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Total Factor Productivity Growth and the Productivity Slowdown in the West German Industrial Sector, 1970-1981

Douglas Todd*

Internal Paper

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ABSTRACT

The productive performance of the West German industrial sector through the 1970s is analysed within a simple growth accounting framework. Taking the decade as a whole, the suggestion is that total factor productivity or 'residual' growth and capital/labour substitution accounted for the growth of output per head in roughly equal proportions.

Whilst total factor productivity increased at an annual average rate of 2.5 per cent per annum, capital productivity declined throughout the period. In addition, capital per head continued to rise whilst industrial employment fell. In other words, factor substitution has not generated gains in terms of additional employment. Further, if there has been significant embodied technical advance via increases in the capital stock, it does not appear to have been revealed in these same terms.

CONTENTS

I. Introduction

In an earlier paper (Todd 1983) a series of annual static productive efficiency indices were estimated for the West German Manufacturing sector over the period 1970-1980. Most attention was focused on comparisons between the two snapshots in time provided by the end years of this particular sample period. However, it was noted that the static productive efficiency frontier for the post oil shock year 1975, when output fell dramatically, had moved outwards to a marked extent and that this was another way of illustrating the sharp jolt which the German manufacturing sector had to contend with.

The series of snapshots yielded by the frontier technique suggested that it might be worthwhile looking at the German industrial and manufacturing sectors in a more dynamic setting. Thus, the following is an extension or sequel of that work, being concerned with the evolution of output, labour and capital over the past decade.

The statistical basis for the exercise again is that provided by the Deutsches Institut für Wirtshaftsforschung (DIW) in their detailed publication (1). The period covered is 1970-1981 and relates to thirty-five sectors of the mining and manufacturing.

II. The Approach

The analysis here is set in a growth accounting framework which places emphasis on the relative contributions of factor inputs to total output growth with reference to a base year(2). Any differences or 'residual' factors not accounted for are usually referred to as total factor productivity. This can be expressed in numerous ways as is well known, but a convenient summary description is provided by the following:-

(1) Rolf Krengel et al, "Produktionsvolumen und-potential", Berlin, October 1982.

(2) Similar analyses at the broad sectoral level for France, West Germany, Italy and the United Kingdom are being undertaken by the author and will be available shortly.

$$TFPg = Vg - TFIg \tag{1}$$

$$TFIg = s_w L_g + (1 - s_w) Kg \tag{2}$$

Hence:-

$$TFPg = Vg - Kg - s_w (Lg - Kg) \tag{3}$$

or alternatively

$$TFPg = Vg - Lg - s_\pi (Kg - Lg) \tag{4}$$

where

TFPg	=	growth of total factor productivity
TFIg	=	growth of total factor input
Vg	=	growth of output
Lg	=	growth of labour input
Kg	=	growth of capital input
s_w	=	share of labour income
s_π	=	share of profits

The basis for the above being a Solow-type production function with Hicks-neutral technical progress of the form V = A (t) F (L, K).

One can have different views about approaches to problems of this kind. In particular, some may hold a preference for a direct production function approach, and which might be regarded as a more conventional methodology. Of course, within the growth accounting framework, although there is an underlying function which relates inputs to output, one does not have to set this out explicitly. In place of formal statistical estimation of parameters, the exercise becomes one of the appropriate arithmetic. Recent advances in the theory and estimation of production functions have yielded highly flexible forms which at least in principle can encompass a wide range of production technologies. On the other hand, there remains a serious problem of how inhrently awkward and rather complicated a priori notions of technology might be written down and this problem is present at both aggregated and disaggregated levels. One can pose the two questions: what is an aggregate technology and how can disaggregated technologies be specified in detail?

Such points as these apply equally to the growth accounting approach and it is largely because of this and the fact that eleven annual observations only are available which has tipped the balance of judgment in favour of the route chosen (3).

As noted, the method summarised in equations (1) to (4) implies that total factor productivity is in the nature of a residual item which has given cause for much controversy. It can be argued that this residual arises from the fact that the labour and capital inputs may not be correctly specified, or other inputs are omitted. On the first of these, once this is done, then the technical knowledge or progress interpretation of the residual can be greatly reduced and can come close to disappearing, which implies that advances in knowledge become embodied in the factor inputs. A view to the contrary would be that events such as educational improvements, inventions and so on are not part of standard factor inputs and are properly a part of total factor productivity (4). On the second point, the importance of energy as a factor input has been stressed recently and whilst the two factor approach does not accommodate this, more is said on the matter at a later stage.

In summary, the interpretation of TFP rather like the production function issue discussed above rests partly on the taste of the researcher and reader. Those who prefer to call TFP the effects of omitted elements will no doubt continue to do so.

III. Data and Definitions

The basic data are extracted from the DIW publication as stated earlier. Here, output volume is defined as gross value added. The labour input is numbers employed with the volume of capital defined as gross fixed assets. The price base is that at 1976 (5).

(3) The author is influenced also by a series of highly perceptive points in Chapter 4, pages 118 to 128 of Varian (1978).

(4) The literature here is huge but a good presentation of what might be termed crudely the Jorgenson and Griliches, and Denison views are presented fully in Kennedy and Thirlwall (1972).

(5) A full discussion on definitions of factor inputs is in Todd (1983).

Factor shares presents a problem. Since 1976 is the price base, that year gives an estimate of the share of wages and salaries in gross value added. This does not however include all labour costs such as social security payments and so on. In order to come closer to an acceptable figure for s_w, the wage and salary share was grossed up by 25 per cent to take some account of these other costs (6). The procedure certainly is arbitrary and cannot be expected to hold for all sectors in the sample, thus it is at best something of a gesture, the absence of which would lead to unrealistically high measured profit shares in gross net product.

The factor share base therefore is that in the mid-year of the sample period. Thus the implicit question posed in this procedure is what evolution of total factor productivity, total factor input and factor substitution emerges if both labour and capital are assumed to have received payments in relation to their relative marginal products in the base year 1976.

The sectors of German industry to which the analysis applies are three industries in Mining, together with thirty two industries in Manufacturing, that is thrity five in all. The broad groups can be summarised:-

Sector	Number of Industries	
Mining		3
Manufacturing, of which:-		
Manufacture of Basic Products	11	
Manufacture of Capital Goods	10	
Manufacture of Consumer Goods	10	
Food, Drink and Tobacco	1	32
		35

(6) The author here followed a suggestion from Prof Rolf Krengel made in private correspondence and which he offered as a very rough indicator only.

IV. Results

(1) Aggregated Sectors

Table 1 summarises the broad trends in the evolution of gross value added, numbers employed and gross fixed assets for the eleven year period overall and two sub-periods (7). Between 1970 and 1981 employment in Mining plus Manufacturing fell by around 1.5 per cent at an annual average rate. The extent to which this decline accelerated from 1973 is brought out clearly when one refers to the sub-periods.

Real output rose by only around 1.4 per cent per annum and in Mining itself it actually fell. This growth overall looks modest indeed when set against the period 1960-73, for example, when Manufacturing output rose by over 5 per cent at an annual rate. Between the first three years of the last decade, the figure still averaged some 3.5 per cent per annum. Again, the sub-periods indicate the weakening of industrial output growth through the 1970s.

Turning to productivity growth, Table 2 provides a similar summary for the major industrial groupings. The growth of output per head averaged around 3 per cent for Manufacturing as a whole over the complete period but fell by around one half a per cent on average from 1973 onwards. The biggest reductions in both output and output per head took place in manufacturing basic products.

Throughout the sample period, the capital stock rose at a marked rate. This is particularly noticeable in the early years 1970-73, with Mining being the only exception. It is therefore not surprising to observe that output per unit of capital fell over the decade. There was however a moderation in this rate of decline from 1973 onwards due to the much depressed growth of output volume. By the same token, we observe relatively large increases in capital per man with the same general sort

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(7) A discussion of medium term productive and more general economic performance appears in Algayer et al (1983). See also K. Hennings' chapter in Boltho (1982) and Todd (1983).

Table 1

Growth of Output (V), Labour (L), and Capital (K) (per cent)

	1970-1981			1973-1981		
	V	L	K	V	L	K
Mining	-1.67	-2.51	-0.80	-1.04	-1.33	-0.14
Manufacturing of Basic Products	1.15	-1.85	2.20	-0.12	-2.11	1.06
Manufacture of Capital Goods	1.97	-0.88	3.79	1.56	-1.16	2.95
Manufacture of Consumer Goods	0.70	-2.55	2.81	-0.28	-2.98	1.85
Food, Drink and Tobacco	1.96	-1.67	2.63	1.62	-2.06	1.85
Manufacturing Total	1.54	-1.51	2.90	0.80	-1.82	1.94
Mining plus Manufacturing	1.41	-1.54	2.70	0.73	-1.81	1.84

	1970-1973		
	V	L	K
Mining	-3.33	-5.60	-2.52
Manufacturing of Basic Products	4.61	-1.16	5.32
Manufacture of Capital Goods	3.06	-0.15	6.07
Manufacture of Consumer Goods	3.35	-1.38	5.41
Food, Drink and Tobacco	2.88	-0.61	4.73
Manufacturing Total	3,54	-0.68	5.52
Mining plus Manufacturing	3.25	-0.85	5.04

Table 2

Growth of Labour and Capital Productivity
and the Capital/Labour Ratio (per cent)

	1970-1981			1973-1981		
	$\left(\frac{V}{L}\right)$	$\left(\frac{V}{K}\right)$	$\left(\frac{K}{L}\right)$	$\left(\frac{V}{L}\right)$	$\left(\frac{V}{K}\right)$	$\left(\frac{K}{L}\right)$
Mining	0.84	-0.87	1.72	0.29	-0.89	1.19
Manufacturing of Basic Products	3.00	-1.06	4.05	1.99	-0.90	1.19
Manufacture of Capital Goods	2.85	-1.82	4.67	2.72	-1.39	4.10
Manufacture of Consumer Goods	3.25	-2.10	5.35	2.70	-2.12	4.83
Food, Drink and Tobacco	3.63	-0.66	4.29	3.68	-0.23	3.91
Manufacturing Total	3.05	-1.36	4.41	2.62	-1.14	3.76
Mining plus Manufacturing	2.96	-1.29	4.25	2.54	-1.10	3.64

	1970-1973		
	$\left(\frac{V}{L}\right)$	$\left(\frac{V}{K}\right)$	$\left(\frac{K}{L}\right)$
Mining	2.27	-0.81	3.08
Manufacturing of Basic Products	5.76	-0.71	6.47
Manufacture of Capital Goods	3.21	-3.00	6.22
Manufacture of Consumer Goods	4.73	-2.06	6.79
Food, Drink and Tobacco	3.49	-1.85	5.34
Manufacturing Total	4.22	-1.98	6.20
Mining plus Manufacturing	4.09	-1.79	5.89

of slowing down in the rate of increase post 1973. Even so, the Capital and Consumer Goods sectors still experienced annual increases in capital per head in excess of 4 per cent.

The summary picture presented therefore is one where following two oil price shocks and depressed conditions in the world economy, both output and employment growth decelerated, presumably leaving increasing proportions of the capital stock as conventionally measured unutilised. Thus the capital/output ratio rose. What is interesting to note also is that throughout this period, the stock of fixed assets continued to grow at a rate of around 1.8 per cent per annum and this point will be taken up later in Section VI.

