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Factor Productivity Growth in Four EEC Countries, 1960-1981

Douglas Todd*

Internal Paper

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ABSTRACT

A simple growth accounting framework is used to try and identify the contribution of total factor inputs and total factor productivity as components of the evolution of real output in the four largest Community countries. In addition, some attention is paid to the growth of factor substitution and capital productivity in explaining observed changes in the growth of output per head. The general impression given by the analysis is that for some time, the efficiency of investment in all four countries has been declining.

CONTENTS

I. Introduction and Overview

A good deal of interest has centred on the observed deceleration in the annual average rate of growth of both real output and real output per head in OECD countries during the 1970's. Recent examples of detailed analysis and alternative explanations in this area include those by Baily (1981/1982) and Dennison (1983) for the United States. For other countries and OECD countries in general we have Kendrick (1981), the volume of contributions edited by Matthews (1982) and the Economic Journal Symposium (1982), together with a considerable number of other exercises.

As to the occurence of a deceleration in the evolution of general economic activity there is no reasonable doubt. Real GDP for OECD countries as a whole grew at an annual compound rate of 4.0 per cent between 1960 and 1981. From 1973 to 1979 this rate of evolution fell to 2.7 per cent. For EEC countries taken together the figures are 3.6 and 2.5 per cent respectively.

Table 1 below shows for some selected sub-periods between 1960 and 1981 how the slowdown has evolved.

Table 1
Growth of Real GDP %

Growth of real GDP*	1960-81	1960-68	1968-73	1973-79
OECD countries	4.0	5.1	4.7	2.7
EEC countries	3.6	4.5	4.9	2.5
Growth of real GDP per employee*				
OECD countries	3.0	4.1	3.6	1.6
EEC countries	3.4	4.4	4.4	2.3

* Source : OECD "Historical Statistics 1960-1981", Paris 1983.

Thus looking at the picture overall in terms of national output, the OECD statistical series suggests a more or less continuous tendency for the rate of increase in activity in OECD countries to decline through the last two decades. Within the EEC bloc however the rate of expansion

increased up to 1973. From that year onwards, the pace appears to have decelerated sharply for both groups of countries.

Of at least equal interest over this same period is the behaviour of productivity, that is of output in relation to the more important of those inputs which generate it. By far the most popular indicator used is real output per head. The measure is widely available, often on alternative bases and there are good and obvious reasons as to why labour productivity is of interest in its own right. Initially, therefore, it is useful to see how this has evolved over the more recent past.

Again, we find that for the OECD and European Community countries considered as broad groups, the growth of total output per head decelerated sharply in the past 1973 period. As Table 1 shows, between 1973 and 1979, labour productivity growth was around one half of the rate experienced through the nineteen sixties and early seventies.

We turn next in similar fashion to a summary appraisal of economic performance in the four largest Community countries, namely France, Germany, Italy and the United Kingdom.

Looking at the two decades 1960-81 together, Table 2 shows that the average growth of real GDP in both France and Italy exceeded both the EEC and OECD average. The same is true of the growth of real output in the Industrial and Manufacturing sectors. Whilst the United Kingdom has lagged behind through the post-war period, it is interesting to note the weakening performance of the German economy. Once a prominent leader through the fifties and sixties, economic performance in these terms began to weaken.

Table 2 shows also that following the first oil price shock in 1973, essentially a similar story holds in aggregate. Again, France and Italy have an above average growth record in the three sectors, whereas the German and UK economies are at, or below, the group averages.

Turning next to the evolution of real output for persons employed, Table 3 summarises the comparisons in the same way. Over the complete sample period, a similar story emerges which serves to underline the relative strength of France and Italy. Indeed, the labour productivity performance of Germany was well above the European Community and OECD country averages. In the UK, the growth of labour productivity through the sub-period was relatively weak, particularly in the manufacturing sector.

The reason why labour productivity growth was maintained in the German economy is to be found initially in the fact that employment growth virtually stagnated as compared with France and Italy. Indeed, over the 1973-79 period, in Germany only did total employment decline at a rate of 0.6 per cent per annum. France and the UK experienced modest increases of around 0.2 per cent per annum and in Italy the annual average increase was around 1.0 per cent.

