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VERTICALLY INTEGRATED MEASURES OF THE RATE OF PROFIT IN THE UNITED STATES 1950–90

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This paper investigates the importance of increases in the productivity of producing capital in estimates of the profit rate decline which occurred in the United States during the period 1950-90. We find that, when profit rate measures take into account the increasing productivity of producing capital stock (as measured by the embodied labor required to produce it), the observed decline is about one-half that found using conventional measures of profit. This finding has important implications for interest rate and investment policies.

I. INTRODUCTION

The long-run tendency of the rate of profit to decline has been recognized for quite some time. Smith, Ricardo, Marx, Jevons, and Mill, for different reasons, all expected the rate of profit to decline in the long run (Blaug, 1985; Eltis, 1987). In the 20th century, however, discussion of the tendency was generally confined to Marxian writers until quite recently (Meek, 1960; Reuten, 1991). The discussion reentered the mainstream with studies sponsored by the Brookings Institute in the early 1970s (Feldstein and Summers, 1977; Lovell, 1978; Nordhaus, 1974; Okun and Perry, 1970). More recent studies using a variety of measures of profit (or the rate of return on investment) have confirmed a significant decline since the 1950s (Duménil, Glick, and Rangel, 1987; Duménil, Glick, and Lévy, 1993; Moseley, 1987; Wolff 1979). The decline in the rate of profit has been reported for most of the EEC countries as well as for the U.S., so the phenomenon has great importance as one of those economic "sea changes" that appears to be independent of the unique structural characteristics and different economic policies of individual countries. Explanations of the decline in profit rates vary widely, as do explanations of the determination of profit itself (Naples and Aslanbeiqui, 1996). Weisskopf (1979) presents evidence that the decline was the result of the rising strength of labor, while Moseley (1985, 1987) believes that it is due to an increasing share of unproductive labor.

In this study we use vertically integrated measures (Pasinetti, 1973, 1981) of profit which include the effects of changes in the productivity of producing capital. In contrast to standard productivity measures, vertically integrated measures yield consistent results when aggregated.[1] When neoclassical measures of productivity growth rates are aggregated, each sector's rate of productivity growth is weighted by the ratio of its gross output to the total final output of the economy. These weights sum to more than one, so it would be possible for the productivity growth rate of every sector to be less than the measure for the economy as a whole (see the discussions of input–output productivity measures by Peterson, 1979; Rymes, 1972, 1983, 1986; and Wolff, 1994). In the IO approach aggregation yields consistent results since each sector's weight is simply its share of total final demand.

We calculate two rates of profit for ten sectors of the U.S. economy and we find that when increases in the productivity of producing capital are included in productivity measures, the decline in profit rates is much less pronounced. The first measure is equivalent to the standard rate of return based on the estimated dollar value of net replacement capital. The second is based on profit calculated when capital is measured in embodied labor inputs. A list of the sectors used is given in Appendix A. Data sources are given in Appendix B.

II. Two Measures of Profit Rates

Profit rates were measured for each sector as follows:

Let:

$$VA = W + Z + V. \tag{1}$$

where VA = (column) vector of value added by sector; W = (column) vector of each sector's wage bill (total value of employee compensation); Z = (column) vector of other factor payments (sector depreciation + sector net interest + sector indirect tax + sector corporate tax); V = (column) vector of total sector profits, $V = (VA - W - Z)$ and let,

$$Ks = B\hat{X} \tag{2}$$

where Ks = a matrix of total sector capital/output requirements; B = a matrix of capital/output coefficients; $\hat{X}$ = a diagonal matrix of gross sector output

The vertically integrated factor shares per dollar of final demand are,

$$\Theta_{\pi j} = v[\mathbf{I} - \mathbf{A}]^{-1} \quad \text{(profit share)} \tag{3}$$

$$\Theta_{wj} = w[\mathbf{I} - \mathbf{A}]^{-1} \quad \text{(wage share)} \tag{4}$$

$$\Theta_{zj} = z[\mathbf{I} - \mathbf{A}]^{-1} \quad \text{(share of other factors)} \tag{5}$$

where $[\mathbf{I} - \mathbf{A}]^{-1}$ = the Leontief inverse matrix of direct and indirect coefficients; I = identity matrix; A = direct coefficient matrix; v = (row) vector of profits per dollar of sectoral gross output $(VA - W - Z)(\hat{X})^{-1}$; w = (row) vector of wages per dollar of sectoral gross output $W(\hat{X})^{-1}$; z = (row) vector of other factor shares per dollar of gross output $Z(\hat{X})^{-1}$