In Table 3, the identity expressed in equation (1) is given with output growth decomposed into total factor input and the residual term which is here termed total factor productivity. The 1976 weights used in the construction of the TFI and TFP indices are:-

	s_W	s_π
Mining	0.69	0.31
Manufacturing of Basic Products	0.56	0.44
Manufacture of Capital Goods	0.76	0.24
Manufacture of Consumer Goods	0.74	0.26
Food, Drink and Tobacco	0.40	0.60
Manufacturing Total	0.66	0.34
Mining plus Manufacturing	0.66	0.34

What the figures in Table 3 suggest is that on average the factor share weighted fall in employment over the decade has been sufficient to outweigh the growth of capital and output such that in all but two of the groupings, total factor input is negative. In the capital goods industries, labour and capital growth explains 12 per cent of total output growth. It is in the food indsutries only that these conventional inputs account for a significant proportion of total output over the period, the figure being 46 per cent. For Manufacturing taken as a whole,

Table 3

Growth of Output (V) Total Factor Input (TF1) and Total Factor Productivity (TFP) (per cent)

	1970-1981			1973-1981		
	V	TF1	TFP	V	TF1	TFP
Mining	-1.67	-1.98	0.31	-1.04	-1.12	-0.08
Manufacturing of Basic Products	1.15	-0.07	1.22	-0.12	-0.71	0.59
Manufacture of Capital Goods	1.97	0.23	1.74			
Manufacturing of Consumer Goods	0.70	-1.13	1.83	-0.28	-1.71	1.43
Food, Drink and Tobacco	1.96	0.91	1.05	1.62	0.28	1.34
Manufacturing Total	1.54	-0.02	1.56	0.80	-0.55	1.35
Mining plus Manufacturing	1.41	-0.13	1.54	0.73	-0.59	1.32

	1970-1973		
	V	TF1	TFP
Mining	-3.33	-4.64	1.31
Manufacturing of Basic Products	4.61	1.69	2.92
Mqnufacturing of Capital Goods	3.06	2.32	1.74
Manufacture of Consumer Goods	3.35	0.42	2.93
Food, Drink and Tobacco	2.88	2.59	0.29
Manufacturing Total	3.54	1.40	2.14
Mining plus Manufacturing	3.25	1.13	2.12

total factor productivity growth as measured accounts for the whole of the recorded increase in output.

In the sub period 1973-81, this picture is emphasised even more with three of the groups recording declines in total factor input which exceed the fall in growth of real output. However, in both capital goods and food sectors, total factor productivity growth increased or was maintained as compared with the total sample period.

In sharp contrast, the earlier period 1970-73 presents a picture in which all sectors but Mining registered a positive growth of total factor input. In addition, with the same exception of Mining as before, the growth of total factor productivity was below that of output as a whole, the total industry average contribution being of the order of 65 per cent. The range however is considerable.

Table 4 breaks down the contribution to the growth of output per head into the two components, total factor productivity growth and the growth of factor substitution (see equation 4). For Manufacturing and all industry over the whole period, factor substitution in favour of capital accounted on average for about one half of the increase in real output per employee. Alternatively, the calculations suggest that factor substitution took place at roughly the same rate as the growth of total factor productivity. This is true also of the 1970-73 sub-period.

In the industrial sector, the rate of increase of output per head fell by 0.80 per cent which is virtually the same for Manufacturing. The summary figures in Table 5 below show the relative contribution of total factor productivity growth and capital deepening to this decline between the two sub-periods. We see that in both instances the simple growth accounting computations suggest a comparable contribution from the two components.

Within the manufacturing sector, there is a good deal of variability. In capital goods for example comparing the sub-periods, changes in output growth are closely matched by changes in factor substitution so leaving

Table 4

Growth of Labour Productivity $\left(\frac{V}{L}\right)$ Substitution of Capital for Labour $\left(\frac{K}{L}\right)$ and Total Factor Productivity (TFP) (per cent)

	1970-1981			1973-1981		
	$\left(\frac{V}{L}\right)$	$S_{\pi}\left(\frac{K}{L}\right)$	TFP	$\left(\frac{V}{L}\right)$	$S_{\pi}\left(\frac{K}{L}\right)$	TFP
Mining	0.84	0.53	0.31	0.29	0.37	-0.08
Manufacturing of Basic Products	3.00	1.78	1.22	1.99	1.40	0.59
Manufacture of Capital Goods	2.85	1.11	1.74	2.72	0.98	1.74
Manufacture of Consumer Goods	3.25	1.42	1.83	2.70	1.27	1.43
Food, Drink and Tobacco	3.63	2.58	1.05	3.68	2.34	1.34
Manufacturing Total	3.05	1.49	1.56	2.62	1.27	1.35
Mining plus Manufacturing	2.96	1.42	1.54	2.54	1.22	1.32

	1970-1973		
	$\left(\frac{V}{L}\right)$	$S_{\pi}\left(\frac{K}{L}\right)$	TFP
Mining	2.27	0.96	1.31
Manufacture of Basic Products	5.76	2.84	2.92
Manufacture of Capital Goods	3.21	1.47	1.74
Manufacture of Consumer Goods	4.73	1.80	2.93
Food, Drink and Tobacco	3.49	3.20	0.29
Manufacturing Total	4.22	2.08	2.14
Mining plus Manufacturing	4.09	1.97	2.12

total factor productivity growth unchanged. In the food industries on the other hand, comparing 1970-81, output growth remained unchanged, whereas factor substitution fell which increased total factor productivity growth in the 1973-81 period.

Thus, what Tables 1 - 4 indicate is that although output per head rose on average by around 3 per cent between 1970 and 1981, the rise in the capital/labour ratio, or fall in capital productivity was such that total factor productivity as represented here, rose at about one half of this rate, that is around 1.5 per cent per annum. From 1973 onwards, this rate of increase began to slacken in nearly all sectors, although as stated already, there was a lot of variation.

Table 5

Growth in Output per Head (per cent)

	1970-1973	1973-1981	Difference
	Mining plus Manufacturing		
$\left(\frac{V}{L}\right)g$	4.09	2.54	1.55
$S_{\pi}\left(\frac{K}{L}\right)g$	1.97	1.22	0.75
TFPg	2.12	1.32	0.80
	Manufacturing		
$\left(\frac{V}{L}\right)g$	4.22	2.62	1.60
$S_{\pi}\left(\frac{K}{L}\right)g$	2.08	1.27	0.81
TFPg	2.14	1.35	0.79

One can see this variety of experience again in a slightly different way. Table 6 below provides two examples of how the year-by-year profile of total factor productivity growth evolved when measured from the year 1970 using 1976 factor share weights.

Table 6

Evolution of TFPg for two

Sectors (per cent)

	Manufacturing	Food, Drink and Tobacco
1971	- 0.80	2.16
1972	0.99	0.18
1973	2.14	0.29
1974	1.18	0.07
1975	0.23	0.25
1976	1.76	1.00
1977	1.82	0.80
1978	1.74	0.93
1979	2.04	0.99
1980	1.78	1.00
1981	1.56	1.01

The figures highlight the very depressed year 1975 when industrial output measured from the 1970 base fell to zero. The Food and Drink sectors however, being much closer to the cyclical trend in what is a relatively stable sector, experienced rather less fluctuation than did Manufacturing as a whole. Indeed, total factor productivity growth in Food etc, has evolved steadily if not dramatically from 1975.

IV. (ii) Disaggregated Results

The major series together with calculations of total factor productivity and total factor input growth for each of the 35 industry groups are set out in the detailed Annex Tables 1 to 10. The first three of these refers to the whole sample period 1970-1981, the second to experience after 1973, with the third being concerned with 1970-73. The final Annex Table 10 is analogous to the aggregated Table 5 in the main text. The difference between growth of output per head in the periods 1970-73 and 1973-81 is given and divided into that part associated with changes in total factor productivity and that part associated with changes in capital deepening.

Looking at Annex Tables 1, 4 and 7 first of all, whereas 19 out of 35 industries recorded output growth of below 1 per cent per annum over the whole period, this becomes 22 when the sub-period 1973-81 is considered and 12 for 1970-73. Some sectors however, Aerospace, Office Machinery, Plastics and Cellulose, for example, continued to maintain high growth rates of net output. Employment growth was negative in the great majority of industries throughout, whereas the capital stock tended to expand rapidly in virtually all sectors. Thus, as shown in Annex Tables 2, 5 and 8, the steady fall in output per unit of capital was widespread. In some industries the decline was dramatic.

Annex Tables 3, 6 and 9 contain the main calculations and these display a variable pattern of growth in total factor productivity. Although average growth of total factor productivity between 1970 and 1981 was around 1.5 per cent as we have seen, the range varied from 5.6 per cent per annum in Timber industries to minus 2 per cent in Leather goods manufacture. This is reflected in part in the equally variable pattern which emerges in the annual growth of output per head. One can see, however, that from 1973 onwards, the rate of growth of TFP slowed down.

Taking the Annex Tables together, the clear impression is that increases in output per head through the decade which have tended to average around 3 per cent per annum, have been offset largely by relatively sharp reductions in output per unit of capital such that total factor productivity growth has been either limited or negative. In other words, for many industries, the measured contribution of total factor input over the whole period was negative. The reduction in employment, together with the increase in the capital stock when weighted together produce the negative effect:

$$TF1g = S_{\pi}Kg + (1 - S_{\pi}) \; Lg < 0$$

This is in contrast with the first three years of the period when one third of the sample industries registered this characteristic. Nevertheless, the eight industries which show the fastest growth in output per head for example in the period 1970-1981 with the exception of Electrical Equipment, show the most rapid growth of total factor productivity.

The differences in growth of output per head shown in Annex Table 10 illustrate this general tendency in somewhat more detail. These industries which register the biggest reductions in growth of labour productivity, Oil and Natural Gas, Chemicals, Iron and Steel, Cellulose for example, experienced the biggest reductions in total factor productivity growth. In symmetrical fashion, Stone, Rubber, Engineering, Office Machinery for example, which performed well in terms of output per head, had relatively high total factor productivity growth. Capital deepening on the other hand tends to be distributed more unevenly across the various sectors:

V. Some Analysis

The previous two sub-sections offer what is only a summary description of what seems to emerge from the Tables. A more convenient method of analysing this information is to see what light a few of the many possible economic explanations might shed upon the trends observed.

Initially, we can refer back to the relationships set out in Section II and split total factor productivity growth into its component parts in the manner of the broad sectoral summary tables presented earlier.

In Charts IA and IB we plot the growth of output per head against the growth in the capital/labour ratio for the whole sample period. An estimated linear regression line given by

$$1970\text{-}1981 \left(\frac{V}{L}\right) g \quad = - \underset{(0.982)}{0.829} + \underset{(4.662)}{0.810} \left(\frac{K}{L}\right) g \qquad R^2 = 0.38 \quad (4a)$$

is shown also for the disaggregated set. Given the form of equation (4), one would expect the constant term in the regression to represent the average growth of total factor productivity with the coefficient on $\left(\frac{K}{L}\right)g$ being the average share of profits or elasticity of growth in output per employee with respect to the growth in capital per employee. It is clear that the estimated form (4a) does not yield anything like the required result since through 1970-1981, as we have seen, total factor productivity grew at around 1.55 per cent whilst the average 1976 value for $S_\pi =$ 34 per cent. The constant term however is insignificant and shifting this upwards to the average value of 1.55 and inserting mean values for $\left(\frac{V}{L}\right)g$ and $\left(\frac{K}{L}\right)g$ gives the required value for S_π as one would expect.

