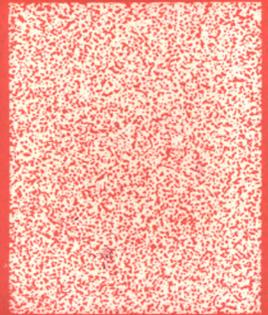


L 2.3:  
1613

**MOTOR VEHICLES AND EQUIPMENT  
INDUSTRY, 1957-66**



**INDEXES OF  
OUTPUT PER  
MAN-HOUR**

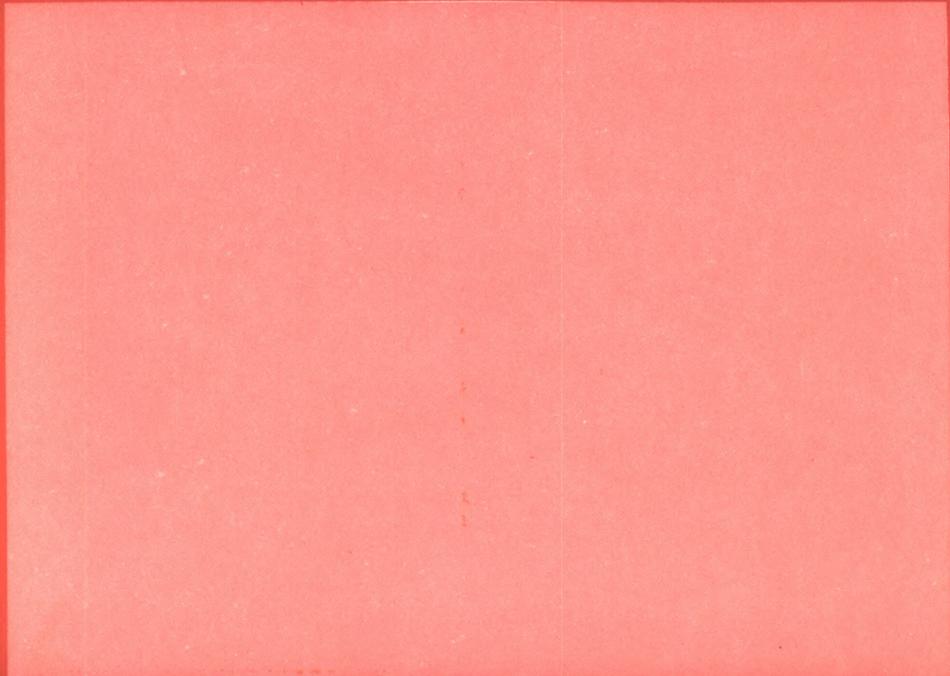
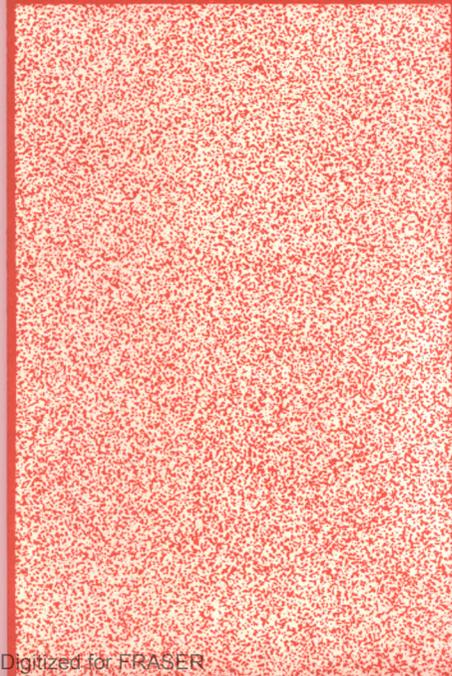
**BLS BULLETIN NO. 1613**

Dayton & Montgomery Co.  
Public Library

MAR 18 1969

DOCUMENT COLLECTION

U.S. DEPARTMENT OF LABOR  
BUREAU OF LABOR STATISTICS





**INDEXES OF OUTPUT  
PER MAN-HOUR**

**Motor Vehicles and Equipment  
Industry, 1957- 66**

December 1968

**U.S. DEPARTMENT OF LABOR  
BUREAU OF LABOR STATISTICS  
Ben Burdetsky, Acting Commissioner**





## Preface

The Bureau of Labor Statistics has been publishing reports on output per man-hour for selected industries for many years. The motor vehicles and equipment industry will be the most important of the published series in terms of the number of persons employed.

The problems of measurement in this report are complex in view of the industry structure, the range of products, and the rapidly changing product mix. As a result, the Bureau made extensive use of detailed information provided by the motor vehicles manufacturers to supplement regular sources of published information.

This study was prepared in the Office of Productivity, Technology and Growth, under the direction of Jerome A. Mark, Assistant Commissioner. The measures were prepared by Clyde Huffstutler, Jeffrey Hohenstein, and Edwin Adelman, of the Division of Industry Productivity Studies, under the direct supervision of Chester Myslicki, Chief. Arthur S. Herman of the Division of Technological Studies wrote the section relating to technological developments.



## CONTENTS

	Page
Introduction .....	1
Trends in output per man-hour, output and employment .....	2
Technological developments .....	14
Technical note .....	16
Definition of the industry .....	16
General procedures .....	17
Output indexes .....	17
Employment and man-hour indexes .....	21

### Tables:

#### Motor vehicles and equipment industry:

1. Output per man-hour, unit labor requirements, and related data, all employees, 1957-66 .....	4
2. Output per man-hour, unit labor requirements, and related data, production workers, 1957-66 .....	6
3. Output per man-hour, unit labor requirements, and related data, nonproduction workers, 1957-66 .....	8
4. General characteristics, selected years, 1957-66 .....	10
5. Distribution of U.S. automobile model year production by price group, car size, and body style, 1957-66 .....	12
6. Factory installations of selected equipment items (percentages), model years, 1957-66 .....	13

### Charts:

#### Motor vehicles and equipment industry:

1. Output per all employee man-hour, output, and all employee man-hours, 1957-66 .....	5
2. Output per production worker man-hour, output, and production worker man-hours, 1957-66 .....	7
3. Output per nonproduction worker worker man-hour, output, and nonproduction worker man-hours, 1957-66 .....	9
4. New plant and equipment expenditures for motor vehicles and equipment .....	11

### Appendixes:

A. Weighting diagram for the motor vehicles and equipment industry .....	23
B. Accessories covered in the optional equipment output index .....	24
C. Unit value weights used in compiling the truck trailer output index .....	25
D. Motor vehicles and equipment industry: Average annual rates of change (percent).....	27
Output per man-hour and related indexes	



INDEXES OF OUTPUT PER MAN-HOUR  
MOTOR VEHICLES AND EQUIPMENT INDUSTRY, 1957-66

Introduction

The efficient use of resources in the production of a nation's goods and services has long been recognized as the means to higher levels of economic well-being and national strength. One measure of change in resource use is productivity, and one form of productivity measurement is output per man-hour, which reflects the change in output (the quantity of goods produced) per unit of labor input.

Measures of output per man-hour for a specific industry are particularly useful for studying changes in manpower utilization, projecting future manpower requirements, analyzing trends in labor costs, comparing productivity progress among countries, examining the effects of technological developments on employment and unemployment, and analyzing related economic and industrial activities. Such analyses usually require that indexes of output per man-hour be used in conjunction with other industry data. For example, to study technological effects, related data on production and employment are useful; to study trends in labor costs, data on earnings and other labor expenditures are essential.

Although the measures relate output to one input--labor--they do not measure the specific contribution of labor, of capital, or of any other single factor. Rather, they reflect the joint effect of a number of interrelated influences such as changes in technology, capital investment per worker, utilization of capacity, layout and flow of operations, skill and effort of the work force, managerial skill, and labor-management relations.

In general, industry measures of output per man-hour are subject to certain qualifications. First, existing data techniques cannot fully take into account changes in the quality of goods produced. Second, although efforts are made to maintain consistency of coverage between the output and labor input estimates, some slight statistical differences may remain. Third, changes in the degree of plant integration and specialization are often not reflected adequately in the production statistics. Overstatement of productivity gains in some years and understatement in others may result. Fourth, year-to-year changes in output per man-hour are irregular and, therefore, not necessarily indicative of basic changes in long-term trends. Conversely, long-term trends are not necessarily applicable to any one year or to any period in the future. Because of these and other statistical limitations, these indexes cannot be considered precise measures; instead, they should be interpreted as general indicators of movements of output per man-hour.

This report includes new measures of output per man-hour for the motor vehicles and equipment industry. Included also is some analysis of the trends in output per man-hour and related series as well as a description of some of the technological developments that have occurred in the industry. Finally, there is a detailed technical note which describes the sources of data and the statistical techniques utilized.

## Trends in Output Per Man-Hour, Output, and Employment

Output per man-hour of all employees in the motor vehicles and equipment industry increased at an average rate of 4.8 percent per year between 1957 and 1966 (appendix D). <sup>1/</sup> The 1966 index of output per man-hour exceeded the 1957 level by over 45 percent (table 1). This annual rate of gain compares favorably with the 3.7 percent rate for manufacturing and the 3.4 percent rate for the entire private economy.

The gain in output per man-hour for the industry was closely related to the high rate of output increase. Over the 9-year period, total production of motor vehicles and equipment rose at an annual rate of 8.2 percent. The industry's growth rate was considerably above the 5.3 percent rate for manufacturing and the 4.4 percent rate for the private economy.

Major factors underlying output per man-hour movements are changes in output and in technology. Technological progress generally operates as a positive factor in good and bad years; in the automotive industry, its impact over the long run has been obscured by the effects of dramatic yearly fluctuations in output. (See p. 14 for a detailed discussion of technological developments in the industry.)

The automotive industry is particularly responsive to changes in general economic conditions; cyclical factors strongly influence production and consequently output per man-hour. Thus, productivity did not increase at a uniform rate: year-to-year changes ranged from a decline of 2.8 percent between 1957 and 1958 to an increase of approximately 10 percent between 1961 and 1962. The 1958 decline reflects a recession-induced production cutback of more than 25 percent. Correspondingly, the high increase in 1962 occurred when output rose over 25 percent in a strong rebound after another recession.

---

<sup>1/</sup> Average annual rates in this report are based on the linear least squares trend line fitted to the logarithms of the index numbers.

Business cycles were not the only factor in the short-term variations in output that explain much of the variation in the rate of productivity growth. For instance, strikes in the industry affected production in 1961 and 1964, as did the lengthy steel strike in 1959. Changes in the relative importance of imported cars have had a significant impact too. Imports took an increasing proportion of the automobile market until 1960, when the American industry introduced the compact car and the sale of imported cars dropped sharply. Over the next several years imports climbed back steadily; a sizable increase in sales occurred in 1966. (See table 4.) Customer response to style changes and the degree of inventory buildup also directly influenced the industry's production; thus, all of these factors helped determine variations in output per man-hour.

Cyclical factors probably account for the divergence in the relation between output and in output per man-hour that began in 1962. Output per man-hour rose an average of 6.7 percent a year from 1958 through 1962, but only 3.3 percent a year from 1962 through 1966. On the other hand, output rose almost as much in the later years--9.6 percent per year, as in the earlier years--9.7 percent per year.

