared by others, that described the circumstances surrounding the 1973-1974 shortages and the actions needed to deal with them.

We also reviewed and analyzed events reported by a broad range of trade journals over a fifteen to thirty year period. These sources provided most of the data on business trends--materials prices, investments, and profits--that shaped capacity decisions in the years just before the 1973-1974 shortages.

Some of our data had inherent limitations. Although list prices for materials are published, transaction prices in the market must be inferred from other sources. Information on attitudes and competitive orientation, as well, has to be inferred from behavioral and other unquantifiable evidence. Capacity utilization data, if available at all, can also be imprecise, and comparisons among industries or over time must be made with caution. Another limitation is that little systematic data exist for pollution clean-up costs and capacity retirements prior to 1973.

We used a variety of analytical techniques in examining the causes of the 1973-1974 shortages. We were looking for an explanation of why materials were in short supply and other manufactured products were not, as well as why shortages took place during 1973 and not during previous business cycle peaks. Additionally, we reviewed other explanations of the shortages which were offered in and after the shortage period, notably in the 1976 NCSS study, "Government and the Nation's Resources."

Finally, we conducted numerous interviews with industry officials, trade association representatives, and Government commodity specialists and policymakers. These interviews, augmented by data in official Government publications and reports, were particularly helpful in our analysis of the events that have transpired since the 1973-1974 shortages.

Even though several Federal agencies collect and use data on materials capacity, a review of their programs was outside the scope of this report. Furthermore, since we did not critique their actions preceding or during the 1973-1974 shortages, we did not ask for their comments on this report.

CHAPTER 2

MATERIALS AVAILABILITY DEPENDS ON INDUSTRIAL CAPACITY

What do we mean by "industrial capacity"? For the purpose of this report we define industrial capacity for materials as the measure of maximum output that a plant, firm, or industry can produce when demand is unlimited and prices allow for a reasonable return on investment.

Why Capacity is Important

When demand exceeds potential output, bottlenecks usually occur in the manufacturing process leading to a situation referred to as "bottleneck inflation." The Wharton Magazine contained an interesting observation on this in an article by a former senior staff member of the Council of Economic Advisers 1/:

"A bottleneck can emerge at any stage-of-process, usually because of a shortage of labor, capital or materials and sometimes because of a shortage of services like transportation. In recent times, however, the shortages have tended to arise in industries which manufacture primary commodities and they have been due to a shortage of physical capital--plant and equipment--rather than of labor or raw materials or services. And shortages in such industries can be far more deleterious in their effect than shortages in industries which produce finished goods. . . In fact the further back in the processing chain a shortage occurs, the greater its potential impact because there is a larger number of industries that rely on the material."

A vivid illustration of this point was provided by the cement shortages which have periodically affected the economy during the late 1970s. During the fall of 1978, for example, one Congressman from a mid-western metropolitan area wrote to GAO about the problems caused by the cement shortages in his district. He reported that there had been a strong surge in concrete prices (from \$26 per cubic yard to \$60, or an increase of 130 percent), and that the local labor force (e.g.,

1/Popkin, Joel, "Early warning For Bottleneck Inflation", Wharton Magazine (Summer 1977), page 55. Dr. Popkin worked for the Council during the 1973-1974 shortage period.

cement masons) had been reduced to a two or three day work-week despite an abundance of on-going construction projects. About the same time, a Labor Department official told the Council on Wage and Price Stability (COWPS) of a similar impact from cement shortages in another large metropolitan area:

"While it is not possible at this time to estimate the full multiplier effect, the initial impact in Chicago for cement masons alone is a 50 percent decline in job opportunities." 2/

Industrial capacity in basic raw materials has also emerged as one of the factors underlying recent concerns with "supply-side economics." Three interrelated but separate problems--productivity, trade imbalance, and undercapacity--comprise the triad of these supply-side concerns. These problems in turn are thought to have a significant influence on inflation, slow economic growth, a weak dollar, and persistently high levels of unemployment.

In one sense, inadequate capacity is central to supply-side concerns. If a lack of capacity causes a shortage, then the productivity of downstream industries will be affected. Productivity in manufacturing was stagnant from early 1973 to mid-1975. Short supply at home also creates greatly improved export opportunities for other countries. Cement shortages in 1978 and 1979 virtually forced imports to triple. In this way, capacity problems can exacerbate productivity and trade problems.

In another sense, however, the nature of capacity problems tends to be in contrast to those of productivity and trade. Capacity problems tend to be intense but brief; a material may be in short supply during one business cycle upturn, but not during another. Capacity problems can also usually be counted on to pass during recessions. Productivity and trade problems, however, tend to be more persistent and long-term, although somewhat milder in their short-term effects.

At first glance, undercapacity seems the simplest of the three problems to correct--simply build more capacity. This was done when bottlenecks in materials capacity were encountered during the Korean War. Provisions of the 1950 Defense Production Act and the accelerated amortization provisions of the Internal

2/October 4, 1978, testimony before the Council on Wage and Price Stability by Edward M. Hogan, Director of the Chicago Construction Coordination Committee, Labor-Management Services Administration, U.S. Department of Labor.

Revenue Code were used to create incentives for new industrial capacity--materials industries received up to 80 percent of the funds so allocated. The problems of productivity and trade cannot be solved so directly.

However, the creation of new capacity is not quite that simple. It is an expensive process--significant additions to materials capacity often cost millions, even hundreds of millions, of dollars--and a lengthy one, often taking upwards of five to ten years to complete. As the decisionmaking environment for business grows more complex and uncertain, both the cost and the lead times for investments in capacity are likely to grow. The capacity problem thus emerges as one almost as intractable and complex as those presented by productivity and trade. In fact, it is difficult to see how solutions to any of these problems can be pursued independently.

Problems Encountered in Measuring Materials Capacity

When we refer, in this report, to industrial capacity for materials, we are referring specifically to those industries that produce metals, chemicals, paper, petroleum products, and building supplies. There are a number of public and private organizations which monitor capacity utilization for the entire economy--the Federal Reserve Board, the Bureau of Economic Analysis at the Department of Commerce, the economics department of McGraw-Hill, and Wharton Econometric Forecasting Associates Inc., among others. Trade associations, the Bureau of Mines and the Department of Energy maintain capacity statistics of physical output for specific commodities. Each of these groups, however, faces a similar problem in providing this service--that of measuring capacity utilization.

One basic problem is that the nominal stated measures of physical capacity may not necessarily be what a given industry can actually produce on a year-round basis. Nominal capacity is a measure, based on machine ratings, of how much the plant and equipment can produce when they operate 24 hours a day, every day of the year. Practical capacity, the more useful but less reported figure, measures the output that can be obtained from all operable facilities based on actual running experience with expected downtime and normal maintenance thrown in.

Because the operating practices and counting conventions vary among different materials producers, estimates of practical capacity (and thus capacity utilization) may vary from estimates of nominal capacity by greater or lesser amounts. This means that a nominal utilization rate of 85 percent in the cement industry, for example, may have a very different meaning than a comparable figure in the aluminum industry. For cement, it means

that capacity is operating very close to preferred rates, with only limited excess available before touching off significant price rises and/or shortages. For aluminum, it means that capacity is still running 15 percent below practical maximum, thus allowing considerable room for increased production. Because materials production is capital intensive, measures of capacity in these industries have much more significance for the upper limits of production than for other manufacturing industries.

As a final note of caution, a number of factors, including the new economics of energy, have made much of the capacity counted on the books obsolete under current economic conditions. The new economics of energy, for example, have probably rendered part of the Nation's capital stock obsolete. Such high cost capacity is usually idle until shortage-induced price hikes can justify its operation. In August 1978, the Federal Reserve Board Chairman alluded to this, saying, "Many studies show that we are near the point now where using additional existing capacity brings on high-cost capacity and this adds to inflationary pressures."

