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# Trends in Manufacturing: A Chartbook

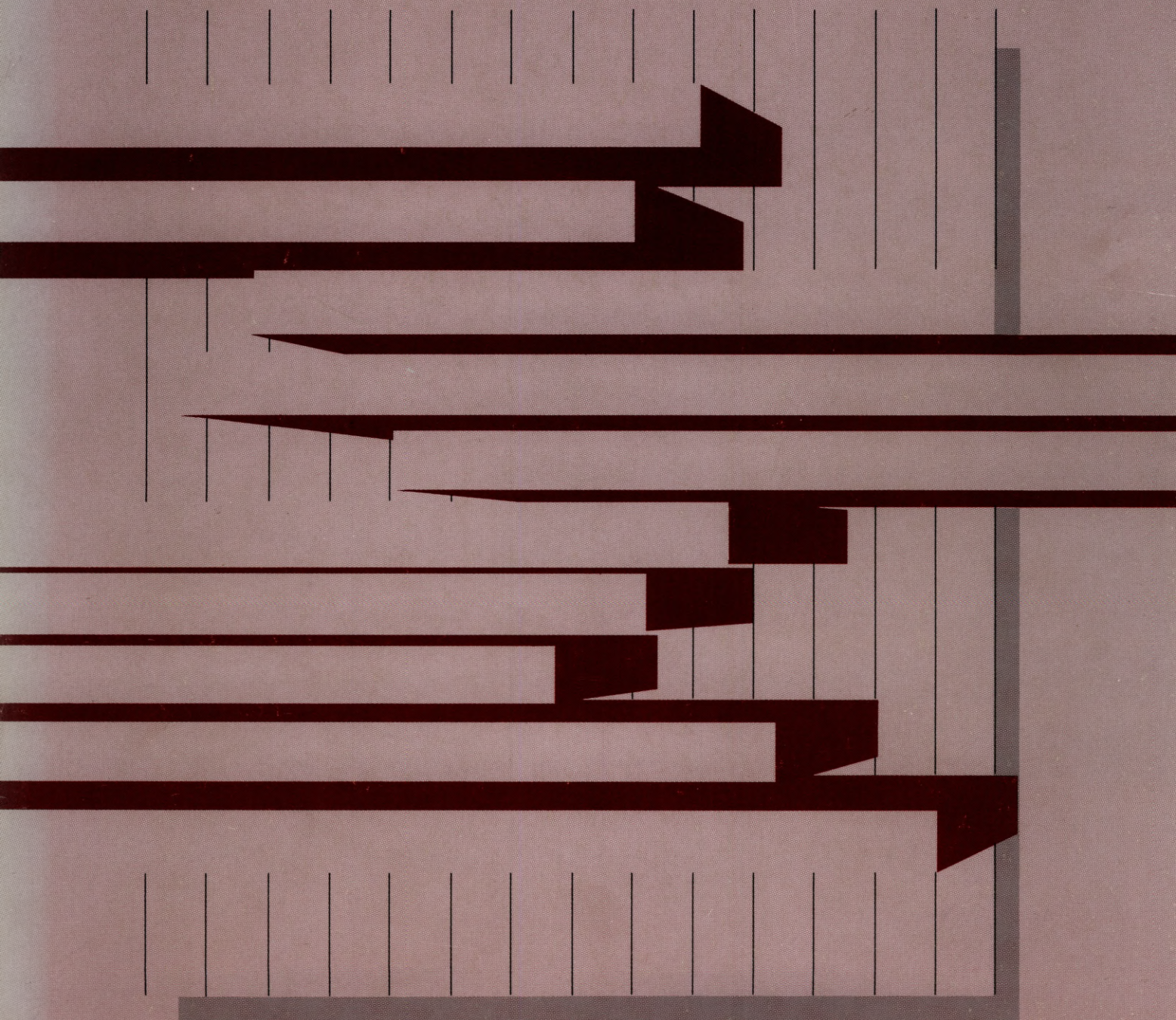


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Bureau of Labor Statistics  
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# Trends in Manufacturing: A Chartbook

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U.S. Department of Labor  
Ford B. Ford, Under Secretary

Bureau of Labor Statistics  
Janet L. Norwood, Commissioner  
April 1985

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# Preface

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Through charts, tables, and text, this chartbook portrays long-term trends in manufacturing output, employment, productivity, and related economic indicators and, wherever possible, comparable international data. It also devotes attention to developments in the last decade. Although movements of employment, production, and productivity are affected by the business cycle, the periods examined in this report were believed to be, for the most part, at comparable stages of the cycle. The chartbook also includes BLS projections of employ-

ment and occupations for 1995 in the manufacturing sector.

This chartbook was produced in the Office of Productivity and Technology in the Bureau of Labor Statistics by Rose N. Zeisel assisted by Charles Bell, under the direction of Jerome A. Mark, Associate Commissioner, in collaboration with the Manufacturing Studies Board of the National Academy of Sciences. Material in this publication is in the public domain and, with appropriate credit, may be reproduced without permission.



# Contents

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	<i>Page</i>
<b>Part I: Output, employment, and trade in manufacturing .....</b>	<b>1</b>
<i>Chart</i>	
1. Output, 1950-83.....	3
2. Employment, 1950-83.....	5
3. Employment by industry sector, 1950 and 1983.....	7
4. Employment by occupation, 1983.....	9
5. Employment by sex, 1960-83.....	11
6. Occupational distribution by sex, 1983.....	13
7. Educational attainment, 1973 and 1983.....	15
8. Imports and exports, 1973 and 1981.....	17
9. Export trade, selected countries, 1955 and 1980.....	19
<b>Part II: Productivity trends in manufacturing .....</b>	<b>21</b>
10. Output per hour of all persons, 1950-83.....	23
11. Output per employee hour, selected countries, 1950-83.....	25
12. Output per hour, output, and hours, 1950-73 and 1973-83.....	27
13. Output per hour, output, and hours, selected countries, 1950-73 and 1973-83.....	29
14. Output per hour, output per unit of capital, and multifactor productivity, 1950-83.....	31
15. Output per hour, capital effects, and multifactor productivity, 1950-73 and 1973-83.....	33
16. Output per employee hour, selected industries, 1960-83.....	35
17. Productivity rates before and after 1973, selected industries.....	37
<b>Part III: Implications of productivity growth for employment, compensation, unit labor costs, and prices in manufacturing .....</b>	<b>39</b>
18. Output per employee hour and employment, selected industries, 1973-83.....	41
19. Output and employment in selected industries with similar productivity growth, 1973-83.....	43
20. Output per hour, unit labor costs, and compensation per hour, 1950-83.....	45
21. Composition of price changes, 1950-83.....	47
22. Output per employee hour and prices, selected industries, 1973-81.....	49
23. Output per employee hour and compensation per employee hour, selected industries, 1973-81.....	51
24. Hourly compensation costs for production workers, selected countries, 1960-83.....	53
25. Output per hour, hourly compensation, and unit labor costs, selected countries, 1960-73 and 1973-83.....	55
26. Unit labor costs, measured in U.S. dollars, selected countries, 1973-80 and 1980-83.....	57



# Contents—Continued

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	<i>Page</i>
<b>Part IV: Factors affecting productivity change in manufacturing .....</b>	<b>59</b>
<i>Chart</i>	
27. Capital investment as percent of output, selected countries, 1965-73 and 1974-82.....	61
28. Research and development funds, current and constant dollars, selected years, 1967-82 .....	63
29. Research and development funds as percent of net sales in companies performing R&D, by size of company, 1981 .....	65
30. Research and development funds as percent of net sales in companies performing R&D, selected industries, 1981.....	67
31. Research and development scientists and engineers per 1,000 employees, selected industries, 1982 .....	69
<b>Part V: Employment and occupational projections to 1995 in manufacturing .....</b>	<b>71</b>
32. Employment growth in high-technology industries and in total manufacturing, 1982-95 .....	73
33. Projected changes in occupational employment, 1982-95 .....	75
34. Projected employment changes in fastest growing and most rapidly declining occupations, 1982-1995 .....	77
<b>Appendix: Supporting data for charts .....</b>	<b>79-104</b>



# Part I.

## Output, employment, and trade in manufacturing

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1

This section presents information on long-term trends in output, employment, and trade in the manufacturing sector of the

economy. In addition, it contains data on labor composition, sex, occupation, and educational attainment.

## Output of manufactured goods nearly tripled since 1950, but growth has slowed sharply in the last decade

While the long-term growth of manufacturing output was moderately strong from 1950 to 1983, it slowed sharply in the last decade. Before 1973, the output of manufactured goods rose an average of 4.0 percent annually; after 1973, the growth rate was down to 0.9 percent, reflecting largely the decline in the early 1980's.

The slowdown was more pronounced in durable than in nondurable goods manufacturing.

Nevertheless, manufacturing output continued to account for almost one-quarter of total output of the economy through the postwar period.

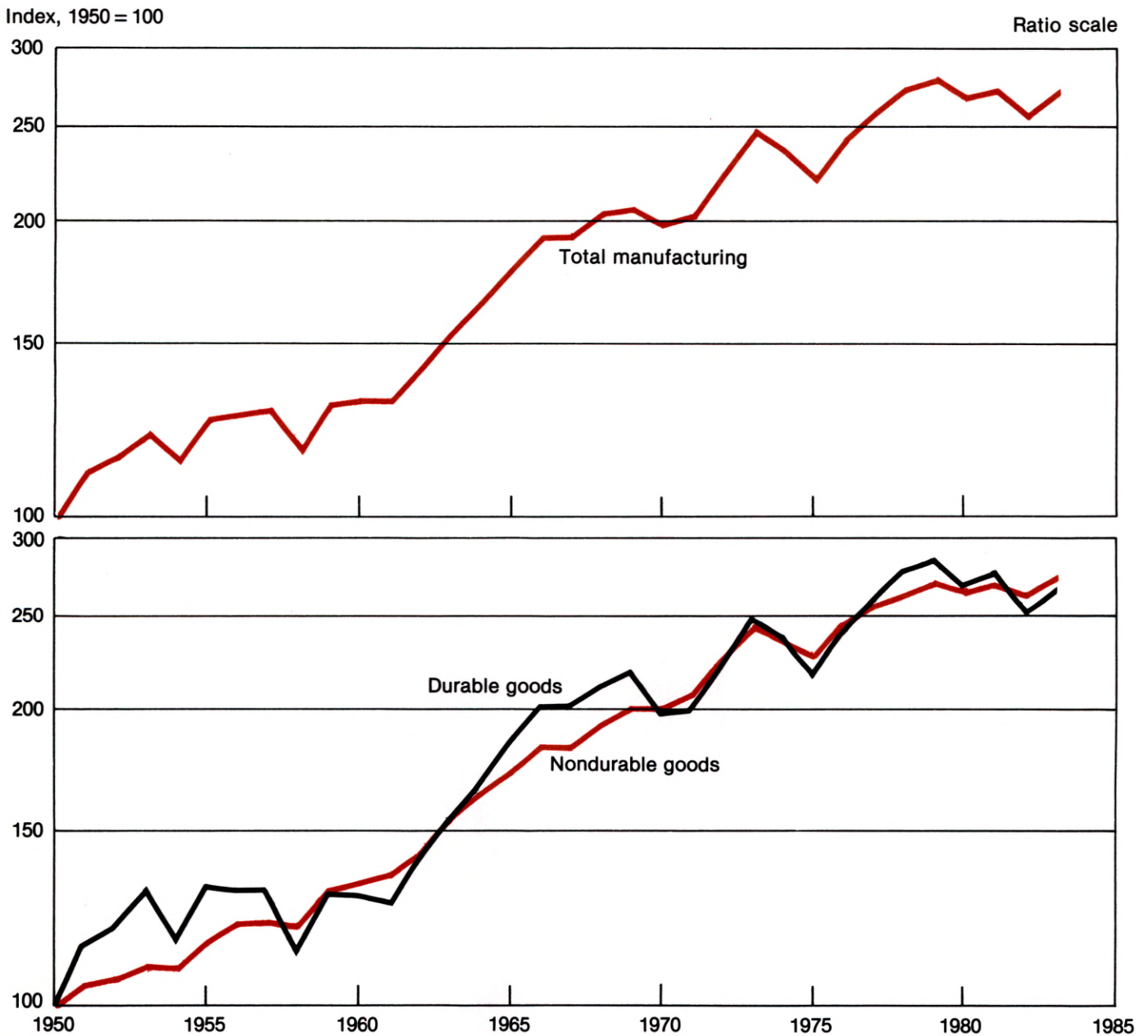
Period	Manufacturing output <sup>1</sup> (average annual percent change)			Manufacturing output as a percent of total output <sup>2</sup> (average)
	Total	Durable goods	Nondurable goods	
1950-83 .....	3.1	3.0	3.1	24.4
1950-73 .....	4.0	4.0	4.0	24.6
1973-83 .....	0.9	0.7	1.1	24.1
Slowdown .....	3.1	3.3	2.9	0.5

<sup>1</sup> Gross product originating in manufacturing in constant dollars.

<sup>2</sup> Gross national product in constant dollars.



Chart 1  
Output<sup>1</sup> in manufacturing, 1950-83



<sup>1</sup>Gross product originating in manufacturing, constant dollars.  
Source: Bureau of Labor Statistics.

## **There were 3 million more manufacturing jobs in 1983 than in 1950, but nearly 1.7 million fewer than in 1973**

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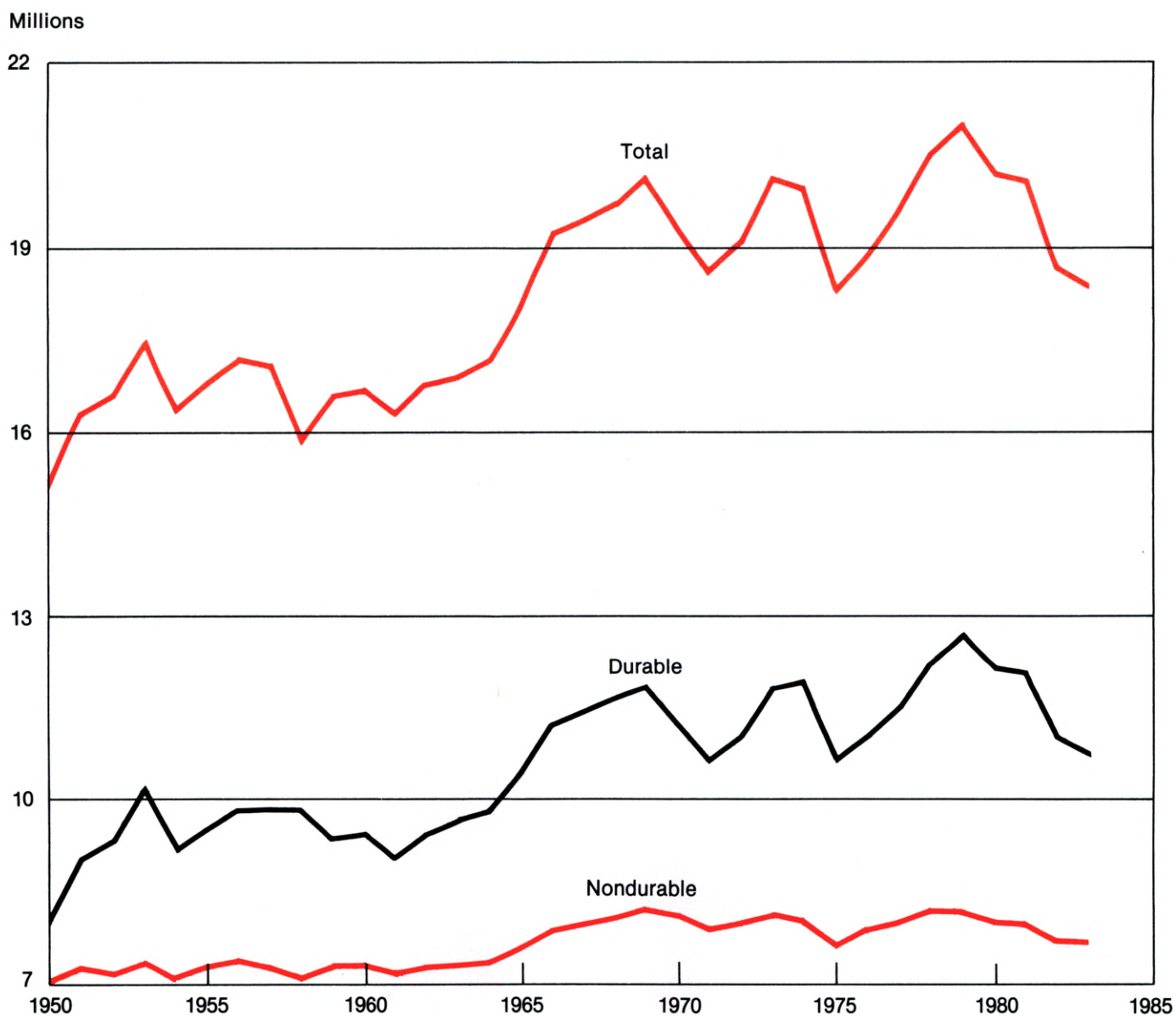
Over the last three decades, from 1950 to 1983, manufacturing employment rose from about 15.2 million to 18.5 million. While the growth rate was moderate from 1950 to 1973, employment declined in the following decade, reflecting the slowdown in output. In 1983, there were nearly 1.7 million fewer employees in manufacturing than a decade earlier.

Two-thirds of the decline in

employment was in the durable goods sector, a reversal of the 1950-73 experience when more than three-quarters of the employment gains in manufacturing occurred in that sector. In 1983, the durable goods industries still accounted for a larger share (58 percent) of all manufacturing jobs than in 1950 (53 percent).



Chart 2  
Employment in manufacturing, 1950-83



Source: Bureau of Labor Statistics

## **Manufacturing accounted for less than one-fifth of all civilian jobs in 1983**

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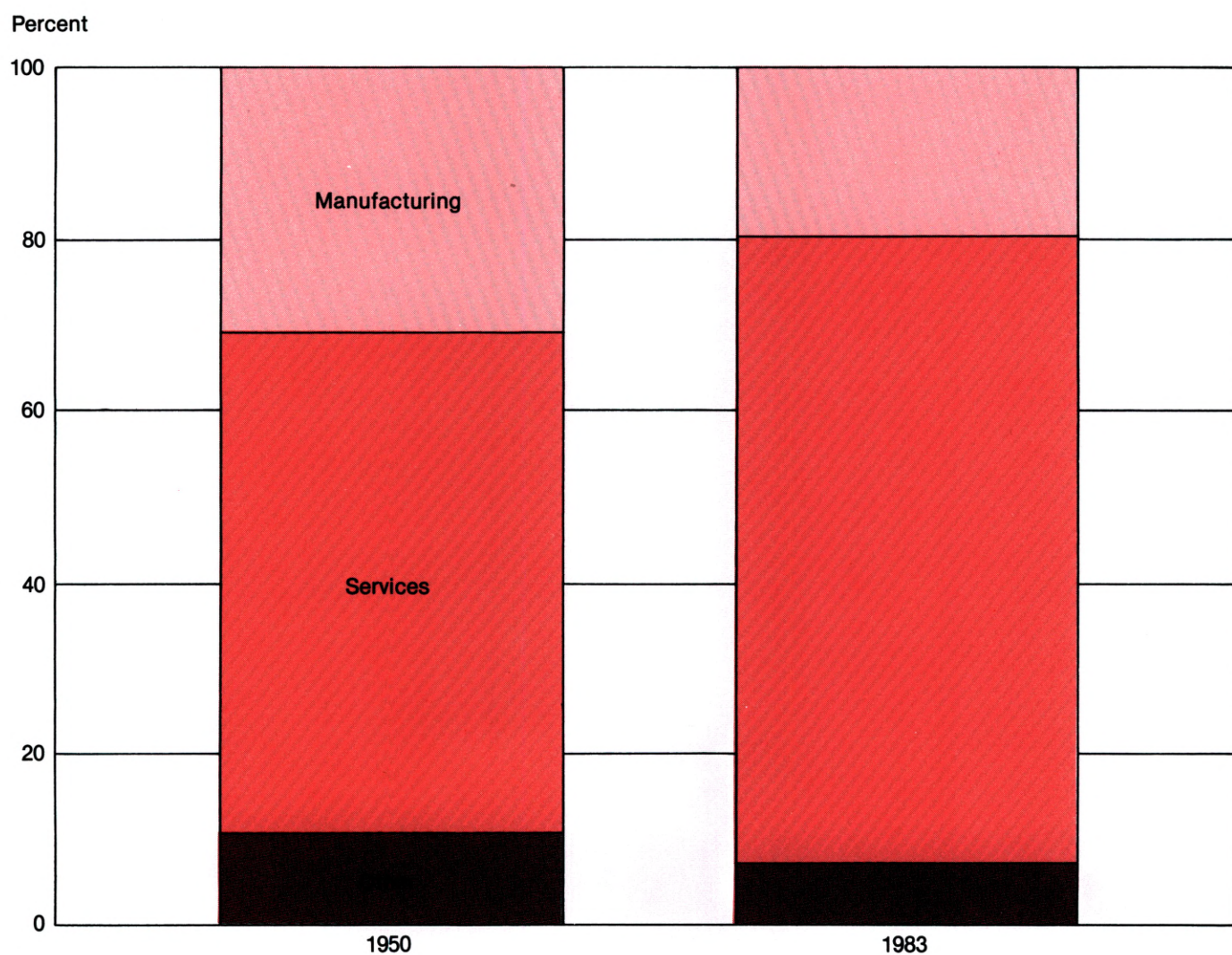
While manufacturing employment increased by about a fifth (3 million jobs) since 1950, employment in service-producing industries more than doubled (40 million jobs). Consequently by 1983, manufacturing accounted for less than a fifth of civilian employment, down from

almost a third in 1950. In contrast, the share of employment in service industries rose to about three-quarters of the total by 1983.

These changes in the industrial distribution of employment reflect different rates of growth in productivity and demand.



**Chart 3**  
**Employment by industry sector, 1950 and 1983**



Source: Bureau of Labor Statistics

## **Manufacturing jobs are heavily concentrated in production operations**

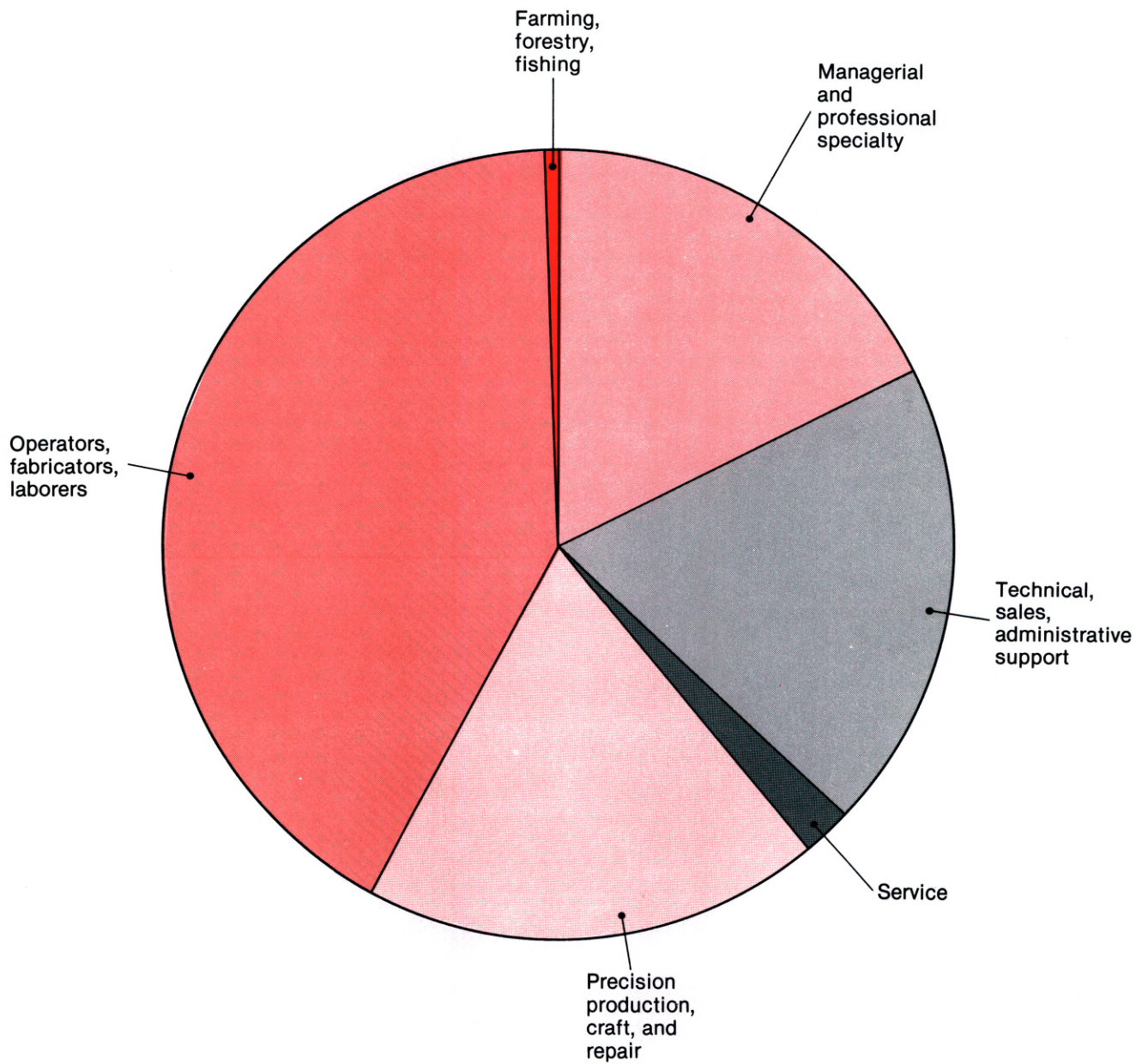
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About 6 of every 10 employees in manufacturing in 1983 held operator, craft, laborer, or other production jobs. The other 4 held managerial, professional, technical, sales, or administrative support jobs. Comparable data are not available for earlier years, but statistics for a wide

range of industries suggest that the proportion of operators, fabricators, and laborers has declined substantially in the last several decades with the introduction and diffusion of advanced technology and materials-handling equipment.



Chart 4  
Manufacturing employment by occupation, 1983



## **Women have filled an increasing share of manufacturing jobs over the past quarter century**

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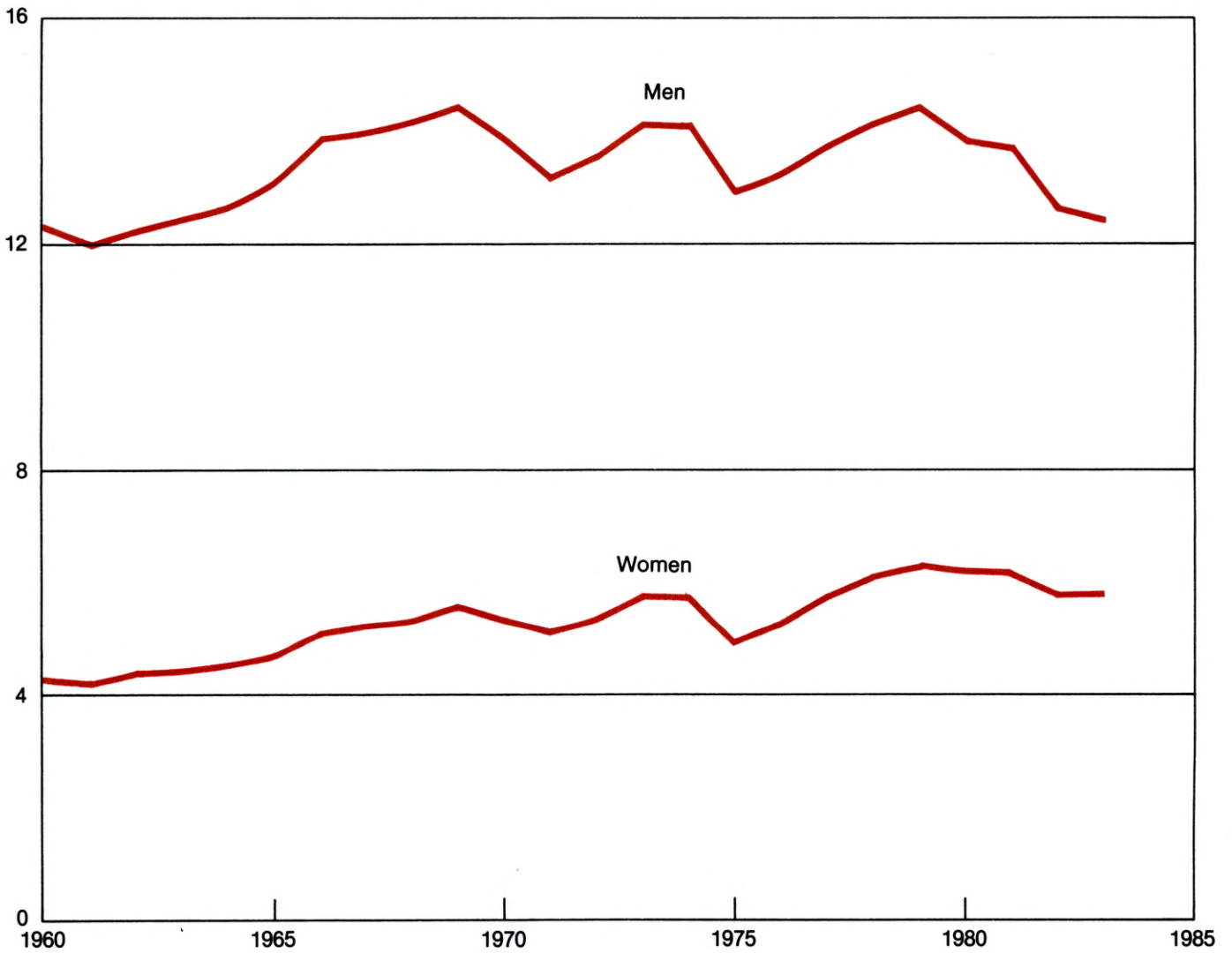
Women employees in manufacturing increased by 37 percent from 1960 to 1983, while the number of employed men was virtually unchanged.

