A STATISTICAL ANALYSIS OF PRODUCTIVITY IN SELECTED SERVICE INDUSTRIES IN THE UNITED STATES, 1939–63

VICTOR R. FUCHS[1]

Associate Director of Research
National Bureau of Economic Research

This paper examines differentials in output, employment and productivity across seventeen service industries in the United States from 1939 to 1963. Included are 9 retail trades and 8 services mostly from the personal service group. The industries chosen were those for which it was possible to obtain from available data reasonably comparable measures of output and input for selected years since 1939. Also, they are industries for which it is possible to calculate a measure of real output that is not based on labor input.

Sixteen of the industries show positive rates of change of real output per man. Thus there appears to be no basis for assuming that productivity cannot or does not increase in industries providing services. However, the rate of increase for the group as a whole was not as rapid as in manufacturing or in goods production as a whole.

The data for the seventeen industries give strong support to the hypothesis of a positive correlation between industry rates of growth and rates of change of productivity. The correlations are of the same order of magnitude as those found by other investigators in studies of manufacturing industries.

The coefficient of correlation between growth of output per man and growth of output is .93; between growth of output per man and growth of employment it is .54 for 1939–63. The comparable coefficients for the 1948–63 period are .70 and .13.

The results also parallel those reported for manufacturing in one other respect, namely, the absence of any correlation between changes in output per man and changes in compensation per man.

The paper concludes with a discussion of the problems encountered in measuring changes in real output in these industries and presents some alternative estimates based on different concepts and different sources.

INTRODUCTION

A tendency for employment to grow more rapidly in the service industries than in the rest of the economy is one of the best-documented aspects of economic growth. In the United States, where we have reasonably good information on the industrial distribution of the employed population for at least the last

hundred years, the shift to services has occurred almost without interruption and has been more rapid in recent decades than in the period before 1929. Currently, well over half of total employment is accounted for by wholesale and retail trade, finance, insurance, and real estate; professional, personal, business, and repair services; and general government.

Until 1920, the shift of U.S. employment could, in very large measure, be described simply as a movement from agricultural to nonagricultural pursuits. Employment in commodity-producing industries outside of agriculture tended to grow as rapidly as in the services. In the 1920's, however, service industry employment accelerated relative to the rest of the nonagricultural economy. In the 1930's this shift was very pronounced under the double impact of the Depression and the secular trend. In the post-World War II period, services have accounted for virtually all of the net absolute growth of employment, as gains in manufacturing and construction have barely been large enough to offset declines in agriculture and mining. Table I shows the levels and shares of employment by major industry group in 1929, 1939, 1948, and 1963.

The growing importance of the service sector, combined with the prominence now given to problems of economic growth, has resulted in a sharp increase in interest in the productivity of the service industries. It is generally believed that productivity in services has not (and perhaps cannot) improve as rapidly as in goods-producing industries. Doubts concerning the accuracy of the underlying data are widespread, however, and the analysis of the lag in service productivity, if it exists, has not been pushed very far.

Comparison of the goods and service sectors in the aggregate does reveal substantial difference in sector rates of growth of output per man; indeed, it is this differential rather than a drastic change in the composition of final output that appears to account for most of the shift of employment since 1929. However, when sector differences in rates of change of hours per man, quality of labor, and physical capital per worker are also taken into account, the productivity differential is much smaller than that based on output per man.

Two previous papers on the service industries were focused at a highly aggregative level; the comparisons made were primarily between the goods and service sectors and among major industry groups.[2] In the present paper, an attempt is made to study productivity at a much finer level of industry detail. Such an approach has some clear limitations. It will not be possible to include all the service industries. Moreover, the danger of errors in the data may be greater than when we work with sector aggregates or broad industry groups. Generalizations can be made only with the greatest caution. Nevertheless, we know from preliminary study that substantial differences in rates of growth of productivity exist within the service sector. It may be that an analysis of such differences would provide some insight as to why services as a group tend to improve their output per man less rapidly than do the goods industries. Further-

2. See V. R. Fuchs, *Productivity Trends in the Goods and Service Sectors, 1929–61: A Preliminary Survey*, Occasional Paper 89, National Bureau of Economic Research, Inc., New York, 1964, and *The Growing Importance of the Service Industries*, Occasional Paper 96, NBER, New York, 1965.

TABLE 1

EMPLOYMENT IN THE UNITED STATES BY MAJOR INDUSTRY GROUP,
SELECTED YEARS, 1929–63

Industry	Employment (thousands)	Percentage of U.S. Total	Employment (thousands)	Percentage of U.S. Total
	1929		1939	
Agriculture, forestry, and fishing	9,205	19.9	8,273	17.8
Mining	1,017	2.2	870	1.9
Construction	2,306	5.0	1,864	4.0
Manufacturing	10,556	22.8	10,086	21.6
Transportation	3,034	6.6	2,169	4.7
Communications and public utilities	1,034	2.2	871	1.9
Government enterprise	409	.9	503	1.0
Wholesale trade	1,744	3.8	1,942	4.2
Retail trade	6,077	13.1	6,440	13.8
Finance and insurance	1,207	2.6	1,066	2.3
Real estate	368	.8	494	1.1
Households and institutions	3,249	7.0	3,033	6.5
Professional, personal, business, and repair services	3,235	7.0	3,363	7.2
General government (including armed forces)	2,775	6.0	5,630	12.1
	1948		1963	
Agriculture, forestry, and fishing	7,012	12.0	4,725	6.8
Mining	1,021	1.7	654	.9
Construction	3,262	5.6	4,305	6.2
Manufacturing	15,468	26.4	16,767	24.2
Transportation	3,000	5.1	2,546	3.7
Communications and public utilities	1,281	2.2	1,461	2.1
Government enterprise	720	1.2	987	1.4
Wholesale trade	2,712	4.6	3,391	4.9
Retail trade	8,597	14.7	10,537	15.2
Finance and insurance	1,349	2.3	2,437	3.5
Real estate	574	1.0	763	1.1
Households and institutions	3,051	5.2	4,316	6.2
Professional, personal, business, and repair services	4,449	7.6	6,182	8.9
General government (including armed forces)	6,080	10.4	10,336	14.9

Source: Office of Business Economics, *Survey of Current Business*, July 1962, July 1964; *U.S. Income and Output*, 1958; *National Income, 1954 Edition*.

more, there are a number of important conceptual problems concerning the measurement of output and input in service industries which are likely to be brought out more clearly by a consideration of detailed industries. Finally, the analysis of changes in productivity over time in selected service industries may provide some guidance for the study of intercountry differences in productivity at a given point in time.

This paper examines differential trends in output, employment, and productivity across seventeen service industries from 1939 to 1963. The analysis is largely statistical, relying heavily on correlation and regression techniques.

Such an approach, if applied with the caution that the imperfections in data and analytical techniques require, should permit some test of conclusions about productivity that have been reached on the basis of intersector comparisons and studies of productivity trends within manufacturing industries.

SCOPE, DEFINITIONS, AND SOURCES

The service industries discussed in this paper are shown in Table 2. They include all of retailing, divided into ten *retail trades*, and eight *services*, mostly of the "personal service" category. Together, they account for 17 per cent of total U.S. employment in 1963, 30 per cent of service sector employment,[3] and

TABLE 2

LEVEL OF EMPLOYMENT AND PERCENTAGE OF TOTAL U.S.
EMPLOYMENT IN 18 SELECTED SERVICE INDUSTRIES, 1963

Industry	Level of Employment (thousands)	Percentage of U.S. Total
Services		
Auto repair	414	.60
Barber shops	180	.26
Beauty shops	345	.50
Dry cleaning	268	.39
Hotels and motels	544	.78
Laundries	346	.50
Motion picture theaters	106	.15
Shoe repair	34	.05
Total	2,238	3.22
Retail trades		
Apparel stores	659	.95
Automobile dealers	860	1.24
Drug stores	365	.52
Eating and drinking places	1,933	2.78
Food stores	1,490	2.15
Furniture and appliances	459	.66
Gasoline stations	682	.98
General merchandise	1,434	2.06
Lumber dealers	466	.67
Other	870	1.25
Total	9,217	13.28
Total, 18 selected service industries	11,455	16.50

Source: U.S. Bureau of the Census, *1963 Census of Business*. Coverage details are in the Appendix. U.S. employment is the number of persons engaged in production from U.S. Department of Commerce, *Survey of Current Business*, July 1964.

3. The service sector is defined to include wholesale and retail trade; finance, insurance, and real estate; general government; and the services proper, including personal services,

51 per cent of the service sector excluding government, households, and institutions.

The industries chosen were those for which it was possible to obtain from available data reasonably comparable measures of output and input for selected years during the period 1939–63. Also, they are industries for which it is possible to calculate a measure of real output that is not based on labor input. It is widely recognized that where real output is estimated from labor input, as in government and much of the households and institutions sector, analysis of productivity change is scarcely possible.

A summary of the definitions, methods, and sources follows. Detailed information, as well as the actual data, are provided in the Appendix.

Real Output

For the eight services, real output was defined as receipts in constant (1954) dollars. These were estimated from receipts in current dollars, as reported in the Census of Business, deflated by price indexes published by the Bureau of Labor Statistics (BLS).[4] To the extent that the price indexes take account of changes in the quality of services rendered, the real output measures do also.

For the ten retail trades, real output was assumed to be equal to the volume of sales of goods in real terms. This was estimated from receipts by type of store in current dollars, as reported in the Census of Business, deflated by price indexes prepared by David Schwartzman at the National Bureau. These indexes were based on detailed commodity components of the BLS consumer price index weighted by the importance of each commodity in each store type as reported in the 1948 Census of Business. The BLS price indexes for retail sales of commodities do not attempt to allow for changes in quality of service rendered by retailers.

