Testing Marx: Some new results from UK data

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Testing Marx: Some new results from UK data

Analysing UK economic data over an extended historical timespan, from the mid-nineteenth to the late twentieth centuries, the authors use 'quantitative' or 'empirical' Marxist techniques to test key Marxian theses and categories. They argue that Marxian economics has nothing to fear from a confrontation with empirical data.

Introduction

Quantitative or empirical Marxism has passed through three main phases in the postwar West.[1] In the first phase, statistical measurement of the economic indices of Marxist political economy was pioneered by Joseph Gillman (1957) who used National Income figures to obtain estimates of the rate of surplus value, organic composition of capital and rate of profit for the US economy. The measurements presented in this paper draw on his methodology. In his Ph.D. dissertation, Mage (1963) also tackled the rate of profit in the US using methods broadly similar to Gillman's.

This work was not immediately followed up, but in the 1970s a second phase opened as the empirical reality of a falling rate of profit in Britain drew attention from orthodox economists (e.g. Panic and Close, 1973) as well as Marxists. Among the latter the most notable contribution came from Glyn and Sutcliffe (1972). But instead of the 'classical' Marxian measures, Glyn and Sutcliffe used surrogates such as the Wage Ratio and the Share of Profits in company product. These measures seemed to show the rate of exploitation to be declining, perhaps in consequence of trade union power. Whereas Gillman had distinguished in his estimates of the rate of surplus value between productive and unproductive

labour, following Marx, the categories used by Glyn and Sutcliffe aggregated all wage incomes.[2] This could mask an actual increase in the exploitation of productive workers behind a change from productive to unproductive labour. This objection was raised by Bullock and Yaffe (1975) who used a comparison of the rates of change of take home pay and of productivity to indicate that the rate of relative surplus value had risen over the same period. The same conclusion was arrived at on different grounds by Bacon and Eltis (1976), whose analyses of the share of purchases by the non-industrial sector, led them to conclude that the main problem of the British economy was the shift from productive to unproductive employment. This, they said was the primary cause of the decline in profitability.

The third phase of empirical Marxism (roughly, from the mid-1980s to the present) is exemplified by the work of Shaikh (1984), Moseley (1991) and that collected in Dunne (1991). One of the themes here is a revitalisation of the classical Marxian labour theory of value, along with a reassertion of the relevance of the distinction between productive and unproductive labour. This paper is conceived as a contribution to this 'third phase'.[3] We offer a set of time series for the classical Marxian indices, covering a longer run of history than most other contributions (cf. Freeman, 1991, whose data are drawn from 1950–1986). We also offer some arguments, complementary to those in the existing literature, for the relevance and validity of data of this sort. And we show how the data may be used for the testing of Marxian theses, taking for illustration those concerning the 'immiserisation' of the proletariat and the tendency for the rate of profit to fall.

Justifying empirical Marxism

It is noteworthy that Marx himself did not hesitate to use empirical data to measure the rate of surplus value. He estimated, using the prevailing wage rates, costs of constant capital and final selling price for No.32 yarn, that the rate of surplus value in the Manchester cotton industry in 1871 was 154 per cent, and that the rate in wheat farming in 1815 was just over 100 per cent (Marx, 1970: 219–220). Throughout the first volume of *Capital*, Marx constantly uses official statistics and factory inspectors' reports to justify his theoretical claims. When dealing with the production of absolute surplus value he produces statistics

comparing the production of absolute surplus labour in industrial England with feudal Romania: when dealing with the concentration of capital he uses Income Tax statistics to document the concentration of wealth.

Given the limitations of the then existing official statistics, however, it was not possible to estimate the average rate of surplus value for the whole economy. Only with the publication of National Income statistics in the twentieth century did this become practicable.

It may be objected that the National Income statistics are given in price terms not value terms, and that their use for calculating Marxian categories could be invalid. We believe such fears to be unfounded. We argue this on the grounds of dimensional analysis, the artificiality of the objection, and empirical validation of the concepts we use.

Dimensional analysis

In what follows we will use the standard notation with the set of symbols $c, v, s,$ standing respectively for constant capital, variable capital and surplus value.

If one had National Income figures in value terms, these variables would be measured in millions of person hours per annum. This would give them the dimension $t \times h \times t^{-1}$ where t stands for time and h for humans. Cancelling the time terms, the resulting dimension is h, or so many million people. This may seem unexpected, but it means that s, c and v measure the number of full-time person-equivalents employed on the production of consumer goods (v), the reproduction of constant capital (c) and on the production of luxuries, new capital goods, etc. (s). The value variables s, c and v measure the size and activity distribution of the workforce.

The main ratios of interest — $s' = s/v$ = rate of surplus value, $p' = s/(c+v)$ = rate of profit on a flow basis, and $o' = c/v$ = organic composition of capital — are all dimensionless numbers. For example s' is of dimension $h \times h^{-1}$ which cancels out.

In the case of actual National Income figures, by appropriate choice of categories we can arrive at a monetary estimate of s in terms of £ million per annum or dimension $£t^{-1}$. Similar arguments apply to c and v, but computing the ratios s', o' and p' will again yield dimensionless numbers. Hence on purely dimensional grounds there is no contradiction in estimating these ratios from monetary magnitudes.

There are a couple of other interesting ratios:

1. The rate of profit on a stock basis, $p'_s = s/(k + Tv)$, where k is the stock of constant capital and T is the turnover time of variable capital; and
2. the organic composition of capital on a stock basis, $o'_s = k/Tv$.

The dimension of k in value terms is millions of person hours, or *ht.* and clearly Tv is also of dimension *ht.* The resulting dimension of p'_s is t^{-1}. This is what one would expect since the rate of profit in stock terms measures the expansion of capital values per unit time. The organic composition on a stock basis is again a dimensionless quantity. Monetary calculation likewise gives us a rate of profit as per cent per annum, which is t^{-1}, and a dimensionless number for o'_s.

Since monetary ratios are *dimensionally* compatible with the value ratios, using the former as an estimate of the latter is legitimate provided that the monetary measures s_m, v_m, and c_m are approximated by linear functions of the corresponding value measures s_l, v_l, and c_l with positive slope and intercepts at the origin. But is this the case?

Value versus price data

Are values linear approximations of prices and vice-versa? This has been disputed by authors basing themselves on Sraffa (Steedman 1975; Hosoda 1993), but we consider that their arguments are unconvincing. It has been shown (Wolfstetter, 1976; Farjoun, 1984; Cottrell, 1993) that the examples purporting to demonstrate profit and surplus value to be anti-correlated rest on highly artificial assumptions. In particular, negative labour 'values' can arise only in systems that are inefficient in the sense that they are not on the production possibility frontier. In such circumstances the labour 'values' calculated do not correspond to the definition of socially necessary labour. Such occurrences would be highly unstable and improbable in a real capitalist economy. The construction of such forced examples is of little scientific, as opposed to ideological, value.

Shaikh (1984) has argued that the question of whether prices are closely correlated with values is essentially an empirical one. One can in principle measure the degree of correlation between the two provide that one has independent measures of each.

Shaikh's method uses input-output data to estimate labour contents and then measures the correlation between these and prices. He presents results derived from Italian and US input-output tables which show, as one would expect from value theory, that relative prices are almost entirely determined by labour content. He obtains correlation coefficients of well over 90 per cent. More recently, Petrovic (1987) and Ochoa (1989) have carried out very similar studies (using data from the Yugoslav and US economies respectively), with much the same results. To reinforce this conclusion, we have replicated Shaikh's analysis using the UK input-output tables for 1984 (Central Statistical Office, 1988).