Since the two periods began at different stages of the business cycle, changes in capacity utilization probably account for some of the decrease in the rate of productivity increase. The 1958-62 period not only followed the 1957-58 recession but also a peak automobile production year of 1955 and the peak employment year of 1953. Thus, the industry had both plant and labor reserves to draw on when production picked up. In contrast, the 1962-66 period started from a level of output 60 percent higher than that of 1958. The industry's productivity rate thus appears to follow a fairly typical pattern of more rapid increases in output per man-hour in the earlier stages of business expansion than in the later stages.

Although isolating the contributions of separate factors to changes in productivity is impossible, to some extent the lower productivity gains for the 1962-66 period reflect a change in the type of production. In contrast to the earlier period, when plainer, compact cars played an important role, car production after 1962 featured an increasing variety of models and equipment. (See tables 5 and 6.) Consequently, the industry had less opportunity to derive the benefits that result from a smooth workflow--including ease of mechanization.

A change in the industry's capital expenditures may have had an additional influence on output per man-hour. After the high levels of 1954-57, capital expenditures fell between 1958 and 1962 (chart 4). Establishing a direct relationship between changes in capital expenditures and in output per man-hour is difficult, but in many industries increases in the rate of productivity gain have followed periods of high capital expenditures. A lag appears between the time when expenditures for plant and equipment are made and when these facilities--which usually incorporate new technological advances--become fully operative. Similarly, cutbacks in the level of capital expenditures tend to retard the rate of productivity growth in subsequent years.

A further damper on the rate of growth in the later period may have occurred as the job market tightened. Both employment and man-hours fluctuated widely between 1957 and 1962, but their net effect was a small decline in both figures. After 1962, employment rose 5.8 percent a year, total man-hours 6.2 percent. As employment expanded, overtime hours increased, the quit rate rose, skill shortages occurred, and employers hired new inexperienced workers.

Clearly, cyclical factors had the most important effect on changes in output per man-hour during the period studied--not only for automotive employees in general, but also for production workers. The production worker output per man-hour index, increasing at an average of 4.5 percent a year, was both smaller and steadier than the all employee measure. It was steadier because production worker man-hours tend to follow changes in output more closely than nonproduction worker man-hours do. It was smaller because the high and continuing increase in output caused a slightly faster rate of increase of man-hours and employment for production than for nonproduction workers. Thus, a turnaround occurred in the post-war decline of production workers as a percentage of all automotive employment.

Table 1. Motor Vehicles and Equipment Industry:  
Output Per Man-Hour, Unit Labor Requirements, and Related Data,

All Employees, 1957-66

(Indexes, 1957-59=100)

Year	Output per--		Unit labor requirements for--		Related data		
	All employee	All employee man-hour	All employees	All employee man-hours	Output	All employees	All employee man-hours
1957 ....	99.2	98.7	100.8	101.4	110.7	111.6	112.2
1958 ....	94.1	95.9	106.3	104.2	82.8	88.0	86.3
1959 ....	106.1	104.9	94.3	95.3	106.5	100.4	101.5
1960 ....	114.9	113.9	87.1	87.8	120.6	105.0	105.9
1961 ....	114.1	115.3	87.7	86.7	104.6	91.7	90.7
1962 ....	131.9	126.7	75.8	78.9	132.3	100.3	104.4
1963 ....	137.5	131.6	72.7	76.0	147.8	107.5	112.3
1964 ....	139.5	133.0	71.7	75.2	152.3	109.2	114.5
1965 ....	152.2	141.8	65.7	70.5	186.0	122.2	131.2
1966 ....	150.2	143.4	66.6	69.7	187.1	124.6	130.5

Source: Output based on data from company records; Automobile Manufacturers Association; Automobile Invoice Service Company; Automobile Pricing Publications, Inc.; National Automobile Dealers Used Car Guide Company; Powers and Co., Inc. (Ward's Automotive Yearbooks); Bureau of the Census, U.S. Department of Commerce; Bureau of Labor Statistics, U.S. Department of Labor. Employment and man-hours based on data from the Bureau of Labor Statistics, U.S. Department of Labor, and company records.

Chart 1.

## MOTOR VEHICLES AND EQUIPMENT INDUSTRY

Output Per All Employee Man-Hours, Output,  
and All Employee Man-Hours, 1957-66

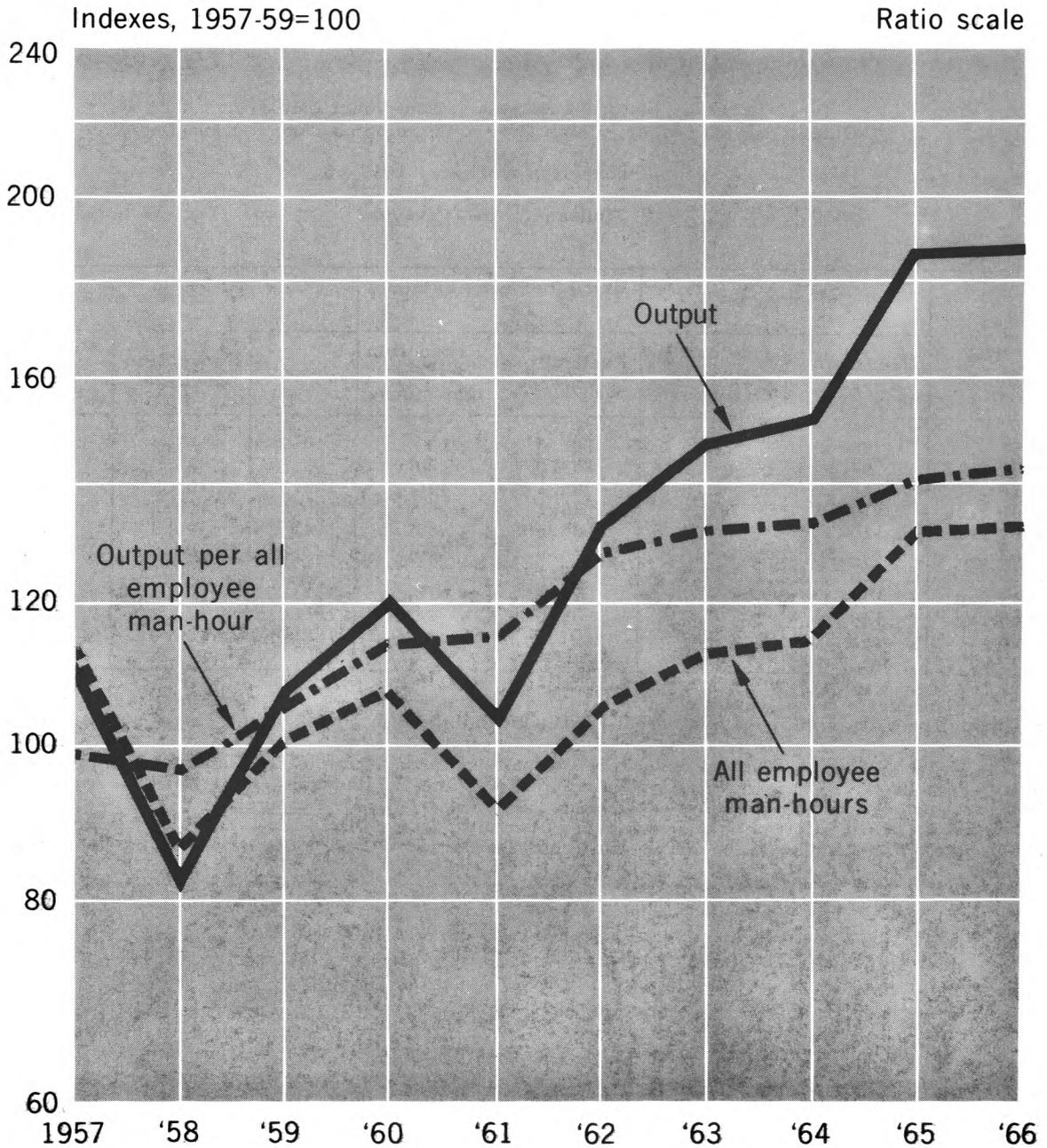


Table 2. Motor Vehicles and Equipment Industry:  
Output Per Man-Hour, Unit Labor Requirements, and Related Data,  
Production Workers, 1957-66  
(Indexes, 1957-59=100)

Year	Output per--		Unit labor requirements for--		Related data		
	Production worker	Production worker man-hour	Production workers	Production worker man-hours	Output <sup>1</sup>	Production workers	Production worker man-hours
1957 ....	97.6	96.9	102.4	103.2	110.7	113.4	114.2
1958 ....	97.1	99.4	103.0	100.6	82.8	85.3	83.3
1959 ....	105.1	103.9	95.1	96.2	106.5	101.3	102.5
1960 ....	113.6	112.5	88.1	88.9	120.6	106.2	107.2
1961 ....	115.8	117.4	86.3	85.2	104.6	90.3	89.1
1962 ....	131.5	125.0	76.0	80.0	132.3	100.6	105.8
1963 ....	136.7	129.8	73.1	77.1	147.8	108.1	113.9
1964 ....	139.5	131.7	71.7	75.9	152.3	109.2	115.6
1965 ....	149.8	137.7	66.8	72.6	186.0	124.2	135.1
1966 ....	148.5	141.0	67.3	70.9	187.1	126.0	132.7

<sup>1</sup>The measures of output used in this table represent the total production of the industry resulting from all employees and do not represent the specific output of any single group of employees.

Source: Output based on data from company records; Automobile Manufacturers Association; Automobile Invoice Service Company; Automobile Pricing Publications, Inc.; National Automobile Dealers Used Car Guide Company; Powers and Co., Inc. (Ward's Automotive Yearbooks); Bureau of the Census, U.S. Department of Commerce; Bureau of Labor Statistics, U.S. Department of Labor. Employment and man-hours based on data from the Bureau of Labor Statistics, U.S. Department of Labor.

Chart 2.

