# A Statistical Analysis of the Operation of the Law of Value under Modern Capitalism. An Application to Austria

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Abstract

A Statistical Analysis of the Operation of the Law of Value under Modern Capitalism with an Application to Austria*)

This paper deals with the inner relationship between technological advance and the inter-industry pattern of net price dynamics. Economic theory predicts that the price of commodities depends, ceteris paribus, on the productivity of labour, and this variable in turn on the scale of production. Estimates of the pace of technological progress are based on growth rates of labour productivity. A theoretical price model is tested against Austrian data for 1975-1984: it helps to reveal and to explain the close association between changes in productivity and relative prices.

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# A STATISTICAL ANALYSIS OF THE OPERATION OF THE LAW OF VALUE UNDER MODERN CAPITALISM WITH AN APPLICATION TO AUSTRIA

According to /3/, there is a close agreement between prices and values of produced commodities in the USA for the period 1948 to 1981. It is not a priori clear whether this agreement is also valid for Austria with its relatively open economy. The present paper attempts to answer this question at least in a first approximation with the help of the formalization advanced in /3,4/ which is based mainly on /1,2/.

It is known that the magnitude of value of any commodity is the amount of labour socially necessary for its reproduction[1)]. Without going into detail, we shall demonstrate a connection between value and its money form - price - in a simplified case. The most important assumptions are the following.

Let private commodity production be such that every branch specializes in manufacturing only one kind of commodity and that all firms are strictly monoproduct ones. The economy is a closed one. It is characterized by a state of market equilibrium. We abstract from non-reproducible resources.

The total sum of labour directly and indirectly expended on the production of any product (per year) can be calculated approximately using the following equation:

$$W = l(I_1 - A)^{-1}, \qquad (1)$$

where $w = (w_1, \ldots, w_n)$ is the row vector of the total labour input coefficients; n is the number of products in the economy, $n \geq 2$; $A = \{a_{ij}\}$ is a quadratic matrix of coefficients of expenditure of means of production of kind i on producing one unit of commodity of kind j; (in other words, $a_{ij}$ is the amount of the ith product required per unit of the jth product)[2]; $l = (l_1, \ldots, l_n)$ is a row vector of direct labour input coefficients, $l_j$ ($j = 1, \ldots, n$) is the direct labour input of the jth product; $I_1$ is a unit matrix.

Denote the firm's index by k , $k \in E$ -a set of private capitalist firms that actually operate during the given year. Let $q_j^k$ denote the output of commodity j by firm k. Then the output of each branch is:

$$q_j = \sum q_j^k > 0, \quad j = 1, \ldots, n.$$

Individual input coefficients by firms are designated by $a_{ij}^k$, $l_j$, i, $j = 1, \ldots, n$; $k \in E$. Then coefficients $a_{ij}$

and $l_j$ are average weighted input quantities, the weights being output volumes $q_j$.

For convenience both terms "value" and "magnitude of value" are being used as synonyms.

The sum of labour spent to produce commodity in the k-th private firm is called individual value. It is approximated as

$$w_j^k = \sum w_i a_{ij}^k + l_j^k, \quad k \in E, \quad j = 1,\ldots,n, \qquad (2)$$

where $a_{ij}^k$, $l_j^k$ are direct input coefficients for this firm.

Technologies providing individual value lower than the social one ($w_j^k < w_j$) are, as a rule, getting a wide difusion, while extra-surplus-value is vanishing, and the social value of the i-th product is decreasing. The law of value as such presupposes net prices being proportional to corresponding direct labour input coefficients:

$$P_j - \sum p_i a_{ij} = v_j = g l_j, \qquad (3)$$

where $P_j$ is the price of the j-th commodity, $v_j$ is its net price, g is a constant for all j , $g > 0$.

The following formula is an expression of the law of value with reference to the dynamics of prices:

$$I\ v_j = I\ g\ I\ l_j \quad \text{for all } j = 1,\ldots,n, \tag{4}$$

where $I\ v_j$, $I\ l_j$ are indices of net price and direct labour intensity of commodity j (without regard for the reduction of qualified labour to a simple one), I g is assumed to be a reflection of inflation. Thus direct proportionality must exist between net prices and labour input coefficients. Hence it is likely that relative net prices drop for commodities of branches with relatively high growth of labour productivity.

The formula (4) may be tested statistically. Each branch is treated as one observation, and the movements of the variables are correlated with each other in the form of an inter-industry cross-section analysis[3]. If formula (4) is valid, there must be a negative linear correlation between indices of prices and those of labour productivity. Therefore, a linear regression model is appropriate. Its standard form is as follows:

$$y_i = \beta_o + \beta_1 x_i + u_i \quad (i = 1, \ldots, m), \qquad (5)$$

where $y_i$ is the i-th observation of the dependent variable, $x_i$ is the i-th observation of the independent (explanatory) variable, $u_i$ is i-th unobserved disturbance term; $\beta_o$ and $\beta_1$ denote the constant term and the regression coefficient to be estimated, m is the number of observations (branches).

In what follows we use the same statistical procedure not only for testing the correlation between relative net prices and relative dynamics of labour productivity, but also for a study of inter-industry pattern of growth. All regressions are of the type (5)[4].

The link between wage rates and labour productivity is not similar to that between productivity and relative prices. Wage rates in the various sectors of the economy grow at roughly the same rate because the market for labour power is not strongly segmented. This provisional assessment is supported by the relatively small variation in the movement of earnings (see below).

Suggestions to link wages and productivity at the industry level appear therefore unrealistic because they contradict this tendency (see also 19, pp.125-128/).

Differences between price and value are inherent in the priceform as such. They allow the law of value to impose itself only as the mean of apparently lawless irregularities that compensate one another.