[1]The many criticisms of standard measures of total factor productivity (Cornwall, 1987; Denison, 1989; Gowdy and Miller, 1990; Harcourt, 1993; Kendrick, 1989; Miller and Gowdy, 1992; Rymes, 1972, 1983) also apply to neoclassical measures of profit rates for individual sectors.

Our first measure of the rate of profit is based on an estimate of the value of the vertically integrated capital stock requirements. These are,

$$\Theta_{k\$j} = k[\mathbf{I} - \mathbf{A}]^{-1} \tag{6}$$

where $k = i'B$, and i' is a row vector of ones and k is a row vector of capital stock requirements per dollar of gross sector output. Let $\hat{\Theta}_{k\$j}$ be a diagonal matrix with the inverse of the elements of the vector $\Theta_{k\$j}$ on the diagonal. The dollar-value vertically integrated rate of profit per dollar of output is,

$$\Theta_{\Pi\$j} = v[\mathbf{I} - \mathbf{A}]^{-1}[\hat{\Theta}_{k\$j}]. \tag{7}$$

Our second measure of the rate of profit is based on capital stock as measured in units of embodied labor. Total capital stock requirements are:

$$Ks = \mathbf{B}\hat{X} = \mathbf{B}[\mathbf{I} - \mathbf{A}]^{-1}\hat{Y}. \tag{8}$$

Equation (8) shows the stock of capital required to produce output, $\hat{Y}$, where $\hat{Y}$ is a diagonal matrix of final demand elements. Premultiplying (8) by the direct and indirect requirements matrix gives the replacement capital stock requirements.

$$K_R = [\mathbf{I} - \mathbf{A}]^{-1}\mathbf{B}[\mathbf{I} - \mathbf{A}]^{-1}\hat{Y}. \tag{9}$$

$$\mathrm{K}_{RHj} = h([\mathbf{I} - \mathbf{A}]^{-1}\mathbf{B}[\mathbf{I} - \mathbf{A}]^{-1})\hat{Y}. \tag{10}$$

Where h = a row vector of labor hours required per dollar of gross sector output, embodied-labor capital requirements per dollar of final output are,

$$\Theta_{KHj} = h([\mathbf{I} - \mathbf{A}]^{-1}\mathbf{B}[\mathbf{I} - \mathbf{A}]^{-1}). \tag{11}$$

Let $\hat{\Theta}_{KHj}$ be a diagonal matrix with the inverse of the elements of the row vector Θ_{KHj} on the diagonal. The embodied-labor vertically integrated profit rate equals,

$$\Theta_{\Pi Hj} = v[\mathbf{I} - \mathbf{A}]^{-1}[\hat{\Theta}_{KHj}]. \tag{12}$$

III. Estimation Results

The estimates presented are for the aggregate economy. These estimates are derived by weighting each of ten individual sector's output by its contribution to final demand. Figure 1a plots the vertically integrated value profit rate (equation 7) and 1b plots embodied-labor profit rate (equation 12). The trend lines for these figures are estimated for the period 1950–90.[2] Figure 1a shows that value profit

[2]Regression equations for value profit

$\Theta_{\$\pi}$ 1950–90 = 0.120 − 0.0018(t) AVG = 0.085 %Δ = −0.0208 $R^2 = 0.78$