## MOTOR VEHICLES AND EQUIPMENT INDUSTRY

Output Per Production Worker Man-Hour, Output, and Production Worker Man-Hours, 1957-66

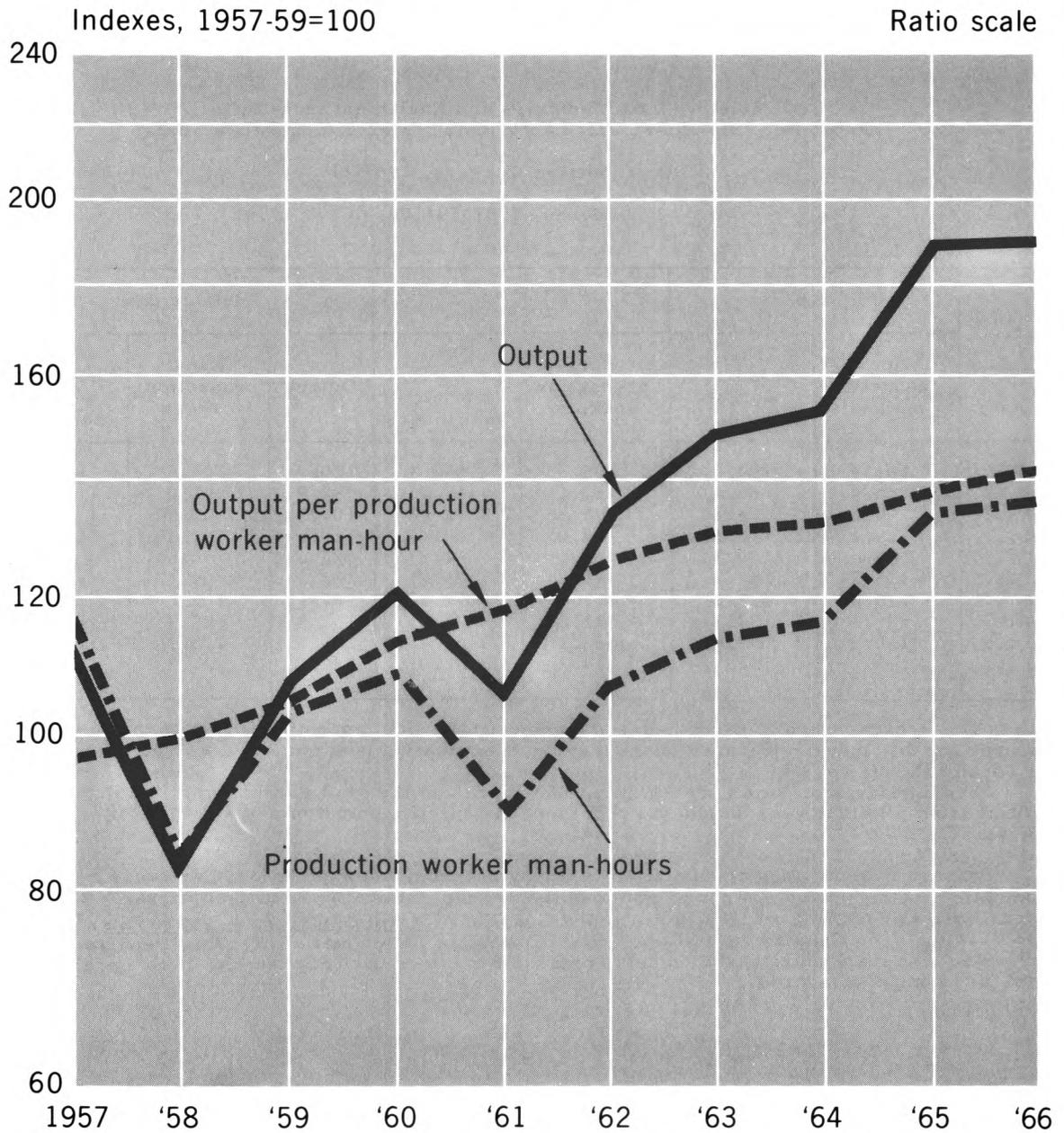


Table 3. Motor Vehicles and Equipment Industry:  
Output Per Man-Hour, Unit Labor Requirements, and Related Data,  
Nonproduction Workers, 1957-66  
(Indexes, 1957-59=100)

Year	Output per--		Unit labor requirements for--		Related data		
	Non-production worker	Non-production worker man-hour <sup>1</sup>	Non-production workers	Non-production worker man-hours <sup>1</sup>	Output <sup>2</sup>	Non-production workers	Non-production worker man-hours <sup>1</sup>
1957 . . . .	104.9	(104.6)	95.3	( 95.6)	110.7	105.5	(105.8)
1958 . . . .	85.4	( 86.4)	117.1	(115.7)	82.8	97.0	( 95.8)
1959 . . . .	109.2	(108.2)	91.5	( 92.4)	106.5	97.5	( 98.4)
1960 . . . .	119.1	(118.5)	84.0	( 84.4)	120.6	101.3	(101.8)
1961 . . . .	108.4	(109.3)	92.3	( 91.5)	104.6	96.5	( 95.7)
1962 . . . .	133.2	(132.2)	75.1	( 75.7)	132.3	99.3	(100.1)
1963 . . . .	140.0	(138.0)	71.4	( 72.5)	147.8	105.6	(107.1)
1964 . . . .	139.2	(137.1)	71.8	( 72.9)	152.3	109.4	(111.1)
1965 . . . .	160.8	(157.0)	62.2	( 63.7)	186.0	115.7	(118.5)
1966 . . . .	155.7	(151.7)	64.2	( 65.9)	187.1	120.2	(123.3)

<sup>1</sup>The figures shown in parentheses are subject to a wider margin of error than are other measures for this industry because of the method of estimating nonproduction worker man-hours. (See Technical Note, p. 22.)

<sup>2</sup>The measures of output used in this table represent the total production of the industry resulting from all employees and do not represent the specific output of any single group of employees.

Source: Output based on data from company records; Automobile Manufacturers Association; Automobile Invoice Service Company; Automobile Pricing Publications, Inc., National Automobile Dealers Used Car Guide Company; Powers and Co., Inc. (Ward's Automotive Yearbooks); Bureau of the Census, U.S. Department of Commerce; Bureau of Labor Statistics, U.S. Department of Labor. Employment and man-hours based on data from the Bureau of Labor Statistics, U.S. Department of Labor, and company records.

Chart 3.

### MOTOR VEHICLES AND EQUIPMENT INDUSTRY

Output Per Nonproduction Worker Man-Hour, Output, and Nonproduction Worker Man-Hours, 1957-66

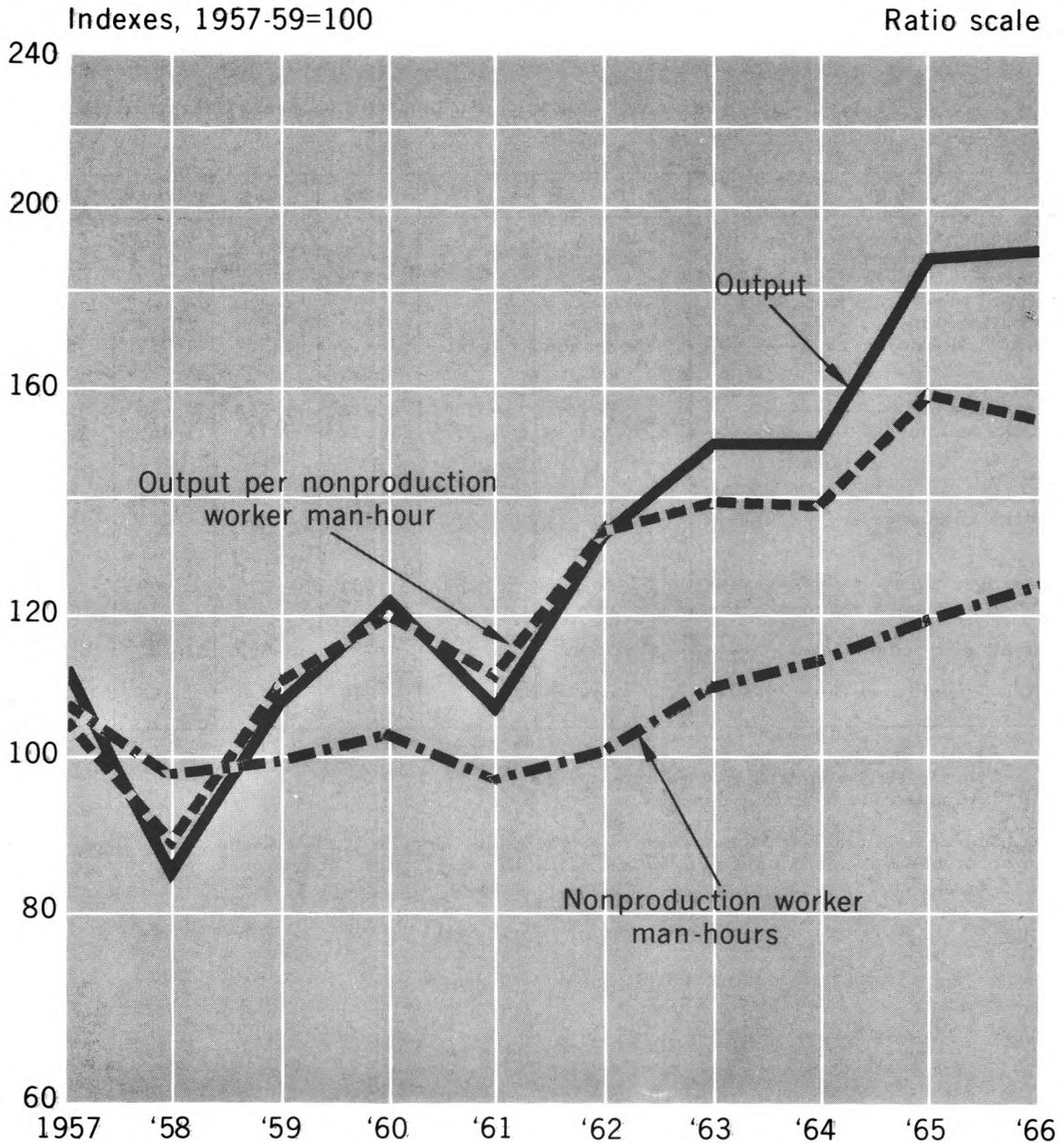


Table 4. Motor Vehicles and Equipment Industry: General Characteristics,  
Selected Years, 1957-66

Item	Unit	1957	1958	1961	1963	1965	1966
Establishments -----	Number	( <sup>1</sup> )	2, 292	( <sup>1</sup> )	2, 765	( <sup>1</sup> )	( <sup>1</sup> )
Total employment -----	Thousands	769.3	606.5	632.3	741.3	842.7	859.2
Production workers -----	-do-	601.7	452.5	479.1	573.6	658.9	668.4
Ratio of production workers to all employees -----	Percent	78.2	74.6	75.8	77.4	78.2	77.8
Nonproduction workers -----	Thousands	167.6	154.0	153.2	167.7	183.8	190.8
Factory Sales:							
Passenger cars -----	-do-	6, 113	4, 258	5, 543	7, 638	9, 306	8, 598
Trucks and buses -----	-do-	1, 107	877	1, 134	1, 463	1, 752	1, 731
Exports:							
Passenger cars -----	-do-	161	126	140	<sup>2</sup> 194	<sup>2</sup> 205	<sup>2</sup> 261
Trucks and buses -----	-do-	212	179	209	<sup>2</sup> 146	<sup>2</sup> 136	<sup>2</sup> 125
Imports:							
Passenger cars -----	-do-	259	431	279	409	559	913
Trucks and buses -----	-do-	8	15	9	18	31	57
Value added by manufacture <sup>3</sup> ----	\$million	<sup>2</sup> 8, 577	6, 781	8, 860	12, 781	16, 450	16, 086
Capital expenditures (new) -----	-do-	( <sup>1</sup> )	343	426	655	1, 251	1, 177

<sup>1</sup> Not available.

<sup>2</sup> Not strictly comparable with other years.

<sup>3</sup> Adjusted for inventory changes.

