

International comparisons

Comparing 50 years of labor productivity in U.S. and foreign manufacturing

Although manufacturing labor productivity increased less in the United States than in other G-7 countries over the last 50 years, the growth rate has accelerated in the United States after 1973, while slowing down in the other countries

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Labor productivity in manufacturing has been a topic of interest throughout recent decades. Research was directed at different issues at different times, depending on economic developments. For example, after 1973, discussion focused on whether there was a historical slowdown in productivity growth in the industrialized countries.¹ Currently, an issue has focused on whether and how the introduction of information technology is affecting manufacturing productivity.² In addition, the progressive globalization of the world economy, increasing exposure of individual countries to international trade and capital movements, has heightened interest in productivity, particularly in comparisons among countries. For instance, analysts are examining the relations among labor costs, productivity, prices, and competition.³

The Bureau of Labor Statistics international comparisons program began estimating and comparing trends in manufacturing labor productivity and unit labor costs in 1973, making comparisons back to 1950. These accumulated data make it possible to now look at these trends from the perspective of half a century.

Labor productivity in the U.S. manufacturing sector grew continuously over the last half of the 20th century, and this growth accelerated during the 1990s. This is different from most of the other countries in this article, for which productivity

increases slowed over time. The growth in U.S. labor productivity was accompanied by relative stability in manufacturing employment and hours worked, in contrast to most other countries, where manufacturing employment and hours declined. Historically, increases in manufacturing hourly compensation and in unit labor costs have been more moderate in the United States than elsewhere, although, during the 1990s, other countries have succeeded in reducing their hourly compensation and unit labor cost increases to the U.S. rates or below.

In this article, labor productivity is measured as the value of real manufacturing output produced per hour of labor input. Increases in labor productivity reflect the joint effects of many influences, including capital investment, advances in technology, and organizational efficiencies, as well as improved skill levels of the workforce.

Unit labor costs are defined as the cost of labor input required for the production of one unit of output. They are computed as labor compensation in nominal terms divided by real output. Changes in unit labor costs reflect the net effect of changes in hourly worker compensation and in labor productivity. Unit labor costs rise when compensation per hour rises faster than labor productivity. Conversely, if labor productivity rises faster than hourly compensation, unit labor costs decline.

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This article discusses the trends in U.S. manufacturing labor productivity and unit labor costs that have occurred over the half-century 1950–2000, comparing and contrasting these trends with those of the other G-7 countries (Canada, Japan, France, Germany, Italy, and the United Kingdom).⁴ Developments in the manufacturing sectors of five other European countries, and of Korea and Taiwan, are also summarized. The data analyzed are from the BLS data on international comparisons, in which U.S. and foreign data are produced according to comparable concepts, definitions, and classifications.⁵

This article first presents an overview of the entire 1950–2000 period, showing the long-term similarities and differences between the manufacturing sectors in the United States and abroad, and contrasting developments during three subperiods: 1950–73; 1973–90; and 1990–2000. The discussion then focuses on each of these three subperiods in turn, examining how changes in labor productivity and labor inputs combined to meet changing demand for output, and explains how changes in manufacturing unit labor costs were in turn the outcome of changes in labor productivity and in hourly compensation rates. The analysis focuses on developments in the U.S. manufacturing sector, contrasting them with developments in other countries. In addition to the three main subperiods, the study also examines developments over certain shorter time periods, whenever this contributes to a better understanding of the underlying trends.

Sometimes, to facilitate comparisons for this analysis, the European members of the G-7 are treated as a unit, and referred to as “Europe G-4.” When numerical growth rates are given for “Europe G-4,” these are simple arithmetic averages of the respective growth rates for France, Germany, Italy, and the United Kingdom.

Comparative growth varied over time

This study uses BLS comparative time series data for manufacturing labor productivity and related measures. These data are available beginning with 1950 for most of the countries included in this study, with the most recent data available for 2000.

The comparative productivity measures used in this study employ a “value-added” concept of manufacturing output, defined as the value of gross output less the value of all intermediate purchases of goods and services. The value-added data are produced by the statistical agencies of the countries compared, as part of their national accounts. In its system of official productivity measures for the United States, BLS employs a measure of “sectoral” output, which equals the value of gross output less the value of intrasector sales and transfers. In general, measures of “sectoral” output are preferred for industry productivity measurement. Value-added output is used in the present study because the data

are available and because the economies of compared countries differ in size and in the extent of vertical integration of their industries.

Because the comparative value-added series for U.S. manufacturing begin in 1977, for prior years we link the sectoral output series for U.S. manufacturing to the value-added output series at 1977, to create an analytic data set for the 1950–2000 period. It is important to recognize that while these two output series tend to have similar trends over longer periods of time, their growth rates may diverge over shorter time periods. This issue and other aspects of the comparative productivity series and related measures are described more fully in the appendix.

To compare and contrast the changes that have taken place in the competitive position of the United States vis-à-vis the other countries, the 1950–2000 interval has been divided into three periods: the period before 1973; the period between 1973 and 1990; and the most recent decade, 1990–2000. Local cyclical peaks in manufacturing output were reached in 1973 in the United States, Germany, Japan, and the United Kingdom. In Canada, France, and Italy manufacturing output peaked the following year. In addition, 1973 was a cyclical peak for U.S. labor productivity in manufacturing, after many years of continuous productivity growth.

The year 1973 is also a convenient benchmark because certain developments, which had important financial effects on all industrial economies, occurred during that year. One development was the end of the Bretton Woods system of controlled exchange rates and the introduction of floating exchange rates. Another development was the first of two major oil price shocks of the 1970s. The U.S. dollar appreciated strongly against most currencies after the second oil price shock in 1979. Then in 1985, as a result of the “Plaza Accord,” the dollar began a decade of major weakness.⁶ One consequence of the events of 1973 and 1979 was instability in the foreign exchange markets, causing sudden shifts in comparative production costs among countries. Another consequence was that the industrial economies were subjected to inflationary pressures, and manufacturing productivity increases slowed in most countries.

Five of the G-7 countries reached local peaks in manufacturing output between 1989 and 1991. The U.S. manufacturing output peaked in 1988, however the total economy reached a cyclical peak in 1990. In 2000, the terminal year of the comparative series, labor productivity reached its highest level in all G-7 countries, and output reached its highest level in all countries except Germany. Hours worked were at the lowest levels in Germany, France, and the United Kingdom. On foreign exchange markets, several years of relative stability began after 1990, following the U.S. dollar weakness in the second half of the 1980s. (A separate examination of the 1990s makes it possible to focus on the

trends that determine the current comparative position of the U.S. manufacturing sector.)

Overview, 1950–2000

During the last half of the 20th century, labor productivity in the manufacturing sector increased less in the United States than in the other G-7 countries—Canada, Japan, and Europe G-4 (France, Germany, Italy, and the United Kingdom). (See table 1; definitions of the measures presented in table 1 and in subsequent tables can be found in the appendix.) This slower overall growth in U.S. productivity is largely attributable to the pre-1973 period, when manufacturing productivity rose considerably more in the other regions than in the United States. (See chart 1, panel 1.) After 1973, growth in U.S. productivity continued and even accelerated, whereas productivity growth slowed in most other countries.

The pattern across time of U.S. productivity increases differed from that of the other countries. The U.S. productivity growth rate was relatively stable over the different time periods and subperiods covered by this study, and reached its maximum in the 1990s. The remaining G-7 countries, however, experienced their highest rates of productivity increases during the pre-1973 period, followed by considerably lower rates of growth in subsequent years. The one exception was the United Kingdom, where productivity growth remained relatively stable over the entire 50-year period.

All of the G-7 countries except the United States had their largest increases in manufacturing output during the 1950–73 period. As was the case in other countries, U.S. output growth slowed after 1973, but then it grew faster after 1990, regaining and even surpassing its pre-1973 growth rate. In the other countries, the output growth rate continued to slow after 1990, or made only a partial recovery. (See chart 1, panel 2.)

U.S. manufacturing employment, as well as average and total hours worked, remained relatively stable during the last half of the 20th century, compared with Japan and Europe G-4. (See chart 1, panels 3 and 4.) Manufacturing employment in the United States increased before 1973, then declined slowly afterwards. This resulted in a small net gain in employment and total hours between 1950 and 2000. As in the United States, employment in Europe G-4 grew before 1973, but employment and hours fell much more steeply after 1973. A similar pattern developed in Japan, where manufacturing employment grew rapidly before 1973, but then stagnated and declined, falling rapidly after 1990. Canada was the only G-7 country to experience growth in manufacturing employment during each of the three periods.