The operation of the law of value includes movements of supply, demand, prices, as well as intra- and inter-industry competition. This mechanism has not been described by our set of equations. It requires special models that cannot be developed here. A brief hint at a few important aspects of the operation of the law of value must suffice.

Deviations of prices from value are partly due to market disequilibrium: prices deviate upward or downward from the centre of gravity depending on the extent of excess demand or excess supply.

These deviations provide for a redistribution of surplus-value produced in slowly growing or even declining industries in favour of fast growing ones (differences in output growth rates can be expected to reflect the differences in the rates of increase in demand for the output of various industries). In this way relatively fast growing industries get additional resources for their development.

Endogeneous technological progress brings about structural changes in the economy which in turn serve as its indicator.

The fast growing industries are usually characterized by rapid technological progress and by above-average increases in labour productivity which in turn cause both relative values and relative prices to fall. This process stimulates demand for the products of these industries; therefore their relative net prices decrease, but at a slower pace than the corresponding values.

Branches facing structural and (or) industrial crises are often not able to stimulate demand even by a sharp absolute or relative reduction in prices of their output. In these cases output growth does not respond directly to price adjustments. "It is in relation to these (declining - A.R.) industries, where the possibility of expanding demand is limited, that rapid technological progress will lead most directly to "technological unemployment" /11, p.133/.

Under the conditions of developed free competition, values of commodities transform into prices of production and a general rate of profit (average rate of profit) emerges. An uneven composition of capital in the various branches results, ceteris paribus, in a redistribution of surplus value in favour of those which have higher than average

organic composition of capital.[5] A further transformation is taking place under monopoly capitalism. It is likely that monopolies are able to limit interindustry redistribution of surplus-value. The degree of validity of these arguments is tested statistically in the following paragraphs.

## CALCULATIONS BASED ON MANUFACTURING DATA

The information used here is based on the Austrian Annual Census of Manufacturing Establishments, which takes the establishment as its base unit. The data were supplied by the Austrian Institute of Economic Research, and were compiled from industrial statistical surveys which cover all establishments affiliated with the Industry Section of the Chamber of Commerce, but not establishments belonging to the "Small Industry Section". The results do not include any estimates for units not covered by the surveys. The manufacturing branches do not comprise a randomly selected sample from the general population of branches of the economy.

We have used two classifications of industry branches. The first covers 19 branches, the second 10 branches aggregated on the basis of the initial subdivision. The second classification allow us to calculate net prices, while the first one does not.

The second classification was aggregated from the first one in the following way:

| | |
|---|---|
| Basic metal industries | Iron and steel, non-ferrous metals, foundries |
| Pottery, china, glassware | Stone and clay products, glass and glass products |
| Paper, paper products | Pulp and paper, paper products |
| Textiles, apparel, leather | Leather, textiles, apparel |
| Metal products, machinery, equipment | Machinery, transport equipment, metal products, electro-industry. |

The categories "Mining", "Petroleum and petroleum products", "Chemicals", "Food, beverages, tobacco", "Wood, wood products, furniture" were left unchanged.

Calculations were carried out on the basis of production data at 1976 "constant" prices. This means that a fixed weight volume index of output was used with all its

well-known shortcomings (it does not take into account the appearance of new products and the disappearance of old ones, etc.). The Austrian statisticians noted that a base for such indices must be changed every 5 years in order to avoid great statistical distortions (for details see /6/).

Labour productivity is defined here as the ratio of output of an industry to its labour input. Output is measured by value added at 1976 "constant" prices. Labour input is measured by the number of employees.

Data on compensation of employees were taken without any corrections. Data on the number of employees by branches were also accepted without any adjustments.

Net price indices were obtained by dividing value added for every branch at current prices by value added at constant prices. Here, a net price presents not only new value created in production by labourers but also depreciation of fixed capital. It thus differs from $v_j$ by depreciation, whose share in total value added is small, as a rule. In the following we shall approximate $v_j$ by the price index for value added.

Estimates of fixed capital used in this study are based on the perpetual-inventory method according to Almon's model (for details see /7,8/).

1975 was the first year of the crisis in the economy cycle, whose upward phase came to an end in 1980. 1984 corresponds to the upward phase of the next cycle. This year was the latest one for which data were available.

Table 1 sets out the dynamics of labour productivity, net prices, gross wages and salaries per person employed, and a number of statistics relating to these variables.

Both in the period 1975-1980 and in the period 1975-1984 labour productivity rose in all branches but "Petroleum and petroleum products". The highest growth was recorded for "Paper and paper products" (+43% and 87,2%, respectively). For net prices, "Petroleum and petroleum products" posted the highest rate of increase, while commodity prices of the branches "Wood, wood products, furniture" (1975-1980) and "Chemicals" (1975-1984) showed the lowest increase. In these two branches the rate of labour productivity growth was higher than the arithmetic mean. In 1984 the price index for "Paper, paper products" was lower than the arithmetic mean, but was approximately equal to the mean in 1980.

These comparisons show that the expected statistical relationship between net prices and labour productivity is apt to hold.