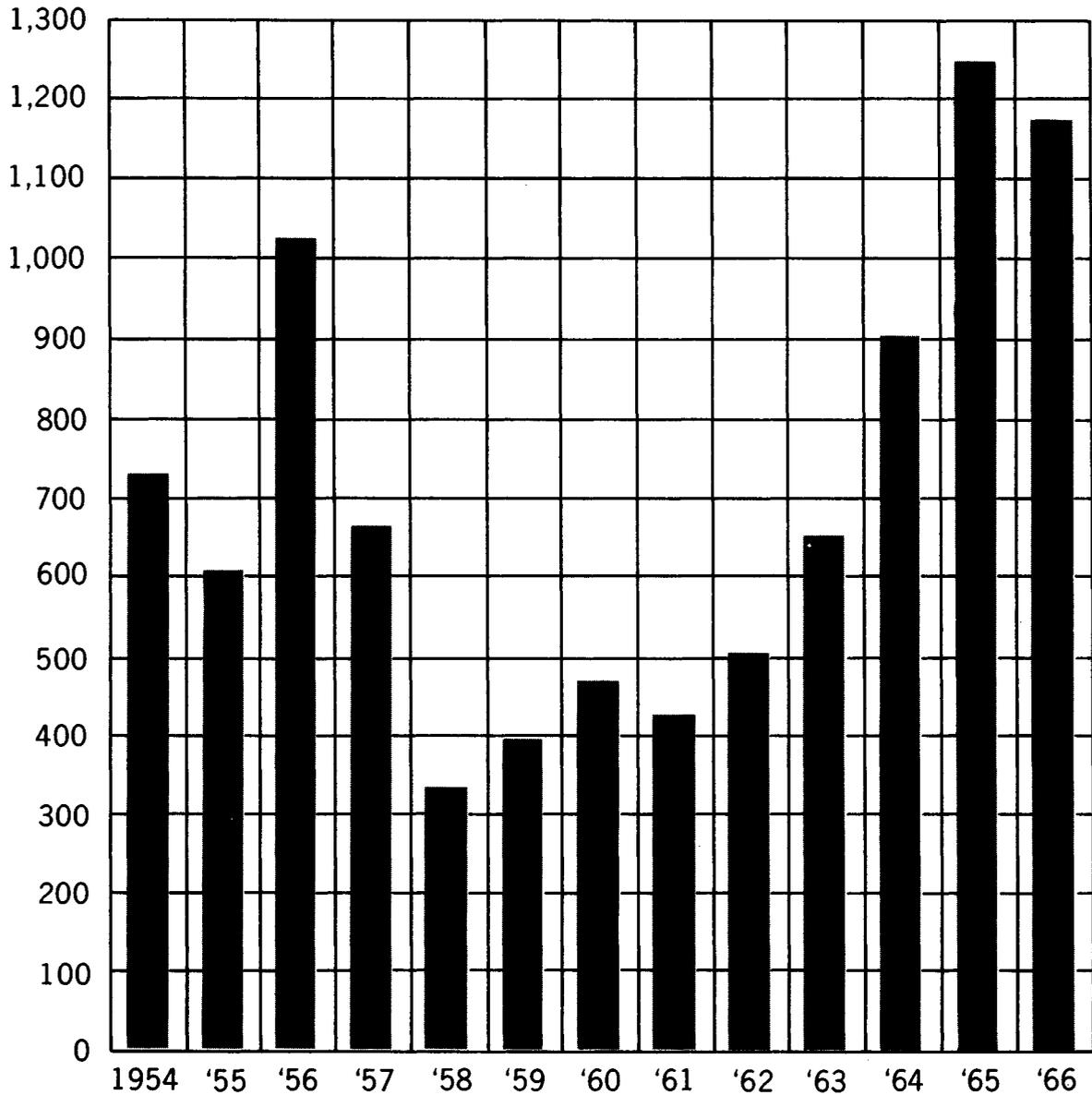
Source: Automobile Manufacturers Association, Bureau of the Census, U.S. Department of Commerce, and Bureau of Labor Statistics, U.S. Department of Labor.

**Chart 4.**

**NEW PLANT AND EQUIPMENT EXPENDITURES FOR MOTOR  
VEHICLES AND EQUIPMENT**

**1954-66**

(Millions \$)



Note: Data for 1956, 1957, 1959, and 1960 not strictly comparable with other years.

Source: Bureau of the Census, U.S. Department of Commerce.

Table 5. Distribution of U.S. Automobile Model Year Production by Price Group, Car Size, and Body Style, 1957-66

(Data Expressed as Percent of Total)

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
U.S. auto production (thousands)	6, 212	4, 260	5, 568	6, 011	5, 409	6, 687	7, 340	7, 891	8, 843	8, 606
Auto production by price group										
\$2, 000 or less -----	( <sup>1</sup> )	10.6	3.4	17.9	19.7	19.3	15.8	8.1	5.6	3.0
2, 001 - 2, 500 -----	( <sup>1</sup> )	58.5	53.5	46.4	48.0	47.9	50.0	40.5	41.8	37.5
2, 501 - 3, 000 -----	( <sup>1</sup> )	18.3	29.9	24.4	22.0	21.9	22.9	39.0	39.3	43.1
3, 001 - 3, 500 -----	( <sup>1</sup> )	6.2	6.3	5.5	3.4	3.6	4.1	5.3	6.5	8.3
3, 501 and over -----	( <sup>1</sup> )	6.4	6.9	5.8	6.9	7.3	7.2	7.1	6.8	8.1
Auto production by car size										
Luxury -----	3.7	3.9	3.4	2.9	3.5	3.0	2.8	2.7	2.8	3.1
Medium -----	27.0	23.6	22.4	19.7	16.4	17.9	18.4	16.9	18.4	19.0
Regular -----	67.4	67.4	67.0	49.9	42.6	39.5	41.1	36.0	35.5	31.8
Intermediate -----	--	--	--	4.6	9.6	13.5	13.6	20.0	22.2	26.0
Compacts -----	1.9	5.1	7.2	22.9	26.3	25.0	23.2	17.9	12.5	8.5
Specialty -----	--	--	--	--	1.6	1.1	0.9	6.5	8.6	11.6
Auto production by body style										
Sedans										
2-door -----	<sup>2</sup> 16.4	16.2	15.7	16.4	17.5	17.3	13.8	11.7	7.9	6.7
4-door -----	32.6	34.2	34.8	40.2	39.5	37.5	36.1	33.7	30.6	27.9
Convertibles										
2-door -----	4.4	4.4	4.6	4.7	4.8	5.9	6.6	6.3	5.7	4.9
4-door -----	--	--	--	--	0.1	0.1	0.1	--	--	--
Hardtops										
2-door -----	18.3	16.9	14.0	11.9	11.0	15.5	20.5	26.4	33.8	37.4
4-door -----	14.6	13.0	14.0	11.4	11.1	9.9	9.8	10.0	11.0	12.5
Wagons										
2-door -----	3.2	2.3	2.7	1.9	1.2	0.5	0.3	0.1	0.2	--
4-door 2-seat -----	} 10.4	} 13.0	11.7	10.9	12.3	11.0	10.3	9.2	8.0	7.4
4-door 3-seat -----			2.4	2.6	1.8	1.7	2.0	2.2	2.3	2.7
5-6 door -----	<sup>3</sup> 0.1	--	--	--	0.7	0.6	0.5	0.4	0.5	0.5

<sup>1</sup> Not available.

<sup>2</sup> Includes business coupe and club coupe.

<sup>3</sup> Miscellaneous.

Note: Sums of individual items may not equal totals because of rounding.

Source: Ward's Automotive Yearbook.

Table 6. Factory Installations of Selected Equipment Items, Model Years, 1957-66

(Percent)

Equipment	1957 <sup>1</sup>	1958 <sup>1</sup>	1959	1960	1961	1962	1963	1964	1965	1966
Automatic transmission-----	75	77	75.1	71.6	72.8	74.1	75.6	77.5	80.7	83.6
Manual transmission, 3 speed-----	} 25	} 23	} 20.8	} 25.7	} 25.3	} 24.5	} 23.1	16.8	14.3	11.6
Manual transmission, 4 speed-----								4.6	5.0	4.8
Overdrive transmission-----								4.1	2.6	1.9
V-8 engine -----	--	--	71.8	56.7	52.9	55.6	62.2	69.0	73.4	80.0
6-cylinder engine -----	--	--	28.3	43.3	45.3	42.0	36.6	31.0	26.6	20.0
4-cylinder engine -----	--	--	( <sup>2</sup> )	( <sup>2</sup> )	1.8	2.5	1.2	--	--	--
Power brakes -----	29	31	29.5	32.4	22.8	25.7	27.2	34.0	32.3	35.3
Power steering -----	33	36	42.9	39.2	38.4	42.7	47.7	51.9	59.6	66.6
Power windows -----	6	8	6.3	6.3	6.9	9.8	12.2	13.0	14.3	13.7
Power seats -----	7	11	5.9	6.3	6.4	6.4	7.3	7.4	7.2	8.1
Radio -----	85	81	58.8	56.4	55.3	59.6	61.6	64.4	74.2	78.9
Air conditioning -----	4	5	6.2	6.9	8.1	11.3	14.0	17.1	23.3	29.3
Locking differential -----	--	--	--	3.5	( <sup>2</sup> )	4.6	5.5	6.7	1.6	8.5
Movable steering wheel -----	--	--	--	--	--	--	2.5	5.2	4.0	6.1
Disc brakes -----	--	--	--	--	--	--	--	--	2.2	2.9
Tape recorder -----	--	--	--	--	--	--	--	--	--	1.0

<sup>1</sup> Data not comparable to later years.

<sup>2</sup> Not available.

Source: Based on data from Automobile Facts and Figures.

## Technological Developments

Although changes in output greatly influence short-run movements in output per man-hour, long-term trends are affected by additional, interrelated factors--changes in technology, capital investment, research and development, skill and effort of the work force, managerial ability, and labor-management relations. Changes in technology are especially important, although the precise effect on output per man-hour cannot be measured.

The industry had been involved in a substantial program of modernization during the 1962-66 period. A 1966 McGraw-Hill Survey <sup>2/</sup> indicates that the industry's producing facilities five years old or less increased from 29 percent in 1961 to 58 percent in 1966, the highest proportion of new equipment reported by any manufacturing industry in that year. Moreover, 25 percent of the industry's capital spending in 1965 was for automated machinery and equipment, well above the average for all manufacturing.

Important technological changes have been taking place in almost all phases of motor vehicles manufacture--designing, machining, inspection, assembly, and data processing. Many of these changes are designated to meet the need of greater flexibility in production techniques brought about by the large number of different automobile models and accessory items being manufactured. The use of most of these innovations, however, is still quite limited and their future diffusion will depend on such nontechnical factors as market prospects, competitive conditions, union attitudes, capital requirements, and character of management. Information on some of the more important technical developments that have been taking place in the industry, obtained from a review of annual reports of corporations and trade and technical publications, is presented below.

### Advances in Machining

In machining, a significant number of numerically controlled machine tools have been in-

stalled. This technique, consisting of automatic operation and control of machine tools by electronic devices and coded tape instructions, is suitable particularly for small volume production. Because of greater accuracy in reproduction of parts and elimination of jigs and fixtures, numerical control has been applied in the auto industry largely to increase efficiency in manufacture of the many tools and dies needed by the industry for the large number of automobile models produced. Numerical control is also being used increasingly to produce small volume parts and in combination with conventional machine tools on transfer lines to increase their flexibility.