The Relationship Between Capacity and Shortages

Post-war history shows that capacity shortages are a problem only when the economy has reached or lies near a business cycle peak--that is, when demand is high, unemployment is relatively low, and the Gross Domestic Product is at or near its potential. Changes in capacity are, for the most part, uniform, relatively predictable, and difficult to alter on short notice. The problems more often arise with projecting demand, which usually fluctuates much more rapidly, sharply, and often unexpectedly. Shortages of capacity rarely occur during recessions because, by definition, the level of demand is usually less than what it was during the previous business cycle and less than the long-term investment profile for any given industry.

The warning flags of shortages building within the economy include depletion of inventories; firming of prices and cancellation of discounting practices; rising prices in spot markets; increasing lead times for the delivery of products; placing customers on allocation, and giving preference to established customers; and rising capacity utilization rates.

Business cycle peaks inevitably produce tight markets for materials but only rarely produce shortages stemming from inadequate capacity. Both are characterized by firm or rising prices, growing lead times, depleting inventories, etc. The difference between the two is imprecise and mostly a matter of degree. Shortages to which we refer--those of 1973-1974 and later aluminum, cement, benzene, or magazine paper shortages--have featured

spot prices at least fifty percent higher than producers' list prices, unexpected delays in supply, and some downstream disruptions. Tight markets, roughly speaking, have less extreme characteristics.

What is more difficult, however, is determining, for any particular situation, why a capacity shortage developed. Was it because prices were too low, perceived risks to investment too high, or were desired rates of return "unrealistic"? Were the costs of meeting environmental standards a factor, or were energy costs to blame? Were potential taxes too burdensome? Or, were the shortages due to something less fundamental--such as construction delays, break-in difficulties, or the vagaries of timing?

The basic model of capacity formation is that capacity is likely to be adequate to meet projected demand when the total payoff on new investment is sufficiently high. Another way of viewing the process is to assume that all current costs are covered by existing prices, leaving as other criteria

- the differential cost of environmental controls for new versus old capacity,
- the differential cost of energy for new versus old capacity,
- possible gains from technological improvements,
- after-tax capital costs weighted by risk factors,
- operating profit, and
- market growth prospects.

Our survey into capacity problems prior to, and since, the 1973-1974 shortages suggests three basic problems as sources of capacity shortages.

1. Excessive price discounting. This weakens earnings and expected returns on investment. In such situations even nearly full capacity utilization does not allow much improvement. This supports a belief among producers that excess capacity characterizes the market--a belief that may persist even when utilization rates approach the range that normally triggers expansion. This increases the delay in expanding. Such a pattern was reflected in the 1973 capacity shortages, and in part the recent cement shortages of 1978. Overly stringent price controls could produce similar effects.

2. Cost problems. Prices could allow for good profits, but new capacity becomes very costly relative to existing capacity.

Lengthy permit processes, differentially higher prices for energy, or prolonged problems in getting capital would do this. The current trend toward locating new aluminum production capacity offshore reflects the influence of these factors. ^{3/} New electrical power contracts, if available, cost considerably more than the existing ones (from which good current profits are being made).

3. Capital exhaustion. Prices and costs per se might allow expansion but firms might be so financially exhausted by years of weak earnings that they lack the capital to expand. Industry officials contend that if problems arise with domestic steel capacity in the coming decade, they will be largely attributable to a shortage of capital to finance necessary modernization and expansion.

None of these factors is absolute. It should be noted that a generalized inability of industry to raise the risk capital for expansion will exacerbate all three of these problems. Another point to note is that capital investment is not necessarily synonymous with creation of additional capacity. In this regard, Barry Bosworth raised an important issue in his 1976 article "Capacity Creation in Basic Materials Industries." ^{4/} He showed that investment outlays per se are an unreliable indicator of capacity changes. The steel industry invested virtually the same amount of money in the 1950s as in the 1960s. The key difference, however, is that the industry added 50 million tons of new capacity in the 1950s, and only one-tenth of that in the 1960s. Correlations performed on capital expenditures in the paper industry also find very weak relationships between investment outlays per se and changes in capacity. The point that should be kept in mind is that investment and capacity formation have different dynamics and that what increases one may not increase the other.

We turn now to a brief review of the 1973-1974 shortages, with an assessment of their significance and causes.

^{3/}"Domestic Aluminum Resources: Dilemmas of Development", (EMD-80-63, July 17, 1980).

^{4/}Bosworth, Barry, "Capacity Creation in Basic Materials Industries," Brookings Papers on Economic Activity, 2:1976.

CHAPTER 3

THE SHORTAGES OF 1973-1974: THEIR SIGNIFICANCE AND CAUSES

Even at the height of the oil embargo, a McGraw-Hill poll found that the oil boycott had less of an impact on business than the capacity shortages.

"The energy shortage, such as it is, has still had only a modest impact on over-all business. To this point, shortages of other materials and capacity limitations have been major causes of the slower tempo of business." 1/

Similarly, the Economist observed in mid-1973 that "the recent slowdown in growth was caused by . . . bottlenecks in supply . . . the American industrial machine is being slowed down by serious delivery problems."

Virtually every material used for industrial production was difficult to get during the shortage years of 1973 and 1974. Aluminum, for instance, which traded at 21-1/2 cents per pound in early 1972, cost traders around 50 cents per pound in 1974, if they could get it at all. 2/ Similarly, benzene, a precursor to half of all petrochemicals, traded at 21 cents per gallon in 1972, but cost over ten times that much in the spot markets of 1974. 3/ Overall, data from the Department of Commerce show that industrial materials prices nearly doubled during this period, moving from a second quarter 1972 average of 120.3 on its index to a second quarter 1974 average of 230.7. 4/

An excerpt from an article published after the shortages in the Brookings Papers on Economic Activity provides some indication of their significance in a historical context:

"These are extraordinary changes. During the 115 years that the Economist index for all commodities (including foodstuffs, but excluding fuels) has been compiled, in no year have com-

1/Business Week, Jan. 4, 1974, page 13.

2/Spot market quotations from Metals Week, 1972-1974.

3/Spot market quotations from Chemical Marketing Reporter, 1972-1974.

4/Business Conditions Digest, Table 1, December 1974.

modity prices risen as rapidly (63 percent) as they did from 1972 to 1973 and in no three-year period have they risen as rapidly (159 percent) as in 1971-74." 5/

Other items in short supply at the time--food, fuel, and fibers--were clearly related to the pressure of a growing world economy on a finite resource base. Some analysts also ascribed materials shortages to a similar shortage of raw minerals. Yet, what did prevent greater materials output was actually a lack of physical processing capacity in the United States, and to a lesser extent, the world. The bottlenecks, in a sense, were preventable. If investment in materials processing capacity had been greater during the early 1970s, many of the subsequent shortages could have been avoided. Instead, by early 1973, virtually all materials sectors were running their plants flat-out, with customer demand still rising.

Previous Analyses of the Shortages

The most prominent analysis of the shortages was contained in the 1976 NCSS report, Government and the Nation's Resources. NCSS rejected the view that the materials shortages resulted from a depletion of minerals from the earth's crust. Instead they cited three causal factors

- a worldwide surge in demand that began in 1972 which prevented this country from relieving the pinch with relatively cheap imports as it had done in the past,
- insufficient productive capacity in the materials industries stemming from a low rate of capital formation, and
- a shortage mentality which spurred purchasing agents to order in excess of need, and manifested itself in excessive inventory accumulation.