Women's share of total manufacturing employment rose almost steadily over the period; in the 1960's

and 1970's, there was a greater increase in women employees than men and in the 1980's, the number of women workers declined less rapidly. By 1983, they accounted for one-third of the manufacturing work force.

Chart 5  
Employment in manufacturing by sex 1960-83

Millions of employed persons



Source: Bureau of Labor Statistics



## Women hold almost 40 percent of operator, fabricator, and laborer jobs

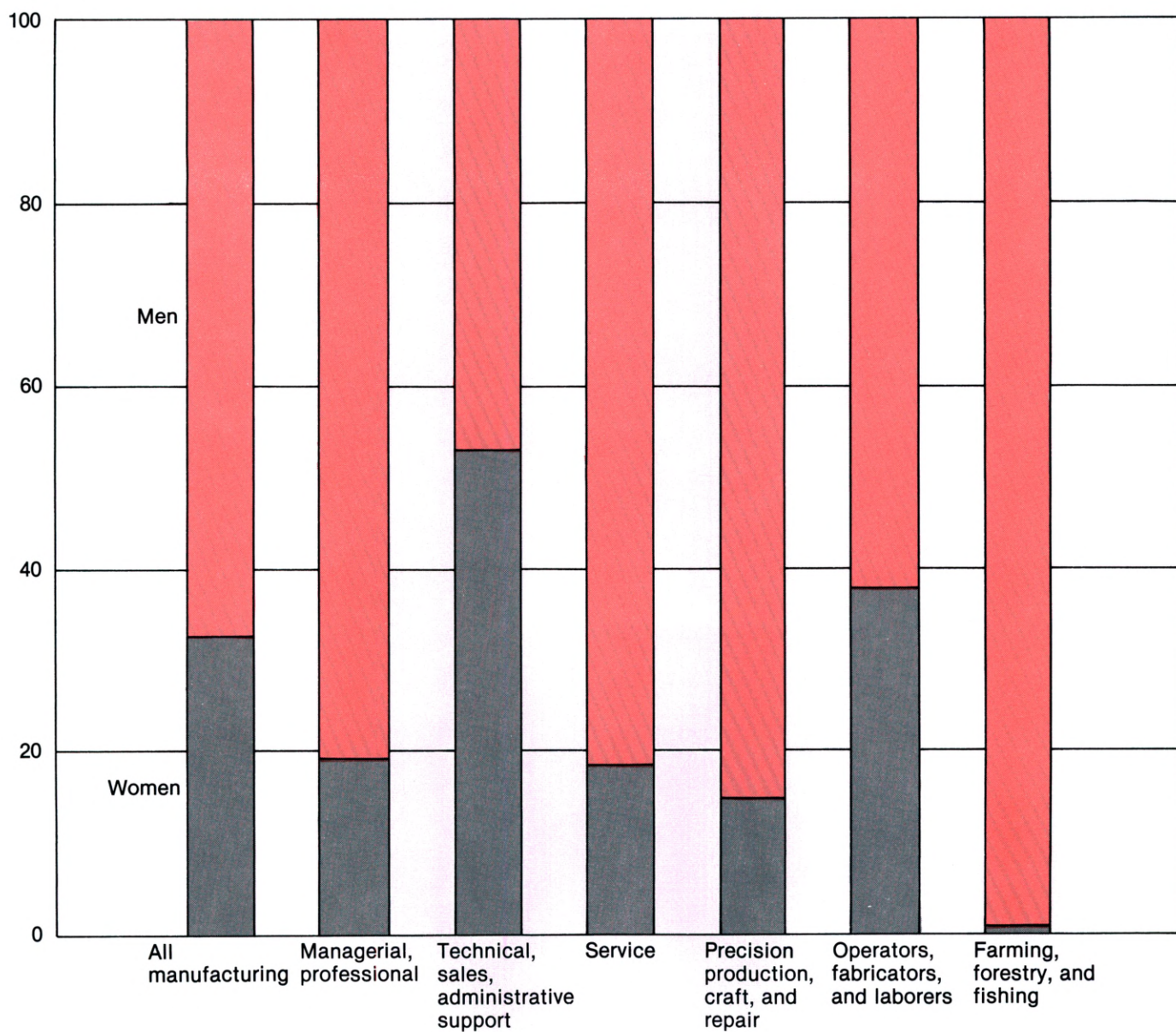
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In the largest manufacturing occupational group, operators, fabricators, and laborers, men and women shared jobs in a ratio of 6 to 4 in 1983. In the managerial and professional group, 8 out of every 10 jobs were held by men. The largest concentration of women was in the technical, sales, and administrative support group. They held more than half of the jobs in this occupational category.

Although comparable occupational data are not available for other years, an earlier series suggests significant changes in the jobs women hold. For example, from 1968 to 1982, the proportion of women in professional and technical jobs rose from 10 to 20 percent, and in manager, official, and proprietor jobs from 7 to 15 percent.

Chart 6  
Occupational distribution in manufacturing by sex, 1983

Percent



Source: Bureau of Labor Statistics

## **Workers in manufacturing are better educated today than in the past**

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Educational attainment of manufacturing employees is rising and is associated with patterns of industrial growth that require more education. Between 1973 and 1983, the proportion of employees with 4 years of college or more almost doubled, while the proportion that

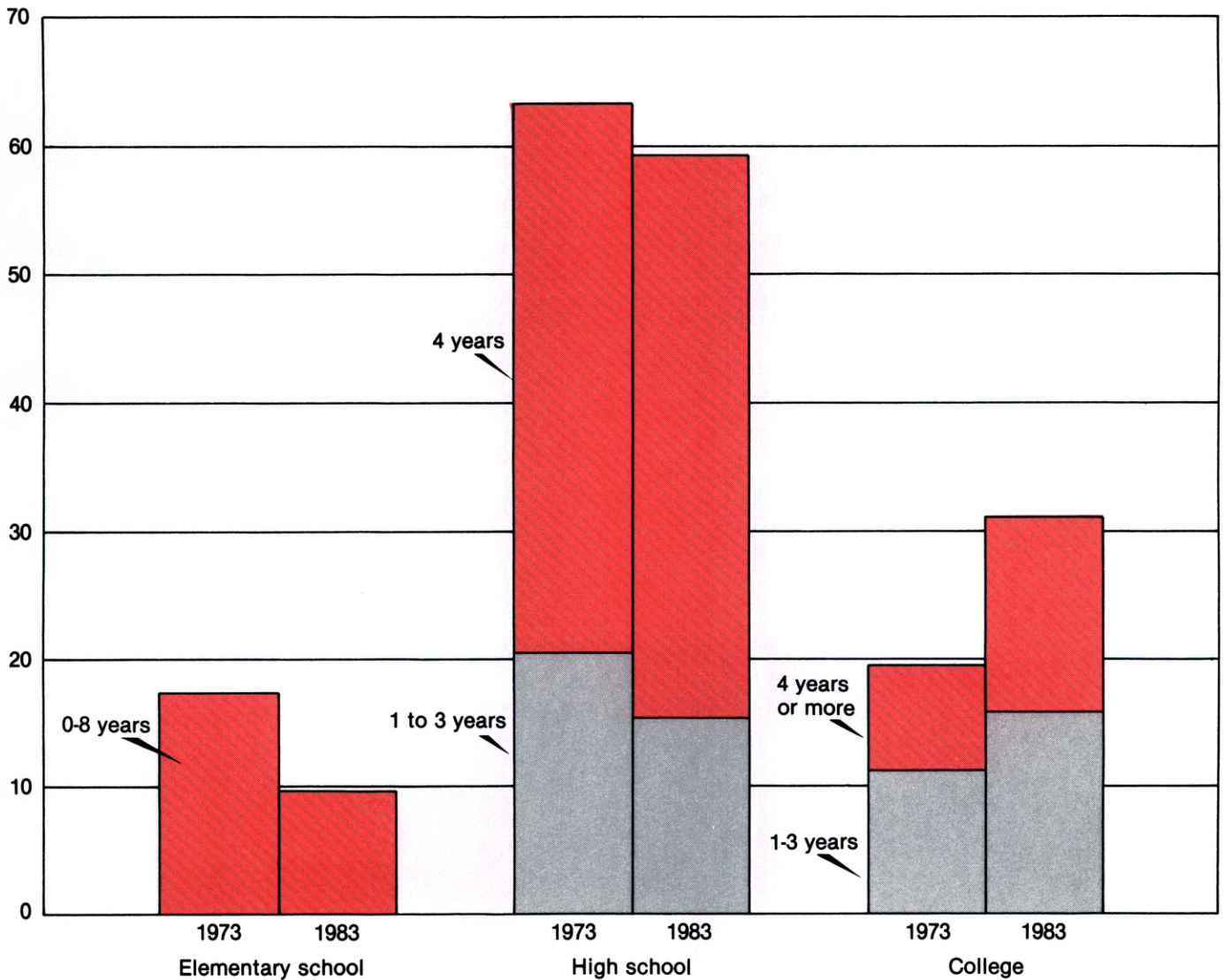
did not continue on to high school fell by almost half.

By far the largest proportion of the workforce, almost half, has completed 4 years of high school, and this group has increased only slightly in the last decade.



Chart 7  
Educational attainment in manufacturing, 1973 and 1983

Percent of all manufacturing employees



Source: Bureau of Labor Statistics

## Imports and exports account for an increasing proportion of manufacturing shipments

International trade is becoming increasingly important to manufacturing. Exports as a percent of shipments (export proportion) rose by half between 1973 and 1981 (latest available data). At the same time, im-

ports as a percent of supply (import penetration) increased by almost a third.

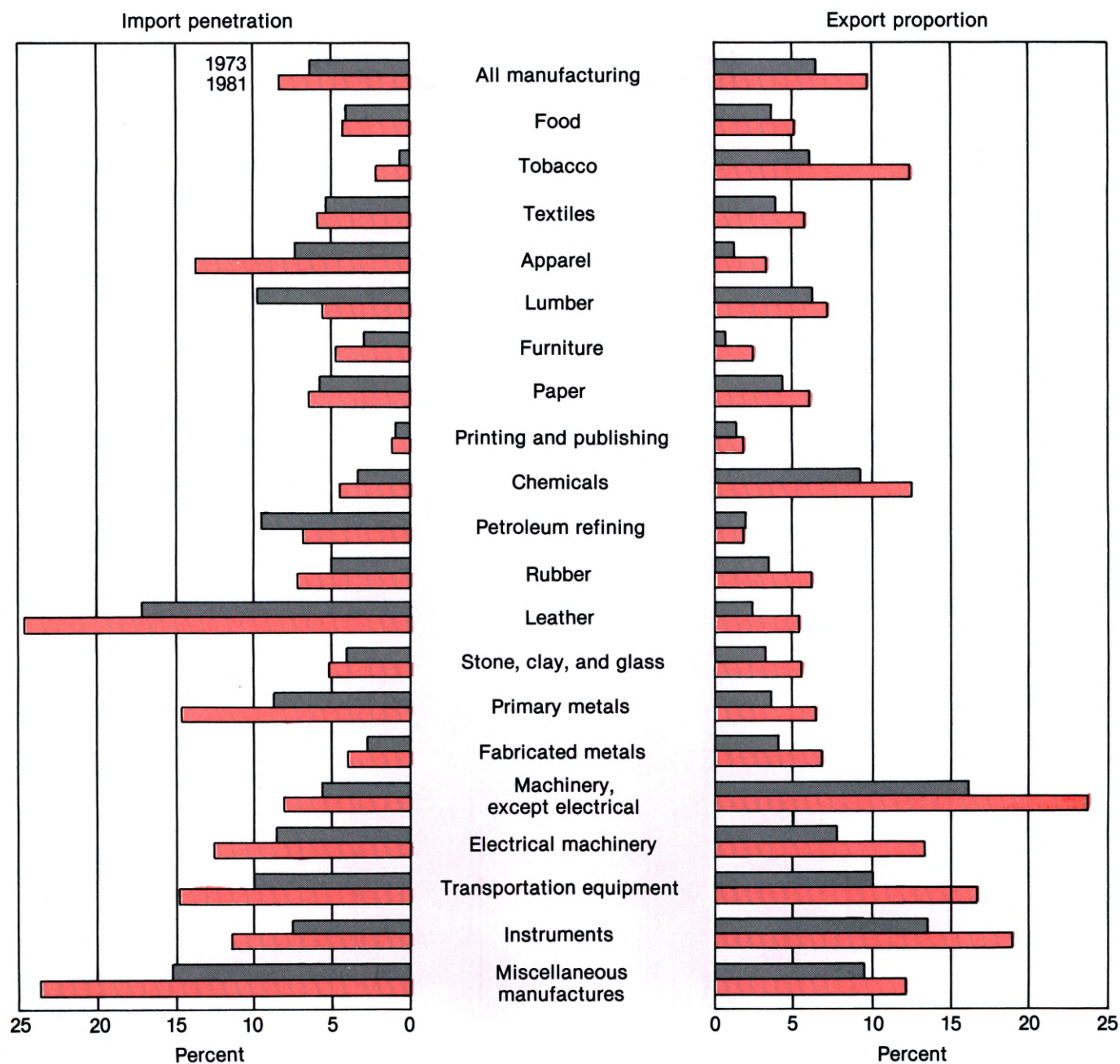
Import penetration and export proportion increased from 1973 to 1981 in almost every major industry group.

Year	Import penetration <sup>1</sup> Manufacturing	Export proportion <sup>2</sup> Manufacturing
1973.....	6.4	6.6
1974.....	7.3	8.0
1975.....	6.5	8.7
1976.....	6.9	8.2
1977.....	7.1	7.7
1978.....	7.9	8.0
1979.....	7.9	9.0
1980.....	8.2	10.0
1981.....	8.4	9.9

<sup>1</sup> Imports as a percent of the sum of U.S. product shipments and imports.

<sup>2</sup> Exports as a percent of U.S. product shipments.

Chart 8  
Imports and exports by major manufacturing group, 1973 and 1981



Source: Bureau of Labor Statistics



## **The U.S. share of export trade in manufactured goods has declined sharply in the postwar period**

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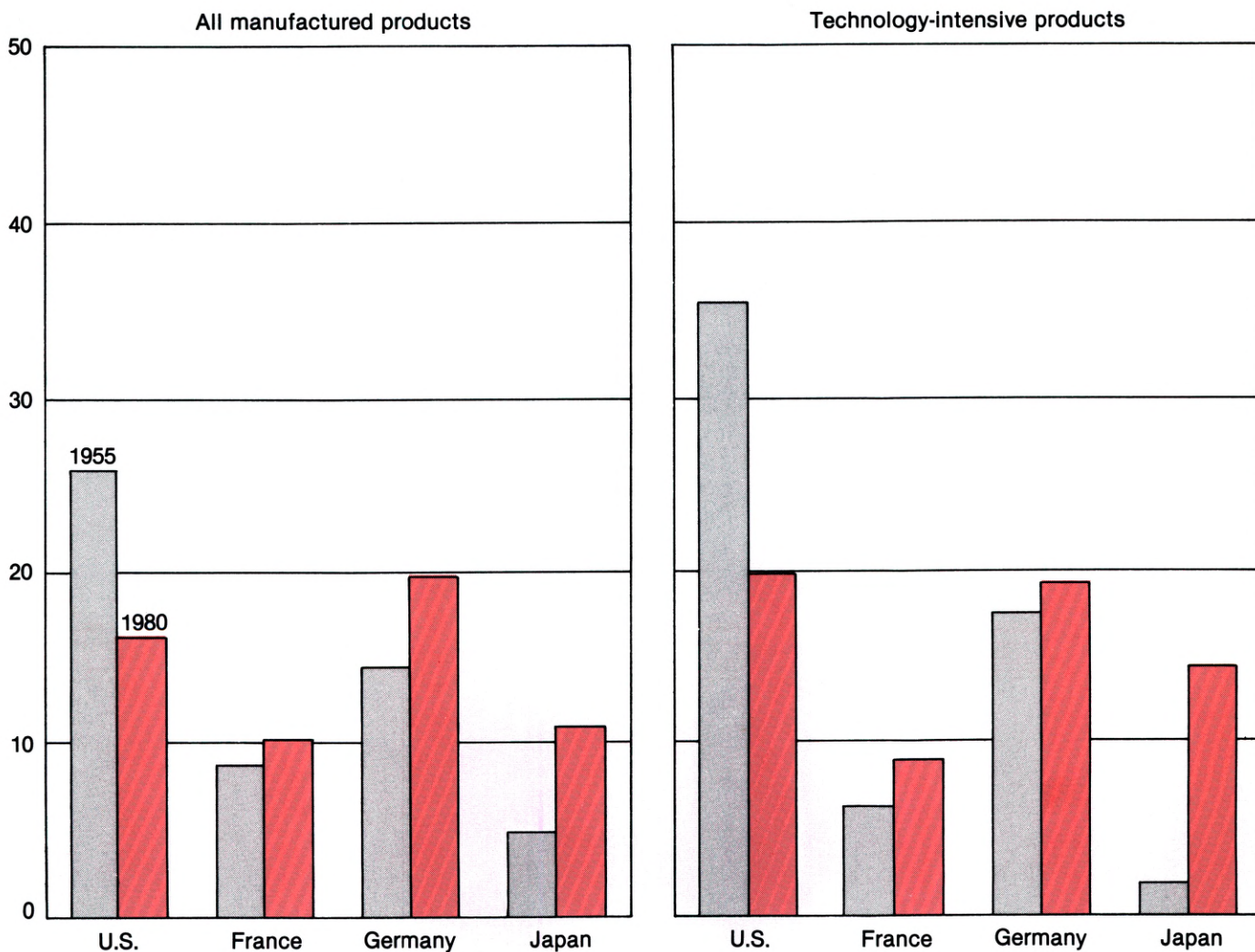
While international trade has become more important in the postwar period, the U.S. share of world export trade of all manufactured goods and of technology-intensive products declined sharply. By 1980 (latest available data), Germany had a larger share of trade in manufactured goods than the United States, and almost the same share of the technology-intensive product

market. At the same time, Japan was rapidly approaching the U.S. share of both of these export markets.

The loss of American market shares to other countries is associated with many changes here and abroad, including comparative productivity growth, relative compensation per hour, and the increasing value of the dollar abroad.

Chart 9  
Share of export trade of all manufactured products and technology-intensive products, selected countries, 1955 and 1980

Percent



Note: For definitions, see footnote 2, table 9.

Source: U.S. Department of Commerce





# Part II.

## Productivity trends in manufacturing

21

This part presents labor productivity measures for the manufacturing sector and for 75 manufacturing industries. It also contains multifactor productivity measures for manufacturing. Comparable data are presented for 5 foreign countries where available.

The BLS productivity data measure output per hour of all employed persons for the manufacturing sector, and output per employee hour for the industry groups. The BLS indexes of labor productivity relate output to the input of labor time, i.e., output per hour. Output is a measure of the amount of finished product provided by the manufacturing sector, while input is a measure of paid labor time.

Labor is not solely or primarily responsible for productivity growth

and the use of labor productivity indexes is not meant to imply this. In a technologically advanced society, labor effort is only one of many sources of productivity improvement. Trends in output per hour also reflect technological innovation, changes in capital stock and capacity utilization, scale of production, materials flow, management skills, and other factors.

The BLS multifactor productivity measure shows the changes in the amount of labor and capital used in production. As with the labor productivity index, this measure also reflects the joint effect of many influences, but does not reflect the effect of the substitution of capital for labor.

## Manufacturing productivity has continued to climb, but at a slower rate

Productivity in manufacturing was more than twice as great in 1983 as in 1950. The average annual gain over the entire period was 2.5 percent as productivity grew more rapidly in the nondurable goods sector than in the durable goods sector.

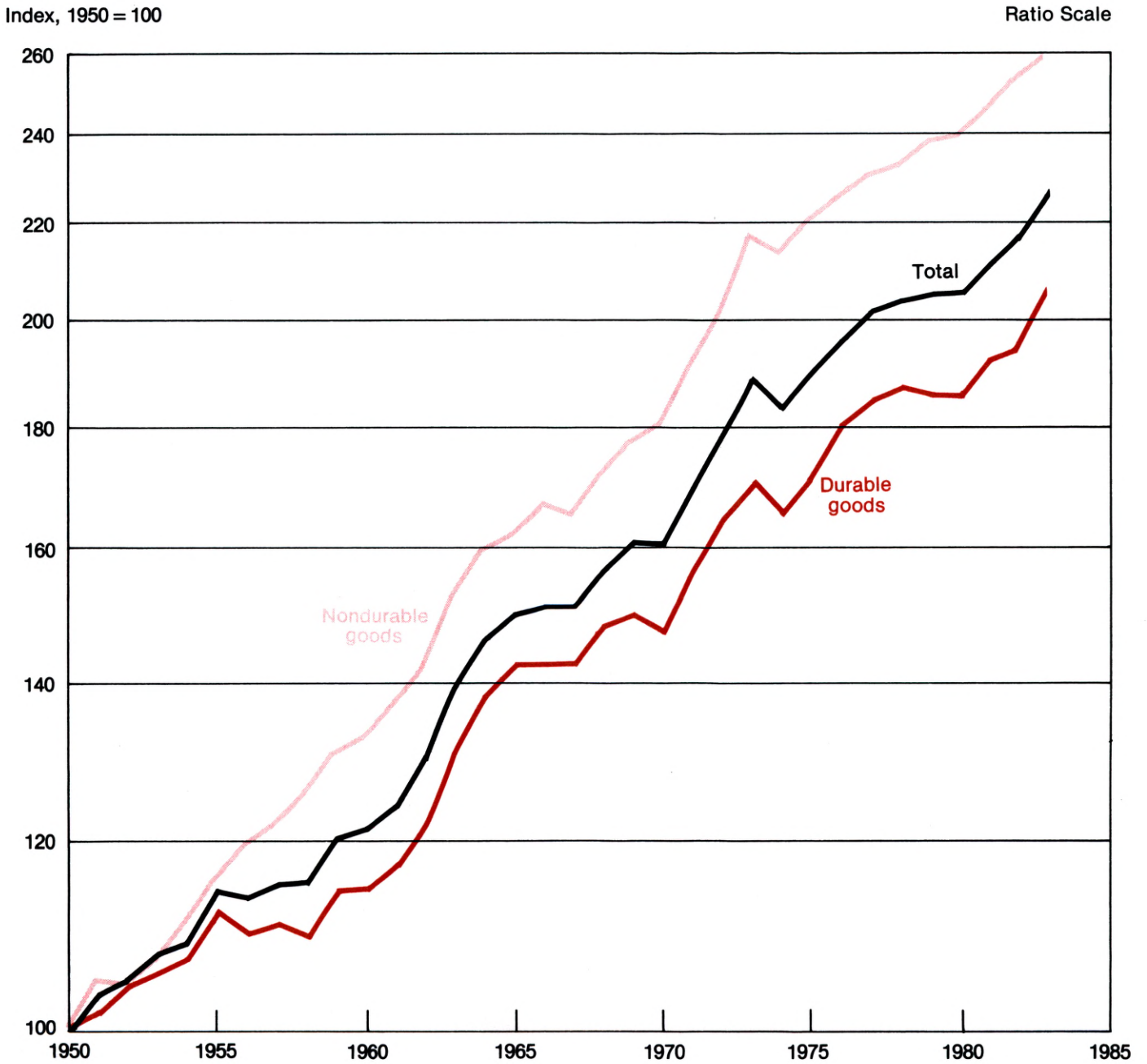
The increase in manufacturing productivity began to slow in 1973. Earlier it had grown at an annual rate of 2.8 percent, but during the decade ending in 1983, its growth rate slowed to 1.8 percent. The slowdown was evident in both the durable and nondurable goods sectors.

No simple explanation exists for the decline in productivity growth since 1973, nor is there general

agreement on the quantitative impact of the factors which are thought to have contributed to the slowdown. Various explanations have been presented by researchers, but none, singly or in total, fully explains the falloff. Some of these explanations have been the effects of changes in the composition of the labor force, a leveling off in research and development expenditures in the late 1960's, the maturation of some industries with little new technology, the diversion of investment funds to pollution abatement in some industries, energy price increases, and even changes in attitudes toward work.

Period	Output per hour of all persons in manufacturing (average annual percent change)		
	Total manufacturing	Durable goods	Nondurable goods
1950-83.....	2.5	2.2	2.9
1950-73.....	2.8	2.3	3.4
1973-83.....	1.8	1.9	1.7
Slowdown.....	- 1.0	- 0.4	- 1.7

Chart 10  
Output per hour of all persons in manufacturing, 1950-83



Source: Bureau of Labor Statistics



## U.S. productivity growth has been among the lowest of the industrial countries before and after 1973

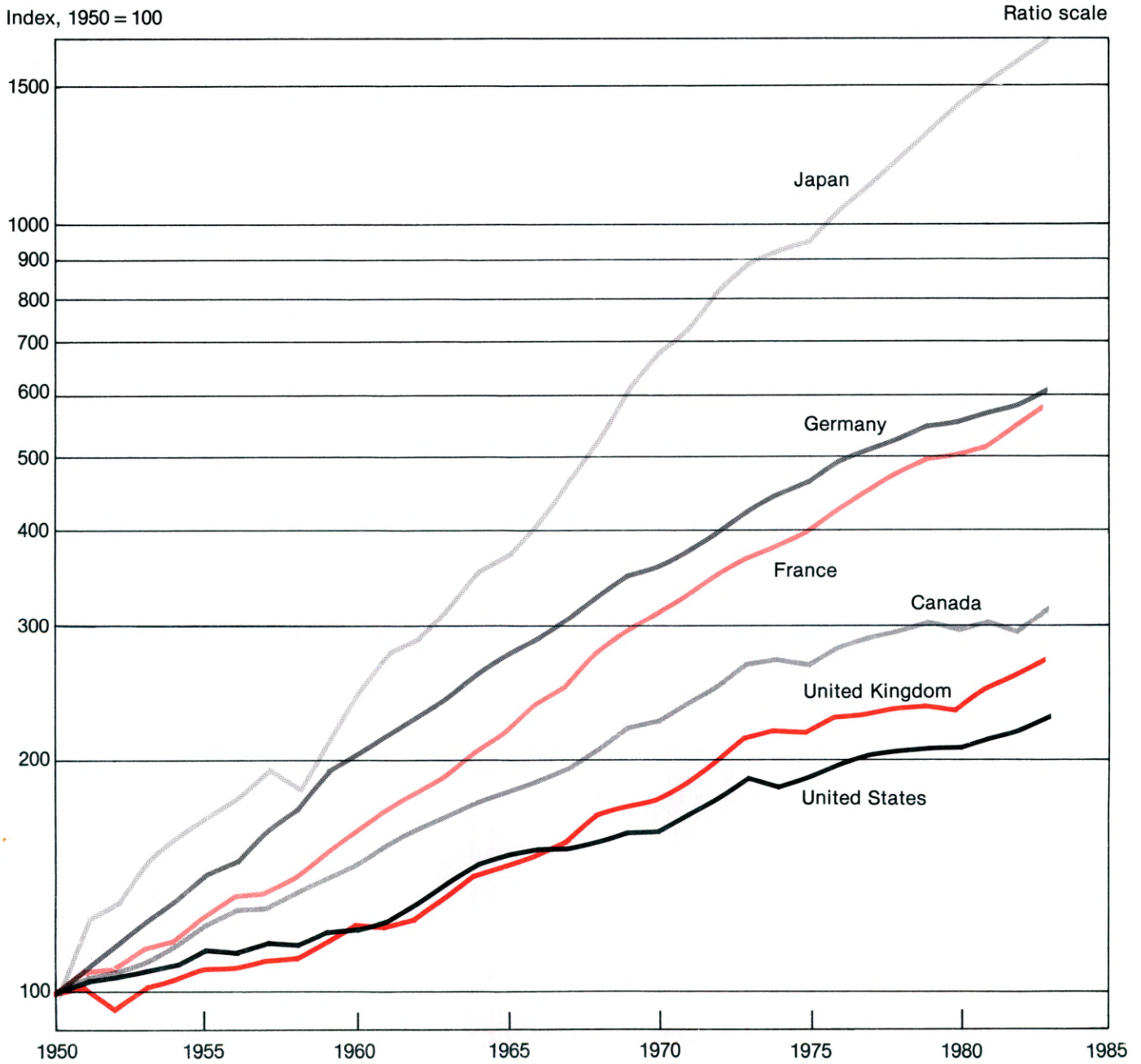
Productivity gains in manufacturing were lower in the United States over the period 1950-83 than in the other major industrial countries studied by BLS.

