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# NOTES AND COMMENTS

# A note on the organic composition of capital and profit rates

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It is widely believed that the rate of profit across industrial sectors, while not in fact uniform as stipulated in the theory of prices of production, is independent of the sectoral organic composition of capital. It follows that the simple labour theory of value must be systematically in error as a predictor of actual sectoral aggregate prices. We offer empirical evidence from the US economy (1987 input–output table) suggesting that this is not so: there is a substantial and statistically significant negative association between organic composition and profit rate across sectors.

*Key words:* Organic composition, Profit rates, Transformation problem
*JEL classifications:* B51, E11, P16

## 1. Introduction

In Part II of *Capital*, Volume III, Marx struggled to reconcile the labour theory of value with the proposition that an equalised rate of profit prevails—as a general tendency—across the economy as a whole. The problem was clear: if prices were proportional to embodied labour content, and if there was a common rate of surplus value across industries, then industries with a high organic composition of capital would show a low rate of profit, while industries with low organic composition of capital would show relatively high rates of profit.

Students of the Marxian 'transformation problem' differ widely on whether, or to what extent, Marx was successful in his attempted reconciliation. They also differ over whether, once equalised-profit prices (or prices of production) are given a correct analysis, any theoretical role remains for labour values (cf., Samuelson's 'erase and replace' critique). Writers on this problem have, however, been virtually unanimous in holding that the assumption of an equal rate of profit must be maintained, come what may.[1]

Now, of course, nobody believes that a uniform rate of profit is ever actually realised in capitalist economies: everyone knows there are wide disparities both between and within industries at any point in time. The key premise of the theory of prices of production is really that *the rate of profit is statistically independent of the organic composition of capital*. The problem

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[1] For various approaches to the transformation problem, see for instance Bortkiewicz (1966), Samuelson (1971), Steedman (1977), Desai (1991), Freeman and Carchedi (1996). See also the debate on 'Marx, the transformation problem and opacity' in the *Journal of Economic Literature* for March 1974 (Baumol, 1974; Samuelson, 1974 and associated articles).

 

**Table 1.** *Correlation matrix for organic composition (o), rate of profit (r) and profit share (p), UK data for 96 industries from 1984. All magnitudes in flow terms.*

| | *o* | *r* | *s* |
|---|---|---|---|
| $o = c/(s + v)$ | 1·000 | | |
| $r = s/(c + v)$ | –0·288 | 1·000 | |
| $p = s/(s + v)$ | 0·369 | 0·517 | 1·000 |

*Notes*: For a sample size of 96, the 1% critical value of the correlation coefficient, $\hat{\varrho}$, is 0·262. For methodology, see Cockshott and Cottrell (1998).

with the simple labour theory of value is that it violates this condition, predicting *systematically* lower profits for industries with high organic composition.

Nonetheless, there is now a substantial body of empirical evidence to indicate that price formation in capitalist economies can be modelled at least as well by simple labour values as it can by prices of production.[1] How can this be, if the simple labour theory of value is systematically in error, as is generally assumed? One theoretical possibility is simply that there is little variation in organic composition of capital across sectors, or that the rate of profit is very low, so that prices of production and labour values are very close.[2] But even a casual look at the data shows that this is not the explanation. The remaining possibility is that there *is* in fact a negative association between organic composition and profit rates.

In a study based on the UK input–output table for 1984 (Cockshott and Cottrell, 1998), we found that the data were inconsistent with the theory of prices of production: there was a significant negative correlation between profit rates and organic compositions of capital as predicted by the simple labour theory of value (see Table 1). The results of that study were, however, open to the criticism that our dataset (based solely on input–output flows) lacked proper capital stock figures. Capital stock figures are somewhat easier to obtain for the USA, and we present below an analysis using these data.

## 2. The US study

Our data were drawn from the 1987 US input–output table along with Bureau of Economic Analysis (BEA) capital stock figures for the same year. The BEA give figures for plant and equipment at a higher level of aggregation than that employed in the input–output table. We therefore had to merge some rows and columns of the table to ensure that each industry had a distinct figure provided for the value of plant and equipment. The resulting table has 47 columns and 61 rows. The columns—which constitute a square submatrix along with the first 47 rows—represent the aggregated industry groups. The remaining rows consist of:

- inputs for which there is no corresponding industry output listed such as 'Educational and social services, and membership organisations' or 'Noncomparable imports' (a total of nine rows).