The commodity-use matrix in *Table 4* of the input-output tables was used to provide estimates of total labour content of the outputs of each commodity group. Both direct and indirect labour inputs were calculated using the recursive approximation $l_{(n)} = c_{l(n-1)} + v_m/w$, where $l_{(n)}$ is the nth estimate of labour content, $c_{l(n-1)}$ is the $(n-1)$th estimate of the labour content of constant capital, and w is the money wage per hour. Recursion was terminated at a depth of 8 giving answers to three significant digits. In the input-output tables, labour input is given in £s. This amounts to measuring the price of the labour power used rather than being a direct measure of the labour used. We tried two alternative methods of going from these figures to estimates of abstract labour (see the discussions of Models A and C below).

Table 1: **Regressions of price on labour-values and prices of production — UK input-output data, 1984**

	Model A	Model B	Model C	Model D
constant	–0.055 (0.027)	–0.034 (0.019)	–0.046 (0.023)	–0.049 (0.017)
labour-value	1.024 (0.022)	1.014 (0.016)	1.024 (0.020)	
pr. of prod.				1.024 (0.015)
T	101.00	100.00	100.00	100.00
R^2	0.955	0.976	0.964	0.980
Mean Abs. Error	13.5%	11.8%	15.0%	10.0%
Max. Error	157.0%	65.0%	67.0%	57.0%

(standard errors in parentheses)

The results of our regressions are shown in *Table 1*. The various models differ as follows.

Model A: *Value/price regression for all industries assuming uniform wage rate.* A dummy wage rate of £1 per hour was assumed for all industries. On this assumption the labour content of the output of each industry was calculated. The assumed wage rate was unrealistically low, but this is of no significance in computing the correlations since it is equivalent to a uniform scaling factor in our time unit. In this and all other cases, the variables enter the regressions in logarithmic form.[4]

Model B: *As above but excluding the oil industry.* Among the industries there was one outlier with an anomalously high price/value ratio — the oil industry. This is exactly what one would expect from the Ricardian/Marxian theory of differential rent. Non-marginal oil fields could be expected to sell their output at above its value. Model B shows the result of excluding the oil industry from the sample.

Model C: *Values assuming non-uniform wage rates.* In practice wages differ between industries. The actual hourly wage rates for the different industries in 1984 were obtained from the New Earnings Survey and used to convert the monetary figures for direct labour into hours. Again the oil industry was excluded from the final regression.

Model D: *No oil industry, price of production is independent variable.* Price of production was computed using the recursive application of the formula $P_{prod(n)} = p'(c_{pprod(n-1)} + v_m)$ to all industries, where $c_{pprod(n-1)}$ is the $(n-1)$th estimate of the price of production of the constant capital inputs, and $P_{prod(n)}$ is the nth estimate of the price of production.

Interpretation of regression results

Our findings, for the case of the UK, are in remarkable agreement with the previous results of Shaikh, Petrovic and Ochoa for the US, Italian and Yugoslav economies. The regressions with labour content as independent variable show an excellent fit (with R^2 in the range of 96 to 98 per cent), and a close approximation to the 'ideal' result, from the standpoint of the labour theory of value, of a zero intercept and unit slope. In relation to Model B, $t(98) = 0.834$ for the null hypothesis of a unit slope, with a two-tailed p-value of 0.41, so the hypothesis is not rejected.[5]

Since the regressions are logarithmic, the errors or residuals (actual minus predicted money price, industry by industry) are in percentage form. As can be seen from *Table 1,* the mean absolute residuals are fairly small, although even when the oil industry is dropped there are a few other outlier industries where the discrepancy between actual and predicted price is on the order of 60 per cent. It may be that rent factors are important in those industries too.

It is noteworthy that Model C, in which the labour content figures are adjusted using *New Earnings Survey (NES)* data, shows a somewhat less good fit than Model B, in which labour content was figured on the assumption of a uniform wage per unit labour across the industries. It may well be that using the *NES* data 'over-corrects' labour content. The issue here concerns the source of inter industry wage differentials. If these differentials were arbitrary, or reflected differential bargaining power, there would be a case for removing the resulting 'distortion' from the labour content estimates via the use of the *NES* wages data. But if, on the other hand, actual inter-industry wage differentials reflect differential skill levels, then one could argue that the theoretical assumption of a uniform wage-per-unit-labour-input across industries is appropriate, amounting in effect to a reduction to hours of simple labour (cf. Marx 1970, ch.1).

The fourth estimate (Model D) shows that the use of price of production as independent variable produces a marginally better linear fit with market prices. This is consistent with Ochoa (1989), and is in conformity with the modification to value theory presented by Marx in Volume III of *Capital* (Marx 1971, ch.19). But prices of production only introduce a minor correction to the underlying determination of market price by labour content. The correction term due to prices of production is so small that it can for practical purposes be ignored. This is especially the case when constructing estimates of ratios like s/v where each individual term is an aggregate of many different types of commodities. The term v, for instance, denotes a sum of value that is realised as all of the commodities upon which the wage is spent. Since these will be drawn from many industries the random correction terms due to prices of production in each industry, already small, will tend to cancel out.

We conclude from this discussion that there is no serious problem with using price denominated data from the National Income statistics to produce estimates of the classical Marxian value ratios such as the rate of surplus value.

Preparation of the series

We have constructed four distinct sets of time series for the British economy in Marxian categories. The first runs from 1855 to 1919, the second from 1920 to 1938, the third from 1948 to 1969, and the last from 1970 to 1989. The sets of series are not directly commensurable since they are derived from different sources, which makes it difficult to apply exactly the same empirical definitions of the Marxian categories. The source data for the most recent period were obtained from the CSO databank on magnetic media. Unfortunately, the CSO can not provide continuous time series on magnetic media for the years before 1970. For the years 1948 to 1969 our sources were the annual Blue Books of National Income and Expenditure. These started publication in 1948. For the period 1855 to 1938 we used the historical tables of national income produced by Feinstein (1976).

The principal differences in the series centre on the definition of variable capital. One has to decide which categories of labour count as productive labour, whose remuneration should be included in v, and which count as unproductive labour. (Following Gillman, we denote the wages of the latter as u, an expenditure which represents a share of the surplus value produced by productive labour.) The information available differs for each time period.

For the earliest period, the only breakdown of income from employment is into wages and salaries. For this period we chose to assume that all salaries were payments to unproductive labour, which, given the social structure of the period, is perhaps not unreasonable. Conversely, all wages were assumed to represent payment to productive labour: this probably overestimates the wages of productive labour, since the incomes of such categories as domestic servants were thereby aggregated into v.

For the inter-war years Feinstein provides a breakdown of income from employment by industrial category. For this period, variable capital was taken as wages in Agriculture, Forestry and Fishing; Mining and Quarrying; Manufacturing; Building and Construction; Gas, Electricity and Water; and Transport and Communication. All other labour income was treated as unproductive. It may be argued that this underestimates v as it excludes salaries in productive industries. Some of these salaried workers would be involved in unproductive tasks, such as accounting and marketing, but others, such as gas engineers, would be productive.

