# Testing the labor theory of value in Sweden

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**Abstract:** This study aims to investigate the empirical strength of the labor theory of value. Using input-output data and labor hour statistics for Sweden it replicates tests done by Cockshott and Cottrell (1998) for the British economy. Its results are broadly consistent: labor values are closely correlated with market prices. When it comes to reality, the labor theory of value works at least as well as the theory of production prices.[1]

## 1. Introduction

The labor theory of value states that the market prices of commodities tend to be proportionate to the labor socially necessary to produce them. The scientific status of the theory depends on what it can say, theoretically and empirically, about reality. It is clearly not needed to understand exploitation; basic historical materialist concepts such as 'surplus-' and 'necessary labor' are enough, so the explanatory scope of the labor theory of value (LTV) is restricted to market economies.

The LTV can generate interesting predictions regarding price-formation, the decreasing labor content of commodities, relative exchange rates etc. More importantly it is potentially a powerful analytical tool for understanding how market economies regulate social labor. Labor value is an attractor to market price, or to put it in a different way, as Valle Baeza (1997) argues, the latter can be interpreted as a measure of the former and random price-value deviations as signals to which the market, as a control system, regulates production.

But the time and effort spent investigating what merits the LTV may have in real capitalist economies pales in significance to that spent on the so-called “transformation problem” – the problem of reconciling the LTV with the theory of production prices (TPP) within a deterministic, mathematical framework.

The TPP states that prices are formed to ensure an equal profit rate across the economy. The problem is that if there was a common rate of surplus value, the LTV would predict that firms with higher composition of capital would earn lower rates of profit, and vice versa. The argument rests, however, on the assumption that there is an equalization of profit rates. Farjoun and Machover's *Laws of Chaos* (1983) is a bold attempt to break with this paradigm. Using arguments from statistical mechanics they formulate a powerful critique of the theoretical status of the assumption. To deal with chaotic market phenomena one must apply appropriate probabilistic concepts.

If the regulation of social labor in capitalism operates in the way stated above, then we should expect a linear co-variation between market prices and labor values. Also, the dispersion of price-value ratios must be relatively 'narrow'. The purpose of this article is to contribute to the empirical research on these issues. Using the approach outlined by Farjoun and Machover, it will replicate Cockshott and Cottrell's (1998) study for the UK with data from Sweden.

## 2. Data and Method

Data was taken from Statistic Sweden's input-output table (use table at purchasers' prices) and labor hour statistics from 1999. Excluding non-output sectors, the resulting table was taken as a 54 x 54 matrix of product flows across industry sectors. The number of labor hours performed were

1 Thanks to Paul Cockshott for helpful comments.

extrapolated for each sector. Seven of the sectors were considered unproductive and were excluded as production inputs (intermediate consumption) of the other sectors. These sectors were business, financial and real estate services, public administration and membership organizations.

This study is unfortunately limited by lack of data on capital stocks, so profit rates and organic composition of capital are all in flow, rather than stock terms. Nevertheless, this was the case for the UK study as well and the comparison with its results will still give us important indications. One advantage of the Swedish data is that the estimated direct labor hours are more accurate than taking the wage-bill as a proxy which is usually done in similar studies.

This reveals a real problem of measurement. Since no skill weighting is used we are in effect assuming that all labor hours are of average skill, 'simple labor'. If one uses wages instead the assumption would be that different wage-rates reflect exact skill differences. Reality lies somewhere between these opposite assumptions and although the empirical significance of this problem is likely to be limited, both methods are tested.

### 2.1 Discrete observations

From the data we obtain a discrete observation for each sector: output price $P$, constant capital $C$, variable capital $V$, surplus value $S$, labor content of output $\Lambda$ and production price of output $\Pi$.

Constant capital, variable capital and surplus value were all taken in money terms. $C$ was the total intermediate consumption of each sector and $V$ was taken its wage sum. Assuming that $C + V + S$ adds up to the output $P$ of each sector, surplus value was calculated as $S = P - (C+V)$.