[1] See, for instance, Farjoun and Machover (1983), Shaikh (1984), Petrovic (1987), Ochoa (1989), Valle Baeza (1994), Cockshott *et al.* (1995) and Cockshott and Cottrell (1997). Cf., Freeman (1998) for a sceptical assessment.

[2] The quantitative distinction between labour values and prices of production disappears if the aggregate rate of profit is zero or the organic composition of capital is uniform.

- 'Compensation of employees', which we treat as equivalent to variable capital.
- items which form part of surplus value:
  - 'Indirect business tax and nontax liability';
  - 'Other value added', we treat this as being profit;
  - 'Finance', we treat this as corresponding to interest; and
  - 'Real estate and royalties', which we treat as corresponding to the category rent.

The BEA figures are for fixed capital; we assumed that, in addition, industries held stocks of work in progress valued at one month's prime costs (excluding wages). The capital stock figures used were then taken as the sum of work in progress plus plant and machinery.

Modelling capital stocks is the logical dual of modelling turnover times. We are in effect assuming that, for the aggregate capital the turnover time of circulating capital is one month. This assumption is based upon the heroic simplification that there exist 12 production periods per year and that the total stocks of goods held in the production, wholesale and retail chain amount to one month's sales. A more sophisticated study would look at company accounts for firms in each sector to build up a model of the actual stocks of work in progress. Industries operating just-in-time production will have considerably lower stocks and thus faster turnover. For other industries, one month's stocks may be an underestimate. We do some rudimentary sensitivity analysis in this respect below.

*2.1 Correlations*

We computed the total value of output, industry by industry, using the labour-value and price of production models.[1] This gave two estimates for the sectoral aggregate price vector; the correlation matrix with observed prices is given in Table 2. Both estimates of the value of total industry output are highly correlated with market prices, but the labour-value estimates are marginally better.

That prices of production do not come out ahead of simple labour values in predicting market prices is comprehensible in terms of the observation that profit rates are, in general, lower in industries with a high organic composition of capital. This is shown in both Table 3 and Figure 1.

Table 3 displays the correlation coefficient between the rate of profit and organic composition, and also between the profit rate and the inverse of organic composition, across the 47 sectors. The former coefficient, at –0·454, is statistically significant at the 1% level. If, however, prices corresponded to the simple labour theory of value, we should expect to find

**Table 2.** *Correlation matrix of logs of estimates of total industry output for 47 sectors of US industry ($P$ = observed price, $E_1$ = labour values, $E_2$ = prices of production)*

| | $P$ | $E_1$ | $E_2$ |
|---|---|---|---|
| $P$ | 1 | | |
| $E_1$ | 0·971 | 1 | |
| $E_2$ | 0·968 | 0·936 | 1 |

[1] Please see Cockshott *et al.* (1995) and Cockshott and Cottrell (1997) for accounts of our methodology and caveats: we do not wish to suggest that measuring the value of output is unproblematic.

a positive linear relationship between profit rate and the inverse of organic composition (in other words, the relationship between profit rate and organic composition would be inverse, rather than negative linear), so the second coefficient is perhaps more telling: at 0·780 it has a $p$-value or marginal significance level $<0{\cdot}0001$.

Figure 1 shows three sets of points:

(1) the observed rate of profit, measured as $s/c$, where $c$ denotes capital stock;
(2) the rate of profit that would be predicted on the basis of commodities exchanging at prices proportional to their labour values, i.e., $s'v/c$ where $s'$ is the mean rate of exploitation in the economy as a whole; and
(3) the rate of profit that would be predicted on the basis of prices of production (mean $s/c$).

**Table 3.** *Profit rates and organic composition, BEA fixed capital plus one month's circulating constant capital as estimate of capital stock (c). Summary statistics weighted by denominator in each case.*

| | $s/c$ | $c/v$ | $s/v$ |
|---|---|---|---|
| Mean | 0·292 | 1·948 | 0·569 |
| Standard deviation | 0·221 | 3·042 | 0·500 |
| Coefficient of variation | 0·756 | 1·562 | 0·878 |
| | $s/c$ and $c/v$ (weighted by $c$) | $s/c$ and $v/c$ (weighted by $c$) | |
| Correlation coefficient | –0·454 | 0·780 | |