For the post-1948 figures, the same industry categories were used to obtain v but now salaries for these industries have been included in v, since for the later years the CSO figures no longer treat wages and salaries as distinct. This of course means a certain underestimation of the level of unproductive labour by the contrary argument to that applying to the inter-war years.

Further details on the construction of the series can be found in the Appendix.

What do the series show?

Empirical data on an individual capitalist economy can be used for two types of theoretical investigation. They may be used in a conjunctural analysis whose objective is to arrive at a political strategy to be applied in that country, or they may be used to test the validity of certain general hypotheses of historical materialism against a particular real instance. We gave an example of the latter use of empirical data with our test of the labour-value hypothesis against input-output data. In the next two sub-sections we use our data to examine two other Marxian hypotheses, the immiserisation thesis and the law of the tendency for the rate of profit to fall.

Immiserisation

> [A]s capital accumulates, the lot of the labourer, be his payment high or low, must grow worse. The law, finally, that always equilibrates the relative surplus population, or industrial reserve army, to the extent and energy of accumulation, this law rivets the labourer to capital more firmly than the wedges of Vulcan did Prometheus to the rock. It establishes an accumulation of misery, corresponding with accumulation of capital. (Marx 1970: 645).

By this thesis Marx clearly does not mean that real wages continuously fall under capitalism, since he makes the qualification 'be his payment high or low'. John McMurtry (1978: 62) has argued that Marx should be understood as claiming that a greater and greater share of the total resources of society accrues to the capitalist class, and a correspondingly smaller share to the labouring class. In empirical terms, this would imply a rising trend of the rate of exploitation over time.

In fact this is exactly what the data for Britain show. As *Figure 1a* shows, whichever time period one looks at for *s/v* the conclusion is the same: there is a secular trend towards increasing exploitation. Disregarding cyclical movements in the rate of exploitation due to the business cycle the trend is clearly upwards. Over the period of 125 years covered by the figures, the only substantial interval during which the rate of surplus value declined was from 1870 to 1890.

Figure 1a: **Organic composition, Surplus Value 1855 to 1989**

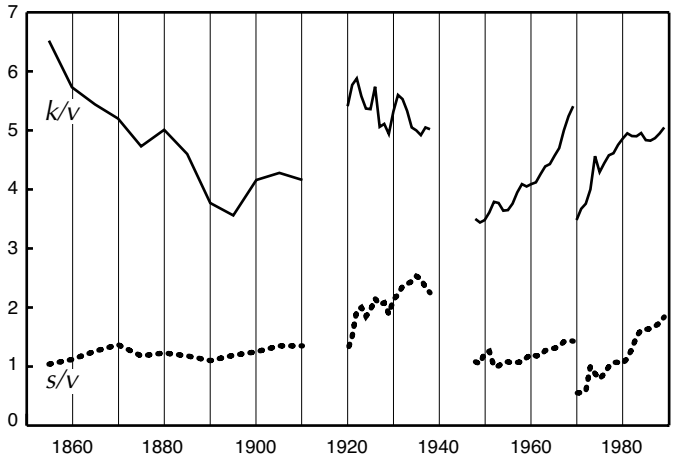
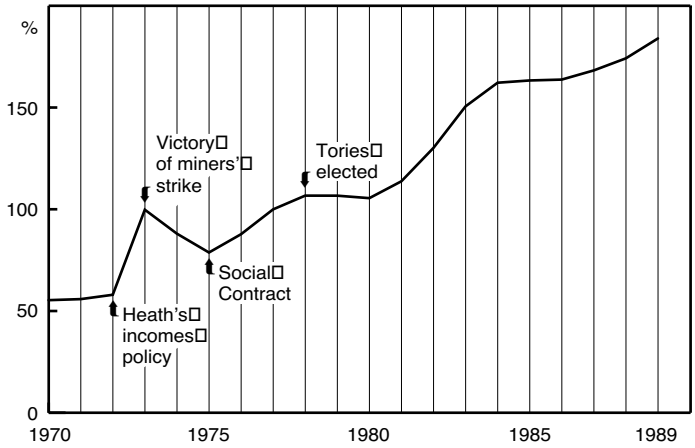


Figure 1b: **Evolution of the rate of *p* Surplus Value 1970 to 1989**



Our results for the period 1970 to 1989 are summarised in *Tables 2.1* and *2.2*. The series for the rate of surplus value is picked out in more detail in *Figure 1b*. The general trend is upwards, rising from 55 per cent in 1970 to 183 per cent at the end of the 1980s. This means that productive workers have gone from a situation in which they performed 21 minutes per hour unpaid labour, to one in which they performed 38 minutes unpaid labour. Our finding of increasing exploitation in Britain is consistent with Freeman (1991); Moseley (1991) also finds a rising trend in the rate of exploitation in the postwar US economy.

Within this tendency, several turning points are visible. The incomes policy under Edward Heath's Conservative government in the early 1970s was associated with a sharp rise in exploitation, partially reversed after his government was defeated by the miners. A more gradual rise in exploitation followed under the 'Social Contract' between the Labour government of 1974–79 and the trade unions. This rise was temporarily halted by the 'winter of discontent' (1978–79), only to resume shortly after the Thatcher government came to power. Exploitation then rose remorselessly

Table 2.1: **Main ratios 1970 to 1979**

year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Constant capital £m, k_m	59,200	67,200	77,200	95,200	128,000	155,600	181,400	207,400	239,700	289,600
Variable capital £m, v_m	17,001	18,304	20,542	23,797	28,050	36,239	40,820	45,302	51,955	60,902
Unproductive wages £m, u_m	3,814	4,119	4,650	13,368	15,683	19,016	22,017	25,969	32,798	38,263
Rate of surplus value 1, s'_1%	55.33	55.84	57.97	99.78	88.01	78.75	87.74	99.95	106.70	106.68
Organic composition %	348.21	367.13	375.82	400.05	456.33	429.37	444.39	457.82	461.36	475.52
Rate of profit, p' %	5.15	4.97	5.30	6.73	4.09	3.39	4.62	5.84	5.85	5.70
Flow rate of profit %	18.98	18.91	20.55	27.50	18.43	14.62	20.27	25.99	26.21	26.39
Rent/surplus value %	17.77	18.09	17.47	9.97	10.64	10.55	9.84	10.06	10.08	10.37
Profit/disposable *sv* %	70.11	69.70	71.34	77.18	70.83	68.38	74.45	76.41	75.31	74.78
Accumulation /*sv* %	1.74	-1.89	-5.38	-0.23	-2.35	-6.50	-7.82	-9.70	-9.38	-8.11
Unproductive wages/*sv* %	40.54	40.30	39.05	56.30	63.52	66.64	61.47	57.35	59.16	58.89

Table 2.2: **Main ratios 1980 to 1989**

year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Constant capital £m, k_m	337,800	359,900	370,600	382,700	401,000	421,700	442,100	471,200	517,900	573,700
Variable capital £m, v_m	69,504	72,703	75,566	78,090	80,928	87,210	91,612	96,789	104,655	113,614
Unproductive wages £m, u_m	43,267	48,437	54,209	65,039	72,836	78,480	86,076	93,300	103,568	115,839
Rate of surplus value 1, s'_1%	105.46	113.75	130.15	150.56	162.19	163.30	163.73	168.24	174.17	183.95
Organic composition %	486.02	495.03	490.43	490.08	495.50	483.55	482.58	486.83	494.86	504.96
Rate of profit, p' %	5.53	5.93	7.58	8.76	9.24	9.61	8.99	9.30	9.76	10.70
Flow rate of profit %	25.82	27.79	35.15	40.41	42.90	43.95	41.17	43.10	46.17	54.39
Rent/surplus value %	10.20	10.40	10.48	10.33	10.59	10.56	10.63	10.28	9.85	9.37
Profit/disposable *sv* %	74.97	74.91	76.65	76.88	76.22	76.47	75.05	75.94	77.18	78.98
Accumulation /*sv* %	-12.00	-16.37	-13.86	-12.46	-9.59	-7.77	-8.16	-4.93	0.34	6.42
Unproductive wages/*sv* %	59.03	58.57	55.12	55.32	55.49	55.11	57.39	57.30	56.82	55.43

through the '80s. One can no longer identify the effects of short-term measures like incomes policies, but there are several long term processes which may help to explain this — although we do not pretend that the following is a definitive account of the matter.