Table 2

Growth of Real Output %

	1960-81			1973-79		
	Growth of GDP	Growth of Industrial Output	Growth of Manufacturing Output	Growth of GDP	Growth of Industrial Output	Growth of Manufacturing Output
France	4.4	4.9	5.4	3.1	2.4	2.9
Germany	3.6	3.3	3.7	2.4	1.6	1.8
Italy	4.2	4.7	5.6	2.6	2.3	3.1
U.K.	2.1	1.3	0.9	1.4	0.6	-0.6
OECD countries	4.0	4.1	4.6	2.7	2.1	1.9
EEC countries	3.0	3.6	3.9	2.5	1.7	2.4

Source : OECD "Historical Statistics 1960-1981", Paris 1983.

Table 3

Growth of Output per Person Employed

%

	1960-1981			1973-1979		
	Real GDP per person employed	Real Value Added in industry per person employed	Real Value Added in manufacturing per person employed	Real GDP per person employed	Real Value Added in industry per person employed	Real Value Added in manufacturing per person employed
France	3.9	4.7	5.4	2.9	3.7	4.1
Germany	3.6	3.8	3.9	3.0	3.4	3.2
Italy	4.1	4.2	5.1	1.6	1.9	3.1
U.K.	2.1	2.6	2.5	1.2	1.9	0.8
OECD countries	3.0	3.4	4.0	1.6	2.2	2.8
EEC countries	3.4	3.9	4.3	2.3	2.8	3.1

Source: OECD "Historical Statistics 1960-81", Paris 1983.

Although there is much to be said for looking at the growth of both real output and output per head as global and national performance indicators, some studies have preferred to include estimates of output per unit of capital also. Thus estimates of total factor productivity attempt to account for differences in performance in a more comprehensive way (1). Whilst there are numerous and now well-rehearsed arguments concerned with the notion of total factor productivity, what it might mean in practice, how it can be approximated and so on, there are undoubtedly very good grounds for trying to account for output variations in terms of more than just one major factor input.

This exercise looks at a few aspects of the growth of productivity and factor inputs in the four largest EEC countries, France, Germany, Italy and the United Kingdom. There is no attempt at repeating a Dennison-style detailed assessment of the multitude of factors which might have been responsible for observed growth performance. Instead, more attention is paid to sectoral differences in the four countries and of the relative contribution which changes in the growth of total factor productivity and factor substitution might have made to changes in the growth of output per employee.

The level of disaggregation here prevents one from making many of the more popular statistical adjustments or refinements. International comparisons are bedevilled by problems of definition and comparability which are particularly important when even mild efforts to disaggregate are made. Here, for the most part, the periods selected for comparison are 1960 to 1981 and the two sub-periods 1960-73 and 1973-81.

The approach adopted concentrates in particular on the observed changes in numbers employed, the stock of fixed assets and the flow of real output in a few broadly defined groups of what can be called the industrial production sector. Such groupings inevitably are somewhat arbitrary, but the intention is to construct similar groupings across countries as far as is possible. The basic

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(1) See for example Baily (1981, 1982), Nordhaus (1981), and Dennison (1983). The Nordhaus paper is based upon OECD estimates in OECD (1980).

statistical sources, however, are based on the individual country National Accounts. Some further details concerned with various adjustments which had to be made are set out in a separate Annex on Data Sources and Methods.

The paper is organised in the following way. Section II discusses a few conceptual points and offers some justification for the approaches used. It is fairly short given the already voluminous literature and surveys on the subject. The data used is described briefly in Section III. The main results appear in Section IV where both aggregated and sectoral comparisons are presented with some commentary. Further Sections deal with various adjustments, some of which lead to illustrative refinements of the figures derived in Section III. A final part is concerned with comments, limitations and conclusions. More detailed Tables appear in separate Annexes.

II. The Total Factor Productivity Approach

At the outset one must start on what is an apologetic note. In some respects, a focus of interest on the behaviour of productivity is a strange preoccupation in economics. By productivity changes, in practice one nearly always means output divided by a factor input or a combination of factor inputs. That is, changes in average product. The fundamental nature and role of marginal products need not be stressed but as Stigler has so aptly remarked "productivity measures .... arose in the face of a theoretical tradition which denied them any relevance to economic structure or policy". Again,"so far as I know, not a single theoretical statement of any importance can be made about the average products of factors" (Stigler 1961).

Yet, as is abundantly obvious, the overwhelming bulk of comparisons are based on average product measures. Further, these have now become enshrined in the general statistical apparatus to an extent such that it is difficult not to go along with the general trend.