Table 1

Changes over the period 1975-1984 for aggregated branches of Austrian industry[1)]

1975 = 100

| Branches | Labour productivity | | Net price | | Gross wages and salaries per employee | |
|---|---|---|---|---|---|---|
| | 1980 | 1984 | 1980 | 1984 | 1980 | 1984 |
| 1.Mining | 127.1 | 146.3 | 116.0 | 133.1 | 144.0 | 174.5 |
| 2.Petroleum and petroleum products | 93.2 | 74.0 | 146.3 | 205.3 | 159.9 | 191.2 |
| 3.Basic metal industries | 131.2 | 150.0 | 118.5 | 130.2 | 138.1 | 171.7 |
| 4.Pottery, china, glassware | 138.8 | 158.9 | 118.8 | 144.0 | 148.7 | 185.5 |
| 5.Chemicals | 130.2 | 166.5 | 111.5 | 108.5 | 143.9 | 182.7 |
| 6.Paper, paper products | 143.0 | 187.2 | 121.4 | 130.4 | 147.4 | 191.6 |
| 7.Wood, wood products, furniture | 132.8 | 139.3 | 110.6 | 131.7 | 145.4 | 180.3 |
| 8.Food, beverages, tobacco | 121.1 | 139.7 | 121.7 | 135.0 | 144.0 | 183.0 |
| 9.Textiles, apparel, leather | 125.9 | 134.2 | 122.0 | 142.2 | 140.7 | 179.2 |
| 10.Metal products, machinery, equipment | 129.7 | 156.9 | 121.6 | 130.9 | 143.8 | 185.0 |
| Unweighted average $X_j$ | 127.3 | 145.3 | 120.8 | 139.1 | 145.6 | 182.5 |
| Root-mean-square deviation $S_{xj}$ | 13.5 | 29.5 | 9.9 | 25.1 | 5.9 | 6.4 |
| Coefficient of variation (%) | 10.6 | 20.3 | 8.2 | 18.1 | 4.0 | 3.5 |
| Range $X_j^{max}-X_j^{min}$ | 49.8 | 113.2 | 35.7 | 96.7 | 21.9 | 20.0 |

1) Source: WIFO data bank.

Coefficients of variation of labour productivity indices exceeded those of price indices which in their turn were higher than coefficients of variation of gross wages and salaries per person employed.

A priori one cannot state that the manufacturing branches do represent all branches of the economy. Hence the application of standard statistical procedures for testing the significance of the coefficients are not well-grounded. Nevertheless, these procedures have been used (see some results below). The outcome will be compared with other statistical estimations.

Table 2 lists the statistical characteristics of the closeness of the relationship between net price and labour productivity indices. Correlation coefficients are negative; their absolute values are rather high. They seem to be significant at the 1%-level of significance. The null-hypothesis $H_o : R_{ij} = 0$ may be rejected. This conclusion should be considered as a provisional one.

We applied the ordinary least squares procedure without thoroughly testing for all the necessary conditions for its application, but some additional computations were used in order to verify the OLS estimates.

We calculated the values of Spearman's rank correlation coefficients by the formula

$$r_{kj} = 1 - \frac{6S_{kj}(d^2)}{m(m^2-1)},$$

where $S_{kj}(d^2)$ is the sum of squared deviations of the ranks of variables. Here m is the number of branches.

The values of $r_{kj}$ for 1975-1984 and for 1975-1980 are rather high (0.636, 0.6).

The a priori probability of obtaining the sum $S \leq S_{kj}(d^2)$ was sufficiently small: for 1975-1980 it was 0.037 and for 1975-1984 0.030. From this point of view, calculations of $r_{kj}$ and Pr $[S \leq S_{kj}(d^2)]$ support the rejection of the null-hypothesis.

The coefficients of determination (cf.Table 2) equal 0.666 for 1975-1980 and 0.751 for 1975-1984, while adjusted ones equal 0.621 and 0.714, respectively. In other words, approximately two thirds of the variations in net prices can be explained (in a purely statistical sense) by movements of labour productivity. In terms of elasticity (evaluated at the mean), an increase in labour productivity by 10% leads to a 6,0 or 7,4% reduction in net prices.

Table 2

OLS regression of net price indices on indices of labour productivity.
Ten branches of Austrian industry.[1)]

| | 1975-1980 | 1975-1984 |
|---|---|---|
| Constant term $b_o$ | 196.6 | 246.4 |
| Estimated standard deviation of the constant term as a percentage of the size of the coefficient | 10 | 9 |
| Regression coefficient $b_1$ | -0.595 | -0.738 |
| Estimated standard deviation of the regression coefficient as a percentage of the size of the coefficient | 25 | 20 |
| Coefficient of correlation $R_{ij}$ | -0.816 | -0.867 |
| Coefficient of determination ($R_{ij}^2$ ) | 0.666 | 0.751 |
| Corrected coefficient of determination | 0.621 | 0.714 |
| Standard error of the disturbances | 6.04 | 13.3 |
| t - value of the regression coefficient | -3.99 | -4.91 |
| Critical value for the t-distribution under two-sided significance level 0.01 | 3.169 | 3.169 |

1) Calculated according to Table 1.

Now let us consider indices of wages and salaries per person employed. As has been expected, the inter-industry variations in movements of earnings is small. The standard variation (for 1975-1980) is 44% of that of labour productivity and 60% of that of prices (for 1975-1984 22% and 25%, respectively).

There is no indication that an increase in earnings is positively correlated with an increase in labour productivity in the cross-section analysis (cf.Table 3).

The author of this paper agrees with W.Salter that "... in view of the extreme uneveness of productivity movements, any direct link between wages and productivity in individual industries would soon lead to a hopelessly distorted wage structure" /5, p.116/.

It appears that our calculations contradict the concept of a "price-wage" spiral. Spearman's rank correlation coefficients between indices of net prices and indices of average gross earnings (in a cross-section) equal 0.13 for 1975-1980 and 0.273 for 1975-1984. These values are hardly statistically significant.