Electrical discharge and electrochemical machining techniques, which apply electrical energy to shape metal parts, provide much closer tolerances than conventional techniques, and reduce much of the time and hand labor formerly needed. Electrical discharge machining is used mainly for tool and die production; electrochemical machining is being applied to debur parts and to a limited extent to produce actual parts.

New transfer lines permit greater product flexibility and more efficient operations than older equipment by incorporating multipurpose machines, which, can produce a number of variations of a given part with minimum adjustment. These lines feature automatic work handling devices, and built-in storage areas for parts in process which allow shutdown and maintenance of individual stations without stopping the whole line. The number of automatic operations performed on transfer lines, including time consuming functions such as gaging and inspection has been increasing.

---

<sup>2/</sup> Data from this survey include investments made in some automotive stamping plants that are classified outside of the motor vehicles and equipment industry.

## Use of Computers

Over 400 computers are being used for such applications as accounting, payrolls, inventory control, and for scientific, engineering, and manufacturing functions. In the final assembly line operation computer systems match parts of different models, styles, and colors of motor vehicles. This procedure permits smaller parts inventories, warns of interruption of parts flow, and adjusts the model mix to provide more efficient assembly operations. Computer assembly line applications also provide daily work schedules, on-line quality control, and reports of bad assemblies to repairmen. In some cases computers are connected to gages and equipment on the lines to directly monitor operations. Computer applications in other areas of manufacturing monitor and control individual and banks of production machines, check automatic transmissions, and test completed automobiles for safety, quality, and air pollution control.

Advanced techniques, incorporating computers, which reduce the lead time between design and production of individual automobile models, have been gaining acceptance for engineering and design functions. Computers are useful in solving complex engineering problems that previously would have taken many computational man-hours. New techniques to increase designer and draftsmen productivity include computer aided design techniques and digitizing drafting machines, which translate auto body contour drawings into numbers and record points on tape used on numerically controlled drafting machines to produce perspective drawings. Another system consists of a contour scanner using a TV camera which records data from clay models. The data are fed into a computer which produces tapes for numerically controlled die making machines to speed up greatly the design cycle.

## New Materials

New and substitute materials for motor vehicle manufacture include plastics for numerous components ranging from grilles to rear fender extensions. Injection molded plastic parts, such as instrument panels and inner fender panels, have been substituted increasingly for die cast metal parts. They reduce the amount of labor needed for parts production and assembly since they are generally molded in one piece and require fewer finishing operations. They also provide substantial weight savings and reduction in the number of dies needed. Aluminum is being substituted for iron and steel in making gear housings, rocker arm covers, and components of accessory options such as power steering, power brake units, and air conditioners. Crankshafts and connecting rods, formerly produced as steel forgings, are now made of nodular iron castings which reduce man-hours in subsequent processing. Zinc die castings, stainless steel, fiber glass, and adhesive for bonding are some other new materials.

## Mechanization of Assembly

Automatic assembly machines, which can perform screwdriving, nut running, riveting, feeding and aligning operations, reduce unit labor requirements in the assembly of large volume, fixed design parts, such as door locks and brake components. Automatic assembly may improve product quality, increase production speed, and reduce inventories.

Major subassemblies, such as different horsepower V-8 engines, are produced containing numerous interchangeable parts. This technique allows a number of different subassemblies to be built using the same production equipment, reduces drastically the number of different parts to be manufactured, allows longer production runs for individual components, simplifies assembly operations, and reduces the inventory of parts needed for service.

Definition of the Industry

The motor vehicles and equipment group, as defined in this report, is based on the 1967 Standard Industrial Classification, (SIC) Group No. 371. <sup>3/</sup> This consists of the 4-digit industries defined in the following paragraphs. For each industry, an alphabetical list of the principal products appears in the SIC manual.

1. Motor Vehicles (SIC 3711)

Establishments primarily engaged in manufacturing or assembling complete passenger automobiles, trucks, commercial cars and buses (except trackless trolleys--Industry 3742), and special purpose motor vehicles such as ambulances and fire engines.

2. Passenger Car Bodies (SIC 3712)

Establishments primarily engaged in manufacturing passenger car bodies, but not engaged in manufacturing complete passenger automobiles. (Establishments primarily engaged in manufacturing stamped body parts for passenger cars are classified in Industry 3461.)

3. Truck and Bus Bodies (SIC 3713)

Establishments primarily engaged in manufacturing truck and bus bodies, for sale separately or for assembly on purchased chassis. (Establishments primarily engaged in manufacturing stamped body parts for trucks and buses are classified in Industry 3461.)

---

<sup>3/</sup> 1967 Standard Industrial Classification Manual, U.S. Bureau of the Budget. Some industry sources have recommended expanding the definition to include all automotive stamping plants. At present, only those plants producing automobile bodies as final products or considered integral parts of motor vehicle establishments are included.

4. Motor Vehicle Parts and Accessories (SIC 3714)

Establishments primarily engaged in manufacturing motor vehicle parts and accessories, but not engaged in manufacturing complete motor vehicles. (Establishments primarily engaged in manufacturing tires and tubes are classified in Industry 3011, automobile glass in Major Group 32, automobile stampings in Industry 3461, vehicular lighting equipment in Industry 3642, ignition systems in Industry 3694, and storage batteries in Industry 3691.)

In addition to the specific exclusions noted above, a considerable number of components, parts, and accessories for motor vehicles are classified in other SIC industries, and are based on the characteristic of the product itself, rather than the specific application. The U.S. Bureau of the Census lists some of these other important exclusions: <sup>4/</sup> automotive hardware, SIC 3429; diesel and semidiesel engines, SIC 3519; sealed beam and other electric lamps, SIC 3641; automobile radios, SIC 3651; and carburetors and pistons, SIC 3599.

5. Truck Trailers (SIC 3715)

Establishments primarily engaged in manufacturing truck trailers and truck trailer chassis for sale separately, but not engaged in manufacturing complete trucks and buses.

One of the data sources for this report is the Census of Manufactures of the U.S. Bureau of the Census. In collecting and publishing statistics for this group, the Bureau of the Census has combined SIC industries 3711, 3712, and 3714 into Census code 3717 - Motor Vehicles and Parts. This grouping was made because large establishments which have integrated operations produce parts or bodies as well as assemble complete vehicles. This complexity in the structure of the industry group has prevented the development of output per man-hour indexes for the component 4-digit industries.

---

<sup>4/</sup> 1963 Census of Manufactures.

## General Procedures

The indexes for the motor vehicles and equipment industry presented in this report were developed according to the general procedures followed by the Bureau of Labor Statistics for deriving industry output per man-hour indexes. For an industry producing a single homogeneous product, the indexes measure the change over a period of time in the ratio of the number of units produced to the number of man-hours expended. For an industry producing many products, such as the motor vehicles and equipment industry, the indexes measure the change in the ratio of a composite of the products appropriately weighted to the man-hours. To derive the output per man-hour index, an output index is developed and is divided by the corresponding man-hour index.

To construct industry output per man-hour measures, the preferred output index is obtained by weighting the quantities of the industry's products by the average man-hours required to produce one unit of each product in a specified year. Thus, those products which require more labor time are given more importance in the output index. For the automotive industry, however, unit man-hour data are not available for most of the products and the substitution of weights which are assumed to be proportional to unit man-hours was necessary. Both unit value and unit value added weights were used as substitutes.

## Output Indexes

The output index for the motor vehicles and equipment industry was constructed by computing indexes for three major component industries and combining these indexes with aggregate man-hour weights. <sup>5/</sup> The three industries within the group are (1) Motor Vehicles and Parts

(SIC Codes 3711, 3712, 3714--Census Code 3717), (2) Truck and Bus Bodies (SIC 3713), and (3) Truck Trailers (SIC 3715). 1958 man-hours based primarily upon published BLS data supplemented by special BLS surveys were used as weights for 1957-63; from 1963 forward, 1963 man-hours were used. The motor vehicles and parts index represented about 94 percent of the total weight in the output index for the group; the remaining weights were divided between truck and bus bodies and truck trailers. (See appendix A.)

### A. Motor Vehicles and Parts (SIC 3711, 12, 14--Census Code 3717)

To obtain the output index for this industry group, separate indexes were constructed for (1) passenger cars and equipment, (2) trucks and buses, and (3) replacement parts and accessories. These indexes were combined with 1958 aggregate value of shipments weights for 1957-63 and 1963 weights for 1963 and subsequent years. The value of shipments data were obtained from the 1963 Census of Manufacturers. Although combining these indexes with total man-hour weights would have been desirable, separate man-hour data for each of these product groupings were not available.

#### (1) Passenger Cars and Equipment

The output index for passenger cars and equipment, which represents about three fourths of the motor vehicles and parts industry, was derived by combining two production indexes: One for passenger cars with standard equipment and another for optional equipment. These two indexes were combined with base year (1958 and 1963) aggregate value weights derived from detailed production and unit value data.

#### Passenger Cars with Standard Equipment.

The output index for this component of the industry was derived by removing from the change in current value of passenger car production the change in prices. To obtain a base year weighted production index consistent with the other segments of the output index, the index of current value of production should be divided by a current year weighted price index as noted in the following formulation:

---

<sup>5/</sup> This procedure is equivalent to combining quantities of products with unit man-hour weights.

Value of produc- ÷ Price index = Output index  
tion index (Paasche) (Laspeyres)

$$\frac{\sum P_i Q_i}{\sum P_o Q_o} \div \frac{\sum P_i Q_i}{\sum P_o Q_i} = \frac{\sum P_o Q_i}{\sum P_o Q_o}$$

where P represents prices, Q quantities and subscripts i and o refer to current and base year values, respectively.

The current value of production for each year was calculated by multiplying calendar year production of passenger cars (including standard equipment) for approximately 500 product classifications 6/ by the introductory wholesale price for each classification as reported in the New Car Cost Guide. 7/ Prices exclude excise taxes and freight charges.

The price index used for this industry was prepared especially for this report and is based on the data and techniques underlying the development of the BLS Wholesale Price Index for Passenger Cars, WPI 14-11-01. The differences from the published index essentially reflect exclusion of imported cars and use of current year weights rather than base year weights. November data were used as the best match for the introductory prices used for current valuations.

Each of the specified domestic car models which were priced for the Wholesale Price Index for a given period was selected to represent a broader range of models so that all domestically produced cars would be included either directly or indirectly. Thus, for 1966 the price index for a priced model was usually given a weight that reflected not only the value of production of all models which have the same nameplate but also the value of production of unpriced nameplates made by the same company.

---

6/ Detailed production breakdown was received directly from automotive manufacturers.

7/ Automobile Invoice Service Company, a division of the Chek-Chart Corporation, Chicago, Illinois.