One very simple and well used approach is the growth accounting methodology which is that followed here. This rests implicitly within the standard neo-classical formulation. From the usual Solow-type production function $V = A(t)\, F(L, K)$ which is assumed homogeneous of degree one and with neutral technical progress we obtain the following:-

$$Vg = TFIg + TFPg \qquad (1)$$

$$TFIg = s_w\, Lg + (1 - s_w)\, Kg$$

hence

$$TFPg = Vg - Kg - s_w\,(Lg - Kg) \qquad (2)$$

or alternatively:

$$TFPg = Vg - Lg - s_\pi\,(Kg - Lg) \qquad (3)$$

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

Thus, under competitive conditions and whilst assuming also that labour and capital are paid the value of their respective marginal products, total factor productivity growth emerges as a residual, after account has been taken of total factor input. It corresponds in principle to the term A (t) in the basic neo-classical formulation.

The expression total factor productivity can be thought of a measure of total productive efficiency. We can see this by writing the TFP index in static terms as :

$$TFP = \frac{V}{F(L,K)} = \frac{V}{wL + rK} \qquad (4)$$

where w is the wage rate and r the rental on capital employed. In other words (4) is a ratio of outputs to inputs but unlike the engineering concept it takes account of both technical and economic or price components. The residual nature of the total factor productivity notion as formulated emerges because if the idea of efficiency in the ratio given by (4) is to convey any real meaning, it is only via the fact that output V and inputs L and K, must be defined in such a way that they are not equal. As Boulding commented, "For the concept to be useful, it is necessary to differentiate between significant and non-significant input or output" (Boulding 1961).

In such a scheme it is this feature which creates risks that empirical estimates of total factor productivity growth will pick up and include not only the effects of factor inputs other than labour and capital but also any errors in definition and measurement of the included factors. This sort of entirely valid criticism leaves several choices open to the practitioner.

Using labour input as an example, one could adjust the labour variable for educational differences and 'embody' these changes in the input itself. An alternative would be to specify an educational input separately and increase the number of factors. Or one could regard improved education necessarily as part of disembodied technical progress and treat such effects as total factor productivity changes.

The standard growth accounting methodology, at least as followed by its better known adherents, lends itself more readily to the last of these alternative interpretations.

Returning to equations (3) and (4), if all variables are defined 'correctly' the intention is to capture the separate effects of shifts in the underlying production, which one may wish to identify as a form of technical progress and at the same time, movements along the production surface brought about through factor substitution. The various problems noted, however, may lead to difficulties in making this distinction in an unambiguous way such that an estimate of TFPg can be hard to isolate from the factor substitution expression s_{π} (Kg - Lg) (2).

It goes almost without saying that many practitioners in this area of interest have preferred to work with an explicit production function and try to identify shifts in this over time given various assumptions about the character of technical progress. But, whilst the problems of specifying factor inputs remains, there is an additional important difficulty in being able to approximate the appropriate technology

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(2) A good critique is Nelson (1973)

accurately enough within a manageable functional form. For example, although recent developments in duality theory have yielded important unifying links between production, cost and profit functions, this throws the burden of input measurement on to real costs and unit profits where on the face of it there seems to be just as many obstacles.

An additional issue which merits some mention concerns the meaning and nature of such work at highly aggregated levels. Quite apart from fundamental disagreements about what capital or labour inputs may or may not be, there is a question to be asked about what a technology might mean for say "manufacturing", "consumption goods" or "energy goods" production and so on. Thus, whilst one may wish to hold Samuelson's faith and pending a repeal of the laws of thermodynamics, continue to relate inputs to output, one is still faced with the fact that at such levels of aggregation, the engineering or more precise notions of a technology in which the conventional production function is both rooted and intended to describe, seem at times to be somewhat remote. In other words, one is entitled to ask, what does an algebraic formulation set in a few arguments and which purports to describe an aggregate which includes even broadly defined sectors as disparate as chemicals, food, processing, bricks, pottery and glass and so on, really mean? Yet at the same time, if one can or chooses to disaggregate down to manageable levels within say a standard national accounting framework, can one hope to approximate differential technologies across such industries with essentially simple functional forms? In addition, the problem remains that all too frequently one can be faced with the practical and legitimate question - how does country A or sector B compare with country C or sector D? There is in these common circumstances an inevitably delicate and unsatisfactory trade-off between satisfying the priors imposed by rigorous demands of theory on the one hand and the need to recognise that aggregated data sets fall some way short of such demands on the other.

