Why Is The Rate of Profit Still Falling?

by

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ABSTRACT

This paper elaborates a fixed-coefficient, capital, labor, non-raw material intermediates, raw materials production model; estimates the wage share-profit rate frontier associated with it for U.S. manufacturing from 1949 to 1986; and suggests the following explanation of declining profitability. From 1949 to 1970, a rising wage share drove the manufacturing industries up along the wage-profit frontier. Declines in relative raw material prices shifted the frontier out in this period. From 1970 to 1986, raw material prices shocks shifted the frontier in, but as raw material prices declined in the 1980s, the failure of either the wage share or the rate of profit to recover to their previous levels suggests that a secular decline in the output-capital ratio has rotated the frontier inwards. This finding has significance for the theory of technical change.

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I. Introduction

According to estimates developed for this paper, the before-tax rate of return on fixed capital and inventories in U.S. manufacturing industries declined by over 50 percent from 1949 to 1986. The paper elaborates a fixed-coefficient capital, labor, intermediates production model, estimates the wage share-profit rate frontier (hereafter the wage-profit frontier) corresponding to it, and suggests the following explanation.

From 1949 to 1970, profits were squeezed by a rise in the wage share, accounting for most of the roughly 40 percent decline in profitability. Declines in the output-capital ratio and relative raw material prices offset one another over this interval. From 1970 to 1986, the wage share declined, yet the rate of profit declined another 15 percent. Since raw material prices fell in the 1980s to 1960s levels, a reduced output-capital ratio emerges the likely source of reduced profitability. Indeed, the persistent decline in the output-capital ratio suggests that technical change has a capital-using bias.

The explanation compares with that of Bruno and Sachs (1985), who assume a putty-putty production function with Harrod neutral technical change. In this model, the profit squeeze that occured in the 1960s caused capital deepening as an effect of rising product wages measured in efficiency units of labor. By extension, a period of falling product wages should initiate capital shallowing. The final sections develop the comparison.

II. The Wage-Profit Frontier

It will be useful to describe the model and the data simultaneously. The model metaphorically assumes that manufacturing produces one homogenous good (corn oil) by means of capital, labor, raw materials (corn) imported from a primary sector, and non-raw material intermediates (corn oil lubricates the presses). At a point in time, production coefficients are fixed. One may justify the capital coefficient by assuming putty-clay technology, and noting that most of the capital stock is committed to old vintages. The growth rate of the gross capital stock (about 3.4 percent per year) roughly measures the proportion of putty in a given year. Over time, new vintages cumulatively affect the technological structure, much technical change is of the disembodied variety (learning by doing, e.g.), and the coefficients evolve as a net effect in ways that can be captured by trends.

Fixed capital destroys the simplicity of the corn oil metaphor. For a large variety of indexes, the relative price of the capital stock of manufacturing rises over the interval; see column 7 of table 1 for an example. Given that much manufacturing capital stock was yesterday's own-product, one infers that technical progress has bestowed its blessings less generously upon the capital goods department than upon the consumption and intermediate goods departments.[1] As this represents a technological effect internal to manufacturing, I gainsay the relevance of distinguishing a real from a nominal output-capital ratio (note both have the dimension 1/time) within the confines of the model.

Both the total output and GDP to gross capital ratios decline over the sample; see columns 8 and 9 of table 1. A simple trend on the capital-output ratio is assumed in estimating the wage-profit frontier. For additional discussion, see the penultimate section.

Non-raw material intermediates behave similarly to manufacturing output in general; about 60 percent are own-inputs. Their relative price, measured by the Producer Price Index for Materials and Components for Manufacturing and a price index for total manufacturing output, diverges little from unity; see column 5 of table 1.