Over the entire 1950–2000 period, U.S. manufacturing unit labor costs increased less than those of most other countries, measured in national currencies. The greatest differences, however, occurred in the period after 1973 and before 1990.

(See chart 1, panel 6.) Before 1973, unit labor costs in U.S. manufacturing increased at an annual rate which was within 2 percentage points of the growth rates in the other G-7 countries. But during the following period, 1973–90, U.S. unit labor costs grew markedly more slowly than unit labor costs in most other G-7 countries. The U.S. unit labor cost increases during this period were particularly modest when compared with unit labor cost increases in the average of Europe G-4 countries, some of which were almost double the U.S. rate. After 1990, unit labor cost growth slowed in all G-7 countries, and the difference between the U.S. increases and those of the other G-7 countries was, again, comparatively small.

Modest hourly compensation increases were the main reason for the moderate growth in U.S. manufacturing unit labor costs.⁷ Over the entire 1950–2000 interval, hourly compensation increased in all countries and all periods compared, however the U.S. increases were, on the whole, more moderate (table 1). The U.S. average hourly compensation growth rate was markedly below the hourly compensation growth rates in Japan and the Europe G-4 countries. Among the major competitor countries, some had lower hourly compensation growth rates than the United States, but only during certain subperiods. Overall, labor productivity was less important, and hourly compensation more important in limiting unit labor cost increases in U.S. manufacturing than they were in the other countries.

Currency fluctuations played an important role in determining comparative trends in unit labor costs denominated in U.S. dollars during some periods, especially after 1973, when the Bretton Woods system of controlled exchange rates was replaced by floating exchange rates. The effect on U.S. competitiveness was positive or negative, depending on the period. Looking at trends in unit labor costs denominated in U.S. dollars over the entire 50-year period, one can see that the average U.S. increases were smaller than, or the same as, unit labor cost increases in the other countries (table 1).

Comparative trends of labor productivity and unit labor costs from 1950 to 2000 are summarized in charts 2 and 3. In these charts, indexes of manufacturing output per hour and of dollar-denominated unit labor costs (with 1973 = 100, for each of Europe G-4, Japan, and Canada) are divided by the corresponding index for the United States. (Japanese data begin with 1955.)

The slope of each line at a given year indicates the relative growth rates of the underlying measure. When the slope is rising, it means that the measure in the given country or region is growing faster, or declining more slowly, than the corresponding measure in the United States. The converse is indicated by a falling slope. The magnitude of the difference in growth rates is shown by the steepness of the slope.

Table 1. Average annual rates of change in manufacturing labor productivity and related measures, G-7 countries, 1950–2000

Period and country	Output per hour	Output	Total hours	Employment	Average hours	Hourly compensation	Unit labor costs		Exchange rate
							National currency	U.S. dollars	
Total, 1950–2000									
United States	2.9	3.3	0.4	0.4	0.0	5.6	2.6	2.6	...
Canada	3.0	3.9	.8	.9	–.1	6.3	3.2	2.6	–.6
Japan (1955–2000)	6.3	7.1	.8	1.2	–.4	8.3	1.9	4.7	2.7
Europe G-4	4.3	3.6	–.7	–.2	–.5	9.2	4.7	3.7	–.9
France	4.8	3.8	–.9	–.5	–.5	9.1	4.1	2.6	–1.4
Germany	4.7	4.0	–.7	.1	–.8	7.7	2.9	4.3	1.4
Italy	4.5	5.0	.4	.6	–.2	10.5	5.7	3.2	–2.4
United Kingdom	3.2	1.7	–1.5	–1.1	–.3	9.3	6.0	4.7	–1.2
1950–73									
United States	2.6	3.7	1.1	1.2	–.1	5.3	2.6	2.6	...
Canada	4.1	5.5	1.3	1.6	–.3	6.1	1.9	2.3	.4
Japan (1955–73)	10.0	13.8	3.5	4.0	–.4	12.6	2.4	4.1	1.6
Europe G-4	5.5	6.3	.7	1.2	–.5	9.4	3.7	3.8	.2
France	6.0	6.4	.4	.7	–.3	10.1	3.9	2.8	–1.0
Germany	6.9	7.6	.7	1.7	–1.0	9.8	2.7	4.8	2.0
Italy	6.1	7.9	1.7	2.0	–.3	9.7	3.4	3.7	.3
United Kingdom	3.3	3.1	–.2	.2	–.4	8.0	4.6	4.0	–.6
1973–90									
United States	2.8	2.5	–.3	–.3	.0	7.1	4.1	4.1	...
Canada	2.1	2.0	–.1	.0	–.1	8.8	6.5	5.5	–.9
Japan	4.1	3.9	–.2	.1	–.3	7.4	3.2	7.1	3.7
Europe G-4	3.4	1.6	–1.7	–1.2	–.6	11.9	8.2	6.9	–1.1
France	3.6	1.5	–2.1	–1.4	–.7	11.3	7.4	6.1	–1.2
Germany	2.9	1.4	–1.5	–.6	–.8	6.8	3.9	6.9	2.9
Italy	3.8	3.2	–.6	–.4	–.2	15.4	11.2	6.5	–4.2
United Kingdom	3.3	.3	–2.9	–2.4	–.5	13.8	10.2	8.2	–1.9
1990–2000									
United States	4.0	3.8	–.2	–.4	.2	3.7	–.2	–.2	...
Canada	2.1	3.3	1.2	.9	.3	2.9	.8	–1.6	–2.4
Japan	3.6	1.0	–2.5	–1.7	–.7	2.4	–1.2	1.8	3.0
Europe G-4	3.1	1.1	–1.9	–1.7	–.2	4.3	1.2	–1.9	–3.1
France	4.2	2.0	–2.1	–1.5	–.6	3.3	–.8	–3.4	–2.6
Germany	3.0	.3	–2.6	–2.5	–.1	4.5	1.5	–1.2	–2.7
Italy	2.3	1.4	–.9	–.7	–.2	4.5	2.2	–3.4	–5.4
United Kingdom	2.8	.7	–2.0	–2.1	.1	5.0	2.1	.5	–1.6

The 1950–73 period

Output, labor input, and labor productivity. All the G-7 countries recorded growth in manufacturing output, labor productivity, and employment during the 1950–73 period. (See table 1.) This was a period in which major productivity gains were accompanied by output gains rather than reductions in labor input. Indeed, all countries experienced employment growth, and only the United Kingdom recorded a decline in hours worked.

Between 1950 and 1973, manufacturing labor productivity and output increased less in the United States than in Canada, Japan, and the average of Europe G-4. In fact, the United States was the only country that did not have its highest output growth rates during the pre-1973 years. Japan achieved growth in manufacturing productivity that averaged 10.0 percent per year and posted output gains of 13.8 percent

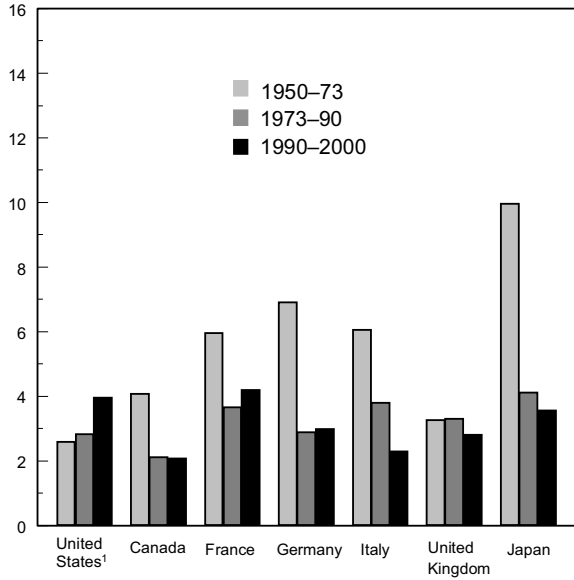
per year—by far its highest rates of productivity and output growth among the periods compared. Similarly, Canada and Europe G-4 experienced their highest rates of productivity and output growth during this period.