To explain the insufficient productive capacity, NCSS noted that the capital stock of materials processing industries grew very slowly after 1966, even as the capital stock of other industries continued to grow at traditional rates. NCSS focused on several factors relating to the influence of Government regulations which, they claimed, accounted for the poor investment

5/Cooper, Richard, and Lawrence, Robert, "The 1972-75 Commodity Boom", Brookings Papers on Economic Activity, 3:1975, page 673.

record. They included the progressive overvaluation of the dollar, the uncertainty engendered by environmental legislation, and price controls (imposed in 1971) which complicated both investment and production decisions in the early 1970s. Additionally, NCSS noted the steep decline in corporate profits after 1966 but only for the economy as a whole.

From a policy standpoint, according to NCSS, Government was the one at fault for its failure to appreciate the impact of its actions:

"Price controls were a compounding factor whose long-run effects seem not to have been fully grasped by many observers. The fact that the cost of meeting environmental and occupational safety and health regulations would be likely to divert some funds away from capital expansion should have been evident but seems to have been underrated. . . . To the extent that economic impacts were considered, each law or regulation was viewed largely in isolation." 6/

The NCSS study placed great weight on the Government's role and activities in bringing about the circumstances which led to materials shortages in 1973 and 1974. However, we believe that other factors--particularly developments in the materials industries during the late 1960s and early 1970s--may have been equally if not more significant as causes of deficient materials capacity which limited output. For example, an argument can be made that the strong emphasis on growth in the materials sector during the late 1960s led to rapid debt accumulation, keen price competition and, as a result, unprecedentedly low profits during the 1970-1971 recession. This reduced both the incentive and ability of these firms to invest in further capacity expansion.

Background to the Shortages

Explaining the circumstances which resulted in deficient materials capacity in 1973-1974 requires examining the particular characteristics of the materials industries and how they reacted to events of the prior ten to twenty years. Our explanation is inherently related to short-term and cyclical phenomena and does not pretend to be a definitive account of the overall investment process. Fundamentally, decisions to add, retain, or retire capacity remain based on expectations about future market conditions. That this process works for the most part is confirmed by the

6/National Commission on Supplies and Shortages, Government and the Nation's Resources, Government Printing Office, 1976, p. 59.

relative lack of shortages in the economy (at least until recently). Nevertheless, an explanation of what happened when the investment process did not support the materials needs of the economy helps in understanding some of the factors which can prevent adequate growth in future materials capacity.

Materials industries differ from product industries in that all materials of one sort (e.g., ammonia) are so similar that different producers must sell them at virtually identical prices. Products (e.g., copy machines), on the other hand, are usually different and their producers can sell them at different prices. If materials prices vary, customers will quickly switch to the lowest price seller, reasoning that since what is being purchased is identical then the lowest price is the best value. Even if product prices vary, customers will purchase from a variety of different producers, since each product may offer a different array of qualities and features whose relative worth will depend on what the customer may need. Differences among products may be emphasized to give each producer some insulation against the others. This protects each of them against being unilaterally dragged into a price-discounting contest.

Because materials must be similarly priced, it is relatively easy for an aggressive producer (who is sufficiently large) to lower the industry's price in the act of lowering its own. If a number of producers try to undersell one another, the result can easily be a price war.

For materials industries, this means that surviving recessions is a potential problem. Since most firms have excess capacity during recessions and since their factories have to be paid for whether or not they are being used, there is always a temptation to run the factories flat-out and sell the last bit of output at a price just sufficient to clear a small profit. However, as business behavior in the 1949, 1954, 1958 and 1961 recessions showed, materials industries managed to avoid that behavior, and they survived those recessions with their profits intact. There was, in effect, a tacit target operating profit that firms demanded for their output. Even though further individual transactions would make money at lower prices, such prices, were they to prevail industry-wide, would make it difficult for firms to survive recessions. In this way, industries revealed a preference for maintaining unit profit margins over sales growth.

During the early 1960s, there was a temporary, but fundamental, change in this behavior--the goal of sales growth began to be seen as a better route to higher earnings than retention of the traditional emphasis on high unit profits. This change started a sequence of events that culminated in the materials shortages of 1973-1974. Although the evidence on this point is somewhat indirect, the shift can be detected in the

trade press. For instance, Business Week looked back over this period and noted:

"Many companies caught up in the growth fever that hit its peak in the mid-1960s, acquired new product lines or entire companies, and put the emphasis on sales rather than profits." 7/

Similarly, an executive of a mid-sized aluminum company was quoted in the November 14, 1970, issue of Business Week:

"A lot of these guys have tremendous egos. They want to build the biggest company and grow-grow-grow. . . But what is it all worth if you don't make any money?" 8/

The December 11, 1965 issue of Chemical Week noted:

"Lately many companies have found that the only way to make the most of opportunities that have come along has been to borrow and in some cases, at least, the result has been impressive . . . Growth-oriented management can be expected to borrow as needed for such purposes." 9/

A final example comes from Pulp and Paper, which quotes this comment by an executive of a major paper manufacturer to a convention of printing executives:

"To understand what's happening in the paper industry today, we should take a look at what's been going on in the past. During the 50s, 60s, and early 70s the name of the game in the paper industry was expansion. Expansion at almost any cost. Expansion regardless of economics. So what happened? Capacity outpaced demand and as a result our industry conditioned yours to the habit of expecting cheap paper whenever you wanted it." 10/

What is most important, however, is that this new orientation towards the importance of growth demanded different strategies among manufacturers and a substantial influx of outside capital.

7/Business Week, Jan. 5, 1974, page 50.

8/Business Week, Nov. 14, 1970, page 30.

9/Chemical Week, Dec. 11, 1965, page 22.

10/Pulp and Paper, "North American Review," (1973), page 20.

Manufacturers of products needed money to finance sales growth investments, such as new product development, improving corporate image, extending the marketing and sales apparatus, and building the white-collar infrastructure necessary to do this. Manufacturers of materials had to do things differently. They could not rely on new products to boost growth since the basic commodity materials, strictly speaking, are the same from year to year. Industry growth comes from displacing other materials, from substitution, and from the growth in products that use materials. Corporate growth comes from greater market share per se. Therefore, producers of materials had to shave prices just under those of competing firms and make inroads into their actual or potential markets in order to grow.

Both strategies needed outside capital to work. Makers of products had to pay for accelerated product development and infrastructure, and producers of materials had to compensate for temporarily lower margins necessary to increase growth or decrease the shrinkage of market share. As a result, from 1964 to 1970, the ascendance of growth as a corporate goal was supported by an increase in net liabilities per sales at a rate five times faster than previous historical rates (1947-1964).