Before 1973, the U.S. productivity growth rate was the lowest of the countries shown; after 1973, the United States and Canada had the smallest gains. The slowdown in the last decade from the earlier postwar

advance was pervasive among the industrial countries, but affected them unevenly. Except for the United Kingdom, the U.S. slowdown was the least severe of the countries shown. Although Japan experienced the largest falloff in productivity growth after 1973, its growth rate continued to be substantially greater than the rates in the other countries.

Country	Output per employee hour in manufacturing (average annual percent change)			Change, 1950-73 to 1973-83
	1950-83	1950-73	1973-83	
United States .....	2.5	2.8	1.8	- 1.0
Canada .....	3.5	4.3	1.8	- 2.5
France .....	5.4	5.8	4.6	- 1.2
Germany .....	5.6	6.5	3.7	- 2.8
Japan .....	9.0	10.0	6.8	- 3.2
United Kingdom .....	3.0	3.3	2.4	- 0.9

Chart 11  
Output per employee hour in manufacturing, selected countries, 1950-83



Source: Bureau of Labor Statistics

## The productivity slowdown after 1973 is associated with greatly reduced output

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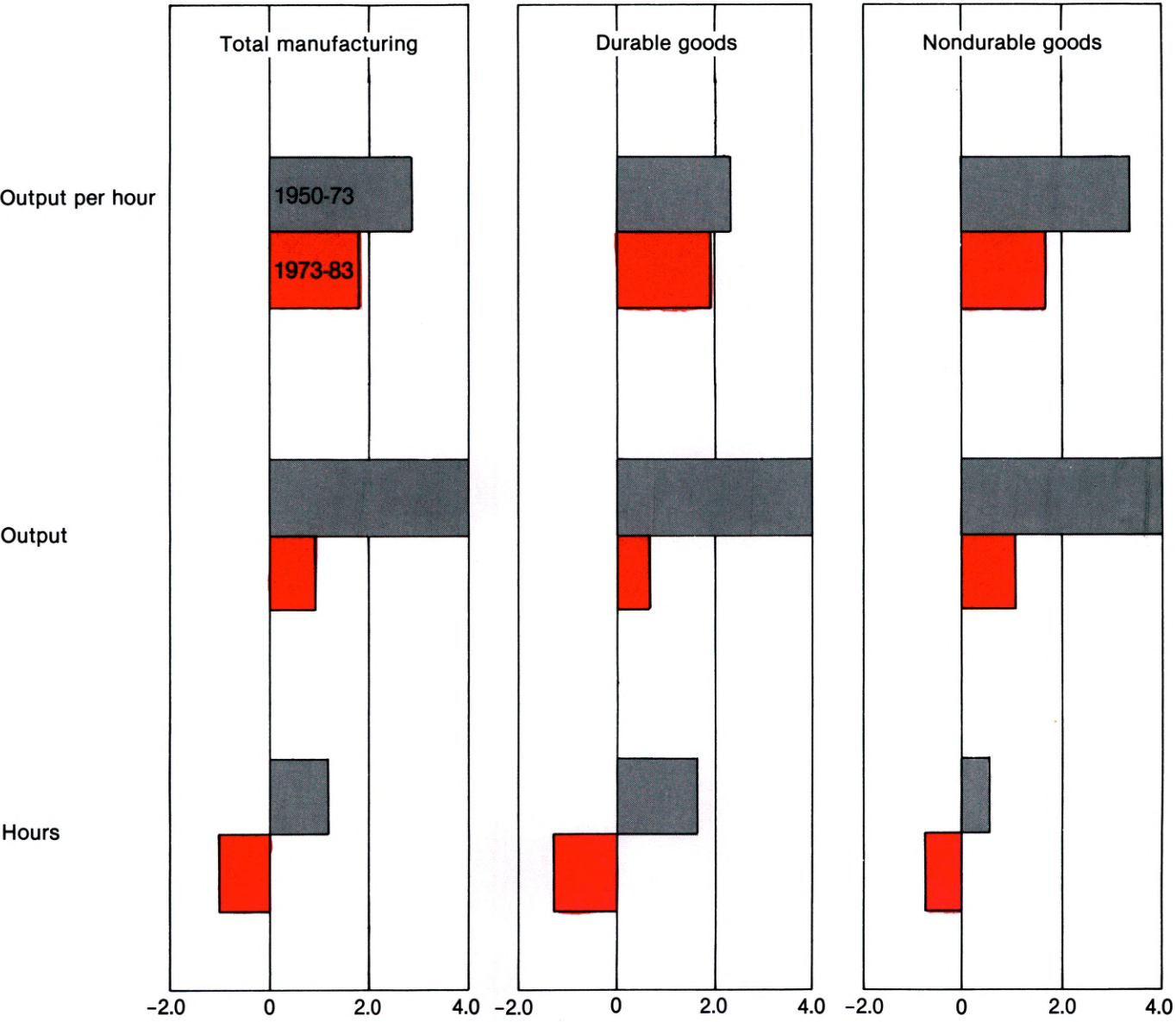
The productivity slowdown after 1973 is associated with a steeper drop in output growth than in hours. Both the durable and nondurable goods sectors recorded slower productivity growth rates after 1973, and

reflected greatly reduced output growth. However, the slowdown was more severe in the nondurable goods sector, where output growth declined considerably more rapidly than hours.



Chart 12  
Output per hour, output, and hours in manufacturing, 1950-73 and 1973-83

Average annual percent change



Source: Bureau of Labor Statistics

## **In all major industrial countries, output growth slowed down after 1973**

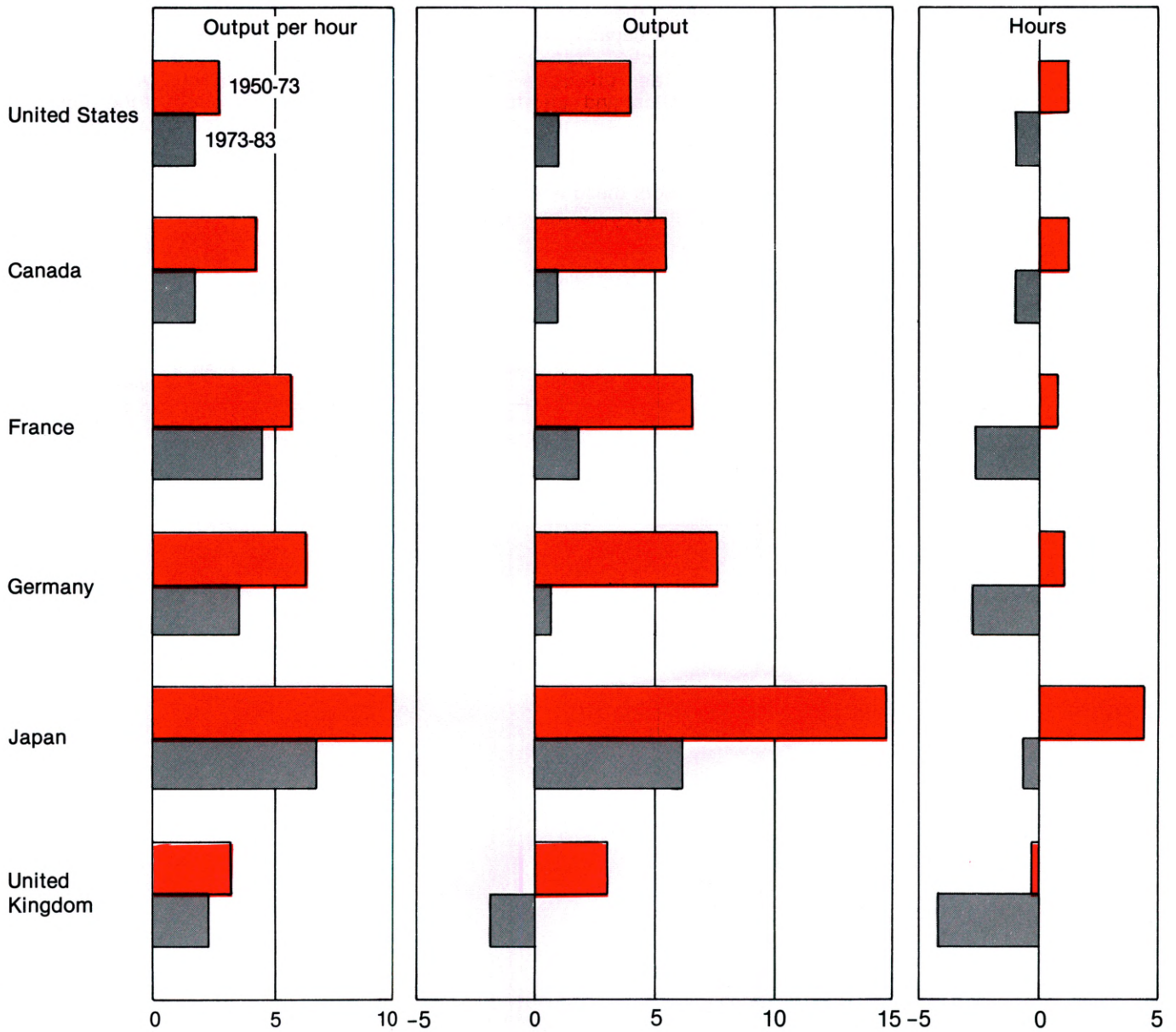
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As in the United States, the productivity slowdown after 1973 in the other major industrial countries shown reflected substantially lower rates of output growth than in earlier years. The U.S. output growth drop-

ped to an average of less than 1 percent annually in the past decade, while Japan's rate fell to about 6 percent annually. In the United Kingdom, output declined almost 2 percent.

**Chart 13**  
**Output per hour, output, and hours in manufacturing, selected**  
**countries, 1950-73 and 1973-83**

Average annual percent change



Source: Bureau of Labor Statistics

## Multifactor productivity increased by three-quarters over the last three decades

Multifactor productivity is a measure of output per unit of combined labor and capital input. This productivity series shows the changes in the amount of labor and capital used in production. It reflects the combined effects of many influences, including changes in technology, the level of output, utilization of capacity, the organization of production, managerial skills, as well as changes in the characteristics and efforts of the work force.

The traditional productivity series—output per hour of all persons—reflects these influences and also the impact of changes in capital

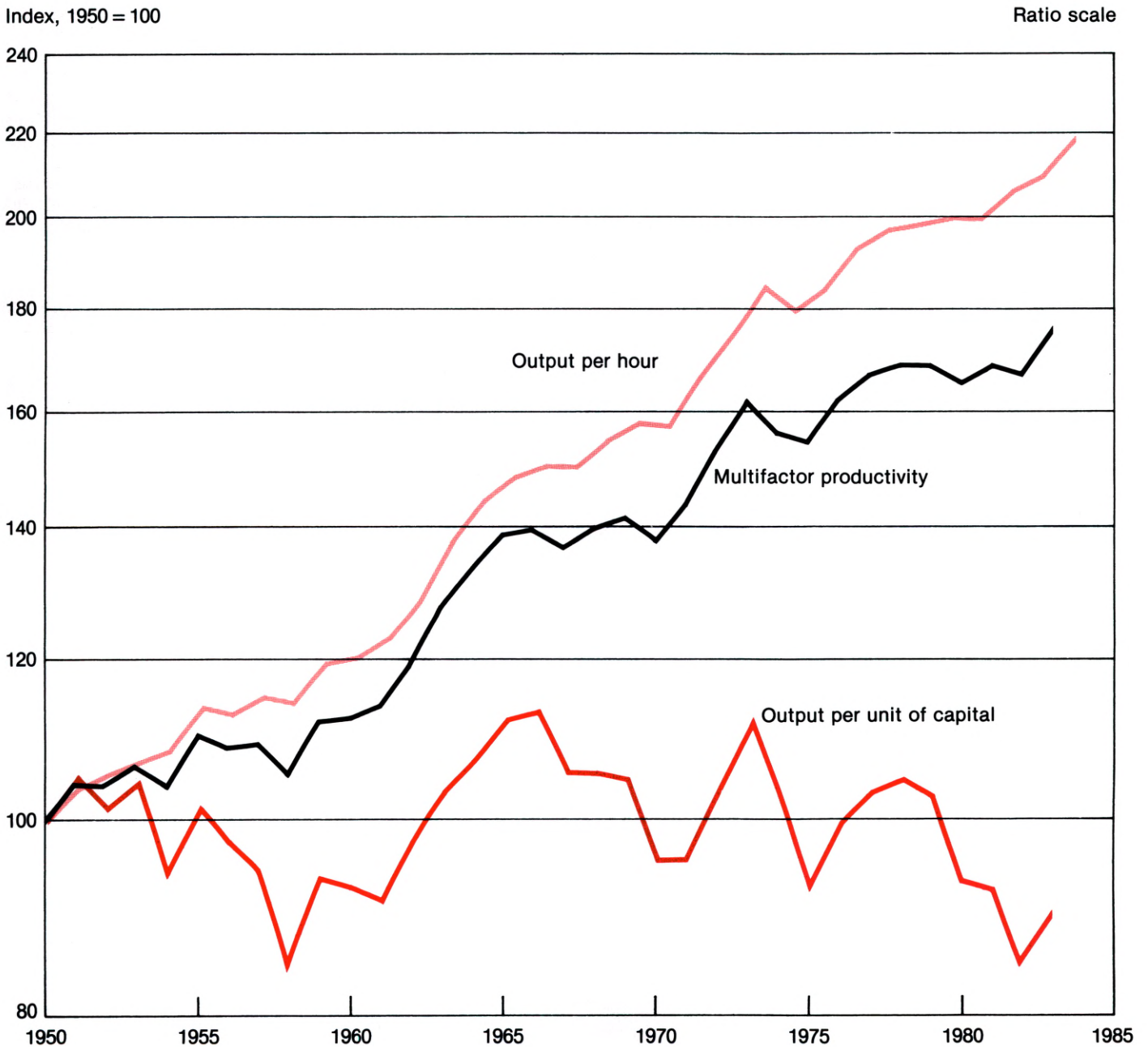
per unit of labor. The new measure, therefore, supplements the existing measure by providing a basis for measuring that impact.

Over the 1950-83 period, when multifactor productivity increased 1.7 percent per year, the traditional productivity measure of output per hour in manufacturing rose 2.5 percent per year. The difference between the growth in labor productivity and multifactor productivity, 0.8 percent per year, is the effect of the substitution of capital for labor. Output per unit of capital (capital productivity) fluctuated over this period but did not register a significant trend.

Measure	1950-83
	Average annual percent change
Output per hour.....	2.5
Multifactor productivity.....	1.7
Capital services contribution.....	0.8



Chart 14  
Output per hour, output per unit of capital, and multifactor productivity in manufacturing, 1950-83



Source: Bureau of Labor Statistics

## Multifactor productivity growth slowed significantly after 1973

Multifactor productivity in manufacturing grew at an average annual rate of 2.1 percent from 1950 to 1973, and 0.8 percent from 1973 to 1983. This slowdown of 1.3 percentage points per year reflects a greater decline in the rate of output growth

than in the combined inputs of labor and capital services.

The capital-labor ratio did not contribute to the slowdown in output per hour, as it grew faster after 1973 than during the earlier period.

**Contribution of capital services per hour to productivity in manufacturing, 1950-83**  
(Average annual percent change)

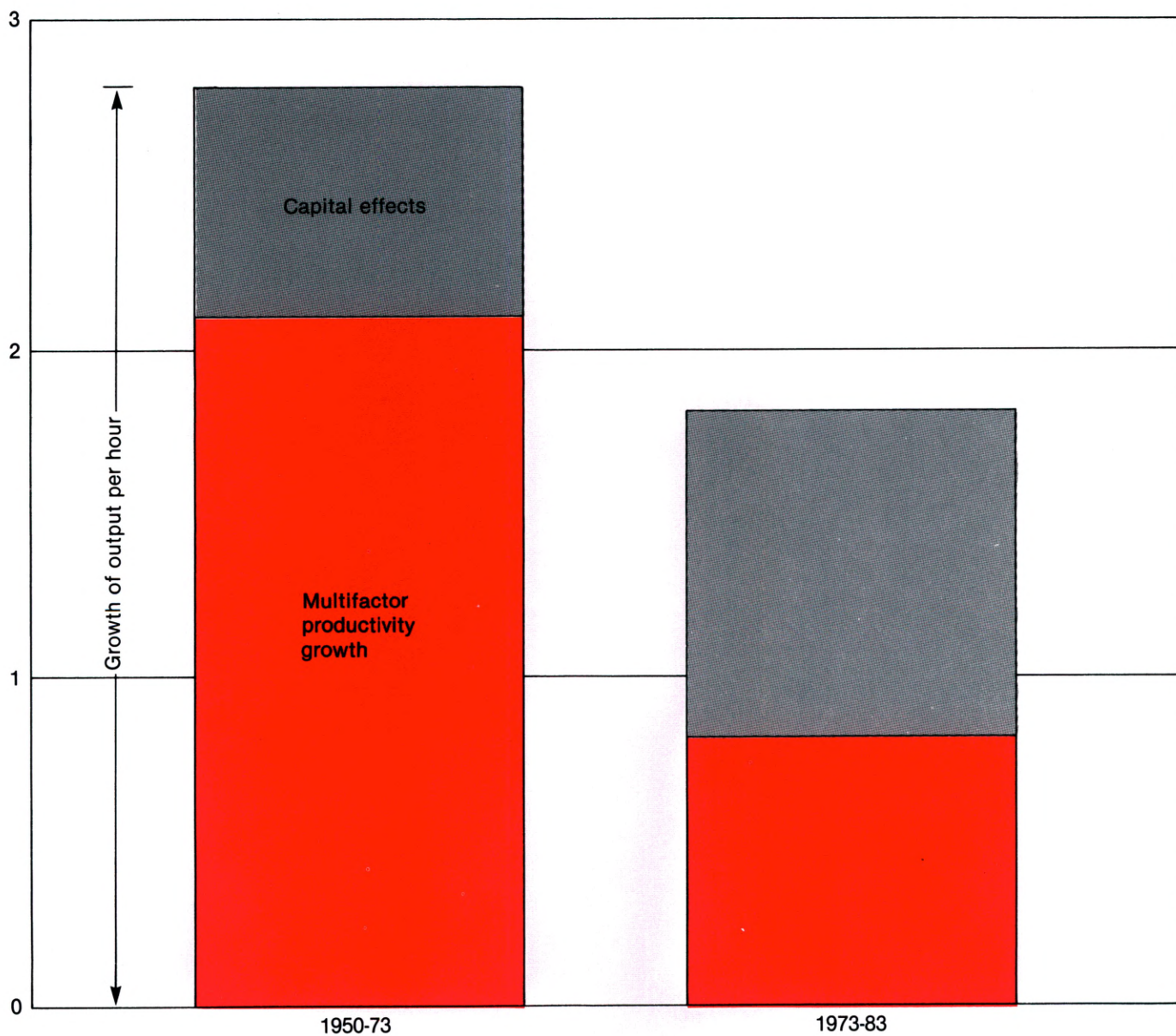
Measure	1950-73	1973-83	Change 1950-73 to 1973-83
Output per hour .....	2.8	1.8	- 1.0
Minus: Capital effects <sup>1</sup> .....	0.7	1.0	0.3
Equals: Multifactor productivity <sup>2</sup> .....	2.1	0.8	- 1.3

<sup>1</sup> Contribution of capital services per hour to output per hour.

<sup>2</sup> Output per unit of combined labor and capital input.

Chart 15  
Output per hour, capital effects, and multifactor productivity in  
manufacturing, 1950-73 and 1973-83

Average annual percent change



Source: Bureau of Labor Statistics

## Productivity has advanced in almost all manufacturing industries since 1960

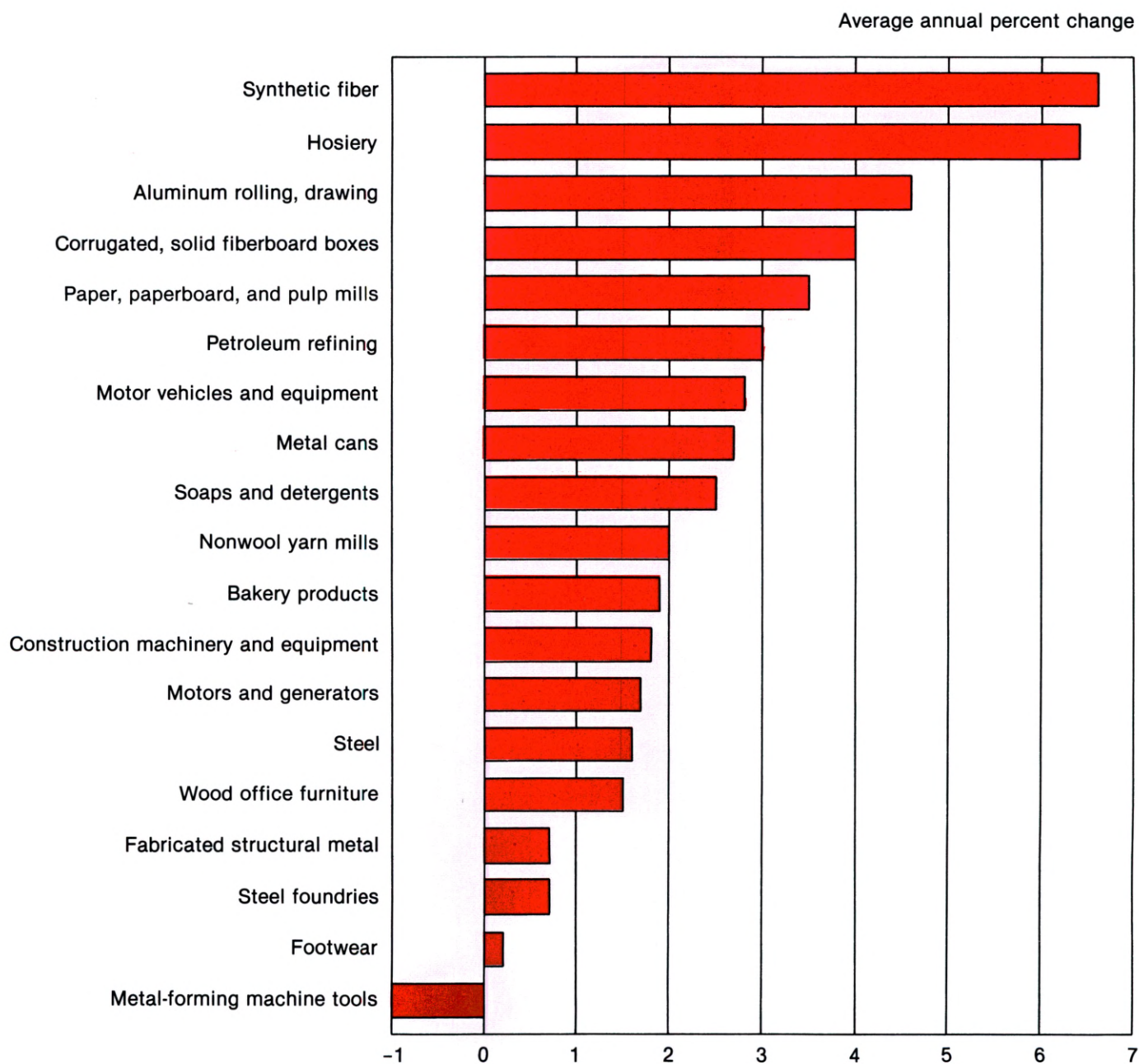
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Almost all the manufacturing industries measured by BLS have shown productivity gains since 1960. The rates of growth for the individual industries were widely dispersed around the average rate for all manufacturing. Productivity changes differed among industries for a variety of reasons. Some industries, such as hosiery and synthetic fibers, which were among the leaders for the period, with an average annual in-

crease of about 6.5 percent, installed highly advanced production machinery and enjoyed rapidly growing demand. In contrast, the decline in productivity in metal-forming machine tools and the low growth rate in steel were associated with wide swings in output, aging equipment, rising imports, and capacity utilization rates below efficient levels.



Chart 16  
Output per employee hour, selected manufacturing industries, 1960-83



Source: Bureau of Labor Statistics

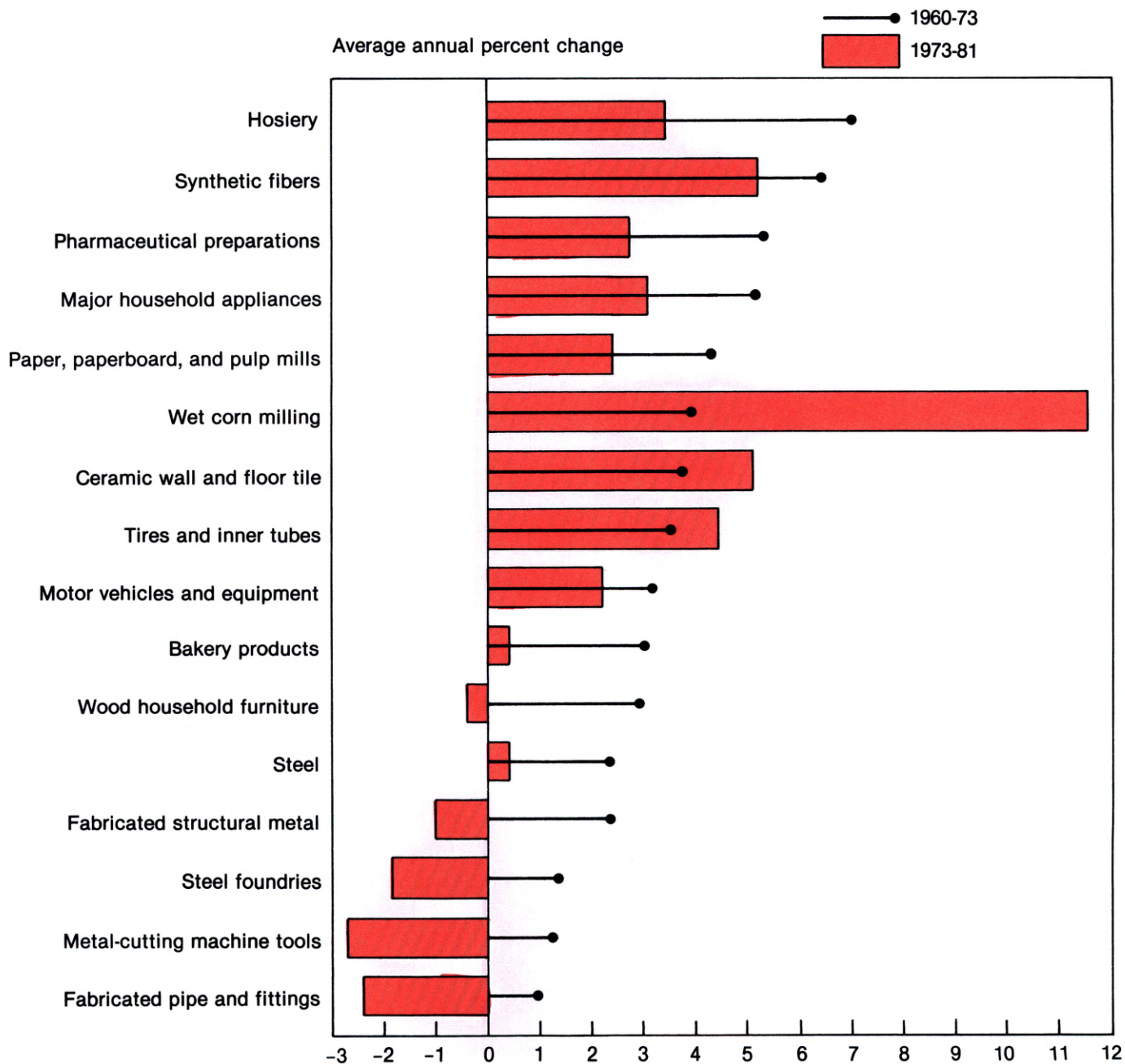
## Many manufacturing industries registered productivity declines after 1973

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Although most industries showed gains over the last two decades, the growth was not steady. A slowdown in productivity growth after 1973 affected more than half of the industries measured by BLS; about one-fifth showed actual productivity declines. However, more than one-

fourth of the industries registered higher productivity gains after 1973. These included several food processing and furniture industries, ceramic tile, and metal cans. Their higher productivity rates are generally associated with the diffusion of new technology.

Chart 17  
Productivity rates before and after 1973, selected manufacturing industries



Source: Bureau of Labor Statistics





# Part III.

## Implications of productivity change for employment, compensation, unit labor costs, and prices in manufacturing

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This section shows the implications of productivity change for variations in prices, hourly compensation, unit labor costs, and employment in manufacturing. It presents comparable data for the United States and other major industrial countries, where available, and explains the effects of changes in exchange rates on our competitive position.

Output per hour is a critical link between the cost of labor and the price of goods and services. Labor costs, which include rates of pay, overtime, and fringe benefits, represent the largest single cost element for most industries. Thus, the trend in labor costs per unit of output plays a major role in determining prices.