The real output measures for the eighteen industries should be considered only as approximations; they are not exactly equivalent either to the gross measures of physical output that are possible for some goods industries or to the estimates of real gross product originating that would be obtained through separate deflation of outputs and inputs.

Employment

The basic employment concept used is "persons engaged" as defined by the Office of Business Economics of the U.S. Department of Commerce. This is

professional services, business services, and repair services. This somewhat arbitrary definition was chosen because of our interest in a group of industries that have not received much attention in the past from economists interested in productivity analysis. The boundary between service and goods production is very difficult to draw, and probably no division based on industrial classification would be completely satisfactory. Note that Table 2 is based on the 1963 Census of Business, which became available in 1965. These figures are somewhat different from those in Table 1, which are based on earlier data published by the Office of Business Economics.

4. Prices for hotels and motels were obtained from Horwath and Horwath, Hotel Operations in 1963.

estimated from *Census of Business* data on employment and payrolls, with part-time wage and salary employees converted to full-time equivalents by assuming that their share of total wage and salary employment is equal to their share of total payroll. In addition to wage and salary workers, persons engaged includes self-employed proprietors, as reported in the *Census of Business*, all of whom are counted as employed full-time.

The estimates of the number of self-employed may be subject to considerable error because it is difficult to obtain complete coverage of numerous small firms and because the Bureau of the Census definitions of the minimum-sized firm to be included have varied from one census to another. Some attempt was made to adjust for changes in coverage (see the Appendix). Also, it is some comfort to note that the number of self-employed reported in the *Census of Business* for 1948 corresponds closely to the number reported in the *Census of Population* for 1950 for the eighteen industries.

The importance of obtaining an accurate count of the self-employed is considerable; they account for a significant fraction of total employment in many of the service industries, as may be seen in Table 3. The employment estimates for these industries are probably not as reliable as those that can be obtained for manufacturing and other industries in which the self-employed play a much less important role.

Doubts may arise concerning the accuracy of the figures on self-employment, but the situation with respect to unpaid family workers is far worse. The *Census*

TABLE 3

NUMBER OF SELF-EMPLOYED AS A PERCENTAGE OF TOTAL EMPLOYMENT IN 18 SERVICE INDUSTRIES, SELECTED YEARS, 1939–63

Industry	1939	1948	1954	1958	1963
Services					
Auto repair	48.6	41.3	40.4	34.9	33.1
Barber shops	66.9	61.8	62.3	60.7	61.4
Beauty shops	47.4	47.8	46.6	46.7	44.8
Dry cleaning	37.9	24.4	24.4	23.6	22.1
Hotels and motels	10.4	12.2	12.3	14.1	11.6
Laundries	8.2	10.2	9.2	10.0	12.8
Motion picture theaters	5.8	5.0	6.1	7.7	7.0
Shoe repair	71.9	69.1	68.4	64.8	65.2
Retail trades					
Apparel stores	19.5	16.0	16.1	15.3	13.8
Automobile dealers	11.7	11.2	10.2	10.7	9.0
Drug stores	22.1	17.2	17.1	14.8	12.4
Eating and drinking places	29.3	23.9	23.7	21.7	16.9
Food stores	44.8	38.2	32.1	27.2	21.6
Furniture and appliances	17.7	18.6	23.5	22.7	20.8
Gasoline stations	52.0	44.1	39.3	36.0	31.2
General merchandise	8.8	5.4	6.3	6.6	3.2
Lumber dealers	21.8	16.9	19.5	20.2	16.5
Other	34.8	29.3	33.9	31.8	28.5

Source: U.S. Bureau of the Census, *Census of Business*. Coverage details are in the Appendix.

of Business does not regularly report the number of such workers, and no attempt was made in this paper to include them in the measure of total employment. Some data for the eighteen service industries reported in the 1948 *Census of Business* indicate that unpaid family workers (adjusted to full-time equivalents) amounted to about 8 per cent of total employment. The *Census of Population* for 1950, on the other hand, presents figures showing that unpaid family workers accounted for less than 2 per cent of employment in these industries.[5]

Labor Input

Industry trends in effective labor input may diverge from trends in employment (full-time equivalents) because of differences in rates of change in hours per full-time worker or in the quality of labor as reflected in intelligence, strength, training, and so on. In the study of productivity, it is useful to have a measure of labor input that does more than simply "count heads," i.e., that tries to take into account these other factors. Given certain assumptions, it is possible to estimate industry *differentials* in rates of change of labor input from rates of change in labor compensation. If we assume that the price of a composite unit of labor of a given quality changes at the same rate in all branches of the economy, then the change in total labor compensation in a particular industry relative to the change in some other industry is equal to the relative rates of change of labor input in those two industries.[6] Labor compensation for wage and salary workers was calculated from payroll data in the *Census of Business*. Compensation per man for self-employed was assumed to be the same as for employees in the same industry.[7]

Output per Man

This is real output divided by employment.

Output per Unit of Labor Input

This is real output divided by labor input. Absolute percentage rates of change for this measure have not been calculated because of the way in which the relative percentage rates of change of labor input are estimated. Relative values were obtained and used to rank the industries.

5. The exclusion of unpaid family workers probably biases the estimates of the growth of output per man downward, because paid employment probably rose more rapidly than unpaid employment over the period studied. David Schwartzman, in the study of productivity growth in distribution that he is preparing for the National Bureau, estimates that the annual rate of growth of output per man in retailing, 1929–58, would be raised .08 per cent if unpaid family workers were included.

6. Note that this formulation does not require that a dollar's worth of compensation buy the same amount of labor input in all industries. There may be variations based on nonpecuniary factors, monopoly, or monopsony power, and so on. The relative change in compensation will still be equal to the relative change in labor input, provided these other factors do not change differentially by industry over time.

7. Analysis of annual earnings of self-employed and wage and salary workers in these industries, as reported in the *1960 Census of Population*, indicates that this procedure probably results in an underestimate of the level of self-employment earnings.

Output per Unit of Total Input

If one is interested only in ranking the industries according to their relative rates of change of output per unit of total input, an estimate can be obtained for the eight services by using the reciprocal of the rates of change of price. The rationale is that under competitive conditions, rates of change of price of service industries that have very little material input will tend to be inversely correlated with the rates of change of productivity. The implicit assumption is that the price of a composite unit of total input changes at the same rate in all industries. This is an extension of the assumption underlying the calculation of relative rates of change of labor input.

Annual Percentage Rates of Change

The average annual percentage rate of change between 1939 and 1963 for each variable is calculated by fitting a least-squares equation of the form $lnx = a + bT + u$ on observations for 1939, 1948, 1954, 1958, and 1963. The regression coefficient b yields the annual percentage rate of growth compounded continuously. The annual rates for 1948–63 are obtained in a similar fashion by omitting the observation for 1939. It should be noted that the percentage rate of change of a variable formed by dividing one variable by another (e.g., real output per man) is approximately equal to the percentage rate of change of the numerator minus the percentage rate of change of the denominator.

An alternative way of calculating average percentage rates of change would be to use the initial and terminal years only. The difference in results obtained from the two methods is slight in most instances, but there are several industries where differences of .2 to .3 percentage points per annum are observed. Use of all the observations appears to be preferable in order to minimize the influence of the cyclical position of the initial or terminal year, or the influence of random events or errors in the data for one of those years.

The question of cyclical effect as opposed to trend is most important for comparisons based on 1939 because the economy had not yet fully recovered from the Depression and the unemployment rate was 17.2 per cent. The years 1948, 1954, 1958, and 1963 were all at a much higher level of activity than 1939, although 1954 and 1958 were marked by mild recessions. The unemployment rates for the four years were 3.8, 5.6, 6.8., and 5.7 per cent respectively.

EMPIRICAL RESULTS

Rates of Change, 1939–63

Table 4 presents average percentage rates of change for each of the 18 service industries. Table 5 gives comparable figures for the aggregates and permits comparison with manufacturing, the total goods and service sectors, and the total economy. These tables are more or less self-explanatory and only a few brief comments need be made.

Perhaps the first and the most important point is that sixteen of the eighteen industries show positive rates of change of output per man. Unless the real output rates of change are systematically and markedly biased upward,

TABLE 4

AVERAGE ANNUAL PERCENTAGE RATES OF CHANGE, OUTPUT PER MAN AND
RELATED VARIABLES, 18 SELECTED SERVICE INDUSTRIES, 1939–63

Industry	Real Output per Man	Real Output	Employment	Compensation per Man
Services				
Auto repair	3.32	7.14	3.82	5.06
Barber shops	.60	.60	.00	5.67
Beauty shops	1.69	4.08	2.39	5.37
Dry cleaning	2.47	4.41	1.94	4.75
Hotels and motels	.49	2.20	1.71	5.35
Laundries	1.42	2.36	.94	4.78
Motion picture theaters	−2.83	−3.28	−.45	2.98
Shoe repair	1.16	−2.07	−3.23	4.77
Retail trades				
Apparel stores	.99	2.86	1.87	4.17
Automobile dealers	2.09	4.82	2.73	5.19
Drug stores	2.68	4.71	2.03	5.29
Eating and drinking places	−.18	2.30	2.48	5.31
Food stores	2.44	3.62	1.18	5.32
Furniture and appliances	2.88	5.37	2.49	4.88
Gasoline stations	3.25	5.25	2.00	5.08
General merchandise	1.40	3.53	2.13	4.38
Lumber dealers	1.21	3.07	1.86	4.99
Other	2.09	4.11	2.02	4.63

Source: Appendix.