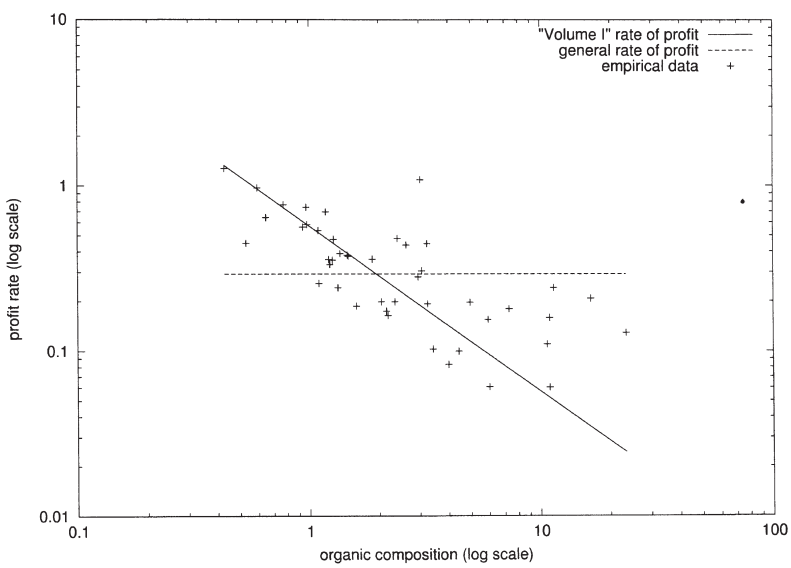


**Fig. 1.** *Relation between profit rates and organic composition, 47 sectors of the US economy, 1987.*

Note that the observed rates of profit fall close to the rates that would be predicted by the simple labour theory of value (labelled the 'Volume I rate' for short in Figure 1, since it corresponds to Marx's assumption in Volume I of *Capital* that prices are proportional to values). The exception is for a few industries with unusually high organic compositions >10.

But what are these industries? They fall into two categories, each arguably exceptional. First, there are the regulated utilities, electricity supply and gas supply. Electricity supply has an organic composition of 23·15, and displays a rate of profit half way between that predicted by the simple labour theory of value and that predicted by the price of production theory. The gas utilities have a rate of profit of 20% on an organic composition of 10·4; the labour theory of value would predict a profit rate of 7%, and the production price theory 32%. In each case, the industry is regulated and, of course, the regulatory system builds in the assumption that the utilities should earn an average rate of profit. Second, there are industries of high organic composition in which rent plays a major role. At an organic composition of 16·4, the crude petroleum and natural gas industry has a rate of profit substantially in excess of that predicted by the labour theory of value, and approximating more closely that predicted by an equalisation of the rate of profit. But this industry would be expected, on the basis of the Ricardian theory of differential rent, to sell its product above its mean value, and hence report above-average profits. In a similar position, we find the oil-refining industry with an organic composition of 9·4. Oil production and oil refining have similar rates of profit, at 31% and 32%. Since the industry is vertically integrated, this would indicate that the oil monopolies chose to report their super-profits as earned pro rata on capital employed in primary and secondary production. In both cases, however, the super-profit can be explained by differential rent.

### *2.2 Sensitivity to turnover time*

As mentioned above, we do not currently have independent data on turnover times across the sectors, hence our figures for sectoral capital stocks are not entirely satisfactory. The most we can do here is examine the sensitivity of the results to the (common) assumption about turnover time. Table 4 replicates Table 3 under the alternative assumption that industry capital stocks are composed of BEA fixed capital plus two months' worth of wages plus three months' worth of circulating constant capital. The correlations indicative of a negative or inverse association between profit rate and organic composition are still statistically significant, and apparently robust with respect to this sort of change.

**Table 4.** *Profit rates and organic composition, BEA fixed capital plus three months' circulating constant capital and two months' wages as estimate of capital stock (c)*

| | $s/c$ | $c/v$ |
|---|---|---|
| Mean | 0·239 | 2·218 |
| Standard deviation | 0·133 | 3·146 |
| Coefficient of variation | 0·558 | 1·418 |
| | $s/c$ and $c/v$ (weighted by $c$) | $s/c$ and $v/c$ (weighted by $c$) |
| Correlation coefficient | –0·457 | 0·650 |

## 3. Conclusion

The statistical independence of the rate of profit and organic composition of capital across industries in a given time interval that is assumed in price of production theories does not appear to hold for the US in 1987. The data indicate that there is an inverse relationship between the rate of profit and oranic composition across industries. (Note that this is quite distinct from any possible tendency for the rate of profit to decline *over time* as a consequence of secular changes in the economy-wide organic composition of capital.)

These data, in conjuction with other studies, do not support the idea that prices of production serve as a more accurate predictor of actual market prices than labour values. In particular, the industries which, in the USA, conform most closely to the theoretical model of production price theory are those under government regulation. To that extent, production price theory may find its true application in state-regulated capitalism.

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