The list of cars selected for pricing changed frequently during the 1957-66 period to reflect changing models, increased coverage, and shifts in the volume sellers. Price imputation patterns were shifted concurrently. The price indexes related to the selected models were adjusted for differences in quality, i.e., for additional features and product improvement or deterioration. 8/

An effort was made to derive a physical production measure for passenger cars with standard equipment by utilizing detailed data on calendar year production of automobile by nameplate (Chevrolet, Buick, Dodge, etc.) model (Bel Air, Galaxie 500, etc.), body style (convertible, 2 door hardtop, etc.) and number of cylinders. This detail resulted in approximately 500 separate product classifications each year. For the base years of 1958 and 1963, these automobile types were grouped by unit values into weight classes with \$100 class intervals. For later years the current models were compared with the base year models. If a new model was introduced or if the specifications (including standard equipment) were changed significantly, an appropriate base year weight class had to be determined. The comparability of the current models was determined after examination of data from several sources including wholesale values and specification changes from New Car Cost Guide and Official Used Car Guide 9/, BLS Wholesale Price Indexes, and a special listing made by the automobile manufacturers of the models they considered generally equivalent from year to year. The volume and complexity of the annual changes taking place in passenger car production meant that the determinations of appropriate weight classes were often subjective and could lead to a serious bias. As a result of these difficulties, a more accurate index could be obtained by analyzing the information available

8/ For further detail on the techniques and guidelines used in adjustments for quality changes, see Margaret S. Stotz, "Introductory Prices of 1966 Automobile Models," Monthly Labor Review, February 1966.

9/ National Automobile Dealers Used Car Guide Company, Washington, D. C.

on the price and quality changes for the sample cars selected for the BLS Wholesale Price Index and assuming that the price movements of the individual cars, properly weighted, would represent all cars.

Ideally, the output index should be unit man-hour weighted. Since the passenger car with standard equipment accounts for about 60 percent of the total weight, a partial check was made on the validity of the assumption that unit man-hours weights tend to be proportional to unit value weights. A special examination of unpublished data from both the 1958 and 1963 Census of Manufactures was made for establishments both specializing in automotive assembly and fabrication and highly integrated, i.e., value added was more than 75 percent of the value of shipments. A regression equation was developed from the weighted establishment averages for unit values and unit man-hours. The relative weights obtainable from the relevant range of unit values corresponded fairly closely with relative weights derived from the unit man-hours developed from the regression equation.

Optional Equipment. This output index was based on production of the major items of non-standard equipment installed by the motor vehicles and equipment industry plus an estimate for all other optional equipment. The total items covered directly ranged from 13 in 1957 to 23 in 1966. Production of equipment after 1957 was linked into the index if these items had been available previously to customers but not counted due to lack of adequate information or relative unimportance. The 1957-63 output index was based on the annual production of 13 to 17 items. (See appendix B for list.) The 1963-66 index was based on 17 to 23 major items.

Actual calendar year production data were available from 1957 to 1963 for automatic transmissions, power steering, and power brakes from Ward's Automotive Yearbooks. <sup>10/</sup> For the other accessories, production was estimated

---

<sup>10/</sup> Powers and Company, Inc., Detroit, Michigan.

by applying model year installation percentages, from Ward's, to the calendar year production data for cars. Installation percentages include both standard and optional equipment. Therefore, standard equipment, as determined from New Car Cost Guide and Auto Bluebook, <sup>11/</sup> was subtracted from the total installed equipment.

The weights for the optional equipment items were derived from 1958 (1963) wholesale prices for each auto series (Fairlanes, Tempests, Valiants, etc.), from New Car Cost Guide. When a choice of prices existed for the same item, the most popular type of equipment was selected. These are used directly as weights for equipment classified as primary products of the industry since they are produced largely by establishments classified in the motor vehicles and equipment group. A fraction of the wholesale price was used as a weight for those items classified as primary products of other industries to represent the installation costs incurred by the industry. <sup>12/</sup> This weight was based on unpublished special analyses of installation costs provided by the motor vehicle manufacturers.

When an accessory was introduced as a new item or on an auto series for the first time, a 1958 (1963) unit value weight was derived from the price trend of a similar item or from the price trend of an item from the most closely related series.

The estimate for all other optional equipment items was based on a comparison between maximum value of optional equipment items per car <sup>13/</sup> and maximum value of major items per

---

<sup>11/</sup> Currently known as the Complete Automobile Pricing Manual published by Automobile Pricing Publications, Inc., Burlingame, California.

<sup>12/</sup> Items such as tinted glass and white wall tires, which require no additional man-hours by the industry, are not covered.

<sup>13/</sup> Only those items were considered which were either produced in the industry or had significant installation costs.

car for the passenger car models priced for the price indexes. A weighted ratio was used to adjust a production index based on the major items only. The list of available equipment for the sample cars and the related prices were determined from the New Car Cost Guide. The estimated value of the optional items not covered directly ranged from 20 to 25 percent of the total optional equipment index. Many implicit assumptions were involved in this type of estimate; representativeness of sample, comparability of installation percentages and charges between covered and uncovered items, and similarity of price movements. The overall weight of the uncovered sector represents less than 3 percent of the total index of the motor vehicles and equipment index.

The same adjustment factor for noncovered optional items was used to blow up value of production figures for covered optional equipment items for both 1958 and 1963 to provide weights for combining the optional equipment index with the index for passenger cars (including standard equipment).

## (2) Trucks and Buses

The output index for trucks and buses is based on the deflated value of shipments for these two product groups. The current dollar value of shipments for truck tractors, truck chassis, and trucks is converted into a constant dollar series by using a deflator composed of BLS Wholesale Price Indexes 14-1 (Motor Vehicles and Equipment) and 14-11-02 (Motor Trucks). These WPI's were combined with value of shipments weights from the 1963 Census of Manufactures. Similarly, the shipments data for buses and fire department vehicles were deflated using BLS Wholesale Price Index 14-11-03 (Motor Coaches).

Annual shipments data were obtained from the Census of Manufactures and Annual Survey of Manufactures.

## (3) Replacement Parts and Accessories

This index reflects the production of parts and accessories for passenger cars, trucks, and buses shipped to other than domestic motor

vehicle manufacturers. (Parts and accessories shipped to or produced by motor vehicle manufacturers are included directly or indirectly in other output indexes.) Rebuilt motor vehicle engines and parts also are included. The shipments cover export shipments as well as shipments to distributors, dealers, wholesalers, service stations, etc.

The output index was based on the total value of shipments of motor vehicle parts and accessories shipped to other than domestic motor vehicle manufacturers (Census code 37176), plus rebuilt motor vehicle engines and parts (Census code 37177), as deflated by BLS Wholesale Price Index 14-1, (Motor Vehicles and Equipment). Only those parts and accessories which are classified in SIC 371 were included. (See page 16 for definition.) Value data for 1958-63 were taken from the 1963 Census of Manufactures. An estimate was made for 1957 based on the 1957-58 percentage change in value of sales of replacement parts and accessories as published by the Automobile Manufacturers Association in Automobile Facts and Figures. These data were adjusted by BLS to include exports and to exclude replacement batteries. Value data for years subsequent to 1963 were taken from the Annual Survey of Manufactures.

To combine this index with other components of industry 3717, base year (1958 and 1963) Census values for codes 37176 plus 37177 were used as weights. The industry value was used for 1963, and the product value (wherever made) was used for 1958.

## B. Truck and Bus Bodies (code 3713)

The output index for truck and bus bodies was based on the value of output expressed in constant 1958 (1963) dollars. The value of output was derived from data on (1) the industry value of shipments of truck and bus bodies, converted to constant dollars plus (2) the net change in the value of finished goods inventories, also in constant dollars. Value data were from the Census of Manufactures and the Annual Survey of Manufactures.

Industry value of shipments for 1957, 1958, and 1963 exclude resales; value of shipments for 1959-62 as it appears in the Census of Manufactures includes resales. To exclude resales from the data for intercensal years, the 1958 and 1963 ratios of value of shipments without resales to value of shipments with resales were used to interpolate the 1959-62 value of shipments excluding resales. For intercensal years after 1963, the 1963 ratio was used to adjust value of shipments.

Annual value of shipments was deflated by a special industry price index constructed from the yearly averages of BLS Wholesale Price Index 14-11-02 (Motor Trucks) and BLS Wholesale Price Index 14-11-03 (Motor Coaches). In combining the commodity price indexes into an industry price index, the weight assigned to WPI 14-11-02 was equal to the 1958 (1963) total value of shipments and interplant transfers of all truck bodies, shipped by all manufacturing establishments; the weight assigned to WPI 14-11-03 was equal to the 1958 (1963) total value of shipments and interplant transfers of all bus bodies. Value of shipments weights were from the 1963 Census of Manufactures.

Beginning-of-year and end-of-year values of finished goods inventories were deflated by a special price index constructed from the December figures of WPI 14-11-02 and WPI 14-11-03. The commodity price indexes were combined into an industry price index by using the method described in the preceding paragraph.

### C. Truck Trailers (code 3715)

The output index for truck trailers was constructed from data on the annual physical quantities of trailers produced, as published in the Current Industrial Reports series of the Bureau of the Census. Product detail is by use (e.g., insulated vans, high pressure tanks, dump trailers, etc.) and material (steel and aluminum). For 1957-63, each product was weighted by its 1958 unit value. (See appendix C.) Unit values were derived from Census of Manufactures data by dividing the total value of shipments and interplant transfers by the total quantity of shipments and interplant transfers for each product.

For 1963-66, output was measured by the quantity of units shipped since actual production figures are not available after 1963. No inventory adjustment was made, but inventories have not been significant for this industry. <sup>14/</sup> At the same time, product detail was revised and reduced. Also, 1963 unit value weights were used for this period.

### Employment and Man-Hour Indexes

Employment and man-hour indexes measure the change in aggregate number of employees or man-hours over a period of time. Employees and employee man-hours are treated as homogeneous and additive. Changes in qualitative aspects of employment such as skill, efficiency, health, experience, age, and sex of persons comprising the aggregate are not reflected in the indexes. The man-hour data relate to total time expended by employees in establishments classified in the industry group. These data include not only the hours spent on primary activities of the establishment, but also those on other activities and miscellaneous operations. Paid time for vacations, holidays, or sick leave when the employee is not at the plant also is included.

Six labor input indexes were developed for the motor vehicles and equipment group for 1957-66: All employees, production workers, nonproduction workers, man-hours of all employees, man-hours of production workers, and man-hours of nonproduction workers.

"Production workers" cover working foremen and all nonsupervisory workers (including leadmen and trainees) engaged in fabricating, processing, assembling, inspection, receiving, storage, handling, packing, warehousing, shipping, trucking, hauling, maintenance, repair,

---

<sup>14/</sup> The 1964 Current Industrial Reports for truck trailers states: "Data on the number of units produced, collected for prior years, were eliminated in 1964 in recognition of the fact that in this industry no great time difference occurs between products (sic) and shipments."

janitorial, watchman services, product development, auxiliary production for plant's own use (e.g., power plant operations), and recordkeeping and other services closely associated with the above production operations. The term thus includes some indirect as well as direct plant labor.

"Nonproduction workers" include employees engaged in the following activities: Executive, purchasing, finance, accounting, legal, personnel, cafeterias, medical, professional and technical activities, sales, sales-delivery (e.g., routemen), advertising, credit, collection, and in installation and servicing of own products, routine office function, factory supervision (above the working foreman level); and force account construction employees on the payroll engaged in construction of major additions or alterations to the plant who are utilized as a separate work force.

Employment and man-hour indexes for the motor vehicles and equipment industry group were derived from data published by the Bureau of Labor Statistics in Employment and Earnings Statistics for the United States, 1909-1936 and subsequent monthly issues of Employment and Earnings and Monthly Report on the Labor Force.