During 1950–73, total manufacturing hours worked increased in all the G-7 countries except the United Kingdom, as a direct result of increased employment, because average hours declined everywhere. The increases in manufacturing employment ranged from a high of 4.0 percent per year in Japan to a low of 0.2 percent per year in the United Kingdom. Most countries also experienced their fastest declines in average hours worked during this period, but average hours worked in U.S. manufacturing declined less than elsewhere. Employment in the United States and in Europe G-4 grew at the same rate before 1973. However, this employment growth was offset by bigger declines in average hours worked in Europe G-4, so that total hours worked in Europe G-4

Chart 1. Productivity, unit labor costs, and related measures in manufacturing, G-7 countries, 1950–2000

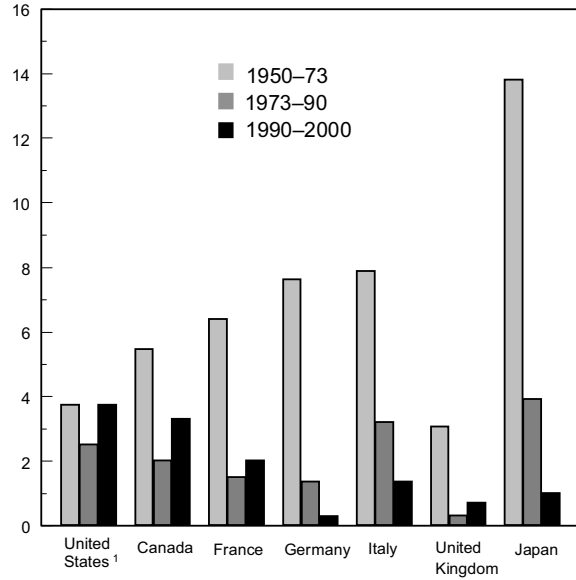
Average annual growth rates (percent)

Panel 1. Productivity



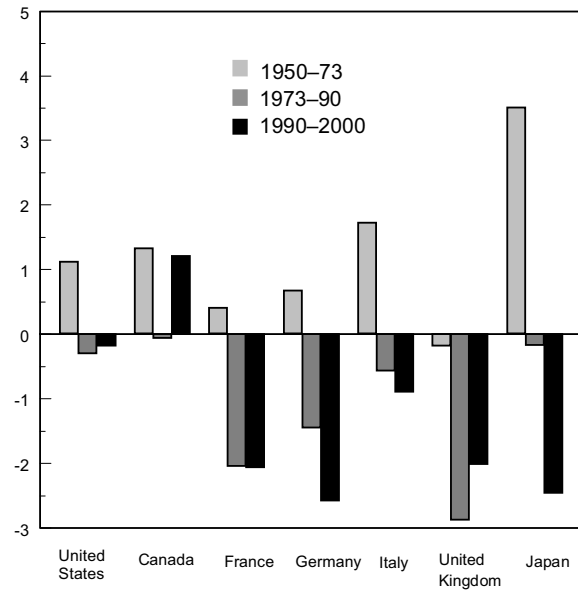
Average annual growth rates (percent)

Panel 2. Output



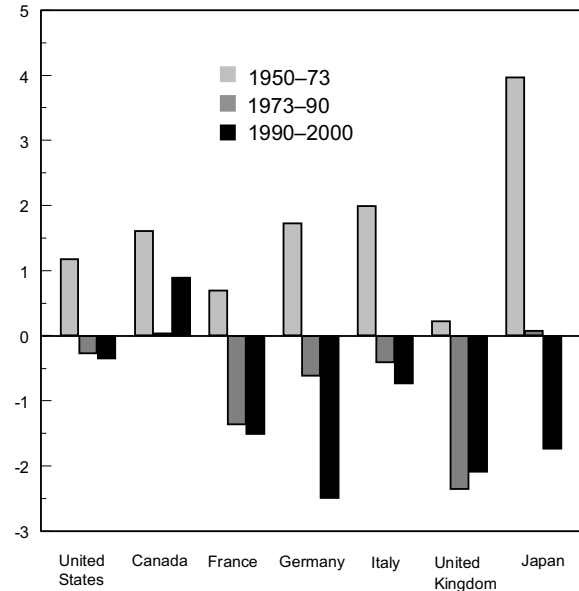
Average annual growth rates (percent)

Panel 3. Total hours



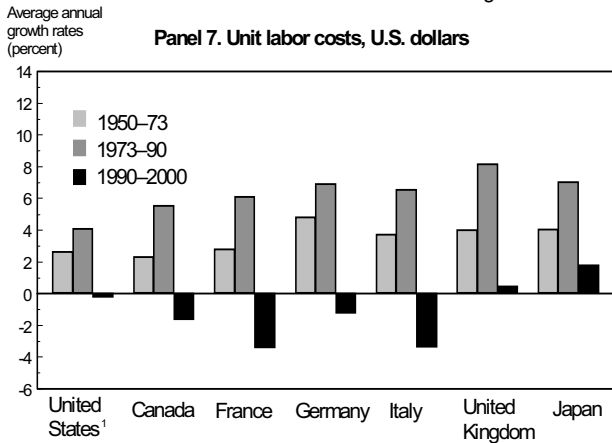
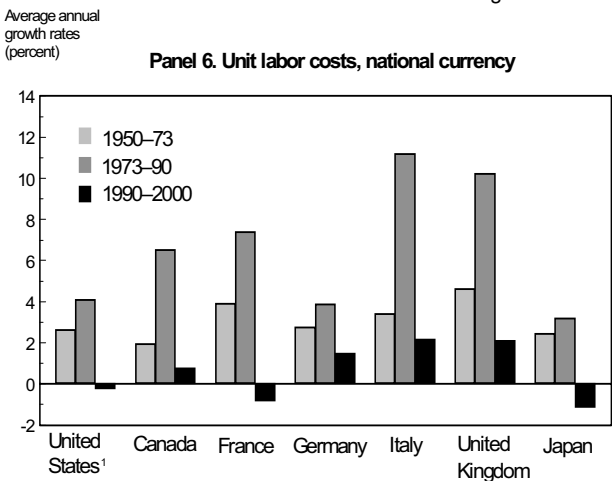
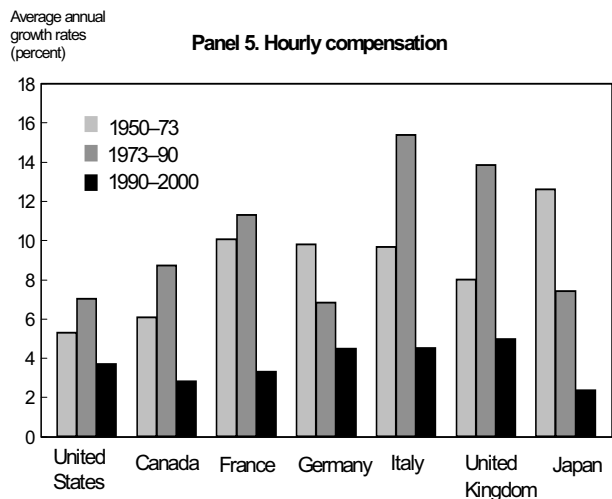
Average annual growth rates (percent)

Panel 4. Employment



¹ The U.S. growth rates shown in panels are based on sectoral output for years prior to 1977, and on value-added output for subsequent years.

Chart 1. Continued—Productivity, unit labor costs, and related measures in manufacturing, G-7 countries, 1950–2000



¹ The U.S. growth rates shown in panels are based on sectoral output for years prior to 1977, and on value-added output for subsequent years.

increased less than those in the United States. In Canada and Japan, however, total hours worked increased more, despite declines in average hours, because manufacturing employment grew more in these two countries than it did in the United States. In Japan, for example, total hours grew at a rate 3.5 percent per year, due to employment growth of 4 percent per year, which swamped a decline in average hours of 0.4 percent per year.

Hourly compensation and unit labor costs. Before 1973, the average rate of unit labor cost growth in the United States was 2.6 percent per year, which was below the growth rates of most of the other G-7 countries, expressed in their national currencies. (See table 1.) Only Canada, Japan, and Germany had unit labor cost increases similar to or lower than the rate for the United States. However, the factors which resulted in these relatively moderate unit labor cost increases differed among these four countries. Modest hourly compensation increases were the main reason for the moderate growth in U.S. unit labor costs during this period. Before 1973, the hourly compensation increase in U.S. manufacturing was the lowest among the G-7 countries, at 5.3 percent per year. Only Canada experienced hourly compensation increases roughly close to the United States, whereas hourly compensation in the European countries and in Japan grew much more. In Japan and Germany, high hourly compensation growth rates were offset by high productivity growth rates. Both hourly compensation and productivity growth rates in these two countries were considerably higher than the rates in the United States. For example, Japan's hourly compensation growth before 1973 was more than twice the U.S. rate, but its productivity gains were almost four times those of the United States. Unit labor costs increased more in the other European countries, because those countries were unable to match rising hourly compensation with adequate productivity gains.