The first three columns of table 1 use BEA Input-Output data to show cost shares of intermediates. Raw materials from agriculture and mining account for most of the variation in total intermediate cost shares. Their relative price, using the Producer Price Index for Crude Materials for Further Processing, declines from 1949 to the early 1970s, exhibits two familiar spikes in the 1970s, and then drifts down to levels of the late 1960s; see column 6 of table 1. Input-output coefficients for the two categories of intermediate goods are assumed constant in estimating the wage-profit frontier.[2]

The internal rate of return of the capital stocks is usually approximated by a net accounting rate of return, but as this measure can be obtained only with difficulty owing to the nonexistence of capital consumption adjustments I use a gross accounting rate, gross operating surplus divided by gross capital stocks. Hill (1979, Ch. 3) describes the conditions under which the gross accounting rate measures the internal rate at least as precisely as does the net accounting rate. For a comparison of the net and gross rates in the nonfinancial corporate sector, consult Feldstein and Summers (1977).

The gross rate of return is adjusted for capacity utilization by dividing it by the capacity utilization index, as are the output-capital ratios in table 1. More complex techniques were not obviously superior at filling the valleys of the time series. The capacity utilization index cumulates the net additions to capacity reported by the McGraw- Hill capacity survey and divides into the FRB Industrial Production Index. This index seems to capture both cyclical and secular changes in utilization and aligns closely for years of overlap with that constructed by Christensen and Jorgenson (1969) from horsepower ratings of the electric motors in manufacturing. Where appropriate, sensitivity of results to an alternative capacity adjustment using the FRB Capacity Utilization Index is indicated. The declines in output-capital ratios in table 1 do not depend on index choice.

The wage-profit frontier for the KLNM (capital, labor, non-raw material intermediates, raw materials) model derives from the following price equation, which applies to a state of full utilization

$$(1) \quad P = [a(t)P_K]\,R_g + W\,l(t) + n\,P_n + m\,P_m$$

P - Price of output, X
$a(t)$ - Gross capital-output coefficient, K/X, at time t
K - Gross capital stocks equal end-of-year gross fixed stocks plus end-of-year inventories, constant 1982 dollars
P_K - Price deflator for gross capital stocks, K
R_g - Gross accounting rate of return, adjusted for utilization
W - Nominal wage
$l(t)$ - Labor hours-output coefficient, L/X, at time t
P_n - Price of non-raw material intermediates, N
n - Non-raw material intermediate-output coefficient, N/X
P_m - Price of raw materials, M
m - Raw material-output coefficient, M/X

The wage-profit frontier is

$$(2) \quad w = 1 - [a(t)p_K]\,R_g - np_n - mp_m$$

w - Wage share in total output, WL/PX
p_i - Relative price of i, P_i/P

One advantage of this framework is that it does not require us to specify the time-dependent movement of labor productivity.

The wage share in total output uses the BEA estimate of total compensation in manufacturing divided by the total output estimate from the BLS Time Series Data for Input-Output Industries. The price deflator for total output comes from the same BLS source. The BLS data begin in 1958, and have been extrapolated backwards with shipments (for total output) and the Producer Price Index for Finished Goods (for price deflator).

To aid interpretation of the results, and the narrative drawn from them, consider the slope and intercepts of (2). The R_g intercept is $(1 - mp_m - np_n)/a(t)p_K$ or the ratio of GDP to capital stock. It declines if the total output-capital ratio falls, or if either intermediate price rises. The raw material price changes described above account for much interesting variation in this intercept, but the decline in the total output-capital ratio reduces it secularly. The w-intercept is $(1 - mp_m - np_n)$ or the ratio of GDP to total output. Raw material price increases thus shift the frontier toward the origin, while declines in the total output-capital ratio rotate the frontier about its w-intercept, **ceteris paribus.**

III. Estimates of the Wage-Profit Frontier

Because OLS versions of equation (2) generate Durbin-Watson statistics well below the lower limit for positive first-order correlation, all estimates appearing in table 2 use a Cochrane-Orcutt transformation. One explanation for the serial correlation may simply be that the capacity adjustment (or lack of it for some variables) inevitably leaves a residue of cyclical error in the data.