In order to estimate variations in the organic composition of capital, ratios of fixed capital to persons employed were

Table 3

OLS regression of indices of gross wages and salaries per employee on indices of labour productivity. Ten branches of Austrian industry[1)]

| | 1975-1980 | 1975-1984 |
|---|---|---|
| Constant term $b_o$ | 180.3 | 185.7 |
| Estimated standard deviation of the constant term as a percentage of the size of the coefficient | 8 | 6 |
| Regression coefficient $b_1$ | -0.273 | -0.02 |
| Estimated standard deviation of the regression coefficient as a percentage of the size of the coefficient | 44 | 345 |
| Coefficient of correlation $R_{ij}$ | -0.628 | -0.1 |
| Coefficient of determination $R^2_{ij}$ | 0.394 | 0.01 |
| Corrected coefficient of determination | 0.341 | 0 |
| Standard error of the disturbances | 4.85 | 6.78 |
| t-value of the regression coefficient | -2.28 | -0.29 |
| Critical value for the t-distribution under two-sided significance level 0,01 | 3.169 | 3.169 |

1) Calculated according to Table 1.

calculated. Movements in fixed capital per employee show greater diversity than net output per employee. A comparison of the change in the ratios of fixed capital to wages and salaries, on the one hand, with the change in the ratios of net output to gross wages and salaries, on the other hand, yielded similar results.

Deviations of prices from value are to some extent related to the suggested approximate measures of the organic composition of capital. For example, surplus-value tends to stream into the branches "Petroleum and petroleum products" and "Chemicals", which have, according to our estimates, a relatively high organic composition of capital (cf.Tables 4,5).

Spearman's rank correlation coefficient between fixed capital per employed person and net output per gross wages and salaries for 1976 and 1984 was equal to 0.52 and 0.53, respectively. These values are apparently statistically significant at the 2.5%-level of significance[6].

Some additional calculations were carried out in order to investigate the nature of the relationship between prices and the organic composition of capital.

The branches of manufacturing were classified into two groups: the first group comprises branches with an above -

Table 4

A test of the relationship between the organic composition of capital and the divergence of the price of a commodity from its value. 19 branches of Austrian manufacturing. Original aggregation, 1976[1)].

| | Ratios and their ranks (in parenthesis) | |
|---|---|---|
| | of fixed capital (at current prices) to employees (mill.AS per capita) | of value added (at current prices) to gross wages and salaries (AS/AS) |
| 1. Mining | 1.091 (17) | 1.563 ( 5) |
| 2. Petroleum and petroleum products | 2.847 (19) | 3.518 (19) |
| 3. Iron and steel | 0.875 (14) | 1.836 (11) |
| 4. Non-ferrous metals | 0.931 (16) | 2.075 (14) |
| 5. Stone and clay products | 0.923 (15) | 1.946 (12) |
| 6. Glass and glass products | 0.497 ( 8) | 1.780 ( 8) |
| 7. Chemicals | 0.664 (12) | 2.289 (16) |
| 8. Pulp and paper | 1.115 (18) | 2.000 (13) |
| 9. Paper product | 0.514 ( 9) | 1.783 ( 9) |
| 10. Wood, wood products, furniture | 0.656 (11) | 2.527 (17) |
| 11. Food, beverages, tobacco | 0.724 (13) | 3.076 (18) |
| 12. Leather | 0.230 ( 2) | 1.788 (10) |
| 13. Textiles | 0.437 ( 7) | 1.720 ( 7) |
| 14. Apparel | 0.192 ( 1) | 1.455 ( 4) |
| 15. Foundries | 0.606 (10) | 0.726 ( 1) |
| 16. Machinery | 0.347 ( 6) | 1.610 ( 6) |
| 17. Transport equipment | 0.309 ( 3) | 1.309 ( 3) |
| 18. Metal products | 0.341 ( 5) | 1.169 ( 2) |
| 19. Electrical equipment | 0.309 ( 4) | 2.281 (15) |
| Total industry | 0.562 ( -) | 1.951 ( -) |

1) Calculations based on WIFO data bank.

Table 5

A test of the relationship between the organic composition of capital and the divergence of the price of a commodity from its value. 19 branches of Austrian manufacturing. Original aggregation, 1984[1)].

| | Ratios and their ranks (in parenthesis) | |
|---|---|---|
| | of fixed capital (at current prices) to employees (mill.AS per capita) | of value added (at current prices) to gross wages and salaries (AS/AS) |
| 1. Mining | 2.000 (17) | 1.777 ( 8) |
| 2. Petroleum and petroleum products | 5.747 (19) | 2.901 (18) |
| 3. Iron and steel | 1.815 (15) | 1.886 ( 9) |
| 4. Non-ferrous metals | 1.667 (14) | 2.175 (12) |
| 5. Stone and clay products | 1.836 (16) | 2.125 (11) |
| 6. Glass and glass products | 1.179 ( 9) | 2.737 (17) |
| 7. Chemicals | 1.266 (10) | 2.383 (13) |
| 8. Pulp and paper | 3.191 (18) | 2.581 (15) |
| 9. Paper product | 0.930 ( 8) | 2.073 (10) |
| 10. Wood, wood products, furniture | 1.439 (13) | 2.673 (16) |
| 11. Food, beverages, tobacco | 1.418 (12) | 3.047 (19) |
| 12. Leather | 0.390 ( 2) | 1.693 ( 6) |
| 13. Textiles | 0.862 ( 7) | 1.730 ( 7) |
| 14. Apparel | 0.356 ( 1) | 1.436 ( 3) |
| 15. Foundries | 1.336 (11) | 0.690 ( 1) |
| 16. Machinery | 0.770 ( 5) | 1.368 ( 2) |
| 17. Transport equipment | 0.682 ( 9) | 1.527 ( 5) |
| 18. Metal products | 0.800 ( 6) | 1.437 ( 4) |
| 19. Electrical equipment | 0.713 ( 4) | 2.454 (14) |
| Total industry | 1.156 ( -) | 2.034 ( -) |

1) Calculations based on WIFO data bank.

