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Volume Title: Productivity Trends in the United States

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Volume Publisher: UMI

Volume ISBN: 0-87014-070-1

Volume URL: <http://www.nber.org/books/kend61-1>

Publication Date: 1961

Chapter Title: Productivity, Factor Prices, and Real Incomes

Chapter Author: John W. Kendrick

Chapter URL: <http://www.nber.org/chapters/c2241>

Chapter pages in book: (p. 111 - 130)

## CHAPTER 5

### Productivity, Factor Prices, and Real Incomes

PRODUCTIVITY gains provide the increments to real product out of which the real incomes of the factors are increased. If productivity advances, wage rates and capital return necessarily rise in relation to the general product price level, since this is the means whereby the fruits of productivity gains are distributed to workers and investors by the market mechanism. The shares of the factors in the productivity increment depend on relative price movements. Changes in the factor shares in the national income as a whole depend on changes in the relative quantities of each used in the productive process as well as on changes in their relative prices.

In this chapter we shall quantify these relationships and attempt to say something about the forces underlying the divergent movements of the prices of the factors. We do not delve into the broader analysis of the dynamics of the price-cost-productivity relationship. The statement that the general price level always rises less than the average prices of the factors in proportion to the increase in total factor productivity is neutral with respect to the question of what causal forces produce price change. Nevertheless, effective price analysis requires estimates of the interrelated variables which this chapter seeks to provide. Our focus is on the increases in real income made possible by productivity advance and on the distribution of income and productivity increments between the factors.

The analysis is confined to the private domestic economy. Market price is the major means of allocating and compensating resources in this sector, and the estimates are more reliable than for the total economy including government. Most of the analysis relates to the period since 1919, for which the detailed Kuznets and Commerce estimates of income as well as product are available. It will be remembered that 1919 marked the beginning of a higher productivity trend, which has continued into the 1950's. Occasional reference will be made to changes in the variables between 1899 and 1919. These are based on current-dollar income estimates obtained by extrapolating the 1919 figures back by our estimates of gross national product and the reconciliation items and then splitting the resulting national income figures by ratios based on estimates by King and, more recently, by Budd.<sup>1</sup> The estimates for the earlier period are of

<sup>1</sup> See Willford I. King, *The National Income and Its Purchasing Power*, New York (NBER), 1930. The King estimates were used as a basis for extrapolating the factor proportions

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poorer quality than those for the years since 1919, but the trends and relationships are similar to those in the later years.

### *Concepts and Measures*

"Factor price" is used in this chapter as shorthand for the compensation (income) per unit of weighted factor input. Total factor price is obtained by dividing factor income by the sum of real labor and capital inputs, as shown in Table 25. Total factor price can be more specifically defined in terms of its components. The price of labor is the average compensation per manhour in the various industries, combined by changing manhour weights. This is a broader measure than wage rates, since it includes overtime and the cost of "fringe" benefits. Shifts of manhours among the forty or so industry groups for which manhours are estimated separately (see Appendix A) do not affect the over-all price index, but shifts among industries within these groups would.

The price, or average compensation per unit of capital input, is a compound variable, measuring, in effect, the product of the average price of capital goods and the average rate of return on the capital stock of the sector. This measure may also be interpreted as an index of the net rent earned per hour that the capital stock is available for use. As in the case of labor, the price of capital is not affected by relative shifts of capital among the twenty-five or so industry groups for which separate estimates were made, but it would be affected by intra-industry shifts.

Operationally, the average price of each of the two factor classes is obtained as the quotient of the total compensation of each and the corresponding real-input measure, as shown in Table 26. The derivation is not as simple as it may appear from the table. The national income estimates give employee compensation but do not break down the net income of proprietors between the returns on the labor and capital services furnished by proprietors. This we have done by imputing to proprietors of each industry segment the average hourly compensation of the employees of that industry. Other conventions, such as imputing the same rate of return to proprietors' capital as is earned by small corporations in the same industry, are possible, but differences stemming from alternative procedures are not crucial.<sup>2</sup>

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from 1919 to 1909. Extrapolation from 1909 to 1899 was based on estimates from Edward C. Budd, "Factor Shares, 1850-1910," *Trends in the American Economy in the Nineteenth Century*, Studies in Income and Wealth, Volume 24, Princeton (for NBER), 1960.

<sup>2</sup> Kravis has experimented with four different methods of splitting the net income of proprietors. All methods give him the same general result, i.e., returns from property ownership have a declining share in the national income since 1900; but the degree of decline differs somewhat depending on the method (see Irving B. Kravis, "Relative Income Shares in Fact and Theory," *American Economic Review*, December 1959; for a discussion of the same problem for an earlier period, see Budd, *op. cit.*).

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TABLE 25

Private Domestic Economy:  
Factor Prices, Product Prices, and Productivity, Key Years and  
Subperiods, 1899-1957

	<i>Net Domestic Product at Factor Cost<sup>a</sup></i>		<i>Factor Input</i>	<i>Factor Productivity<sup>c</sup></i>	<i>Average Price</i>	
	Current Dollars (1)	1929 Dollars (2)	1929 Dollars <sup>b</sup> (3)	(4)	Factors <sup>d</sup> (5)	Products <sup>e</sup> (6)
	MILLIONS OF DOLLARS			INDEX (1929 = 100)		
1899	13,767	28,438	44,054	64.6	31.3	48.4
1919	60,848	56,628	70,207	80.7	86.7	107.5
1929	82,669	82,669	82,669	100.0	100.0	100.0
1937	66,433	84,240	73,720	114.3	90.1	78.9
1948	203,191	135,991	92,827	146.5	218.9	149.4
1957	318,970	185,592	105,090	176.6	303.5	171.9
	LINK RELATIVES					
1899-						
1919	442.0	199.1	159.4	124.9	277.0	222.1
1919-57	524.1	327.7	149.7	218.8	350.1	159.9
1919-29	135.9	146.0	117.8	123.9	115.3	93.0
1929-37	80.4	101.9	89.2	114.3	90.1	78.9
1937-48	305.9	161.4	125.9	128.2	243.0	189.4
1948-57	157.0	136.5	113.2	120.5	138.6	115.1
	AVERAGE ANNUAL PERCENTAGE RATES OF CHANGE DERIVED FROM LINK RELATIVES					
1899-						
1919	7.7	3.5	2.4	1.1	5.2	4.1
1919-57	4.5	3.2	1.1	2.1	3.4	1.2
1919-29	3.1	3.9	1.7	2.2	1.4	-0.7
1929-37	-2.7	0.2	-1.4	1.7	-1.3	-2.9
1937-48	10.7	4.4	2.1	2.3	8.4	6.0
1948-57	5.1	3.5	1.4	2.1	3.7	1.6