Comparing unit labor cost trends during this period in U.S. dollars, the United States was able to improve its competitive position against all countries except Canada. Although Japan's and Germany's unit labor cost increases (denominated in their national currencies) were similar to or lower than the U.S. increases, their strong currency appreciation raised their unit labor costs denominated in U.S. dollars considerably, weakening their competitive positions. Exchange rate movements had only a minor impact on the unit labor costs of the other countries during this period.

The 1973–90 period

Output, labor input, and labor productivity. The period following 1973 was characterized by inflationary pressures, including large increases in hourly compensation in manufacturing, and by a slowdown in manufacturing output.

Chart 2. Manufacturing labor productivity in foreign countries relative to that in the United States, 1950–2000

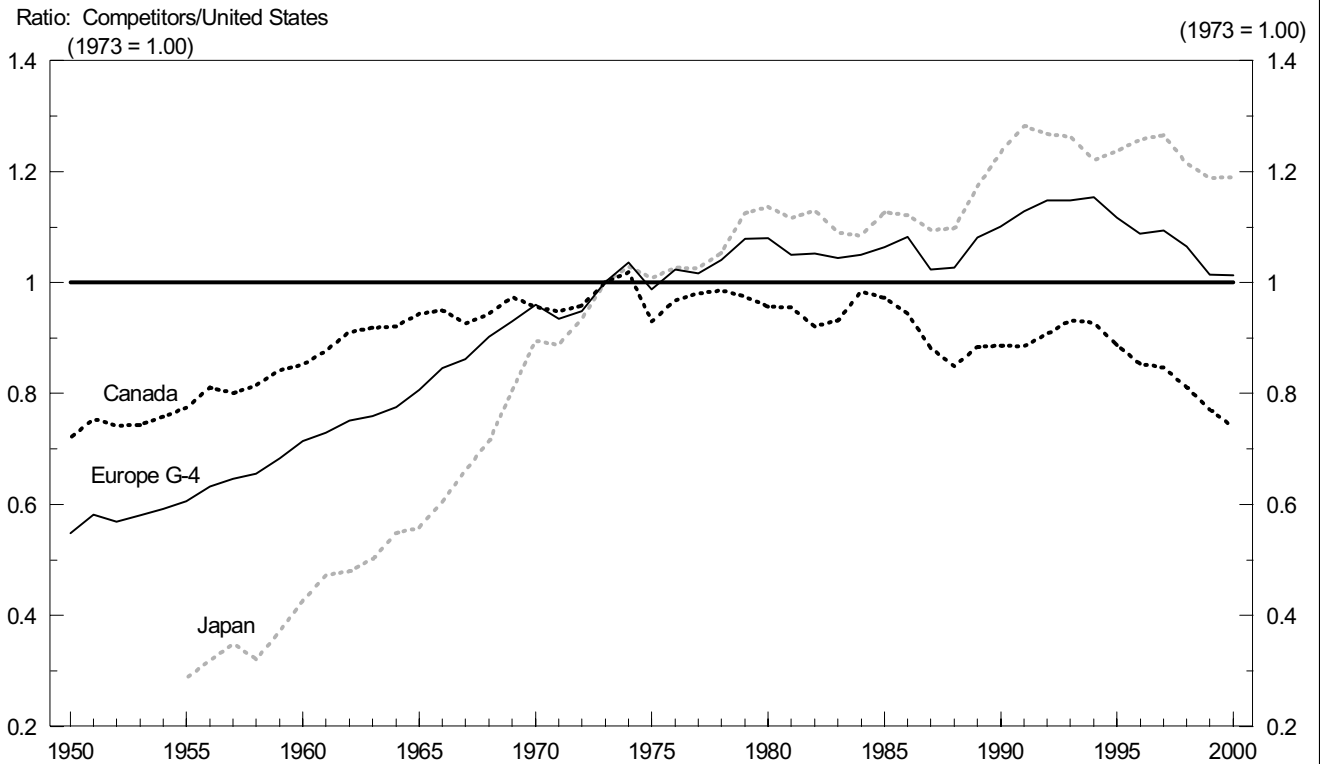
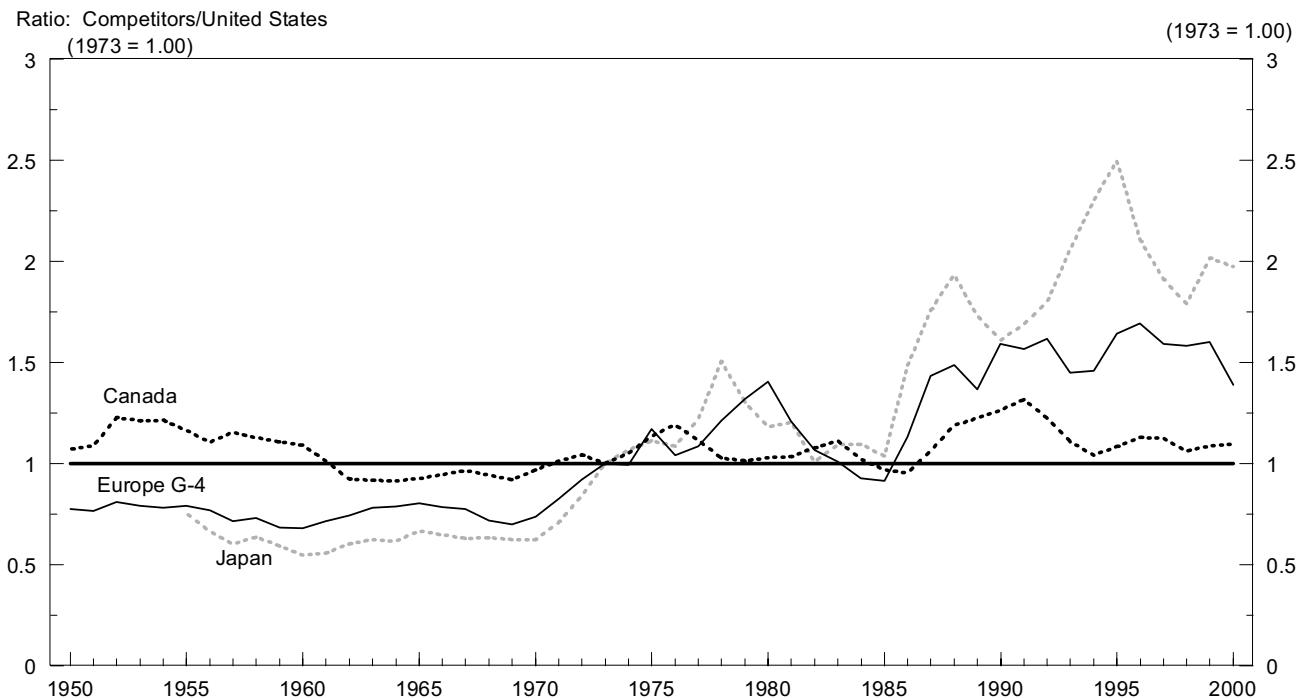


Chart 3. Manufacturing unit labor costs in foreign countries, relative to those in the United States, 1950–2000 (U.S. dollar basis)



Also during this period, manufacturing employment and hours worked stopped growing and then declined in all regions.

After 1973, U.S. manufacturing productivity continued to increase at roughly the same rate as in the earlier period, as was the case in the United Kingdom. In comparison, the rate of productivity growth fell noticeably in the other G-7 countries during this period.⁸ Labor productivity grew by 2.8 percent per year on average in the United States over the entire 1973–90 period, which was still below the corresponding growth rates in Japan and Europe G-4 (table 1). The German and Japanese productivity increases of the 1973–90 period were less than half of their pre-1973 average annual growth rates.

Manufacturing output growth slowed in each of the regions compared, during the 1973–90 period. (See chart 1, panel 2.) The U.S. output growth rate slowed by more than 1 percentage point, but Japan and Europe G-4 experienced pronounced slowdowns in output growth after 1973. In Japan, the manufacturing output growth rate declined by 10 percentage points and in Europe G-4 the output growth rate fell by almost 5 percentage points. Among the Europe G-4 countries, Germany experienced the sharpest slowdown in output growth—falling from 7.6 to 1.4 percent per year. Furthermore, the output growth rate in Canada slowed by 3–1/2 percentage points.