The second and third estimates in table 2 suggest that the model is robust with respect to capacity utilization adjustments (estimate 2 uses the FRB index) and sample size (estimate 3 eliminates the poorer-quality pre-1958 data).

Coefficient estimates in table 2 are plausible but some are not very precise. The actual capital-output ratio, adjusted for utilization, was about 0.426 in 1949; estimate 1 of table 2 implies a ratio of 0.278. One may rationalize this discrepancy by noting that the wage-profit frontier for a multi-industry model with Leontief technology is probably convex to the origin, owing to "price Wicksell effects." A linear approximation such as equation (2) could be expected to misstate the R_g intercept. Evidently this is an inefficient technique for measuring the capital-output ratio.

The average annual increase in the actual adjusted capital-output ratio was 0.0119; all the estimates in table 2 come close to this benchmark.

The implied share of non-raw material intermediate costs in estimate 1 appears too large, and that of raw materials too small. The coefficients represent implied shares measured at the base year, 1982. Estimate 4 includes a one-period lagged value of p_m on the grounds that the production lag generates a lag between raw material price changes and their effects on booked profits. Another rationale is that P_n, an index which includes intermediates at various stages of production from gasoline to auto parts, suffers from multiple counting. Including the lagged raw material price improves the distribution of price effects over non-raw material intermediates and raw materials. The implied raw material share in 1982 becomes 12.9 percent and the implied non-raw material intermediate share 54.1 percent.[3]

For a broad view of devèlopments, all of the estimates in table 2 agree, but as the narrative that follows does require some precision about the intermediate shares for the 1980s, figure 1 plots the average predictions of estimate 4 for selected intervals. To avoid compressing the actual data into a replica of the Pleiades, the origin of figure 1 is (23.5,8); the reader should ignore apparent vertical axis intercepts, as these can mislead.

The connected raw data for R_g (adjusted) and w in figure 1 begin in the southeast corner at 1949, wind their way up to 1970 in a suggestive profile, and then are driven to the southwest by repeated raw material price shocks.[4] In 1986, when the raw material price index falls to roughly its 1968 level, the datum remains in the southwest region, **prima facie** evidence of the decline in capital productivity modeled by the trend terms in table 2.

The raw material price declines from the 1950s to the 1960s push the frontier out, so that most of the profit squeeze occurs under conditions of an improvement in the wage-profit tradeoff. Note that the secular rise in the capital-output ratio steepens the frontier over this interval. The raw material price shocks of the early 1970s shift the frontier inward quite sharply, as do those (not shown) in the late 1970s.

The decline in raw material prices by 1986 seems not to have raised the w-intercept to its 1968 level because the relative price of non-raw material intermediates remains quite high. Both the predictions of estimate 4 and the actual data[5] reported in column 4 of table 1 suggest that the total intermediate share in 1986 is about the same or slightly larger than it was in the early 1970s, and that it is larger than it was in the 1960s. Thus, since they share an intercept, comparison of the 1986 and 1970s frontiers in figure 1 dramatizes the importance of declining capital productivity, which has rotated the frontier inward over this interval. The remaining two sections address alternative interpretations of a simultaneously falling wage share,[6] output-capital ratio, and rate of profit.

IV. A Neoclassical Interpretation?

Since many readers will suspect that the decline in the output-capital ratio reflects traditional capital deepening, which has been assumed away by the KLNM model, I present some weak evidence to the contrary. Bruno and Sachs's (1985) estimates of the wage rate-profit rate frontier for U.S. manufacturing invite comparison. They assume a capital, labor, materials production function weakly separable in materials. Capital and labor produce value added in a Cobb-Douglas function; value added and materials produce output in a CES function; there are constant returns to scale. Technical change is assumed to be Harrod neutral, and to be uniform through time. The model is estimated by[7]

$$(3)\quad \log(R) = b_0 + b_1\ \text{Time} + b_2 \log(W/PPI) + b_3 \log(P_m/PPI) + b_4 \log(\text{FRB Capacity Utilization})$$

Table 4 reports results of fitting this model to more recent issues of the same data used by its authors. In particular, note that data for the net accounting rate of return (R) from Holland and Myers (1984) are now available for a larger sample.