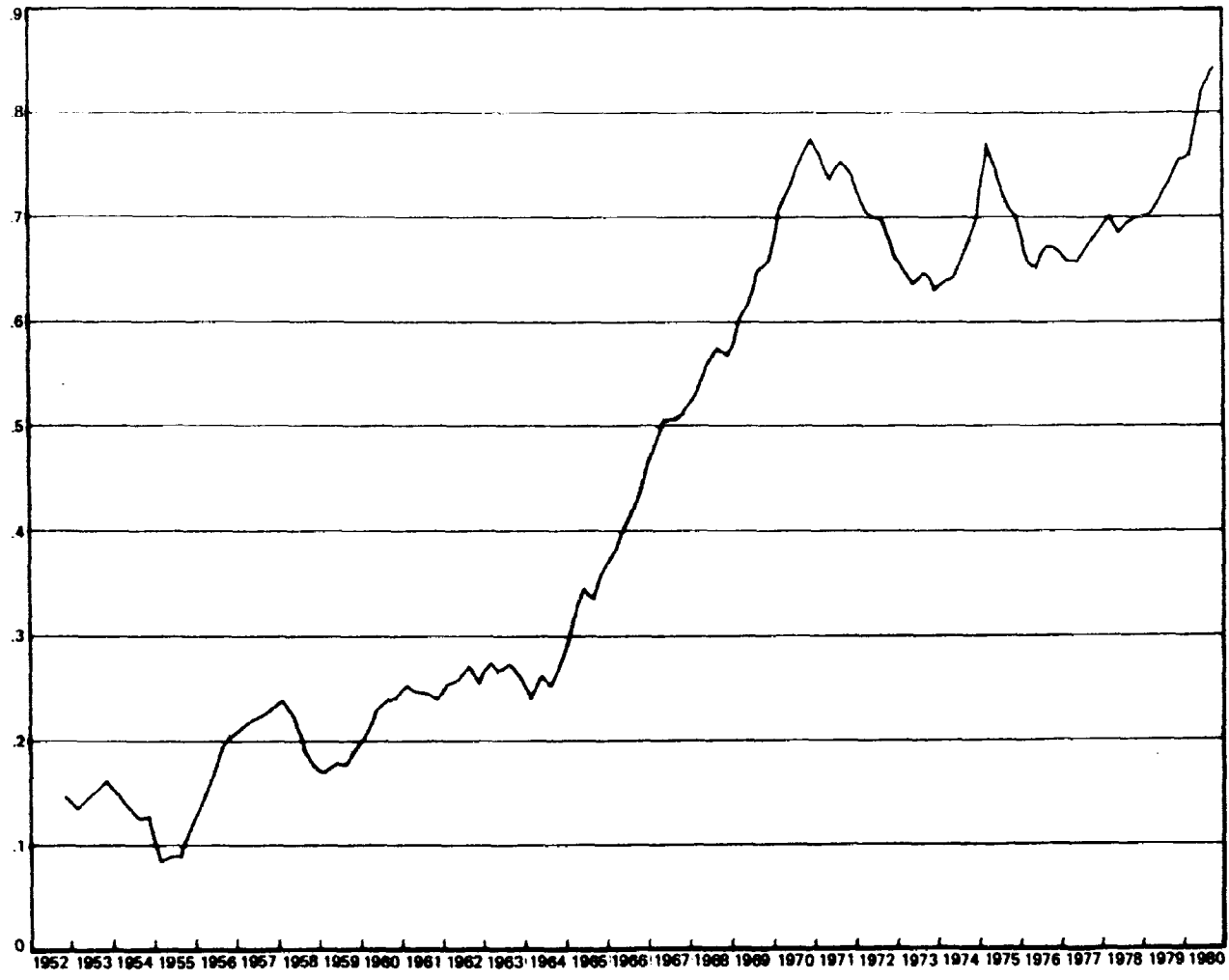
The rapid accumulation of debt, as depicted in Chart 2, was definite, significant, and unprecedented. On average, manufacturing firms accumulated two cents worth of added cash flow, through debt increase, for every dollar in sales--a flow rivaling retained earnings over that six-year period, 1964-1970.

The Effect of the 1970 Recession

The price shaving that characterized materials industries in the mid to late 1960s was tolerable to individual competitors only so long as overall capacity utilization was high. Less aggressive firms would not lose many sales because each firm had only so much capacity to fill. Yet the price-shaving acted to erode the tacit margins that had previously supported unit profits and prevented greater discounting in recessions. Periods of such temporarily weak demand such as late 1966 (petrochemicals), 1967 (paper, aluminum), and late 1968 (steel), revealed a significant potential for deep price discounting under excess capacity. Indeed, fertilizer producers, whose sales saturated the potential market in the late 1960s, achieved overcapacity in 1968 and from that point on began losing money. Nevertheless, good markets through 1969 hid such problems for other materials industries.

The 1970 recession opened spare capacity throughout the materials industries, and price competition suddenly intensified. Aggressive marketing practices most likely set off the discounting, but the presence of spare capacity meant that everyone had

Chart 2
Ratio of Net Debt to Quarterly Sales: All Manufacturing Corporations



Source: Federal Trade Commission: Quarterly Financial Reports

to meet (or beat) the market's lowest prices to sell at all. At that stage, it is difficult to make a clear distinction between initial or defensive price-discounting. The essential feature of the 1970 recession was that the tacit price margins (which earlier had inhibited firms from pricing just to cover marginal costs) had been eroded by several years of growth-oriented marketing. It therefore became difficult for any firm to estimate in advance where its competitors would stop in offering discounts. There was no place to hold the line.

The intensified price discounting took its toll on profits. Comparing profits per sales dollar in 1971 and 1961 (the last comparable recession year) shows that profits for materials industries ranged from 49 to 81 percent of what they had been ten years earlier (see Table 1). Conversely, profits for product industries were at least 84 percent of, and usually much greater than, what they had been ten years before. Most of the relative drop took place between 1969 and 1971, reflecting the sudden impact of overcapacity on earnings.

Manufacturers of products managed to fare better in 1971 because the latter recession was slightly milder and output was closer to potential. Since their growth aggressiveness did not manifest itself in price-discounting, such firms found it easier to withstand recession by reducing much of their white collar infrastructure--employed in advertising, research and development, internal consulting, and public relations--that was acquired during the heyday of growth (white collar unemployment in 1970 reached a thirty-year high).

For manufacturers of materials, however, the recession simply added to the pressures on prices and this induced further discounting. Aluminum, for example, listed at \$.29/lb. but traded below \$.22/lb. for most of the recession. These industries had worked themselves into a price trap, one which was all the more significant because capacity utilization was higher in 1971 than it had been in 1961. 11/

The unprecedentedly low earnings from 1970 to 1972 had a depressing effect on both old and new capacity. Many firms re-viewed their capital stock, much of it needing modifications to meet pollution abatement requirements, and decided to make some plant closings. Others figured that a market which featured such

11/Capacity utilization in steel, for example, was 78 percent in 1971 as opposed to 69 percent in 1961; for aluminum, the figures were 88 percent vs. 77 percent; for cement, 88 percent vs. 73 percent; for paper, 92 percent vs. 85 percent; and for petroleum 94 percent vs. 89 percent.

TABLE 1

PROFITS ON SALES OF MANUFACTURING SECTORS:
1961, 1971 AND RATIOS

Sector	1961	1971	Ratio
Paper	4.7	2.3	.49
Steel	4.6	2.6	.56
Basic Chemicals	8.2	5.0	.61
Nonferrous Metals	5.3	3.3	.62
Stone, Clay and Glass	5.8	4.5	.78
Petroleum Refining	10.3	8.3	.81
(1972:		6.6	.64)
Automobiles	5.5	4.6	.84
Miscellaneous	3.6	3.2	.88
Rubber	3.8	3.6	.95
Aircraft	1.8	1.8	1.00
Electrical Machinery	3.5	3.5	1.00
Other Machinery	4.1	4.2	1.02
Tobacco	5.6	6.1	1.07
Other Chemicals	6.6	7.1	1.08
Food Processing	2.3	2.6	1.13
Textiles	2.1	2.4	1.14
Metal Processing	2.5	2.9	1.16
Instruments	5.4	7.2	1.33
Printing	2.8	4.1	1.46
Leather	1.1	2.0	1.82
Apparel	1.3	2.4	1.85
Furniture	1.6	3.0	1.88
Wood	1.9	4.4	2.32

Source: Federal Trade Commission, Quarterly Financial Reports.

weak pricing was not one in which new capacity was likely to return good earnings. A number of trade officials cited "over-capacity" as the source of low industry earnings, and argued that it must be eliminated in order to return to adequate profitability. This explanation seems curious given the fact that many of these industries were on the threshold of full capacity utilization and subsequent shortages. In essence, prices were failing to give the correct signal that more capacity was needed. From

1970 to 1972, materials prices were seriously deficient as sources of information.