Table 6

A test of the relationship between the organic composition of capital and price value differences.
19 branches of Austrian manufacturing, 1976[1].

| Branches with a ratio of value added to gross wages and salaries | Branches with a ratio of fixed capital to employees: Higher than average | Branches with a ratio of fixed capital to employees: lower than average |
|---|---|---|
| higher than average | Petroleum and petroleum products<br>Chemicals<br>Pulp and paper<br>Wood and wood products<br>Food, beverages, tabacco<br>Non-ferrous metals | Electrical equipment |
| lower than average | Mining<br>Foundries<br>Iron and steel<br>Stone and clay products | Leather<br>Textiles<br>Apparel<br>Metal products<br>Maschinery<br>Transport equipment<br>Paper products<br>Glass and glass products |

1) Calculations based on Table 4.

Table 7

A test of the relationship between the organic composition of capital and price value differences.
19 branches of Austrian manufacturing, 1984[1].

| Branches with a ratio of value added to gross wages and salaries | Branches with a ratio of fixed capital to employees: Higher than average | Branches with a ratio of fixed capital to employees: lower than average |
|---|---|---|
| higher than average | Petroleum and petroleum products<br>Chemicals<br>Chemicals<br>Pulp and paper<br>Wood and wood products<br>Food, beverages, tobacco<br>Non-ferrous metals<br>Stone and clay products<br>Glass and glass products | Electrical equipment<br>Paper products |
| lower than average | Mining<br>Foundries<br>Iron and steel | Leather<br>Textiles<br>Apparel<br>Metal products<br>Maschinery<br>Transport equipment |

1) Calculations based on Table 4.

average ratio of fixed capital to employees, the second one - those with a below average ratio. Observations were treated as positive outcomes of statistical experiments if a branch from the first groups had a ratio of net output to gross wages and salaries that was higher than average or if a branch from the second group had a below average ratio. Other observations were considered as negative outcomes.

In 1976 and 1984 the expected correspondece held in 14 out of 19 cases (73,7% all cases). It is likely that the surplus-value is really redistributed by the price mechanism itself in favour of branches with a higher organic composition of capital.

The outcomes partly reflect the differences in the rates of increase in demand for output of various branches and the degree to which this demand is met. For 1976 divergences were registered for 4 branches from the first group ("Mining", "Iron and steel", "Foundries", "Stone and clay products") and for one branch from the second group ("Electrical equipment"); for 1984 divergences were registered for 3 branches from the first group ("Iron and steel", "Mining", "Foundries") and two branches from the second one ("Paper products", "Electrical equipment" (cf.Table 7).

Thus, surplus-value is likely to be redistributed in favour of rapidly expanding branches where supply does not satisfy effective demand, although branches facing a crisis and (or) a depression frequently claimed a bigger share of the sum total of surplus-value because of a higher organic composition of capital.

## Handling of national accounts statistics

This section uses data on net and gross output at 1976 prices. 1976 was taken as the starting year because in this year there was a change in the statistical method of gross output measurement. The basic data disaggregate the economy into 19 sectors. The sectors "Financing, insurance, real estate and business services", "Social and personal services", "Public administration and defence" do not produce exchangeable goods[7)], they were therefore excluded from the analysis.

The sector "Trade" was not excluded. It partly performs the function of continuing the process of production and partly the pure function of changing the forms of labour-value. The author was not able to separate one from the other.

For each sector estimates of the development of the following indicators were prepared for the years 1976, 1980, 1984:

economically active population
fixed capital
net output
labour productivity
unit materials costs
capital intensity
net price.

An explanation of the precise meanings of these measures may be useful. Volume of net output refers to net output valued at 1976 prices (a fixed weight volume index). Labour productivity is measured as net output divided by the total number of economically active persons (a sum total of employees and self- employed agents)[8]. Net price refers to value added per unit of output or, precisely, the value of net output at current prices per unit of output.

Fixed capital was estimated by the method mentioned above. The ratio of capital to net output is called capital intensity and the ratio of capital to economically active persons capital per head.

Unit materials costs were, roughly estimated as a ratio of intermediate product (gross output less net output) to gross output. This quantity should be viewed with great caution because the measure as such does not take into account the influences of advancing division of labour on the share of the intermediate products in gross output by branch[9)].

Tables 8 and 9 list these estimates. The fugures given are relatives, with 1976 = 100.

For the period 1976-1984 the following rates of change apply on average:

employment decreased by 5,7%, fixed capital rose by 23,5%, fixed capital per head by 30,8%, net output by 16,3%, labour productivity by 24,4%, unit materials costs by 0,6%, capital intensity by 9,1% and net prices by 43,9%.

Capital intensity shows the greatest diversity: the coefficient of variation equals 25,1%, while that of unit materials costs is the lowest one with 4,2%.

There is also considerable variation in the movements of labour productivity and of net output: this is very important, for, as we shall see, these variations are reflected in relative prices. Notice that the movements of net prices are much more diverse than those of net output.