## Employment increased in some manufacturing industries with rising productivity, but declined in others

---

As the chart illustrates, productivity gains may be accompanied by increases or decreases in employment; no relationship between the two has been established. Of the industries which have shown some productivity growth since 1973, 72 percent registered employment losses, 26 percent had employment gains, and 2 percent had no change. In contrast,

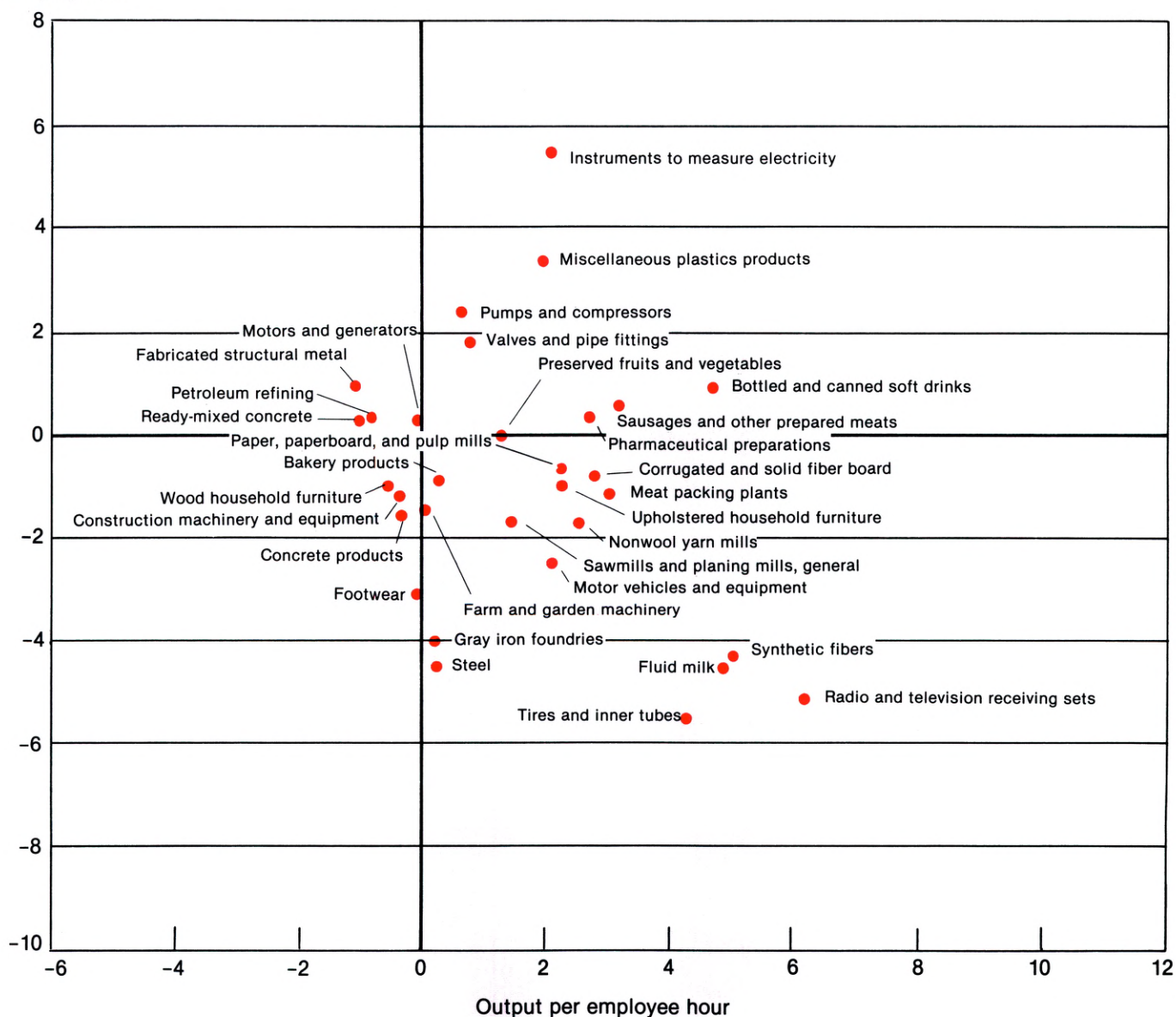
in 1960-73, fewer than one-third of the industries with productivity growth had registered declines in employment.

Reductions in employment are associated with productivity growth either because of strong technological progress or modest or declining output.

Chart 18  
Output per employee hour and employment, selected manufacturing industries, 1973-83

Average annual percent change

Employment



Source: Bureau of Labor Statistics

## Similar productivity trends in different industries may reflect differing trends in output and hours

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The relation between labor productivity growth and employment trends is associated with an industry's change in output. This is illustrated by the three industries shown on the chart, all of which had approximately the same productivity growth rate in 1973-83. Output rose considerably faster than productivity in the

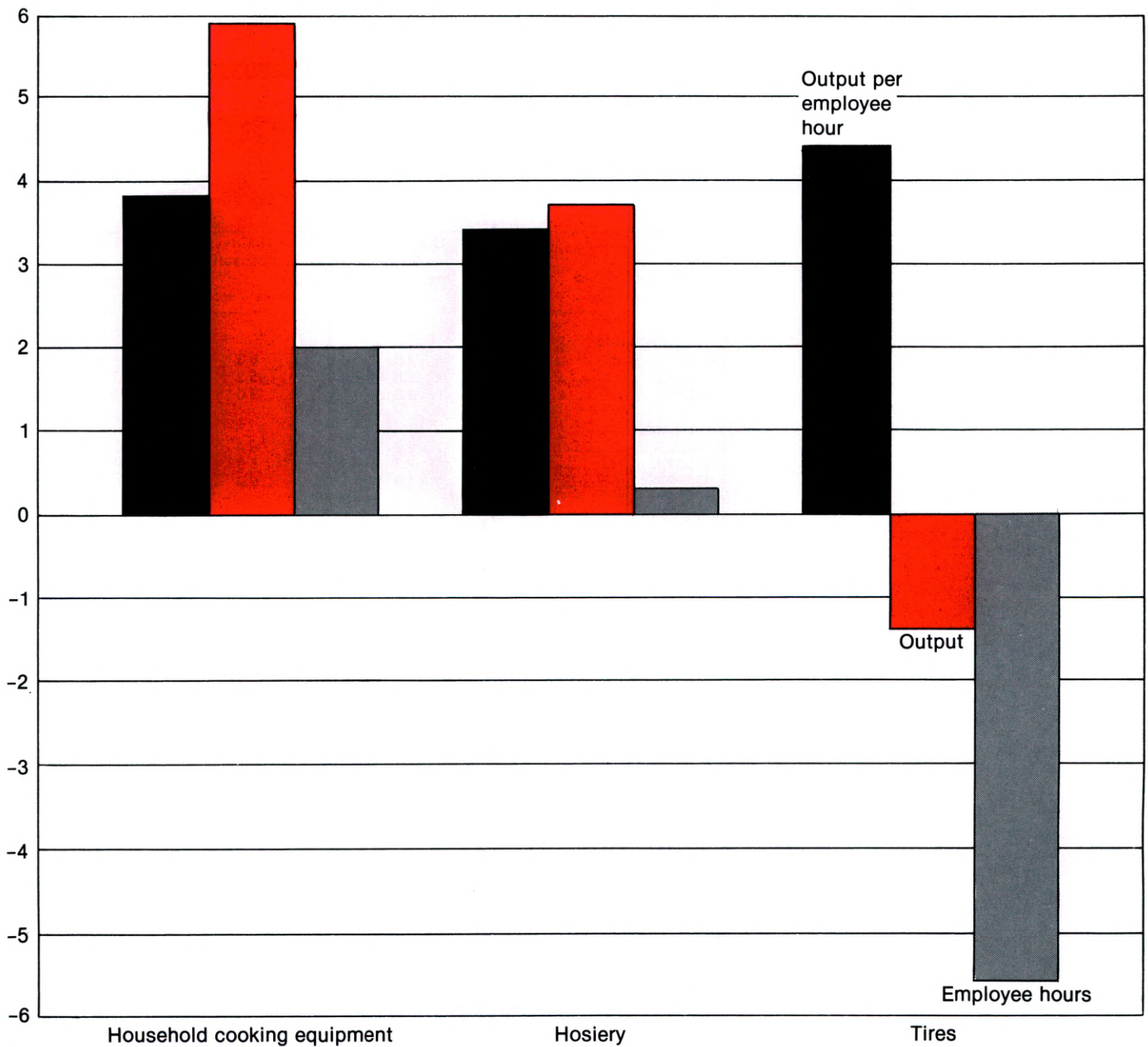
household cooking equipment industry, and employee hours increased. Where output gains exceeded the productivity rise only slightly (e.g., hosiery), employee hours rose only very moderately. In contrast, output in the tire industry declined, and employee hours dropped sharply.



Chart 19

Output and employment in selected industries with similar productivity growth, 1973-83

Average annual percent change



Source: Bureau of Labor Statistics

## Hourly compensation rose more after 1973 than before, and productivity growth declined; hence, unit labor costs rose much more rapidly after 1973

Unit labor cost is the ratio of hourly compensation to output per hour. Thus, productivity change is an important determinant of cost movements. This is demonstrated by the two top panels of the chart, showing that changes in unit labor costs are inversely related to changes in productivity. Unit labor costs tend to rise when productivity growth slows or declines, and to slow or decline when productivity growth accelerates.

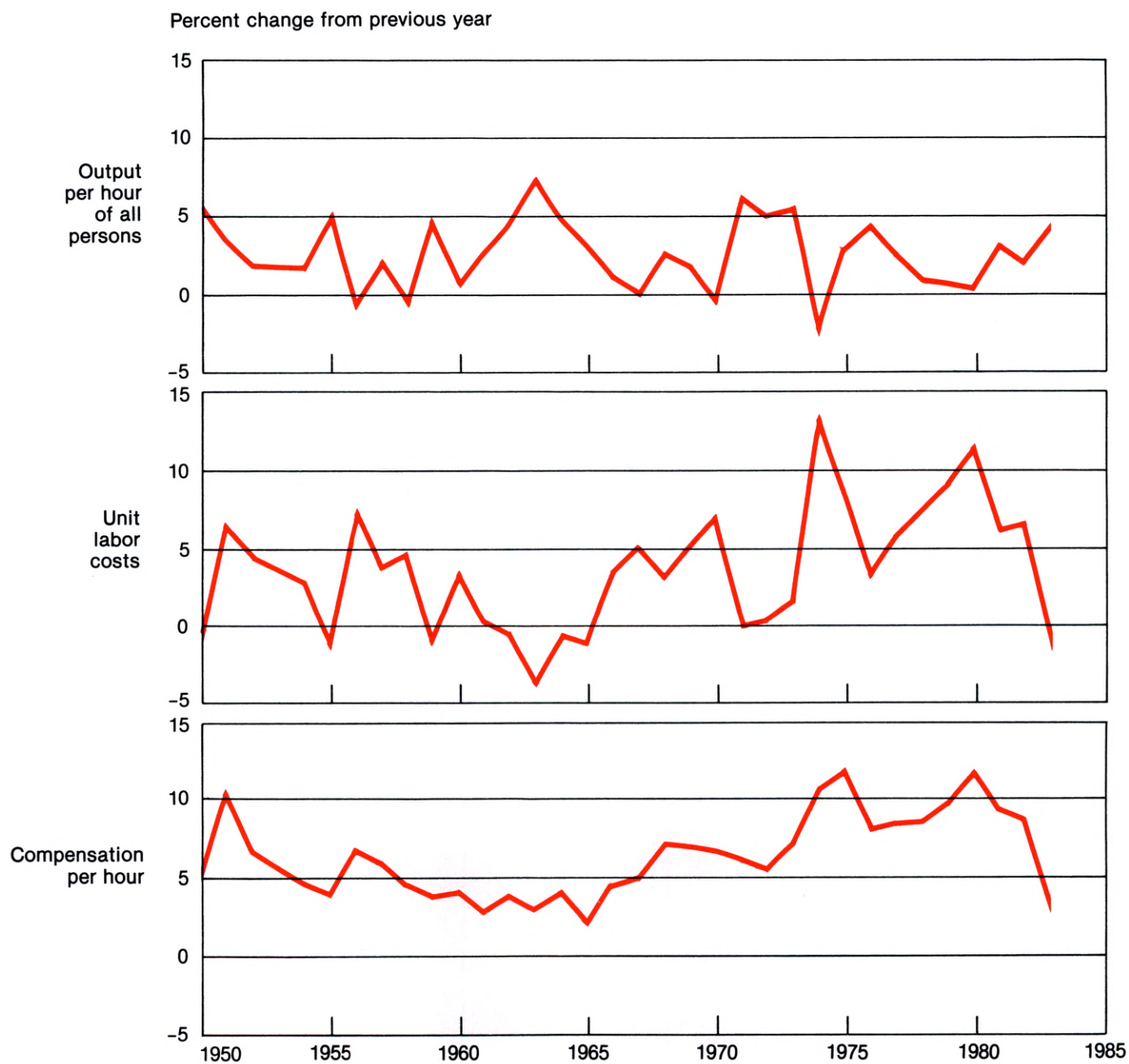
Hourly compensation in manufac-

turing rose more sharply after 1973 than before. At the same time, the rate of productivity growth slowed down. Consequently, unit labor costs rose much more rapidly after 1973 than before.

Hourly compensation changes in durables and nondurables were about the same before and after 1973; but because the slowdown in output per hour in nondurables was greater than in durables, unit labor costs accelerated more sharply in nondurables after 1973.

Period and sector	Output per hour	Hourly compensation	Unit labor costs
	Average annual percent change		
Total manufacturing:			
1950-83.....	2.5	6.3	3.8
1950-73.....	2.8	5.2	2.4
1973-83.....	1.8	9.0	7.0
Durable goods:			
1950-83.....	2.2	6.4	4.1
1950-73.....	2.3	5.3	2.9
1973-83.....	1.9	9.0	7.0
Nondurable goods:			
1950-83.....	2.9	6.2	3.2
1950-73.....	3.4	5.0	1.5
1973-83.....	1.7	9.1	7.2

Chart 20  
Output per hour, unit labor costs, and compensation per hour in  
manufacturing, 1950-83



Source: Bureau of Labor Statistics

## Unit labor costs and prices in manufacturing accelerated after 1973

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Changes in unit labor costs are generally the most important component of price change, as the chart shows. Thus if productivity growth mitigates increases in unit labor costs, this can in turn, mitigate increases in prices.

However, unit labor costs can be a result as well as a cause of price

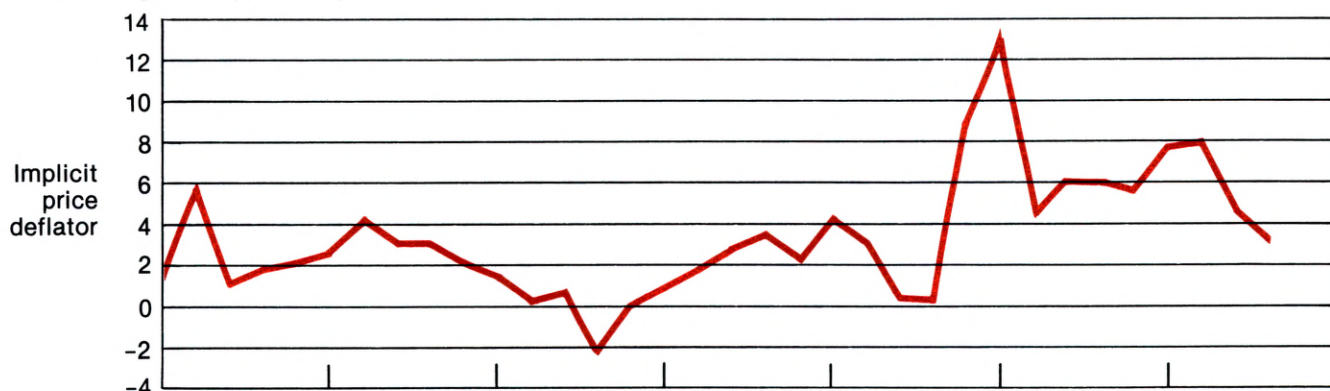
rises. Price increases that cause employee purchasing power to fall lead to pressure for higher wages.

As shown in the chart, prices and unit labor costs in manufacturing accelerated after 1973, as hourly compensation increased and productivity growth slowed down.

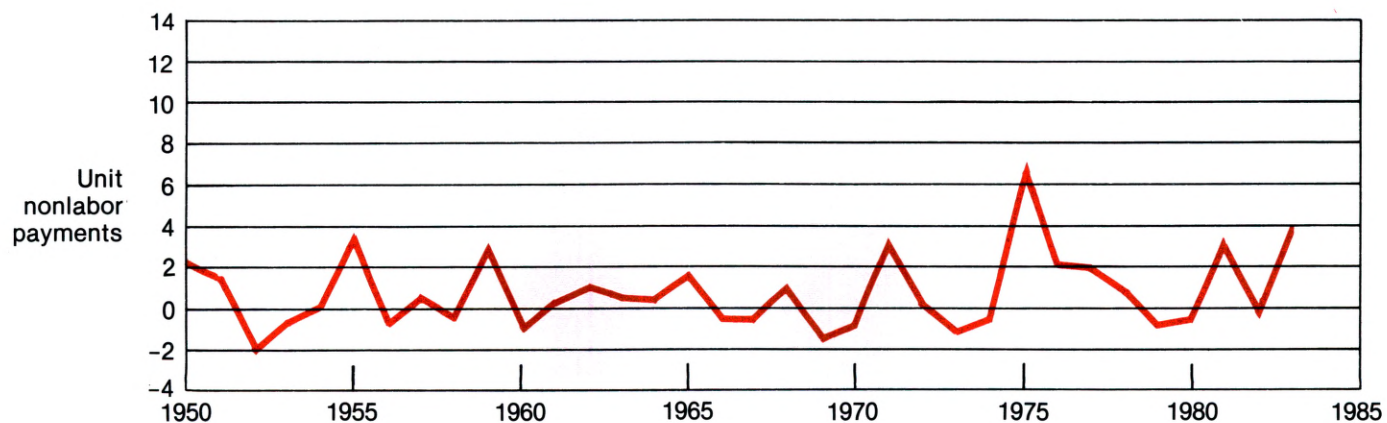
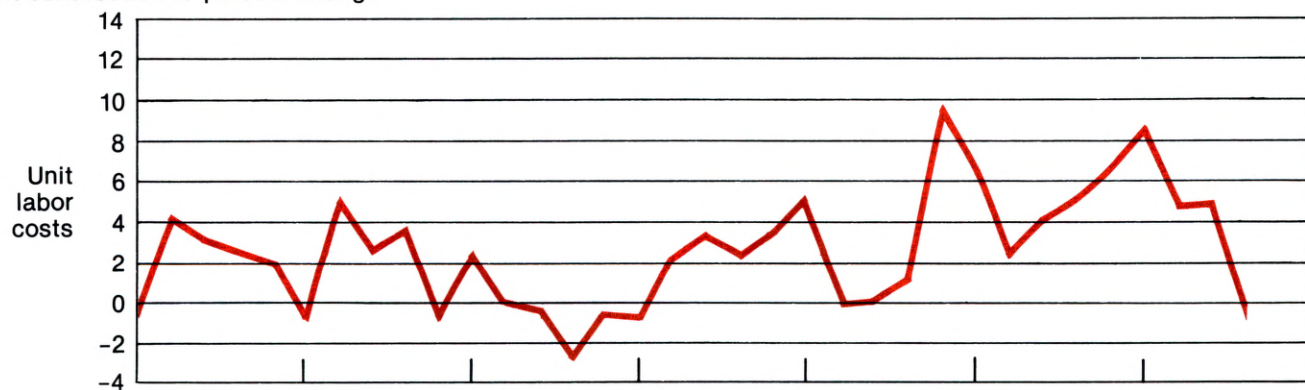


Chart 21  
Composition of price changes in manufacturing, 1950-83

Percent change from previous year



Point contribution to percent change



Source: Bureau of Labor Statistics

## **In many manufacturing industries, prices rose strongly while productivity declined**

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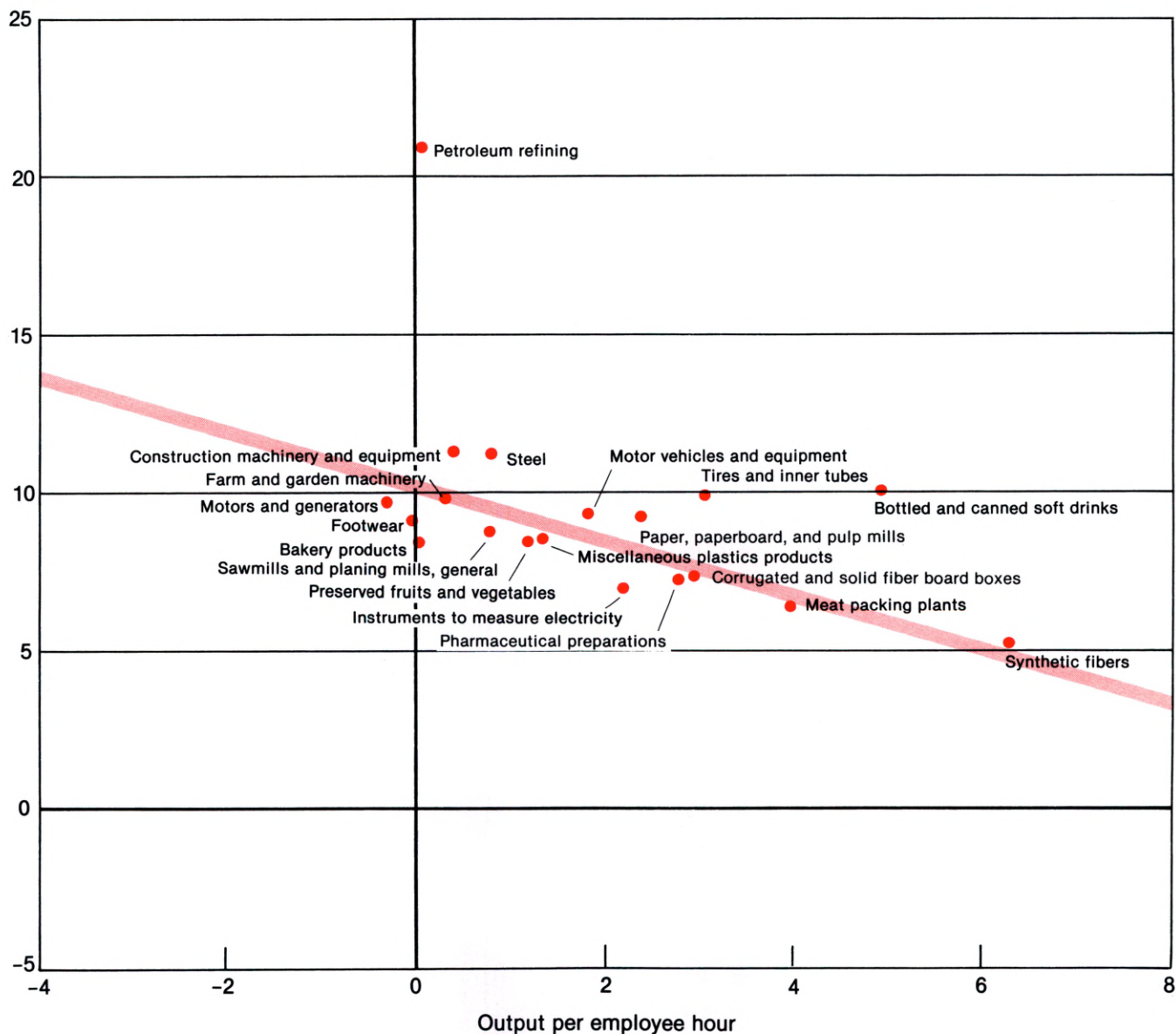
The inverse relationship that generally prevails between price change and productivity change at the industry level is very evident for the 1973-81 period. Prices rose less than the average or declined in industries such as food processing, hosiery, synthetic fibers, and radio and television, where productivity

rose at above-average rates. In contrast, prices rose strongly where productivity declined over this period, or increased relatively slowly. Of the group where productivity declined, primary aluminum, steel foundries, and metal-cutting machine tools registered the largest price increases.

Chart 22  
Output per employee hour and prices, selected manufacturing industries, 1973-81

Average annual percent change

Prices



## Hourly compensation rose about as much in industries with declining productivity as in industries with productivity growth

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In contrast to prices, the factors influencing changes in compensation in individual industries have been independent of the factors influencing changes in productivity. This is shown by the high degree of uniformity in changes in hourly compensation among the industries. Hourly compensation increased about as

much between 1973 and 1981 in industries with declining productivity, such as steel foundries, metal-forming machine tools, and primary aluminum, as in industries with a high rate of productivity growth, such as hosiery and wood office furniture.

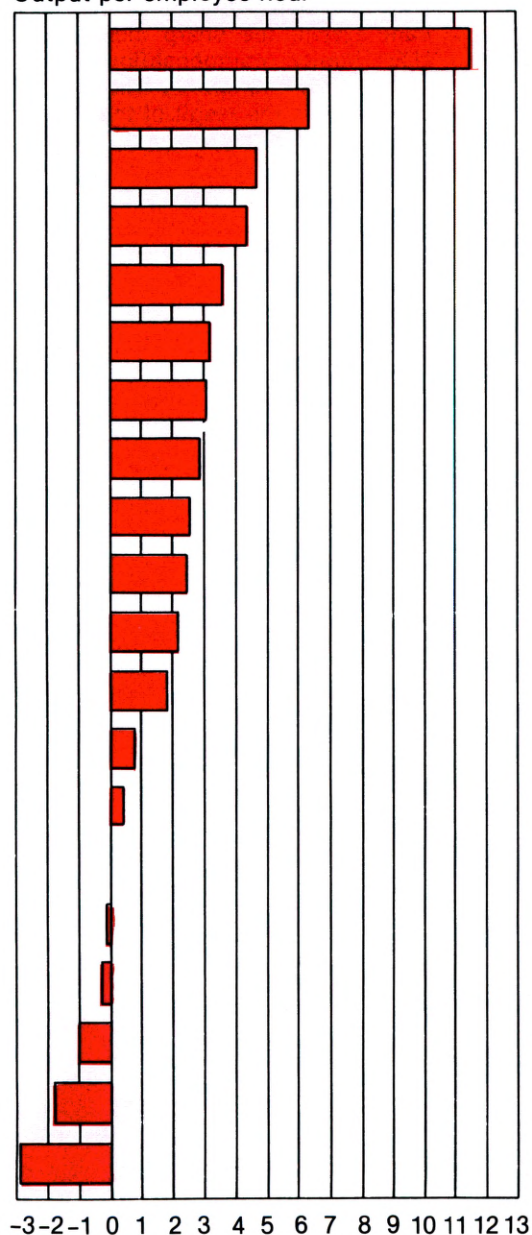


Chart 23

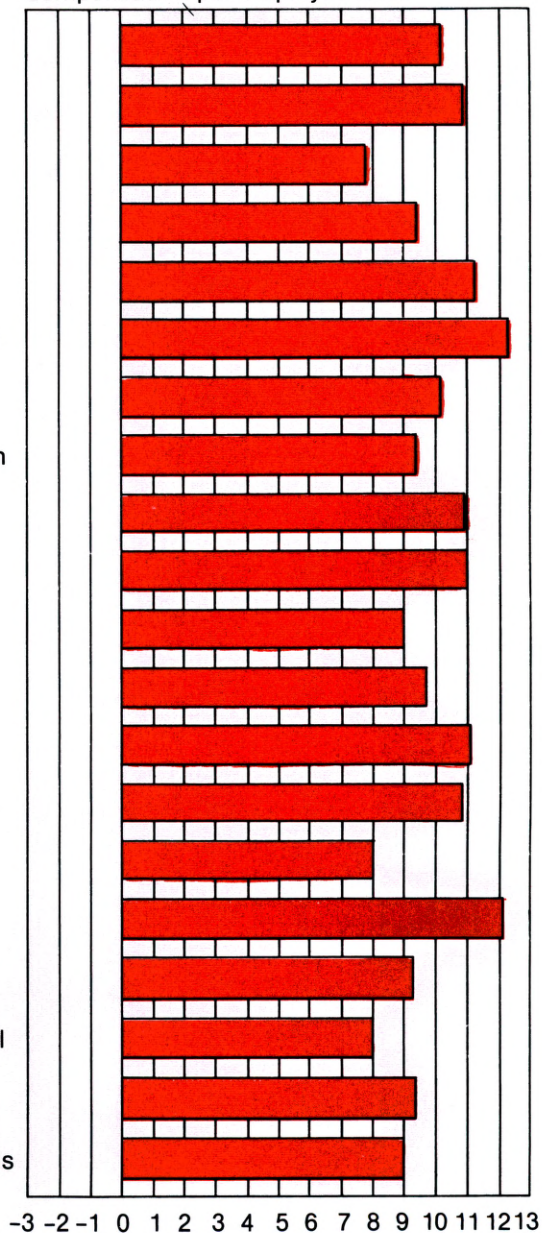
Output per employee hour and compensation per employee hour,  
selected manufacturing industries, 1973-81

Average annual percent change

Output per employee hour



Compensation per employee hour



## Hourly compensation costs in major industrial countries have been declining relative to the United States

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In 1983, at current exchange rates, hourly compensation costs for manufacturing production workers are higher in the United States than in Canada, France, Germany, Japan, or the United Kingdom. Hourly compensation costs in these countries ranged from about 50 percent to over 90 percent of U.S. costs.