Direct estimates from Annex Table 3 suggest that factor substitution given by $S_\pi\left(\frac{K}{L}\right) g$ accounted on average for 41 per cent of the growth in output per head 1970-81 which is only one half of that yielded by the estimated equation. One presumes that the variable $\left(\frac{K}{L}\right)$ is serving to pick up possibly important other elements which affect output per head; factors such as quality changes in both labour and capital embodied

CHART 1A

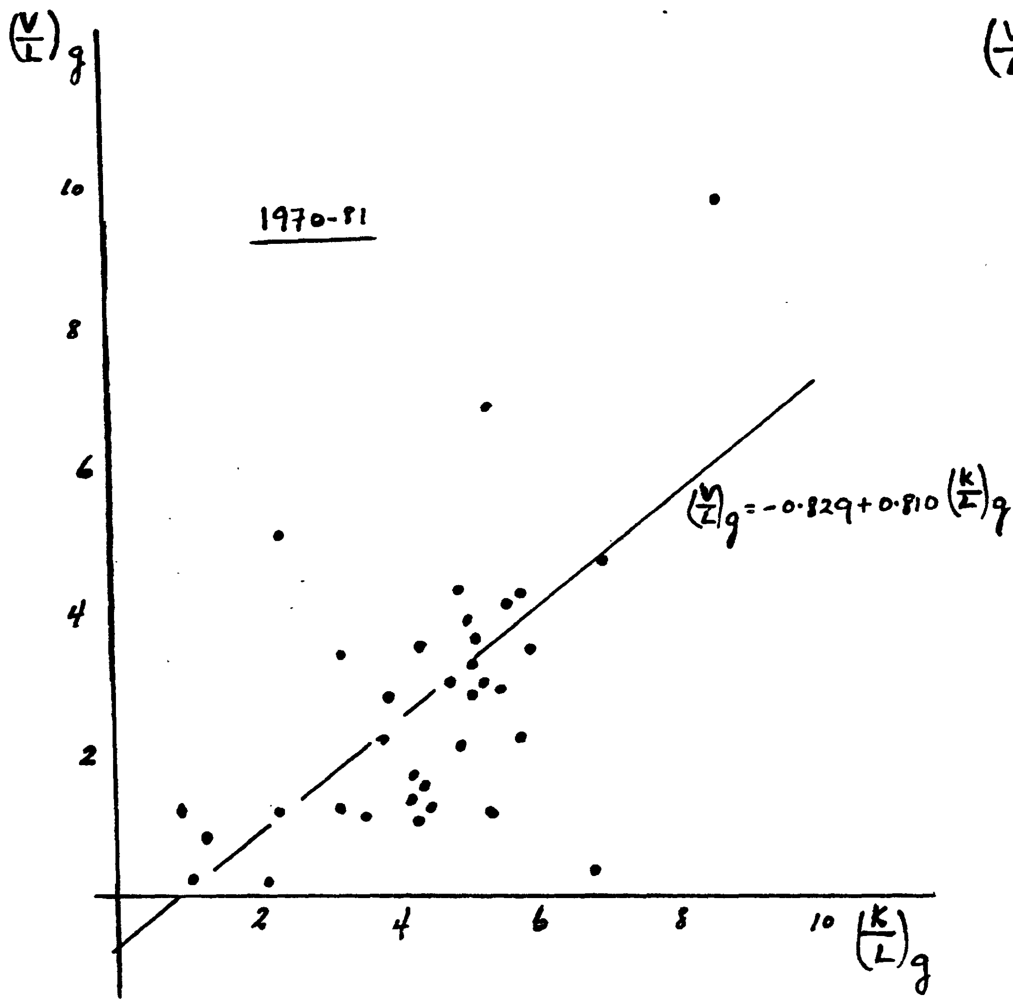
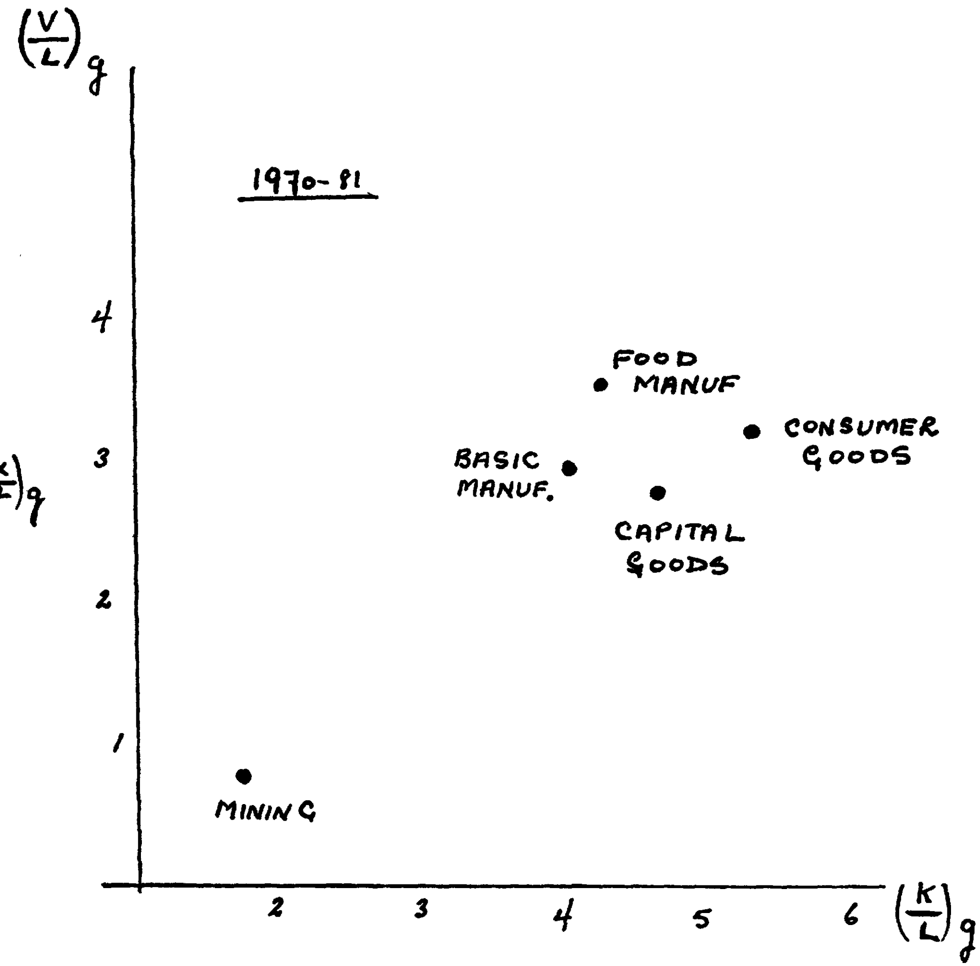


CHART 1B



technical progress and so on. In this respect one may prefer this higher figure to the lower direct estimates. The equation re-estimated for 1973-1981 shows little difference with the coefficient on $\left(\frac{K}{L}\right)$ rising very slightly. The result here is similar to those obtained by Kendrick (1981) and Lindbeck (1983) even though these were concerned with OECD cross-country comparisons. Typically one seems to derive a coefficient on $\left(\frac{K}{L}\right)$ g of 0.7 - 0.85.

If we confine ourselves to some simple tests of association between some of the variables used, some interesting comparisons emerge. The first two estimated cross-section relationships show the association between labour and capital productivity growth respectively and the growth of gross value added for industry as a whole 1970-81.

$$1970\text{-}81 \quad \left(\frac{V}{L}\right) g = \underset{(9.084)}{2.226} + \underset{(6.880)}{0.594}\ Vg \qquad R^2 = 0.577 \qquad (5)$$

$$1970\text{-}81 \quad \left(\frac{V}{K}\right) g = \underset{(7.686)}{2.033} + \underset{(3.176)}{0.196}\ Vg \qquad R^2 = 0.211 \qquad (6)$$

These suggest that what can be termed Kaldor or Verdoorn effects are much much weaker on the capital input side. Indeed, equation (5) yields what is a virtually standard 'Verdoorn' coefficient of 0.6. Nevertheless, the significance of output growth in explaining albeit a minor part of the growth of capital productivity remains of some importance. The equation indicates that even though capital productivity has tended to decline in the industrial sector, those industries which have managed to achieve above average growth of real output, have achieved higher than average capital productivity also. Generalising to total factor productivity yields the equation:

$$1970\text{-}81 \quad TFPg = \underset{(4.310)}{1.109} + \underset{(5.490)}{0.499}\ Vg \qquad R^2 = 0.362 \qquad (7)$$

which is a rough indicator of efficiency. The gains in output per unit of weighted inputs from output growth is not that much different than for labour productivity considered alone. In other words, the decline in capital productivity is an indication that German industry has found it more difficult to economise in capital usage than in the use of labour.

Another dimension of this association is seen when total factor productivity growth is regressed on growth of the capital stock. It is a popular notion that productivity overall takes place partly because increases in the gross capital stock embody newer and more up to date vintages of equipment. If this is so, one would expect to identify some relationship between the above two variables.

$$1970\text{-}81 \quad TFPg = \underset{(1.736)}{0.838} + \underset{(2.200)}{0.294}\ Kg \qquad R^2 = 0.109 \qquad (8)$$

For the sub-period 1973-81, the coefficient on Kg falls to 0.18 and is insignificant. Thus, if embodied technical progress is occurring to a significant extent, the weak explanatory power indicates that it is not shown up in this way which is rather surprising. Further, it casts some doubt on the size of the estimated coefficient of 0.8 on (K/L)g in equation 4 (a).

Continuing with the role of capital and capital deepening as a determinant of growth in output per head, we have seen from the growth accounting calculations that total factor productivity growth and capital/labour substitution contributed to the growth in output per head and to the slowdown in this rate of increase in broadly equal proportions. Kendrick's (1981) calculations for a cross-section of OECD countries yielded a capital deepening contribution of around 35 per cent.

Whilst there are undoubted difficulties in measuring labour input, those associated with capital are thought usually to be more problematical. Whether this really is true or not is a genuinely difficult question to answer. If, however, one proceeds along mainstream lines and assumes that capital is a major source of difficulty, what avenues of approach can one adopt?

Some years ago in an interesting and novel paper, Johansen (1961) used a method which attempted to deal with the issue by not using capital at all. The method in brief is to write a production function in intensive form:

$$\left(\frac{V}{L}\right) = A \left(\frac{K}{L}\right)^{\beta}$$

Between the two periods one can compare the relative increase in output per head

$$\left(\frac{V}{L}\right)_2 \Big/ \left(\frac{V}{L}\right)_1 = \frac{A_2}{A_1} \cdot \left(\frac{K_2 / L_2}{K_1 / L_1}\right)^{\beta}$$

$$= \frac{A_2}{A_1} \cdot \left(\frac{K_2 / K_1}{L_2 / L_1}\right)^{\beta}$$

where in a cross section analysis, the subscript 'i' is omitted for notational convenience. Under the assumptions of constant returns to scale and that competitive conditions prevail, the relative increase in capital per head can be taken to equal the increase in wage costs relative to capital costs, that is

$$\left(\frac{V}{L}\right)_2 \Big/ \left(\frac{V}{L}\right)_1 = \frac{A2}{A1} \; W$$

or $$pr = \alpha W^{\beta}$$

and $$\log pr = \log \alpha + \beta \log W$$

where pr = the relative increase in output per head.
In order to apply this relationship across industries, one must assume (a) that the relative increase in wage costs is the same in all industries and (b) that the term log α is not correlated with β. If these do not apply it becomes invalid to apply the cross-section methodology which in the above equation uses log α to denote shifts in the production function and log W to describe movements along it.
Thus one requires observations on β for each industry. The constant returns and competitive assumptions enable β to be defined as the share of capital in net output which leads to a bivariate regression equation of the form:-

$$\log pr = \log \alpha + (\log W) \quad S_{\pi} + \mu$$

with μ being a random error term assumed to satisfy the usual properties.