Labor content and production prices were obtained following Shaikh and Tonak (1994, p.80-1) and Cockshott and Cottrell (1997, p.2):

Labor content $\Lambda$ for each sector was computed by first obtaining the vector of embodied labor-output ratios $\boldsymbol{\lambda} = (\mathbf{I}-\mathbf{A})^{-1}\mathbf{l}$, where $\mathbf{I}$ is the identity matrix, $\mathbf{A}$ is the matrix of input-output coefficients and $\mathbf{l}$ is the vector of direct labor-output ratios. Labor content for sector $i$ is then its embodied labor-output ratio $\lambda_i$ multiplied by its output $P_i$.

Production price $\Pi$ for each sector was computed by first obtaining the vector of production price-output ratios $\mathbf{p} = (\mathbf{I}-(1+r)\mathbf{A})^{-1}\mathbf{w}$, where $\mathbf{I}$ is the identity matrix, $\mathbf{A}$ is the matrix of input-output coefficients, $\mathbf{w}$ is the vector of wage-output ratios and $r$ is the general rate of profit computed for the productive $C$, $V$ and $S$. Production price for sector $i$ is then its production price-output ratio $p_i$ multiplied by its output $P_i$.

### 2.2 Probability distributions

Due to the chaotic nature of the market the variables of our interest must be treated as stochastic ones, with their specific probability distributions and statistical connections. The distributions we will investigate here are: 1. the ratio of market prices to labor content $\upsilon = P/\Lambda$. 2. profit rate $r = S/(C+V)$. 3. the ratio of market prices to prices of production $\pi = P/\Pi$. 4. organic composition of capital $o = C/(S+V)$. 5. rate of surplus value $s = S/(S+V)$.

The organic composition of capital and rate of surplus value are traditionally written as $C/V$ and $S/V$. There are however advantages of writing them as the ratio of dead to living labor and profit share as we have done here. The profit share is bounded and will have a value between 0 and 1, while $S/V$ can rise to infinity and thus has a less intuitive appeal. The ratio of dead to living labor is not affected by the distribution between wages and profits and is closer to the Marxian argument of the cause of the secular depression of the rate of profit.

What we would want is to have data on these variables at firm and commodity level. However the available data is for industry sectors so products as polyvinyl chloride will have to merge into 'rubber and plastic products'. Following Cockshott and Cottrell (1998) each sectoral observation is treated as the mean of a normal distribution since it represents the aggregation of many firms and products. The probability density function (pdf) for variable $x$ is then defined as

$$f(x) = \Sigma\, w_i N_{\mu i,\sigma}(x)$$

Here $N_{\mu i,\sigma}(x)$ is the normal pdf with mean $\mu_i$ (the observation of sector $i$) and standard deviation $\sigma$ (which was set to one fifth of the standard deviation of the whole convolving function). Each observation was also given a weight $w_i$. For the distribution of $\upsilon = P/\Lambda$ this was $w_i = \Lambda_i/\Sigma\Lambda_i$, for $\pi = P/\Pi$ it was $w_i = \Pi_i/\Sigma\Pi_i$ and for the remaining distributions the weights were $w_i = (C_i+V_i)/\Sigma(C_i+V_i)$.

The probability density functions should be interpreted the following way: The integral of $f(r)$ in interval $[a,b]$ gives the fraction of the total social capital earning a profit rate $r$ between $a$ and $b$. The integral of $f(\upsilon)$ in interval $[a,b]$ gives the fraction of the total social product, measured in embodied labor-time, exchanging for a price-value ratio $\upsilon$ between $a$ and $b$. Similar can be said for the remaining pdf:s.

## 3. Results

### 3.1 Market prices, labor values and prices of production

The relation between market prices and labor content is plotted in log-log scale in Figure 1. Unproductive sectors, which according to theory don't create value, are separated here. The greatest deviation from these comes from 'Real estate services'.