NOTE: Table may not be internally consistent due to rounding.

<sup>a</sup> Differs from net domestic product at market prices chiefly by the amount of indirect business taxes. The estimate for 1929 is equal to the national income less income originating in the general-government and rest-of-the-world sectors.

<sup>b</sup> Factor input here is derived as the sum of labor and capital inputs in absolute terms (see Table 26). It differs slightly from the index given in the basic appendix tables, which represents a variable weighted average of indexes of labor and capital inputs.

<sup>c</sup> Col. (2) divided by col. (3).

<sup>d</sup> Col. (1) divided by col. (3).

<sup>e</sup> Col. (1) divided by col. (2) or col. (5) divided by col. (4).

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Capital compensation is total income less employee compensation and the imputed labor compensation of proprietors. It represents the sum of net interest, rents, royalties, and profits (corporate and noncorporate). Since net profits are influenced by the method of depreciation accounting, it should be noted that the depreciation of nonfarm assets is based on original cost. Revaluation in terms of replacement cost would give somewhat different, but not substantially different, results. The Commerce Department did adjust book depreciation figures to eliminate the effect of the accelerated amortization allowed by the Internal Revenue Service beginning in 1950.

TABLE 26  
Private Domestic Economy:  
Input, Cost, and Average Price of Labor and of Capital,  
Key Years, 1899-1957  
(dollars in millions)

	<i>Labor Cost</i>		<i>Average Price of Labor<sup>a</sup> (1929 = 100)</i>	<i>Capital Cost</i>		<i>Average Price of Capital<sup>b</sup> (1929 = 100)</i>
	<i>Current Dollars (1)</i>	<i>1929 Dollars (2)</i>		<i>Current Dollars (4)</i>	<i>1929 Dollars (5)</i>	
1899	9,623	33,878	28.4	4,144	10,176	40.7
1919	43,814	51,802	84.6	17,034	18,405	92.6
1929	59,749	59,749	100.0	22,920	22,920	100.0
1937	52,400	52,221	100.3	14,033	21,499	65.3
1948	154,769	66,859	231.5	48,422	25,968	186.5
1957	259,611	68,831	377.2	59,359	36,259	163.7

SOURCE: Current-dollar costs represent total labor compensation plus capital compensation derived as the difference between national income and labor compensation. Constant-dollar costs are computed from indexes of labor and capital input (Table A-XXII) multiplied by the 1929-dollar estimates.

<sup>a</sup> Col. (1) divided by col. (2).

<sup>b</sup> Col. (4) divided by col. (5).

Finally, since we deflate the compensation per unit of the factor inputs by an over-all price index to get real incomes, a few words should be said about the nature of the deflator used. To obtain an index of final-product prices consistent with the factor price index, it is necessary to compute the quotient of net private domestic product at factor cost in current prices and in constant prices. As a "net" measure, the implicit price deflator accords a smaller weight to the prices of capital goods than would a deflator of gross product, since the capital outlays required to offset capital consumption are excluded. By measuring the average prices of national product "at factor cost," the effect of indirect business taxes on market price is eliminated. In practice, the price index is obtained by dividing

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income in the private domestic economy by the corresponding real net product at factor cost. The latter variable is computed by extrapolating base-period income by the index of real net product at market price, since the deflated net product at factor cost should show virtually the same movement as deflated net product at market price.<sup>3</sup>

### *Total Factor Price and Productivity*

Between 1919 and 1957, total factor price more than tripled, which represents an average annual rate of advance of 3.4 per cent (see Chart 9). Average product prices went up by almost two-thirds over the same period, or at an average rate of 1.2 per cent a year. Therefore, the increase in real income per unit of total factor input amounted to 119 per cent—2.1 per cent a year on the average. By definition, the increase in real income per unit of total factor input is identical with the increase in total factor productivity, and both may be derived as the quotient of average total factor price and average product price (as defined above).<sup>4</sup>

Rough estimates for 1899–1919 imply an average annual rate of increase in total factor price of 5.2 per cent—more than in the succeeding thirty-eight years. But the average productivity advance of 1.1 per cent a year in the earlier period was significantly less than the later trend rate, and the average annual rise in the general-product price level was substantially greater—4.1 per cent compared with 1.2 per cent. Much of the increase occurred during the World War I period, but prices were already rising significantly by the turn of the century.

<sup>3</sup> See John W. Kendrick "The Estimation of Real National Product," *A Critique of the United States Income and Product Accounts*, Studies in Income and Wealth, Volume 22, Princeton University Press (for NBER), 1958. The implicit price deflators for the net product at factor cost and at market prices do not diverge substantially over the longer periods, as shown below. Nevertheless, for short-term analysis, I recommend the use of a market price index plus a reconciliation index to avoid possible misleading movements.