Applying the above form to the 1970-81 cross-section of 35 observations on pr and using the 1976 sample mid-point value for S_{π} yields the following estimated relationship (8):

$$\log pr = \underset{(3.590)}{0.249} + \underset{(1.770)}{0.264}\, S_{\pi} \qquad R^2 = 0.16 \qquad (9)$$

Despite the lack of statistical significance of the coefficient log W on S_{π}, it is faintly amusing to note that the value of 0.264 is all but identical to that obtained by Johansen who derived an estimate from his much earlier British sample of 0.266! Taking anti-logs and working through the implications of the above, we find that the implied production function is shifting by around 2.25 per cent per annum over the eleven year period, as compared with the growth accounting estimate for total industry of 1.54 per cent. The implied cost of labour relative to that of capital is 1.30. Chart II provides an illustration of the scatter of observations.

(8) Johansen used the average of S_{π} between the two end years of his sample period.

Equation (9) was re-estimated with one rather awkward observation eliminated, namely that for Oil Refining which has a measured increase in output per head between 1970-1981 of only 1.7 per cent, but a profit share in excess of 90 per cent. As a result of this excursion into data mining, the new estimated equation becomes:

$$\log pr = \underset{(3.068)}{0.2103} + \underset{(2.01)}{0.473}\, S_{\pi} \qquad R^2 = 0.21 \qquad (10)$$

The estimated shift in the production now falls to 1.9 per cent per annum with an implied relative factor cost of 1.60.

Choosing the average industry value for S_{π} of 0.34 and substituting this in the equation (9) yields a breakdown between shifts or total factor productivity movements and capital deepening as follows:

	per cent
shift effect	28.32
factor substitution	9.40
Total	37.72

Total growth of gross value added per head yielded by the equation is 40.4 per cent yielding 2.67 per cent remaining either unexplained or explained perhaps by

$$\operatorname{cov}(\beta, \log \alpha) \neq 0$$

Measured output per head was in fact 39.0 per cent. With this same value of S_{π} at 0.34, the second equation (10) gives:

	per cent
shift effect	23.40
factor substitution	17.45
Total	40.85

Total growth of output implied is 44.9 per cent which leaves 4.0 per cent to be explained possibly by some interaction between log α and β

Thus the removal of the one 'offending' observation in this method makes a great deal of difference to the division between capital deepening and technical progress induced shifts in the aggregate production frontier. Although the split is not equal in describing what has happened to the evolution of output per head, as in the growth accounting computations, the role of capital deepening or factor substitution remains important.

Continuing with the Johansen approach Chart II reveals that eight out of the twelve industries which experienced the fastest growth of gross value added lay above the regression line given by equation (10). These are the encircled points in Chart II. Removing these and repeating the procedure on these twelve observations resulted in the following:

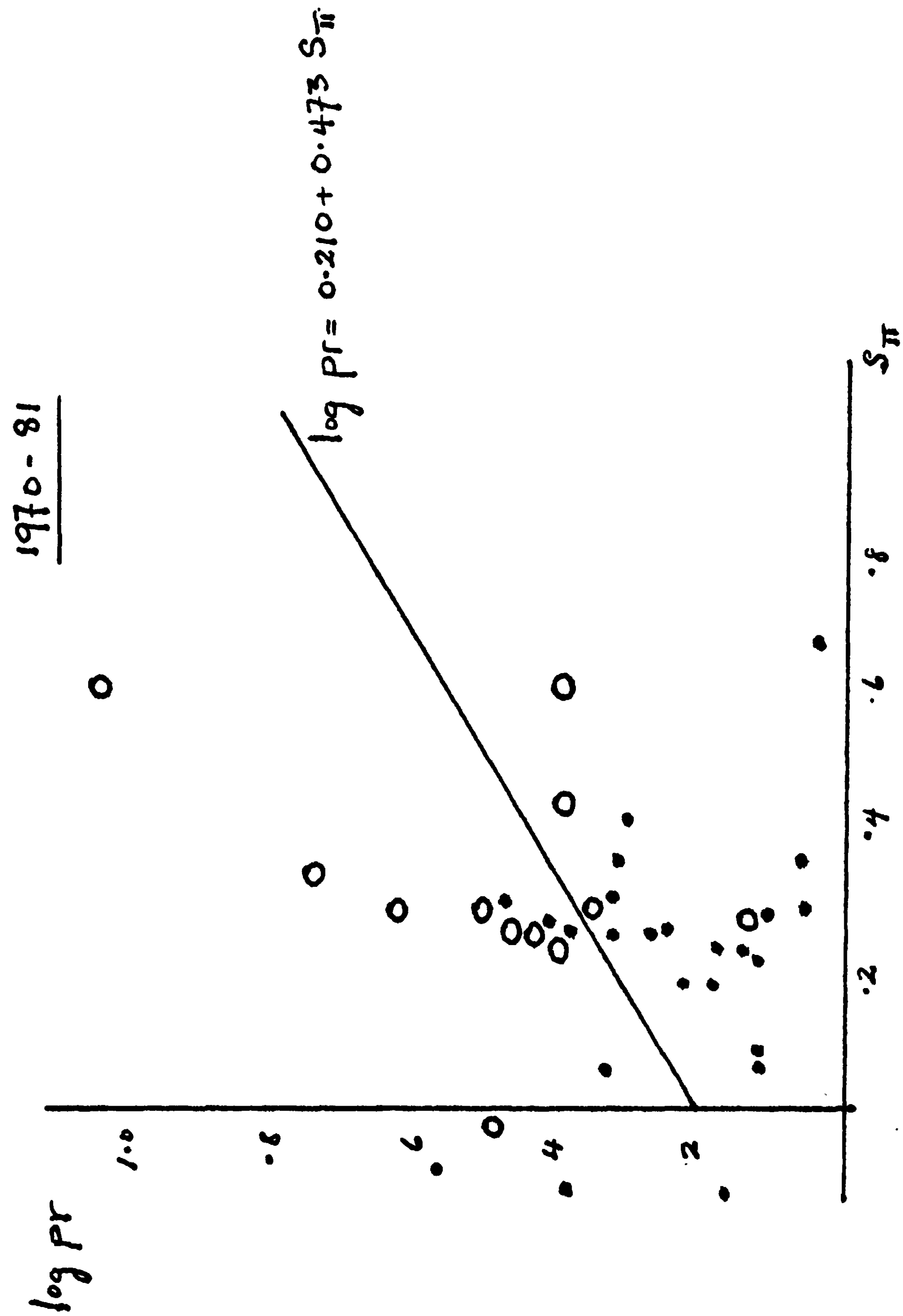
$$\log pr = \underset{(2.422)}{0.353} + \underset{(2.233)}{0.511}\, S_{\pi} \qquad R^2 = 0.22$$

Using this time an average value for the twelve industries of $S_{\pi} = 0.37$, the breakdown between shift and factor substitution effects is

	per cent
shift effect	42.33
factor substitution	21.11
Total	63.34

The total growth of output per head implied for this set of fastest growers is 72.3 per cent which leaves a residual or interaction effect of 9 per cent. The relative factor cost increase yielded by this restricted set is 1.66. It will be observed that the contribution of technical progress appears to be more substantial than in equation (10).

CHART II



On the question of whether the relative factor costs suggested by the above are reasonable or not, some recent work by Kopits (1982) is of value. For several countries Kopits calculates factor price ratios for the two years 1973 and 1978. In the case of Western Germany the relative increase is estimated to have been between 1.2 and 1.7. The figures derived here therefore are not inconsistent with this other evidence.

VI. Comments on Capital Productivity

One of the more interesting features which has emerged in all of the above concerns the observed fall in gross value added per unit of capital in all but a small number of the 35 sectors. This has worked in the opposite direction to the recorded increases in output per head, so pulling down the growth of total factor productivity. In turn, this focuses attention on the fact that the gross capital stock has continued to increase at an average compound rate of around 2.75 per cent over the decade. In the slowdown post-1973, as indicated earlier Section IV, the rate of increase was in excess of 1.8 per cent. Indeed, it appears that the decline in capital productivity in the West German economy has proceeded at a more rapid rate than that in other Community countries, with the exception of the United Kingdom (see European Economy 1981). Whether this decline is due primarily to depressed demand conditions and a much slower growth of real output, coupled with poor profit expectations or under-utilisation of the existing stock of capital is difficult to say with any degree of certainty. Several points can be made, however.

The very fixity of the capital stock will, in itself, tend to lower average measured capital productivity as the growth of real output declines. But, as lower rates of utilisation continue, the expectation would be that the rate of gross capital accumulation should begin to ease. The figures in Table 2 suggest that the growth of the average capital/output ratio has declined; the industry figure for 1970-73 being 1.79 as against 1.10 for 1973-81. Thus some adjustment has occurred (9).

The problem arises, however, in the fact that the stock of fixed assets as recorded may not take into account fully changes in economic factors which have occurred through the decade. Two of these are firstly

(9) See Allgayer et al (1983) p. 37 for further comments on this.

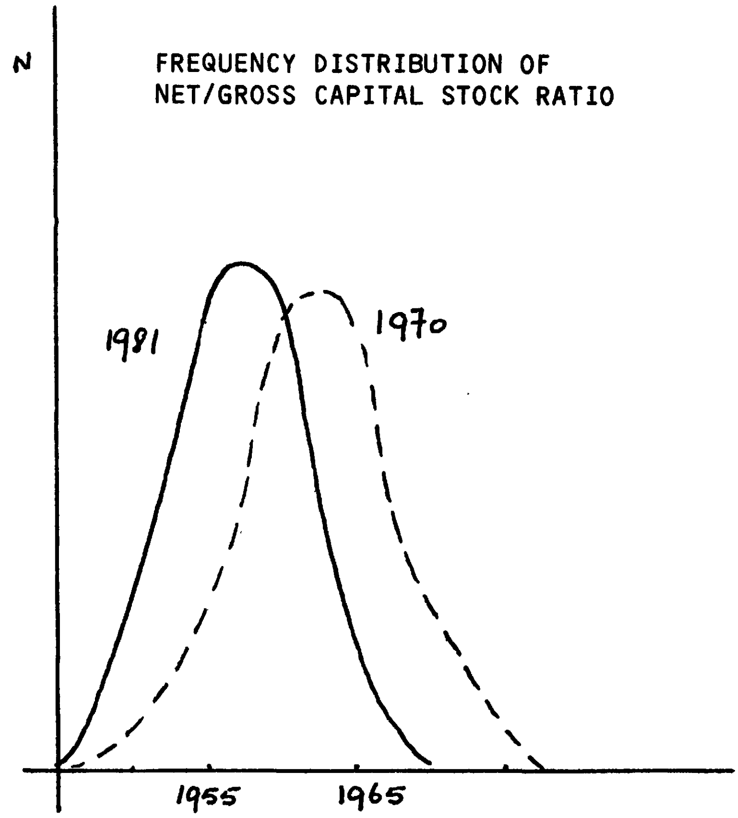
the influence of technical progress and, secondly, the possible effects of changes in relative factor prices.