A Blurred Picture in 1972

The year 1972 was characterized by the anomalous combination of still-weak earnings, heavy price discounting, claims of overcapacity, and warnings of shortages together with their initial appearance in many lines.

Profits, as a percentage of sales, for most materials producers showed little improvement over levels of a year earlier. Construction materials' profits were up somewhat because of the improved housing market, and there was some recovery in paper's profits. However, steel and chemical earnings remained flat, nonferrous metals earnings declined somewhat, and petroleum earnings fell sharply. Rising capacity utilization did little to blunt price discounting. This was much to the surprise of trade officials. However, this behavior is consistent with the wearing away of tacit price restraints. The presence of spare capacity meant that firms would continue to undercut one another's prices as long as competition was necessary.

By mid-1972, shortages started appearing in zinc, cement, phosphoric acid and soda ash. Additional shortages soon followed in titanium dioxide, benzene, fuel oil and plywood, and warnings of shortages in other materials became more frequent.

By the end of 1972, although demand was rising sharply, there were no major expansions in steel, petroleum refining, zinc and many other non-ferrous metals. Only one expansion was being brought to completion in aluminum, and there was only relatively minor activity in paper and chemicals. There was, in short, nearly a complete cessation of capacity expansion on the eve of the 1973-1974 shortages.

The Role of Excess Demand, Inventory Speculation and Price Controls

The year 1973 was characterized by high demand, price controls, and the presence of a shortage mentality which manifest itself in frequent ordering in excess of need, all of which contributed to the severity of the shortages. Could these factors have caused shortages irrespective of capacity deficiencies? To some extent, they could have.

Yet, the level of realized demand--that is, production--was no greater than what a normal business cycle peak would have produced in 1973. From 1968 (the last previous business cycle peak) to 1973, the gross domestic product grew at an annual rate of 3.4 percent. This was lower than the historic rate of 3.6 percent

(1953 to 1968). Industrial production, similarly, grew at a 4.1 percent annual rate between 1968 and 1973--again slower than the historic rate of 4.5 percent a year (1953 to 1968).

Inventory accumulation (i.e. change in non-farm inventories) was 1.2 percent of the gross domestic product in 1973. Stock building thus added to materials demand in 1973; but to no greater extent than it had in previous business cycle peak years--1950 (1.7 percent of gross domestic product), 1951 (2.1 percent), 1955 (1.1 percent), 1966 (1.7 percent), 1967 (1.1 percent) or 1978 (1.0 percent). Hence, although potential demand may have been excessive, actual output or inventory accumulation was not.

It is worth noting that industry had to strain to meet even these moderate levels of peak output. For example, steel mills reduced tolerance specifications on many shipments, pigment plants and paper mills limited the number of grades offered in order to reduce machinery downtime, and petroleum refiners reduced octane levels one point. Such actions indicate that capacity was unprecedentedly deficient relative to a normal business cycle peak.

Price controls can create shortages when they discourage capital formation and raise long-term demand to unrealistic levels. Even over the short run, keeping prices below the level which equilibrates supply and demand will create shortages. Therefore, during 1973 and 1974, price controls did influence how efficiently a limited supply was to be allocated. However, they appear to have had much less effect in decreasing the growth of materials capacity in the early 1970s--and were thus not major causes of the undercapacity which characterized materials production.

It is true that on August 15, 1971, when price controls were imposed, the operating margins of materials producers were at their lowest. Materials producers, therefore, had particular problems in restoring normal profit margins while controls were in force. For this reason, many fault price controls for having been a major cause of undercapacity. In 1978, an economist with the National Bureau of Economic Research found that price controls ended up raising prices, and cited as explanation the "conventional wisdom" that they "discouraged business from adding to plant and equipment and thus reduced the potential output of the economy." 12/

However, the effect of price controls in the expansion of

12/Blinder, Alan S., and Newton, William J., The 1971-1974 Controls Program and the Price Level, an Econometric Post-mortem, National Bureau of Economic Research Working Paper 279; also Blinder, Alan S. as quoted in Business Week, Feb. 26, 1979, p 12.

materials capacity may, in fact, be less than conventionally believed. For example, at the outset of controls, there were many nominal prices which were lower than the legal limits allowable under the controls program and which did not recover their former levels until 1973. These include aluminum, copper, steel reinforcing bar, and retail gasoline. Steel and chemical firms, among others, were allowed to raise their average nominal prices by a certain amount but could not achieve these prices in the marketplace throughout much of 1972.

Secondly, because prices were being discounted heavily from the late 1960s through 1972, controls on nominal price levels had only a marginal impact on the actual discounted transaction prices of most materials industries until after the summer of 1972. Since new capacity takes at least 21 months to install, it is unlikely that the controls program significantly delayed projects that would have been due onstream before mid-1974. By then, shortages were on their way out.

Other Factors in the Shortages

The world-wide economic upturn during this period had a distinct effect on the inability of imports to relieve domestic shortages, but not on the fact that there was basic undercapacity at home. Had imports been available, however, it would have marked the first time that the United States was dependent, to that extent, on imports to get it through a business cycle peak. Previous peaks in the mid 1950s and the late 1960s found the domestic economy to be relatively self-contained for most materials.

In a secondary way, we believe that the initial implementation of environmental standards did make some contribution to the 1973-1974 shortages.

Environmental controls, acting in concert with the heavy discounting of materials prices, may have had a bearing on decisions to add new capacity. ^{13/} This is because the controls

^{13/}Environmental controls in the early 1970s, as a rule, meant a 10 percent surcharge for the costs of new capacity. Given the historic two to one capital-output ratio for materials investment, as well as some standard amortization and financing assumptions, we estimate that it would have taken two cents per pretax sales dollar (about one cent in after-tax profits) to defray the capital costs of pollution control. This two percent cost compares to the four or five percent which materials prices would have had to rise before manufacturers' profits in the 1971 recession would have been brought up to normal for recessions of that magnitude. In other words, the weakened ability to recover pollution control capital expenditures on new capacity hurt half as much as the poor profitability alone did.

imposed requirements on new capacity which had to be met in a market where prices had not yet risen to reflect the cost of such controls on existing capacity. In addition, older plants--faced with retrofit requirements--were frequently of marginal profitability, not worth further investment and therefore candidates for closing when such investment was required. Both effects reflected the weak materials markets of the 1970-1972 era which did not give producers much confidence that environmental costs could be passed forward to customers. If they had to be absorbed, then marginally profitable capacity expansion (or retention) would be made unprofitable and thus postponed.

In addition, as noted in Table 2 below, the fall in the ratio of debt to sales among manufacturing firms from year-end 1969 to year-end 1973 indicates that resources available for investment exceeded the incentive to invest. For this reason, it also seems unlikely that money used for pollution controls would have otherwise gone into expanding capacity.

Given the confusing picture presented to most producers by the materials' market immediately preceding the shortages, we believe that environmental controls merely reinforced the existing disincentives to investment and thereby played a much more limited role than has previously been suggested.

Table 2

The Ratio of Net Debt to Quarterly Sales for Selected Materials Industries: 1969 and 1973

	<u>Ratio of Net Debt to Quarterly Sales Year-end 1969</u>	<u>Ratio of Net Debt to Quarterly Sales Year-end 1973</u>
Steel	1.105	.912
Nonferrous	1.184	1.066
Stone, Clay & Glass	.563	.576
Paper	.921	.791
Chemicals	1.084	.836
Petroleum Refining	1.051	.804

Source: Federal Trade Commission Quarterly Financial Reports.