Since about 1980, hourly compensation costs in major industrial countries have been declining relative to the United States, reversing the longer term trend. For the 4 years ending in 1980, Germany hourly com-

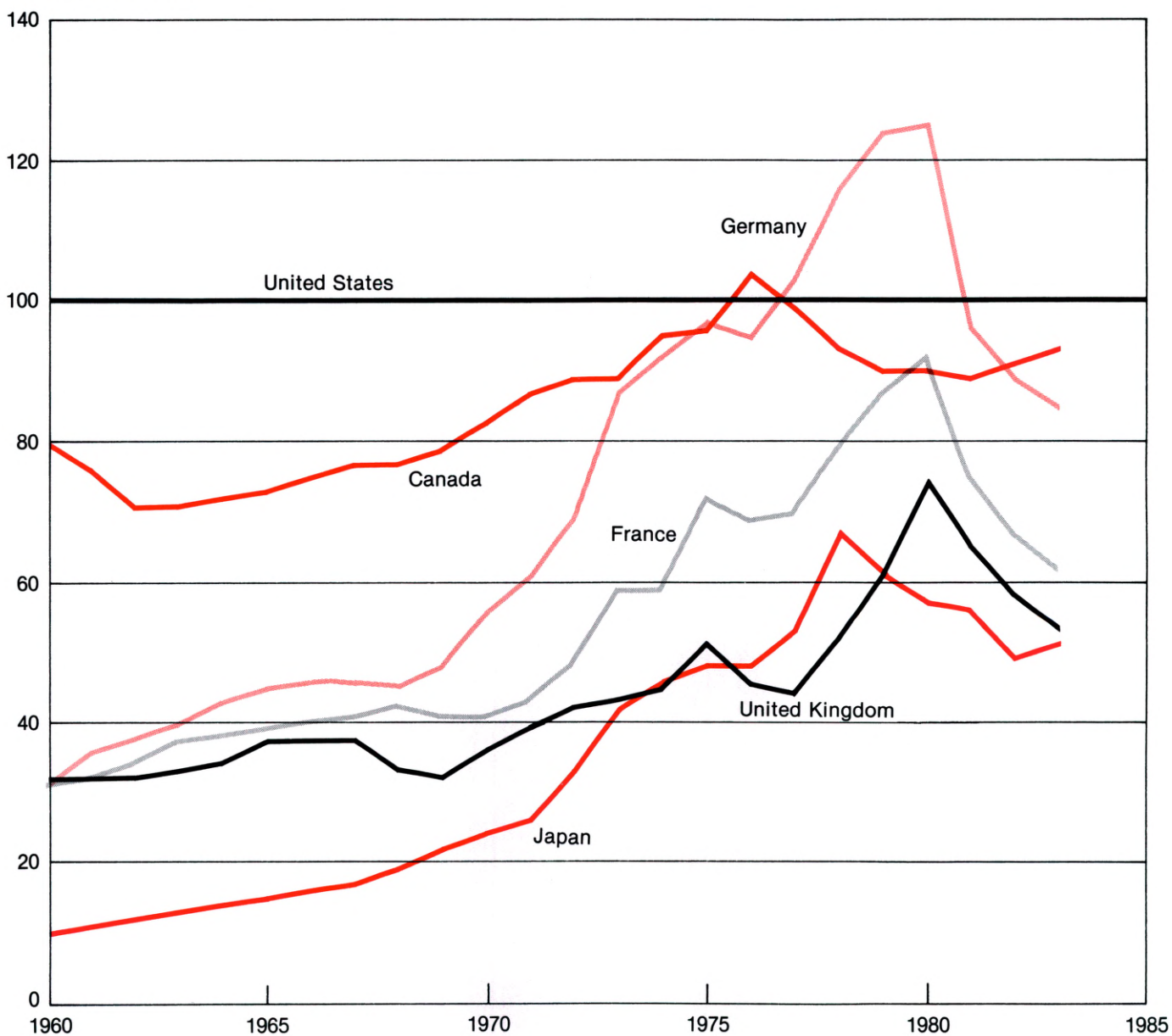
pensation costs actually surpassed those in the United States; by 1983, they were 85 percent of U.S. costs.

The changes shown in relative compensation levels reflect changes in relative currency values as well as differential rates of gain in hourly compensation as measured in each country's own currency. To a significant extent, the sharp increase in U.S. hourly compensation costs since 1980, compared with other countries, is the result of the strong appreciation of the dollar.

Chart 24

Hourly compensation costs for production workers in manufacturing, selected countries, 1960-83

Index, United States = 100



Source: Bureau of Labor Statistics

## **Unit labor costs in manufacturing accelerated after 1973 in almost all industrial countries**

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In almost all industrial countries, slower productivity advances after 1973, combined with increased gains in hourly compensation, resulted in higher rises in unit labor costs. From 1973 to 1983, unit labor costs in the United States accelerated to an average of 7 percent annually, up from 1.5 percent per year in 1960-73. While productivity gains slowed

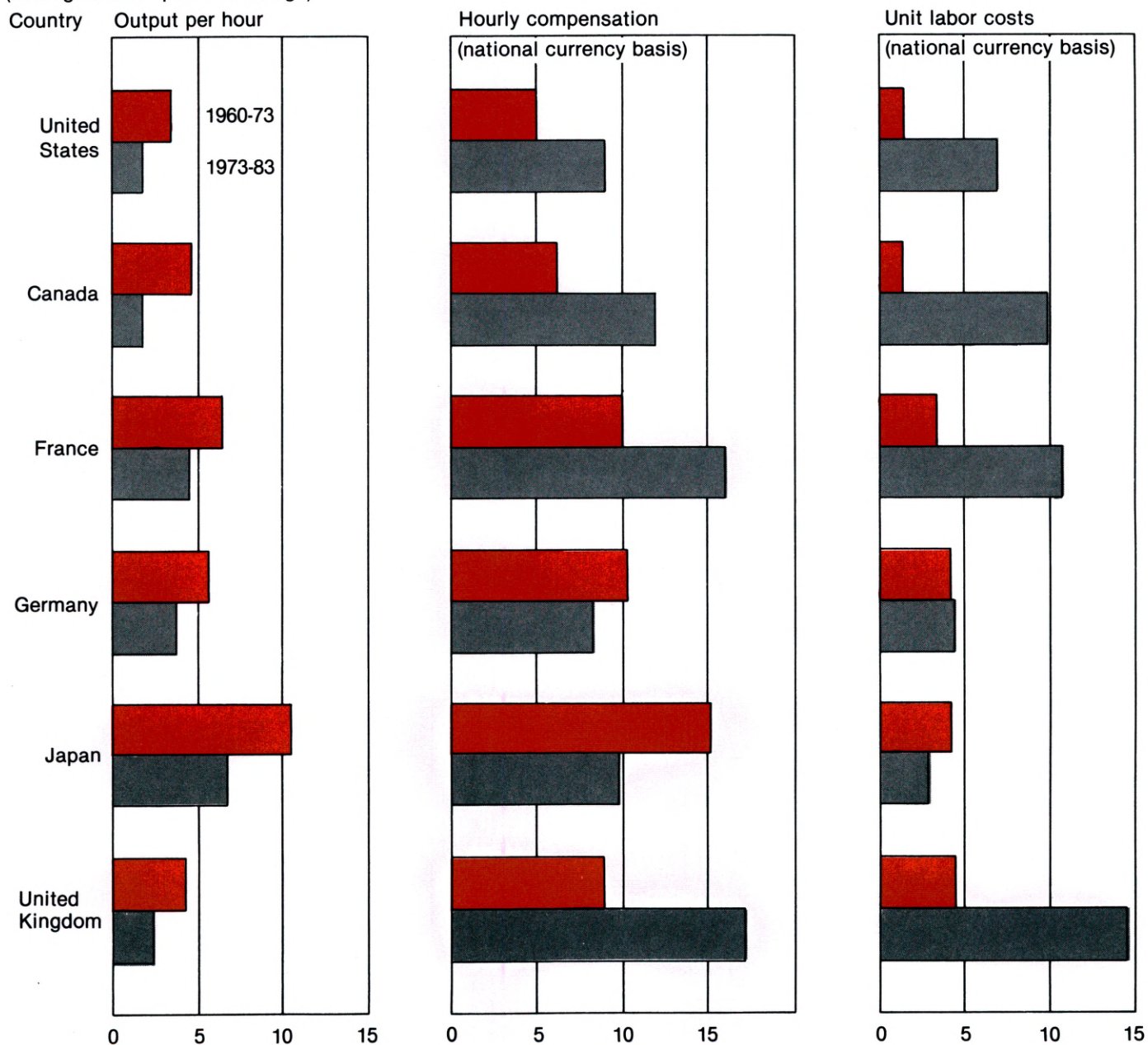
down to 1.8 percent after 1973, hourly compensation rose to 9 percent.

Every country shown except Japan experienced higher unit labor costs (in national currency) after 1973. While all countries had slower productivity growth after 1973, all countries except Japan and Germany had more rapid increases in hourly compensation.



**Chart 25**  
Output per hour, hourly compensation, and unit labor costs in  
manufacturing, selected countries, 1960-73 and 1973-83

(Average annual percent change)



Source: Bureau of Labor Statistics

## Measured in U.S. dollars, unit labor costs in most industrial countries declined after 1980

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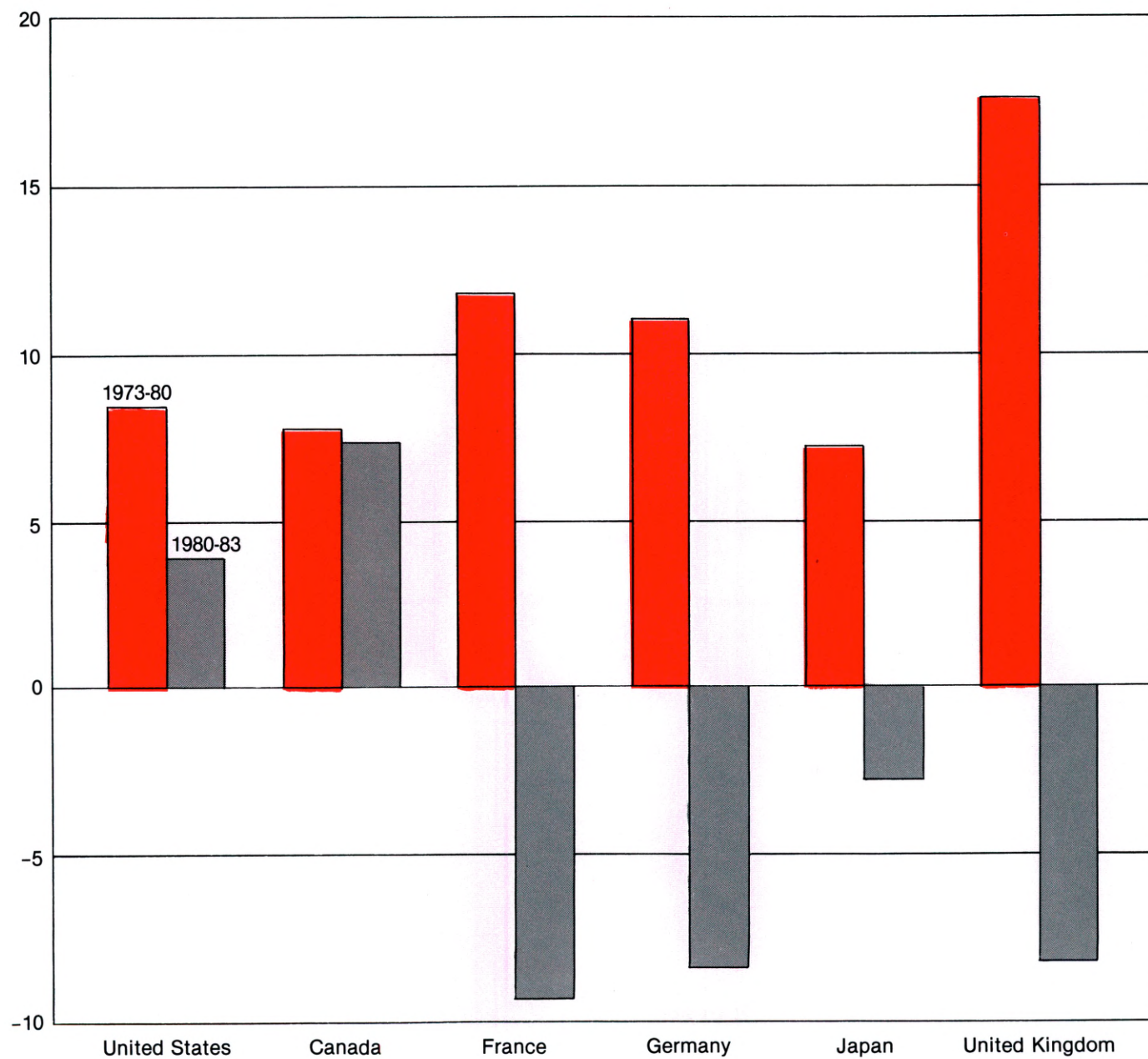
Competitive relationships among countries are affected by relative changes in currency exchange rates as well as by relative changes in unit labor costs. Exchange rates have been especially volatile since the early 1970's, in some cases accentuating and in other cases counterbalancing relative changes in unit labor costs measured in national currencies.

Since 1980, the value of the U.S. dollar has appreciated strongly, particularly against the currencies of the European countries. Consequently, unit labor costs measured in U.S. dollars declined by about 8 or 9 percent per year in the European countries shown, and by nearly 3 percent in Japan, compared with an increase of almost 4 percent in the United States.

Chart 26

Unit labor costs in manufacturing, measured in U.S. dollars, selected countries, 1973-80 and 1980-83

Average annual percent change



Source: Bureau of Labor Statistics





# Part IV.

## Factors affecting productivity change in manufacturing

59

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This section presents data on some of the forces underlying productivity changes in manufacturing. The charts show capital investment as a percent of output in the United States and in other industrial countries, and data on research and development in the United States.

Capital investment and research and development funds can have an

important role in productivity growth, but, for many reasons, cannot be directly tied to it. For example, expenditures for safety and health equipment may or may not relate to changes in output per hour. Also, the time lag between investment and its impact on productivity varies considerably.

## **The ratio of investment to output has been lower in the United States than in other industrial countries**

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Capital investment as a percent of output in manufacturing in the United States averaged 11.1 percent in 1974-82, slightly above the average for 1965-73.

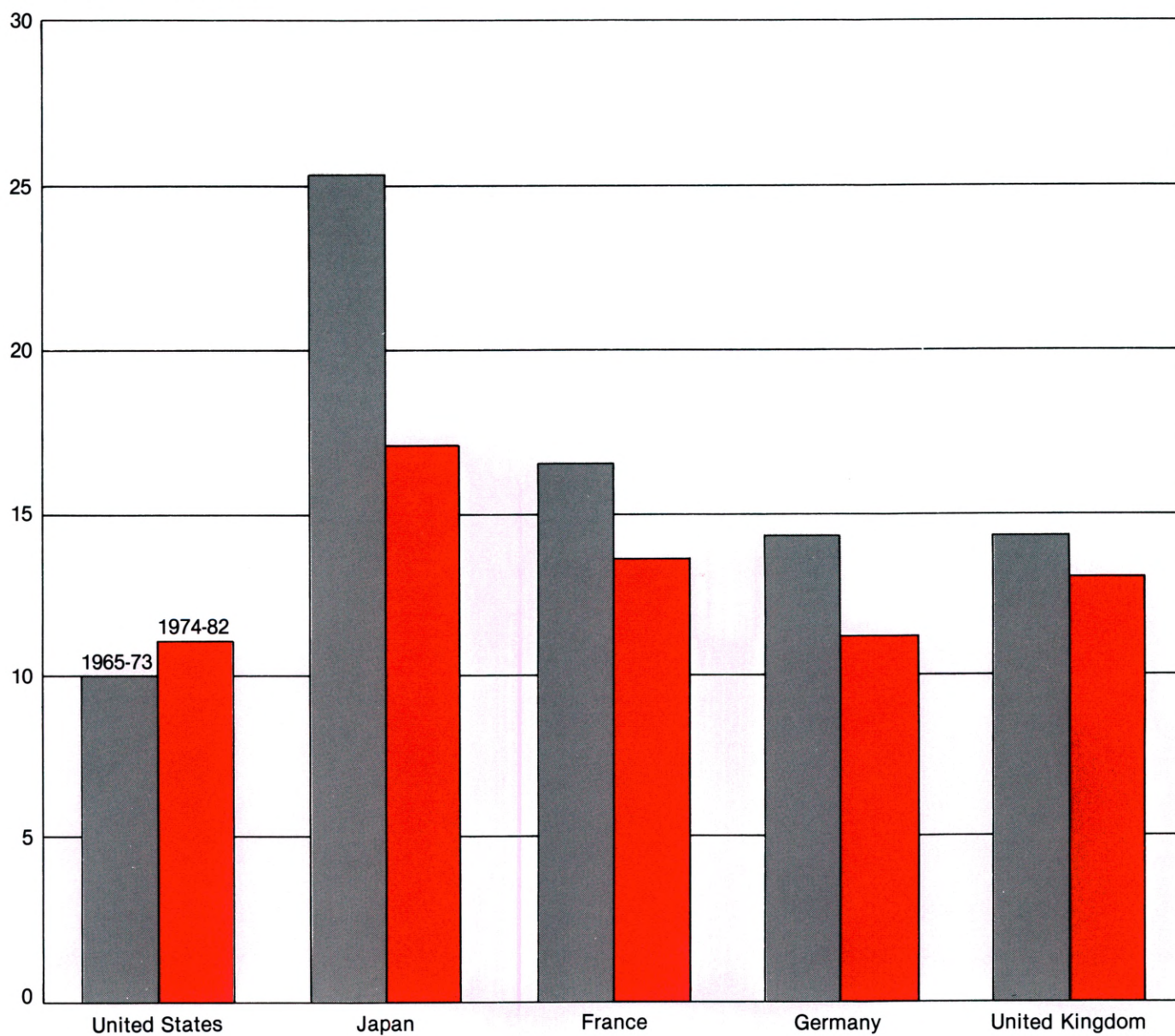
Compared to the other industrial

countries shown here, however, the U.S. investment rate has been low since at least 1965. The differences narrowed in the more recent period, when the other countries reduced their investment rates.

Chart 27

Capital investment as percent of output in manufacturing, selected countries, 1965-73 and 1974-82

Annual averages, percent



Source: Bureau of Labor Statistics

## **Real outlays for research and development in manufacturing have risen by three-fifths over the last two decades**

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Funds for research and development can generate increases in productivity through the subsequent application of more efficient equipment and processes.

R&D expenditures by manufactur-

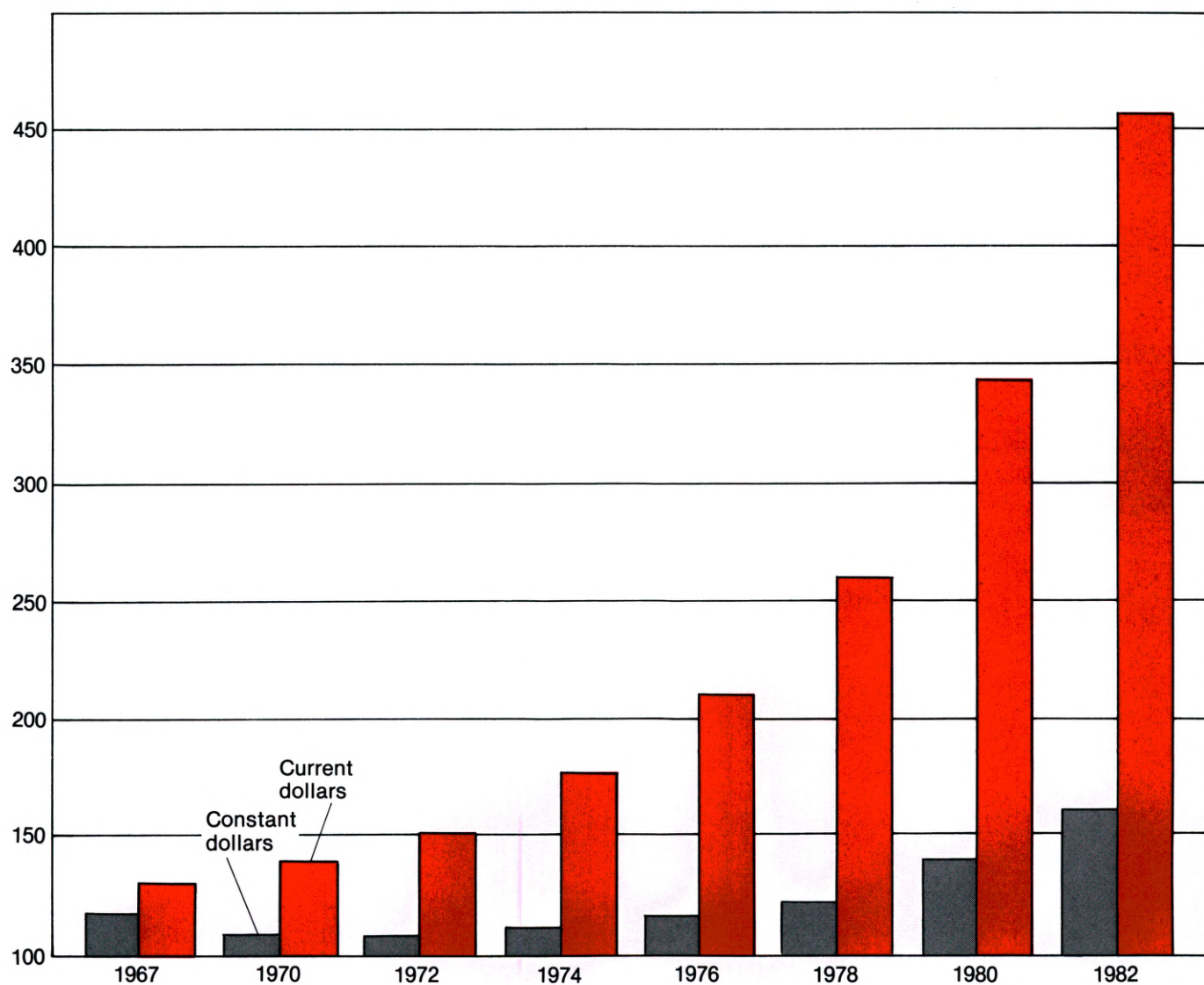
ing companies were more than four times larger in 1982 than in 1963. But in constant dollars, i.e., eliminating price changes, they increased only 60 percent, with almost all of the increase coming after 1975.



Chart 28

Research and development funds, manufacturing companies, current  
and constant dollars, selected years, 1967-82

Index, 1963 = 100



Source: National Science Foundation

## On average, large companies are more R&D intensive

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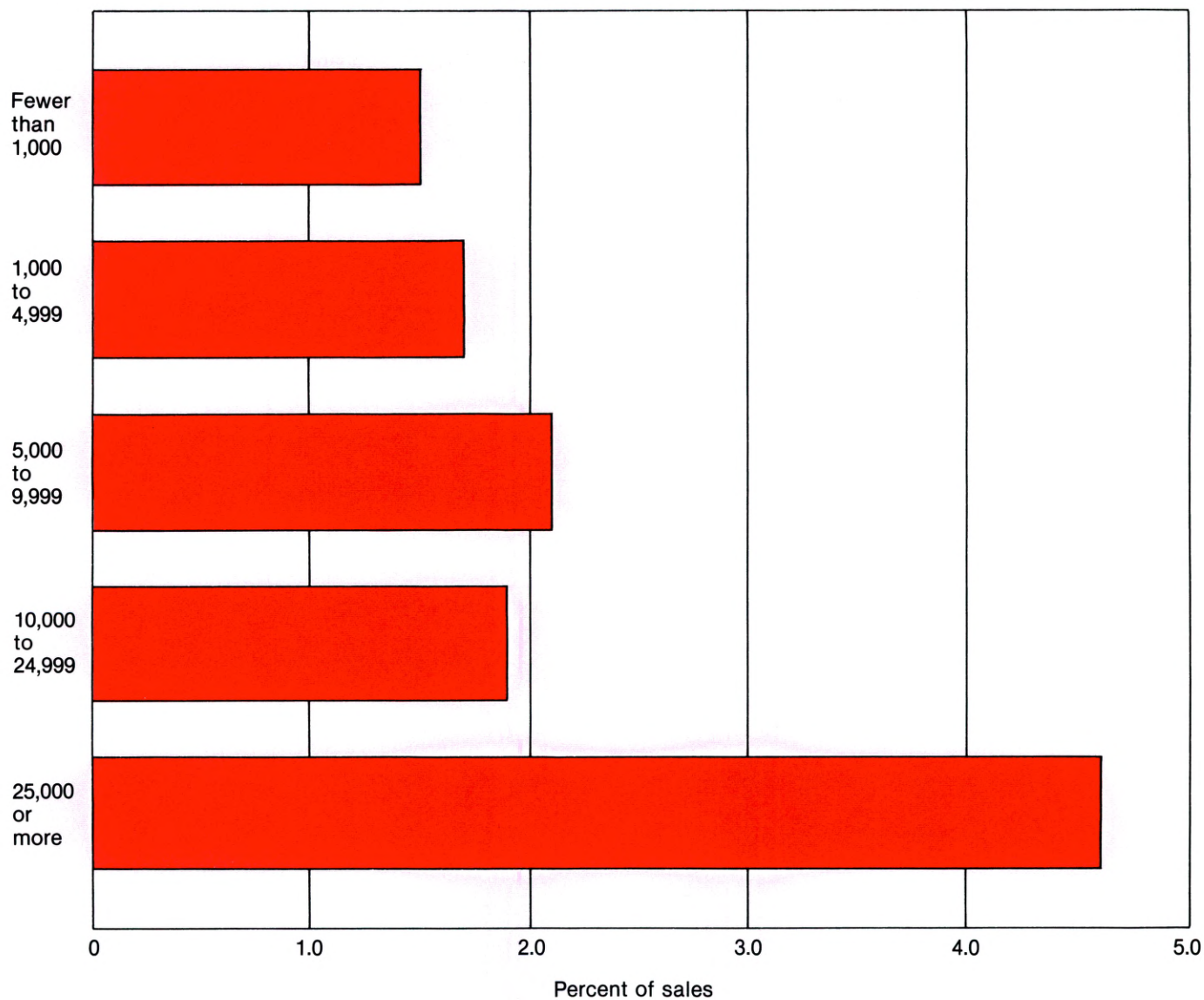
In general, large manufacturing companies are more R&D intensive than small companies. In 1981, companies which performed R&D and had 25,000 employees or more spent

an average of 4.6 percent of their net sales on R&D, while those with fewer than 25,000 employees averaged about 2 percent or less.

Chart 29

Research and development funds as a percent of net sales in manufacturing companies performing R&D, by size of company, 1981

Number of employees



Source: National Science Foundation

## The rate of R&D spending as a percent of net sales in manufacturing has declined

Research and development funds have not increased as rapidly as sales for the manufacturing companies engaged in R&D. Consequently, R&D funds as a percent of net sales have declined from 4.5 percent in 1963 to a low of 2.6 percent in 1979. By 1982, the rate had moved up to 3.7 percent, but it reflected reduced sales. At the same time, Federal funds as a percent of R&D outlays

dropped sharply over the 20-year period.

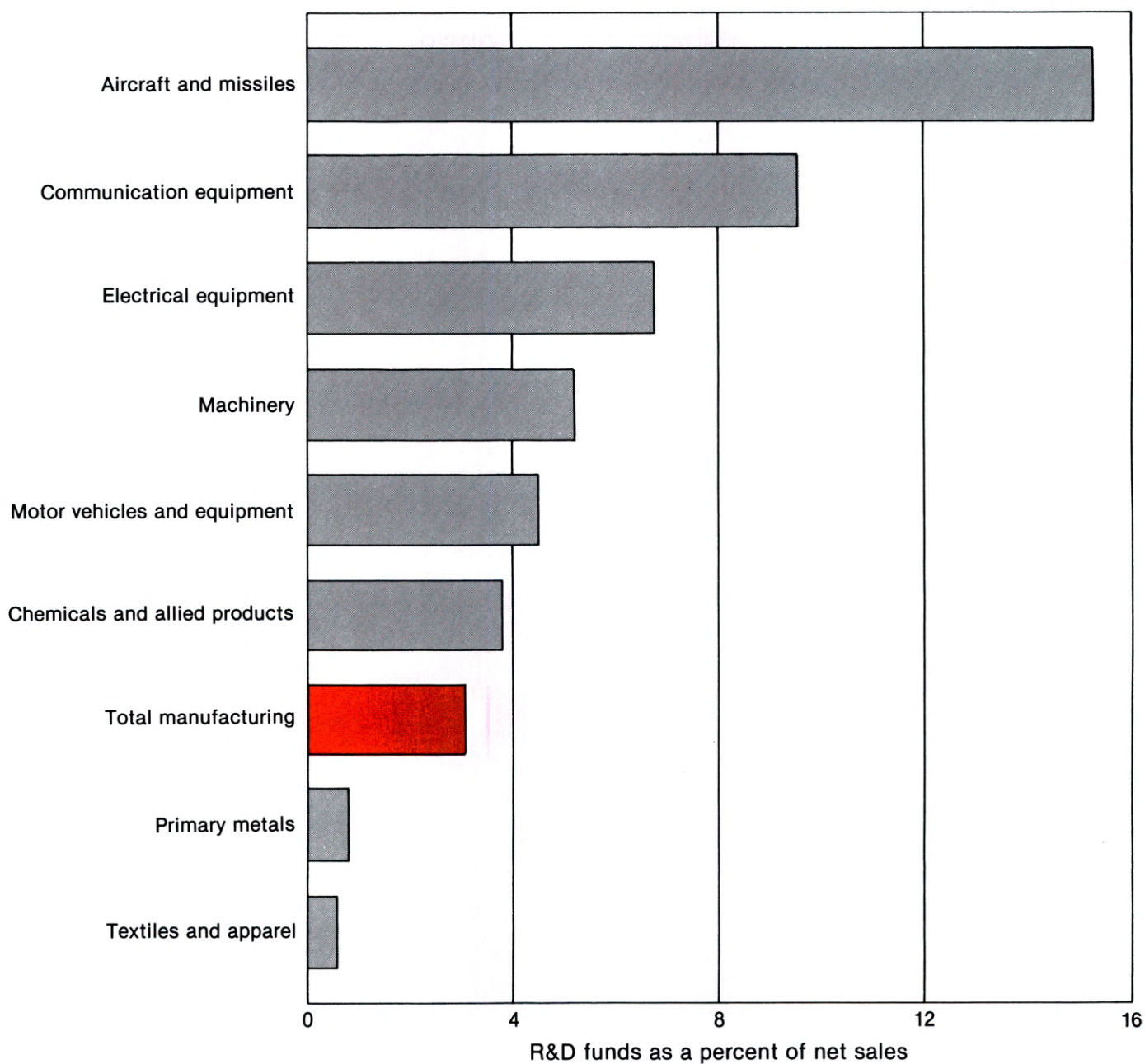
Of the major industries, aircraft and missiles registered the highest outlays for R&D as a percent of net sales in 1981, while textiles and apparel had the lowest ratio. About three-fourths of the aircraft outlays were federally funded compared to less than 1 percent for textiles and apparel.