[FIGURE AND LABEL ABOUT HERE]
Figure 1. Price versus labor content in log-log scale.

The correlation coefficient is one of the tools used to quantify the relation between market prices, labor values and prices of production. It has the property of measuring the linear co-variation between two sets of data. However, since multiplicative errors for a few sectors can dominate the calculation it is common to measure the correlation on logs to even out the observations. The measure was applied for the 47 productive sectors. Correlation coefficients between market price and labor content were 0.930 and 0.965 for logs. Corresponding figures for prices of production were 0.859 and 0.978 for logs. These results are summarized in Table 1, as one can see the LTV is virtually the same as the TPP.

**Table 1.** Correlation matrix of logs of estimates of total industry output for 47 sectors

| | $P$ | $\Lambda$ | $\Pi$ |
|---|---|---|---|
| $P$ | 1 | | |
| $\Lambda$ | 0.965 | 1 | |
| $\Pi$ | 0.978 | 0.982 | 1 |

### 3.2 Empirical distributions

We now turn to the distribution of the variables of interest. The findings are summarized in Table 2 and Figures 2, 3 and 4.

**Table 2.** Summary statistics for empirical distributions

| | Sweden, 1999. 47 samples | | | UK, 1984. 96 samples[2] | | |
|---|---|---|---|---|---|---|
| Distribution | Mean | Std. Dev. | C.V. | Mean | Std. Dev. | C.V. |
| $r = S/(C+V)$ | 0.405 | 0.311 | 0.767 | 0.211 | 0.129 | 0.608 |
| $o = C/(S+V)$ | 0.902 | 0.583 | 0.647 | 0.846 | 0.636 | 0.752 |
| $\pi = P/\Pi$ | 1.000 | 0.469 | 0.469 | 1.000 | 0.114 | 0.114 |
| $\upsilon = P/\Lambda$ | 1.000 | 0.463 | 0.463 | 1.000 | 0.104 | 0.104 |
| $s = S/(S+V)$ | 0.487 | 0.149 | 0.306 | 0.315 | 0.134 | 0.423 |

Table 2 is sorted by coefficient of variation for the Swedish distributions. First one notes the data shows no support for the assumption of a narrow distribution of the rate of profit, the dispersion is wide in comparison to the other variables. Seven sectors show remarkably high rates of profit (above 80%) and the mean also much higher than in the UK study.

Secondly, the unit of labor-time is chosen so the mean price-labor content ratio $\upsilon$ is 1. Same is done for $\pi$. The dispersion of $\upsilon$ and $\pi$ are approximately the same and both are narrower than $r$ and $o$. But they are considerably wider than what Cockshott and Cottrell find (coefficient of variation of about 1/10). The theoretical considerations by Farjoun and Machover lead them to estimate the coefficient of variation to about 1/6.[3]

The difference is possibly related to the fact that the data for the UK study is less aggregated (96 samples versus 47). Moreover, it excludes four sectors from the original data that exhibit strong rent effects, no such considerations were taken in this study. If one uses the wage-bill instead of estimated direct labor hours, as discussed above, coefficient of variation drops from 0.463 to 0.372. For reference, one can also measure the coefficient of variation of price-value ratios for some alternative value base, say energy-, chemical- or fuel content.[4] These were 0.841, 1.154 and 1.306, in other words considerably higher than labor content and prices of production.

[FIGURE AND LABEL ABOUT HERE]
Figure 2. Distribution of organic composition

[FIGURE AND LABEL ABOUT HERE]
Figure 3. Distribution of rate of profit and rate of surplus value

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Figure 4. Ratios of output prices to labor content and to prices of production

### 3.3Some implications of the data

What are we to make of these results? In Sweden, market prices of industry output are correlated with their labor content. This is in line with other empirical investigations using input-output tables for the economies of the USA, the UK, former Yugoslavia, Italy, Hungary and Austria (see Maniatis and Tsoulfidis 1998, p. 14). Also, the simple labor theory of value clearly predicts market price

2 Data from Cockshott and Cottrell 1998, p. 8.
3 Farjoun and Machover 1983, chapter 5.
4 The direct and indirect input of 'Electrical energy, gas, steam and hot water' (energy), 'Chemicals, chemical products and man-made fibres' (chemical) and 'Coke, refined petroleum products, nuclear fuels' (fuel).

equally well as the theory of prices of production; both correlations coefficients and dispersion of distributions are approximately the same.