First, the '80s were a period in which cheap microprocessor technology allowed automation and the use of smaller workforces. The consequent increases in productivity are unlikely to have been balanced by a commensurate rise in wages. The resulting displacement of labour by new technology and the decline in established industries has created a large pool of unemployed throughout this period. This will have acted as a downward pressure on wages. And to the extent that new jobs have been created, the '80s saw an expansion of low paid casual and part time work.

Second, in many sections of the economy, particularly those that have been privatised, both working hours and the intensity of labour have been increased, whilst pay has fallen or at best remained constant. Indeed, contractors have claimed that the whole process of contracting out local authority work would become uneconomic were the EC to prohibit such wage cuts.

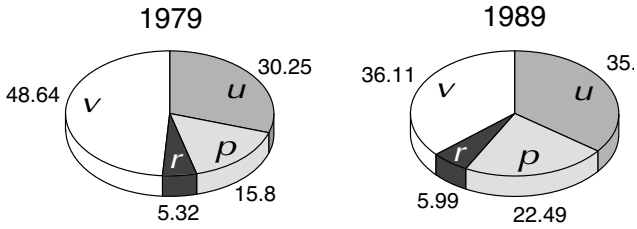
Third, unlike the 1970s, the ability of unions to defend working conditions was increasingly compromised by restrictive laws. At the same time union membership declined, as a result of both unemployment and the shift of the workforce into new firms and sectors where conditions for union organisation are less favourable.

Many of these factors flowed from a government policy that aimed to change the balance of forces against the working classes: the evidence suggests that the policy has succeeded.

By looking at the different categories of income into which the value created by labour flows, we can identify the principal beneficiaries of the rise in exploitation. *Figure 2* shows the distribution of the value product, both when the Tories came to power, and a decade after. There has been a shift from wages of productive workers towards profits and unproductive wages. Unproductive wages grew from 30 to 35 per cent of the value product, a relative rise of 17 per cent. More significant, however, was the rise in profits, which grew by 6.7 per cent of the net value product, or by 42 per cent of their level at the start of the decade.

One possible reaction to our claim that there occurred a remarkable rise in the rate of exploitation during the 1970s and '80s, would be to discount this result as a misleading artifact of

Figure 2: **Change in % composition of the value product 1979 to 1989**



the way the statistics were calculated. If one did not accept Marxian value theory or the distinction between productive and unproductive labour, one could say: 'Of course a decline in manufacturing employment, the traditional core of the "productive" workforce, associated with a rise in employment in banking, financial services and other "unproductive" sections will, of itself, appear to produce an increase in the rate of exploitation. But this is unreal, since the so-called unproductive sectors are just as much wealth creators as the "productive" ones.'

If this objection were valid, however, we would expect to see an increasing proportion of the total surplus value going as unproductive wages; and as can be seen from *Figure 2* this has not been the case. A more realistic hypothesis is that the processes of increased exploitation described above — automation, intensification of labour and the weakening of the trade unions — have produced a growing surplus which has then been divided in a relatively consistent fashion between industrial capital, landed property, the financial institutions and the state. We would argue that surplus value is the prior category, which is later divided between profit, rent and unproductive expenditure. Marxian theory would predict changes in the mass of profit to be strongly correlated with changes in the mass of surplus value. If, on the other hand, surplus value is an synthetic category, an artificial aggregate of heterogeneous revenues, these variables would be only weakly correlated

More specifically, the Marxian hypothesis would predict the rate of profit to be an approximately linear function of the rate of surplus value, with intercept at zero. In other words as the rate of surplus value tends to zero so does the rate of profit. The scatter plot of profit against surplus value *(Figure 3)* reveals that this is indeed the case. The trend lines for both stock and flow

rates of profit pass close to the origin and the data-points are clustered on the trend lines. The data are consistent with Marx's claim that surplus value is the prior category and the profit, rent, interest, etc., are derived categories.

Figure 3: **Dependence of profit on surplus value**

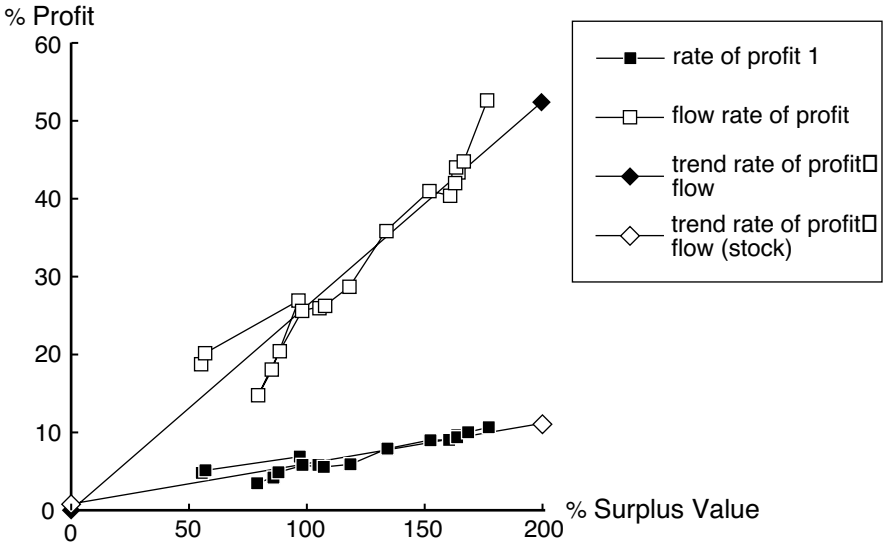
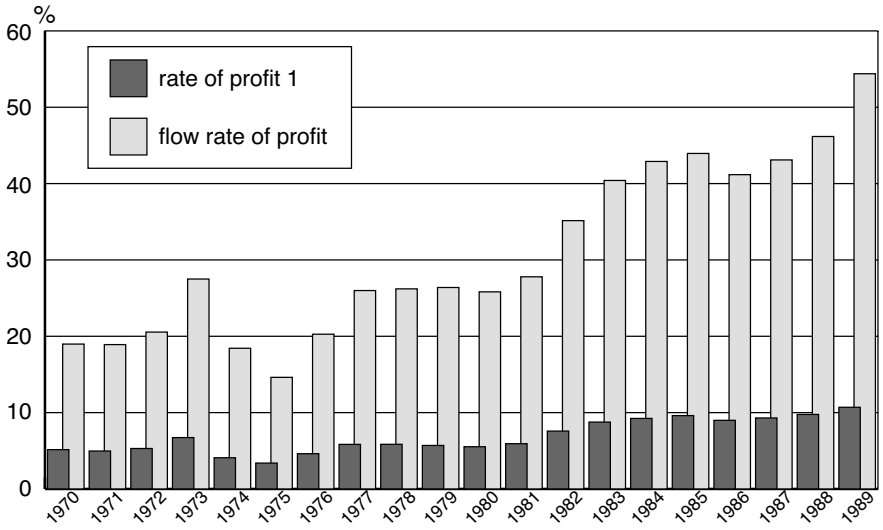