TABLE 5

AVERAGE ANNUAL PERCENTAGE RATES OF CHANGE, OUTPUT PER MAN AND RELATED
VARIABLES, INDUSTRY GROUPS AND TOTAL ECONOMY, 1939–63

	Real Output per Man	Real Output	Employment	Compensation per Man
8 Services, total	1.14	2.68	1.54	5.07
10 Retail trades, total	1.63	3.67	2.04	4.90
18 Selected service industries, total	1.52	3.45	1.93	4.96
Manufacturing, total	2.26	4.22	1.96	6.32
Service sector, total	1.45	3.75	2.30	5.62
Goods sector, total	3.03	3.94	.91	6.83
Total economy	2.23	3.84	1.61	6.22

Source: Appendix.

there appears to be no basis for assuming that productivity cannot or does not increase in service industries. However, Table 5 does show that the rate of increase for the services and the retail trades as a group was not as rapid as for manufacturing, the total goods sector, or the total economy.

If service industries generally tend to show positive rates of change of output per man, a serious question arises concerning the practice of assuming a zero rate of change for government and other service industries for which no convenient method of estimating output, independently of employment has

yet been found. Why not assume some constant, positive rate of increase, e.g., 1 per cent per annum, instead? It could be argued that such a procedure would be no more arbitrary and perhaps more accurate. Alternatively, one could assume for such industries the same average rate of increase as is found for those service industries for which an independent measure of output is available.

In a similar vein, the practice of assuming no differences in output per man for service industries across countries at a given point in time must be questioned. It is not likely that some of the same factors that have contributed to increases in output per man in service industries in the United States over time might also be contributing to international differences in output per man at a given time?

A second point to be noted is the tremendous diversity of experience among the eighteen service industries. In one-third of the cases, output per man actually grew more rapidly than in the total economy. The range of variation for output and employment was also very great; only compensation per man tended to change at similar rates in the various industries.

Rates of Change, 1948–63

Tables 6 and 7 present the rates of change for the 1948–63 period. Output per man in manufacturing shows a higher rate of increase for this period, as do half of the retail trades, but the services all show higher rates for 1939–63. A

TABLE 6

AVERAGE ANNUAL PERCENTAGE RATES OF CHANGE, OUTPUT PER MAN AND
RELATED VARIABLES, 18 SELECTED SERVICE INDUSTRIES, 1948–63

Industry	Real Output per Man	Real Output	Employment	Compensation per Man
Services				
Auto repair	1.85	5.78	3.93	3.27
Barber shops	.19	1.48	1.29	3.48
Beauty shops	1.54	6.76	5.22	3.34
Dry cleaning	1.65	.90	−.75	3.02
Hotels and motels	−.68	.86	1.54	3.19
Laundries	−.03	.86	.89	2.16
Motion picture theaters	−3.40	−6.46	−3.06	1.93
Shoe repair	1.16	−2.84	−4.00	3.03
Retail trades				
Apparel stores	1.62	2.06	.44	2.81
Automobile dealers	1.91	3.28	1.37	3.57
Drug stores	2.15	3.58	1.43	4.19
Eating and drinking places	.12	1.63	1.51	2.80
Food stores	2.75	3.58	.83	3.08
Furniture and appliances	3.38	3.40	.02	3.51
Gasoline stations	1.92	4.95	3.03	3.27
General merchandise	2.32	3.80	1.48	2.68
Lumber dealers	1.09	.18	−.91	3.59
Other	1.00	2.78	1.78	3.21

Source: Appendix.

TABLE 7

AVERAGE ANNUAL PERCENTAGE RATES OF CHANGE, OUTPUT PER MAN AND
RELATED VARIABLES, INDUSTRY GROUPS AND TOTAL ECONOMY, 1948-63

	Real Output per Man	Real Output	Employment	Compensation per Man
8 Services, total	.21	1.66	1.45	3.08
10 Retail trades, total	1.72	2.93	1.21	3.05
18 Selected service industries, total	1.41	2.65	1.24	3.07
Manufacturing, total	2.60	3.04	.44	4.86
Service sector, total	1.23	3.52	2.29	4.25
Goods sector, total	3.07	2.96	−.11	4.92
Total economy	2.14	3.23	1.09	4.54

Source: Appendix.

tentative explanation is that *cyclical* fluctuations in output per man are more important in services, where employment is relatively insensitive to changes in demand and output.[8] We again observe tremendous diversity among the eighteen industries in rates of growth of all the variables except compensation per man.

Tables 8 and 9 present seventeen service industries,[9] ranked according to the various measures of output, input, and productivity. Table 10 shows the correlations between the rankings for 1939-63 and 1948-63. Most of these correlations are significantly different from zero; this is not surprising considering the fact that there is a great deal of overlap between these two periods. The correlations are sufficiently below 1.00, however, to indicate that the inclusion or exclusion of 1939 can make a substantial difference, especially for the retail trades.

Interindustry Differences in Rates of Change of Output per Man

Given the substantial variation among service industries in rates of change of output per man, it is of interest to see whether the same pattern of variation can be found in some of the other variables, i.e., whether rates of change are correlated across industries.

The relationship between industry rates of growth and output per man is of particular interest. Many previous studies have found a significant positive correlation between these two variables.[10] The explanation of the relationship usually runs in two directions—from productivity change to industry growth, and from industry growth to productivity. The first argument is that rapid productivity growth leads to lower prices which stimulate demand and output. The

8. See Victor R. Fuchs, *The Growing Importance of the Service Industries*, pp. 45-51.

9. "Other retail trade" is omitted from the rankings because it is a miscellaneous category of questionable significance for economic analyses across industries.

10. See, for example, Solomon Fabricant, *Employment in Manufacturing, 1899-1939*, New York, NBER, 1942, pp. 88, 146; John W. Kendrick, *Productivity Trends in the United States*, Princeton University Press for NBER, 1961, pp. 207-216, W. E. G. Salter, *Productivity and Technical Change*, Cambridge, Eng., 1960, p. 123.

TABLE 8

RANKINGS OF 17 SELECTED SERVICE INDUSTRIES, AVERAGE ANNUAL PERCENTAGE RATES OF CHANGE OF OUTPUT PER MAN AND RELATED VARIABLES, 1939-63

Industry	Real Output per Man	Real Output per Unit of Labor Input	Real Output	Employment	Compensation per Man	Real Output per Unit of Total Input[a] (8 services only)
Auto repair	17	17	17	17	9	7
Gasoline stations	16	16	15	10	10	
Furniture and appliances	15	15	16	15	7	
Drug stores	14	13	13	11	12	
Dry cleaning	13	14	12	9	4	8
Food stores	12	12	10	5	14	
Automobile dealers	11	10	14	16	11	
Beauty shops	10	6	11	13	16	6
Laundries	9	8	6	4	6	5
General merchandise	8	11	9	12	3	
Lumber dealers	7	5	8	7	8	
Shoe repair	6	7	2	1	5	3
Apparel stores	5	9	7	8	2	
Barber shops	4	3	3	3	17	1
Hotels and motels	3	4	4	6	15	2
Eating and drinking places	2	2	5	14	13	
Motion picture theaters	1	1	1	2	1	4

Source: Table 4 and Appendix.
[a]Based on the reciprocal of the rate of change of price.

222

TABLE 9

RANKINGS OF 17 SELECTED SERVICE INDUSTRIES, AVERAGE ANNUAL PERCENTAGE RATES OF CHANGE OF OUTPUT PER MAN
AND RELATED VARIABLES, 1948-63

Industry	Real Output per Man	Real Output per Unit of Labor Input	Real Output	Employment	Compensation per Man	Real Output per Unit of Total Input[a] (8 services only)
Furniture and appliances	17	17	11	5	14	
Food stores	16	16	12.5	7	8	
General merchandise	15	15	14	12	3	
Drug stores	14	7	12.5	11	17	
Gasoline stations	13	13	15	15	10.5	
Automobile dealers	12	10	10	10	15	
Auto repair	11	11	16	16	10.5	5
Dry cleaning	10	12	6	4	6	8
Apparel stores	9	14	9	6	5	
Beauty shops	8	9	17	17	12	7
Shoe repair	7	8	2	1	7	6
Lumber dealers	6	5	3	3	16	
Barber shops	5	3	7	9	13	1
Eating and drinking places	4	4	8	13	4	
Laundries	3	6	4.5	8	2	4
Hotels and motels	2	2	4.5	14	9	2
Motion picture theaters	1	1	1	2	1	3

Source: Table 6 and Appendix.
[a]Based on the reciprocal of the rate of change of price.

223

TABLE 10

COEFFICIENTS OF RANK CORRELATION BETWEEN AVERAGE ANNUAL
PERCENTAGE RATES OF CHANGE, 1939–63 AND 1948–63, of
OUTPUT PER MAN AND RELATED VARIABLES,
SELECTED SERVICE INDUSTRIES

	17 Selected Service Industries	8 Services	9 Retail Trades
Real output per man	.77	.93	.72
Real output per unit of labor input	.79	.86	.58
Real output	.75	.76	.58
Employment	.58	.81	.25
Compensation per man	.58	.90	.20
Real output per unit of total input	n.a.	.81	n.a.

Source: Tables 8 and 9.
Note: Minimum values of rank correlation coefficients for various
levels of statistical significance (two-tailed test):

α	$N = 8$	$N = 9$	$N = 10$	$N = 25$
.10	.64	.58	.56	.34
.05	.73	.68	.65	.40
.01	.86	.82	.79	.53

alternative argument is that increased demand and output permit economies of scale and other efficiencies which show up as higher productivity.