Year	R&D funds as percent of net sales <sup>1</sup>	Federal funds as percent of R&D funds (Manufacturing)
1963.....	4.5	57.3
1967.....	4.2	50.4
1970.....	3.7	42.0
1971.....	3.5	41.0
1972.....	3.4	40.3
1973.....	3.3	37.6
1974.....	3.1	35.1
1975.....	3.1	35.4
1976.....	3.1	35.1
1977.....	2.9	34.9
1978.....	2.9	33.2
1979.....	2.6	32.3
1980.....	3.0	31.0
1981.....	3.1	31.1
1982.....	3.7	31.8

<sup>1</sup> Only for those companies engaged in R&D activities.



Chart 30  
Research and development funds as percent of net sales in  
manufacturing companies performing R&D, selected industries,  
1981



Source: National Science Foundation

## There is wide variation in use of R&D scientists and engineers among industries

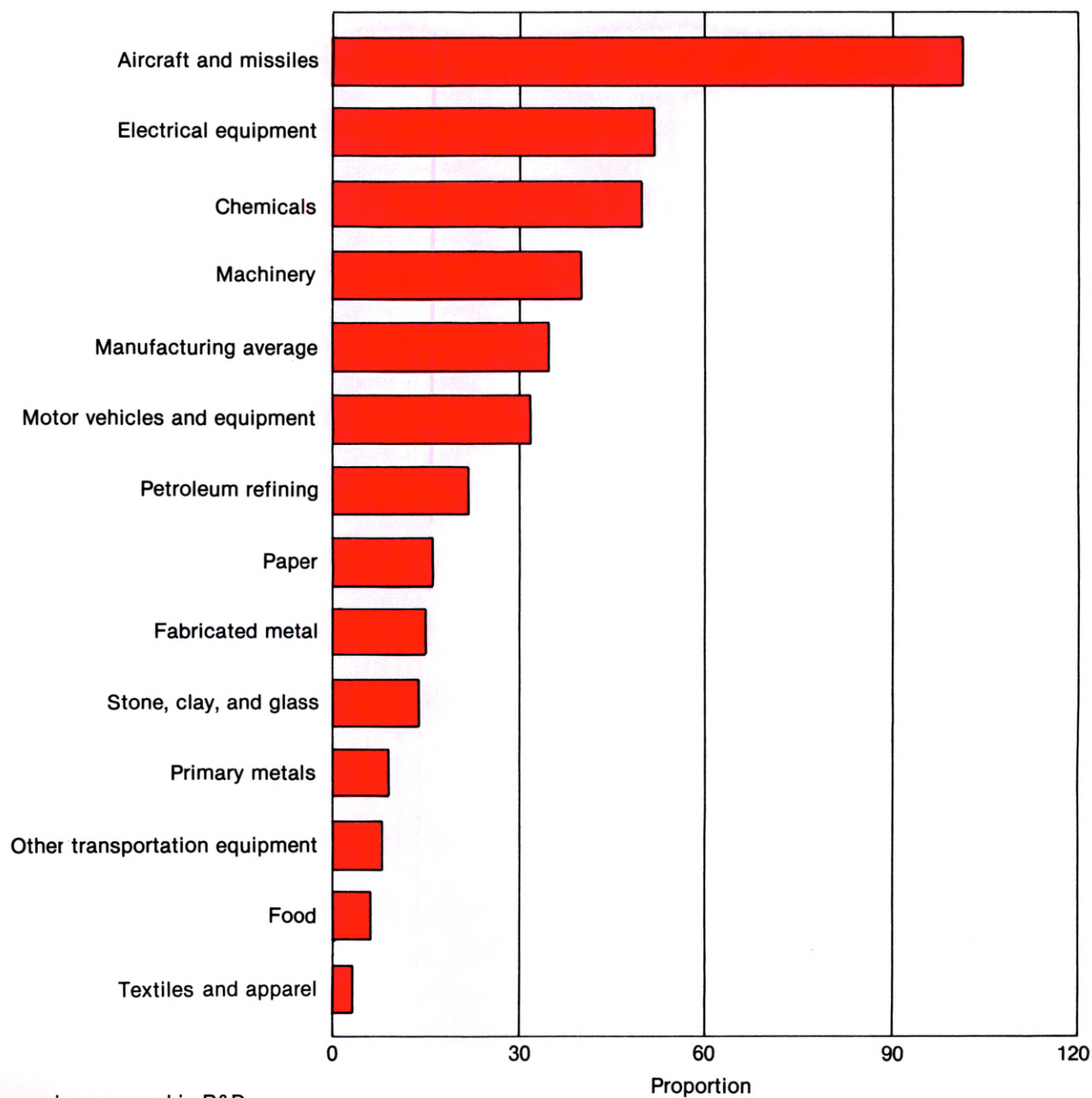
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For all manufacturing companies engaged in R&D in 1982, the last year for which data are available, there were 35 R&D scientists and engineers per thousand employees, the highest rate in at least 20 years. Although the growth of R&D scientists and engineers, in general, was relatively steady over the two decades, employment of other occupations was more sensitive to the business cycle. The high rate in 1982, in part,

reflects the falloff of other manufacturing employment which was associated with the economic downturn in that year.

The proportion of R&D scientists to employment varies widely among the major industries in manufacturing companies engaged in R&D. In 1982, aircraft and missiles had the highest proportion, 102 per thousand, while textiles and apparel had the lowest, 3 per thousand.

Chart 31  
Research & development scientists and engineers per thousand  
employees,<sup>1</sup> selected manufacturing industries, 1982



<sup>1</sup> In companies engaged in R&D.

Source: National Science Foundation





# Part V.

## Employment and occupational projections to 1995 in manufacturing

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71

This section presents projections of employment and occupations for 1995, with special emphasis on high-technology industries. BLS has developed three alternative employment projections to 1995, based on low, moderate, and high economic growth models for the overall economy. Data presented in this section are based on the moderate trend version.

The criteria used by BLS to

classify high-technology industries are explained in table 32. Briefly, they are based on the amount of research and development expenditures, the proportion of scientific and technical personnel relative to total employment, and the degree of product sophistication. Employing these criteria, the BLS developed three definitions of high technology to analyze employment trends in manufacturing industries.

## Employment in high-technology industries is expected to increase more rapidly than manufacturing employment as a whole

Employment in manufacturing is projected to grow by 1.6 percent annually between 1982 and 1995. This growth rate is well above the rate of the 1970's and in part reflects recovery from the 1982 employment low. By 1995, there would be about 4.3 million new manufacturing jobs.

Continuing the trend of the 1970's, employment in high-technology industries is expected to increase more rapidly than total manufactur-

ing employment. Employment in high-technology industries will increase by 2.1 to 2.3 percent annually between 1982 and 1995 under the three definitions of high-tech industries developed by BLS. This would mean an increase of 0.9 to 2.3 million new high-tech industry jobs by 1995, or between one-fifth and one-half of all new jobs in manufacturing.

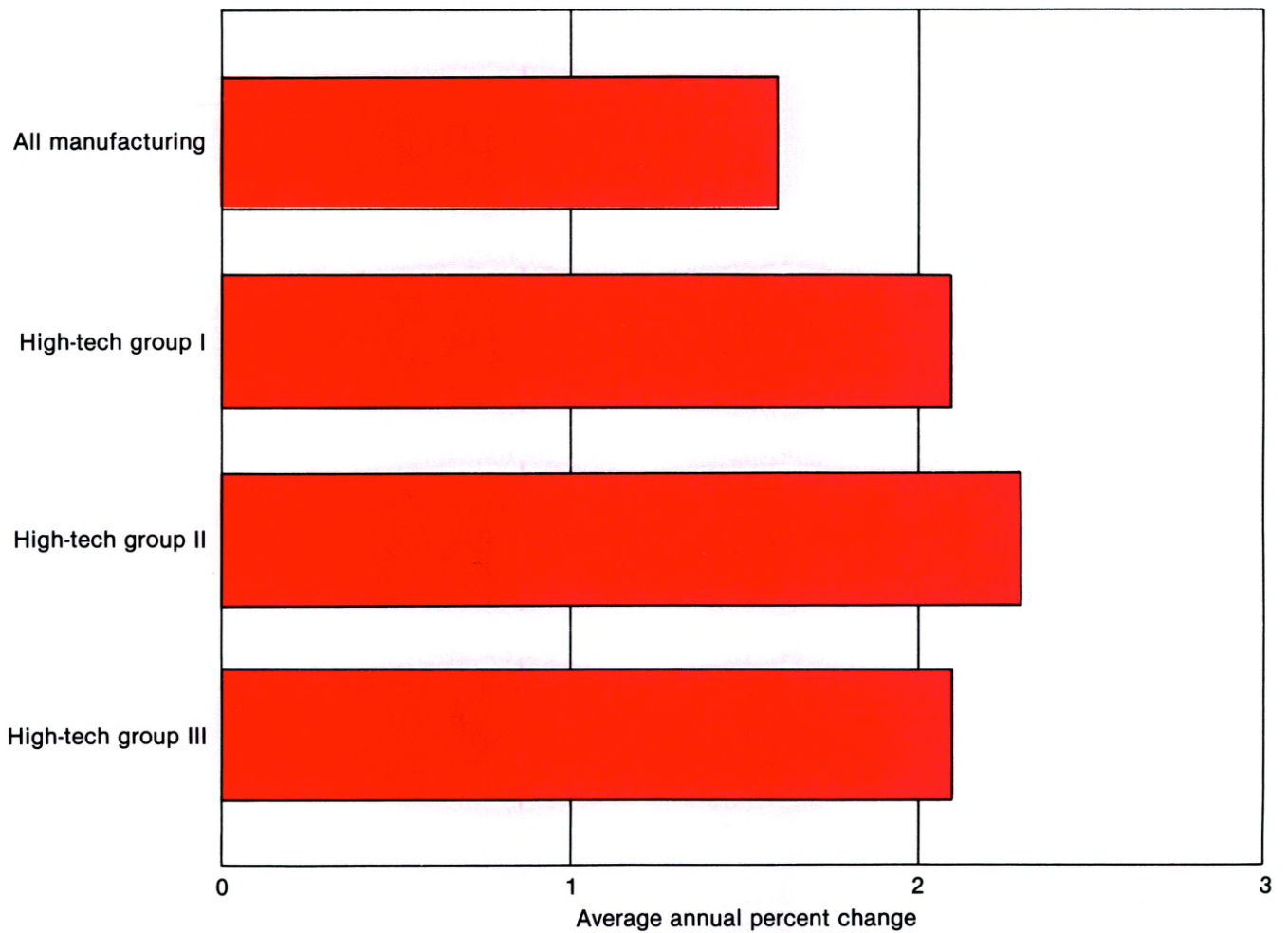
Employment group <sup>1</sup>	Projected change in employment <sup>2</sup> 1982-95	
	Millions of workers	Percent of total
Total manufacturing .....	4.3	—
High-tech Group I .....	2.3	53
High-tech Group II .....	.9	20
High-tech Group III .....	1.6	38

<sup>1</sup> Data do not add to total because some industries are included in more than one group. For definitions of high-technology employment groups, see table 32, footnote 1.

<sup>2</sup> Projected changes in employment between 1982-95 are based on the moderate trend alternative of economic growth for the overall economy developed by BLS.

Chart 32  
Employment growth in high-technology industries and in total  
manufacturing, 1982-95

Industry classification



Note: For definitions of high-tech groups I-III, see table 32.  
Source: Bureau of Labor Statistics

## The shift in occupational structure from lower to higher skilled jobs is expected to continue through 1995

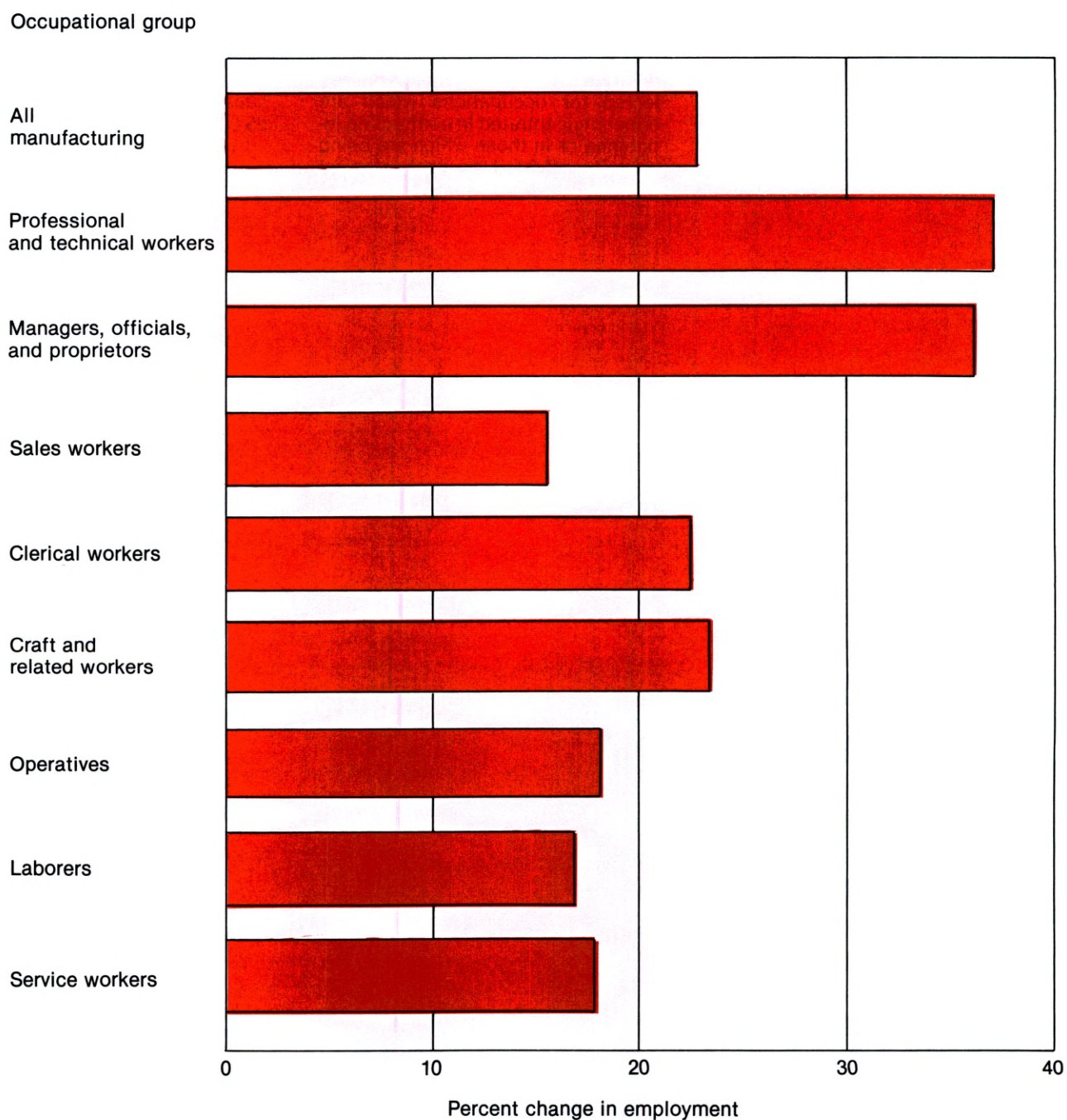
Technological advance and changing patterns of industrial growth are expected to contribute to a continued shift in the occupational structure of the work force between 1982 and 1995. In manufacturing, these factors will increase demand for highly educated and skilled

workers while reducing requirements for lower skilled workers. The fastest growing occupational groups will be professional and technical workers and managers, officials, and proprietors, while the slowest growth is expected for sales workers and laborers.

Occupational group	Percent distribution	
	1982	1995
Total manufacturing employment .....	100.0	100.0
Professional and technical workers .....	10.3	11.5
Managers, officials, and proprietors.....	6.7	7.4
Sales workers .....	2.2	2.1
Clerical workers .....	11.7	11.7
Craft and related workers.....	18.6	18.4
Operatives.....	40.2	38.7
Laborers.....	8.5	8.1
Service workers.....	1.8	1.8



Chart 33  
Projected changes in occupational employment in manufacturing,  
1982-95



Source: Bureau of Labor Statistics

## High-technology occupations are expected to account for 6 of the 10 most rapidly growing occupations

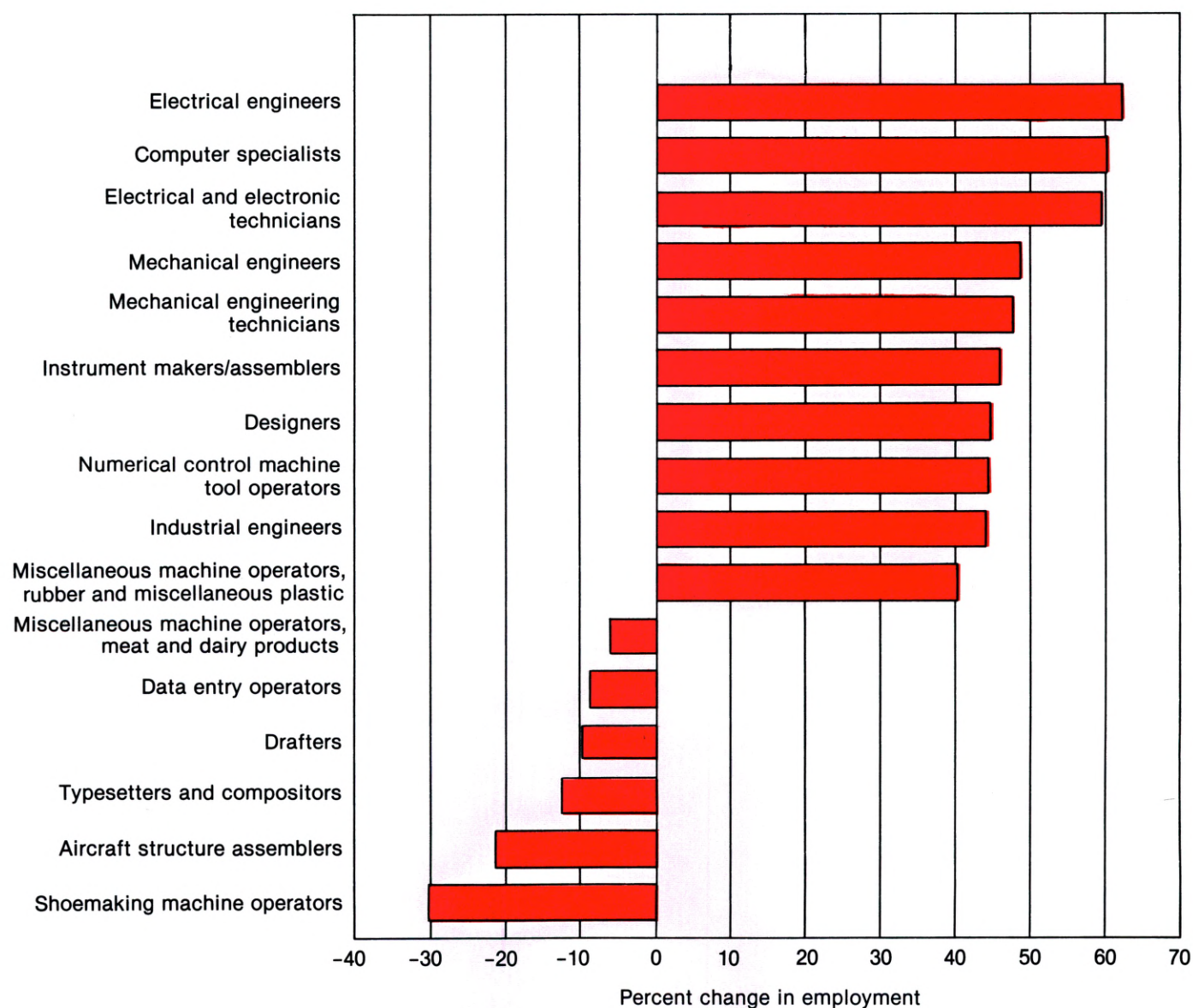
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The Bureau of Labor Statistics projects that employment will rise in almost all manufacturing occupations between 1982 and 1995, a trend which partially reflects recovery from low 1982 recession levels. Sharp increases are projected for a number of occupations which are predominantly found in rapidly expanding industries. A few declines are projected for occupations which are either concentrated in contracting industries or in those which are being severely affected by technological change.

The expansion of high-technology in manufacturing is expected to fuel demand for workers in high-tech oriented occupations, all of which are classified as professional or technical. Based on the BLS moderate trend version of economic growth, these occupations are projected to account for 6 of the 10 fastest growing manufacturing occupations with 1982 employment of 25,000 or more.

Chart 34

Projected employment changes in fastest growing and most rapidly declining occupations<sup>1</sup> in manufacturing, 1982-95



<sup>1</sup> Includes all occupations with 1982 employment of 25,000 or more which are projected to increase by more than 40 percent or decline by more than 5 percent in the moderate trend projection.





# Appendix

## Supporting Data for Charts

79

**Table 1. Output<sup>1</sup> in manufacturing, 1950-83**  
(Index, 1950 = 100)

Year	Total manufacturing	Durable goods	Nondurable goods
1950.....	100.0	100.0	100.0
1951.....	111.4	115.1	105.9
1952.....	115.0	120.7	106.7
1953.....	122.9	131.4	110.4
1954.....	114.1	117.4	109.3
1955.....	126.4	132.4	117.6
1956.....	127.3	131.3	121.5
1957.....	128.0	131.8	122.3
1958.....	117.0	113.8	121.7
1959.....	130.6	129.2	132.7
1960.....	131.1	129.3	133.7
1961.....	131.2	127.4	136.8
1962.....	142.5	140.9	144.8
1963.....	154.3	153.0	156.2
1964.....	165.3	166.3	164.0
1965.....	180.6	185.2	173.8
1966.....	194.5	201.4	184.2
1967.....	194.0	201.6	183.0
1968.....	204.6	211.9	193.9
1969.....	211.5	218.1	201.7
1970.....	199.3	198.7	200.1
1971.....	203.6	200.3	208.5
1972.....	223.2	221.8	225.2
1973.....	248.2	248.7	247.4
1974.....	237.8	238.6	236.6
1975.....	221.0	216.1	228.1
1976.....	242.2	239.8	245.7
1977.....	258.8	259.8	257.2
1978.....	272.6	278.4	264.0
1979.....	280.0	286.1	271.0
1980.....	267.8	269.2	265.8
1981.....	274.4	276.9	270.8
1982.....	256.8	252.2	263.7
1983.....	270.2	266.6	275.5

<sup>1</sup> Gross product originating in manufacturing, in constant dollars.

**Table 2. Employment in manufacturing, 1950-83**  
(in thousands)

Year	Total manufacturing	Durable goods	Nondurable goods
1950.....	15,241	8,094	7,147
1951.....	16,393	9,089	7,304
1952.....	16,632	9,349	7,284
1953.....	17,549	10,110	7,438
1954.....	16,314	9,129	7,185
1955.....	16,882	9,541	7,341
1956.....	17,243	9,833	7,411
1957.....	17,174	9,855	7,321
1958.....	15,945	8,829	7,116
1959.....	16,675	9,373	7,303
1960.....	16,796	9,459	7,337
1961.....	16,326	9,070	7,256
1962.....	16,853	9,480	7,373
1963.....	16,995	9,616	7,380
1964.....	17,274	9,816	7,458
1965.....	18,062	10,405	7,656
1966.....	19,214	11,282	7,930
1967.....	19,447	11,439	8,007
1968.....	19,781	11,626	8,155
1969.....	20,167	11,895	8,272
1970.....	19,367	11,208	8,158
1971.....	18,623	10,636	7,987
1972.....	19,151	11,049	8,102
1973.....	20,154	11,891	8,262
1974.....	20,077	11,925	8,152
1975.....	18,323	10,688	7,635
1976.....	18,997	11,077	7,920
1977.....	19,682	11,597	8,086
1978.....	20,505	12,274	8,231
1979.....	21,040	12,760	8,280
1980.....	20,285	12,187	8,098
1981.....	20,170	12,109	8,061
1982.....	18,781	11,039	7,741
1983.....	18,497	10,774	7,724

<sup>1</sup>Wage and salary workers

**Table 3. Distribution of civilian employment by industry sector, selected years, 1950-83**  
(Percent)

Year	Manufacturing	Service-producing <sup>1</sup>	Other goods-producing <sup>2</sup>
1950.....	31.1	58.9	10.0
1955.....	31.0	59.6	9.4
1960.....	28.8	62.3	8.9
1965.....	27.9	64.2	7.9
1970.....	26.1	66.9	7.0
1975.....	22.9	70.4	6.7
1980.....	21.8	71.4	6.9
1983.....	19.8	73.5	6.7

<sup>1</sup> Transportation, communication, public utilities, trade, finance, insurance and real estate, services, government, and miscellaneous.

<sup>2</sup> Farming, mining, and construction.

**Table 4. Manufacturing employment by occupation, 1983<sup>1</sup>**

Occupational group	Total (in thousands)	Percent distribution
Total manufacturing <sup>2</sup> .....	19,947	100.0
Managerial and professional specialty.....	3,530	17.7
Technical, sales, and administrative support.....	3,812	19.1
Service.....	388	2.0
Precision production, craft, and repair.....	3,815	19.1
Operators, fabricators, and laborers.....	8,297	41.6
Farming, forestry, fishing.....	105	0.5

<sup>1</sup> Earlier data are not available due to changes in occupational classifications. As a result, data in this table are not comparable to data in table 33.

<sup>2</sup> Includes wage and salary workers, self-employed, and unpaid family workers.

**Table 5. Employment in manufacturing by sex, 1960-83**  
(in thousands)

Year	Women	Men	Women employees as percent of total
1960.....	4,371	12,425	26.0
1961.....	4,292	12,034	26.3
1962.....	4,474	12,379	26.5
1963.....	4,482	12,513	26.4
1964.....	4,537	12,737	26.3
1965.....	4,768	13,294	26.4
1966.....	5,213	14,001	27.1
1967.....	5,353	14,094	27.5
1968.....	5,490	14,291	27.8
1969.....	5,667	14,500	28.1
1970.....	5,448	13,919	28.1
1971.....	5,229	13,394	28.1
1972.....	5,470	13,681	28.6
1973.....	5,865	14,289	29.1
1974.....	5,849	14,228	29.1
1975.....	5,257	13,066	28.7
1976.....	5,607	13,390	29.5
1977.....	5,880	13,802	29.9
1978.....	6,237	14,268	30.4
1979.....	6,466	14,574	30.7
1980.....	6,317	13,968	31.1
1981.....	6,341	13,829	31.4
1982.....	5,990	12,791	31.9
1983.....	5,981	12,516	32.3

**Table 6. Occupational distribution in manufacturing by sex,<sup>1</sup> 1983**  
(in thousands)

Occupational group	Total	Men	Women	Women as percent of total
Total manufacturing.....	19,947	13,455	6,492	32.5
Managerial and professional specialty .....	3,530	2,852	678	19.2
Technical, sales, and administrative support ..	3,812	1,791	2,021	53.0
Service .....	388	315	73	18.8
Precision production, craft, and repair .....	3,815	3,252	563	14.8
Operators, fabricators, and laborers .....	8,297	5,141	3,156	38.0
Farming, forestry, fishing.....	105	104	1	1.0

<sup>1</sup> Includes wage and salary workers, self-employed, and unpaid family workers.