Implicit Price Deflators for Net Private Domestic Product,  
Key Years, 1899–1957  
(1929 = 100)

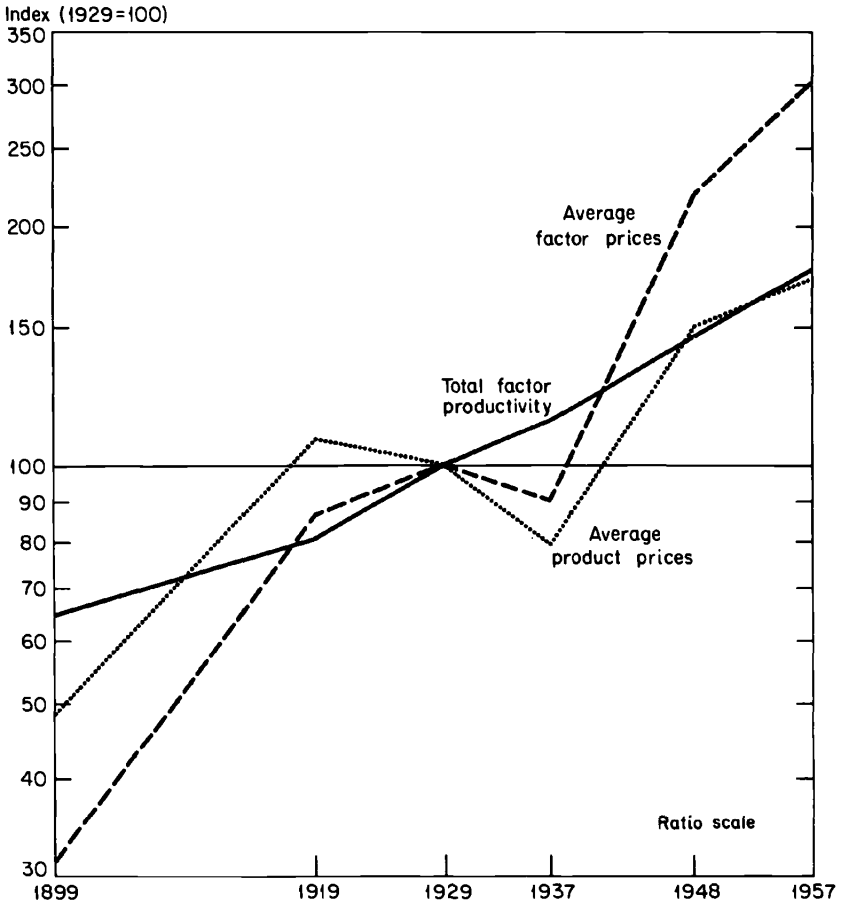
	At Market Prices	At Factor Cost	Ratio
1899	49.4	48.4	102.1
1919	108.4	107.5	100.8
1929	100.0	100.0	100.0
1937	82.1	78.9	104.1
1948	144.3	149.4	96.6
1957	172.5	171.9	100.3

<sup>4</sup> Let  $Y$  be total income, or product at factor cost,  $O$  the corresponding real product, and  $I$  the real factor input; then  $O/I = Y/I \div Y/O$ .

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CHART 9

Private Domestic Economy: Factor Prices, Product Prices, and Productivity, Selected Key Years, 1899–1957



As shown in Table 25 and Chart 9, both price composites have risen in the subperiods since 1937; in the subperiod 1929–37 both fell; from 1919 to 1929 factor price rose while product price fell. But whatever the movement of average total factor price, it will exceed the average product price movement in proportion to the productivity change, which is also the measure of change in the real income per unit of total factor input. Conversely, we may say that with any given increase in factor prices, the

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movement of the general price level will be cushioned in proportion to the increase in productivity.

Although our estimates describe the relative movements of factor price, product price, and productivity, they do not permit us to explain the price movements. The latter is, of course, a very complex matter involving demand forces, monetary factors, supply elasticities, monopolistic pricing practices in product and factor markets, and other elements. Since many of the variables are interrelated in the sequence of price change, it would be very difficult to isolate the effect of individual elements, even if all the necessary detailed estimates were at hand.

Our estimates do permit us to analyze the movement of relative factor prices and, thus, relative changes in real income per unit of labor and capital input and in their shares of the national income and productivity increments. It is to these matters that the remainder of the chapter is devoted.

### *Relative Changes in Factor Prices and Income Shares*

The index of total factor price is a composite. Each individual factor price may have changed by more or less than the weighted average of all. Average hourly labor compensation has changed in somewhat different proportions in the various occupational or industry groupings, and the price of capital has varied in different degree in the several industries. But the interindustry structures of wage rates and of capital compensation per unit have been relatively stable over time, in contrast to the marked difference in movement between the prices of the two major factor classes, labor and capital.

Between 1919 and 1957, average hourly labor compensation increased at an average annual rate of 4.0 per cent a year—more than double the 1.5 per cent average increase in the price of capital. The total increase over the thirty-eight years was 346 per cent in the case of labor rates compared with 77 per cent in the case of unit capital compensation. Reflecting the heavier weight of unit labor compensation, total factor compensation per unit rose by 250 per cent over the period, which reduces to an average annual gain of 3.4 per cent (see Table 27).

It will be noted that the 1.5 per cent average annual increase in the price of capital is somewhat higher than the rate of advance in average product prices generally. Since there was little trend in the rate of return on capital, the explanation lies primarily in a somewhat faster rise in the prices of capital goods as measured (especially plant) than in other final products. Insofar as the quality of capital goods increased more than the quality of other goods, the relative price rise is overstated.