The slowdown in manufacturing output among the G-7 countries was accompanied by declines in total hours worked (table 1). In the United States, total hours worked in manufacturing fell by 0.3 percent per year during the 1973–90 period, due to a slight fall in employment and no change in average hours worked. In contrast, the decline in total hours worked in Europe G-4 was due to decreases in employment and declines in average hours worked. The average annual rates of decline of employment among the Europe G-4 countries ranged from 0.4 percent in Italy to 2.4 percent in the United Kingdom. As a result, by 1990, manufacturing employment was 7 percent below its 1973 level in Italy, and 33 percent below the 1973 level in the United Kingdom. This fall in employment was accompanied by a steady decline in average hours worked, resulting in an average decline in total hours worked in Europe G-4 of 1.7 percent per year between 1973 and 1990. Total hours worked also fell in Japan, even though Japan was the only G-7 country to experience employment growth during this period, because average hours worked decreased more than employment increased. Total hours worked in Canada also declined due to a fall in average hours worked combined with stagnating employment.

Within the 1973–90 interval, three subperiods deserve special attention: 1973–79, 1979–85, and 1985–90. At the end of the first subperiod, 1979, the United States, Canada, France, and Germany, reached local cyclical peaks in manufacturing output. Also in that year, the Iranian revolution erupted,

followed by a sharp increase in the price of crude oil—126 percent. After 1979, the U.S. dollar strengthened against most other currencies. The second subperiod, 1979–85, ended with the “Plaza Accord,” which included an international agreement to lower the value of the U.S. dollar. As a result, most currencies strengthened against the dollar during the third subperiod, 1985–90. Exchange rates are a major factor in determining unit labor costs denominated in U.S. dollars, and therefore directly affect the international competitiveness of a country’s manufactures.

Output, hours, and productivity trends in manufacturing varied among the three subperiods of the 1973–90 interval. U.S. manufacturing output grew at approximately the same rate in each of three subperiods examined, ranging between 2 percent and 3 percent per year. (See table 2.) In contrast, two European countries experienced a drop in output during some of the subperiods, reducing their overall output growth. In the United Kingdom, output fell during the first two subperiods (1973–79, 1979–85) before rebounding during the third subperiod (1985–90). Output in France fell in the second subperiod (1979–85).

The United States experienced moderate employment growth during the first subperiod (1973–79) followed by declines in employment during the second and third periods (1979–85, 1985–90). Japan had the opposite experience, its employment falling during the first subperiod followed by employment growth during the second and third subperiods (table 2). France and the United Kingdom experienced a drop in employment in all three subperiods.

Hourly compensation and unit labor costs. During 1973–90, U.S. unit labor costs rose by 4.1 percent per year—faster by more than a third from the preceding period—due to larger hourly compensation increases that were not accompanied by faster productivity growth. (See chart 1, panel 6.) Still, the U.S. increase in unit labor costs was smaller than the increase for most G-7 countries, when measured in national currency units. The average annual increases in unit labor costs of the other G-7 countries more than doubled during this period, so that the U.S. increases were noticeably smaller by comparison. Only the two countries that had been able to reduce the rate of their hourly compensation increases during this time period—Germany and Japan—had smaller increases in manufacturing unit labor costs (table 1).

In the 1973–90 period, which was marked by high inflation following the first and second oil crises, hourly compensation increases accelerated considerably in most countries. Nevertheless, the spurt in U.S. manufacturing hourly compensation increases was among the most moderate. Most competitors experienced greater increases in hourly compensation, especially Italy and the United Kingdom (table 1). Only two countries, Germany and Japan, were able

Table 2. Average annual rates of change in manufacturing labor productivity and related measures, G-7 countries, selected periods, 1973-90

Period and country	Output per hour	Output	Total hours	Employment	Average hours	Hourly compensation	Unit labor costs		Exchange rate
							National currency	U.S. dollars	
1973-79									
United States	2.6	2.9	0.3	0.8	-0.4	9.7	6.9	6.9	...
Canada	2.1	2.3	.2	.5	-.3	12.4	10.0	7.2	-2.6
Japan	4.6	2.5	-2.0	-1.6	-.4	12.8	7.8	11.8	3.7
Europe G-4	3.8	2.3	-1.5	-.6	-.9	16.6	12.4	11.9	-.3
France	4.5	2.6	-1.8	-.9	-1.0	15.8	10.9	11.6	.7
Germany	4.2	1.7	-2.4	-1.6	-.8	9.2	4.8	11.4	6.3
Italy	5.3	5.5	.2	1.4	-1.1	22.0	15.9	9.2	-5.8
United Kingdom	1.1	-.7	-1.8	-1.4	-.5	19.4	18.1	15.3	-2.4
1979-85									
United States	3.5	2.2	-1.2	-1.4	.2	7.2	3.6	3.6	...
Canada	3.4	1.9	-1.5	-1.3	-.2	9.1	5.5	2.8	-2.5
Japan	3.5	4.7	1.1	1.2	.0	4.7	1.1	-.3	-1.5
Europe G-4	3.3	-.1	-3.2	-2.6	-.7	11.7	8.2	-2.7	-10.0
France	3.0	-.4	-3.3	-2.3	-1.0	12.8	9.5	-3.3	-11.7
Germany	2.1	.2	-1.9	-1.1	-.8	6.0	3.8	-4.1	-7.6
Italy	3.5	.9	-2.5	-2.3	-.1	15.9	12.0	-2.5	-12.9
United Kingdom	4.4	-1.2	-5.3	-4.6	-.8	12.2	7.5	-1.0	-7.9
1985-90									
United States	2.4	2.5	.0	-.1	.1	3.9	1.4	1.4	...
Canada .....	.5	1.8	1.3	1.2	.1	4.2	3.7	7.0	3.2
Japan	4.3	4.8	.5	.8	-.3	4.6	.3	10.8	10.5
Europe G-4	3.1	2.9	-.2	-.2	.0	6.6	3.3	13.5	9.9
France	3.4	2.6	-.8	-.9	.1	4.5	1.0	11.6	10.5
Germany	2.1	2.3	.2	1.1	-.9	5.0	2.8	15.9	12.7
Italy	2.4	3.2	.8	-.2	1.0	7.4	4.8	15.1	9.8
United Kingdom	4.6	3.4	-1.2	-.9	-.3	9.4	4.5	11.4	6.6

to resist this trend, and to lower their hourly compensation growth rates. The hourly compensation growth rate in the Japanese manufacturing sector declined by more than a third from its pre-1973 growth rate. (See chart 1, panel 5.)

These high hourly compensation growth rates decelerated markedly after 1979, however. Between 1973 and 1979, manufacturing hourly compensation in the G-7 countries increased by an average of 14.5 percent per year. This rate first slowed to 9.7 percent per year between 1979 and 1985, and then to 5.6 percent per year between 1985 and 1990 (table 2). In all three subperiods of the 1973-90 interval, U.S. manufacturing hourly compensation increased less than those of its major competitors, with the exception of Germany, in the 1973-85 period, and Japan, in the 1979-85 period. For all G-7 countries, the biggest increases in unit labor costs occurred between 1973 and 1979 (table 2). By the third period, 1985-90, unit labor cost increases for most countries had slowed down to rates lower than those in the 1950-73 period.

Wide currency exchange rate fluctuations between 1973 and 1990 had a significant impact on unit labor costs denominated in U.S. dollars. The influence of currency fluctuations was especially important in the 1979-85 period, when the U.S. dollar appreciated strongly against most

currencies, temporarily improving the competitive position of foreign manufacturers. Changes in currency values also had a major impact during the 1985-90 period, when the U.S. dollar depreciated sharply, thus reversing the competitive positions. Overall, after taking currency exchange rate movements into account, U.S. unit labor costs increased less than the unit labor costs in any other country during the 1973-90 period (table 1).

The 1990-2000 period

Output, labor input, and labor productivity. Manufacturing labor productivity grew at a higher rate in the United States than in Canada, Japan, and the average of Europe G-4, during the 1990s (table 1). In fact, U.S. manufacturing productivity attained its highest growth rates during the 1990s, increasing at an average annual rate of 4.0 percent. This differs from the remaining G-7 countries, in which the highest productivity increases occurred before 1973. After slowing during the 1973-90 period, labor productivity growth made a partial recovery in Germany and France. However, productivity growth continued to slow in Japan, Italy, and the United Kingdom. (See chart 1, panel 1.) During the decade,

productivity growth was dominated by output increases in the United States and in Canada, and by reduced hours in Japan and in Europe G-4.