On the first, a crude and approximate indicator of quality or vintage is provided by the DIW "Modernitaetsgrad" variable (Krengel et al 1982, page 40) which is the ratio of net fixed to gross fixed volume of capital stock. Thus if net investment is proceeding at a faster rate than is capital consumption, the ratio is increasing in value. If one assumes that technical progress is embodied in new net accumulation, a rise in the stock ratio would indicate an improvement in vintage or quality of the stock available. It need not however say anything about the age or time dimension of this stock. To take a much exaggerated and extreme case, if capital consumption and replacement are identical but replacement is literally what it means, then any age structure would be consistent with a stable ratio of net to gross stock. But, if one follows the line of reasoning argued forcibly by, say, Scott (1976), all physical replacement should be assumed to embody new technology. In this situation, one could find replacement investment or capital consumption exceeding the rate of net new formation (the ratio falling), but quality of the stock improving. The implications one draws from the behaviour of such an indicator are therefore not entirely unambiguous.

What we find is that over the eleven year sample period, all 32 sectors of Manufacturing show a decline in the ratio of net to gross fixed stock of capital. But, this decline occurs for the main part from 1973 onwards. In the remaining three sectors of industry, only two, coal mining and natural gas extraction show an increase. If the more up-to-date methods are thought to be embodied in net accumulation, the inference is that quality of the stock is declining. To the extent that replacement investment has an embodiment dimension also, this will, to some extent, modify such a conclusion.

Chart III graphs the two frequency distributions of the ratio and it can be seen that the profile of 'quality' has moved some way towards the 50 per cent level which would correspond to a steady state condition

CHART III


N
FREQUENCY DISTRIBUTION OF
NET/GROSS CAPITAL STOCK RATIO
1981
1970
1955
1965

in the particular sense that net and replacement changes are exactly matched. The average for industry as a whole in 1970 was 62.3, 62.1 in 1973 and 56.8 in 1981.

One might wish to hypothesise that those sectors which experience the most rapid decline in the value of the ratio would have relatively lower growth of total factor productivity. This is no more than another manifestation of the embodiment hypothesis alluded to earlier in the bivariate regression equation (8). That is to say, those industries which maintain a more favourable quality structure of equipment will, on average, tend to be the most efficient. A simple scatter diagram relating changes in the ratio and total factor productivity growth revealed no clear association between the two variables. Nevertheless, in the Manufacturing sector, the extreme cases of those few industries which experienced very substantial increases in both output and total factor productivity, experienced also only modest reductions in the above ratio.

Turning next to the time dimension, in the German case, estimates of service life are for the most part calculated from Ministry of Finance published information on tax conventions. Within any feqsible administrative framework however, tax life of asset types must be simplified in structure and this material tends in practice to be supplemented with survey information (Lützel 1977).

The average service life of plant and machinery in the German Manufacturing sector as estimated by DIW appears to be about 20 years (Paccoud 1983), with the range varying from 17 years in Metal Products to 25 years in the case of Food, Drink and Tobacco. In all sectors, buildings have a common assumed life of 40 years.

There is some evidence that service lines of productive assets in Germany are being revised downwards (see Paccoud op cit and Blades 1983). If statistical, accounting methods have not incorporated an adjustment for this, the size of the capital stock is likely to be overestimated. In this event, for given output, the decline in capital productivity will, in turn, tend to be overstated. Using the DIW methodology (10), Paccoud (1983) for example, shows that if capital spending grows at a constant rate of 5 per cent per annum, a shortening of asset life from 30 to 20 years will reduce the existing capital stock by some 18 per cent.

Some simple interpolation based on Paccoud's tables suggest that a shortening of average service life by, say 3 years, reduces the 1981 end year stock of capital by 9 per cent. Assuming somewhat unrealistically that both output growth and the 1976 profit share remain unchanged, this yields over the sample period a growth of capital productivity in total manufacturing of - 0.46 per cent (compared with - 1.36 per cent). Total factor productivity growth 1970-1981 now becomes 2.12 per cent as compared with 1.56 per cent.

Collecting this part of the discussion together, the suggestion is that although the average quality of capital may have been falling, the service life has been falling also. One would expect the former to lower measured capital productivity and hence total factor productivity, whereas for the reasons mentioned above, the latter will work in the opposite direction.

The first effect in several respects is the more awkward one. A decline in quality can be ecpected to affect the flow of services from the existing stock. However, this sidesteps the question of why such a decline might have occurred. A potentially fruitful approach is that suggested by Baily (1981 and 1983). The degree of shorter run complementarity between energy inputs and capital is such that the sharp rise in the relative price of energy reduced the worth of the capital asset via the diminished flow in capital services. This in turn affects both output and productivity growth adversely. The more usual capital stock accounting methods follow some variant of the perpetual inventory method which cannot take adequate account of relative price changes. It calls into question also the kind of interpretation which can be placed on the more common two-factor production function forms which underly the growth accounting and other formulations used here.

As to the role and significance of the capital stock in affecting the behaviour of factor productivity it seems clear that both official data and other information point to a substantial fall in capital productivity and a rise in capital per head. It must be presumed that underutilisation of the existing stock has increased, which in a putty-clay scenario one would expect. The net effect has been to reduce total factor productivity growth and the growth of output per head also.

VII. Productivity Growth and Farrell Efficiency

Work by the author cited earlier (Todd 1983) concentrated largely on two snapshorts provided by the end years of the earlier sample, namely 1970 and 1980 where the price basis was that at 1970. To update the whole of that exercise would be a considerable undertaking. However, for the two end years 1970 and 1981 in the current data set, Farrell frontiers were estimated relating to the 32 industries in the Manufacturing sector. These are shown in Chart IV(a) where once again it can be seen that the productive efficiency frontiers show relatively little difference in movement. There is a slight movement in a more capital intensive direction. This is brought out more clearly if the data is grouped into the broad sectors as in Tables 1 - 4. Chart IV(b) shows the implied frontiers where it can be seen that all sectors drift downwards and to the right over the decade. The two encircled points refer to the average for all industry, that is mining plus manufacturing.

Thus what these two snapshots illustrate again is the increase in output per head being offset by the fall in capital productivity. Remembering the extreme sensitivity of technical frontiers of this kind to particular observations, it is nevertheless interesting to note that in terms of a radial measure, the broad sectoral frontier in Chart (b) has at the average 1970 capital/labour ratio for all industry, moved inwards at an annual compound rate of 1.71 per cent. This compares with the total factor productivity growth figure of 1.54 per cent given in Table 3.

CHART IV (a)

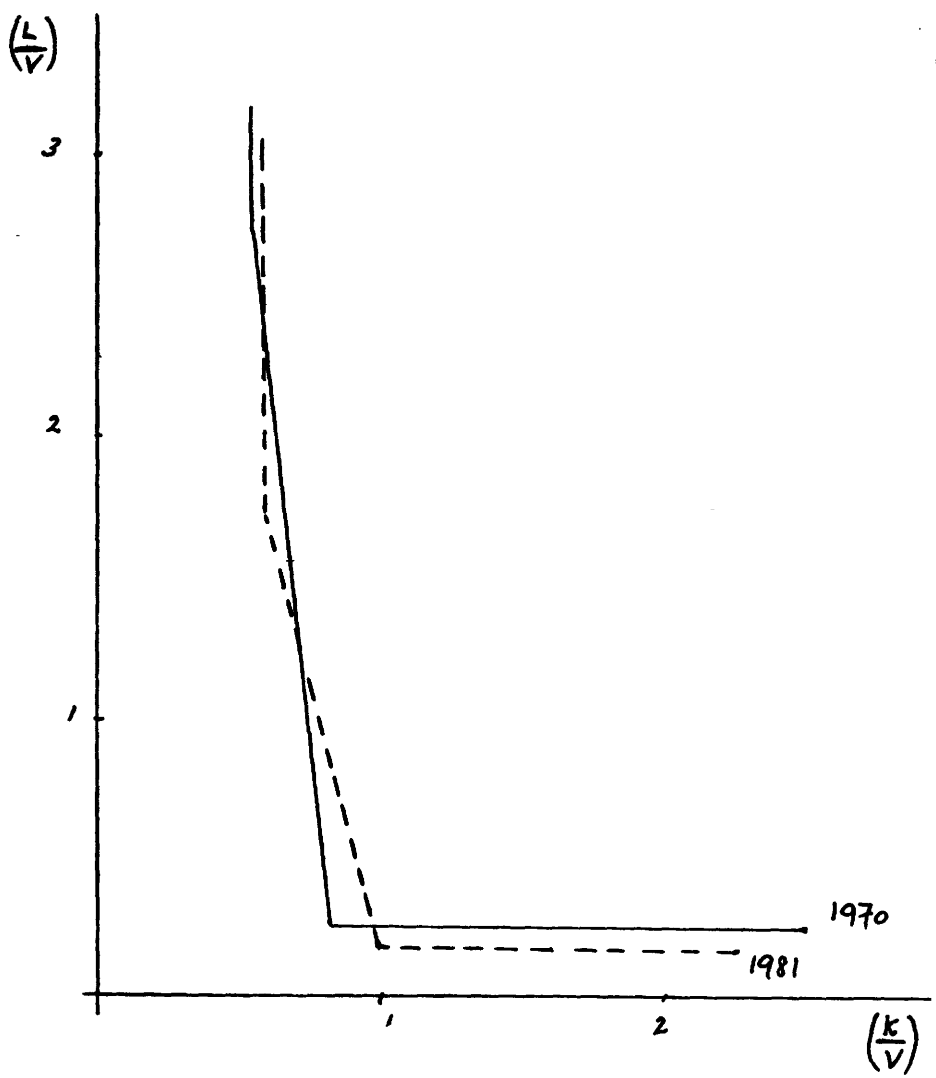
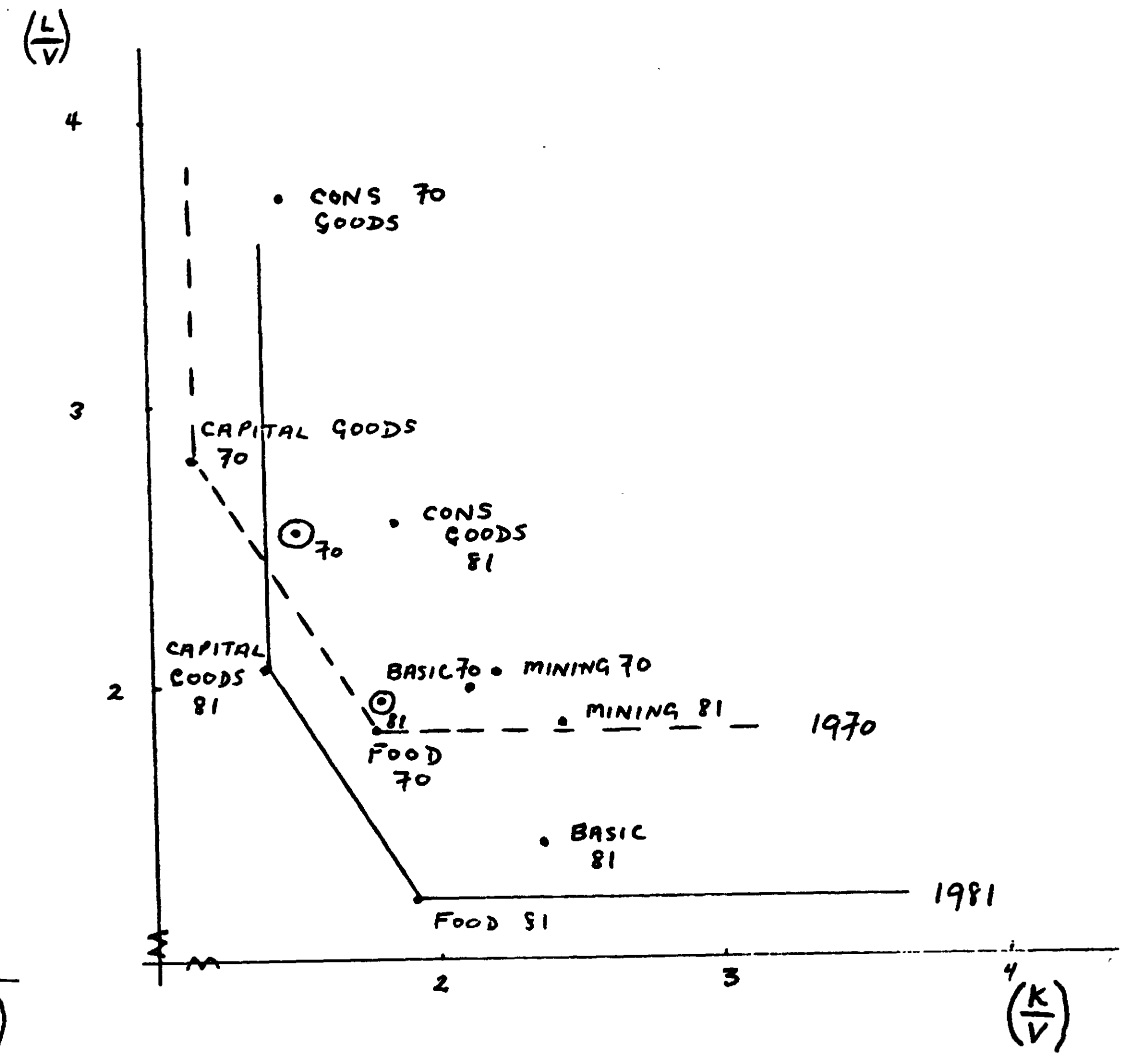