Figure 4: **Evolution of the rate of profit 1970 to 1989**



The falling rate of profit

Marx hypothesised that capitalism had a long term tendency for the rate of profit to fall due to a rising tendency of the organic composition of capital. The math is simple: since organic composition $o' = k/v$, the rate of surplus value $s' = s/v$, and the rate of profit $p' = (s-r-u)/k$ (where r denotes rent and u denotes expenditure on the wages of unproductive labour), it follows that the rate of profit is an inverse function of the organic composition, $p' = s'/o'$, so long as $r = u = 0$, Marx's assumption at this stage of the argument.

Thus, a rising organic composition would clearly imply a decline in the rate of profit, other things being equal. Marx allowed for the possibility of two main sorts of offsets to this process. First, a rise in the rate of exploitation would tend to counteract the effect on the rate of profit of a rising organic composition of capital; and second the 'cheapening of the elements of constant capital' (due, for instance, to technical advance) would tend to retard the growth of the organic composition itself. The first of these factors is clearly valid, but Marx's treatment of the second seems to us superficial and unsatisfactory. The cheapening of the elements of constant capital has complex and potentially contradictory effects on the rate of profit and its time-path. By devaluing the existing stock of means of production it reduces the denominator of the rate of profit; but at the same time by accelerating depreciation it tends to reduce the numerator. And as for the effect on the pace of new accumulation, this will be conditional on a variety of factors. Suppose that due to 'cheapening' a certain sort of means of production is producible using only 50 per cent of the total labour time that was previously required: Does this mean that capitalists will buy the same number of new machines that they otherwise would have (in which case the pace of accumulation in value terms slows, as does the increase in the organic composition)? Or does it mean that the capitalists buy twice as many machines (in which case the organic composition may be unaffected, while the technical composition of capital rises markedly)? Marx's suggestion, that 'cheapening' represents an unproblematic offset to the tendency for the rate of profit to fall, seems much too simple.

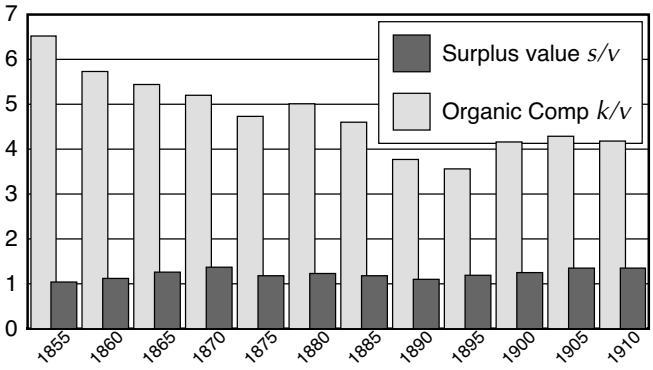
At any rate, to return to the main line of argument, why did Marx suppose that the organic composition of capital would

tend to rise over time? His basic argument was that capital, accumulating at an exponential rate, would eventually be sure to exceed the growth of the working population:

> As soon as capital would, therefore, have grown in such a ratio to the labouring population that neither the absolute working time supplied by this population nor the relative surplus working time, could be expanded any further (this last would not be feasible at any rate in the case when the demand for labour were so strong that there was a tendency for wages to rise); at this point, therefore, when the increased capital produced just as much, or even less surplus value than before its increase, there would be an absolute over-production of capital; i.e., the increased capital C + DC would produce no more, or even less, profit than capital C before its expansion by DC. (Marx 1971: 251)

This is a robust argument. We can express it more formally as follows. First, let us assume the working population and working day to be constant so by choice of units we can set $(s+v) = 1$. Thus the rate of profit is given by $p' = (1-v)/k$. Now, provided that capital accumulation is positive for all t (time), clearly the limit of k as t tends to ∞ is ∞. On the other hand, even if the rate of exploitation increases over all time horizons, the limit of $s = (1-v)$ is 1, since v is non negative. It then follows that $\lim_{t\to\infty}(1-v)/k$ must be 0.

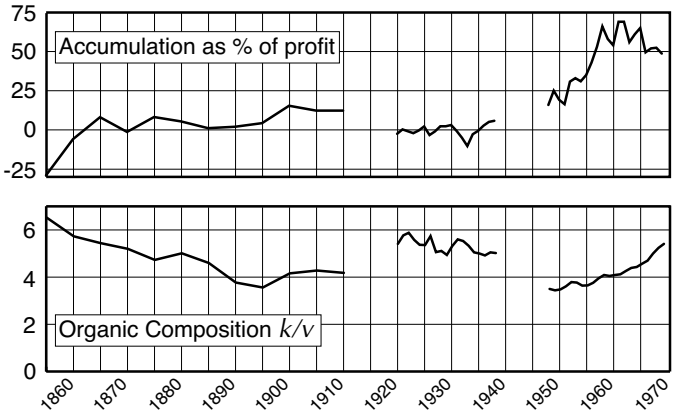
Figure 5: **Evolution of organic composition and surplus value 1855 to 1910**



What is crucial here — besides the stipulation that the limit of the exploitable workforce has been reached — is the assumption that the rate of accumulation will always be positive. This may have seemed a reasonable assumption to Marx, whose view of capitalism was formed during the first part of the 19th century with its railway mania and frantic accumulation in the cotton industry. However the assumption appears to have been invalid for British capitalism for much of the period since the 1850s. Historically the organic composition has a tendency to rise during periods of rapid accumulation as the amount of capital equipment used per worker goes up. Conversely, during periods of relative stagnation the organic composition falls. The organic composition on a stock basis k/v is determined by the integral over time of the relative rates of growth of constant capital and variable capital. The growth of variable capital is more or less limited by the growth of the employed proletarian population. The growth of constant capital depends upon the rate at which profits are reinvested in new plant and machinery. When this rate is high, the value of plant and machinery per worker grows. When, conversely, the rate of accumulation out of profit fell, the rate of growth of the constant capital stock could fail to keep up with the growth of the proletarian population.

This is particularly clear when viewed over long periods. *Figure 6* shows how over roughly a century, from the 1870s to the 1960s, the organic composition has depended upon the rate of

***Figure 6*: The organic composition is determined by the rate of accumulation (from *Table 3*)**



accumulation. Overall the picture is a pretty bleak one. With the exception of the period from 1945 to the 1970s, the level of accumulation out of profits was generally low, rarely reaching 20 per cent, and for much of the period it was below 10 per cent.[6] Both the recession of the late 19th century and the inter-war period actually saw the organic composition falling. These falls occurred during periods in which accumulation, though low, was in most years still positive. This implies that the rate of accumulation was insufficient to keep up with the growth in the workforce. The boom years after the second world war saw rapid accumulation and mounting organic composition.