In the earlier period, 1899–1919, the 5.2 per cent average gain in total factor price per year is a weighted average of 5.5 per cent for average



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hourly labor compensation and 4.2 per cent for capital compensation per unit. Since the relative increase in labor compensation per unit was less than in the subsequent period despite a faster growth of capital per man-hour, it may be inferred that innovation tended to be relatively more labor

TABLE 27  
Private Domestic Economy:  
Relative Factor Prices of Labor and of Capital, Key Years and  
Subperiods, 1899-1957

	<i>Price per Unit of Factor Input</i>			<i>Reciprocal Ratios</i>	
	Labor	Capital	Total	Labor to Capital <sup>a</sup>	Capital to Labor <sup>b</sup>
	(1)	(2)	(3)	(4)	(5)
INDEX (1929 = 100)					
1899	28.4	40.7	31.3	69.8	143.3
1919	84.6	92.6	86.7	91.4	109.5
1929	100.0	100.0	100.0	100.0	100.0
1937	100.3	65.3	90.1	153.6	65.1
1948	231.5	186.5	218.9	124.1	80.6
1957	377.2	163.7	303.5	230.4	43.4
LINK RELATIVES					
1899-1919	297.9	227.5	277.0	130.9	76.4
1919-57	445.9	176.8	350.1	252.1	39.6
1919-29	118.2	108.0	115.3	109.4	91.3
1929-37	100.3	65.3	90.1	153.6	65.1
1937-48	230.8	285.6	243.0	80.8	123.8
1948-57	162.9	87.8	138.6	185.7	53.8
AVERAGE ANNUAL PERCENTAGE RATES OF CHANGE					
1899-1919	5.5	4.2	5.2	1.3	-1.3
1919-57	4.0	1.5	3.4	2.5	-2.4
1919-29	1.7	0.8	1.4	0.9	-0.9
1929-37	0.0	-5.2	-1.3	5.5	-5.2
1937-48	7.9	10.0	8.4	-1.9	2.0
1948-57	5.6	-1.4	3.7	7.1	-6.7

SOURCE: Tables 25 and 26. Due to rounding, ratios may not exactly equal quotients of unit prices as shown.

<sup>a</sup> Col. (1) divided by col. (2).

<sup>b</sup> Col. (2) divided by col. (1).

saving in the earlier period. In this earlier period, the price of capital also showed a slightly greater increase than the general-product price level.

During the decade 1919-29, total factor price rose by 1.4 per cent a year—less than half its rate of increase over the whole period. The average increase in wage rates of 1.7 per cent was twice the average increase in the

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price of capital. Between 1929 and the submerged peak of 1937, wage rates barely held their own, while the price of capital, reflecting the incomplete recovery from the great depression, declined substantially. The next subperiod, 1937-48, was the only one in which the rate of increase in the price of capital exceeded that in the price of labor—10 per cent as compared with 8 per cent a year—a situation due both to the low 1937 base and to the postwar shortage of capital still prevailing at the high 1948 peak.

The relationship between factor prices reversed completely in the following period. Between 1948 and 1957, while the rate of increase in wage rates slowed somewhat, to a 5.6 per cent annual average, the price of capital declined absolutely as well as relatively. This reflected a decline in the rate of return on capital, since the prices of capital goods continued to rise.

Despite the decline in the actual average rate of return on capital in the postwar period, the expected marginal rate of return was still sufficient to induce a volume of new investment consistent with relatively full employment. In this connection, it should be noted that the early postwar rate of return on capital was abnormally high. But it is obvious that the rate of return could not continuously decline without dampening expectations and, thus, new-investment demand.

Assuming that the monetary authorities, with due regard for maintenance of high-level production, eventually pursue a policy permitting a stable or rising rate of return on capital, the partial offset to price inflation provided by a declining rate of return in the decade after 1948 would no longer operate. This would tend to promote a higher rate of advance in prices than in the 1948-57 period, unless productivity gains accelerate or the increase in wage rates relative to the price of capital slows as a result of changes in the variables we shall now examine.

### THE INVERSE RELATION OF RELATIVE FACTOR PRICES AND QUANTITIES

Why has the relative price of capital fallen over most of the period under review? Two major influences stand out—one relating to the rate of return on capital and the other, to the prices of capital goods; the product of these two variables equals the price of capital as we define and measure it.

With respect to the first influence, the amount of net capital formation has been high enough secularly in this country to result in a significantly greater increase in real capital stocks and services than in the labor force and manhours worked. The law of diminishing marginal productivity states that under these circumstances, and in the absence of technological advance, the rate of return on capital will decline. Actually, technological advance has shifted the factor demand curves upwards; so there has been no pronounced trend in the rate of return to capital, while wage rates have risen more than the price level.

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The second influence relates to the prices of capital goods. Increasing productivity in the capital goods industries, as in the economy generally, means that capital goods prices fall in relation to wage rates (or increase less), assuming relatively full employment and competitive conditions which tend to cause prices to approximate the cost of production per unit, and result in labor being paid in accordance with its (rising) marginal productivity. Since there has been no corresponding offset, i.e., no rising rate of return on capital over the long run, the decline in capital goods prices relative to wage rates is a built-in factor in dynamic economies that facilitates the substitution of capital for labor.

On the demand side, it is conceivable that inventions might be sufficiently capital-using (that is, require increasing quantities of capital relative to labor, given constant relative factor prices) to cause the demand for capital to increase more rapidly than the demand for labor. But if this has been the case (as distinguished from the substitution of capital for labor due to changing relative factor prices), the tendency has not been strong enough to offset the effect on relative price of the greater increases in the supply of capital than of labor—since the estimates show that wage rates have consistently risen relative to the price of capital in all periods when capital per unit of labor was rising.<sup>5</sup>

### FACTOR SHARES IN NATIONAL INCOME

The national income accruing to each factor is the product of the quantity employed and its price (cost per unit). Aggregate national income is the sum of the compensations of all the factors. Thus, the share of each factor in total national income will vary in accordance with the net effect of changes in the quantity of the factor employed relative to total input, and in the price of the factor relative to average factor price.