An apparent problem for the TPP is that the distribution of profit rates is far from degenerate, contrary to the assumption in theoretical models were profit rates are equal, but this is not what anyone expects to find. Cockshott and Cottrell argue instead that '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*'.[5] The labor theory of value on the other hand predicts *systematically* lower profit rates for industries with high organic composition of capital.

Table 3 shows that there is a negative correlation between profit rates $r$ and organic composition of capital $o$, as predicted by the LTV. This is also found in the UK study. It, however, detects a profit-equalizing mechanism, which is the assumption of the TPP, in that there is also a significant positive correlation between organic composition $o$ and rate of surplus value $s$. In other words, there is a certain tendency for capitals with higher organic composition to have higher rates of surplus value. This mechanism doesn't exist, or in any case is a lot weaker, for the Swedish data were the correlation between $o$ and $s$ is negative. Why the TPP still predicts market prices well is related to the fact that the rate of profit is generally a small number; a large variation in the rate of profit will produce a smaller variation in price.

**Table 3.** Correlation matrices for industry sectors. All magnitudes in flow terms

Sweden, 1999. 47 samples

| | $o$ | $r$ | $s$ |
|---|---|---|---|
| $o = C/(S+V)$ | 1.000 | | |
| $r = S/(C+V)$ | -0.542 | 1.000 | |
| $s = S/(S+V)$ | -0.201 | 0.712 | 1.000 |

UK, 1984. 96 samples[6]

| | $o$ | $r$ | $s$ |
|---|---|---|---|
| $o = C/(S+V)$ | 1.000 | | |
| $r = S/(C+V)$ | -0.288 | 1.000 | |
| $s = S/(S+V)$ | 0.369 | 0.517 | 1.000 |

Figure 5 shows the empirical relation between organic composition and rate of profit in flow terms. The fitted line is the regression of the rate of profit on the inverse of the organic composition. This does not necessarily mean that there is a tendency for the rate of profit to decline due to a general rise of organic composition of capital. However, Edvinson (2003) finds evidence in favor of this theory in Sweden, when using data on the material capital stock for the years 1800-2000, at least between the 1850s and 1970s.

[FIGURE AND LABEL ABOUT HERE]
Figure 5. Organic composition versus rate of profit

## 4. Conclusion

This article has shown that, in Sweden at least, market prices and labor content of industry output are closely correlated. This is in line with similar studies done for other economies. Also the simple LTV predicts prices equally well as the TPP. Profit rates are however neither narrow nor statistically independent from organic composition of capital, which is what one would expect from the TPP.

The distribution of price-value ratios is, although narrower than profit rates, organic composition or any reasonable alternative value base, wider than what is found in Cockshott and Cottrell's study. Whether this is a consequence of the quality of data or a real difference between economies remains unanswered.

5 Cockshott and Cottrell 2003, p. 749-750.
6 Data from Cockshott and Cottrell 1998, p. 12.

The results suggest that labor value is an attractor to market price. This could be interpreted as a practical way for market economies, capitalist or socialist, to regulate social labor. Market prices are then a measurement of labor value and, according to measurement theory, they will be subject to (1) random errors caused by supply-demand discrepancies, these are necessary for the market to regulate social labor, (2) systematic errors caused by profit-equalizing mechanisms and rent effects.

From this perspective the preoccupation with the "transformation problem" appears to be a mistake, drawing time and effort away from useful theoretical and empirical research. I believe advances in political economy will occur when one abandons the paradigm on which the transformation problem rests.

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