Aftermath

The shortages of 1973-1974 were largely ended by the recession of 1975. Paradoxically, the excessive inventories that had been built as a hedge against the shortages contributed to the severity of the ensuing recession. Once the end of the shortages became clear, there was little need for these hedge inventories and an abrupt and sharp decline in orders followed. This cut demand to recessionary levels.

In the next chapter, we will examine the presence of capacity problems in the latest business cycle peak (1979) and we will identify certain factors that may have a bearing on the adequacy of materials capacity in the future.

CHAPTER 4

TRENDS THAT MAY SHAPE THE STATE OF MATERIALS CAPACITY IN THE 1980s

Capacity deficiencies can hinder the economy in the 1980s. Over the last decade, new obstacles have arisen to inhibit domestic capacity formation. These include regulatory costs and delay, uncertain energy costs, potential import gluts, and capital availability problems. Each of these, by itself, is capable of hindering the expansion of capacity within specific materials industries. Taken together they raise the possibility of significant capacity problems to a level of national concern.

Capacity Problems Continue

In the fall of 1979, under a headline entitled "Capacity Utilization Goes Nearly to the Limit", Business Week observed:

"The Federal Reserve Board's recent revision of its capacity utilization figures shows that the current inflation is more attributable to capacity shortages than previously thought. The figures for manufacturing as a whole changed only slightly, with capacity utilization in December 1978, moving up half a point to 86.8 %. In three sectors, however, there were large revisions, which indicates that production was straining against very real limits. Metals were revised upward by 5.3%, to 96%; textiles were raised by 5.9% to 87.8%, and paper by 7.1%, to 93.9%. For these industries, the capacity utilization was close to the 1973 peak, when the "capacity shortage" was seen as the major inflationary force." 1/

In short, materials capacity problems have continued to plague the economy. This has occurred despite the economy's generally weak recovery from the 1974 recession, despite a slowdown in the growth rate for materials and, in some cases, despite a new increase in imports of some materials. If demand for materials had grown at historical rates, capacity for almost all materials would have been deficient by late 1978 or early 1979.

Capacity problems since 1978 have been more sporadic and,

1/Business Week, Oct. 1, 1979, page 18.

in most cases, less severe than those which took place in 1973 and 1974. By early 1979, the steel industry had worked itself up very close to full capacity, making supplies tight but not short. ^{2/} Capacity utilization was also high in the paper industry. Magazine grade paper was short for several years, and newsprint was tight throughout 1979. A combination of a crude oil pinch in 1979 and deficient catalytic reforming capacity in domestic refineries hurt the production of benzene, toluene, and xylene. Benzene prices, for instance, rose from 65 cents a gallon in the spring of 1978 to \$2.40 a gallon a year later.

In a few instances, however, the problems prompted analogies to the situation just five years earlier:

"Most of you experienced the shortages of 1973-1974. The 1979 shortfall in titanium supplies virtually duplicates the 1973-1974 shortfall." ^{3/}

Chart 3, below, shows what has happened in the last few years to lead times for aircraft-quality raw materials as a result of the shortages of aluminum and titanium capacity.

Aluminum smelters world-wide worked at full capacity (when they had electricity) starting in early 1978. Strong demand outstripped production and depleted inventories so that by early 1980, shortages had doubled the spot prices of aluminum over their levels of a year before. Prices of tin and lead nearly doubled in that period. Shortages of silver, molybdenum, cobalt and tantalum pushed their spot prices to levels as much as five to ten times higher than in 1978.

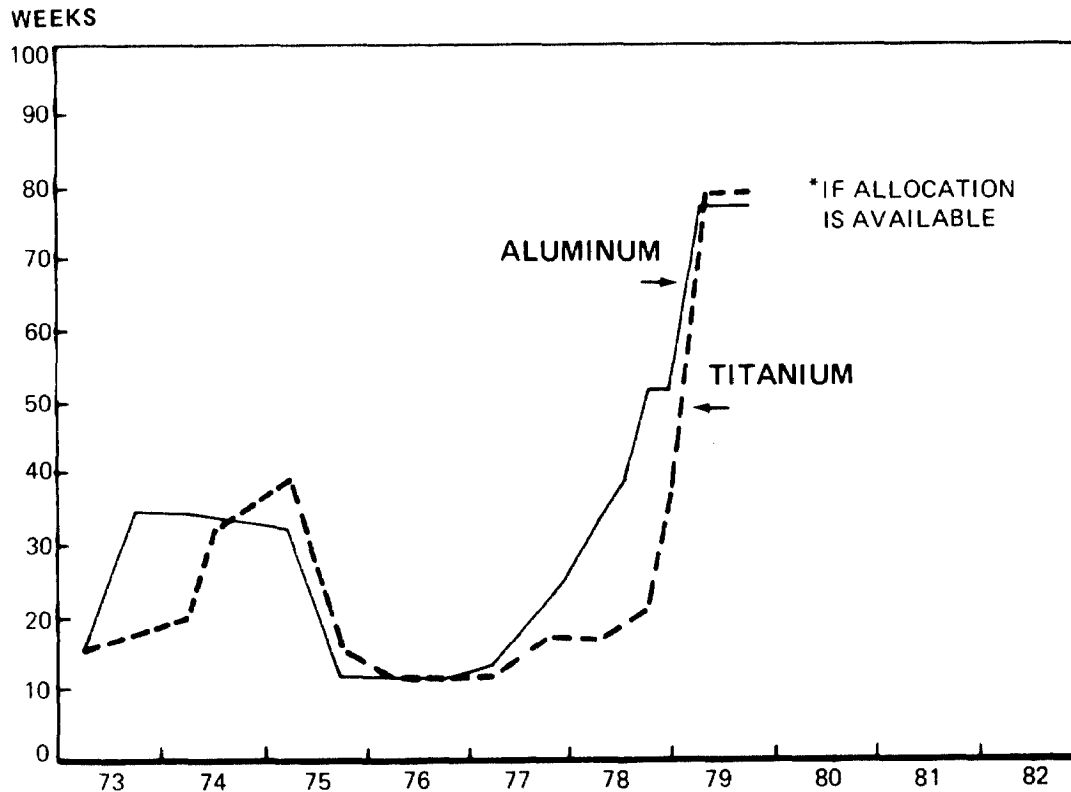
Cement and gypsum shortages during this period were comparable to, or even slightly more severe than, the 1973 experience. Cement shortages started in the Southwest in 1977, spread to most of the western half of the country by mid-summer of 1978, and began to affect eastern markets by the fall of that year. The shortages became so bad that construction contractors in North Dakota, for example, were forced to seek cement supplies from as far away as South Carolina. Average cement prices rose

^{2/}Shortages in steel were prevented by a significant shift in the balance of steel trade between 1973 and 1979; net imports of steel in 1973 were 11.1 million tons; in the year between July 1978 and June 1979 net imports were 15.6 million tons.

^{3/}Excerpts of a speech by William L. Swager, Battelle Memorial Institute, reprinted in the American Metal Market, May 22, 1979, p. 18.

Chart 3

Lead Times in the Aerospace Industry
for Titanium and Aluminum Sheet and Plate



Source: Testimony given by Phillip Vassallo, Senior Vice President of Grumman Aerospace Corporation, before joint subcommittee hearings of the House Committee on Science and Technology, October 23, 1979.

29 percent from 1973 through 1974, and 30 percent from 1977 through 1979. 4/ The pattern was similar for gypsum, with the national average price of gypsum board moving from \$44 per thousand board feet at the beginning of 1977 to \$66 per thousand board feet at the beginning of 1978. Prices then moved to \$99 per thousand board feet by the end of 1978 and then to \$114 by the end of 1979, with customers in many cases being put on allocation. 5/

4/ Prices f.o.b. plant, taken from the Bureau of Mines monthly survey of Minerals and Materials.