It is apparent from Tables 26 and 29 that the input of capital rose substantially relative to labor input between 1899 and 1957 and in all subperiods except 1937–48. Between 1919 and 1957, the ratio of capital to labor input went up by 48 per cent. As a ratio to total factor input, the increase was only 32 per cent—since the marginal rate of substitution of capital for labor was more than three to one, based on the average weights accorded the two factors over the period. The ratios of the input of each factor to total factor input is shown in the first two columns of Table 28. From 1899 to 1919, the ratio of labor to total factor input had declined from 77 to 74 per cent; between 1919 and 1957 it fell further, to 66 per cent.

The decline in relative labor input was associated with a more than proportional increase in the price of labor services relative to total factor price. From 1899 to 1929, the ratio increased by 10 per cent; from 1929

<sup>5</sup> See Kravis, *op. cit.*, for further discussion of causal forces.

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to 1957, the increase was 24 per cent (Table 28). Only in the subperiod 1937-48 did the relative price of labor decline. But in all subperiods, relative prices and relative inputs of the two factors moved inversely. Clearly, it was through relative price movements that the varying supplies of the two factors were absorbed by the productive system. That is,

TABLE 28  
Private Domestic Economy:  
Factor Shares of National Income, in Current and Constant Dollars,  
Key Years, 1899-1957

	<i>Distribution of Real Factor Cost in 1929 Prices</i>		<i>Relative Factor Prices<sup>a</sup></i>		<i>Distribution of National Income in Current Prices</i>	
	Labor	Capital	Labor	Capital	Labor <sup>b</sup>	Capital <sup>c</sup>
	(1)	(2)	(1929 = 100) (3)	(4)	(5)	(6)
1899	76.9%	23.1%	90.7	130.0	69.9%	30.1%
1919	73.8	26.2	97.6	106.8	72.0	28.0
1929	72.3	27.7	100.0	100.0	72.3	27.7
1937	70.8	29.2	111.3	72.5	78.8	21.2
1948	72.0	28.0	105.8	85.2	76.2	23.8
1957	65.5	34.5	124.3	53.9	81.4	18.6

SOURCE: Tables 26 and 27. Table may not be internally consistent due to rounding.

<sup>a</sup> Indexes of ratios of individual factor prices to total factor price (see Table 27).

<sup>b</sup> Col. (1) times col. (3).

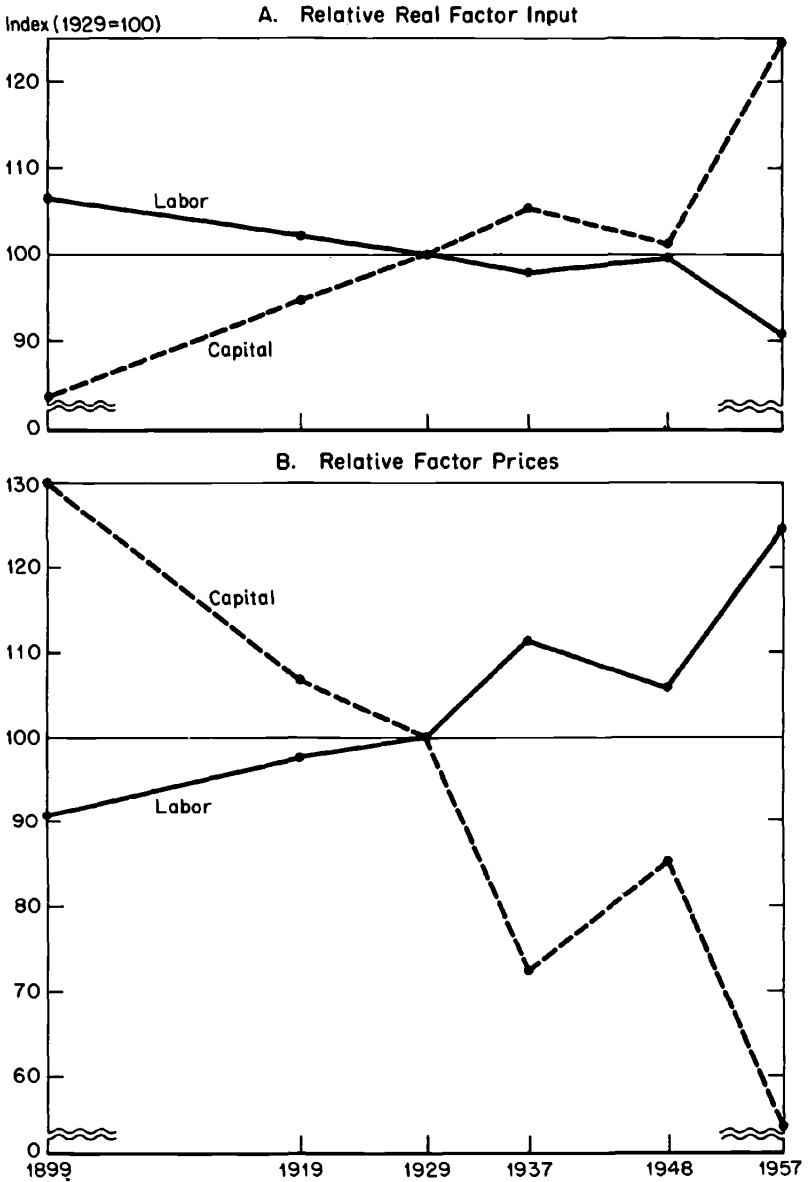
<sup>c</sup> Col. (2) times col. (4).

producers achieved cost economies by substituting the factor that was becoming relatively cheaper for the one that was growing dearer as a result of changing relative supplies. Over the period since 1919, the ratio of the percentage change in relative factor inputs to the percentage change in relative factor prices was  $-0.2$ , as shown in Table 29. The elasticity of substitution varied considerably among the subperiods, however. Between 1899 and 1919, the coefficient was almost  $-0.5$ , whereas in the two decades since 1937, it has averaged about  $-0.3$ .