Employment and Production Worker Man-Hours. Employment indexes are based on BLS data for the motor vehicles and equipment industry group (SIC 371). These are 12-month averages of persons who worked full- or part-time or received pay for any part of the payroll period which includes the 12th of each month.

Man-hour indexes for production workers are based on production worker employment and average weekly hours data published by the BLS. Man-hours include all the hours at the plant plus all paid time for vacations, holidays, disability time, and personal time off, when the employee is not at the plant. Overtime and other premium pay hours are included on the basis of actual time at the plant.

All Employee Man-Hours. The index of all employee man-hours is derived from three components: (1) production worker man-hours, derived from BLS data; (2) number of nonproduction workers, derived from BLS data; and (3) an estimate of average annual paid hours of nonproduction workers derived from special confidential company studies. For consistency with production worker man-hours, these data also include time paid for vacations, holidays, disability time, and personal time off.

Appendix A. Weighting Diagram for the Motor Vehicles  
and Equipment Industry

(Weights Expressed as Percent of Total)

Output Components	Weights (Percent)		Type of index <sup>1</sup>
	1958	1963	
Motor vehicles and equipment index -----	100.0	100.0	
(A) Motor vehicles and parts -----	93.1	92.9	
(1) Passenger cars and equipment --	68.8	70.4	
(a) Passenger cars and standard equipment -----	59.0	61.2	DV
(b) Optional equipment -----	9.8	9.2	PP
(2) Trucks and buses -----	15.2	14.9	DV
(3) Replacement parts and accessories -----	9.1	7.6	DV
(B) Truck and bus bodies -----	4.2	4.2	DV
(C) Truck trailers -----	2.7	2.9	PP

<sup>1</sup> DV = Deflated value; PP = Physical production.

Notes: Indexes of (A), (B) and (C) are combined with man-hour weights.  
 (A) (1), (2) and (3) are combined with value of shipments weights.  
 (A) (1) (a) and (b) are combined with value of production weights.

See text for fuller explanation.

Source: Bureau of Labor Statistics, U.S. Department of Labor.

Appendix B. Accessories Covered in the Optional  
Equipment Output Index

Items primarily classified and installed in the motor vehicles and  
equipment industry:

	Automatic transmission
	Power brakes
	Power steering
	Overdrive
	Window washer
	Heater
	Limited-slip differential
	4-speed synchromesh transmission
	Electric wipers
Added after 1963:	Disc brakes
	Speed regulating device
	Movable steering
	Vinyl tops

Items primarily classified outside but installed by the motor vehicles and  
equipment industry:

	Air conditioner
	Radio
	Power windows
	Power seats (2-, 4-, and 6-way)*
	Backup lights
	Power antenna
	Bucket seats
Added in 1963:	Rear power window, station wagons

\*After 1963, power seats are separated into 2-way, and 4- and  
6-way seats.

**Appendix C. Unit Value Weights Used in Compiling the  
Truck Trailer Output Index (SIC 3715)**

Product group	Unit value weights	
	1958	1963
I. Complete trailers -----		
A. Vans -----		
1. Insulated, semi-insulated and refrigerated -----		
Steel -----	\$ 7,464	\$ 5,525
Aluminum -----	7,697	8,293
2. Furniture -----		
Steel -----	4,372	} 5,577
Aluminum -----	4,612	
3. Other closed top vans -----		
Steel -----	4,664	4,541
Aluminum -----	6,031	5,167
4. Open top vans -----		
Steel -----	4,616	4,864
Aluminum -----	5,495	5,244
B. Tanks -----		
1. Petroleum and aircraft refuelers -----		
Carbon and alloy steel -----	6,508	} 9,010
Stainless steel -----	11,233	
Aluminum -----	9,174	
2. Chemical, food, and sanitary -----	11,026	11,262
3. Dry materials and other low pressure tanks -----	8,743	9,527
4. High pressure -----	11,779	13,297
C. Pole and logging -----		
1. Single axle -----	1,333	} 3,674
2. Tandem axle -----	3,535	
D. Platform -----		
1. Racks, livestock, and stake -----	4,546	} 3,820
2. Grain bodies -----	3,465	
3. Other platforms -----	3,432	
E. Low-bed heavy haulers -----	4,250	4,559

Appendix C. Unit Value Weights Used in Compiling the  
Truck Trailer Output Index (SIC 3715) — Continued

Product group	Unit value weights	
	1958	1963
F. Dump trailers <sup>1</sup> -----	\$ 4,474	\$ 5,666
G. All other trailers -----	4,681	} 3,089
II. Trailer chassis only, for sale separately <sup>2</sup> -----	2,578	
III. Detachable trailer van bodies, for sale separately -----	3,645	3,445

<sup>1</sup> Includes dump trailer chassis in 1963.

<sup>2</sup> Includes dump trailer chassis in 1958.

Source: 1963 Census of Manufactures, table 6A.

APPENDIX D. MOTOR VEHICLES AND EQUIPMENT INDUSTRY  
AVERAGE ANNUAL RATES OF CHANGE (PERCENT)<sup>1</sup>

(To obtain annual rate of change between any 2 years shown, find row for initial year at left of table and read figure in that row under the terminal year shown on top.)

Output per All Employee Man-Hour

Initial year	Terminal year								
	1958	1959	1960	1961	1962	1963	1964	1965	1966
1957....	-2.8	3.1	5.3	5.0	5.5	5.6	5.2	5.1	4.8
1958....	---	9.4	8.9	6.5	6.7	6.4	5.7	5.4	5.0
1959....	---	---	8.5	4.8	6.0	5.8	5.0	4.9	4.6
1960....	---	---	---	1.3	5.5	5.4	4.5	4.6	4.2
1961....	---	---	---	---	9.9	6.8	4.8	4.7	4.2
1962....	---	---	---	---	---	3.9	2.5	3.5	3.3
1963....	---	---	---	---	---	---	1.1	3.8	3.3
1964....	---	---	---	---	---	---	---	6.6	3.8
1965....	---	---	---	---	---	---	---	---	1.1

Output

Initial year	1958	1959	1960	1961	1962	1963	1964	1965	1966
1957....	-25.2	-1.9	5.2	2.7	5.0	6.6	6.9	8.1	8.2
1958....	---	28.6	20.7	8.6	9.6	10.2	9.6	10.4	10.1
1959....	---	---	13.2	-0.9	5.2	7.8	7.8	9.3	9.1
1960....	---	---	---	-13.3	4.7	8.8	8.5	10.2	9.8
1961....	---	---	---	---	26.5	18.9	13.2	13.8	12.0
1962....	---	---	---	---	---	11.7	7.3	11.1	9.7
1963....	---	---	---	---	---	---	3.0	12.2	9.5
1964....	---	---	---	---	---	---	---	22.1	10.8
1965....	---	---	---	---	---	---	---	---	0.6

All employee man-hour

Initial year	1958	1959	1960	1961	1962	1963	1964	1965	1966
1957....	-23.1	-4.9	-0.1	-2.2	-0.5	1.0	1.7	2.8	3.2
1958....	---	17.6	10.8	1.9	2.7	3.6	3.8	4.7	4.8
1959....	---	---	4.3	-5.5	-0.7	1.9	2.7	4.2	4.4
1960....	---	---	---	-14.4	-0.7	3.2	3.8	5.4	5.3
1961....	---	---	---	---	15.1	11.3	8.0	8.7	7.5
1962....	---	---	---	---	---	7.6	4.7	7.3	6.2
1963....	---	---	---	---	---	---	2.0	8.1	6.0
1964....	---	---	---	---	---	---	---	14.6	6.8
1965....	---	---	---	---	---	---	---	---	-0.5

See footnote at end of table.

APPENDIX D. MOTOR VEHICLES AND EQUIPMENT INDUSTRY--Continued  
 AVERAGE ANNUAL RATES OF CHANGE (PERCENT)<sup>1</sup>

(To obtain annual rate of change between any 2 years shown, find row for initial year at left of table and read figure in that row under the terminal year shown on top.)

Output per All Employee

Initial year	Terminal year								
	1958	1959	1960	1961	1962	1963	1964	1965	1966
1957.....	-5.1	3.4	5.8	4.9	6.1	6.4	6.0	6.1	5.7
1958.....	---	12.7	10.5	6.8	7.8	7.5	6.8	6.7	6.1
1959.....	---	---	8.3	3.7	6.7	6.8	6.0	6.1	5.5
1960.....	---	---	---	-0.7	7.2	7.1	5.9	6.0	5.3
1961.....	---	---	---	---	15.6	9.8	6.7	6.5	5.3
1962.....	---	---	---	---	---	4.2	2.8	4.5	3.7
1963.....	---	---	---	---	---	---	1.4	5.2	3.6
1964.....	---	---	---	---	---	---	---	9.1	3.8
1965.....	---	---	---	---	---	---	---	---	-1.3

All employees

Initial year	Terminal year								
	1958	1959	1960	1961	1962	1963	1964	1965	1966
1957.....	-21.1	-5.2	-0.5	-2.1	-1.0	0.2	0.8	1.9	2.4
1958.....	---	14.1	9.2	1.7	1.7	2.5	2.7	3.5	3.8
1959.....	---	---	4.6	-4.4	-1.4	0.9	1.7	3.0	3.5
1960.....	---	---	---	-12.7	-2.3	1.6	2.4	3.9	4.3
1961.....	---	---	---	---	9.4	8.3	6.1	6.8	6.3
1962.....	---	---	---	---	---	7.2	4.3	6.3	5.8
1963.....	---	---	---	---	---	---	1.6	6.6	5.7
1964.....	---	---	---	---	---	---	---	11.9	6.8
1965.....	---	---	---	---	---	---	---	---	2.0

Output per production worker man-hour

Initial year	Terminal year								
	1958	1959	1960	1961	1962	1963	1964	1965	1966
1957.....	2.5	3.5	5.0	5.2	5.4	5.3	5.0	4.8	4.5
1958.....	---	4.5	6.4	6.0	6.0	5.7	5.1	4.8	4.5
1959.....	---	---	8.3	6.3	6.2	5.7	4.9	4.6	4.3
1960.....	---	---	---	4.4	5.4	5.0	4.2	4.1	3.8
1961.....	---	---	---	---	6.5	5.1	3.9	3.8	3.5
1962.....	---	---	---	---	---	3.8	2.6	3.1	3.0
1963.....	---	---	---	---	---	---	1.5	3.0	3.0
1964.....	---	---	---	---	---	---	---	4.5	3.4
1965.....	---	---	---	---	---	---	---	---	2.4

See footnote at end of table.

APPENDIX D. MOTOR VEHICLES AND EQUIPMENT INDUSTRY--Continued  
 AVERAGE ANNUAL RATES OF CHANGE (PERCENT)<sup>1</sup>

(To obtain annual rate of change between any 2 years shown, find row for initial year at left of table and read figure in that row under the terminal year shown on top.)