These previous studies have mostly been confined to or dominated by manufacturing industries. When this relationship was tested across ten major industry groups in the United States, no correlation between growth and productivity could be observed.[11] In this paper the hypothesis is tested across the seventeen service industries.

Tables 11 and 12 show the coefficient of rank correlation for every combination of variables. Correlations between output per man (O/E) and output (O) and employment (E) are the ones to be considered first. Either output or employment can be used to measure industry rates of growth; therefore, we must look at both sets of correlations. The correlation with output tends to be biased upward, and the reverse is true of employment.[12]

The coefficients shown in Tables 11 and 12 tend to support the hypothesis of a positive correlation between growth and productivity. Table 13 indicates that the relationship found among the seventeen service industries is of the same order of magnitude as that found by other investigators for manufacturing industries.

One way of circumventing the problem of spurious correlation between output per man and output, or between output per man and employment, is to

11. Fuchs, *Productivity Trends*, p. 17.
12. Whenever a correlation coefficient is calculated between one variable and another which is based in part on the first, the danger of spurious correlation arises. To the extent that there are errors in the observations, these errors alone would tend to produce a positive or negative correlation, depending upon the position of the variable in numerator or denominator on both sides of the equation.

TABLE 11

COEFFICIENTS OF RANK CORRELATION, AVERAGE ANNUAL PERCENTAGE RATES OF CHANGE (1939-63) OF OUTPUT PER MAN AND RELATED VARIABLES, ACROSS SELECTED SERVICE INDUSTRIES

		Real Output per Man	Real Output per Unit of Labor Input	Real Output	Employment	Compensation per Man	Real Output per Unit of Total Input
Real output per man	(1)		.94	.93	.54	.06	
	(2)		.90	.90	.74	.07	.81
	(3)		.97	.93	.07	.12	
Real output per unit of labor input	(1)			.87	.50	−.15	
	(2)			.81	.57	−.14	.74
	(3)			.87	.03	.00	
Real output	(1)				.79	.10	
	(2)				.93	.21	.76
	(3)				.33	.02	
Employment	(1)					.10	
	(2)					.33	.67
	(3)					−.06	
Compensation per man	(1)						
	(2)						−.38
	(3)						

Source: Table 8.
(1) Across 17 selected service industries.
(2) Across 8 services.
(3) Across 9 retail trades.

TABLE 12

COEFFICIENTS OF RANK CORRELATION, AVERAGE ANNUAL PERCENTAGE RATES OF CHANGE (1948-63) OF OUTPUT PER MAN AND RELATED VARIABLES, ACROSS SELECTED SERVICE INDUSTRIES

		Real Output per Man	Real Output per Unit of Labor Input	Real Output	Employment	Compensation per Man	Real Output per Unit of Total Input
Real output per man	(1)		.88	.70	.13	.38	
	(2)		.95	.71	.33	.43	.69
	(3)		.85	.69	−.10	.04	
Real output per unit of labor input	(1)			.71	.03	.07	
	(2)			.60	.21	.21	.83
	(3)			.51	−.25	−.26	
Real output	(1)				.73	.31	
	(2)				.84	.78	.26
	(3)				.55	−.13	
Employment	(1)					.18	
	(2)					.69	−.05
	(3)					−.38	
Compensation per man	(1)						
	(2)						−.14
	(3)						

Source: Table 9.
(1) Across 17 selected service industries.
(2) Across 8 services.
(3) Across 9 retail trades.

fit least-squares regression lines directly to two equations relating changes in output and changes in employment. In one equation, output is treated as dependent upon employment; in the other equation, the relationship is reversed. If there is no correlation between industry rates of growth (measured by output or employment) and industry rates of change of output per man, the slope of the regression line between output and employment should equal unity. Regression lines with slopes greater than unity indicate a positive correlation. Slopes smaller than unity indicate a negative relationship.[13]

TABLE 13

SUMMARY OF COEFFICIENTS OF RANK CORRELATION BETWEEN RATES OF CHANGE OF OUTPUT PER MAN AND OUTPUT AND EMPLOYMENT ACROSS INDUSTRIES

			Output per Man and	
			Output	Employment
1.	U.S.	1939–63—17 service industries	.93	.54
2.	U.S.	1948–63—17 service industries	.70	.13
3.	U.S.	1899–1937—56 manufacturing industries	.73	.31
4.	U.S.	1899–1953—33 industry groups	.64[a]	.33[a]
5.	U.S.	1899–1954—80 manufacturing industries	.67[b]	.33[c]
6.	U.K.	1924–50—28 manufacturing industries	.83	.57
7.	U.S.	1929–61—10 major industry groups	−.01	−.84

Source: 1, Table 11; 2, Table 12; 3, Fabricant, *Employment in Manufacturing*; 4 and 5, Kendrick, *Productivity Trends in the U.S.*; 6, Salter, *Productivity and Technical Change*; 7, Fuchs, *Productivity Trends*.
[a]Based on output per unit of total factor input.
[b]Based on output per adjusted man-hour.
[c]Based on output per man-hour.

The regression lines for Charts 1 and 2 are as follows:

1939–63

$$O = .813 + 1.435E \qquad \bar{R}^2 = .727$$
$$\quad (.469) \quad (.217)$$

$$E = -.032 + .519O$$
$$\quad (.309) \quad (.078)$$

1948–63

$$O = .944 + 1.245E \qquad \bar{R}^2 = .768$$
$$\quad (.396) \quad (.169)$$

$$E = -.411 + .629O$$
$$\quad (.313) \quad (.086)$$

The slopes of the lines on the charts when employment is dependent are the reciprocals of the regression coefficients.

Both the rank correlations and the regression slopes indicate that the relation between growth and productivity was stronger for 1939–63 than for

13. Cf. Fabricant, *Employment in Manufacturing*, p. 87.

Chart 1

Relation Between Average Annual Percentage Rates
of Change of Real Output and Employment,
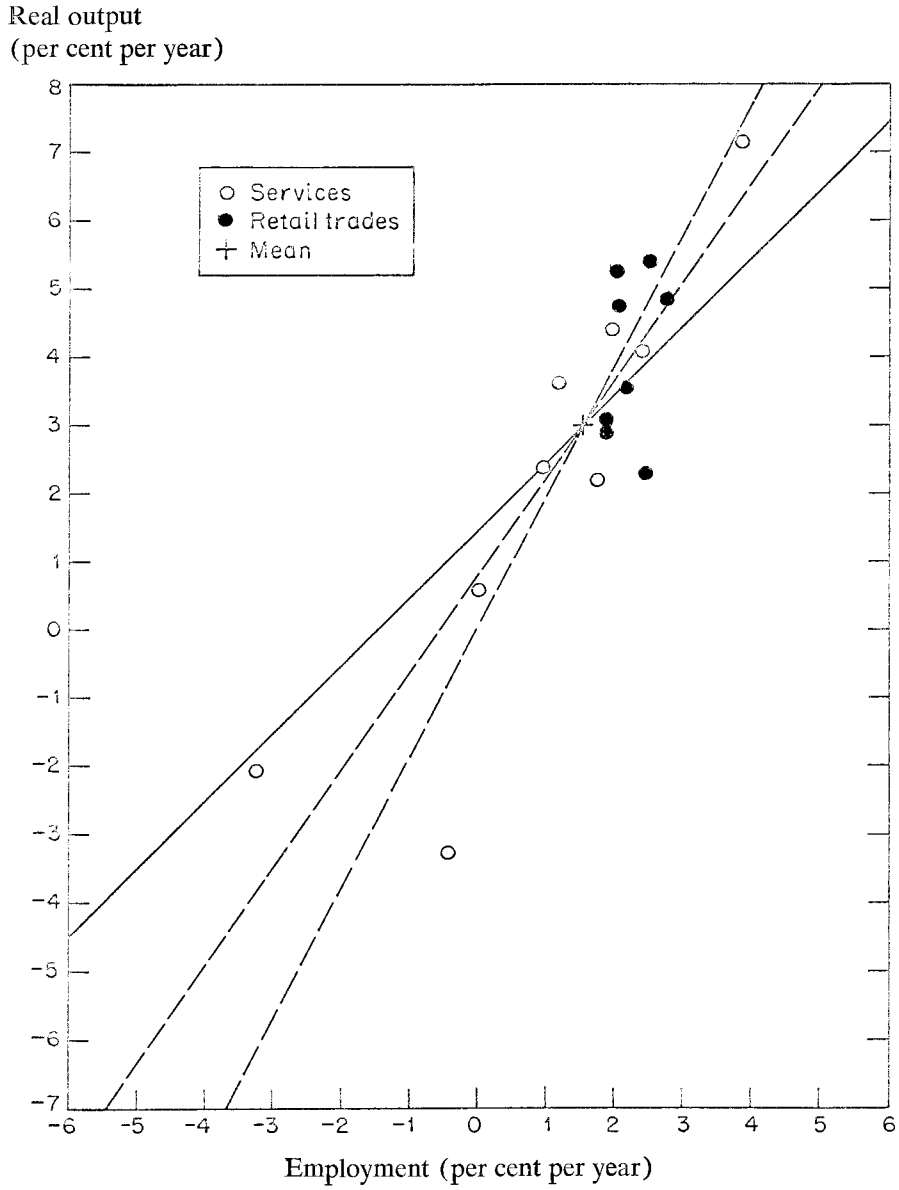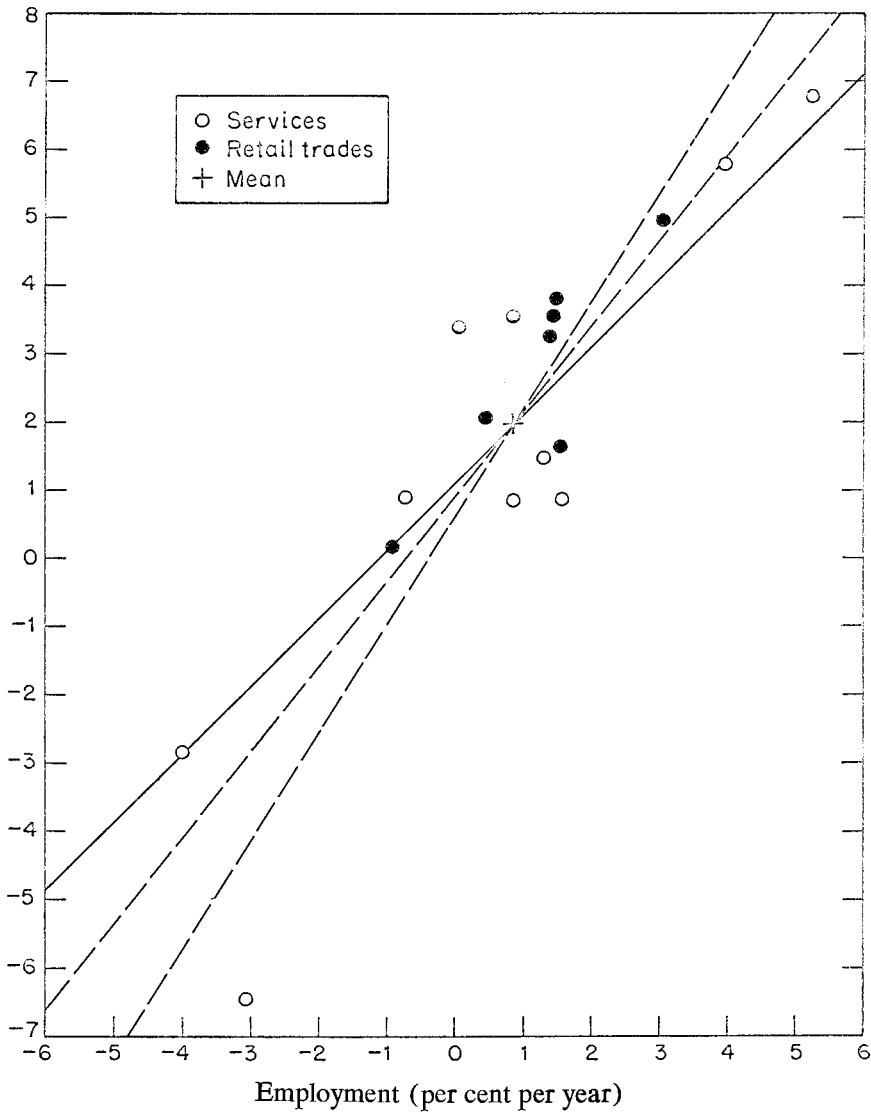17 Selected Service Industries, 1939–63