As *Table 3.2* shows, the rate of accumulation out of profits was frequently negative between 1855 and 1938. Even when it was positive, it was often not high enough to compensate for the growth in the working population. Thus from 1855 to the mid 1890s and again during the 1920s and '30s the organic composition declined. Paradoxically, therefore, at the time Marx was writing *Capital*, the organic composition of capital was falling and the rate of profit was rising, reaching a peak in 1871.

A dramatically different picture emerges when we look at the period since 1948, which can be divided into two sub-periods, 1948–79 and 1979–89.

1948–79: Allowing for some dislocation between successive time series, the organic composition can be seen to be steeply rising. This appears to have been the result of the very high rates of capital accumulation in the late 1950s and early 1960s. The series for the rate of profit (which does not suffer from discontinuities in the definition of v) shows that the rate of profit had a declining tendency and was on the whole markedly lower than in the previous periods. It would appear, that over these years Marx' s hypothesis about a declining rate of profit did hold. The sharp recovery in the rate of profit between 1975 and 1979 was due to one of Marx's offsetting factors, a steep increase in the rate of exploitation. Coupled with this was a decline in the share of surplus value going to unproductive wages, down from 66 per cent in 1975 to 58 per cent in 1979. These figures would appear to testify to the effectiveness of the then Labour government's wage restraint policies.

1979–89: Over this period the organic composition continued to rise, but much more slowly. Since these years saw negative accumulation, the rise in the organic composition is probably an artifact of the rise in the rate of surplus value. Since both s' and

Table 3.1: **Main ratios 1948 to 1969**

Year	Organic Composition k/v	% Rate of profit $p'=100p/(v+k)$	Rate of surplus value s'	Accumulation as % of profit
1948	3.50	7.8	1.08	15.9
1949	3 44	7.1	1.05	25.0
1950	**3.48**	**10.4**	**1.23**	**19.2**
1951	3.61	10.6	1.26	16.4
1952	3.79	4.6	1.00	30.8
1953	3.77	4.8	1.01	33.0
1954	3.64	6.1	1.07	31.0
1955	**3.65**	**6.5**	**1.08**	**35.0**
1956	3.76	5.7	1.06	43.0
1957	3.95	5.3	1.07	53.0
1958	4.09	4.2	1.08	66.0
1959	4.05	5.2	1.15	58.0
1960	**4.09**	**6.1**	**1.21**	**54.0**
1961	4.12	5.3	1.18	69.0
1962	4.26	4.7	1.19	69.0
1963	4.39	5.5	1.27	56.0
1964	4.43	6.0	1.30	61.0
1965	**4.57**	**5.6**	**1.31**	**65.0**
1966	4.70	7.1	1.34	49.5
1967	5.00	7.0	1.42	52.0
1968	5.24	6.9	1.44	52.4
1969	5.41	6.7	1.43	48.7

Table 3.2: **Main ratios 1855 to 1938**

Year	Organic Composition k/v	% Rate of profit $p'=100p/(v+k)$	Rate of surplus value s'	Accumulation as % of profit
1855	6.52	7.5	1.04	-29.0
1860	5.73	9.2	1.12	-5.9
1865	**5.44**	**11.7**	**1.26**	**8.1**
1870	5.20	13.5	1.37	-1.3
1875	4.73	12.3	1.18	8.2
1880	5.01	11.1	1.23	5.4
1885	4.60	10.5	1.18	1.1
1890	**3.77**	**12.7**	**1.10**	**2.0**
1895	3.56	13.9	1.19	4.3
1900	4.16	13.0	1.25	15.4
1905	4.28	12.9	1.35	12.3
1910	4.18	13.0	1.35	12.3
1920	**5.41**	**5.0**	**1.27**	**-2.5**
1921	5.77	5.8	1.51	0.3
1922	5.88	10.1	1.95	-0.9
1923	5.58	11.4	2.00	-2.1
1924	5.37	9.6	1.85	-0.4
1925	**5.36**	**10.9**	**1.96**	**2.2**
1926	5.74	10.8	2.15	-3.3
1927	5.06	12.0	2.05	-1.0
1928	5.11	11.5	2.08	2.3
1929	4.94	9.6	1.89	2.3
1930	**5.32**	**10.1**	**2.13**	**3.1**
1931	5.6	9.2	2.22	-0.6
1932	5.53	10.3	2.36	-5.0
1933	5.33	11.4	2.40	-10.3
1934	5.05	13.1	2.44	-2.8
1935	**5.00**	**14.8**	**2.53**	**-0.6**
1936	4.92	15.2	2.49	2.7
1937	5.05	12.2	2.34	5.1
1938	5.02	11.2	2.25	5.8

o' are reciprocals of v, a decline in the share of income going to workers will raise both ratios.

The recovery in profitability affected both the flow and the stock rates of profit (for definitions see the Appendix). The recovery in the rate of profit calculated on a stock basis has been helped by the fact that the organic composition of capital has remained more or less constant since the late '70s. The summary *Tables 2.1* and *2.2* (p.213) show the reason for the stability in the organic composition of capital: for most of the 1980s there was no net accumulation of capital. The level of investment failed to cover depreciation. This fact emphasises the primitive methods by which profitability has been increased. The increase has occurred despite the run-down in the capital stock; it has come not from investment and modernisation so much as from the intensification of labour.

Theoretical periodisation of profit rates

Based on the data we have prepared as well as the theoretical arguments considered above, we can tentatively divide the long-run evolution of the factors governing the rate of profit into three historical periods.

1. Late 18th to early 19th century. During this period machinery was being applied to the production of consumer goods but not to the production of means of production. Organic composition tended to rise in parallel with the technical composition due to a slower rate of productivity in Department I (production of means of production). This was offset by the increased production of relative surplus value. Whether the rate of profit rises or falls under such conditions is determined by technological factors; all that we can say is that there is a relative tendency for it to fall. This is the period with which Marx was familiar, hence his emphasis on the technical composition of capital.

2. Machinery applied to both departments I and II, but the latent reserve population not exhausted. In Britain this roughly corresponds to the second half of the 19th century. Accelerating productivity in Department I cheapens the elements of constant capital and permits growing physical output with very little net capital accumulation. The bourgeoisie spend an increasing proportion of the surplus on servants, country houses and luxury goods as they take on the characteristics of a rentier class. The organic composition can fall and the rate of profit rise.

3. Latent reserve exhausted, size of the proletariat stabilised. Under these conditions there is an unavoidable contradiction between capital accumulation and the rate of profit, since the mass of surplus value is bounded above by the size of the proletariat and the length of the working day, whilst the mass of constant capital has no theoretical upper bound. This has applied for most of the twentieth century. In this third phase, any prolonged capital accumulation chokes off profit both due to its influence on the organic composition of capital and due to a rise in demand for labour. Although the rate of profit on productive capital is limited by the organic composition, no such law applies to financial capital. The laws governing the formation of a rate of interest are quite distinct from those operating in the production of surplus value. Thus individual capitalists have the option of shifting their capital from means of production to more highly paying financial assets. The effect is to generate profound tendencies towards stagnation. When government action to cheapen credit and to expand demand by fiscal measures allows capital accumulation to proceed, then the law of the declining rate of profit asserts itself. The effects of the law are therefore either overt falls in profit, or stagnation once industrial profits have fallen below the prevailing rate of interest.