CHART IV (b)



VII. Concluding Comments

The present work looks at the evaluation of both factor and total factor productivity over the past decade. The estimates highlight the significant slowdown in the growth of both output per head and total factor productivity in the post 1973 period. The simple and well-used growth accounting framework produces a broadly even split between capital deepening and total factor productivity growth in explaining the slowdown within the sample period. The indirect method of Johansen places somewhat less weight on the substitution element and rather more on 'disembodied' technical progress.

Because the growth accounting approach has embodied in it a Cobb-Douglas type technology and in the exercise here, with factor shares constrained to equal unity, it may be argued that this is unrealistic. In some respects it is. However, the alternative of varying the factor share weights or producing separate and perhaps rather 'mysterious' scale contributions to total factor productivity growth has its own disadvantages also. Turner (1983) for example suggests that in German manufacturing, constant returns to scale offers a reasonable description of production possibilities.

Although output per head has continued to grow at a rate of around 2.5 per cent per annum since 1973, capital productivity has declined steadily, albeit at a slower rate than in the years 1970-73. There are some particular difficulties to be faced when attempting to account for the behaviour of capital productivity growth. Some evidence suggests that actual service lives of assets may be shortening. To the extent that these are not incorporated fully into official estimates of the capital stock, this would reduce the decline in capital productivity. On the other hand, sharp increases in energy prices in an energy/capital specific framework will reduce the flow of capital services and weaken capital productivity growth. The precise balance of argument is difficult to assess although it is hard to avoid the conclusion that some considerable and protracted decline in capital productivity has occurred and this has retarded the evolution of total factor growth.

Turning to more practical matters, it can be argued that this apparent characteristic of productive behaviour is of some importance. The German economy, like almost all other advanced industrialised nations, has over a long period of time tended to levy taxes on labour but at the same time attempts to subsidise the capital input. Over the recent past, subsidies to particular kinds of investment have risen substantially. There is thus a built in relative price policy bias in favour of capital deepening or labour saving.

The motives for this are both deep rooted and understandable. There is an almost intuitive belief that new capital automatically embodies the latest knowledge and techniques. Such embodied technical advance contributes automatically to the growth of national output and productivity. In other words, the perception is that normalised future output gains exceed the cost of any subsidy. Whether this really is true or not is extremely difficult to say. Theories abound on the nature of technical progress but whilst there is no shortage of applied work it is fair to say that the importance embodiment as such is by no means a proven case. Indeed it is well known that a significant part of R and D spending is accounted for by new product innovation which affects the output side of the production relationship.

If one goes back to Table 5 we find that capital deepening accounts for about one half of the decline in output per head. What this really means is that despite the substantial fall in labour productivity, capital/labour substitution has continued to occur at around 50 per cent of its previous rate. Moreover and probably the most important telling point of all, is that the alleged benefits of this have not spilled over into employment; the decline in employment accelerated greatly as Table 1 shows. (One can of course always argue that in the absence of capital deepening, employment would have been even less).

The figures in the Tables do not prove the particular point of view expressed here, but at a time when all economies in the western world are seeking an improved growth performance, it is better to have as background those relative price conditions which make for a more appropriate allocation of resources and assist the expansionary phase. It goes almost without saying that such a movement is not an easy thing to achieve.

REFERENCES

1. F. Allgayer et al, "Federal Republic of Germany: Medium Term Economic Trends and Problems", Economic Papers No. 16, Commission of the European Communities, Directorate-General for Economic and Financial Affairs, June 1983.

2. M.N. Baily, "Productivity and the Services of Capital and Labour", Brookings Papers in Economic Activity, No. 1, 1981.

3. M.N. Baily, "The Productivity Growth Slowdown by Industry", Working Paper, The Brookings Institution, October 1982.

4. D. Blades, "Service Lives of Fixed Assets", OECD Working Paper No. 4, March 1983.

5. A. Boltho, "The European Economy", Oxford 1982.

6. L. Johansen, "A Method for Separating the Effects of Capital Accumulation and Shifts in Production Functions upon Growth in Labour Productivity", Economic Journal, December 1961.

7. J.W. Kendrick, "International Comparisons of Recent Productivity Trends" in "Essays in Contemporary Economic Problems" Ed. W. Fellner, American Enterprise Institute, 1981.

8. C. Kennedy and A.P. Thirlwall, "Surveys in Applied Economics: Technical Progress", Economic Journal, March 1972.

9. G. Kopits, "Factor Prices in Industrial Countries", IMF Staff Papers, Vol. 29, No. 3, September 1982.

10. R. Krengel et al, "Produktionsvolumen und-Potential" DIW, Berlin, October 1982.

11. A. Lindbeck, "The Recent Slowdown of Productivity Growth", Economic Journal, March, 1983.

12. H. Lützel, "Estimates of Capital Stocks by Industries in the Federal Republic of Germany", The Review of Income and Wealth, March 1977.

13. Th. Paccoud, "First Report on Fixed Capital Stock", Working Paper, Statistical Office of the European Communities, Luxembourg, December 1982.

14. M. FG. Scott, "Investment and Growth", Oxford Economic Papers, Vol. 28, No. 3, November 1976.

15. D. Todd, "Productive Performance in West German Manufacturing Industry, 1970-80; A Farrell Frontier Characterisation", Economic Papers No. 18, Commission of the European Communities, Directorate-General for Economic and Financial Affairs, August 1983. Journal of Industrial Economics (forthcoming).

16. R.E. Turner, "A Re-examination of Verdoorn's Law and its Application to the Manufacturing Industries of the UK, West Germany and the USA", European Economic Review, 23 September 1983.

17. H. Varian, "Microeconomic Analysis", W.W. Norton and Co, New York 1978.

Table 1

Growth of Output (V), Labour (L) and Capital (K)
1970-81 (per cent)

	V	L	K
1. Coal Mining	-2.03	-2.48	-1.22
2. Oil and Natural Gas Extraction	0.80	0.55	1.67
3. Other Mining	0.85	-3.77	-1.42
4. Oil Refineries	-0.42	-0.58	1.48
5. Stone, Clay, Sand etc.	0.00	-2.95	2.20
6. Iron and Steel Industries	0.00	-2.28	1.52
7. Non-Ferrous Metals	2.74	-1.62	3.25
8. Iron and Steel Foundries	-2.70	-3.97	0.40
9. Non-Ferrous Metals Foundries	0.11	-1.09	1.23
10. Steel Drawing and Cold Rolling Mills	-0.16	-2.97	0.92
11. Chemical Industry	3.04	-0.47	2.72
12. Sawmills and Timber	0.90	-2.76	2.42
13. Cellulose, Paper and Board Industry	3.56	-3.40	1.87
14. Rubber and Asbestos	0.47	-2.47	3.04
15. Steel Forging	0.53	-1.25	2.95
16. Steel Construction	0.49	-0.94	3.25
17. Engineering	0.54	-1.11	3.14
18. Vehicle Building and Repairs	2.17	0.84	3.99
19. Shipbuilding	0.13	-2.94	1.88
20. Aircraft and Aerospace	7.35	2.51	9.53
21. Electrical Equipment	2.73	-1.48	4.14
22. Precision Engineering	-0.27	-1.48	3.85
23. Metal Products	1.25	-1.77	3.61
24. Office and Data Processing Machinery	9.40	-0.97	7.51
25. Musical Instruments, Toys, Games	-0.97	-1.57	5.22
26. Fine Ceramics	-0.67	-1.73	1.81
27. Glass Industries	2.84	-2.35	4.42
28. Wood Processing	1.63	-0.46	4.42
29. Paper and Board	1.94	-1.67	4.19
30. Printing	2.02	-1.27	3.83
31. Plastics Manufacturing	6.09	1.89	7.63
32. Leather and Leather Products	-3.70	-4.84	-0.53
33. Textiles	-1.11	5.00	-0.02
34. Clothing Industry	-2.29	-4.53	1.18
35. Food, Drink and Tobacco	1.96	-1.67	2.63

TABLE 2

Growth of Output per unit of Capital $\left(\frac{V}{K}\right)$ and the Capital/Labour ratio $\left(\frac{K}{L}\right)$ 1970-1981 (per cent)