Real output
(per cent per year)

Employment (per cent per year)

Chart 2

Relation Between Average Annual Percentage Rates
of Change of Real Output and Employment,
17 Selected Service Industries, 1948–63

Real output
(per cent per year)

Employment (per cent per year)

1948–63. This probably reflects a cyclical relation between growth and productivity in addition to the secular one.

The finding of a positive relation between industry rates of growth and changes in productivity raises an interesting question about productivity trends in those service industries not included in the present study.[14] As can be seen in Table 14, the excluded industries had, on average, much faster rates of growth of employment than did the seventeen included industries. If we were to assume that the relationships shown in Charts 1 and 2 between growth of output and growth of employment extended to the excluded industries, we would have to conclude that output per man in those industries grew much more rapidly than in the seventeen industries covered in the present study. Present measures of real gross national product do not yield that conclusion, but they are based for the most part on arbitrary assumptions about real output, including the assumption that labor productivity never changes. No widely acceptable alternative measure of real output for the excluded industries is available.

TABLE 14

COMPARISON OF ANNUAL RATES OF CHANGE OF EMPLOYMENT OF 21 EXCLUDED
SERVICE INDUSTRIES WITH 17 SELECTED SERVICE INDUSTRIES, 1939–63

Industry	1939–63 (per cent per annum)	1948–63 (per cent per annum)
Federal general government, military	8.64	4.12
Engineering and other professional services, n.e.c.	6.20	5.78
Business services, n.e.c.	5.77	5.79
Federal general government, civilian	4.80	1.56
Finance, n.e.c.	4.66	6.78
Commercial and trade schools and employment agencies	4.51	2.76
Nonprofit membership organizations, n.e.c.	4.20	3.22
Medical and other health services	4.17	4.48
Banking	3.84	3.84
Educational services, n.e.c.	3.60	3.89
State and local general government, public education	3.57	4.74
Insurance carriers	3.22	3.30
Insurance agents and combination offices	2.99	3.51
Miscellaneous repair services and hand trades	2.87	1.14
State and local general government, nonschool except work relief	2.83	3.34
Wholesale trade	2.32	1.49
Amusement and recreation except motion pictures	2.13	1.46
Security and commodity brokers, dealers, and exchanges	1.95	4.67
Real estate	1.81	1.90
Legal services	1.06	2.42
Private households	−1.27	−.18
Median of 21 excluded industries	3.57	3.34
Median of 17 selected services	1.87	1.29

Source: U.S. Office of Business Economics, *Survey of Current Business*, July 1964, Table VI-16; *U.S. Income and Output*, Table VI-16; *National Income, 1954 edition*, Table 28.
Note: For excluded industries, rates of change were computed between terminal years.

---

14. I am grateful to Edward F. Denison for calling this question to my attention.

The results shown in Tables 11 and 12 parallel those reported for manufacturing in one other respect, namely, the absence of any correlation between changes in output per man and changes in compensation per man. This result would appear to refute the hypothesis that differential changes in the quality of labor can make a significant contribution to the explanation of differential changes in output per man in these industries. On the other hand, there have been very large differences in rates of change of compensation per man between the service industries and manufacturing. This indicates that a differential change in labor quality may explain part of the differential change in output per man between manufacturing and the service industries.

One other set of correlations that was run tests the relation between changes in output per man and changes in the percentage of employment accounted for by self-employed. It has been argued that large numbers of the self-employed are not really very active and have very low productivity.[15] Their alternative to self-employment may be unemployment. One would expect, therefore, that industries which showed a large absolute decline in the percentage of employment accounted for by self-employed might show large increases in output per man. The coefficients of rank correlation shown in Table 15 provide some slight support for this hypothesis, particularly with respect to the eight services. The same table also shows the correlations between changes in the self-employment percentage and percentage rates of change of output and employment. There is apparently some intercorrelation among all these variables, and much more work needs to be done before any conclusions concerning causality would be warranted.

TABLE 15

COEFFICIENTS OF RANK CORRELATION BETWEEN CHANGE IN
SELF-EMPLOYMENT AS PERCENTAGE OF TOTAL EMPLOYMENT
AND RATE OF CHANGE OF OUTPUT PER MAN,
OUTPUT AND EMPLOYMENT

		1939–63	1948–63
$\Delta S : O/E$	17 service industries	−.36	−.45
	8 services	−.60	−.78
	9 retail trades	−.05	.04
$\Delta S : O$	17 service industries	−.29	−.12
	8 services	−.43	−.29
	9 retail trades	.25	.57
$\Delta S : E$	17 service industries	−.57	−.43
	8 services	−.43	−.26
	9 retail trades	−.40	−.63

Source: Tables 3, 8, and 9.
Note: ΔS = Percentage self-employed in initial year minus percentage self-employed in terminal year. O, E, O/E = Average annual percentage rate of change of real output, employment, and real output per man.

15. Edward F. Denison, "Improved Allocation of Labor as a Source of Higher European Growth Rates," in Michael J. Brennan (ed.), *Patterns of Market Behaviour*, Providence, 1965.

231

In appraising the preceding results, it is well to recall that the measures of real output used can be considered only as approximations. Attempts to measure output and productivity in these and other service industries encounter conceptual and statistical problems which, if not unknown in the commodity-producing industries, take on a new form and increased importance that warrant some discussion.

Retail Trades

The procedure followed in this paper and elsewhere of using the real volume of goods sold as a measure of retail trade output, is open to a number of objections; there are many aspects of retailing that may vary over time or cross-sectionally. These include the following:

1. Terms of sale: credit, delivery, guarantees, replacement of parts, repairs and services, return privileges, etc.
2. Amenities provided to the customer: heating, air-conditioning, lighting, music, rest rooms, etc.
3. Convenience: location with respect to homes, places of work, and other stores, availability of parking facilities, store hours.
4. Aids to customer choice: variety of merchandise, displays, "test drives", "home demonstrations", "try-on" privileges.
5. Sales personnel: intelligence, information, courtesy, attention, etc.
6. Demands on customer: time and effort required to accomplish purchase.
7. Size of transaction.

One important source of difficulty is that shifts in the sales of the identical commodity from one type of retailer to another will affect the measure of productivity in different ways depending upon what assumptions are made. The problem may be seen clearly by means of a numerical example. In the example that follows, store type A represents an "old-style" full-line retailer, and type B a modern supermarket or low-markup retailer.