With the new data, estimate 1 replicates but does not duplicate Bruno and Sachs's original result for 1955-1978. This estimate is a plausible fit for a KLM-type model, with materials defined somewhat more broadly than raw materials above. The implied rate of technical progress is 1.4 percent. The implied material share at a base point is around 40 percent. Based on this estimate, the decline in capital productivity through the 1960s is a straightforward example of capital deepening propelled by the rise in product wage per efficiency unit of labor. Bruno and Sachs show (1985, Fig. 2a.3) that this product wage rises throughout the 1960s and falls during the 1970s.[8] Does capital productivity continue to decline?

The remaining estimates suggest that (3) is misspecified. Enlarging the sample backwards, coefficients remain plausible (technical progress runs at 1.6 percent per year, the material share is about 28 percent). The Durbin-Watson, however, drops to just below its lower limit. Further, both estimate 1 and 2 generate out-of-sample forecasts for 1979-81 that overshoot by around 3 to 4 percentage points. Adding these three years to the sample, in estimate 3, pushes the Durbin statistic well below its lower limit. More disturbing, the coefficients no longer have plausible values; note, in particular the negative sign on the trend. One suspects that these are symptoms of a fairly major specification problem.

All this is no reason to reject a capital deepening explanation. Applied models of this type are chosen for their utility and this one gave its authors great insight into the issue they addressed (specifically, the impact of raw material price shocks on the wage rate-profit rate frontier). More importantly, the above overstates the case. Capital productivity does increase from 1972 to 1977 (see column 8 of table 1) although this is sensitive to the choice of utilization index. The remaining section elaborates the alternative account of technical change that led me to adopt the approach of the present paper, rather than, for example, to search for a putty-putty translog version of the KLNM model.[9]

V. An Alternative Interpretation

To those well-versed in such matters, the rising capital-output ratio might seem to be a confirmation of Marx's rising organic composition of capital, with its attendant **Gesetz des tendenziellen Falls der Profitrate.** Yet few Marxian economists subscribe to this putative law, primarily because of the influence of a theorem due to Okishio (1961) and resurrected by Roemer (1977).

The issue is whether a technical change which is viable, in the sense that it raises the firm's transitional rate of profit or equivalently lowers its unit costs, can cause a general decline in profitability when it diffuses throughout the industry and a new equilibrium price vector forms. Firms calculate the transitional rate at original wages and prices, using the original profit rate for discounting purposes. The Okishio Theorem states that in a circulating capital, Leontief technology world, no viable technique will lower the system-wide rate of profit if product wages remain constant. Roemer (1979) generalizes the result to von Neumann technology, which includes fixed capital as a special case. If product wages are constant, there will be a rising tendency to the rate of profit, even if the output-capital ratio falls.

Roemer (1978) presents the polar opposite case in a model in which product wages rise in response to technical change such that the wage share remains constant in each of two sectors, capital and consumption goods, that have Leontief technology and use circulating capital. A viable, capital-using, labor-saving technical change, (strictly increasing in unit capital requirements, strictly decreasing in unit labor requirements) will always depress the rate of profit if it is introduced in the capital goods sector.[10] It will not affect the profit rate if it is only introduced in the consumption goods sector.

Modeling a rising capital-output ratio with trends follows naturally from the causal ordering of Roemer's (1978) model, at least as a first approximation. Wage increases are an effect, not a cause, of viable technical changes. The rising capital-output ratio is thus one test for the existence of the type of technical change which this theory hypothesizes. The theory neither denies nor requires traditional capital deepening; a putty-clay model would seem to fit well with it, for example.