Table 8

Various indicators for 16 sectors of the Austrian economy for 1980[1)]
1976 = 100

| Sectors | Economically active population | Fixed capital | Fixed capital per capita |
|---|---|---|---|
| 1. Agriculture | 85.6 | 102.6 | 119.9 |
| 2. Mining | 88.0 | 98.5 | 111.9 |
| 3. Food | 97.1 | 113.5 | 116.9 |
| 4. Textiles, apparel | 93.1 | 101.2 | 108.7 |
| 5. Wood, wood products | 107.0 | 115.5 | 108.1 |
| 6. Paper, publishing | 96.2 | 114.6 | 119.1 |
| 7. Chemicals | 102.1 | 113.6 | 111.3 |
| 8. Petroleum | 100.0 | 129.1 | 129.1 |
| 9. Non-metallic minerals | 96.8 | 110.0 | 113.7 |
| 10. Basic metals | 103.2 | 113.5 | 110.0 |
| 11. Metal products | 104.0 | 119.2 | 114.6 |
| 12. Electricity, gas, water | 98.4 | 112.4 | 114.2 |
| 13. Construction | 99.8 | 105.7 | 105.9 |
| 14. Trade | 105.5 | 119.9 | 113.7 |
| 15. Restaurants and hotels | 109.0 | 130.2 | 119.4 |
| 16. Transport and communication | 102.2 | 120.2 | 117.6 |
| Arithmetic mean $x_j$ | 99.3 | 113.8 | 114.6 |
| Root-mean-square deviation $Sx_j$ | 6.4 | 9.0 | 5.7 |
| Coefficient of variation (%) | 6.5 | 7.9 | 5.0 |
| Range ($x_j^{max} - x_j^{max}$) | 23.4 | 31.7 | 23.2 |

1) Source: WIFO data bank.

Table 8 continued

| No | Net output | Labour productivity | Unit materials costs | Capital intensity | Net price |
|---|---|---|---|---|---|
| 1.Agriculture | 108.9 | 127.2 | 100.9 | 94.3 | 111.6 |
| 2.Mining | 103.3 | 117.4 | 100.8 | 95.3 | 118.4 |
| 3.Food | 116.2 | 119.6 | 100.0 | 97.7 | 107.7 |
| 4.Textiles, apparel | 102.7 | 110.3 | 100.2 | 98.5 | 116.2 |
| 5.Wood, wood products | 112.1 | 104.7 | 100.1 | 103.2 | 117.4 |
| 6.Paper, publishing | 112.6 | 117.0 | 100.2 | 101.8 | 115.7 |
| 7.Chemicals | 125.4 | 122.8 | 100.5 | 90.6 | 108.5 |
| 8.Petroleum | 95.0 | 95.0 | 102.8 | 135.9 | 130.8 |
| 9.Non-metallic minerals | 115.9 | 119.7 | 97.3 | 95.0 | 110.4 |
| 10.Basic metals | 116.0 | 112.5 | 98.1 | 97.8 | 116.5 |
| 11.Metal products | 125.7 | 120.9 | 100.5 | 94.8 | 112.5 |
| 12.Electricity, gas, water | 119.6 | 121.5 | 99.7 | 94.0 | 116.1 |
| 13.Construction | 103.3 | 103.5 | 106.9 | 102.3 | 132.8 |
| 14.Trade | 110.0 | 104.3 | 100.4 | 109.0 | 121.6 |
| 15.Restaurants and hotels | 107.7 | 98.8 | 100.6 | 120.9 | 139.7 |
| 16.Transport and communication | 123.0 | 120.3 | 99.2 | 97.7 | 115.6 |
| Arithmetic mean $x_j$ | 112.3 | 113.5 | 100.5 | 101.8 | 118.2 |
| Root-mean-square deviation $Sx_j$ | 8.8 | 9.6 | 2.1 | 11.6 | 9.0 |
| Coefficient of variation (%) | 7.8 | 8.5 | 2.1 | 11.4 | 7.6 |
| Range ($x_j^{max} - x_j^{max}$) | 30.7 | 32.2 | 9.6 | 45.3 | 32.0 |

Table 9

Various indicators for 16 sectors of the Austrian economy for 1984[1)]
1976 = 100

| Sectors | Economically active population | Fixed capital | Fixed capital per capita |
|---|---|---|---|
| 1. Agriculture | 78.7 | 103.9 | 131.9 |
| 2. Mining | 80.8 | 92.6 | 114.6 |
| 3. Food | 92.9 | 122.0 | 131.3 |
| 4. Textiles, apparel | 80.7 | 101.6 | 125.9 |
| 5. Wood, wood products | 104.1 | 125.2 | 120.4 |
| 6. Paper, publishing | 88.3 | 132.4 | 150.0 |
| 7. Chemicals | 94.8 | 120.2 | 126.9 |
| 8. Petroleum | 95.9 | 136.9 | 142.8 |
| 9. Non-metallic minerals | 87.4 | 115.3 | 132.0 |
| 10. Basic metals | 90.5 | 119.1 | 131.6 |
| 11. Metal products | 95.7 | 140.7 | 147.1 |
| 12. Electricity, gas, water | 106.3 | 124.3 | 117.0 |
| 13. Construction | 87.5 | 102.0 | 116.6 |
| 14. Trade | 105.9 | 139.1 | 131.4 |
| 15. Restaurants and hotels | 115.7 | 163.9 | 141.7 |
| 16. Transport and communication | 103.8 | 137.1 | 132.0 |
| Arithmetic mean $x_j$ | 94.3 | 123.5 | 130.8 |
| Root-mean-square deviation $Sx_j$ | 10.6 | 23.3 | 10.7 |
| Coefficient of variation (%) | 11.2 | 18.9 | 8.2 |
| Range ($x_j^{max} - x_j^{max}$) | 37.0 | 71.3 | 35.4 |

1) Source: WIFO data bank.