	$\frac{V}{K}$	$\frac{K}{L}$
1. Coal Mining	- 0.81	1.26
2. Oil and Natural Gas Extraction	- 0.87	1.11
3. Other Mining	2.27	2.34
4. Oil Refineries	1.90	2.06
5. Stone, Clay, Sand, etc.	- 2.21	5.16
6. Iron and Steel Industries	- 1.52	3.80
7. Non-Ferrous Metals	- 0.51	4.87
8. Non-Steel Foundries	- 3.10	4.37
9. Non-Ferrous Metals Foundries	- 1.11	2.32
10. Steel Drawing and Cold Rolling Mills	- 1.09	3.90
11. Chemical Industry	0.31	3.20
12. Sawmills and Timber	- 1.52	5.18
13. Cellulose, Paper and Board Industry	1.69	5.27
14. Rubber and Asbestos	- 2.58	5.52
15. Steel Forging	- 2.42	4.20
16. Steel Construction	- 2.76	4.19
17. Engineering	- 2.59	4.25
18. Vehicle Building and Repairs	- 1.83	3.16
19. Shipbuilding	- 1.75	4.83
20. Aircraft and Aerospace	- 2.18	7.02
21. Electrical Equipment	- 1.41	5.62
22. Precision Engineering	- 4.12	5.34
23. Metal Products	- 2.36	5.38
24. Office and Data Processing Machinery	1.89	8.48
25. Musical Instruments, Toys, Games	- 6.19	6.78
26. Fine Ceramics	- 2.48	3.55
27. Glass Industries	- 1.58	6.76
28. Wood Processing	- 2.79	4.87
29. Paper and Board	- 2.25	5.86
30. Printing	- 1.82	5.10
31. Plastics Manufacturing	- 1.55	5.74
32. Leather and Leather Products	- 3.17	4.31
33. Textiles	- 1.09	4.97
34. Clothing Industry	- 3.47	5.71
35. Food, Drink and Tobacco	- 0.66	4.29

TABLE 3

Growth of Output, Output per head, Total Factor input (TFI), Total Factor Productivity (TFP) and Factor Substitution $s_\pi\left(\frac{K}{L}\right)$ 1970-81 (per cent)

	V	$\frac{V}{L}$	TFI	TFP	$s_\pi\left(\frac{K}{L}\right)$
1. Coal Mining	-2.03	0.45	1.95	-0.08	0.53
2. Oil and Natural Gas Extraction	0.80	0.24	0.85	-0.50	0.74
3. Other Mining	0.85	4.61	-3.32	4.17	0.44
4. Oil Refineries	-0.42	0.16	1.29	-1.71	1.87
5. Stone, Clay, Sand etc.	0.00	2.94	-1.15	1.15	1.79
6. Iron and Steel Industries	0.00	2.29	-1.28	1.28	1.01
7. Non-Ferrous Metals	2.74	4.36	-0.34	3.08	1.28
8. Iron and Steel Foundries	-2.70	1.27	-3.00	0.30	0.97
9. Non-Ferrous Metals Foundries	0.11	1.21	-0.86	0.97	0.24
10. Steel Drawing and Cold Rolling Mills	-0.16	2.81	-1.35	1.19	1.62
11. Chemical Industry	3.04	3.51	0.90	2.14	1.37
12. Sawmills and Timber	0.90	3.66	-6.53	5.63	-1.97
13. Cellulose, Paper and Board Industry	3.56	6.96	-1.69	5.25	1.71
14. Rubber and Asbestos	0.47	2.94	-0.81	1.28	1.66
15. Steel Forging	0.53	1.78	-0.51	1.04	0.74
16. Steel Construction	0.49	1.43	-1.47	1.96	-0.53
17. Engineering	0.54	1.65	-0.13	0.67	0.98
18. Vehicle Building and Repairs	2.17	1.33	1.67	0.50	0.83
19. Shipbuilding	0.13	3.07	-2.77	2.90	0.17
20. Aircraft and Aerospace	7.35	4.84	2.34	5.01	-0.17
21. Electrical Equipment	2.73	4.21	0.07	2.66	1.55
22. Precision Engineering	-0.27	1.21	-1.10	0.83	0.38
23. Metal Products	1.25	3.02	-1.44	1.69	1.33
24. Office and Data Processing Machinery	9.40	10.37	4.10	5.30	5.07
25. Musical Instruments, Toys, Games	-0.97	0.59	0.81	-1.78	2.37
26. Fine Ceramics	-0.67	1.06	-0.76	0.09	0.97
27. Glass Industries	2.84	5.19	-0.51	3.35	1.84
28. Wood Processing	1.63	2.09	0.44	1.19	0.90
29. Paper and Board	1.94	3.61	0.25	1.69	1.92
30. Printing	2.02	3.28	0.22	1.80	1.48
31. Plastics Manufacturing	6.09	4.19	3.19	2.90	1.29
32. Leather and Leather Products	-3.70	1.15	-1.70	-2.00	3.15
33. Textiles	-1.11	3.88	-3.61	2.50	1.38
34. Clothing Industry	-2.29	2.25	-3.11	0.82	1.43
35. Food, Drink and Tobacco	1.96	3.63	0.91	1.05	2.58

TABLE 4

Growth of Output (V), Labour (L), and Capital (K)
1973-81 (per cent)

		V	L	K
1.	Coal Mining	-1.21	-1.23	-0.41
2.	Oil and Natural Gas Extraction	-1.44	1.47	1.93
3.	Other Mining	1.32	-3.33	-1.32
4.	Oil Refineries	-1.82	-1.32	0.34
5.	Stone, Clay, Sand etc.	-1.17	-4.32	0.75
6.	Iron and Steel Industries	-1.44	-2.41	0.18
7.	Non-Ferrous Metals	1.61	-2.05	1.43
8.	Iron and Steel Foundries	-2.44	-3.70	-0.52
9.	Non-Ferrous Metals Foundries	-0.02	-0.98	0.68
10.	Steel Drawing and Cold Rolling Mills	-1.48	-3.47	-0.33
11.	Chemical Industry	1.33	-0.46	1.81
12.	Sawmills and Timber	-0.26	-3.40	1.40
13.	Cellulose, Paper and Board Industry	3.22	-2.37	1.62
14.	Rubber and Asbestos	0.09	-2.99	0.62
15.	Steel Forging	0.82	-1.52	1.91
16.	Steel Construction	-0.54	-1.93	2.27
17.	Engineering	0.65	-1.15	2.26
18.	Vehicle Building and Repairs	1.67	0.63	3.17
19.	Shipbuilding	-0.11	-3.09	1.92
20.	Aircraft and Aerospace	7.24	3.61	9.10
21.	Electrical Equipment	1.48	-1.97	3.31
22.	Precision Engineering	-0.25	-1.17	3.61
23.	Metal Products	0.77	-2.47	2.49
24.	Office and Data Processing Machinery	9.38	-1.14	6.07
25.	Musical Instruments, Toys, Games	-1.37	-1.21	4.61
26.	Fine Ceramics	-1.12	-1.96	1.20
27.	Glass Industries	1.52	-3.05	3.08
28.	Wood Processing	-0.93	-1.71	3.00
29.	Paper and Board	1.06	-1.90	2.65
30.	Printing	1.83	-1.45	3.37
31.	Plastics Manufacturing	3.59	0.80	5.90
32.	Leather and Leather Products	-2.73	-4.10	-1.15
33.	Textiles	-2.17	-5.16	-1.01
34.	Clothing Industry	-3.18	-5.53	0.49
35.	Food, Drink and Tobacco	1.62	-2.06	1.85

Table 5

Growth of Output per unit of Capital $\left(\frac{V}{K}\right)$ and the Capital/Labour ratio $\left(\frac{K}{L}\right)$ 1973-198 (per cent)

	$\frac{V}{K}$	$\frac{K}{L}$
1. Coal Mining	-0.81	0.82
2. Oil and Natural Gas Extraction	-3.37	0.45
3. Other Mining	2.64	2.01
4. Oil Refineries	-2.16	1.66
5. Stone, Clay, Sand etc.	-1.92	5.08
6. Iron and Steel Industries	-1.62	2.59
7. Non-Ferrous Metals	0.18	3.48
8. Iron and Steel Foundries	-1.24	3.18
9. Non-Ferrous Metals Foundries	-0.70	1.66
10. Steel Drawing and Cold Rolling Mills	-1.15	3.14
11. Chemical Industry	-0.48	2.27
12. Sawmills and Timber	-1.66	4.80
13. Cellulose, Paper and Board Industry	1.60	3.90
14. Rubber and Asbestos	-0.52	3.61
15. Steel Forging	-1.09	3.43
16. Steel Construction	-2.81	4.20
17. Engineering	-1.61	3.41
18. Vehicle Building and Repairs	-1.49	2.55
19. Shipbuilding	-2.03	5.01
20. Aircraft and Aerospace	-1.87	5.49
21. Electrical Equipment	-1.83	5.27
22. Precision Engineering	-3.86	4.78
23. Metal Products	-1.71	4.96
24. Office and Data Processing Machinery	3.30	7.21
25. Musical Instruments, Toys, Games	-5.98	5.82
26. Fine Ceramics	-2.32	3.17
27. Glass Industries	-1.56	6.14
28. Wood Processing	-3.94	4.71
29. Paper and Board	-1.59	4.56
30. Printing	-1.54	4.83
31. Plastics Manufacturing	-2.31	5.10
32. Leather and Leather Products	-1.58	2.94
33. Textiles	-1.16	4.15
34. Clothing Industry	-3.66	6.01
35. Food, Drink and Tobacco	-0.23	3.91

Table 6

Growth of Output, Output per head, Total Factor input (TFI), Total Factor Productivity (TFP) and Factor Substitution $S_{\pi}\left(\frac{K}{L}\right)$ 1973-81 (per cent)

	V	$\left(\frac{V}{L}\right)$	TFI	TFP	$S_{\pi}\left(\frac{K}{L}\right)$
1. Coal Mining	-1.21	0.01	0.98	-0.23	0.24
2. Oil and Natural Gas Extraction	-1.44	-2.91	1.77	-3.21	0.30
3. Other Mining	1.32	4.65	-2.95	4.27	0.38
4. Oil Refineries	-1.82	-0.50	0.18	-2.00	1.50
5. Stone, Clay, Sand etc.	-1.17	3.16	-2.56	1.39	1.77
6. Iron and Steel Industries	-1.44	0.97	-1.73	0.29	0.68
7. Non-Ferrous Metals	1.61	3.66	-1.14	2.75	0.91
8. Iron and Steel Foundries	-2.44	1.26	-2.99	0.55	0.71
9. Non-Ferrous Metals Foundries	-0.02	0.96	-0.81	0.79	0.17
10. Steel Drawing and Cold Rolling Mills	-1.48	1.99	-2.16	0.68	1.31
11. Chemical Industry	1.33	1.80	0.51	0.82	0.98
12. Sawmills and Timber	-0.26	3.13	-5.22	4.96	-1.83
13. Cellulose, Paper and Board Industry	3.22	5.59	-1.08	4.30	1.29
14. Rubber and Asbestos	0.09	3.09	-1.92	2.01	1.08
15. Steel Forging	0.82	2.34	-0.91	1.73	0.61
16. Steel Construction	-0.54	1.39	-2.46	1.92	-0.53
17. Engineering	0.65	1.80	-0.36	1.01	0.79
18. Vehicle Building and Repairs	1.67	1.05	1.28	0.39	0.66
19. Shipbuilding	-0.11	2.99	-2.91	2.80	0.19
20. Aircraft and Aerospace	7.24	3.63	3.47	3.77	-0.14
21. Electrical Equipment	1.48	3.44	-0.51	1.99	1.45
22. Precision Engineering	-0.25	0.92	-0.83	0.58	0.34
23. Metal Products	0.77	3.25	-1.26	2.03	1.22
24. Office and Data Processing Machinery	9.38	10.52	3.17	6.21	4.31
25. Musical Instruments, Toys, Games	-1.37	-0.16	0.83	-2.20	2.04
26. Fine Ceramics	-1.12	0.84	-1.09	-0.03	0.87
27. Glass Industries	1.52	4.58	-1.39	2.91	1.67
28. Wood Processing	-0.93	0.78	-0.84	-0.09	0.87
29. Paper and Board	1.06	2.96	-0.41	1.47	1.49
30. Printing	1.83	3.29	-0.05	1.88	1.41
31. Plastics Manufacturing	3.59	2.79	1.95	1.64	1.15
32. Leather and Leather Products	-2.73	1.36	-3.17	0.44	0.92
33. Textiles	-2.17	2.99	-4.00	1.83	1.16
34. Clothing Industry	-3.18	2.35	-4.03	0.85	1.50
35. Food, Drink and Tobacco	1.62	3.68	0.28	1.34	2.34