In the terms of the one manufactured commodity model of the present paper, if we assume constant intermediate coefficients and prices, we might have a one-sector, fixed capital version of Roemer's model. It is intuitive that a viable, capital-using, labor-saving technical change will decrease the rate of return if the wage share in total output remains constant. It follows from Roemer (1979) that no viable technical change can decrease the rate of profit if product wages remain constant. The real world often lies between these polar cases.

In U.S. manufacturing product wages rose less sharply than total average labor productivity from 1970 to 1986, forming an interesting historical experiment which lies between the polar cases noted. Can the basic logic of Roemer's model be applied to it? Viable, capital-using, labor-saving technical changes will not necessarily reduce the rate of profit if they increase labor productivity sufficiently more than product wages and so compensate for the increase in capital per unit of output they require. An increase in the capital-output ratio itself neither confirms nor denies the existence of a falling rate of profit induced by technical change; among others, the issue of precisely how product wages are linked to technical change remains.[11] The decline in the wage share, increase in capital per unit of output, and decline in the rate of profit which coexist from 1970 to 1986 accent the importance of theorems applying to this intermediate case.

VII. Summary

By estimating the wage share-profit rate frontier for U.S. manufacturing industry, it is possible to answer, in a broad way, the rhetorical question posed by the title of this paper. The rate of profit is still falling because the output-capital ratio is still falling. The period from 1949 to 1970 emerges as one of profit squeeze, with a rising wage share dominating other factors; the manufacturing industries moved back along the wage-profit frontier. During the 1970s, sharp raw material price shocks shifted the frontier inward, depressing both the profit rate and the wage share. By 1986, raw material price shocks ended and yet neither the rate of profit nor the wage share have resiliently recovered, consistent with the hypothesis of a persistent decline in the output-capital ratio. It is suggested that deepening our understanding of the Marxian theory of technical change in light of these developments could return a large intellectual dividend.

NOTES

1. Equipment stocks and structures in manufacturing have similarly increased in relative price. The index ratios, for 1952, 1962, 1972, and 1982, of the implicit deflator of stocks to the implicit deflator for manufacturing GDP, taking equipment and structures separately, are 66,71,79,100 and 71,63,87,100.

2. Surprisingly, experiments with dummy variables in estimates below suggested little evidence for a change in the coefficient for raw materials during the price spikes; post-1973 dummied terms were small in magnitude, with t-statistics around unity or less. This issue will not be pursued further.

3. No claim is advanced that this specification is globally valid. For example, because p_m is collinear with its lagged values, changes in sample size result in changes in the coefficients of these variables. As an experiment, I dropped beginning observations sequentially for the first years to verify this. The coefficient on p_n was fairly stable.

4. A straightforward rationale for the choice of capacity utilization adjustment is that it removes much of the bulge in the rate of profit during the 1960s, correctly, I think, identifying it with high levels of activity. See Bruno and Sachs (1985, Fig. 2A.3, p. 55) for a comparison between actual and adjusted rates that agrees with this interpretation. Had figure 1 been generated using the FRB index, the data points during this period would appear to wander off to the northeast.

5. These data use the difference between the BLS Time Series Input Output measure of total manufacturing output and the BEA measure of GDP to approximate total material costs, which are divided by total output to yield their share.

6. Note that a falling wage share in total output need not be mirrored by a rising share of gross operating surplus in total output. Both shares fell from 1972 to 1986. The wage share fell more, and thus the gross profit share in value added increased.

7. See Bruno and Sachs (1985, Ch. 2) for a full description. Equation (3) drops a term that is second-order in p_m because it turns out to be insignificant in estimations (both theirs and mine). PPI is Producer Price Index for Finished Goods.

8. Neither the estimates in table 3 nor Bruno and Sachs's original model make any allowance for declining rates of technical progress in the 1970s. Experiments with alternative trend structures were unsuccessful in generating any meaningful results along these lines.

9. Clearly, all the moving about in the wage share calls the Cobb-Douglas assumption into question since it spans periods of similar material prices, indicating a more general form.