Manufacturing output also grew at a faster rate in the United States than in other regions during the 1990s. The U.S. output growth rate during the 1990s exceeded its pre-1973 growth rate. Output growth also partially recovered from the 1973–90 slowdown in Canada, France, and the United Kingdom. In contrast, output growth slowed even further during the 1990s in Japan, Germany, and Italy. (See chart 1, panel 2.) This slowdown was especially dramatic in Japan, where manufacturing output had achieved double-digit growth rates in the years before 1973, but grew at only 1 percent per year after 1990. The rate of output increase was larger in Canada during the 1990s than in Japan and Europe G-4, even though Canadian productivity growth was lower. This was largely due to an increase in total hours worked in Canada, whereas total hours worked declined in Japan and Europe G-4.

Both manufacturing employment and average hours worked declined in 4 of the 7 G-7 countries during the 1990s, with the United States, Canada, and the United Kingdom being the exceptions (table 1). The net result was that total hours worked fell in 6 of the 7 G-7 countries. Only Canada experienced an increase in total hours. The negligible reduction in total hours worked in U.S. manufacturing was smaller than the corresponding decline in the remaining G-7 countries.

This decline in manufacturing employment during the 1990s was a continuation of the decline which began after 1973. The United States, for example, experienced a drop in employment of 0.4 percent per year in the 1990s, slightly faster than the rate during the 1973–90 period. Japan recorded a decline in employment during the 1990s of a similar magnitude as the average for Europe G-4. Canada was the only G-7 country that did not experience a negative growth rate in employment during any of the periods (1950–73, 1973–90, and 1990–2000). (See chart 1, panel 4.)

It has been widely noted that U.S. productivity growth in the manufacturing sector, and in the entire business sector as well, increased more in the latter half of the 1990s than in the earlier part of the decade. Therefore, for this analysis, the 1990s are divided into two 5-year segments. The acceleration in manufacturing productivity did not occur throughout the G-7 countries, however. (See table 3.) Only Japan and France experienced a speed-up of productivity growth in the latter half of the period, and those gains fell short of the 1.3 percentage-point increase experienced by the United States. All of the countries except Italy experienced increases in output growth between the first and second half of the 1990s, but in all of these foreign countries total hours worked grew more, or fell more slowly, than they did in the earlier part of the period.

Hourly compensation and unit labor costs. Unit labor cost growth rates during the 1990s stand in marked contrast to the previous periods studied, because they were by far the lowest, and in some countries unit labor costs declined. This was due primarily to a general slowdown in hourly compensation increases compared with previous periods, although productivity increases also played a part.

The decline in U.S. unit labor costs during this period followed a decline in the hourly compensation growth rate by almost half, and a rise in the productivity growth rate by more than a third from the previous period. Japan and France were the only other countries to also achieve a decline in unit labor costs (table 1). All other competitors experienced only a deceleration in their unit labor cost increases. Although they were able to restrict hourly compensation growth to low levels, their productivity growth rates were lower still. (See chart 1, panel 6.)

In the 1990s, hourly compensation growth in all G-7 countries was slower than that in any previous period in this analysis. Hourly compensation increases in U.S. manufacturing grew by 3.7 percent per year, and in Japan, Canada, and France hourly compensation increased even less (table 1). The other countries experienced slightly larger increases in hourly compensation.

Overall, during the 1990s the U.S. dollar strengthened against the currencies of all the countries except Japan, especially after 1995. In the 1990–95 period, the U.S. dollar appreciated against the currencies of half the countries, but after 1995, the U.S. dollar appreciated against the currencies of all the countries. The result was that unit labor costs in most countries, measured in U.S. dollars, declined more than unit labor costs in the United States, particularly after 1995 (table 3).

Other European countries

Comparable data are available for five non-G-7 European countries: Belgium, the Netherlands, Sweden, Denmark, and Norway. The trends in manufacturing productivity and unit labor costs in these countries over the 1950–2000 period were, on the whole, similar to the corresponding trends in the Europe G-4 countries. (See table 4.) The greatest differences were in Norway.

Denmark, Norway, Sweden, and the Netherlands all achieved their highest manufacturing productivity and output growth rates during the pre-1973 years. However, employment growth was offset by declines in average hours to the point that total hours worked either remained stable or declined in all four countries. Among the Europe G-4 countries, only the United Kingdom experienced a similar decline in total hours during the 1950–73 period.

During the 1973–90 period, manufacturing productivity and output growth slowed in each of the non-G-7 European

Table 3. Average annual rates of change in manufacturing labor productivity and related measures, G-7 countries, selected periods, 1990–2000

Period and country	Output per hour	Output	Total hours	Employment	Average hours	Hourly compensation	Unit labor costs		Exchange rate
							National currency	U.S. dollars	
1990–1995									
United States	3.3	3.1	-0.1	-0.6	0.4	3.5	0.2	0.2	...
Canada	3.3	2.0	-1.3	-1.5	.3	3.7	.4	-2.8	-3.2
Japan	3.3	.4	-2.8	-1.6	-1.3	3.7	.4	9.5	9.1
Europe G-4	3.6	.6	-2.8	-2.9	.1	5.4	1.8	.7	-1.0
France	4.1	1.1	-2.9	-2.7	-2	3.7	-4	1.3	1.8
Germany	3.3	-7	-3.9	-4.2	.3	6.5	3.0	5.6	2.5
Italy	3.5	1.5	-1.9	-1.8	-1	6.0	2.4	-3.7	-6.0
United Kingdom	3.3	.5	-2.8	-3.1	.3	5.4	2.0	-4	-2.4
1995–2000									
United States	4.6	4.4	-2	-1	-1	3.9	-7	-7	...
Canada .....	.9	4.7	3.8	3.4	.4	2.0	1.1	-5	-1.6
Japan	3.9	1.7	-2.1	-1.9	-1	1.1	-2.6	-5.3	-2.7
Europe G-4	2.6	1.6	-9	-5	-4	3.3	.7	-4.3	-5.0
France	4.2	2.9	-1.3	-4	-9	3.0	-1.2	-8.0	-6.8
Germany	2.6	1.3	-1.3	-8	-5	2.6	-1	-7.6	-7.5
Italy	1.1	1.2	.1	.3	-2	3.1	1.9	-3.1	-4.9
United Kingdom	2.3	1.0	-1.3	-1.1	-2	4.5	2.2	1.3	-8

countries. Employment, average hours, and total hours worked declined in each country. Productivity gains in Belgium, Denmark, the Netherlands, and Sweden corresponded to increases in output and declines in hours worked. This was similar to what occurred in the Europe G-4 countries. Norway, in contrast, achieved a gain in manufacturing productivity even though output declined; hours worked declined at a faster rate than output.

During the 1990s, the growth rate of manufacturing labor productivity in Sweden recovered to nearly its 1950–73 rate. However, productivity growth continued to slow in Belgium, the Netherlands, and Norway. Manufacturing employment continued to decline. Only Norway experienced an overall increase in employment and total hours worked during the 1990s. As was the case with Europe G-4, hourly compensation increases slowed during this period, and unit labor costs went up negligibly or declined in all the countries except Norway.

Korea and Taiwan

Trends of manufacturing productivity and unit labor costs for Korea and Taiwan are examined for the 1985–2000 period, because 1985 is the first year for which comparable data are available for both of these economies. To follow the underlying trends, this analysis divides the 1985–2000 interval into three equal 5-year subperiods (1985–90, 1990–95, and 1995–2000).

Manufacturing productivity. Over the final 15 years of the 20th century, manufacturing output and labor productivity in both Korea and Taiwan increased considerably more than

those in the United States, Japan, or Europe G-4. This was also true for each of the three subperiods. (Compare tables 5, 2, and 3.) Furthermore, during each subperiod, the respective increases in Korea were greater than those in Taiwan.