The last two columns of Table 28 show the net effect on income shares of the inverse movement of relative factor inputs and prices. There was little change in shares from 1899 to 1929. But after 1929, the decline in the relative input of labor was significantly smaller than the increase in relative labor price, and the share of labor increased from 72 per cent in 1929 to 81 per cent in 1957. The same percentages may be calculated directly from Table 26. Only in the subperiod 1937-48 did labor's share in the national income temporarily decline due to the peculiar circumstances described earlier. A picture of the movements of the several variables in key years since 1919 is given in Chart 10.

CHART 10

Private Domestic Economy: Relative Changes in Factor Inputs, Factor Prices, and Factor Shares of the National Income, Selected Key Years, 1899–1957



Relative inputs and prices are ratios of labor and capital inputs and prices to total factor input and price, respectively.

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CHART 10, *continued*

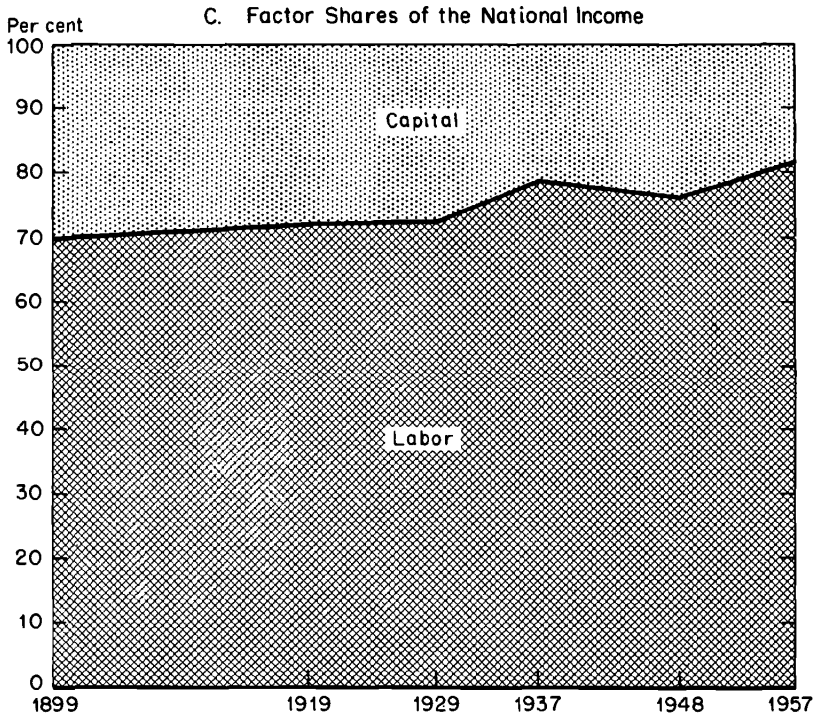


TABLE 29

Private Domestic Economy:  
Relative Changes in Real Inputs and in Unit Compensations of the Factors,  
Subperiods, 1899-1957  
(link relatives)

	<i>Real Factor Inputs</i>			<i>Unit Factor Compensations</i>			<i>Coefficient of Substitution<sup>a</sup></i>
	Labor (1)	Capital (2)	Ratio (3)	Labor (4)	Capital (5)	Ratio (6)	
1899-1919	153	181	85	298	228	131	-0.48
1919-57	133	197	68	446	177	252	-0.21
1919-29	115	125	92	118	108	109	-0.89
1929-37	87	94	93	100	65	154	-0.13
1937-48	128	121	106	231	286	81	-0.32
1948-57	103	140	74	163	88	185	-0.31

SOURCE: Tables 26 and 27. Table may not be internally consistent due to rounding.  
<sup>a</sup> [Col. (3) - 100] ÷ [Col. (6) - 100].

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### *Relative Changes in Real Factor Compensation*

#### REAL COMPENSATION PER UNIT

Once the prices of the factors have been calculated, it is easy to compute indexes of the real earnings per unit of each of the factor inputs. This involves dividing the factor prices (i.e., the current-dollar compensation per unit) by an index of the prices of products for which factor incomes are spent, directly or indirectly. For that index, we use the implicit price deflator for the net domestic product at factor cost. This index is composed of the prices of new capital goods and goods purchased by government, as well as consumer goods, although consumer goods have by far the largest weight.

It could be argued that labor income is distributed among these types of goods (i.e., among spending, saving, and taxes) somewhat differently than is the income accruing to the owners of capital; and, therefore, to measure the purchasing power of each type of compensation, different price indexes should be employed with weights based on the patterns of spending characteristic of each type of income. But both types of income are used for all the major types of final product, and it is statistically impossible to relate patterns of spending to type of factor income since most spending units do not receive a pure form of either. In any case, use of a different deflator would not substantially affect the results. Over the long period, 1919-57, the consumer price index increased by only 1 per cent more than our deflator.<sup>6</sup>

The results of deflating current-dollar factor compensation per unit by product price are shown in Table 30 in index number form. Since average hourly earnings increased substantially more than average compensation per unit of capital, it follows that the real increase in the former would also be greater. Between 1919 and 1957, real average earnings increased by 179 per cent, compared with an 11 per cent increase in real compensation per unit of capital. Between 1899 and 1919, the proportionate increase in real average hourly labor compensation was also much greater.

The gains in the real compensation of each factor can be compared with the gain in productivity, which may also be termed the gain in real income per composite unit of factor input (see Table 31 and Chart 11). The proportionate gain in the real average hourly earnings of labor was one-fourth greater than the percentage increase in productivity over the period since 1919, and between 1899 and 1919 the margin was even larger. The proportionate gain in real unit compensation of capital was

<sup>6</sup> Conceptually, a market price index would be preferable to our index at factor cost; but the differences between the two are minor and our index has the advantage of permitting precise definition of the relationships among productivity, prices, and unit factor costs.