**Table 7. Educational attainment in manufacturing by sex, 1973 and 1983**  
(Percent)

Level of education	All manufacturing employees		Men		Women	
	1973	1983	1973	1983	1973	1983
Total	100.0	100.0	100.0	100.0	100.0	100.0
Elementary .....						
.....0-8 years	17.1	9.5	17.0	9.4	17.5	9.7
High school .....						
.....1-3 years	20.6	14.3	19.2	13.3	24.4	16.5
.....4 years	42.7	45.0	40.5	42.1	48.1	51.3
College .....						
.....1-3 years	11.1	15.9	12.6	16.6	7.3	14.3
.....4 years or more	8.4	15.3	10.7	18.6	2.7	8.2



**Table 8. Import penetration and export proportion by major manufacturing group, 1973 and 1981**  
(Percent)

Manufacturing group	Import penetration <sup>1</sup>		Export proportion <sup>2</sup>	
	1973	1981	1973	1981
All manufacturing.....	6.4	.84	6.6	9.9
Food .....	4.1	4.2	3.6	5.2
Tobacco .....	.5	2.0	6.2	12.7
Textiles .....	5.3	5.9	3.9	5.9
Apparel.....	7.3	13.7	1.4	3.4
Lumber.....	9.8	5.7	6.3	7.3
Furniture.....	2.8	4.8	.7	2.6
Paper .....	5.8	6.4	4.3	6.2
Printing and publishing .....	.9	1.0	1.3	1.9
Chemicals .....	3.2	4.4	9.4	12.7
Petroleum refining .....	9.5	6.8	2.0	1.9
Rubber.....	5.1	7.7	3.6	6.3
Leather.....	17.2	24.7	2.4	5.4
Stone, clay, and glass .....	4.0	5.1	3.2	5.5
Primary metals.....	8.7	14.5	3.6	6.7
Fabricated metals .....	2.6	3.9	4.1	6.9
Machinery, except electrical .....	5.6	8.0	16.3	24.0
Electrical machinery .....	8.5	12.4	7.8	13.5
Transportation equipment ....	10.0	14.8	10.1	16.8
Instruments.....	7.4	11.3	13.5	19.0
Miscellaneous .....	15.1	23.6	9.5	12.1

<sup>1</sup> Imports as a percent of product shipments plus imports.

<sup>2</sup> Exports as a percent of product shipments.

**Table 9. Share of world export trade<sup>1</sup> of all manufactured products and of technology-intensive products,<sup>2</sup> selected countries, selected years, 1955-80**  
(Percent)

Country and product group	1955	1960	1970	1980
United States:				
All manufactured products .....	25.9	22.8	18.4	16.4
Technology-intensive products.....	<sup>3</sup> 35.5	27.6	23.1	19.9
France:				
All manufactured products .....	8.8	9.1	8.3	10.2
Technology-intensive products.....	<sup>3</sup> 6.4	7.7	7.6	9.0
Germany:				
All manufactured products .....	14.6	18.2	19.8	19.8
Technology-intensive products.....	<sup>3</sup> 17.6	21.2	20.4	19.3
Japan:				
All manufactured products .....	4.8	6.5	8.9	11.0
Technology-intensive products.....	<sup>3</sup> 1.8	4.2	9.7	14.5

<sup>1</sup> World export trade is defined as the sum of the exports of 14 or 15 of the most important industrial countries in the Organization for Economic Cooperation and Development.

<sup>2</sup> As defined in this table, technology-intensive products are those produced by industries in which spending on research and development is 5 percent or more of gross product, and "natural" scientists, engineers, and technicians constitute 5 percent or more of total employment, or both.

<sup>3</sup> Data are for 1954.

Source: U.S. Department of Commerce.

**Table 10. Output per hour of all persons in manufacturing, 1950-83**  
(Index, 1950 = 100)

Year	Total manufacturing	Durable goods	Nondurable goods
1950.....	100.0	100.0	100.0
1951.....	103.4	101.9	104.3
1952.....	105.3	104.3	104.9
1953.....	107.1	105.6	106.7
1954.....	108.7	106.5	110.6
1955.....	114.1	112.6	114.5
1956.....	113.3	109.0	118.0
1957.....	115.6	110.8	121.2
1958.....	115.1	108.1	125.0
1959.....	120.6	113.3	130.7
1960.....	121.4	113.6	132.3
1961.....	124.7	116.3	136.6
1962.....	130.1	121.9	141.4
1963.....	139.4	129.9	152.7
1964.....	146.2	137.0	158.6
1965.....	150.8	142.1	161.9
1966.....	152.4	142.1	166.0
1967.....	152.4	142.6	164.9
1968.....	157.7	147.2	171.5
1969.....	160.5	148.7	176.4
1970.....	160.1	146.5	179.8
1971.....	169.9	155.7	190.3
1972.....	178.4	163.3	200.3
1973.....	188.1	169.3	216.3
1974.....	183.7	164.5	212.7
1975.....	189.0	168.8	219.5
1976.....	197.4	178.7	224.9
1977.....	202.3	183.5	229.8
1978.....	204.1	185.2	231.8
1979.....	205.4	184.5	237.0
1980.....	205.8	184.2	238.6
1981.....	212.2	191.0	244.0
1982.....	216.5	193.7	251.0
1983.....	225.8	204.6	257.1

**Table 11. Output per employee hour in manufacturing, selected countries, 1950-83**  
(Index, 1950 = 100)

Year	United States	Canada	France	Germany	Japan	United Kingdom
1950 .....	100.0	100.0	100.0	100.0	100.0	100.0
1951 .....	103.4	104.1	105.2	106.5	125.0	100.2
1952 .....	105.3	106.9	108.8	116.6	131.2	96.2
1953 .....	107.1	110.6	114.0	125.4	149.1	100.9
1954 .....	108.7	115.4	117.6	131.5	160.0	104.3
1955 .....	114.1	122.8	124.5	142.6	168.1	107.8
1956 .....	113.3	128.0	133.7	148.9	178.7	107.8
1957 .....	115.6	128.9	135.9	162.9	195.6	110.4
1958 .....	115.1	133.3	140.7	172.9	182.7	112.7
1959 .....	120.6	140.5	150.5	193.0	212.9	117.1
1960 .....	121.4	145.5	161.6	204.7	245.0	122.5
1961 .....	124.7	153.3	170.9	215.9	277.6	122.8
1962 .....	130.1	161.3	181.3	229.5	289.5	125.6
1963 .....	139.4	167.5	190.1	239.9	312.8	132.2
1964 .....	146.2	174.9	204.3	259.8	354.6	141.0
1965 .....	150.8	181.5	218.3	277.4	369.6	145.4
1966 .....	152.4	187.7	235.4	288.7	406.9	150.3
1967 .....	152.4	193.7	249.8	305.6	466.9	157.4
1968 .....	157.7	206.9	275.9	327.7	525.6	168.8
1969 .....	160.4	219.1	291.9	349.9	607.2	172.8
1970 .....	160.1	222.2	308.6	359.1	684.5	176.7
1971 .....	169.9	238.0	325.6	373.7	727.7	185.3
1972 .....	178.4	248.6	344.9	398.4	810.7	198.7
1973 .....	188.1	264.3	365.1	422.5	893.8	212.5
1974 .....	183.7	270.2	378.6	444.9	915.6	217.1
1975 .....	189.0	263.2	393.4	461.1	951.0	215.1
1976 .....	197.4	278.3	422.6	492.2	1040.4	226.1
1977 .....	202.3	289.3	445.2	512.1	1114.9	227.2
1978 .....	204.0	293.4	471.4	525.2	1202.5	230.1
1979 .....	205.4	301.6	492.6	549.8	1309.4	232.6
1980 .....	205.8	295.1	500.1	557.4	1434.0	230.1
1981 .....	212.2	302.7	513.3	570.3	1513.4	245.2
1982 .....	216.5	295.3	541.9	580.3	1636.6	252.6
1983 .....	225.8	315.3	574.7	606.9	1729.8	268.1

NOTE: Data relate to all employed persons in the United States and Canada; all employees in the other countries.

**Table 14. Output per hour, output per unit of capital, and multifactor productivity in manufacturing, 1950-83**  
(Index, 1950 = 100)

Year	Output per hour	Output per unit of capital	Multifactor productivity <sup>1</sup>
1950.....	100.0	100.0	100.0
1951.....	103.4	104.9	103.9
1952.....	105.3	101.0	103.9
1953.....	107.1	104.1	106.1
1954.....	108.7	94.2	104.0
1955.....	114.1	101.2	110.0
1956.....	113.3	97.8	108.2
1957.....	115.6	94.7	108.7
1958.....	115.1	85.0	105.0
1959.....	120.6	94.2	111.9
1960.....	121.4	93.2	112.0
1961.....	124.7	92.0	113.6
1962.....	130.1	98.3	119.4
1963.....	139.4	104.0	127.5
1964.....	146.2	108.3	133.4
1965.....	150.8	113.5	138.3
1966.....	152.4	115.0	139.9
1967.....	152.4	107.0	136.6
1968.....	157.7	107.0	139.9
1969.....	160.5	106.4	141.3
1970.....	160.1	97.2	137.5
1971.....	169.9	97.7	143.6
1972.....	178.4	105.6	152.2
1973.....	188.1	114.5	161.8
1974.....	183.7	105.4	155.4
1975.....	189.0	94.6	154.0
1976.....	197.4	101.7	162.2
1977.....	202.3	105.8	167.1
1978.....	204.0	107.4	168.8
1979.....	205.4	105.3	168.7
1980.....	205.8	96.0	165.0
1981.....	212.3	95.1	168.3
1982.....	216.8	87.7	167.4
1983.....	225.9	92.7	175.1

<sup>1</sup> For a discussion of multifactor productivity see *Trends in Multifactor Productivity, 1948-81*, BLS Bulletin 2178, Sept. 1983.



**Table 12. Output per hour, output, and hours in manufacturing, 1950-73 and 1973-83**  
(Average annual percent change)

Sector and measure	1950-83	1950-73	1973-83	Slowdown 1950-73 to 1973-83
Total manufacturing:				
Output per hour .....	2.5	2.8	1.8	-1.0
Output .....	3.1	4.0	0.9	-3.1
Hours .....	0.5	1.2	-1.0	-2.2
Durable goods:				
Output per hour .....	2.2	2.3	1.9	-0.4
Output .....	3.0	4.0	0.7	-3.3
Hours .....	0.8	1.7	-1.2	-2.9
Nondurable goods:				
Output per hour .....	2.9	3.4	1.7	-1.7
Output .....	3.1	4.0	1.1	-2.9
Hours .....	0.2	0.6	-0.7	-1.3

**Table 13. Output per hour, output, and hours in manufacturing, selected countries, 1950-73 and 1973-83**  
(Average annual percent change)

Country	Output per hour		Output		Hours	
	1950-73	1973-83	1950-73	1973-83	1950-73	1973-83
United States .....	2.8	1.8	4.0	0.9	1.2	-1.0
Canada .....	4.3	1.8	5.5	.8	1.2	-1.0
France .....	5.8	4.6	6.6	1.8	.8	-2.7
Germany .....	6.5	3.7	7.7	.8	1.1	-2.8
Japan .....	10.0	6.8	14.8	6.2	4.4	-.6
United Kingdom .....	3.3	2.4	3.1	-1.9	-.3	-4.2

NOTE: Data relate to all employed persons in the United States and Canada; all employees in the other countries.

**Table 15. Output per hour, capital effects, and multifactor productivity in manufacturing, 1950-73 and 1973-83**  
(Average annual percent change)

Period	Productivity			Output <sup>2</sup>	Inputs			
	Output per hour of all persons	Output per unit of capital	Multi-factor productivity <sup>1</sup>		Hours of all persons <sup>3</sup>	Capital services <sup>4</sup>	Combined units of labor and capital inputs <sup>5</sup>	Capital per hour of all persons
1950-83 .....	2.5	-0.2	1.7	3.1	0.5	3.3	1.3	2.7
1950-73 .....	2.8	.6	2.1	4.0	1.2	3.4	1.9	2.2
1973-83 .....	1.8	-2.1	0.8	0.9	-1.0	3.0	.0	4.0

<sup>1</sup> Output per unit of combined labor and capital inputs.

<sup>2</sup> Gross domestic product originating in manufacturing, constant dollars.

<sup>3</sup> Paid hours of all employees, plus the hours of proprietors and unpaid family workers engaged in manufacturing.

<sup>4</sup> A measure of the flow of capital services used in manufacturing.

<sup>5</sup> Hours of all persons combined with capital input, using labor and capital shares of output as weights.

**Table 16. Output per employee hour in selected manufacturing industries, 1960-83**

Industry	Average annual percent change	Industry	Average annual percent change
Wet corn milling <sup>1</sup> .....	7.5	Transformers <sup>3</sup> .....	2.2
Malt beverages .....	6.6	Hydraulic cement .....	2.2
Synthetic fibers .....	6.6	Switchgear and switchboard apparatus <sup>3</sup> .....	2.1
Hosiery .....	6.4	Lighting fixtures <sup>4</sup> .....	2.1
Radio and television receiving sets <sup>2</sup> .....	5.0	Beet sugar .....	2.1
Fluid milk .....	4.7	Copper rolling and drawing .....	2.1
Household refrigerators and freezers .....	4.6	Wood household furniture <sup>2</sup> .....	2.0
Aluminum rolling and drawing .....	4.6	Upholstered household furniture <sup>2</sup> .....	2.0
Pharmaceutical preparations <sup>3</sup> .....	4.1	Metal household furniture <sup>2</sup> .....	2.0
Corrugated and solid fiberboard boxes .....	4.0	Nonwool yarn mills <sup>2</sup> .....	2.0
Household laundry equipment .....	4.0	Gray iron foundries .....	2.0
Ceramic wall and floor tile <sup>2</sup> .....	4.0	Brick and structural clay tile .....	2.0
Household cooking equipment .....	4.0	Sawmills and planing mills, general .....	1.9
Mattresses and bedsprings <sup>2</sup> .....	3.9	Bakery products <sup>2</sup> .....	1.9
Veneer and plywood <sup>2</sup> .....	3.5	Metal office furniture <sup>2</sup> .....	1.8
Paper, paperboard and pulp mills .....	3.5	Pumps and compressors <sup>2</sup> .....	1.8
Flour and other grain mill products .....	3.2	Construction machinery and equipment <sup>2</sup> .....	1.8
Household appliances, n.e.c. .....	3.2	Cereal breakfast foods <sup>3</sup> .....	1.8
Cosmetics and other toiletries <sup>2</sup> .....	3.1	Folding paperboard boxes <sup>5</sup> .....	1.7
Bottled and canned soft drinks <sup>2</sup> .....	3.1	Motors and generators <sup>2</sup> .....	1.7
Petroleum refining .....	3.0	Electric lamps .....	1.7
Prepared feeds for animals and fowls <sup>1</sup> .....	3.0	Steel .....	1.6
Tires and inner tubes .....	3.0	Primary aluminum .....	1.6
Preserved fruits and vegetables <sup>2</sup> .....	2.8	Wood office furniture <sup>2</sup> .....	1.5
Motor vehicles and equipment .....	2.8	Ball and roller bearings .....	1.4
Cigars .....	2.7	Cigarettes, chewing and smoking tobacco .....	1.3
Metal cans .....	2.7	Vales and pipe fittings <sup>2</sup> .....	1.1
Clay refractories .....	2.6	Hand and edge tools <sup>4</sup> .....	1.0
Soaps and detergents <sup>2</sup> .....	2.5	Blended and prepared flour <sup>1</sup> .....	1.0
Farm and garden machinery <sup>2</sup> .....	2.5	Ready-mixed concrete <sup>2</sup> .....	.9
Raw and refined cane sugar .....	2.5	Millwork <sup>2</sup> .....	.9
Rice milling <sup>1</sup> .....	2.5	Fabricated structural metal <sup>2</sup> .....	.7
Paints and allied products .....	2.5	Steel foundries <sup>2</sup> .....	.7
Primary copper, lead and zinc .....	2.5	Metal-cutting machine tools .....	.3
Concrete products <sup>2</sup> .....	2.4	Footwear .....	.2
Glass containers .....	2.4	Fabricated pipe and fittings <sup>2</sup> .....	.0
Paper and plastic bags <sup>2</sup> .....	2.2	Metal-forming machine tools .....	-1.0

<sup>1</sup> 1963-81.

<sup>2</sup> 1960-82.

<sup>3</sup> 1963-82.

<sup>4</sup> 1961-82.

**Table 17. Productivity rates before and after 1973, selected manufacturing industries**  
(Average annual percent change)

Industry	1960-73	1973-83	Change 1960-73 to 1973-83
Hosiery.....	7.1	3.4	- 3.7
Malt beverages.....	6.6	5.0	- 1.6
Synthetic fibers.....	6.5	5.2	- 1.3
Household refrigerators and freezers.....	6.5	3.0	- 3.4
Aluminum rolling and drawing.....	5.8	1.7	- 4.1
Pharmaceutical preparations <sup>1</sup> .....	5.4	2.7	- 2.7
Petroleum refining.....	5.3	- 0.7	- 5.9
Major household appliances.....	5.2	3.1	- 2.0
Household laundry equipment.....	4.9	2.6	- 2.3
Radio and television receiving sets <sup>2</sup> .....	4.7	6.3	1.6
Veneer and plywood <sup>2</sup> .....	4.5	2.2	- 2.3
Paper, paperboard and pulp mills.....	4.4	2.4	- 2.0
Cosmetics and other toiletries <sup>2</sup> .....	4.4	- 1.6	- 6.0
Fluid milk.....	4.3	5.0	0.8
Hydraulic cement.....	4.2	0.7	- 3.5
Flour and other grain mill products.....	4.0	2.7	- 1.3
Wet corn milling <sup>3</sup> .....	4.0	11.5	7.5
Concrete products <sup>2</sup> .....	3.9	0.2	- 3.7
Corrugated and solid fiber board boxes.....	3.9	2.9	- 1.0
Ceramic wall and floor tile <sup>2</sup> .....	3.8	5.1	1.2
Prepared feeds for animals and fowls <sup>3</sup> .....	3.8	4.1	0.3
Transformers <sup>1</sup> .....	3.7	2.0	- 1.7
Mattresses and bedsprings <sup>2</sup> .....	3.6	2.2	- 1.4
Household cooking equipment.....	3.6	3.8	0.1
Tires and inner tubes.....	3.6	4.4	0.8
Switchgear and switchboard apparatus <sup>1</sup> .....	3.5	0.6	- 2.9
Household appliances nec.....	3.4	2.9	- 0.5
Cigars.....	3.3	3.2	- 0.2
Motor vehicles and equipment.....	3.2	2.2	- 1.1
Preserved fruits and vegetables <sup>2</sup> .....	3.2	1.4	- 1.8
Soaps and detergents <sup>2</sup> .....	3.2	0.4	- 2.8
Motors and generators <sup>2</sup> .....	3.2	0.0	- 3.2
Beet sugar.....	3.1	1.2	- 2.0
Bakery products <sup>2</sup> .....	3.1	0.4	- 2.7
Ball and roller bearings.....	3.1	- 1.7	- 4.7
Lighting fixtures <sup>4</sup> .....	3.0	0.0	- 3.0
Raw and refined cane sugar.....	3.0	2.2	- 0.8
Sawmills and planing mills, general.....	3.0	1.6	- 1.3
Clay refractories.....	3.0	0.9	- 2.0
Wood household furniture <sup>2</sup> .....	3.0	- 0.4	- 3.3
Farm and garden machinery <sup>2</sup> .....	3.0	0.2	- 2.7
Brick and structural clay tile.....	2.9	- 0.1	- 2.9
Paper and plastic bags <sup>2</sup> .....	2.9	- 0.5	- 3.4
Rice milling <sup>3</sup> .....	2.9	3.7	0.9
Metal household furniture <sup>2</sup> .....	2.8	1.0	- 1.9
Copper rolling and drawing.....	2.7	3.0	0.4
Millwork <sup>2</sup> .....	2.6	- 1.1	- 3.7
Blended and prepared flour <sup>3</sup> .....	2.6	- 1.1	- 3.6
Gray iron foundries.....	2.6	0.4	- 2.1
Glass containers.....	2.5	2.6	0.1
Construction machinery and equipment <sup>2</sup> .....	2.5	- 0.2	- 2.7
Steel.....	2.4	0.4	- 2.0
Primary aluminum.....	2.4	0.6	- 1.8



**Table 17. Productivity rates before and after 1973, selected manufacturing industries—(continued)**  
(Average annual percent change)

Industry	1960-73	1973-83	Change 1960-73 to 1973-83
Pumps and compressors <sup>2</sup> .....	2.4	0.7	-1.7
Paints and allied products .....	2.3	2.7	0.4
Fabricated structural metal <sup>2</sup> .....	2.3	-1.0	-3.3
Ready-mixed concrete <sup>2</sup> .....	2.1	-1.0	-3.2
Cereal breakfast foods <sup>1</sup> .....	2.1	2.3	0.2
Folding paperboard boxes <sup>5</sup> .....	2.0	0.1	-1.9
Primary copper, lead, and zinc .....	2.0	3.9	1.9
Valves and pipe fittings <sup>2</sup> .....	2.0	0.8	-1.2
Hand and edge tools <sup>2</sup> .....	2.0	-0.1	-2.1
Nonwool yarn mills <sup>2</sup> .....	1.9	2.7	0.8
Metal office furniture <sup>2</sup> .....	1.8	3.1	1.3
Metal cans .....	1.8	4.2	2.5
Bottled and canned soft drinks <sup>2</sup> .....	1.8	4.8	3.0
Upholstered household furniture <sup>2</sup> .....	1.6	2.4	0.9
Electric lamps .....	1.5	2.7	1.2
Steel foundries <sup>2</sup> .....	1.4	-1.8	-3.1
Wood office furniture <sup>2</sup> .....	1.4	3.5	2.1
Cigarettes, chewing and smoking tobacco ..	1.3	1.0	-0.3
Metal-cutting machine tools .....	1.3	-2.7	-4.0
Fabricated pipe and fittings <sup>2</sup> .....	1.0	-2.4	-3.4
Footwear .....	0.4	0.0	-0.4
Metal-forming machine tools .....	0.3	-3.8	-4.1

<sup>1</sup> 1963-73 and 1973-82. <sup>2</sup> 1960-73 and 1973-82. <sup>3</sup> 1963-73 and 1973-81.

<sup>4</sup> 1961-73 and 1973-82. <sup>5</sup> 1963-73 and 1973-83.

NOTE: Average annual rates of change based on the linear least squares trend of the logarithms of the index numbers.



**Table 18. Output per employee hour and employment, selected manufacturing industries, 1973-83**

(Average annual percent change)

Industry	Output per employee hour	Employment
Meat packing plants <sup>1</sup> .....	3.4	- 1.2
Sausages and other prepared meats <sup>1</sup> .....	3.5	.7
Fluid milk .....	5.0	- 4.5
Preserved fruits and vegetables <sup>1</sup> .....	1.4	.0
Flour and other grain mill products .....	2.7	- 1.5
Cereal breakfast foods <sup>1</sup> .....	2.3	2.0
Rice milling <sup>2</sup> .....	3.7	3.9
Blended and prepared flour <sup>2</sup> .....	- 1.1	.1
Wet corn milling <sup>2</sup> .....	11.5	- 1.0
Prepared feeds for animals and fowls <sup>2</sup> .....	4.1	- .3
Bakery products <sup>1</sup> .....	.4	- .8
Raw and refined cane sugar .....	2.2	- 1.7
Beet sugar .....	1.2	- 2.2
Malt beverages .....	5.0	- 1.5
Bottled and canned soft drinks <sup>1</sup> .....	4.8	1.0
Cigarettes, chewing and smoking tobacco .....	1.0	.2
Cigars .....	3.2	- 9.5
Hosiery .....	3.4	- .6
Nonwool yarn mills <sup>1</sup> .....	2.7	- 1.6
Sawmills and planing mills, general .....	1.6	- 1.7
Millwork <sup>1</sup> .....	- 1.1	- .5
Veneer and plywood <sup>1</sup> .....	2.2	- 1.9
Wood household furniture <sup>1</sup> .....	- .4	- .9
Upholstered household furniture <sup>1</sup> .....	2.4	- 1.0
Metal household furniture <sup>1</sup> .....	1.0	- 2.0
Mattresses and bedsprings <sup>1</sup> .....	2.2	- 1.0
Wood office furniture <sup>1</sup> .....	3.5	7.6
Metal office furniture <sup>1</sup> .....	3.1	2.7
Paper, paperboard and pulp mills .....	2.4	- .7
Paper and plastic bags <sup>1</sup> .....	- .5	.8
Folding paperboard boxes .....	.1	.5
Corrugated and solid fiber board .....	2.9	- .7
Synthetic fibers .....	5.2	- 4.3
Pharmaceutical preparations <sup>1</sup> .....	2.7	.6
Soaps and detergents <sup>1</sup> .....	.4	1.5
Cosmetics and other toiletries <sup>1</sup> .....	- 1.6	2.7
Paints and allied products .....	2.7	- 1.6
Petroleum refining .....	- .7	.4
Tires and inner tubes .....	4.4	- 5.4
Miscellaneous plastics products <sup>1</sup> .....	2.0	3.4
Footwear .....	.0	- 3.2
Glass containers .....	2.6	- 2.4
Hydraulic cement .....	.7	- 1.9
Brick and structural clay tile .....	- .1	- 4.7
Ceramic wall and floor tile <sup>1</sup> .....	5.1	- .5
Clay refractories .....	.9	- 4.5
Concrete products <sup>1</sup> .....	- .2	- 1.5
Ready-mixed concrete <sup>1</sup> .....	- 1.0	.3

**Table 18. Output per employee hour and employment, selected manufacturing industries, 1973-83—Continued**  
(Average annual percent change)

Industry	Output per employee hour	Employment
Steel.....	0.4	-4.4
Gray iron foundries.....	.4	-4.0
Steel foundries <sup>1</sup> .....	-1.8	.5
Primary copper, lead, and zinc.....	3.9	-8.2
Primary aluminum.....	.6	-1.1
Copper rolling and drawing.....	3.0	-4.5
Aluminum rolling and drawing.....	1.7	-9
Metal cans.....	4.2	-4.1
Hand and edge tools <sup>1</sup> .....	-.1	1.3
Fabricated structural metal <sup>1</sup> .....	-1.0	1.0
Valves and pipe fittings <sup>1</sup> .....	.8	1.8
Fabricated pipe and fittings <sup>1</sup> .....	-2.4	6.5
Farm and garden machinery <sup>1</sup> .....	.2	-1.4
Construction machinery and equipment <sup>1</sup> .....	-.2	-1.2
Metal-cutting machine tools.....	-2.7	-.5
Metal-forming machine tools.....	-3.8	-3.6
Pumps and compressors <sup>1</sup> .....	.7	2.4
Ball and roller bearings.....	-1.7	-1.7
Transformers <sup>1</sup> .....	2.0	-1.9
Switchgear and switchboard apparatus <sup>1</sup> .....	.6	-.2
Motors and generators <sup>1</sup> .....	.0	.3
Household cooking equipment.....	3.8	2.0
Household refrigerators and freezers.....	3.0	-4.6
Household laundry equipment.....	2.6	-2.3
Household appliances nec.....	2.9	-1.1
Electric lamps.....	2.7	-3.5
Lighting fixtures <sup>1</sup> .....	.0	.4
Radio and television receiving sets <sup>1</sup> .....	6.3	-5.2
Motor vehicles and equipment.....	2.2	-2.3
Instruments to measure electricity <sup>1</sup> .....	2.4	5.8

<sup>1</sup> 1973-82.

<sup>2</sup> 1973-81.