Production Worker Man-Hours

Initial year	Terminal year								
	1958	1959	1960	1961	1962	1963	1964	1965	1966
1957.....	-27.1	-5.3	0.2	-2.4	-0.4	1.2	1.9	3.1	3.5
1958.....	---	23.0	13.4	2.5	3.4	4.3	4.3	5.3	5.3
1959.....	---	---	4.6	-6.8	-0.9	2.0	2.8	4.5	4.7
1960.....	---	---	---	-16.9	-0.7	3.6	4.0	5.9	5.7
1961.....	---	---	---	---	18.7	13.1	8.9	9.6	8.1
1962.....	---	---	---	---	---	7.7	4.5	7.8	6.4
1963.....	---	---	---	---	---	---	1.5	8.9	6.3
1964.....	---	---	---	---	---	---	---	16.9	7.1
1965.....	---	---	---	---	---	---	---	---	-1.8

Output per production worker

Initial year	Terminal year								
	1958	1959	1960	1961	1962	1963	1964	1965	1966
1957.....	-0.6	3.8	5.5	5.1	6.2	6.3	6.0	6.0	5.5
1958.....	---	8.3	8.2	6.3	7.3	7.1	6.5	6.3	5.7
1959.....	---	---	8.0	5.0	7.2	7.0	6.2	6.0	5.4
1960.....	---	---	---	2.0	7.6	7.1	5.9	5.8	5.0
1961.....	---	---	---	---	13.5	8.6	6.1	5.9	4.8
1962.....	---	---	---	---	---	4.0	3.0	4.2	3.4
1963.....	---	---	---	---	---	---	2.0	4.7	3.2
1964.....	---	---	---	---	---	---	---	7.4	3.2
1965.....	---	---	---	---	---	---	---	---	-0.8

Production workers

Initial year	Terminal year								
	1958	1959	1960	1961	1962	1963	1964	1965	1966
1957.....	-24.8	-5.5	-0.2	-2.3	-1.1	0.3	0.9	2.0	2.5
1958.....	---	18.8	11.6	2.2	2.2	2.9	3.0	3.8	4.1
1959.....	---	---	4.8	-5.6	-1.8	0.8	1.5	3.1	3.6
1960.....	---	---	---	-15.0	-2.7	1.6	2.4	4.2	4.5
1961.....	---	---	---	---	11.4	9.4	6.6	7.5	6.8
1962.....	---	---	---	---	---	7.5	4.2	6.6	6.1
1963.....	---	---	---	---	---	---	1.0	7.2	6.1
1964.....	---	---	---	---	---	---	---	13.7	7.4
1965.....	---	---	---	---	---	---	---	---	1.4

See footnote at end of table.

APPENDIX D. MOTOR VEHICLES AND EQUIPMENT INDUSTRY--Continued  
 AVERAGE ANNUAL RATES OF CHANGE (PERCENT)<sup>1</sup>

(To obtain annual rate of change between any 2 years shown, find row for initial year at left of table and read figure in that row under the terminal year shown on top.)

Output per Nonproduction Worker Man-Hour

Initial year	Terminal year								
	1958	1959	1960	1961	1962	1963	1964	1965	1966
1957....	-17.4	1.7	6.2	4.1	5.8	6.2	5.8	6.2	5.8
1958....	---	25.2	17.1	8.3	9.0	8.5	7.3	7.4	6.7
1959....	---	---	9.5	0.5	5.3	6.1	5.4	6.0	5.5
1960....	---	---	---	-7.7	5.6	6.7	5.4	6.3	5.5
1961....	---	---	---	---	20.9	12.4	7.5	7.9	6.3
1962....	---	---	---	---	---	4.4	1.8	5.2	4.1
1963....	---	---	---	---	---	---	-0.7	6.6	4.3
1964....	---	---	---	---	---	---	---	14.5	5.2
1965....	---	---	---	---	---	---	---	---	-3.3

Nonproduction worker man-hours

Initial year	Terminal year								
	1958	1959	1960	1961	1962	1963	1964	1965	1966
1957....	-9.5	-3.6	-0.9	-1.4	-0.7	0.3	1.1	1.8	2.2
1958....	---	2.7	3.1	0.3	0.6	1.6	2.2	2.8	3.1
1959....	---	---	3.5	-1.4	-0.1	1.5	2.3	3.1	3.5
1960....	---	---	---	-6.0	-0.8	2.0	2.9	3.7	4.0
1961....	---	---	---	---	4.6	5.8	5.3	5.5	5.3
1962....	---	---	---	---	---	7.0	5.4	5.6	5.3
1963....	---	---	---	---	---	---	3.7	5.2	5.0
1964....	---	---	---	---	---	---	---	6.7	5.3
1965....	---	---	---	---	---	---	---	---	4.0

Output per nonproduction worker

Initial year	Terminal year								
	1958	1959	1960	1961	1962	1963	1964	1965	1966
1957....	-18.6	2.0	6.5	4.1	5.9	6.4	6.1	6.5	6.2
1958....	---	28.0	18.1	8.4	9.2	8.9	7.7	7.8	7.1
1959....	---	---	9.0	-0.4	5.1	6.3	5.6	6.4	5.9
1960....	---	---	---	-9.0	5.8	7.2	5.8	6.8	6.0
1961....	---	---	---	---	22.9	13.6	8.3	8.7	7.0
1962....	---	---	---	---	---	5.1	2.2	5.7	4.6
1963....	---	---	---	---	---	---	-0.5	7.2	4.7
1964....	---	---	---	---	---	---	---	15.5	5.7
1965....	---	---	---	---	---	---	---	---	-3.2

See footnote at end of table.

APPENDIX D. MOTOR VEHICLES AND EQUIPMENT INDUSTRY--Continued  
 AVERAGE ANNUAL RATES OF CHANGE (PERCENT)<sup>1</sup>

(To obtain annual rate of change between any 2 years shown, find row for initial year at left of table and read figure in that row under the terminal year shown on top.)

Nonproduction workers									
Initial year	Terminal year								
	1958	1959	1960	1961	1962	1963	1964	1965	1966
1957....	-8.1	-3.9	-1.2	-1.3	-0.8	0.1	0.8	1.5	1.9
1958....	---	0.5	2.2	0.2	0.4	1.2	1.8	2.4	2.7
1959....	---	---	3.9	-0.5	0.1	1.4	2.1	2.7	3.1
1960....	---	---	---	-4.7	-1.0	1.5	2.5	3.2	3.5
1961....	---	---	---	---	2.9	4.6	4.5	4.7	4.7
1962....	---	---	---	---	---	6.3	5.0	5.1	4.8
1963....	---	---	---	---	---	---	3.6	4.7	4.5
1964....	---	---	---	---	---	---	---	5.8	4.8
1965....	---	---	---	---	---	---	---	---	3.9

<sup>1</sup> All average annual rates of change are based on the linear least squares trends of the logarithms of the index numbers.

OTHER RECENT BLS PUBLICATIONS ON PRODUCTIVITY  
AND AUTOMATION

Indexes of Output Per Man-Hour--

- Selected Industries, 1939 and 1947-67 (Bulletin 1612). October 1968. 102 pp. 65 cents.
- Air Transportation Industry, 1947-64 (Report 308). August 1966. 14 pp. (Free).
- Aluminum Rolling and Drawing Industry, 1958-65 (Report 314). December 1966. 20 pp. (Free).
- Concrete Products Industry, 1947-63 (Report 300). November 1965. 20 pp. (Free).
- Footwear Industry, 1947-63. July 1965. 17 pp. (Free).
- Gas and Electric Utilities Industry, 1932-62. April 1964. 19 pp. (Free).
- Hosiery Industry, 1947-64. (Report 307). June 1966. 22 pp. (Free).
- Man-Made Fibers Industry, 1957-63. October 1965. 20 pp. (Free).
- Primary Aluminum Industry, 1947-62. September 1964. 15 pp. (Free).
- Radio and Television Receiving Sets Industry, 1958-66. November 1968. 27 pp. (Free).
- Labor Productivity of the Steel Industry in the United States (Report 310). July 1966. 36 pp. (Free).
- Productivity: A Bibliography, July 1966. (Bulletin 1514). 129 pp. 65 cents.
- Industry Productivity Projections, A Methodological Study. 1966. 5 pp. (Free).
- Indexes of Output Per Man-Hour, Hourly Compensation, and Unit Labor Costs in the Manufacturing Sector, 1947-66. June 1967. 2 pp. (Free).
- Indexes of Output Per Man-Hour for the Private Economy, 1947-67. March 1968. 5 pp. (Free).
- Indexes of Output Per Man-Hour, Hourly Compensation, and Unit Labor Costs in the Private Sector of the Economy and the Nonfarm Sector, 1947-67. May 1968. 4 pp. (Free).

Implications of Automation and Other Technological Developments

- Technology and Manpower in the Textile Industry of the 1970's (Bulletin 1578, 1968). 60 cents.
- Manpower Planning for Technological Change: Case Studies of Telephone Operators (Bulletin 1574, 1968). 34 pp. 30 cents.
- Job Redesign for Older Workers, Ten Case Studies (Bulletin 1523, 1967). 63 pp. 40 cents.
- Technological Trends in Major American Industries (Bulletin 1474, 1966). 71 pp. 45 cents.
- Technological Change and Disemployment of Labor at the Establishment Level. 1966. 17 pp. (Free).
- Impact of Office Automation in the Insurance Industry (Bulletin 1468, 1966). 71 pp. 45 cents.
- Manpower Planning to Adapt to New Technology at an Electric and Gas Utility (Report 293, 1965). 25 pp. (Free).
- Outlook for Numerical Control of Machine Tools: A Study of a Key Technological Development in Metalworking Industries (Bulletin 1437, 1965). 63 pp. 40 cents.

Labor and Material Requirements for--

- School Construction (Bulletin 1586, 1938). 23 pp. 30 cents.
- Private One-Family House Construction (Bulletin 1404, 1964). 37 pp. 30 cents.
- Public Housing Construction (Bulletin 1402, 1964). 42 pp. 30 cents.
- College Housing Construction (Bulletin 1441, 1965). 34 pp. 30 cents.
- Sewer Works Construction (Bulletin 1490, 1966). 31 pp. 30 cents.
- Construction of Federally Aided Highways, 1958, 1961, and 1964. (Report 299, 1966). 17 pp. (Free).

Sales publications may be purchased from the Superintendent of Documents, Washington, D.C. 20402, or from regional offices of the Bureau of Labor Statistics at the addresses shown below. Free publications are available as long as the supply lasts, from the Bureau of Labor Statistics, U.S. Department of Labor, Washington, D.C. 20212.

Regional Offices

Region I  
Federal Building  
Room 1603-A  
Government Center  
Boston, Mass. 02203

Region II  
341 Ninth Avenue  
New York, N. Y. 10001

Region III  
Jefferson Building  
Room 818  
1915 Chestnut Street  
Philadelphia, Pa. 19107

Region IV  
1371 Peachtree Street, NE  
Suite 540  
Atlanta, Ga. 30309

Region V  
219 South Dearborn Street  
Chicago, Ill. 60603

Region VI  
911 Walnut Street  
10th Floor  
Kansas City, Mo. 64106

Region VII  
Mayflower Building  
411 North Akard Street  
Dallas, Texas 75201

Region VIII  
450 Golden Gate Avenue  
Box 36017  
San Francisco, Calif. 94102





**U.S. DEPARTMENT OF LABOR  
BUREAU OF LABOR STATISTICS  
WASHINGTON, D.C. 20212**

**OFFICIAL BUSINESS**

**POSTAGE AND FEES PAID  
U.S. DEPARTMENT OF LABOR**

**THIRD CLASS MAIL**