According to present methods of measuring real output in retailing in the United States, the index of real output would be 91.8 (i.e., 134 ÷ 146) because

Store Type	Wholesale Price	Margin	Retail Price	Quantity	Sales
		PERIOD 1			
A	$1.00	$.50	$1.50	80	120
B	1.00	.30	1.30	20	26
				100	146
		PERIOD 2			
A	1.00	.50	1.50	20	30
B	1.00	.30	1.30	80	104
				100	134

the price index used to deflate sales would be unchanged from period 1 to period 2. Some economists would regard this as an overstatement of the change in real output in retailing. If the gross margins of the two store types can be regarded as measuring real differences in the services rendered by the two types of retailers, then the real output index should be 73.9 (i.e., 34 ÷ 46). Others would argue that the index should be 100, on the grounds that the same quantity of goods is being sold by retailers and that the lower margin represents a more efficient way of providing the same function. As can be seen, the present technique provides a result which is intermediate between the two extreme positions.

Change in the size of transaction is another difficult item to deal with conceptually. Suppose that all other aspects of the sale remain unchanged, but the customer now buys in each transaction twice as much as before. Shall we say that real output in retailing is twice as great as before? Some have argued that because an increase in the size of the transaction normally does not require a proportionate increase in inputs, the volume of real goods should not be used as the measure of real output. It has been suggested that the number of transactions be used, or at least considered, in determining the real output in retailing.[16]

One difficulty with this line of reasoning is that it is not applied in measuring real output in other industries, such as manufacturing. Businessmen and economists have known for a long time that productivity is often positively related to the "length of the run". But rarely, if ever, does anyone adjust a manufacturing output index based on volume of goods produced in order to allow for changes in the "length of run".

In retailing, the size of the transaction corresponds to the "length of the run", and there would seem to be little reason for treating this industry differently from others. Unless output is redefined in all industries, it seems more reasonable to try to identify what portion of the observed change in output per man in retailing can be attributed to change in the size of transaction.

My colleague, David Schwartzman, believes that differences in transaction size in food stores (and possibly other retail trades) explain a large part of differences in output per man. Margaret Hall appears to have reached the same conclusion. One test of this hypothesis would be to determine whether stores attempt to raise the average size of transaction through price concessions or other inducements.

The following notes on some of the individual retail trades provide some rough alternative measures of real output and compare them with the deflated sales indexes that have been used in this paper. Some of these alternatives serve as a check on the quality of the data; others involve a different concept of real output.

Automobile Dealers

A typical transaction in this industry consists of the sale of one car or one truck. The number of such sales may change radically from the deflated value

---

16. See Margaret Hall and Don Knapp, "Productivity in Distribution with Particular Reference to the Measurement of Output," *Productivity Measurement Review*, February, 1957.

of sales, as shown in the following figures.[17] The explanation for the differences probably lies in changes in the proportion of low-priced, medium-priced, and expensive cars sold. One way of approaching this problem of measurement would be to look at the retail margins realized on cars in different price ranges. If the percentage margins are typically the same, regardless of price range, then the use of deflated sales as a measure of real output without regard to the number of cars sold would seem to be justified.

1958 = 100	Deflated Sales	Number of New Cars and Trucks Sold[a]
1939	39.5	69.9
1948	77.8	102.9
1954	103.8	128.5
1958	100.0	100.0
1963	133.3	177.2

Drug Stores

There seems to be a very close correspondence between deflated sales of drug stores and the total number of prescriptions filled. The index for industrial production of drugs, soap, and toiletries seems to rise more rapidly than either of the other series. It may be that sales of these commodities have been increasing at a rapid rate in retail stores other than drug stores.

1958 = 100	Deflated Sales	Number of Prescriptions[b]	Industrial Production of Drugs, Soap and Toiletries[c]
1939	37.9	32.3	n.a.
1948	71.2	69.8	45.2
1954	84.5	80.4	68.9
1958	100.0	100.0	100.0
1963	121.3	122.5	141.2

Food Stores

Changes in deflated sales of food stores have closely paralleled changes in industrial production of food in the postwar period. The average size of transaction has apparently been rising markedly as people tend to shop less frequently. There would be some increase attributable to higher incomes even if the frequency of shopping was unchanged.

1954 = 100	Deflated Sales	Industrial Production of Food[e]	Number of Transactions[d]
1948	77.8	86.4	n.a.
1954	100.0	100.0	100.0
1958	115.2	110.4	n.a.
1963	132.8	129.8	87.0

17. Sources for all of the series presented in this section are given in footnote 16.

Gasoline Stations

Gas stations are another type of retail outlet where the size of transaction may be of considerable importance. Casual observation suggests that productivity is much greater when pumping fifteen gallons into one tank than when servicing three cars for five gallons each. Transaction size has probably increased over time as gas tanks have become larger and incomes have risen. The following data seem relevant.

1958 = 100	Deflated Sales	Number of Privately Owned Cars, Trucks, and Buses[a]	Number of Vehicle Miles Traveled[a]	Gallons of Motor Fuel Consumed[a]	Size of Gasoline Tank (Ford)[e]	Replacement Production of Tires and Batteries[a]
1939	35.0	45.4	42.8	38.8	70.0	53.8
1948	57.5	60.2	59.8	57.1	85.0	83.1
1954	81.8	85.7	84.4	83.1	n.a.	85.2
1958	100.0	100.0	100.0	100.0	100.0	100.0
1963	120.3	121.0	120.0	114.0	100.0	126.7

General Merchandise Stores

The average size of transactions has apparently risen in general merchandise stores also.

1958 = 100	Deflated Sales (1)	Number of Transactions (3 + 4) (2)	Receipts in Current $[f] (3)	Average Sale in Department Stores in Current $[g] (4)
1939	53.9	61.7	27.4	44.4
1948	74.4	78.5	72.4	92.3
1954	83.2	89.1	81.3	91.3
1958	100.0	100.0	100.0	100.0
1963	131.3	117.7	135.0	114.7

Lumber Dealers, Etc.

The following figures suggest either that lumber dealers are losing out to other forms of distribution or that the deflated sales figures for 1963 understate the real amount of goods passing through this type of retail outlet.

1958 = 100	Deflated Sales	Industrial Production of Lumber and Products[e]	Construction Materials[e]	Farm Equipment[e]
1948	95.2	96.0	79.3	143.5
1954	98.6	104.2	92.5	107.3
1958	100.0	100.0	100.0	100.0
1963	97.4	113.9	123.1	128.0

235

Services

Many of the general points that were made concerning output in retail trades also apply to the services. The attitude and skills of the person supplying the service, the amenities provided to the customer, and the demand made upon the customer's time are clearly factors that should be considered in measuring real output. The principal question in the case of services seems to be: How well does the price index capture the quality dimensions of output? Shifts in the composition of output within a census industry can also present problems, as indicated in the following two examples.

Hotels and Motels

The postwar period has witnessed a marked shift in the composition of this industry from hotels to motels. In 1948, motels accounted for less than 10 per cent of total industry employment. By 1963 the share in motels was one-third. Receipts per worker have typically been about 5 to 10 per cent higher in motels than in hotels; this shift therefore would tend to raise the rate of change of output per man as currently measured. A factor that probably has considerable effect on output per man is the occupancy rate. Between 1939 and 1948 this rate rose markedly, but since then it has declined. By 1963 it was almost down to the 1939 level.

1958 = 100	Deflated Sales	Occupancy Rate[h]
1939	63.2	87.0
1948	103.2	123.2
1954	92.7	n.a.
1958	100.0	100.0
1963	117.4	91.3

Motion Picture Theaters

One of the factors tending to raise measured output per man in motion picture theaters has been a shift from regular movie houses to drive-ins. In 1948 the latter accounted for only 3 per cent of the industry's employment, but by 1963 this percentage had grown to over 20 per cent. Receipts per worker have typically been 10 to 20 per cent higher in drive-ins than in regular theaters.[18]

18. Sources for series presented in this section are:

[a]Automobile Manufacturers' Association, *Automobile Facts and Figures*, various issues.

[b]Number of prescriptions per store from Eli Lilly and Company, *The Lilly Digest*, 1961, 1963, multiplied by the number of establishments from the *Census of Business*.

[c]Board of Governors of the Federal Reserve System, *Industrial Production Indexes*, 1961–63, and *Industrial Production, 1957–1959 Base*.

[d]1963, Progressive Grocer, *Progressive Grocer*; 1954, Cox, Reavis, *et al.*, *Distribution in a High Level Economy*, Englewood Cliffs, N.J., 1965.

[e]Ford Motor Company dealer.

[f]U.S. Bureau of the Census, *Census of Business*.

[g]National Retail Merchants Association, *Merchandising and Operating Results*, various issues. Department and specialty stores until 1948, department stores only subsequently. 1954 data estimated by assuming the 1954–56 change in the average sale of "owned" departments applied to all departments.

[h]Harris, Kerr, and Foster, *Trends in the Hotel-Motel Business, 1963*.

APPENDIX

The Appendix is divided into two sections, one for the eighteen selected service industries and the other for the industry aggregates with which they are compared. The discussion of the industry classifications and a description of the variables is followed by a table containing the basic data.

Selected Services

Industry Classification. Two types of adjustments were necessary to achieve comparability of industries over time. The first consisted of shifting detailed kinds of business between industries. This was necessary because of modifications in the industrial classification adopted by the Census Bureau. The other adjustment concerned the inclusion of units other than stores. Nonstore retailers, which consist of mail-order houses, vending-machine operators, and house-to-house selling organizations, had to be allocated by kind of business, beginning in 1954, when they were first shown separately. Administrative offices, warehouses, and auxiliaries, also shown separately, were included in each year. The eighteen selected service industries as defined in this paper are described in the following paragraphs, and the Standard Industrial Classification codes used in the 1963 *Census of Business* are indicated.