Conclusion

The empirical data we have presented lend strong support to two key theses of historical materialism and conditional support to a third. First, we have been able to confirm the work of Shaikh, Petrovic and Ochoa in demonstrating the validity of the classical labour theory of value. Second, we have shown that the Marx's immiserisation hypothesis, interpreted as a tendency for the rate of exploitation of productive labour to rise, is valid. Third, we have produced evidence that the hypothesis of a rising organic composition of capital and a falling rate of profit has some validity, but is crucially conditional on active capital accumulation, which cannot always be assumed. Our most general conclusion, in line with the other recent work cited in the Introduction, is that Marxian economics has nothing to fear, and a good deal to gain, from a confrontation with the data-record for actual capitalist economies.

Notes

1. For a longer historical perspective on quantitative Marxism, see Desai (1991).
2. Studies of the US economy employing measures similar to those of Glyn and Sutcliffe, and reaching similar conclusions, are found in Weisskopf (1979) and Wolff (1979). For a detailed discussion of these studies, from a standpoint close to our own, see Moseley (1991).
3. We also conceive this paper as complementary to our recent work (Cockshott and Cottrell 1993; Cottrell and Cockshott 1993) on the use of labour values in a socialist planning calculus.
4. For a theoretical argument in favour of the logarithmic specification, see Shaikh (1984: 65–70).
5. Also for Model B, $t(98) = -2.01$ for the null hypothesis of a zero intercept, which appears to suggest rejection of that hypothesis, but this is not really meaningful since in a double-log regression of this type the estimate of the constant term is biased (see for instance Ramanathan, 1992: 122, 477).
6. Given that the common ideological justification given for profit is the need to fund new investment, the gap between ideology and reality is striking.

References

Bacon, R. and W. Eltis (1976) *Britain's Economic Problem: Too Few Producers.* Macmillan, London.

Bullock, Paul and David Yaffe (1975) 'Inflation, the crisis and the post-war boom', in *Revolutionary Communist* 314: 5–45.

Central Statistical Office (1988) *Input-output tables for the United Kingdom 1984.* HMSO, London

Cockshott, W. P. and A. Cottrell (1993) *Towards a New Socialism.* Spokesman, Nottingham.

Cottrell, A. (1993) 'Negative labour values and the production possibility frontier'. mimeo, Wake Forest University.

Cottrell, A. and W.P. Cockshott (1993) 'Calculation, complexity and planning: the socialist calculation debate once again', in *Review of Political Economy* 5/1: 73–112.

Desai, Meghnad (1991) 'Methodological problems in quantitative Marxism', in P. Dunne [ed.] *Quantitative Marxism.* Polity Press, Cambridge: 27–41.

Dunne, P. [ed.] (1991) *Quantitative Marxism.* Polity Press, Cambridge.

Farjoun, E. (1984) 'Production of commodities by means of what?', in A. Freeman and E. Mandel [eds] *Ricardo, Marx, Sraffa.* Verso, London: 11–41.

Feinstein, Charles H. (1976) *Statistical Tables of National Income, Expenditure and Output of the UK 1855–1965.* Cambridge University Press, Cambridge.

Freeman, Alan (1991) 'National accounts in value terms: the social wage and profit rate in Britain 1950-1986', in P. Dunne [ed.] *Quantitative Marxism.* Polity Press, Cambridge: 84–106.
Freeman, Alan and Ernest Mandel [eds] (1984) *Ricardo, Marx, Sraffa.* Verso, London.
Gillman, J. (1957) *The Falling Rate of Profit: Marx's Law and its Significance to Twentieth Century Capitalism.* Oxford University Press, Oxford.
Glyn, Andrew and Bob Sutcliffe (1972) *British Capitalism, Workers and the Profits Squeeze.* Penguin, Harmondsworth.
Hosada, Eiji (1993) 'Negative surplus value and inferior processes', in *Metroeconomica* 44(1), February: 29-42.
Mage, Shane (1963) 'The law of the falling tendency of the rate of profit', Ph.D. dissertation, Columbia University.
Marx, K. (1969) *Theories of Surplus Value,* Vol.1. Lawrence & Wishart, London.
_____ (1970) *Capital,* Vol.1. Lawrence & Wishart, London.
_____ (1971) *Capital,* Vol.3. Lawrence & Wishart, London.
McMurtry, John (1978) *The Structure of Marx's World View.* Princeton University Press, Princeton, NJ.
Moseley, Fred (1991) *The Falling Rate of Profit in the Postwar United States Economy.* Macmillan, London.
Ochoa, Eduardo M. (1989) 'Values, prices, and wage-profit curves in the US economy', in *Cambridge Journal of Economics* 13/3, September: 413–429.
Panic, M. and R.E. Close (1973) 'Profitability of British manufacturing industry', in *Lloyds Bank Review* 109, July: 17–30.
Petrovic, Pavle (1987) 'The deviation of production prices from labour values: some methodology and empirical evidence', in *Cambridge Journal of Economics* 11/3, September: 197–210.
Ramanathan, Ramu (1992) *Introductory Econometrics.* Harcourt, Brace & Jovanovich, New York.
Shaikh, Anwar (1984) 'The transformation from Marx to Sraffa', in A. Freeman and E. Mandel [eds] *Ricardo, Marx, Sraffa.* Verso, London: 43–84.
Steedman, Ian (1975) 'Positive profits with negative surplus value', in *Economic Journal* 85: 114–123.
Weisskopf, Thomas E. (1979) 'Marxian crisis theory and the rate of profit in the postwar U.S. economy', in *Cambridge Journal of Economics* 3, December: 341–78.
Wolff, Edward N. (1979) 'The rate of surplus value, the organic composition of capital and the general rate of profit in the U.S. economy, 1947–1967', in *American Economic Review* 69, June: 329–41.
Wolfstetter, E. (1976) 'Positive profits with negative surplus value: a comment', in *Economic Journal* 86, December: 864–72.

Appendix: Methods of calculation for data series

1. 1855 to 1938

The following time series were calculated using data from Feinstein. They were generated by an ALGOLW program on the St Andrews University IBM 360/44. Only some of the series have been reproduced in this article; the others are available on request from the authors. Units are £million unless otherwise stated.

(1) wages in productive industry = variable capital, v
(2) capital stock excluding dwellings = constant capital on a stock basis, k
(3) gross profits
(4) rent
(5) total wages and salaries = $v+u$
(6) capital formation excluding dwellings = accumulation before depreciation
(7) stock appreciation
(8) depreciation = consumption of fixed constant capital, c
(9) wages of unproductive workers = u = (5)–(1)
(10) net profits = p = (3)–(7)–(8)
(11) disposable surplus value (11) = (4)+(10)
(12) total surplus value = (11)+(9)
(13) net value product = (12)+(1)
(14) rate of surplus value = s' =(12)÷(1) (ratio)
(15) total capital = $k+v$ = (1)+(2)
(16) rate of profit 1 = $p/(k+v)$ = (10)÷(15)×100 (%)
(17) rate of profit 2 = $p/(k+v+u)$ = (10)÷((15)+(9))×100 (%)
(18) rate of profit on a flow basis = (10)÷((8)+(1))×100 (%)
(19) rent divided by surplus value = (4)÷(12)×100 (%)
(20) profit divided by disposable surplus value = (10)÷(11)×100 (%)
(21) accumulation after depreciation divided by surplus value = ((6)–(8))÷(12)×100 (%)
(22) accumulation after depreciation divided by profit = ((6)–(8))÷(10)×100 (%)
(23) organic composition on a flow basis, o' = (8)÷(1)
(24) organic composition on a stock basis, o'_s = (2)÷(1)

2. 1948 to 1969

Series 1 – 8 were prepared by hand from the CSO National Income and Expenditure Blue Books. Series 9 – 27 were prepared from Series 1 – 8 using a computer program in BASIC. Units are £million unless otherwise stated.