Table 9 continued

| No | Net output | Labour productivity | Unit materials costs | Capital intensity | Net price |
|---|---|---|---|---|---|
| 1.Agriculture | 117.8 | 149.7 | 92.6 | 88.1 | 113.4 |
| 2.Mining | 107.2 | 132.6 | 98.3 | 86.4 | 140.1 |
| 3.Food | 118.4 | 127.5 | 100.0 | 103.0 | 131.3 |
| 4.Textiles, apparel | 98.5 | 122.1 | 99.8 | 103.2 | 138.4 |
| 5.Wood, wood products | 113.4 | 109.0 | 99.2 | 110.4 | 128.5 |
| 6.Paper, publishing | 124.2 | 140.8 | 100.4 | 106.6 | 135.2 |
| 7.Chemicals | 148.0 | 156.2 | 101.2 | 81.2 | 121.4 |
| 8.Petroleum | 70.4 | 73.4 | 105.2 | 194.6 | 242.1 |
| 9.Non-metallic minerals | 126.0 | 144.2 | 94.2 | 91.5 | 127.9 |
| 10.Basic metals | 120.4 | 133.1 | 99.3 | 98.9 | 131.3 |
| 11.Metal products | 139.5 | 145.8 | 100.6 | 100.9 | 134.3 |
| 12.Electricity, gas, water | 122.4 | 115.2 | 104.3 | 101.5 | 143.7 |
| 13.Construction | 90.8 | 103.8 | 112.2 | 112.3 | 163.0 |
| 14.Trade | 117.5 | 111.0 | 103.2 | 118.4 | 139.2 |
| 15.Restaurants and hotels | 111.4 | 96.3 | 101.4 | 147.1 | 175.8 |
| 16.Transport and communication | 134.9 | 130.0 | 99.1 | 101.6 | 136.5 |
| Arithmetic mean $x_j$ | 116.3 | 124.4 | 100.6 | 109.1 | 143.9 |
| Root-mean-square deviation $Sx_j$ | 18.8 | 22.0 | 4.2 | 27.4 | 30.1 |
| Coefficient of variation (%) | 16.2 | 17.7 | 4.2 | 25.1 | 20.9 |
| Range ($x_j^{max} - x_j^{max}$) | 77.6 | 82.8 | 18.5 | 113.3 | 128.7 |

The largest increment in net prices was recorded in the sector "Petroleum" (+142.1%), the smallest in the sector "Agriculture" (+13,4%).

Labour productivity rose in all sectors, except in "Restaurants, Hotels", where the pace of technological advance was relatively slow especially among small entrepreneurs, and in "Petroleum", where prevailing natural conditions of mining apparently got worse. In these two sectors labour productivity was down by 3,7% and 26,6%, respectively.

At a first glance, the steady growth of the sector "Restaurants, hotels" contradicts the decrease in labour productivity and the fast increase in net price. In this case demand was probably more influenced by the income elasticity than by the price elasticity.

In general, the less saturated a need is, the higher the growth rates of consumption of goods that satisfy it. The whole issue of the evolution of demand over time goes beyond the scope of this article[10].

## The inter-industry correlation analysis

Tables 10, 11 display the correlation coefficients, Table 12 presents Spearman's rank correlation coefficients between the variables listed above.

The close correlation between indices of labour productivity and indices of relative net prices is shown by the coefficients $R_{ij} = -0,84$ and $r_{ij} = -0,78$ for 1976-1984 ($R_{ij} = -0,85$ for 1976-1980). The goodness of fit is as follows: the ratio of the explained variation to total variation is nearly 71%. Standard errors of the linear regression are 5% and 17% for 1976-1984 and 1976-1980, respectively. On average, a differential increase in labour productivity by 10 percentage points leads to a reduction in relative net prices by 8 to 12 percentage points.

It appears that unequal movements of labour productivity are closely associated with savings in the use of resources per unit of net output. The large increases in labour productivity occur in sectors with large decreases in unit materials cost and capital intensity (cf.Tables 10-12). It is likely that relative net prices decline in those sectors which more rapidly reduce materials costs per unit produced.

Table 10

Coefficients of correlation between various indices for 16 sectors of the Austrian economy, 1976 - 1984 (in parenthesis for 1976-1980)[1].

| | Net output | Labour productivity | Unit materials costs | Fixed Capital | Capital intensity |
|---|---|---|---|---|---|
| Net output | - | 0.80<br>(0.67) | - | - | - |
| Economically active population | 0.16<br>(0.30) | - 0.46<br>(- 0.51) | - | 0.84<br>(0.78) | - |
| Unit materials costs | - 0.43<br>(- 0.52) | - 0.62<br>(- 0.45) | - | - | - |
| Capital intensity | - 0.70<br>(- 0.64) | - 0.87<br>(- 0.85) | - | - | - |
| Net price | - 0.76<br>(- 0.63) | - 0.84<br>(- 0.85) | 0.56<br>(0.58) | - | 0.94<br>(0.77) |

1) Results are based on Table 8, 9.

Table 11

Coefficients of correlation between various indices for 16 sectors of the Austrian economy, 1967 - 1974 (in parenthesis for 1967-1973)[1].

| | Net output | Labour productivity | Unit materials costs | Fixed Capital | Capital intensity |
|---|---|---|---|---|---|
| Net output | - | 0.39<br>(0.28) | - | - | - |
| Economically active population | 0.74<br>(0.81) | - 0.33<br>(- 0.33) | - | 0.61<br>(0.59) | - |
| Unit materials costs | - 0.18<br>(- 0.18) | - 0.48<br>(- 0.46) | - | - | - |
| Capital intensity | - 0.42<br>(- 0.41) | - 0.63<br>(- 0.54) | - | - | - |
| Net price | - 0.46<br>(- 0.57) | - 0.76<br>(- 0.63) | 0.34<br>(0.01) | - | 0.53<br>(0.63) |

1) Results are based on WIFO data bank.