  Barber Shops (SIC 724)—barber shops.

  Beauty Shops (SIC 723)—beauty shops and combination barber and beauty shops.

  Laundries (SIC 7211, 7212, 7213, 7214, 7215)—power laundries, industrial laundries, linen supply, diaper service, self-service laundries, and self-service dry cleaning. (Self-service dry cleaning was included in laundries because separate information was not available prior to 1963.)

  Dry Cleaning (SIC 7216, 7271)—cleaning and dyeing plants (except rug cleaning), and cleaning and pressing shops.

  Shoe Repair (SIC 725)—shoe repair, shoeshine, and hat cleaning establishments.

  Auto Repair (SIC 75)—auto repair shops, parking, auto and truck rentals, and auto laundries.

  Motion Picture Theaters (SIC 783)—regular motion picture theaters and drive-ins.

  Hotels and Motels (SIC 7011)—year-round hotels, seasonal hotels, motels, tourist courts, and motor hotels.

  Lumber, Building Materials, Hardware, Farm Equipment Dealers (SIC 52)—lumber yards, building materials dealers, heating, plumbing equipment dealers, paint, glass, wallpaper stores, electrical supply stores, hardware stores, farm equipment dealers.

  General-Merchandise Group Stores (SIC 53, excluding part of nonstore retailers)—department stores, limited-price variety stores, general-merchandise stores.

  Food Stores (SIC 54)—groceries, delicatessens, meat markets, fish markets, fruit stores, vegetable markets, candy, nut, confectionery stores, dairy products stores, retail bakeries, egg and poultry stores.

Automotive Dealers (SIC 55, excluding 554)—passenger car dealers, tire, battery, accessory dealers, home and auto supply stores, aircraft, motorcycle, boat, and household trailer dealers. (Dealers primarily engaged in selling trucks are classified under wholesale trade.)

Gasoline Service Stations (SIC 554)—gasoline service stations.

Apparel, Accessory Stores (SIC 56)—men's, women's, and children's wear stores, custom tailors, specialty stores, furriers, family clothing stores, shoe stores.

Furniture, Home Furnishings, Equipment Stores (SIC 57)—furniture stores, floor-covering stores, drapery, curtain, upholstery stores, china, glassware, metalware stores, household appliance stores, radio and television stores, music stores.

Eating, Drinking Places (SIC 58)—restaurants, lunchrooms, cafeterias, refreshment places, caterers, drinking places (alcoholic beverages).

Drug Stores, Proprietary Stores (SIC 591)—drug stores, proprietary stores.

Other Retail Stores (SIC 59, excluding 591)—liquor stores, book stores, stationery stores, sporting goods stores, bicycle shops, farm and garden supply stores, jewelry stores, fuel and ice dealers, florists, cigar stores, news dealers, photographic supply stores, optical goods stores, etc.

Current Dollar Output

Current dollar output is defined as receipts from customers for services rendered and merchandise sold, whether or not payment was received. Receipts of income from investments, rental of real estate, and similar items are excluded. Beginning in 1954, state and local sales taxes and federal excise taxes collected by the establishment and paid directly to a tax agency are included. The only exception to this is motion picture theaters, for which taxes are included, beginning in 1939. Sales of each of the ten retail trades were taken as the sum of each component kind of business. For total retail trade, output was derived by adding the margins (sales minus cost of goods sold) of the ten retail trades. The margins as a percentage of sales were derived from Internal Revenue Service tabulations for corporations in 1957, published in the *Statistics of Income . . . 1957–58. Corporation Income Tax Returns* and used for all years. It was determined that there were no significant differences between margins as a percentage of sales for corporations and all firms. The aggregation procedure is not sensitive to possible inaccuracies in the margin percentages.

Prices

Price indexes for all of the eight services, except hotels, are components of the U.S. Bureau of Labor Statistics Consumer Price Index. For hotels and motels, the average room rate for hotels in large cities was taken from Horwath and Horwath, *Hotel Operations in 1963*, p. 21. The drawbacks to this measure are that it is affected by quality of room and extent of multiple occupancy.

For the ten retail trades, price indexes were computed largely from components of the Consumer Price Index. Components of the Wholesale Price Index and

238

other sources were also used. For each kind of business an index was obtained by weighting components by the share of commodity sales in 1948 given in the *Census of Business.*

Real Output

Real output was obtained by deflating current dollar output by the price indexes.

Employment

Employment is defined as the number of full-time equivalent wage and salary workers plus the number of proprietors. The number of proprietors in retail trade was adjusted for changes in coverage, as will be described. Proprietors were assumed to be full-time workers, as were employees in administrative offices, warehouses, and auxiliaries of retail stores. Wage and salary workers were converted into full-time equivalents for 1948, 1954, and 1958 by assuming that the average hourly earnings of part-time workers were the same as the average hourly earnings of full-time workers in the same industry. The number of workers working the full workweek was multiplied by the ratio of payroll of all wage and salary workers to payroll of full-time wage and salary workers. For 1939, the procedure was based on annual rather than weekly earnings, since payroll and employment data were available on an annual basis only. For 1963, the 1958 relation between the total number of wage and salary workers and the number of full-time equivalent wage and salary workers were used because the number of employees working the full workweek was not given. Because data on employees of administrative offices, warehouses, and auxiliaries were not yet published, they were assumed to the same percentage of full-time equivalent wage and salary workers in 1963 as in 1958. Unpaid family workers are not included.

Coverage Adjustment

In retail trade, establishments with no paid employees were excluded from coverage in the *Census of Business* if receipts for the year did not exceed $100 in 1939, $500 in 1948, and $2,500 in 1954 and 1958. An adjustment was made to include proprietors on the 1939 coverage basis. It was assumed that the 1948 ratio of the number of establishments with receipts of $100 to $500 to the number with receipts of $500 to $1,000 equaled the 1939 ratio of the number of establishments with receipts of $100 to $250 to the number with receipts of $250 to $500, i.e.,

$$\frac{1939}{\frac{\$100 - \$250}{\$250 - \$500}} = \frac{1948}{\frac{\$100 - \$500}{\$500 - \$1,000}}$$

It was further assumed that there was one proprietor in each establishment added by the adjustment. The adjustments were made in such a way as roughly to allow for changes in the price level. For 1954 and 1958 the ratio

239

$$\frac{1939}{\$100 \quad -\$1,250} = \frac{1954 \text{ and } 1958}{\$100 \quad -\$2,500}$$
$$\$1,250-\$2,500 \quad = \quad \$2,500-\$5,000$$

was assumed. For 1963 no adjustment was made, since for the first time establishments not operated during the entire year were included if their receipts were at an annual rate of $2,500 or more. The procedure used in 1963 is probably comparable to the coverage adjustment in prior years.

The minimum-receipts sizes for services were $400 in 1948 and $1,000 thereafter. Because the limits were lower, a smaller proportion of proprietors was excluded than was excluded from trade. Moreover, reasonable estimates could not be derived from published class intervals of the receipts-size distributions by the procedure used for retail trade. For these reasons, no adjustment was made for service industries.

Total Labor Input

Total labor input is measured by payroll of all employees. Payroll for the entire year was used throughout. The payroll of proprietors was obtained by assuming that proprietors had the same average annual earnings as full-time wage and salary workers in the same industry. For 1963, payroll of administrative offices, warehouses, and auxiliaries was assumed to be the same percentage of total payroll as in 1958.

Other Industries

Methods and sources of data for the total economy, goods sector, service sector, and manufacturing are described here. Goods includes agriculture, mining, construction, manufacturing, transportation, communications and public utilities, and government enterprise. The service sector includes wholesale and retail trade, finance, insurance and real estate; personal, professional, repair, and other services; and general government. Current- and constant-dollar output are the gross product series of the Department of Commerce published in the *Survey of Current Business* of September 1964 and October 1962. The Office of Business Economics obtains constant-dollar output generally by separately deflating inputs and output. Price indexes are obtained implicitly from the current- and constant-dollar measures. For 1939, real gross product in manufacturing and goods were based on data in John W. Kendrick, *Productivity Trends in the United States*, Princeton University Press for NBER, 1961. The 1939–48 changes in Kendrick's series were applied to the 1948 gross product estimates. Employment is the number of persons engaged in production, published in the *Survey of Current Business* of July 1962 and July 1964, and in *U.S. Income and Output* and *National Income, 1954 Edition*. For total labor input, total compensation was used. Proprietors were assumed to have the same average annual compensation as wage and salary workers in the same industry group. Data on number of full-time equivalent employees and compensation of employees from which the estimate of total compensation was made were obtained from the same sources as the number of persons engaged in production. The employment and compensation figures all relate to full-time equivalents. Unpaid family workers are not included.