10. This literature addresses the possibility of a falling rate of profit, not its necessity. Why should technical progress be capital-using, labor-saving? This is an <u>hypothesis</u> of the model. One might invoke a monitoring and surveillance justification for it.

11. Obviously, there are a host of other extensions needed to bring this model from its high level of abstraction to a more concrete level appropriate for more precise empirical tests, including taxes, interest, and expectations.

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Table 1. -Selected Data for U.S. Manufacturing

	Intermediate Cost Shares (%)			
	Total Intermediates (BEA)	Raw Materials	Non-Raw Material Intermediates	Total Intermediates (BLS)
Column	(1)	(2)	(3)	(4)
Year				
1949	n.a.	n.a.	n.a.	62.3
1958	63.6	10.9	52.7	61.6
1961	63.5	9.8	53.7	60.7
1963	62.7	9.0	53.6	59.9
1967	62.4	7.9	54.4	59.8
1972	61.4	8.2	53.2	61.6
1977	63.5	10.3	53.3	65.6
1982	66.8	13.1	53.7	67.1
1986	n.a.	n.a.	n.a.	63.6
Mean (1948-86)	--	--	--	62.7
St. Dev. (1948-86)	--	--	--	0.3

Table 1. (Continued....)

	Relative Price Indexes			Output-Capital Ratios	
	Non-Raw Material Intermediates	Raw Materials	Capital Stocks	Total Output	GDP
Column	(5)	(6)	(7)	(8)	(9)
Year					
1949	95.2	111.3	81.0	2.34	.883
1958	101.3	98.5	92.2	1.88	.724
1961	99.6	91.5	92.6	1.80	.708
1963	98.3	89.7	93.9	1.69	.680
1967	97.2	88.1	98.1	1.42	.572
1972	95.2	94.1	102.0	1.36	.528
1977	101.0	98.2	100.4	1.39	.478
1982	100.0	100.0	100.0	1.28	.422
1986	102.0	87.7	107.1	1.15	.418
Mean (1948-86)	99.6	100.4	95.9	1.60	.601
St. Dev. (1948-86)	2.5	10.5	6.6	.33	.146

Table 2.-Estimates of the KLNM Wage-Profit Frontier

	Estimates			
	(1)	(2)	(3)	(4)
Years	1949-86	1949-86	1959-86	1950-86
Independent Variables				
R_g	.256 (2.74)	.250 (3.00)	.152 (1.43)	.202 (2.36)
R_g X Time	.011 (2.57)	.008 (3.02)	.014 (3.25)	.017 (3.86)
p_n	.596 (16.29)	.576 (16.14)	.612 (24.06)	.541 (11.29)
p_m	.082 (2.87)	.100 (3.69)	.068 (3.27)	.088 (3.27)
p_m (-1)	---	---	---	.040 (1.17)
R^2	.648	.637	.871	.744
Durbin-Watson	1.722	1.619	1.254	1.947
Auto Rho	.663	.554	.796	.527

Notes: Absolute t-statistic is in parenthesis. The dependent variable is (1 - w) X 100.

Table 3. -Estimates of the KLM Wage Rate-Profit Rate Frontier

	Estimates		
	(1)	(2)	(3)
Years	1955-78	1948-78	1948-81
Independent Variables			
Time	.0115	.0282	-0.0385
	(0.54)	(1.22)	(2.19)
log(W/PPI)	-0.861	-1.766	.662
	(1.01)	(1.99)	(0.92)
log(P_m/PPI)	-1.250	-1.092	-0.202
	(2.95)	(2.36)	(0.43)
log(FRB CU)	3.196	2.915	2.602
	(7.09)	(6.27)	(4.88)
Constant	.975	-1.472	5.75
	(0.41)	(0.59)	(2.72)
R^2	.830	.767	.791
Durbin-Watson	1.504	1.139	0.741

Notes: The absolute t-statistic is in parenthesis. The dependent variable is the log of the profit rate.

Figure 1. -Wage Profit Frontiers, U.S. Manufacturing, 1949-86