1950–70 = 0.111 − 0.0005(t) AVG = 0.106 %Δ = −0.0048 $R^2 = 0.10$

1970–90 = 0.074 − 0.0010(t) AVG = 0.063 %Δ = −0.0165 $R^2 = 0.41$

Regression equations for embodied labor profit

$\Theta_{L\pi}$ 1950–90 = 1.685 − 0.0129(t) AVG = 1.42 %Δ = −0.0090 $R^2 = 0.39$

1950–70 = 1.428 + 0.0174(t) AVG = 1.60 %Δ = 0.0109 $R^2 = 0.38$

1970–90 = 1.442 − 0.0186(t) AVG = 1.25 %Δ = −0.0149 $R^2 = 0.46$

AVG is the average value for the vertically integrated coefficient for the indicated period. %Δ is the growth rate which is calculated by dividing the regression slope coefficient by the average vertically integrated coefficient.

rate ($\Theta_{\Pi\$}$) peaked at 12.2 percent in 1952, declined to 10 percent by 1961, then increased to 11.8 percent in 1964. From 1964 to 1982 value profit rates fell to 4.8 percent and recovered to 6 percent by 1990. Figure 1b shows that the embodied-labor profit rate ($\Theta_{\Pi H}$) equaled \$1.50 profit per hour of embodied labor in 1951. It remained relatively constant until 1961, then increased to \$1.95 per labor hour in 1965. From 1965 embodied-labor profits declined to \$0.97 per labor-hour in 1982, and by 1990 equaled \$1.16 per labor hour. Over the period 1950–90 value profits declined by half at a rate of –2.08 percent per year. Embodied-labor profit declined during the same period by about one-fourth; declining on trend by –0.9 percent per year. The calculated embodied-labor profit rate declined more slowly because it takes into account the increasing productivity of producing capital goods. This phenomenon was also found by Rymes (1983).

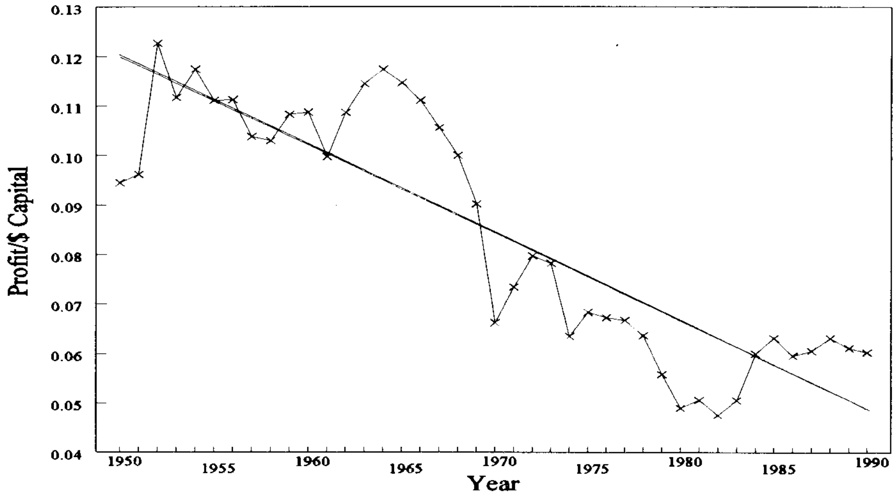

Figure 1a. Value Capital Rate

The decline in profit rates over the postwar period has to a large degree been due to the decline in profit share. Figure 2 plots profit share over the postwar period. The profit share along trend has decreased annually by –1.9 percent, declining from a share of 24 percent in 1950 to 12 percent in 1990. Except for the 1961–64 and 1982–85 periods profit share has fallen steadily. Since profit rates are calculated by dividing the profit share by capacity requirements, both measures of profit rates are affected by the decline in profit share.

In contrast to the falling rate of profit, the wage share has been relatively constant in the postwar period. The wage share rose from 57 percent in 1953 to a high of 61 percent in 1970 and declined slightly to 60 percent in 1990. Other factor shares equaled 21.5 percent in 1950 and increased to 28 percent by 1990.[3]

[3]Time series estimates for wages and other factor shares are:

Wages

1950–90 = $0.563 + 0.0011(t)$ AVG = 0.586 %Δ = 0.0019 $R^2 = 0.56$

1950–70 = $0.553 + 0.0021(t)$ AVG = 0.573 %Δ = 0.0036 $R^2 = 0.63$

1970–90 = $0.609 - 0.0009(t)$ AVG = 0.600 %Δ = –0.0015 $R^2 = 0.55$

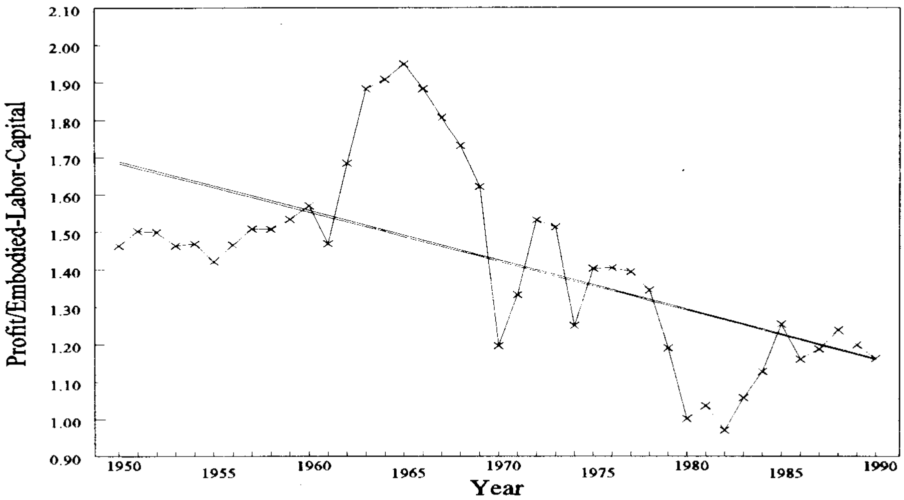

Figure 1b. Embodied-Labor Profit Rate

Figures 3a and 3b plot value–capital/output coefficients and the embodied-labor–capital/output coefficients.[4] Beginning in 1950 with a value 2.56, the value capital ratio decreased during the mid 1950s, and increased to 2.02 in 1959. It fell to 1.77 in 1968 then increased to 2.43 by 1980, and finally fell to 1.99 in 1990. Embodied-labor capital equaled 0.165 hours per dollar of capacity in 1950, and rapidly declined to 0.102 in 1968. Between 1968 and 1990 the embodied-labor capital/output ratio was very stable, the high being 0.118 in 1980 and the low 0.103 in 1989.

Profit rates (Figures 1a and 1b) are calculated by dividing the profit share (shown in Figure 2) by measures of capital capacity requirements (shown in figures 3a and 3b). From 1950 to 1965, profit's share of output decreased from 24 percent to 20 percent. Labor's share of output increased from 54 percent to 57 percent and the share of other factors increased from 21.5 percent to 22.5 percent. However, during this same time period both the value-capital profit rate and the embodied-labor profit rate increased. In both cases the decline in the amount of

[3]Continued

Other

	1950–90 = 0.201 + 0.0021(t)	AVG = 0.243	%Δ = 0.0087	$R^2 = 0.92$
	1950–70 = 0.209 + 0.0012(t)	AVG = 0.221	%Δ = 0.0055	$R^2 = 0.74$
	1970–90 = 0.236 + 0.0028(t)	AVG = 0.264	%Δ = 0.0105	$R^2 = 0.89$

[4]The time series estimates for value and embodied labor capital are:

$\Theta_{K\$}$	1950–90 = 1.963 + 0.0051(t)	AVG = 2.064	%Δ = 0.0025	$R^2 = 0.08$
	1950–70 = 2.182 − 0.0228(t)	AVG = 1.955	%Δ = −0.0116	$R^2 = 0.48$
	1970–90 = 2.132 + 0.0033(t)	AVG = 2.165	%Δ = .0015	$R^2 = 0.01$
Θ_{KL}	1950–90 = 0.145 − 0.0012(t)	AVG = 0.120	%Δ = −0.0102	$R^2 = 0.58$
	1950–70 = 0.165 − 0.0034(t)	AVG = 0.131	%Δ = −0.0261	$R^2 = 0.95$
	1970–90 = 0.108 + 0.0001(t)	AVG = 0.109	%Δ = 0.0010	$R^2 = 0.01$