**Table 19. Output and employment in selected manufacturing industries with similar productivity growth, 1973-83.**  
(Average annual percent change)

Industry	Output per employee hour	Output	Employee hours
Household cooking equipment.....	3.8	5.9	2.0
Hosiery.....	3.4	3.7	.3
Tires.....	4.4	-1.4	-5.6

**Table 20. Output per hour, unit labor costs, and compensation per hour in manufacturing, 1950-83**  
(Percent change from previous year)

Year	Output per hour	Unit labor costs	Compensation per hour
1950.....	5.4	- 0.3	5.1
1951.....	3.4	6.4	10.1
1952.....	1.8	4.6	6.5
1953.....	1.7	3.7	5.4
1954.....	1.6	2.9	4.5
1955.....	5.0	- 1.1	3.9
1956.....	- .7	7.2	6.4
1957.....	2.1	3.8	5.9
1958.....	- .4	4.9	4.5
1959.....	4.8	- .9	3.8
1960.....	.7	3.5	4.1
1961.....	2.7	.1	2.8
1962.....	4.3	- .4	3.9
1963.....	7.2	- 3.9	3.0
1964.....	4.8	- .7	4.1
1965.....	3.1	- 1.1	2.0
1966.....	1.1	3.4	4.5
1967.....	.0	5.0	5.0
1968.....	3.5	3.5	7.1
1969.....	1.7	5.2	7.0
1970.....	- .2	7.0	6.8
1971.....	6.1	.0	6.1
1972.....	5.0	.3	5.4
1973.....	5.4	1.7	7.2
1974.....	- 2.4	13.3	10.6
1975.....	2.9	8.8	11.9
1976.....	4.5	3.4	8.0
1977.....	2.5	5.7	8.3
1978.....	.9	7.3	8.3
1979.....	.7	9.0	9.7
1980.....	.2	11.5	11.7
1981.....	3.1	6.1	9.4
1982.....	2.1	6.6	8.8
1983.....	4.3	- .8	3.4

**Table 21. Composition of price changes in manufacturing, 1950-83**  
(Percent change from previous year)

Year	Implicit price deflator	Point contribution to percent change	
		Unit labor costs	Unit nonlabor payments <sup>1</sup>
1950.....	1.9	-0.2	2.1
1951.....	5.8	4.2	1.6
1952.....	1.1	3.1	-2.0
1953.....	1.9	2.5	-.7
1954.....	2.2	2.0	.1
1955.....	2.6	-.7	3.3
1956.....	4.2	4.9	-.7
1957.....	3.1	2.7	.4
1958.....	3.1	3.5	-.4
1959.....	2.2	-.7	2.8
1960.....	1.5	2.4	-.9
1961.....	.3	.1	.2
1962.....	.7	-.3	1.0
1963.....	-2.1	-2.7	.6
1964.....	.1	-.5	.5
1965.....	.9	-.7	1.6
1966.....	1.8	2.3	-.5
1967.....	2.8	3.4	-.6
1968.....	3.6	2.4	1.1
1969.....	2.3	3.6	-1.3
1970.....	4.3	5.0	-.7
1971.....	3.1	.0	3.1
1972.....	.5	.2	.2
1973.....	.3	1.2	-1.0
1974.....	9.0	9.5	-.5
1975.....	13.1	6.5	6.6
1976.....	4.6	2.4	2.1
1977.....	6.0	4.1	1.9
1978.....	6.0	5.2	.8
1979.....	5.7	6.5	-.8
1980.....	7.9	8.5	-.5
1981.....	8.0	4.7	3.3
1982.....	4.7	4.9	-.2
1983.....	3.3	-.6	3.9

<sup>1</sup> Unit nonlabor payments include corporate profit and the profit component of proprietors' income, as well as capital consumption allowances (replacement basis), net interest, and rental income of persons.

NOTE: Figures in the second and third columns may not add to figures in the first column due to rounding.



**Table 22. Output per employee hour and prices, selected manufacturing industries, 1973-81**  
(Average annual percent change)

Industry	Output per employee hour	Prices
Meat packing plants .....	4.0	5.6
Sausages and other prepared meats .....	4.5	4.6
Fluid milk .....	5.0	7.0
Preserved fruits and vegetables .....	1.2	8.2
Flour and other grain mill products .....	3.0	2.7
Cereal breakfast foods .....	2.1	10.6
Rice milling .....	3.7	1.5
Blended and prepared flour .....	- 1.1	8.1
Wet corn milling .....	11.5	4.8
Prepared feeds for animals and fowls .....	4.1	3.2
Bakery products .....	.1	8.2
Raw and refined cane sugar .....	2.7	5.2
Beet sugar .....	2.0	5.3
Malt beverages .....	5.7	6.1
Bottled and canned soft drinks .....	5.0	10.0
Cigarettes, chewing and smoking tobacco .....	1.7	10.9
Cigars .....	2.5	5.2
Hosiery .....	4.7	3.2
Nonwool yarn mills .....	2.2	6.7
Sawmills and planing mills, general .....	.8	8.5
Millwork .....	- .8	10.3
Veneer and plywood .....	2.2	7.3
Wood household furniture .....	- .4	7.8
Upholstered household furniture .....	2.2	6.0
Metal household furniture .....	.3	7.8
Mattresses and bedsprings .....	2.8	6.6
Wood office furniture .....	4.4	8.6
Metal office furniture .....	3.3	7.9
Paper, paperboard and pulp mills .....	2.4	9.1
Paper and plastic bags .....	- 5	11.0
Folding paperboard boxes .....	.4	7.9
Corrugated and solid fiber board boxes .....	3.0	7.3
Synthetic fibers .....	6.3	5.2
Pharmaceutical preparations .....	2.9	7.2
Soaps and detergents .....	.8	9.2
Cosmetics and other toiletries .....	- 1.5	7.9

**Table 22. Output per employee hour and prices, selected manufacturing industries, 1973-81—Continued**  
(Average annual percent change)

Industry	Output per employee hour	Prices
Paints and allied products .....	2.6	8.3
Petroleum refining .....	.1	20.8
Tires and inner tubes .....	3.1	9.9
Miscellaneous plastics products .....	1.4	8.3
Footwear .....	.0	8.7
Glass containers .....	2.6	11.1
Hydraulic cement .....	-.3	11.2
Brick and structural clay tile .....	-1.1	11.3
Ceramic wall and floor tile .....	5.0	5.3
Clay refractories .....	1.6	10.5
Concrete products .....	.1	9.7
Ready-mixed concrete .....	-.8	10.5
Steel .....	.8	11.0
Gray iron foundries .....	-.4	10.6
Steel foundries .....	-1.8	11.9
Primary copper, lead, and zinc .....	3.2	6.0
Primary aluminum .....	-.1	14.0
Copper rolling and drawing .....	2.1	5.2
Aluminum rolling and drawing .....	1.2	11.5
Metal cans .....	3.6	10.0
Hand and edge tools .....	.1	10.6
Fabricated structural metal .....	-1.0	9.5
Valves and pipe fittings .....	1.0	10.1
Fabricated pipe and fittings .....	-2.6	10.5
Farm and garden machinery .....	.3	9.7
Construction machinery and equipment .....	.4	11.1
Metal-cutting machine tools .....	-.7	11.6
Metal-forming machine tools .....	-2.9	13.3
Pumps and compressors .....	1.0	9.9
Ball and roller bearings .....	-.8	11.0
Transformers .....	2.5	8.5
Switchgear and switchboard apparatus .....	.5	9.5
Motors and generators .....	-.3	9.6
Household cooking equipment .....	2.6	7.1
Household refrigerators and freezers .....	2.9	6.9
Household laundry equipment .....	2.6	7.1
Household appliances nec .....	3.0	6.5
Electric lamps .....	2.4	10.9
Lighting fixtures .....	.2	8.6
Radio and television receiving sets .....	5.1	-.2
Motor vehicles and equipment .....	1.8	8.7
Instruments to measure electricity .....	2.2	6.6

**Table 23. Output per employee hour and compensation per employee hour, selected manufacturing industries, 1973-81**  
(Average annual percent change)

Industry	Output per employee hour	Compensation per employee hour
Wet corn milling.....	11.5	10.2
Synthetic fibers.....	6.3	10.9
Malt beverages.....	5.7	10.9
Radio and television receiving sets.....	5.1	10.1
Fluid milk.....	5.0	4.7
Bottled and canned soft drinks.....	5.0	9.4
Ceramic wall and floor tile.....	5.0	8.2
Hosiery.....	4.7	7.8
Sausages and other prepared meats.....	4.5	9.0
Wood office furniture.....	4.4	9.4
Prepared feeds for animals and fowls.....	4.1	9.3
Meat packing plants.....	4.0	9.2
Rice milling.....	3.7	6.9
Metal cans.....	3.6	11.3
Metal office furniture.....	3.3	10.0
Primary copper, lead, and zinc.....	3.2	12.3
Tires and inner tubes.....	3.1	10.2
Corrugated and solid fiber board boxes.....	3.0	9.4
Household appliances nec.....	3.0	8.5
Flour and other grain mill products.....	3.0	9.6
Household refrigerators and freezers.....	2.9	9.8
Pharmaceutical preparations.....	2.9	9.4
Mattresses and bedsprings.....	2.8	7.2
Raw and refined cane sugar.....	2.7	9.9
Glass containers.....	2.6	10.9
Paints and allied products.....	2.6	8.7
Household cooking equipment.....	2.6	7.3
Household laundry equipment.....	2.6	9.7
Cigars.....	2.5	9.4
Transformers.....	2.5	9.1
Paper, paperboard and pulp mills.....	2.4	11.0
Electric lamps.....	2.4	9.0
Upholstered household furniture.....	2.2	7.2
Instruments to measure electricity.....	2.2	9.7
Nonwool yarn mills.....	2.2	9.0
Veneer and plywood.....	2.2	10.2
Copper rolling and drawing.....	2.1	8.9
Cereal breakfast foods.....	2.1	11.1
Beet sugar.....	2.0	8.6
Motor vehicles and equipment.....	1.8	9.7
Cigarettes, chewing and smoking tobacco.....	1.7	13.1

**Table 23. Output per employee hour and compensation per employee hour, selected manufacturing industries, 1973-81—Continued**  
(Average annual percent change)

Industry	Output per hour	Compensation per hour
Clay refractories .....	1.6	12.5
Miscellaneous plastics products .....	1.4	9.4
Preserved fruits and vegetables .....	1.2	9.0
Aluminum rolling and drawing .....	1.2	11.1
Valves and pipe fittings .....	1.0	9.6
Pumps and compressors .....	1.0	9.9
Soaps and detergents .....	.8	10.3
Sawmills and planing mills, general .....	.8	9.1
Steel .....	.8	11.1
Switchgear and switchboard apparatus .....	.5	8.9
Folding paperboard boxes .....	.4	8.1
Construction machinery and equipment .....	.4	10.8
Farm and garden machinery .....	.3	10.1
Metal household furniture .....	.3	7.5
Lighting fixtures .....	.2	7.8
Concrete products .....	.1	7.9
Hand and edge tools .....	.1	8.2
Bakery products .....	.1	8.8
Petroleum refining .....	.1	10.9
Footwear .....	.0	8.0
Primary aluminum .....	-.1	12.2
Motors and generators .....	-.3	9.3
Hydraulic cement .....	-.3	9.6
Gray iron foundries .....	-.4	9.7
Wood household furniture .....	-.4	7.7
Paper and plastic bags .....	-.5	9.2
Metal-cutting machine tools .....	-.7	8.7
Ready-mixed concrete .....	-.8	8.2
Ball and roller bearings .....	-.8	8.3
Millwork .....	-.8	9.3
Fabricated structural metal .....	-1.0	8.0
Blended and prepared flour .....	-1.1	7.8
Brick and structural clay tile .....	-1.1	8.9
Cosmetics and other toiletries .....	-1.5	7.3
Steel foundries .....	-1.8	9.4
Fabricated pipe and fittings .....	-2.6	8.6
Metal-forming machine tools .....	-2.9	9.0



**Table 24. Hourly compensation costs for production workers in manufacturing, selected countries, 1960-83**  
(Index, United States = 100)

Year	United States (in dollars)	United States	Canada	France	Germany	Japan	United Kingdom
1960 .....	\$ 2.66	100	80	31	32	10	32
1961 .....	2.74	100	76	32	36	11	32
1962 .....	2.85	100	71	34	38	12	32
1963 .....	2.93	100	71	37	40	13	33
1964 .....	3.03	100	72	38	43	14	34
1965 .....	3.14	100	73	39	45	15	37
1966 .....	3.29	100	75	40	46	16	37
1967 .....	3.43	100	77	41	46	17	37
1968 .....	3.68	100	77	42	45	19	33
1969 .....	3.93	100	79	41	48	22	32
1970 .....	4.18	100	83	41	56	24	36
1971 .....	4.49	100	87	43	61	26	39
1972 .....	4.84	100	89	48	69	33	42
1973 .....	5.26	100	89	59	87	42	43
1974 .....	5.75	100	95	59	92	46	45
1975 .....	6.35	100	96	72	97	48	51
1976 .....	6.93	100	104	69	95	48	45
1977 .....	7.59	100	99	70	103	53	44
1978 .....	8.30	100	93	79	116	67	52
1979 .....	9.07	100	90	87	124	61	61
1980 .....	9.89	100	90	92	125	57	74
1981 .....	10.95	100	89	75	96	56	65
1982 <sup>1</sup> .....	11.68	100	91	67	89	49	58
1983 <sup>1</sup> .....	12.26	100	93	62	85	51	53

<sup>1</sup> Preliminary.

**Table 25. Output per hour, compensation per hour, and unit labor costs in manufacturing, selected countries, 1960-73 and 1973-83**  
(Average annual percent change)

Country	Output per hour		Hourly compensation (national currency)		Unit labor costs (national currency)	
	1960-73	1973-83	1960-73	1973-83	1960-73	1973-83
United States.....	3.4	1.8	5.0	9.0	1.5	7.0
Canada .....	4.7	1.8	6.2	11.9	1.4	9.9
France .....	6.5	4.6	10.0	16.0	3.3	10.8
Germany.....	5.7	3.7	10.2	8.2	4.2	4.4
Japan .....	10.5	6.8	15.1	9.8	4.2	2.8
United Kingdom.....	4.3	2.4	8.9	17.2	4.4	14.5

NOTE: Data relate to all employed persons in the United States and Canada; all employees in the other countries.

**Table 26. Unit labor costs in manufacturing, measured in national currencies and in U.S. dollars, selected countries, 1973-83**  
(Average annual percent change)

Country	National currency basis			U.S. dollar basis		
	1973-83	1973-80	1980-83	1973-83	1973-80	1980-83
United States.....	7.0	8.4	3.9	7.0	8.4	3.9
Canada .....	9.9	10.2	9.2	7.6	7.8	7.3
France .....	10.8	11.0	10.5	5.0	11.8	- 9.3
Germany.....	4.4	5.2	2.6	4.8	11.0	- 8.4
Japan.....	2.8	4.5	- 1.1	4.1	7.2	- 2.8
United Kingdom .....	14.5	18.5	5.9	9.2	17.6	- 8.2

**Table 27. Capital investment as percent of output<sup>1</sup> in manufacturing, selected countries, 1965-82**  
(Annual averages)

Period	United States	France	Germany	Japan	United Kingdom
1965-82.....	10.5	15.1	212.8	21.2	13.6
1965-73.....	10.0	16.5	14.3	25.3	14.3
1974-82.....	11.1	13.6	311.2	17.1	13.0

<sup>1</sup> Fixed capital and output measured in constant dollars.

<sup>2</sup> 1965-81.

<sup>3</sup> 1974-81.

**Table 28. Research and development funds, manufacturing companies, current and constant dollars, selected years, 1967-82**  
(Index, 1963 = 100)

Year	Current dollars	Constant dollars
1967.....	128.1	116.1
1970.....	140.5	110.1
1971.....	142.6	106.4
1972.....	152.5	109.3
1973.....	166.2	112.6
1974.....	179.0	111.5
1975.....	189.8	108.2
1976.....	211.7	114.6
1977.....	233.7	119.6
1978.....	259.6	123.7
1979.....	297.0	130.2
1980.....	345.6	138.6
1981.....	404.0	148.1
1982.....	459.7	159.0

Source: National Science Foundation.

**Table 29. R&D funds as a percent of net sales in manufacturing companies performing R&D, by size of company, 1971 and 1981**

Size (number of employees)	1971	1981
Fewer than 1,000.....	1.7	1.5
1,000 to 4,999 .....	1.6	1.7
5,000 to 9,999 .....	2.2	2.1
10,000 to 24,999 .....	4.2	1.9
25,000 or more .....		
		4.6

Source: National Science Foundation.

**Table 30. R&D funds as percent of net sales in manufacturing companies performing R&D, and percent federally funded, by industry group, 1971 and 1981**

Industry	R&D funds as percent of net sales		Federal funds as percent of total R&D funds	
	1971	1981	1971	1981
Total manufacturing.....	3.5	3.1	41.0	31.1
Food and kindred products .....	.5	.4	0.8	0.8
Textiles and apparel .....	.5	.4	1.7	0.8
Lumber, wood products, and furniture .....	.7	.9	(1)	0.0
Paper and allied products.....	.9	(1)	(1)	(1)
Chemicals and allied products.....	3.7	3.8	10.0	7.2
Industrial chemicals .....	3.9	3.5	15.8	14.4
Drugs and medicines .....	6.2	(1)	(1)	(1)
Other chemicals .....	1.9	(1)	(1)	(1)
Petroleum refining and related industries .....	.9	(1)	3.4	(1)
Rubber products.....	2.2	(1)	23.9	(1)
Stone, clay, and glass products.....	1.8	(1)	6.1	(1)
Primary metals.....	.8	.8	2.2	20.5
Fabricated metal products.....	1.2	1.4	4.5	12.5
Machinery .....	4.0	5.2	16.9	10.9
Electrical equipment.....	7.2	6.8	51.4	37.9
Radio and TV receiving equipment .....	2.4	(1)	(1)	(1)
Communication equipment .....	8.2	9.6	54.2	37.8
Electronic components .....		7.4		22.7
Other electrical equipment .....	6.4	(1)	(1)	(1)
Motor vehicles and motor vehicles equipment .....	3.1	4.5	17.5	12.9
Other transportation equipment.....		(1)		(1)
Aircraft and missiles.....	16.2	15.3	79.2	72.6
Professional and scientific instruments .....	5.7	8.2	22.0	17.3
Scientific and mechanical measuring instruments.....	3.7	(1)	10.5	(1)
Optical, surgical, photographic, and other instruments .....	6.4	(1)	24.5	(1)
Other manufacturing industries .....	.8	.4	(1)	0.0

(1) Not separately available but included in total.

Source: National Science Foundation.



**Table 31. R&D scientists and engineers per 1,000 employees in selected manufacturing industries, 1982**

Industry	1982
Total manufacturing.....	35
Food and kindred products .....	6
Textiles and apparel .....	3
Lumber, wood products, and furniture .....	(1)
Paper and allied products.....	16
Chemicals and allied products .....	50
Petroleum refining and related industries .....	22
Rubber products.....	(1)
Stone, clay, and glass products.....	14
Primary metals.....	9
Fabricated metal products .....	15
Machinery .....	40
Electrical equipment.....	52
Motor vehicles and motor vehicles equipment .....	32
Other transportation equipment.....	8
Aircraft and missiles.....	102
Professional and scientific instruments.....	(1)
Other manufacturing.....	8

<sup>1</sup> Not separately available but included in total.  
Source: National Science Foundation.

**Table 32. Employment growth in high-technology industries and in total manufacturing, 1982-95**  
(Numbers in thousands)

Industry classification	Employment	Projected 1995 employment alternatives <sup>2</sup>			Average annual percent change		
		Low	Moderate	High	1982-95		
	1982				Low	Moderate	High
Total manufacturing .....	18,781	22,580	23,110	23,753	1.4	1.6	1.8
Durable goods .....	11,039	14,051	14,284	14,751	1.9	2.0	2.3
Nondurable goods .....	7,741	8,259	8,827	9,003	0.7	1.0	1.2
High-technology manufacturing <sup>1</sup> .....							
Group I.....	7,515	9,744	9,796	10,057	2.0	2.1	2.3
Percent of total manufacturing.....	40.0	43.2	42.4	42.3			
Group II.....	2,532	3,518	3,410	3,453	2.6	2.3	2.4
Percent of total manufacturing.....	13.5	15.6	14.8	14.5			
Group III .....	5,143	6,789	6,757	6,920	2.2	2.1	2.3
Percent of total manufacturing.....	27.4	30.1	29.2	29.1			

<sup>1</sup> The Bureau of Labor Statistics has developed three definitions of high-technology industries: Group I includes industries with a proportion of technology-oriented workers (engineers, life and physical scientists, mathematical specialists, engineering and science technicians, and computer specialists) at least 1.5 times the average for all industries. Group II includes industries with a ratio of R&D expenditures to net sales at least twice the average for all industries. Group III includes industries with a proportion of technology-oriented workers equal to or greater than the average for all industries, and a ratio of R&D expenditures to sales close to or above the average for all industries. The definitions include manufacturing and nonmanufacturing industries, but for this table, only manufacturing industries have been included. Industries may be classified in more than one group. For a listing of the manufacturing industries in each high technology group, see Richard W. Riche and others, "High Technology Today and Tomorrow: A Small Slice of the Employment Pie," *Monthly Labor Review*, November 1983, table 1, p. 52.

<sup>2</sup> Projections for employment in 1995 are based on three alternative versions of economic growth for the overall economy developed by BLS. The alternative assumptions are described in A.J. Andreassen and others, "Economic Outlook for the 1990's: Three Scenarios for Growth," *Monthly Labor Review*, November 1983, pp. 11-23.



**Table 33. Projected changes in occupational employment in manufacturing,<sup>1</sup> 1982-95**

Occupational group	Percent distribution				Percent change in employment 1982-95		
	1982	1995 projections <sup>2</sup>					
		Low trend	Moderate trend	High trend	Low	Moderate	High
Total manufacturing employment.....	100.0	100.0	100.0	100.0	19.8	22.6	26.0
Professional and technical workers.....	10.3	11.7	11.5	11.4	36.3	37.0	40.3
Managers, officials, and proprietors.....	6.7	7.4	7.4	7.4	32.8	36.0	40.0
Sales workers.....	2.2	2.0	2.1	2.1	11.4	15.5	18.8
Clerical workers.....	11.8	11.8	11.7	11.7	19.8	22.5	25.8
Craft and related workers.....	18.6	18.6	18.7	18.7	20.3	23.5	27.2
Operatives.....	40.2	38.6	38.7	38.7	15.1	18.1	21.3
Laborers.....	8.5	8.1	8.1	8.2	13.7	17.0	20.7
Service workers.....	1.8	1.8	1.8	1.8	14.9	17.8	21.1

<sup>1</sup> Data in this table are not comparable to those in table 4.

<sup>2</sup> Occupational employment projections for 1995 are based on three alternative versions of economic growth for the overall economy developed by BLS. The alternative assumptions are described in A. J. Andreassen and others, "Economic Outlook for the 1990's: Three Scenarios for Growth," *Monthly Labor Review*, November 1983, pp. 11-23.

NOTE: Data may not add to total because of rounding.

**Table 34. Projected employment in the fastest growing and most rapidly declining occupations in manufacturing, 1982-95**

Occupation <sup>1</sup>	1982	Projected <sup>2</sup> 1995	Percent change, 1982-95
Total, all manufacturing .....	18,848,278	23,110,229	22.6
Electrical engineers <sup>3</sup> .....	162,705	263,889	62.2
Computer specialists <sup>3,4</sup> .....	124,110	198,928	60.3
Electrical and electronic technicians <sup>3</sup> .....	137,737	219,591	59.4
Mechanical engineers <sup>3</sup> .....	118,759	176,632	48.7
Mechanical engineering technicians <sup>3</sup> .....	36,945	54,584	47.7
Instrument makers/assemblers .....	28,788	42,127	46.3
Designers .....	43,131	62,397	44.7
Machine tool operators, numerical control .....	66,090	95,496	44.5
Industrial engineers <sup>3</sup> .....	120,387	173,609	44.2
Miscellaneous machine operators, rubber and miscellaneous plastic .....	189,738	266,209	40.3
Aero-astronautic engineers <sup>3</sup> .....	29,122	40,442	38.9
Chemical engineers <sup>3</sup> .....	34,030	46,754	37.4
Managers, other than restaurant, cafe, bar .....	1,258,855	1,712,663	36.0
Electronic wirers .....	36,977	49,601	34.1
Electrical machinery equipment assemblers....	98,643	132,144	34.0
Bindery operatives <sup>5</sup> .....	73,611	73,007	- 0.8
Miscellaneous machine operators, food products other than meat and dairy .....	51,750	50,365	- 2.7
Frame spinners .....	25,725	24,784	- 3.7
Miscellaneous machine operators, meat and dairy products .....	42,448	39,917	- 6.0
Data entry operators .....	51,327	46,786	- 8.8
Drafters .....	112,171	101,425	- 9.6
Typesetters and compositors .....	84,721	74,136	- 12.5
Aircraft structure assemblers .....	33,266	26,150	- 21.4
Shoemaking machine operators .....	51,517	35,976	- 30.2

<sup>1</sup> Includes the 15 occupations with 1982 employment of 25,000 or more which are projected to grow most rapidly. Also includes all declining occupations with 1982 employment of 25,000 or more.

<sup>2</sup> Occupational employment projections for 1995 are based on the moderate-trend scenario of economic growth for the overall economy developed by BLS. For the three growth alternatives, see A. J. Andreassen and others, "Economic Outlook for the 1990's: Three Scenarios for Growth," *Monthly Labor Review*, November 1983, pp. 11-23.

<sup>3</sup> Technologically oriented occupations as defined by the BLS. These are occupations in which most workers are involved in developing or applying new technologies. Their work involves in-depth knowledge of theories and principles of science, engineering, and mathematics underlying technology. For more information, see Richard W. Riche and others, "High Technology Today and Tomorrow: A Small Slice of the Employment Pie," *Monthly Labor Review*, November 1983, pp. 50-58.

<sup>4</sup> Includes computer systems analysts and programmers.

<sup>5</sup> Includes assembly and stitching bindery workers and all others.



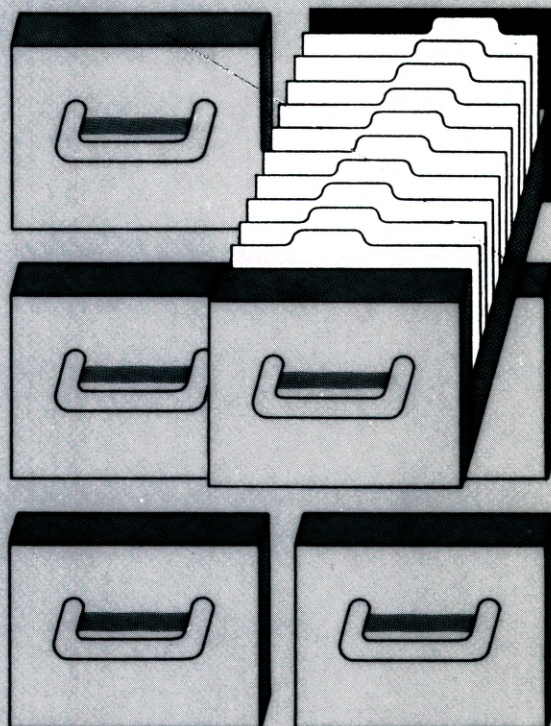
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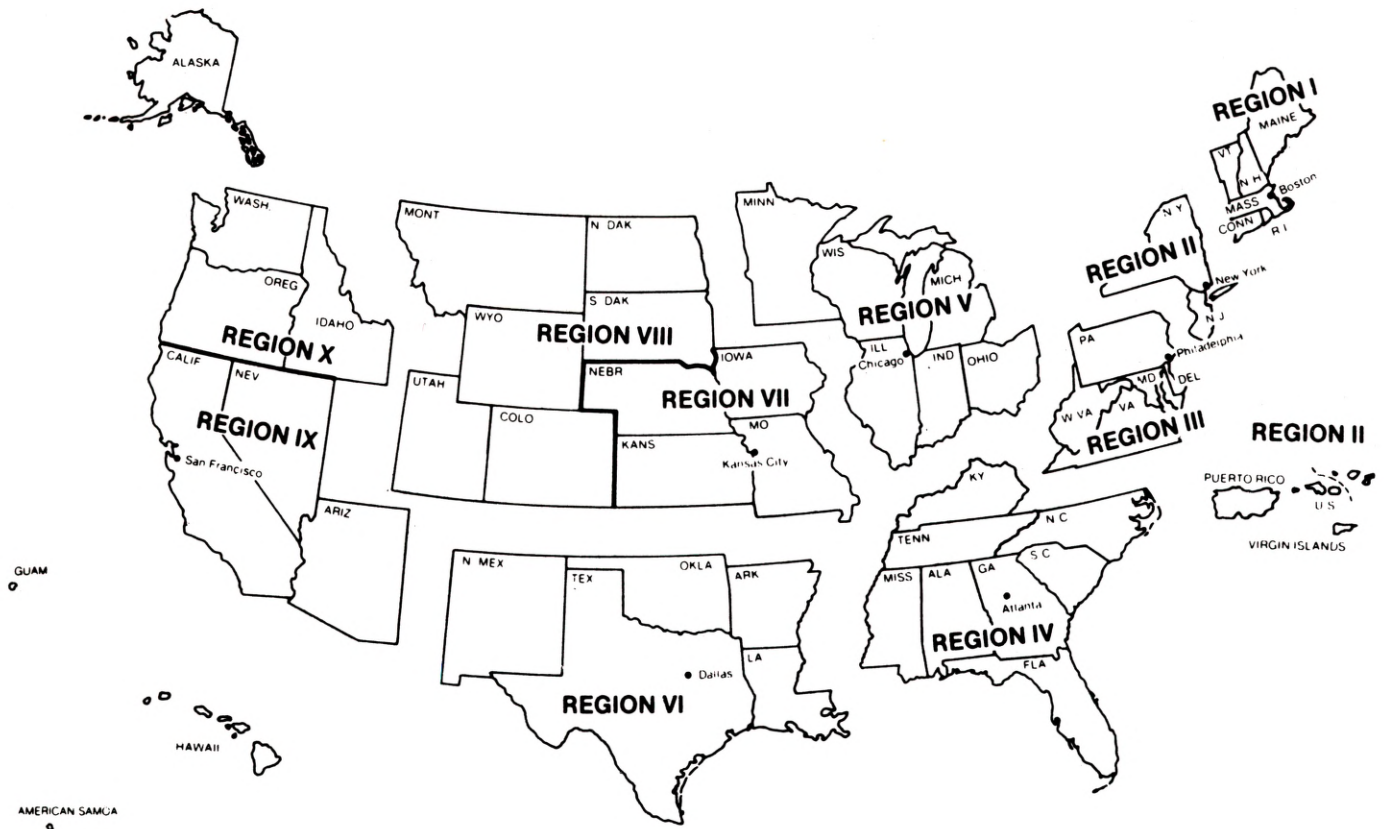
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