Total hours worked in manufacturing declined in both economies between 1985 and 2000 by approximately the same proportion, but the timing of these declines differed somewhat. In Korea, employment increased until 1990, and declined at an accelerating rate after that. After 1995, manufacturing employment in Korea was falling more than 3 percent per year, which was more than the rate in Japan. In Taiwan, employment declined slowly until 1995, then increased after that. In both economies, average hours worked dropped somewhat or remained unchanged. The growth in employment in Taiwan after 1995 was sufficient to produce a slight increase in total hours worked. In comparison, the rate of decline in total hours in Korea between 1995 and 2000 was greater than the declining rates in any other country compared.

Hourly compensation and unit labor costs. Hourly compensation in manufacturing rose more in Korea and in Taiwan than in either the United States, Japan, or Europe G-4 during 1985–2000. Again, this was true during each of the three subperiods. Hourly compensation in Korean manufacturing increased more than that in Taiwan during each subperiod; the differences in the respective growth rates being especially marked between 1990 and 1995, when hourly compensation increases moderated in Taiwan, but continued to accelerate in Korea. After 1995, the rate of hourly

Table 4. Average annual rates of change in manufacturing labor productivity and related measures, European non-G-7 countries, selected periods, 1950-2000

Period and country	Output per hour	Output	Total hours	Employment	Average hours	Hourly compensation	Unit labor costs		Exchange rate
							National currency	U.S. dollars	
1950-2000									
Denmark	—	3.1	—	0.2	—	—	4.5	4.2	-0.3
Netherlands	5.1	4.1	-9	-4	-5	7.8	2.6	3.5	.9
Norway	2.9	2.1	-8	-2	-6	8.7	5.6	5.1	-4
Sweden	4.2	3.4	-8	-4	-4	8.9	4.5	3.3	-1.1
1950-73									
Denmark	4.8	4.8	.0	1.2	-1.2	9.6	4.6	5.2	.6
Netherlands	6.5	6.3	-3	.4	-7	10.6	3.8	5.3	1.4
Norway	4.4	4.3	-1	.6	-7	9.3	4.7	5.7	.9
Sweden	5.1	4.6	-5	.5	-9	9.6	4.2	5.0	.8
1973-90									
Belgium	4.8	2.1	-2.6	-2.2	-4	8.6	3.6	4.5	.9
Denmark	2.3	1.5	-8	-4	-4	9.3	6.8	6.6	-2
Netherlands	4.3	2.4	-1.9	-1.3	-6	6.4	2.0	4.6	2.5
Norway	2.2	-1	-2.2	-1.6	-7	10.4	8.1	7.5	-5
Sweden	2.6	1.4	-1.2	-9	-3	10.9	8.1	6.1	-1.8
1990-2000									
Belgium	3.3	1.9	-1.3	-1.4	.1	3.0	-2	-2.9	-2.6
Denmark	—	2.1	—	-9	—	—	.7	-2.0	-2.6
Netherlands	3.1	2.2	-9	-8	-1	3.7	.6	-2.1	-2.7
Norway .....	.8	1.0	.3	.3	.0	4.3	3.5	.0	-3.4
Sweden	4.7	4.0	-7	-1.6	.9	4.1	-7	-4.9	-4.3

NOTE: Dash indicates data not available.

Table 5. Average annual rates of change in manufacturing labor productivity and related measures, Korea and Taiwan, selected periods, 1985-2000

Period and country	Output per hour	Output	Total hours	Employment	Average hours	Hourly compensation	Unit labor costs		Exchange rate
							National currency	U.S. dollars	
1985-90									
Korea	8.2	12.2	3.7	5.4	-1.6	15.6	6.9	11.1	3.9
Taiwan	7.9	7.0	-8	-5	-4	11.5	3.4	11.8	8.2
1990-95									
Korea	9.7	8.4	-1.2	-9	-2	18.2	7.8	6.0	-1.7
Taiwan	5.3	5.0	-3	-3	.0	7.1	1.7	2.0	.3
1995-2000									
Korea	11.6	8.0	-3.2	-3.1	-1	7.3	-3.9	-11.0	-7.3
Taiwan	5.5	5.7	.2	.5	-3	4.0	-1.5	-4.7	-3.3

compensation increases declined in both economies, the average annual increases in Taiwan being similar to the increases in U.S. manufacturing.

Before 1995, the relatively large hourly compensation increases in Korea and Taiwan caused their unit labor costs, expressed in national currencies, to increase more than the unit labor costs in the United States or Japan. This occurred despite the higher productivity growth rates in Korea and

Taiwan. From 1985 to 1990, the competitive position of both economies was further undermined by the appreciation of their currencies against the U.S. dollar.

After 1995, the more moderate growth in hourly compensation, and continued productivity increases, led to declines in unit labor costs in both economies, which were further reduced by the depreciation of both currencies against the U.S. dollar. □

Notes

¹ Karin Wagner and Bart Van Ark, eds., *International Productivity Differences: Measurement and Explanations* (Amsterdam, The Netherlands, Elsevier Science B.V., 1996).

² Paul Schreyer, "The Contribution of Information and Communication Technology to Output Growth: a Study of the G7 Countries," OECD, STI Working Paper 2000/2 (March 2000).

³ Edwin R. Dean and Mark K. Sherwood, "Manufacturing costs, productivity, and competitiveness, 1979–93," *Monthly Labor Review*, October 1994, pp. 3–16.

⁴ The Group of Seven (G-7) consists of the seven major market economies. It was launched in 1975 at a summit of the heads of state of six countries (United States, France, Germany, Italy, Japan, and the United Kingdom). Canada was included in 1976. Representatives of the G-7 countries meet annually to discuss the principal political and economic issues of the day. Because Russia has taken part in the annual economic discussions since 1997, the group is now often referred to as the G-8.

⁵ Average annual growth rates of the various measures, for selected time periods, are shown on the accompanying tables and charts. The complete historical index series of the measures can be found in BLS Report 962, "International comparisons of labor productivity and unit labor costs in manufacturing, 2000," April 2002. BLS Report 962 is also available at the BLS Division of Foreign Labor Statistics Web site at:

<http://www.bls.gov/fls/home.htm>. The U.S. manufacturing output index for years prior to 1977 is accessible through the BLS Web site at: <http://www.bls.gov/data/sa.htm>

⁶ The Ministers of Finance and Central Bank Governors of five countries (France, Germany, Japan, the United Kingdom, and the United States) met on September 22, 1985, at the Plaza Hotel in New York, to review economic developments and policies in their countries. The results of their meeting were summarized in an agreement, known as the "Plaza Accord." In particular, they noted that the "appreciation of the U.S. dollar" was among the factors that have "contributed to large, potentially destabilizing external imbalances among major industrial countries" and that an "appreciation of the main nondollar currencies against the dollar is desirable. They stand ready to cooperate more closely to encourage this when to do so would be helpful." For further information, access the University of Toronto Library and the G8 Research Group at the University of Toronto Web site at:

<http://www.library.utoronto.ca/g7/finance/fm850922.htm>.

⁷ The measure of hourly compensation used in this study refers to employer cost rather than to the net compensation of employees. In addition to payments to employees, it includes legally required contributions for social benefits. For this reason, and also because differences in national inflation rates are not taken into account, differences in hourly compensation growth do not necessarily reflect changes in relative workers' well-being.

⁸ As discussed earlier, the U.S. output series was derived by linking at 1977 two output series based on two different concepts. The official manufacturing labor productivity series for the United States, based on sectoral output, shows an increase of 2.6 percent per year for 1950–73 and 2.5 percent per year for 1973–90.

APPENDIX: Measuring productivity and unit labor cost trends in manufacturing

The comparative measures of labor productivity and unit labor costs discussed in this article are based on underlying data obtained by the Bureau of Labor Statistics from the statistical agencies of the countries that are compared. BLS attempts, to the extent possible, to insure that the data series used to calculate the measures have comparable definitions, coverage, and reliability. When necessary, different data series are combined to arrive at aggregates that correspond to the required definitions and coverage. However, certain differences remain, such as the ways countries aggregate the components of output, or in the methods used to calculate price deflators for information technology products.

Labor productivity is defined as real output per hour worked. Although the labor productivity measure presented in this article relates output to the hours worked of persons employed in manufacturing, it does not measure the specific contributions of labor as a single factor of production. Rather, it reflects the joint effects of many influences, including new technology, capital investment, capacity utilization, energy use, and managerial skills, as well as the skills and efforts of the workforce.

Unit labor costs are defined as the cost of labor input required to produce one unit of output. They are computed as labor compensation in nominal terms, divided by real output.