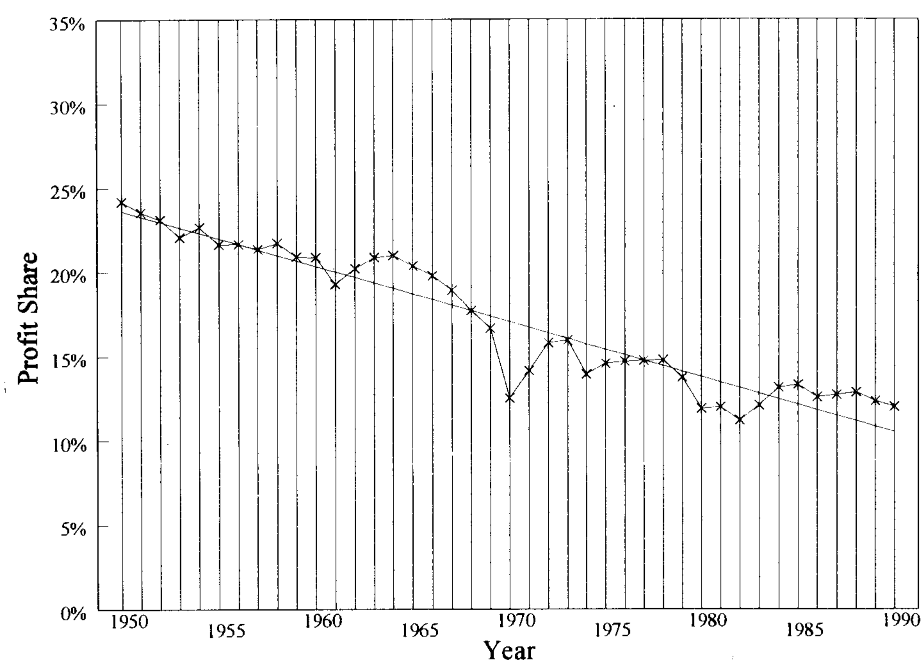

Figure 2. The Decline in Profit Share—1950–90

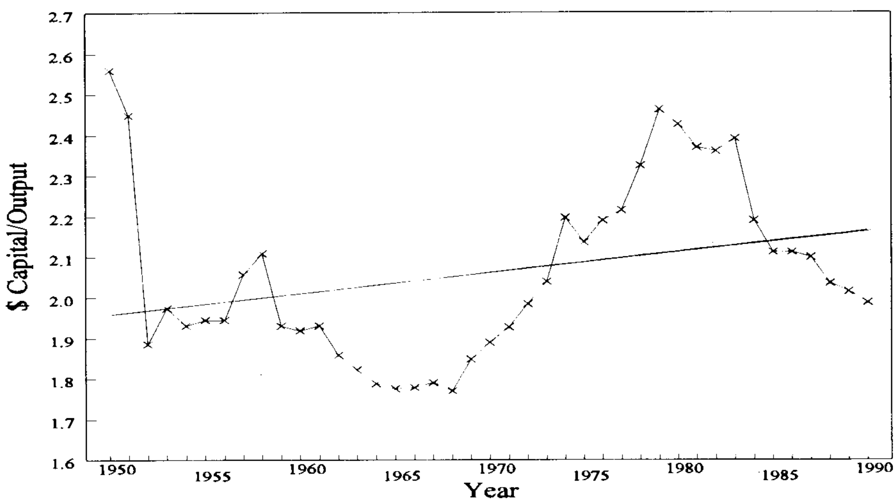

Figure 3a. Value–Capital/Output Ratio

capital needed per dollar of output more than compensated for the decline in profit shares.