240

TABLE A-1
OUTPUT AND INPUT IN SELECTED SERVICE INDUSTRIES, SECTORS AND
TOTAL ECONOMY, SELECTED YEARS, 1939–63

	Current Output (millions of dollars)	Price Index (1954 = 100)	Real Output (millions of 1954 dollars)	Employment (thousands)	Labor Compensation (millions of dollars)
AUTO REPAIR					
1939	441	57.6	766	166.0	199
1948	1,561	79.6	1,961	246.2	605
1954	2,223	100.0	2,223	244.9	818
1958	3,853	111.9	3,443	378.2	1,313
1963	5,444	122.4	4,448	414.4	1,698
BARBER SHOPS					
1939	231	39.9	579	186.3	169
1948	404	75.8	533	155.2	330
1954	552	100.0	552	147.3	417
1958	783	122.3	640	183.7	555
1963	907	139.5	650	180.3	658
BEAUTY SHOPS					
1939	250	50.2	498	190.3	156
1948	434	92.0	472	163.3	293
1954	654	100.0	654	168.0	411
1958	1,028	113.8	903	246.4	642
1963	1,618	125.7	1,287	345.2	1,037
DRY CLEANING					
1939	323	63.9	505	169.4	163
1948	1,128	86.6	1,303	303.7	587
1954	1,497	100.0	1,497	314.1	750
1958	1,671	110.5	1,512	311.8	862
1963	1,763	118.1	1,494	268.1	807
HOTELS AND MOTELS					
1939	900	46.1	1,952	360.0	276
1948	2,368	74.2	3,191	444.3	778
1954	2,862	100.0	2,862	440.2	988
1958	3,644	118.0	3,088	524.8	1,277
1963	4,667	128.7	3,626	544.2	1,553
LAUNDRIES					
1939	528	52.7	1,002	281.7	264
1948	1,323	80.2	1,650	304.9	705
1954	1,605	100.0	1,605	329.2	800
1958	1,943	114.0	1,704	345.5	946
1963	2,493	133.1	1,873	346.5	1,102
MOTION PICTURE THEATERS					
1939	803	52.4	1,532	116.8	140
1948	1,614	85.8	1,881	170.2	319
1954	1,407	100.0	1,407	144.9	309
1958	1,172	116.9	1,003	134.9	294
1963	1,063	146.3	727	105.7	269
SHOE REPAIR					
1939	119	45.2	263	72.3	65
1948	219	88.2	248	64.1	118
1954	202	100.0	202	43.3	100
1958	232	115.4	201	44.7	105
1963	208	132.5	157	33.5	100

	Current Output (millions of dollars)	Price Index (1954 = 100)	Real Output (millions of 1954 dollars)	Employment (thousands)	Labor Compensation (millions of dollars)
APPAREL, ACCESSORY STORES					
1939	3,259	49.2	6,628	421.3	558
1948	9,803	101.1	9,692	625.6	1,507
1954	11,214	100.0	11,214	648.8	1,900
1958	12,706	103.2	12,311	689.1	2,168
1963	14,204	108.2	13,129	658.8	2,446
AUTOMOTIVE DEALERS					
1939	5,549	48.8	11,373	435.9	646
1948	20,104	89.6	22,432	695.0	2,111
1954	29,918	100.0	29,918	775.1	3,127
1958	31,824	110.4	28,833	794.5	3,416
1963	45,402	118.2	38,408	859.5	4,550
DRUG STORES, PROPRIETARY STORES					
1939	1,562	66.2	2,360	225.4	236
1948	4,014	90.7	4,428	300.6	607
1954	5,252	100.0	5,252	316.5	846
1958	6,779	109.0	6,218	361.4	1,079
1963	8,487	112.6	7,537	364.6	1,402
EATING, DRINKING PLACES					
1939	3,527	41.6	8,482	1,046.0	711
1948	10,683	92.4	11,560	1,570.2	2,579
1954	13,101	100.0	13,101	1,600.0	3,332
1958	15,201	110.0	13,818	1,834.8	3,901
1963	18,412	124.5	14,785	1,932.7	4,949
FOOD STORES					
1939	9,560	41.4	23,075	1,134.6	1,267
1948	29,438	93.0	31,654	1,329.9	3,521
1954	40,646	100.0	40,646	1,395.7	4,438
1958	49,693	106.1	46,823	1,492.6	5,147
1963	58,021	107.5	53,983	1,490.1	6,349
FURNITURE, HOME FURNISHINGS, EQUIPMENT STORES					
1939	1,798	54.5	3,300	255.0	351
1948	7,252	100.6	7,210	466.5	1,228
1954	9,450	100.0	9,450	494.6	1,720
1958	10,481	97.4	10,765	517.2	1,923
1963	11,481	95.9	11,972	459.4	2,085
GASOLINE SERVICE STATIONS					
1939	2,822	61.5	4,592	445.4	427
1948	6,483	85.9	7,549	447.9	885
1954	10,744	100.0	10,744	516.8	1,393
1958	14,178	108.0	13,128	657.0	1,820
1963	17,760	112.5	15,788	682.1	2,256
GENERAL MERCHANDISE GROUP STORES					
1939	6,475	51.9	12,478	849.1	983
1948	17,135	99.6	17,206	1,154.2	2,684
1954	19,241	100.0	19,241	1,234.8	3,216
1958	23,665	102.3	23,144	1,339.3	3,982
1963	31,937	105.1	30,381	1,433.9	4,956

	Current Output (millions of dollars)	Price Index (1954 = 100)	Real Output (millions of 1954 dollars)	Employment (thousands)	Labor Compensation (millions of dollars)
LUMBER, BUILDING MATERIALS, HARDWARE, FARM EQUIPMENT DEALERS					
1939	2,735	44.7	6,123	301.4	408
1948	11,152	86.4	12,906	543.7	1,441
1954	13,366	100.0	13,366	553.1	1,895
1958	14,720	108.6	13,556	553.7	2,103
1963	14,792	112.1	13,199	466.2	2,141
OTHER RETAIL STORES					
1939	4,156	53.4	7,778	546.5	712
1948	12,930	92.2	14,025	682.6	1,660
1954	16,628	100.0	16,628	737.3	2,407
1958	19,872	105.4	18,856	863.4	2,860
1963	23,258	109.8	21,178	869.7	3,519
EIGHT SERVICES					
1939	3.60	50.7	7.10	1,543	1.43
1948	9.05	80.5	11.24	1,852	3.74
1954	11.00	100.0	11.00	1,832	4.59
1958	14.33	114.7	12.49	2,170	5.99
1963	18.17	127.4	14.26	2,238	7.22
TEN RETAIL TRADES					
1939	11.20	48.3	23.20	5,661	6.30
1948	34.26	93.9	36.48	7,816	18.22
1954	43.80	100.0	43.80	8,273	24.27
1958	51.71	105.9	48.82	9,103	28.40
1963	62.75	110.6	56.72	9,217	34.65
EIGHTEEN SELECTED SERVICE INDUSTRIES					
1939	14.80	48.8	30.30	7,204	7.73
1948	43.31	90.8	47.72	9,668	21.98
1954	54.80	100.0	54.80	10,105	28.86
1958	66.04	107.7	61.31	11,273	34.39
1963	80.92	114.0	70.98	11,455	41.87
MANUFACTURING					
1939	n.a.	n.a.	47.9	10.09	14.5
1948	73.1	85.0	86.0	15.47	49.2
1954	103.8	100.0	103.8	16.25	71.9
1958	120.9	110.2	109.7	15.72	84.7
1963	160.4	115.8	138.5	16.77	110.2
SERVICES					
1939	n.a.	n.a.	95.3	21.97	28.4
1948	115.9	83.4	139.0	26.81	72.7
1954	172.5	100.0	172.5	31.56	108.1
1958	221.3	113.4	195.1	33.94	142.5
1963	299.2	126.2	237.0	37.96	193.0
GOODS					
1939	n.a.	n.a.	93.7	24.64	28.0
1948	142.4	89.7	158.7	31.76	90.4
1954	189.1	100.0	189.1	31.78	125.6
1958	221.1	108.3	204.2	30.88	148.2
1963	281.6	112.4	250.5	31.45	187.1

TABLE A-1 (concluded)

	Current Output (millions of dollars)	Price Index (1954 = 100)	Real Output (millions of 1954 dollars	Employment (thousands)	Labor Compensation (millions of dollars)
	TOTAL ECONOMY				
1939	90.2	48.1	189.0	46.60	56.3
1948	258.4	88.5	297.8	58.58	163.2
1954	361.5	100.0	361.5	63.35	233.7
1958	442.4	110.8	399.3	64.82	290.7
1963	580.7	118.5	487.6	69.41	380.2

Source: See text of Appendix.

Ce papier examine les différences de production, population active et productivité pour 17 industries de service aux Etats-Unis de 1939 à 1963. Ces industries comprennent 9 commerces de détail et 8 services, principalement du groupe services personnels. Les industries choisies sont celles pour lesquelles il a été possible d'obtenir, avec les statistiques à notre disposition, des mesures raisonnablement comparables de output et input pour certaines années depuis 1939. De plus, ce sont des industries pour lesquelles il est possible de calculer une mesure de output réel qui n'est pas basée sur le input travail.

Seize de ces industries ont des taux de changement de output réel par personne positifs. Ainsi il semble qu'il n'y ait pas de raison de supposer que la productivité ne peut pas croître, ou ne croît pas, dans les industries fournissant des services. Cependant le taux d'accroissement pour le groupe pris en entier n'est pas aussi rapide que pour le secteur manufactures ou pour le secteur de commodités dans son ensemble.

Les statistiques pour les 17 industries supportent fortement l'hypothèse d'une corrélation positive entre les taux de croissance d'une industrie et les taux de changement de la productivité. Les corrélations sont du même ordre de grandeur que celles trouvées par d'autres chercheurs dans des études des industries manufacturières.

Le coefficient de corrélation entre l'accroissement de production par personne et l'accroissement de production est .93; entre l'accroissement de production par personne et l'accroissement de population active, il est de .54 pour 1939–63. Les coefficients correspondants pour la période 1948–63 sont de .70 et .13.

Les résultats correspondent aussi à ceux trouvés pour le secteur manufactures à un autre point de vue : absence de toute corrélation entre les changements de production par personne et les changements de rémunération par personne.

Le papier se termine par une discussion des problèmes rencontrés dans la mesure des changements de production réelle dans ces industries, et présente d'autres estimations basées sur des concepts et sources différents.