BLS constructs comparative trend indexes of manufacturing labor productivity, hourly compensation costs, and unit labor costs from three basic aggregate measures—output, total labor hours, and total compensation. The hours and compensation measures refer to

employees only (wage and salary earners) in Belgium, Denmark, Italy, and Taiwan. For all other countries, the measures refer to all employed persons, including employees, self-employed persons, and unpaid family workers. For all of the countries, the term "hours" refers to hours worked.

In general, the measures relate to total manufacturing as defined by the International Standard Industrial Classification (ISIC). However, the measures for Denmark include mining and exclude manufacturing handicrafts from 1960 to 1966.

The comparisons in this article make use of data made available to BLS as of November 2001 by the statistical agencies of the individual countries. For some countries, the data for the most recent years are based on the European System of Integrated National Accounts (ESA 95) or on the United Nations System of National Accounts 1993 (SNA 93). For other countries, data were compiled according to previously used systems.

To obtain historical time series, BLS may link together data series which were compiled according to different accounting systems by the countries' statistical agencies.

Output. In this article, manufacturing output data for the United States from 1977 forward are the gross product originating (value added) measures prepared by the Bureau of Economic Analysis (BEA) of the U.S. Department of Commerce. U. S. gross product originating is a chain-type annual-weighted series.¹ For years before 1977, U.S. output growth is based on growth of the

manufacturing output series that BLS publishes on quarterly measures of U.S. productivity and costs. The quarterly measures are on a sectoral output basis rather than a value-added basis. Sectoral output is gross output less intra-sector sales and transfers.² These two series are linked at 1977. Before linking the two time series, their movements were compared over the 1977–2000 interval. It was found that the two series have similar long-term trends, and that their annual fluctuations usually are in the same direction, but can differ substantially in magnitude.

A value-added concept has been used for the international comparisons series because the data are more readily available in the countries' national accounts, whereas sectoral output would require a complex estimation procedure. Also, although BLS has determined that sectoral output is the correct concept for U.S. measures of single factor productivity (output per hour), there are other considerations that may make value added a better concept for international comparisons, such as differences among countries in the extent of vertical integration.

For most countries, the output measures are value added in manufacturing from the national accounts. However, output for Japan prior to 1970 and for the Netherlands prior to 1960 are indexes of industrial production. The manufacturing value-added measures for the United Kingdom are essentially identical to their indexes of industrial production.

Estimation of manufacturing real output using moving price weights is becoming prevalent. For example, the output measure for manufacturing in the United States is the chain-weighted index of real gross product originating, based on annually changing price weights. However, even when chain-weighting is introduced in a country, many earlier time periods within a historical real output series may continue to be estimated using fixed price weights, with the weights updated periodically (for example, every 5 or 10 years).

Measures of real output may also differ among countries because of different approaches to estimating the prices of high-technology products like computers and, in general, of products that undergo rapid quality change. Possible measurement problems in comparative estimates of manufacturing productivity, arising from the effect of quality-adjusted price indexes, as well as other measurement issues were examined for the case of the United States and Canada in a paper by Eldridge and Sherwood.³ They found that measurement differences do not explain the differences observed in manufacturing productivity for these two countries between 1988–98. It is the case, however, that the United States and Canada use similar methodologies to estimate price indexes for computers, although the measurements of other high-tech products vary.

The other countries compared in this article vary widely in the methods used to quality-adjust the price indexes of high-technology products. BLS is currently conducting a review of the methods used in the foreign countries.

Labor input. The aggregate hours worked series used for France (from 1970 forward), Norway, Sweden, and Canada are series published with the national accounts. For the former West Germany after 1959 and Germany from 1991, BLS uses aggregate hours worked, which were developed by a research institute of the German Ministry of Labor to use with the national accounts employment figures. For the United Kingdom from 1992, an index of total manufacturing hours is used, derived from published quarterly indices of manufacturing hours. For other countries, the United Kingdom before 1992, and the former West Germany before 1959, BLS constructs its own estimates of average hours, using employment figures published with the national accounts, or other

comprehensive employment series, and estimates of average annual hours worked. For this article, Italian employment is based on a new series of the number of employees in manufacturing, instead of on labor units, as in previous releases.

The new estimates of total hours worked in the manufacturing sector in Korea from 1985 to 2000 are based on an employed persons' series and an average annual hours worked series. The data are prepared by the Korean Productivity Center (KPC) according to the System of National Accounts 1993 (SNA 93). The resulting hours worked series is the same that the Korean Productivity Center uses to calculate manufacturing productivity. The Korean Productivity Center publishes the employed persons series, the average hours series, and the aggregate hours series as indexes in the Korean *Quarterly Productivity Review*.

The new estimates of aggregate hours worked in the manufacturing sector in Taiwan from 1973 to 2000 are based on the number of employees and average annual hours worked data from the monthly "Employees' Earnings Survey" conducted by the Taiwan Directorate General of Budget Accounting and Statistics (DGBAS). The survey covers all establishments with two or more employees in the entire territory of Taiwan. The results are published in the Taiwan *Yearbook of Earnings and Productivity Statistics*.

Compensation (labor cost). The compensation measures are from national accounts data. Compensation includes employer expenditures for legally required insurance programs and contractual and private benefit plans, in addition to all payments made in cash or in kind directly to employees. For Canada, France, and Sweden, BLS increases compensation to account for taxes on payroll or employment. For the United Kingdom, compensation is reduced between 1967 and 1991 to account for subsidies. When data for the self-employed are not available, total compensation is estimated by assuming the same hourly compensation for self-employed and employees; in this article, this procedure is used for the first time to adjust Korean manufacturing compensation to an all-persons basis.

Data for Germany. The German Federal Statistical Office began to publish economic statistical series for unified Germany beginning with 1991, after the re-unification of Germany. For prior years, only data for the former West Germany were available. In this article, the data series for Germany are for the former West Germany for years before 1991, and for unified Germany beginning with 1991. These series are linked at 1991.

Current indicators. The measures for recent years may be based on current indicators of output (such as industrial production indexes), employment, average hours, and hourly compensation until national accounts and other statistics, normally used for the long-term measures, become available.

Level comparisons. The BLS measures are limited to trend comparisons. BLS does not prepare level comparisons of manufacturing productivity and unit labor costs because of data limitations and technical problems in comparing the levels of manufacturing output among countries. Each country measures manufacturing output in its own currency units. To compare outputs among countries, a common unit of measure would be needed. Market exchange rates are not suitable as a basis for comparing output levels. What is needed are purchasing power parities, which are the number of foreign currency units required to

buy goods and services equivalent to what can be bought with one unit of U.S. currency.

Purchasing power parities are available for total gross domestic product (GDP) from the Organization for Economic Cooperation and Development (OECD). However, these parities are derived for expenditures made by consumers, business, and government for goods and services—not for value added by industry. Therefore, the parities for total GDP are not suitable for each component industry, such as manufacturing.

European exchange rates. On Jan. 1, 1999, 11 European countries joined the European Monetary Union (EMU). Greece joined on Jan. 1, 2001. Currencies of European Monetary Union members are established at fixed conversion rates to the euro, the official currency of the European Monetary Union. Exchange rates between the national currencies of European Monetary Union countries and the

U.S. dollar are no longer reported; only the exchange rate between the euro and the U.S. dollar is available.

In this article, exchange rates for the year 2000, in national currencies for Belgium, France, Germany, Italy, and the Netherlands are calculated by taking the number of euros per U.S. dollar and then converting euros into national currencies at fixed conversion rates.

1 euro equals:

40.3399	Belgian francs
6.55957	French francs
1.95583	German marks
1,936.27	Italian lire
2.20371	Netherlands guilders

In 2000, 1 euro was equal to 0.9232 U.S. dollars. The currency exchange rates cited in this publication are annual averages of daily buying rates in New York City.

Notes to the appendix

¹ For more information on the U. S. measure, see Sherlene K.S. Lum, Brian C. Moyer, and Robert E. Yuskavage, "Improved Estimates of Gross Product by Industry for 1947–98," *Survey of Current Business*, June 2000, pp. 24–38.

² For information on sectoral output, see William Gullickson, "Meas-

urement of productivity growth in U.S. manufacturing," *Monthly Labor Review*, July 1995, pp. 13–28.

³ Lucy P. Eldridge and Mark K. Sherwood, "A perspective on the U.S.-Canada manufacturing productivity gap," *Monthly Labor Review*, February 2001, pp. 31–48.