(1) variable capital, v = wages of productive workers, N.I.E. table 3.1, sum of wages and salaries from Agriculture Forestry and Fishing; Mining and Quarrying; Manufacture; Construction; Gas, Electricity and Water; Transport and Communications. Excludes employers' contributions to National Insurance.
(2) constant capital stock, k, from N.I.E. 11.11: Net capital less dwellings, less other buildings and works in Personal sector, Financial sector, Central and Local Government.
(3) gross profits, p_g, from N.I.E. 1.1: Sum of gross trading profits of companies, gross trading surplus of public corporations, gross trading surplus of government enterprises.
(4) rent, r, from N.I.E. 1.1

(5) wages of unproductive workers, u, from N.I.E. 3.1: Sum of wages and salaries in Insurance, Banking, Finance and Other Business Services, Distributive Services, Public Administration and Defence, Public Health Services, Local Authority Educational Services, Other Services. Excludes employers' contributions to National Insurance.
(6) accumulation, a, from N.I.E. 10.3: Sum of gross fixed capital formation from Vehicles, Ships and Aircraft, Plant and Machinery, New Buildings and Works of industrial and commercial companies and public corporations. The categories here correspond to those used in series (2).
(7) appreciation, ap, from N.I.E. 1.1
(8) depreciation, c, from N.I.E., consumption of constant capital.
(9) net profit, p = (3)–(7)–(8)
(10) disposable surplus value, s_d = (9)+(4)
(11) surplus value, s = (10)+(5)
(12) net value product, v_p = (11)+(1)
(13) rate of surplus value, s' = (11)÷(1) (ratio)
(14) total capital, k_t = (8)+(1)
(15) rate of profit 1, p'_1 = (9)÷((2)+(1))×100 (%)
(16) rate of profit 2, p'_2 = (9)÷((2)+(1)+(5))×100 (%)
(17) flow rate of profit, $p'_f = p/(c+v)$ = (9)÷((8)+(1))×100 (%)
(18) rent as share of surplus value, r/s = (4)÷(11) (ratio)
(19) profit as share of disposable surplus value, p/s_d = (9)÷(10) (ratio)
(20) net accumulation out of surplus value, $(a–d)/s$ = ((6)–(8))÷(11) (ratio)
(21) net accumulation out of profit, $(a–d)/p$ = ((6)–(8))÷(9) (ratio)
(22) organic composition on a flow basis, $o'_f = c/v$ = (8)÷(1) (ratio)
(23) organic composition on a stock basis, k/v = (2)÷(1) (ratio)

3. 1970 to 1989

The data were obtained from the CSO in the form of computer disks to speed processing. These were loaded into a PS-algol database and the results calculated by a PS-algol program on an Intel 386 processor. Both on the computer disks, and in the Blue Book, each time series has a 4-letter code in addition to a longer description of its content. In what follows the codes (GIIU, GIIP, etc.) stand for the corresponding time series in the Blue Book. Units are £million unless otherwise stated.

variable capital, v

We define v to be the sum of wages and salaries in productive sectors. Using the categories in the Blue Book this means that v is found by summing the following:

GIIB :- GDP: agriculture, forestry & fishing: income from employment
GIIF :- GDP: energy & water supply: income from employment
GIIK :- GDP: manuf (revised def): income from employment
GIIP :- GDP: construction: income from employment
CCIU :- GDP: transport and communication: Income from employment

This excludes income from employment in banking, finance, and insurance; distribution, hotels and catering; public administration and national defence; and education and health services.

This is not exactly what we want to compute. Labour expended in hotels and catering is productive, but given the aggregation used in the Blue Book, it can not be distinguished from distribution and retailing, which is not. This tends to make our figures for v underestimates. Against this, the figures for income from employment in the industries we do count will include the salaries of those employed within these sectors on unproductive activities like sales, accountancy etc. Without further information, it is hard to estimate how big the error terms introduced by this are.

constant capital stock, k

This represents the outstanding stock of means of production that operate as capital owned either by private companies or as state capital owned by public corporations. Note that this will include the capital employed unproductively. This has to be included, since each capital, whatever its field of application, claims its own aliquot part of the aggregate surplus value in the formation of an average rate of profit. k is found thus:

EXHK :- I&C companies: net capital stock: all fixed assets
+EXHM :- Public corps: net capital stock: all fixed assets
–EXGW :- I&C companies: net capital stock: dwellings
–EXGY :- Public corps: net capital stock: dwellings

Since these are quoted in £billion, they are multiplied by 1,000.

gross profit, p_g

This is the total profit, before allowing for depreciation or stock appreciation, of all productive capitalist enterprises. Here we obviously do not discriminate between different sectors of application of the social capital to which the profit accrues. p_g is found by summing the following:

GIIC :- GDP: agriculture, forestry, fishing: income from self-employment, other trading
GIIG :- GDP: energy & water supply: income from self-employment & company profits
GIIH :- GDP: energy & water supply: gross trading surplus of public enterprises
GIIL :- GDP: manuf (revised def): income from self-employment & company profits
GIIM :- GDP: manuf (revised def): gross trading surplus of public enterprises
GIIQ :- GDP: construction: income from self employment & company profits
GIYU :- Transport + comms. gross profits of coys. + income from self employment
GIYV :- Trans. + comms. gross trdg. spls. of public enterprises
GIJH :- GDP: banking & finance: gross trading profits & other trading income
GIJI :- GDP: banking & finance: adjustment for financial services

unproductive wages, u

This represents the value of the labour power that is exchanged against revenue rather than against capital. It is found by summing the following:

GIIT :- GDP: distribution: income from employment
GIJG :- GDP: banking & finance: Income from employment
GIJK :- GDP: public administration: income from employment
GIJO :- GDP: education & health: income from employment

appreciation, a
This represents the apparent increase in the value of stocks of goods and machinery that is purely due to inflation. This tends to artificially inflate profit figures during periods of rising prices. It is the summation of:

GIIE :- GDP: agriculture, forestry & fishing: stock appreciation
GIIJ :- GDP: energy & water supply: stock appreciation
GIIO :- GDP: manuf (revised def): stock appreciation
GIIS :- GDP: construction: stock appreciation
DHNM :- Stock appreciation for transport communication

depreciation, c
This represents the decline in the value of the capital stock due to wear and tear. It strictly it represents only a part of *c*, the flow measure of constant capital — only part since the flow of raw materials, a part of *c*, is excluded from depreciation. Found by summing the following:

EXEX :- Capital consumption: agriculture, forestry & fishing
EXCK :- Capital consumption: all other energy & water supply
EXCL :- Capital consumption: manufacturing (revised defn)
EXCM :- Capital consumption: construction
EXCP :- Capital consumption: transport
EXCQ :- Capital consumption: communication

The various tertiary data series were constructed according to the same equations as shown for the earlier data-periods.