From 1965 to 1990 the capital output ratio as measured by value capital increased, but the capital output ratio measured by embodied-labor capital

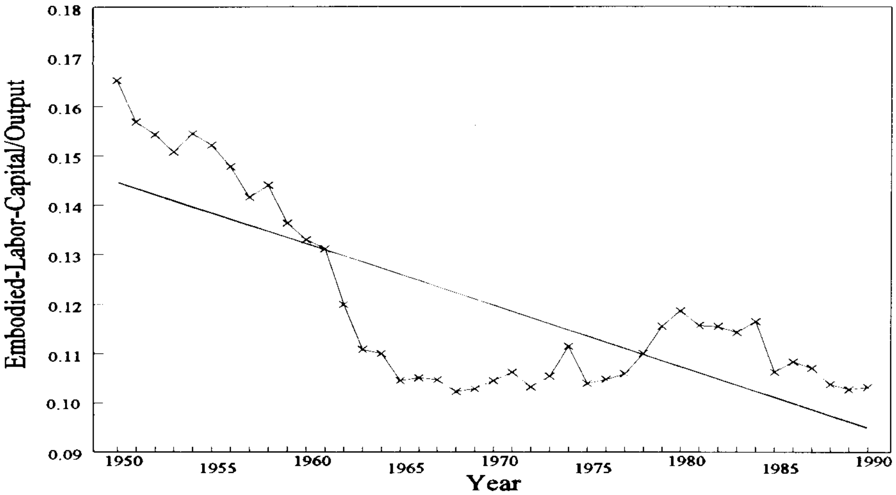

Figure 3b. Embodied–Labor–Capital/Output Ratio

remained constant. Thus, for this period the value capital profit rate fell substantially since the fall in profit shares was reenforced by the increase in capital requirements. The embodied labor profit rate measure declined more slowly since the decline in profit shares was partially offset by an increase in the productivity of producing capital capacity.

IV. Discussion

Previous studies using a variety of measures have shown that profit rates in the postwar period in the U.S. have been falling. Our results confirm this profit rate decline. However, we find that when the increasing productivity of producing capital goods is accounted for, the decline in the rate of profit is only one-half that found using measures which do not take this effect into account. This finding has important policy implications. Keynes (1973, p. 135) argued that the supply price of capital is equal to the replacement cost of production of capital goods, that is, "the price which would just induce a manufacturer newly to produce an additional unit of such assets." If capital stock is produced more efficiently, less labor is required per unit of capacity and, *ceteris paribus*, the supply price of capital should decline. With a lower supply price, full employment interest rates would be higher. If the increasing productivity of producing capital stock is not accounted for in economic forecasts, interest rates may be set below the full employment interest rate causing excess demand and inflation.

Our results imply that, in effect, a unit of productive capital became cheaper to produce over the period studied and thus a given amount of investment generated more profit potential. Over the period studied, rising interest rates could call forth a constant amount of productive capacity. Also, to the extent that standard measures overstate the magnitude of the profit rate decline, the case for policy measures favoring returns to capital against labor and other factors is considerably weakened.

Appendix A

Sectors used in the input–output analysis are:

1. Agriculture
2. Mining
3. Construction
4. Durable Manufacturing
5. Non Durable Manufacturing
6. Transportation
7. Utilities
8. Wholesale—Retail
9. Financial—Real Estate—Insurance
10. Services

Appendix B—Data Sources

The input–output matrices used are the benchmark tables constructed by the Bureau of Economic Analysis, U.S. Department of Commerce. The non-benchmark year tables were constructed by linearly interpolating the coefficients of the benchmark direct coefficient matrices. We felt that this interpolation was preferable to using the non-survey tables available for the non-benchmark table years. Capital stock estimates came from the BEA publication "Fixed Reproducible Tangible Wealth U.S., 1925–88," and unpublished capital stock estimates from BEA, for the years 1989–90. The capital stock matrix is constructed using the gross investment flow matrices published by BEA and the capital stock estimates. Estimates of the wage bill, total labor hours, net interest bill, and total corporate taxes bill are from the "National Income and Product Accounts of the U.S. 1929–82," "National Income and Product Accounts of the U.S. 1959–88," and "Survey of Current Business," July 1990. Indirect tax estimates are taken from the benchmark input–output tables published by BEA and non-benchmark years are linearly interpolated from benchmark data. For a detailed explanation of how the input–output tables were constructed, see J. Miller and J. Gowdy , "Vertically Integrated Productivity Measures: Test of Standard Assumptions," *Review of Income and Wealth*, Series 38, Number 4, pp. 450–51, December 1992.

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