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CHART 11

Private Domestic Economy: Productivity and Real Income per Unit of Factor Input, Selected Key Years, 1899-1957

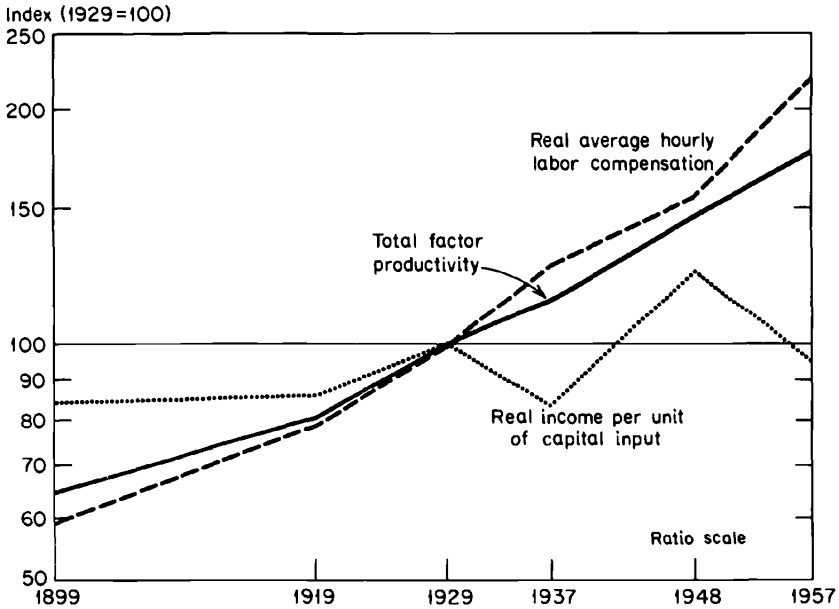


TABLE 30

Private Domestic Economy:  
Derivation of Real Factor Income per Unit, Key Years, 1899-1957  
(1929 = 100)

	Current Income per Unit (Factor Price)		Average Product Price (3)	Real Income per Unit	
	Labor (1)	Capital (2)		Labor <sup>a</sup> (4)	Capital <sup>b</sup> (5)
1899	28.4	40.7	48.4	58.7	84.1
1919	84.6	92.6	107.5	78.7	86.1
1929	100.0	100.0	100.0	100.0	100.0
1937	100.3	65.3	78.9	127.1	82.8
1948	231.5	186.5	149.4	155.0	124.8
1957	377.2	163.7	171.9	219.4	95.2

SOURCE: Tables 25 and 27.

<sup>a</sup> Col. (1) divided by col. (3).

<sup>b</sup> Col. (2) divided by col. (3).



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only about one-tenth of the productivity increase from 1919-57 and about the same in the earlier period.

The marked difference between the increases in real unit earnings of the two factors relative to the productivity increase reflects the differential movement in the prices of the two factors (see Table 31). Between 1919 and 1957, for example, the price of capital fell by around 50 per cent relative to the composite unit factor price. It was this relative decline

TABLE 31  
Private Domestic Economy:  
Productivity and Real Factor Income per Unit, Key Years and  
Subperiods, 1899-1957

	<i>Productivity<sup>a</sup></i>	<i>Relative Factor Prices</i>		<i>Real Income per Unit</i>	
	(1)	Labor (2)	Capital (3)	Labor <sup>b</sup> (4)	Capital <sup>c</sup> (5)
INDEX (1929 = 100)					
1899	64.6	90.7	130.0	58.7	84.1
1919	80.7	97.6	106.8	78.7	86.1
1929	100.0	100.0	100.0	100.0	100.0
1937	114.3	111.3	72.5	127.1	82.8
1948	146.5	105.8	85.2	155.0	124.8
1957	176.6	124.3	53.9	219.4	95.2
LINK RELATIVES					
1899-1919	124.9	107.6	82.2	134.1	102.4
1919-57	218.8	127.4	50.5	278.8	110.6
1919-29	123.9	102.5	93.6	127.1	116.1
1929-37	114.3	111.3	72.5	127.1	82.8
1937-48	128.2	95.1	117.5	122.0	150.7
1948-57	120.5	117.5	63.3	141.5	76.3
AVERAGE ANNUAL PERCENTAGE RATES OF CHANGE					
1899-1919	1.1	0.4	-1.0	1.5	0.1
1919-57	2.1	0.6	-1.8	2.7	0.3
1919-29	2.2	0.2	-0.7	2.4	1.5
1929-37	1.7	1.3	-3.9	3.0	-2.3
1937-48	2.3	-0.5	1.5	1.8	3.8
1948-57	2.1	1.8	-5.0	3.9	-3.0

SOURCE: Tables 25, 28, and 30. Table may not be internally consistent due to rounding.  
<sup>a</sup> Productivity index here differs slightly from that in the basic appendix tables because the input series was differently derived (see Table 25, note b).

<sup>b</sup> Col. (1) times col. (2).

<sup>c</sup> Col. (1) times col. (3).

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that was associated with a smaller increase in real earnings per unit of capital than in productivity and made it possible for the real average earnings of labor to rise substantially more than the proportionate increase in productivity.<sup>7</sup>

Apparently, so long as capital services increase more rapidly than labor services and the price of capital rises less rapidly than wage rates, wage rates can rise somewhat faster than total factor productivity and still be consistent with a stable product price level. Beyond a point, however, increases in wage rates and the price of capital are associated with price inflation, as is indicated by this historical survey.

### TOTAL REAL FACTOR INCOMES

Having estimated real income per factor unit by type, it is only necessary to multiply these estimates by the real input of each of the factors in order to obtain the total real incomes of each. The same result may be obtained by dividing the total current-dollar compensation of each of the factors by the product price deflator. But the more roundabout procedure of taking the product of the deflated unit compensations and inputs yields additional analytical material.