5/ Data from the Bureau of Mines' Mineral Commodity Summaries, 1978 (p. 71), and 1979 (p. 67).

These problems, although not as extensive as those which occurred in 1973 and 1974, helped move the economy to what many felt was its supply potential in 1979 and then into what one prominent forecaster described as the first supply-induced recession in modern U. S. history. 6/

Prospects for the Future

During 1979 and 1980, a recurrent message in the trade press for materials was the warning of shortages in the decade to come-- particularly for steel, aluminum, copper, and petrochemicals such as ethylene, benzene, and ammonia. For example, even though aluminum capacity is expected to grow by three to four percent a year through mid-decade, recorded announcements of new capacity are one or two percent a year behind. This would create conditions for chronic shortages of aluminum in the foreseeable future. It is difficult to locate a materials sector for which adequate capacity availability is assured through the 1980s.

We identified several broad trends that will have a bearing on capacity decisions during the coming decade. Awareness of these factors, and their possible implications, is important because they go to the heart of current concerns over the basic health of the U. S. industrial base.

The Energy Factor

Materials industries are typically energy-intensive. Up to half of the costs of such diverse materials as aluminum, ammonia, cement, chlorine, or ethylene can go to paying for energy in fuel or feedstock form. Rising energy costs also helped retire capacity in many of these industries during the 1970s.

One energy-related capacity problem has to do with the influence of the existing energy cost structure over decisions to add new capacity. During hearings before the Council on Wage and Price Stability, on October 4, 1978, cement industry officials testified that future energy costs provide a major element of uncertainty in their industry with respect to decisions about future capacity. This is also true in both the aluminum and ammonia industry where existing contracts for natural gas and electricity are as little as \$.50 to \$1.00 per million BTU respectively, and new contracts will probably go for over \$3.00 per million BTU. Since existing contracts determine the base for prices, the new higher costs will tend to have an inhibiting effect on new capacity. In our report, "Domestic Aluminum Resources: Dilemmas of Development" (EMD-80-63, July 17, 1980), we noted that these

6/Business Week, "Why Supply-Side Economics is Suddenly Popular", Sep. 17, 1979, p. 116.

problems would probably persuade American aluminum companies to locate new smelters outside the United States, and this has started to occur.

Environmental Regulations

Even though the capital costs of environmental regulations appear to have peaked, having declined 40 percent in real terms since 1975, these standards will continue to affect capacity growth because:

- The lead-times necessary to win approval for new capacity have increased due to extended permit requirements.
- New capacity will have to meet tougher requirements than those imposed for the retrofit of old capacity.
- Expenditures for the installation and maintenance of pollution control equipment will continue to provide significant competition with expansion needs for scarce capital.
- There is uncertainty concerning the enforcement of new types of laws dealing with toxic substances, surface mining, and occupational hazards.

Of these, the long process for obtaining permits appears most likely to have a bearing on the timely growth of capacity. The 1977 Amendments to the Clean Air Act, especially their monitoring and testing requirements, can easily add a year to the permit process and more if there is any controversy surrounding specific capacity projects. There is a greater risk involved in trying to gauge the need for capacity as far as three or four years ahead, compared to the two years ahead once required for new capacity. This may push operating rates closer to peak levels before new capacity can add to supply.

With regard to the other effects, the stricter requirements on new capacity discourage modernization. When the capital costs of new capacity are increased, industry prices (based on the costs of existing capacity) must rise a like amount before the original incentive is restored. Greater lead times, competing capital needs, and uncertainty over the future costs of regulatory enforcement all have a significant but unmeasurable effect on capacity expansion because they complicate the business decision-making environment and increase the risks to timely investment. Even a cursory reading of the trade press since the 1973-1974 shortages leaves little doubt about the increased sensitivity of these industries to the investment risks posed by the enforcement of these standards.

Capital Risks and Imports

Capital risks in expanding materials capacity have become consequential. A typical economically sized integrated steel mill can cost from \$1.5 to \$4.0 billion; an aluminum smelter, \$300 million to \$1.0 billion; a petrochemical plant or a paper mill, \$100 to \$700 million. Compounding these circumstances is the high debt-equity ratios that materials industries have reached in recent years (see chart 4). With all the current difficulties of raising money in the equity market, the materials industries, whose debt-equity ratios exceed those of other industries, are also limited in their ability to raise debt. A recent study by the State of North Dakota looking at the feasibility of their building a cement plant concluded:

"Inflation and environmental restrictions have pushed the price tag for new capacity up to \$100 to \$125 per annual ton. Since the minimum level needed for efficient production is about 500,000 tons, any company contemplating expansion is talking about outlays of at least \$50,000,000; a lot of money in an industry where the company with the largest profits earned only \$35,000,000 last year and where debt ratios are already averaging about 30%." 7/

A final factor concerns the future influence of imported materials. Imports per se do not lead to capacity shortages. Imports of aluminum, for example, may well be needed to compensate for insufficient smelting capacity in the United States. Most capacity problems in the past, and perhaps those of the future, can be traced to prices that were too low to encourage expansion. To the extent that imports weaken the domestic price structure, or to the extent that they capture a portion of the domestic market, they could dampen the expansion of domestic materials capacity. This, in turn, could lead to structural inflationary pressures during future business cycle upturns.