TABLE 7

Growth of Output (V), Labour (L) and Capital (K) 1970-1973 (per cent)

	V	L	K
1. Coal Mining	-4.19	-5.76	-3.37
2. Oil and Natural Gas Extraction	7.02	-1.85	1.00
3. Other Mining	1.71	-4.93	-0.41
4. Oil Refineries	3.40	1.40	4.58
5. Stone, Clay, Sand etc.	3.15	0.80	6.17
6. Iron and Steel Industries	3.97	1.92	5.22
7. Non-Ferrous Metals	5.83	-0.44	8.29
8. Iron and Steel Foundries	-3.39	-4.70	2.88
9. Non-Ferrous Metals Foundries	0.48	-1.39	2.71
10. Steel Drawing and Cold Rolling Mills	3.42	-1.64	4.35
11. Chemical Industry	7.73	-0.49	5.20
12. Sawmills and Timber	4.08	-1.04	5.19
13. Cellulose, Paper and Board Industries	4.47	-6.09	2.54
14. Rubber and Asbestos	1.46	-1.07	9.81
15. Steel Forging	-0.24	-0.54	5.75
16. Steel Construction	3.30	1.76	5.90
17. Engineering	0.26	1.00	5.51
18. Vehicle Building and Repairs	3.49	1.41	6.22
19. Shipbuilding	0.76	-2.55	1.78
20. Aircraft and Aerospace	7.64	-0.37	10.67
21. Electrical Equipment	6.16	-0.16	6.42
22. Precision Engineering	-0.33	-2.31	4.52
23. Metal Products	2.50	0.12	6.64
24. Office and Data Processing Machinery	9.46	-0.51	11.44
25. Musical Instruments, Toys, Games	0.10	-2.50	6.87
26. Fine Ceramics	0.56	-1.11	3.46
27. Glass Industries	6.43	-0.45	8.06
28. Wood Processing	8.81	2.97	8.29
29. Paper and Board	4.34	-1.02	8.41
30. Printing	2.50	-0.76	5.07
31. Plastics Manufacturing	13.04	4.87	12.40
32. Leather and Leather Products	-6.21	-6.80	1.16
33. Textiles	1.76	-4.54	2.67
34. Clothing Industry	0.13	-1.83	3.06
35. Food, Drink and Tobacco	2.88	-0.61	4.73

TABLE 8

Growth of Output per unit of Capital $\left(\frac{V}{K}\right)$ and the Capital/Labour ratio $\left(\frac{K}{L}\right)$ 1970-1973 (per cent)

		$\frac{V}{K}$	$\frac{K}{L}$
1.	Coal Mining	-0.81	2.37
2.	Oil and Natural Gas Extraction	6.01	2.85
3.	Other Mining	1.29	3.22
4.	Oil Refineries	1.18	3.17
5.	Stone, Clay, Sand etc.	3.03	5.37
6.	Iron and Steel Industries	-1.25	7.14
7.	Non-Ferrous Metals	-2.46	8.73
8.	Iron and Steel Foundries	-6.28	7.58
9.	Non-Ferrous Metals Foundries	-2.23	4.10
10.	Steel Drawing and Cold Rolling Mills	-0.93	6.00
11.	Chemical Industry	2.52	5.70
12.	Sawmills and Timber	-1.12	6.24
13.	Cellulose, Paper and Board Industry	1.93	8.63
14.	Rubber and Asbestos	8.35	10.88
15.	Steel Forging	5.99	6.28
16.	Steel Construction	-2.59	4.14
17.	Engineering	-5.25	6.52
18.	Vehicle Building and Repairs	-2.73	4.81
19.	Shipbuilding	-1.02	4.33
20.	Aircraft and Aerospace	3.03	11.04
21.	Electrical Equipment	-0.26	6.58
22.	Precision Engineering	-4.85	6.83
23.	Metal Products	-4.14	6.53
24.	Office and Data Processing Machinery	-1.98	11.95
25.	Musical Instruments, Toys, Games	-6.77	9.36
26.	Fine Ceramics	-2.90	4.57
27.	Glass Industries	-1.63	8.52
28.	Wood Processing	0.52	5.32
29.	Paper and Board	-4.07	9.43
30.	Printing	-2.57	5.84
31.	Plastics Manufacturing	0.64	7.53
32.	Leather and Leather Products	-7.37	7.96
33.	Textiles	-0.91	7.21
34.	Clothing Industry	-2.94	4.90
35.	Food, Drink and Tobacco	-1.85	5.34

TABLE 9

Growth of Output, Output per head, Total Factor Input (TF1); Total Factor Productivity (TFP) and Factor Substitution $s_\pi\left(\frac{K}{L}\right)$ 1970-1973 (per cent)

		V	$\left(\frac{V}{L}\right)$	TF1	TFP	$S_\pi\left(\frac{K}{L}\right)$
1.	Coal Mining	4.19	1.57	-5.06	0.87	0.70
2.	Oil and Natural Gas Extraction	7.02	8.86	0.04	6.98	1.88
3.	Other Mining	-1.71	4.51	-5.61	3.90	1.61
4.	Oil Refineries	3.40	2.00	4.28	-0.88	2.88
5.	Stone, Clay, Sand etc.	3.15	2.35	2.68	0.47	1.88
6.	Iron and Steel Industries	3.97	5.90	-0.04	4.01	1.89
7.	Non-Ferrous Metals	5.83	6.27	1.86	3.97	2.30
8.	Iron and Steel Foundries	-3.39	1.31	-3.01	-0.38	1.69
9.	Non-Ferrous Metals Foundries	0.48	1.87	0.98	1.46	0.41
10.	Steel Drawing and Cold Rolling Mills	3.42	5.06	0.84	2.58	2.48
11.	Chemical Industry	7.73	8.22	1.95	5.78	2.44
12.	Sawmills and Timber	4.08	5.12	-3.41	7.49	-2.37
13.	Cellulose, Paper and Board Industry	4.47	10.56	-3.28	7.75	2.81
14.	Rubber and Asbestos	1.46	2.53	2.19	-0.73	3.26
15.	Steel Forging	-0.24	0.29	0.58	-0.82	1.11
16.	Steel Construction	3.30	1.55	1.23	2.07	-0.52
17.	Engineering	0.26	1.27	0.50	-0.24	1.51
18.	Vehicle Building and Repairs	3.49	2.09	2.66	0.83	1.26
19.	Shipbuilding	0.76	3.31	-2.40	3.16	0.15
20.	Aircraft and Aerospace	7.64	8.00	-0.64	8.28	-0.28
21.	Electrical Equipment	6.16	6.32	1.65	4.51	1.81
22.	Precision Engineering	-0.33	1.98	-1.82	1.49	0.49
23.	Metal Products	2.50	2.38	1.73	0.77	1.61
24.	Office and Data Processing Machinery	9.46	9.97	6.63	2.83	7.14
25.	Musical Instruments, Toys, Games	0.10	2.59	0.78	-0.68	3.27
26.	Fine Ceramics	0.56	1.67	0.14	0.42	1.25
27.	Glass Industries	6.43	6.89	1.96	4.57	2.32
28.	Wood Processing	8.81	5.84	3.95	4.86	0.98
29.	Paper and Board	4.34	5.37	2.06	2.28	3.09
30.	Printing	2.50	3.27	0.93	1.57	1.70
31.	Plastics Manufacturing	13.04	8.17	6.56	6.48	1.69
32.	Leather and Leather Products	-6.21	0.59	-4.31	-1.90	2.49
33.	Textiles	1.76	6.31	-2.54	4.30	2.01
34.	Clothing Industry	0.13	1.96	-0.61	0.74	1.22
35.	Food, Drink and Tobacco	2.88	3.49	2.59	0.29	3.20

TABLE 10

Differences in Growth of Output per Head $\left(\frac{V}{L}\right)$ g, Capital/Labour Substitution $s_{\pi}\left(\frac{K}{L}\right)$ g and Total Factor Productivity (TFPg) between 1970-73 1973-81.

		$\left(\frac{V}{L}\right)g$	$s_{\pi}\left(\frac{K}{L}\right)g$	TFPg
1.	Coal Mining	1.56	0.46	1.10
2.	Oil and Natural Gas Extraction	11.77	1.58	10.19
3.	Other Mining	0.86	1.23	-0.37
4.	Oil Refineries	2.50	1.38	1.12
5.	Stone, Clay, Sand etc.	-0.81	0.11	-0.92
6.	Iron and Steel Industries	4.93	1.21	3.72
7.	Non-Ferrous Metals	2.61	1.39	1.22
8.	Iron and Steel Foundries	0.05	0.98	-0.93
9.	Non-Ferrous Metals Foundries	0.91	0.24	0.67
10.	Steel Drawing and Cold Rolling Mills	3.07	1.17	1.90
11.	Chemical Industry	6.42	1.46	4.96
12.	Sawmills and Timber	1.99	-0.54	2.53
13.	Cellulose, Paper and Board Industry	4.97	1.52	3.45
14.	Rubber and Asbestos	-0.56	2.18	-2.74
15.	Steel Forging	-2.05	0.50	-2.55
16.	Steel Construction	0.16	0.01	0.15
17.	Engineering	-0.53	0.72	-1.25
18.	Vehicle Building and Repairs	1.04	0.60	0.44
19.	Shipbuilding	0.32	-0.04	0.36
20.	Aircraft and Aerospace	4.37	-0.14	4.51
21.	Electrical Equipment	2.88	2.52	0.36
22.	Precision Engineering	1.06	0.15	0.91
23.	Metal Products	-0.87	0.39	-1.26
24.	Office and Data Processing Machinery	-0.55	2.83	-3.38
25.	Musical Instruments, Toys, Games	2.75	1.23	1.52
26.	Fine Ceramics	0.83	0.38	0.45
27.	Glass Industries	2.31	0.65	1.66
28.	Wood Processing	5.06	0.11	4.95
29.	Paper and Board	2.41	1.60	1.81
30.	Printing	-0.02	0.29	0.31
31.	Plastics Manufacturing	5.38	0.54	4.84
32.	Leather and Leather Products	-0.77	1.57	-2.34
33.	Textiles	3.32	0.85	2.47
34.	Clothing Industry	-0.39	-0.28	-0.11
35.	Food, Drink and Tobacco	-0.19	0.86	-1.05

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