We already know that capital stocks and inputs rose in relation to labor input over the period under review. In absolute terms, between 1919 and 1957 labor input increased by one-third, while capital input almost doubled (Table 32). But we also know that relative changes in real income per factor unit were more pronounced and inverse to the relative input changes. Real capital compensation per unit rose by 11 per cent, while real unit labor compensation was up by 179 per cent over the thirty-eight-year period.

Putting the two variables together, we find that total real labor income rose by 270 per cent from 1919 to 1957, while real capital income rose by 118 per cent. Reduced to average annual rates of change, real labor income has grown by 3.5 per cent a year, or 1.4 percentage points more than the rate of growth of real capital income. The faster growth of real labor income prevailed in all subperiods except that of 1937-48.

The important fact is that the larger relative gains in real unit labor compensation more than offset the relative decline in labor input, leading to a greater rise in real labor income than in capital. The proportionate shares of the factors in real national income can be computed from Table 32, but these are the same as shown in Table 28 as computed from current-dollar national income, since the same price deflator was applied to both shares.

<sup>7</sup> For a fuller treatment of the real wage-productivity relation, see John W. Kendrick, "The Wage-Price-Productivity Issue," *California Management Review*, Spring 1960.



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*Factor Shares of Productivity Gains*

The fact that the labor share of national income rose in relation to the labor proportion of factor input implies that the labor share of productivity gains during the period was larger than its share of the national income at the beginning of the period. The estimates in Table 32 permit us to calculate the factor shares of the productivity increment, as shown in Table 33 for the period since 1919.

TABLE 33  
Private Domestic Economy:  
Factor Shares in Productivity Gains, Subperiods, 1919-57  
(millions of 1929 dollars)

	1919- 1957	1919- 1929	1929- 1937	1937- 1948	1948- 1957
<b>Total</b>					
1. Change in real income (product)	+128,964	+26,041	+1,571	+51,751	+49,601
2. Change in factor input	+34,883	+12,462	-8,949	+19,107	+12,263
3. Productivity gain (1 - 2)	+94,081	+13,579	+10,520	+32,644	+37,338
<b>Labor</b>					
4. Change in real income	+110,285	+18,972	+6,676	+37,169	+47,468
5. Change in input	+17,029	+7,947	-7,528	+14,638	+1,972
6. Labor gain (4 - 5)	+93,256	+11,025	+14,204	+22,531	+45,496
7. Labor share of total productivity gain (6 ÷ 3)	99.1%	81.2%	135.0%	69.0%	121.8%
<b>Capital</b>					
8. Change in real income	+18,679	+7,069	-5,105	+14,582	+2,133
9. Change in input	+17,854	+4,515	-1,421	+4,469	+10,291
10. Capital gain (8 - 9)	+825	+2,554	-3,684	+10,113	-8,158
11. Capital share of total productivity gain (10 ÷ 3)	0.9%	18.8%	-35.0%	31.0%	-21.8%

SOURCE: Changes in real income and input computed from estimates shown in Table 32.

For this purpose, we may estimate the real income resulting from productivity advance between two periods as the difference between the increment to real product and the increment to real factor input (cost).<sup>8</sup> Total factor input is an approximation to what real product would have been in the absence of productivity gain, since the volumes of inputs are weighted by the constant, base-period product (at factor cost) accruing

<sup>8</sup> This procedure is also suggested in the United Nations report, *A System of Price and Quantity Indexes for National Accounts*, Economic and Social Council, E/CN.3/C.46, New York, December 27, 1957 (mimeographed, limited distribution).

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to each type of factor. Thus, to the extent that actual real product rises more than factor input, the difference represents that part of the increase in real product resulting from productivity advance.

Similarly, the increment to the real income of each of the factors is compared with its input increment. Real labor input, for example, indicates what the real income of labor would have been had there been no change in real compensation per manhour. The excess of increments to actual real labor income over increments of real labor input is one measure of labor's share in the total gain in real income due to productivity advance. The same reasoning holds for capital input.

Since the real incomes of each of the factors add up to total real product at factor cost, and since the inputs of each add to total factor input, the excess of real income of each factor over the real input adds up to the total productivity increment. Thus, the real income gain of each factor may be expressed as a proportion of the over-all productivity gain. It should be noted that one factor may appropriate more than the total productivity gain if the real unit income of the other factor actually declines in a given period.

Over the entire period, 1919-57, labor obtained 99 per cent of the productivity increment (Table 33). This is consistent with the increase in labor's share of the national income from 72 per cent in 1919 to 81 per cent in 1957, in contrast to its declining proportion of real factor input.

The only period in which labor's share of the productivity increment was less than its share of national income in the initial year was 1937-48. Between these years, labor commanded only 69 per cent of the productivity gain, and its share of national income declined from 79 to 76 per cent. In two of the periods, 1929-37 and 1948-57, labor obtained more than the total productivity increment. These were periods during which the rate of return on capital actually dropped—in the first, because of incomplete recovery from depression, and in the second, because of the readjustment from a condition of postwar capital shortage to a more normal situation. The estimates for the early period are not good enough for this sort of calculation, but the relative factor price movements indicate that the result would be similar to that obtained for the later period.

The mathematics of this approach indicates that labor would get the total productivity increment if the real compensation of capital per unit showed no change. Since the price of capital is the product of the average price of capital goods and the rate of return on capital, this would happen under two circumstances: first, if the average price of capital goods showed the same movement as average final product prices generally; and second, if the rate of return on capital remained constant. That capital obtained some of the productivity increment was due to a small relative increase in capital goods prices, not entirely offset by a slight decline in the rate of return on capital between 1919 and 1957.