Table 12

Spearman's rank correlation coefficients between various indices for 16 sectors of Austrian economy, 1976 - 1984 (in parenthesis for 1967 - 1973)[1)]

| | Labour productivity | Net output | Net price |
|---|---|---|---|
| Economically active population | 0.37<br>(- 0.40) | 0.12<br>(0.64) | -<br>- |
| Capital intensity | - 0.86<br>(- 0.54) | - 0.58<br>(- 0.48) | 0.63<br>(0.53) |
| Net output | 0.75<br>(0.28) | -<br>- | - 0.60<br>(- 0.45) |
| Unit materials costs | - 0.60<br>(- 0.68 | - 0.25<br>(- 0.36) | 0.77<br>(0.41) |
| Net price | - 0.78<br>(- 0.58) | - 0.60<br>(- 0.44) | -<br>- |

1) Results are based on WIFO data bank (see also Table 9 above).

The close associations between the movements of net output, labour productivity, unit materials cost and capital intensity seem to support the existence of economies of scale. These economies could partly explain the general unit costs reduction which accompanied the increases in labour productivity.

A comparison of the coefficients which are in brackets with those which are not (cf.Tables 10-12) shows that both periods (1976-1984 and 1967-1974) are characterized by a close correlation between relative net prices and movements of labour productivity. The absolute value of the correlation coefficient grew from 0,76 to 0,84, while the regression coefficient and the standard errors of the regression hardly changed.

While the relationship between net output and labour productivty growth was not strong for 1967-1974, it strengthened for the more recent period 1976-1984 (cf.Tables 10-12). There remains, however, a considerable amount of unexplained inter-industry variance in labour productivity growth. It might perhaps be explained by a structural reorganization of the declining industries, where the most inefficient plants or vintages are closed down, which leads directly to an increase in productivity of the remaining firms as measured by aggregate indices[11].

The negative correlation between movements of unit materials costs and capital intensity on the one hand and that of labour productivity on the other hand as well as the positive correlation between relative growth of net prices and movements of unit materials cost and capital intensity were more strongly pronounced in the second period (1976-1984) than in the first one (1967-1974). These changes might be interpreted as evidence of an intensification of competitions in the Austrian economy.

This was pointed out by Schulmeister: "Der relative Preisdruck auf jene Bereiche mit überdurchschnittlichen Produktivitätszuwächsen wird zumindest langfristig nicht nur durch die Konkurrenz am Inlandsmarkt, sondern insbesondere durch den internationalen Wettbewerb wirksam. Während aber etwa im skandinavischen Inflationsmodell (Aukrust, 1977)[12] die Preisentwicklung eines Produktionsbereiches entscheidend davon abhängt, ob der jeweilige Bereich zum offenen oder geschützten Sektor gehört, stützen die österreichischen Daten die Annahme, daß langfristig die technologischen Bedingungen den Ausschlag geben" /14, pp.54-55/.

In the long run, the labour productivity dynamics of Austrian manufacturing sectors kept pace with that in other industrialized countries: when individual sectors were

compared internationally, all but chemicals and basic metals exhibited an above-average performance in the relatively open Austrian economy[13]. The revealed close and positive correlation between diferrential rates of labour productivity growth and inter-industry net price growth rates in this economy corroborates the conclusion that prices tend to be determined by international value. Evidence of severe price competition supports this thesis (for example, see /16-18/).

It is well known that the battle of competition is fought by lowering commodities prices and that this fall in prices is brought about by technological progress and economies of scale. Competition and relative price changes are clearly the driving forces of economic growth: these forces, in their turn, are inherent in the law of value and other immanent laws of capitalist production. But international application of these principles should become the object of special investigations.

Footnotes

1) For details see:/1, pp.46-48, 52-53, 567-68; 2, pp.635-36/. In this paper certain terms are used in a sense that differs from that, say, in neoclassical economics. For example, value is used in the sense of labour value or

abstract labour embodied in commodities and not in the sense of "exchange value", interchangeable with "price".

2) The matrix A is considered to be productive. In this case all elements of matrix $(I_1-A)^{-1}$ are non-negative, $w_j>l_j>0$ for all j.

3) A similar formal approach was employed by W.Salter and other economists.

4) W.Salter discussed four possible kinds of statistical problems: i) skewed distributions of the observations which could make the results depend unduly upon extreme cases, (ii) deficiencies in the extent to which the sample is representative, (iii) the ratio form of the correlations, and (iv) errors of measurement (see /5, pp.109-113/). These questions are not considered in detail in this article.

5) The composition of productive capital is understood in the economic science in a two-fold sense. In the sense of value, it is determined by the proportion in which it is divided into value of means of production and value of labour power. It is called value-composition of capital. In the sense of material, productive capital is divided into means of production and living labour power. It is the technical composition of capital. Value-composition of capital, in so far as it is determined by its technical

composition and mirrors the changes in the latter, is called the organic composition of capital. See: /1, p.574/.

6) There is a close positive correlation between ratios of net output to gross wages and salaries and the ratios of the value of capital equipment to the number of employees: Spearman's rank correlation coefficients for 1974 and 1984 are equal to 0,74 and 0,45. They are significant at 1%-level of significance. These outcomes might be considered as a corroboration of the thesis of redistribution of surplus-value (and profit) in favour of industries with a relatively high organic composition of capital. Effects of monopolization on net prices were not uncovered by the author. They need to be investigated further.

7) Remember that the law of value is that of prices.

8) This fraction distorts the actual quantity somewhat because the denominator includes persons which do not perform one of the subordinate functions of a collective labourer (i.e., they are not productive labourers). A proper account of these persons would be desirable, but it was not done in this paper. It is appropriate to regard this estimate and similar ones as indications of the order of magnitude rather than of the magnitude itself.

9) This problem is touched upon in /9,10/.

10) This issue was partly considered in /13/.

11) It is the so-called structural reorganization bypothesis advanced by Wragg and Robertson /12/. There is evidence that the relationship between movements of net output and those of employment weakened (cf.Tables 10-12). See a discussion of this relationship in /9-12/.

12) See /20/.

13) See /15/.

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