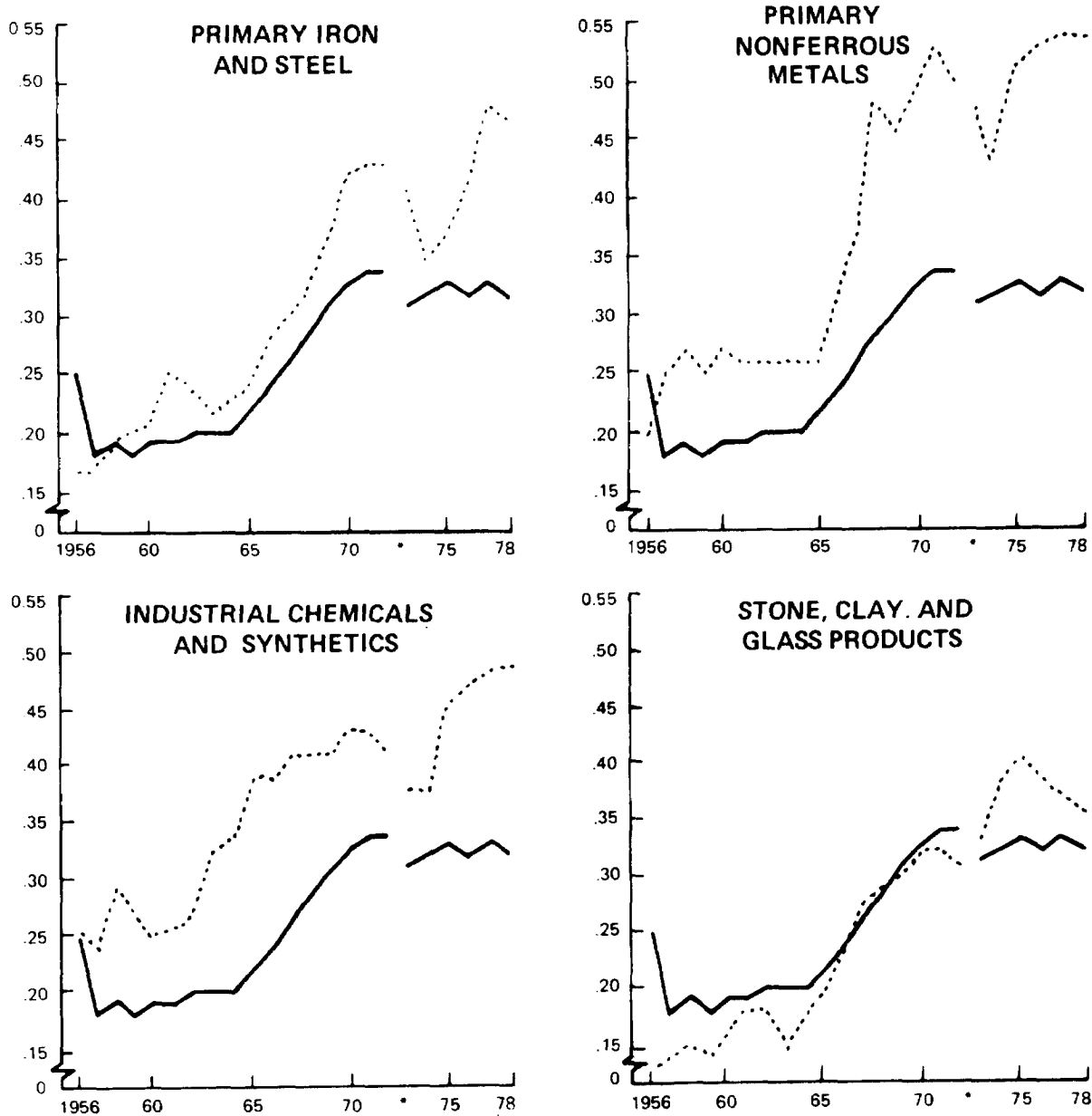
Overall GAO Observations

GAO has prepared this report as part of its continuing efforts to appraise the causes and consequences of the materials problems that continue to affect the American economy, and thereby assist the Congress with its legislative oversight activities in this area. One of the most persistent problems identified by our work is lack of an institutional capability, that transcends individual agency concerns, to monitor and analyze emerging materials issues and to provide policy guidance on a continuing

7/An Analysis of the 1978 Portland Cement Shortage in North Dakota and a Delineation of Possible Solutions to the Shortage, Business Industrial Development Department of the State of North Dakota, December 11, 1978.

Chart 4

DEBT-EQUITY RATIOS (NUMBERS ARE RATIOS OF DOLLARS INVOLVED)



Data after 1972 are not comparable with those for earlier years because of changes in method of consolidation (to minimize the effect of foreign operations of multinational enterprises) which were initiated in 1973.

— ALL MANUFACTURING
..... SPECIFIC INDUSTRIES

Source: Bureau of Mines, Status of the Mineral Industries, Oct. 1979, p. 28.

basis. The need for such a capability has been a recurring theme of our reports. In its absence, Government continues to respond to materials problems in a piecemeal fashion, and generally after the fact.

The importance of materials capacity has been officially recognized in at least one respect, the nation's defense, as attested to by the Defense Production Act of 1950. In broad terms, one of the main purposes of that act was to promote the maintenance of the industrial infrastructure necessary to the Nation's security in times of war. This aspect of materials policy seems likely to receive continued attention, given the recently expressed concerns by the House Armed Services Committee over a potential "resource war", and the resurgence of interest in "strategic minerals" and the surge capabilities of our industrial base.

However, while important, such approaches are not the whole story. Equally important, and what this report suggests has been largely overlooked, is the broader relationship between materials availability and the overall health and performance of the economy. It is in this context that the materials shortages of 1973-1974 derive part of their significance. The bottlenecks and inflation that accompanied those shortages marked the first time that concerns over materials were generated by the working of a peacetime economy.

In our work, we have repeatedly encountered the tendency to view materials problems as the step-child of other issues. However, recognition is slowly growing that this nation's ability to produce and process materials--although often at odds in many important respects with other important national policy thrusts (e.g., environmental policy, land use, energy policy, worker health and safety, trade policy)--is essential to a healthy, growing, and inflation-free economy.

Reflecting this recognition, the Congress enacted, on October 21, 1980, the "National Materials and Minerals Policy, Research and Development Act of 1980" (P. L. 96-479). The act aims to establish a coherent national materials policy and coordinated programs to assure the availability of materials critical to the economic well-being, national defense, and industrial production of the United States. It defines "materials" to include nonfuel materials and minerals. The Congress considers that notwithstanding the Mining and Minerals Policy Act of 1970 (30 U.S.C. 21a), the United States did not have a coherent national minerals policy.

The 1980 Act mandates that the President, through the Executive Office of the President, (a) coordinate the activities of responsible departments and agencies in the materials area, and

(b) assume certain specific responsibilities, including assessing Federal policies at all stages of the minerals cycle, including tax policies. It also assigns several Federal departments and agencies specific responsibilities. The legislative history of the 1980 Act indicates that the Congress aimed to make the Executive Office of the President the locus of responsibility for coordinating and developing Federal materials policies, rather than to assign it to a particular Federal Department or agency. "Elevating the leadership role to the Executive Office of the President should assure that departments and agencies will be permitted to exercise their responsibilities with an oversight of decision and policy coordination provided by the President." 7/

In addition, recent hearings by the House Armed Services Committee on materials problems and the health of the U. S. industrial base are expected to result in legislative action during the 97th Congress.

We believe the materials capacity problems discussed in this report provide further evidence of the continuing importance of materials issues and the need for greater attention to this area. Evidence suggests that the threshold for capacity expansion in materials industries is being pushed closer to peak operating levels than in the past. This means that there could be less slack than supposed for non-inflationary growth during a period of normal expansion in the business cycle. Strong inflationary pressures from the manufacturing sector, in other words, may arise earlier in the cycle. Furthermore, recent work has suggested that the equilibrium between capacity utilization and inflation may lie at lower utilization rates than previously thought. 8/

GAO believes these trends provide a basis for concern, especially given the growing dialogue over the need for industrial

7/U. S. Senate, Report No. 96-937, Sep. 12, 1980, p. 6.

8/See Rose McElhattan's "Estimating a Stable-Inflation Capacity-Utilization Rate" in the Economic Review of the Federal Reserve Bank of San Francisco, Fall 1978, pages 20-30. Although many economists believe that the historical peak of capacity utilization must be surpassed before inflationary pressures arise in the domestic, nonfarm business sector of the economy, McElhattan's analysis suggests that pressure starts to build much earlier--once the operating rates exceed 82 percent, "Once capacity utilization exceeds the range indicated, the increased inflation tends to become imbedded in future inflation, with the current period's higher prices being reflected in the next period's expectations. Our analysis suggests that when the operating rate rises above the full-capacity range, its return to that range will be accompanied by higher rates of inflation.

revitalization. Therefore, as the Congress and the new Administration move to deal with the economic problems that seemed to multiply during the 1970s, GAO believes that the problem of assuring adequate capacity in our basic materials industries merits sustained and high-priority attention. But, Government policymakers must also be sensitive to the possibility that indiscriminate warnings of imminent shortages could precipitate the same kind of panic buying that exacerbated the 1973-1974 shortages. Additionally, they should also recognize that broad policy actions could affect individual industries in different ways, producing desired effects in some while not affecting or being counterproductive in others.

Finally, the capacity problems outlined here bear a striking resemblance to the more general circumstances thought to be plaguing American industry and which underlie the current calls for a program of economic revitalization. Many materials industries have been plagued with almost chronic problems of poor competitiveness. That circumstance, combined with cyclically weak earnings and high debt ratios, has made it difficult for them to attract the capital they need for modernizing and expanding capacity. Since materials production is especially intensive in energy use and potential pollution, the costs of saving energy and cleaning the environment have compounded the materials industries' capital problems even more.

It is these industries, however, which stand at the front of the American industrial infrastructure and, as this report has tried to show, play an important role in its performance. That relationship has been overlooked too often in the past. It is imperative that it not be overlooked in any conscious efforts to revitalize the American economy.

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