Such conumdrums apply to both the direct production function and growth accounting methodologies with equal force and it is because of this that the latter, simpler approach is adopted here (3).

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(3) The author's view is influenced heavily by the highly perceptive remarks in Chapter 4 pages 118-128 of Varian (1978) and also by the extensive discussion in Chapter 7 of Matthews et al (1982).

III. Data and Definitions

For the most part, the observations on real output, numbers employed, the stock of fixed assets and factor income shares are those derived from national accounting estimates in the four countries. There are, however, some exceptions and full details of the sources used, definitions of the sectors etc, are set out in the Annex.

The sectoral breakdown used is as follows:-

Intermediate Goods Industries
(of which) Energy Industries
Equipment Goods Industries
Consumption Goods Industries
Manufacturing Industries
Total Industry including Construction

Output here is a value added concept which does not include raw material inputs. Although this is conventional practice, it does imply that differences in efficiency in the use of raw material and other bought in factor inputs between countries and sectors will be reflected in the total factor productivity residual.

Of the three traditional or classical factors of production, land is omitted. If land is included as an input, a major and probably insoluble problem arises in allocating it across sectors.

The labour input is specified quite simply as numbers employed. It would have been preferable in principle to adopt a definition which is closer to a flow concept. Typically, one uses total hours worked per year, standard hours worked or some such specification. In addition, one can argue for and against making adjustments to allow for

age, educational differences, sex composition and so on. Some researchers do this whilst others do not and the arguments involved are closely bound up with the comments made earlier in Section II. Much depends on how one chooses to interpret the meaning of a total factor productivity index. In fact, it was not possible to obtain uniform and comprehensive estimates of total hours worked in a way which matched the sectoral breakdown for all countries over the sample periods considered here. The simpler, although less satisfactory definition, being numbers employed is therefore used throughout.

The measurement of capital as usual is an awkward issue. The definition used here is gross fixed assets at constant replacement cost prices. First of all, there is the question of which definition is to be chosen, gross or net. Kennedy and Thirlwall (1972) for example, favour the gross definition largely because it helps avoid having to distinguish between economic and physical depreciation. A unit of capital may be physically capable of producing a flow of output but be obsolescent in terms of economic criteria. Because the stock of capital is really a proxy variable for the flow of capital services, a depreciation adjustment which is a function of the age of capital will tend to overstate the decline in this flow. Net measures therefore can be weak in this respect.

This does not close the matter however, Smith suggests (1966) that a stock definition is jutified. The view here is that across a typical range of production technologies, capital stocks must be present if the output is to be produced at all. Utilisation of existing capacity can only be varied by means of adjustments to current inputs. Smith argues that it is, for example, difficult to

conceive of any meaning which might be attached to something like machine hours in an application to pipelines, power lines, or highways. The stocks themselves must be present (4).

The balance of argument here is difficult to asses and in view of this, both gross and net measures of the capital stock are on occasion employed in the estimates of productivity growth. When net measures are cited however, they are related to net value added, that is, gross value added, less depreciation and the factor share weight is a net formulation also.

In the calculations, no adjustments are made to allow for utilisation of capacity. Over the two decades examined here, the pressure of demand has varied a good deal. One common practice is to use the percentage of unemployment, or better, employment, as a means of adjusting the capital stock. Over much of the total period however it has been normal to regard labour as a quasi fixed factor and hoard it through the trough of the cycle. To the extent that this occurs, any adjustment will be understated. The question of how to make any such adjustment, some trend view, averaging cyclical peaks and so on, creates a separate set of problems. Here it was thought better not to make a single statistical adjustment which would have a 'locking in' effect in everything which followed. The results are presented unadjusted and commentary is made separating where appropriate.

The total factor productivity estimates presented in the next sections and as indicated in equations (2) and (3), are all made with reference to a specific base year. Growth rates for the most part are calculated as annual averages measured from

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(4) The argument used by Smith is set very much in engineering production function terms; see pp. 64-65.

1960 or 1973. Such estimates depend heavily on the factor share weight chosen. The most obvious and consistent approach is to use factor shares as in the appropriate base year of the particular sample period. This implies that the growth of both total factor productivity (the 'residual') and total factor input in equation (1), rests on an assumption that the labour and capital inputs are paid the value of their marginal product in that base year.

Alternatives are possible however. One may prefer for example, to analyse the whole period 1960-81 together with the sample sub-periods 1960-73 and 1973-81 using a single constant factor share weight throughout. This weight could be 1960. Alternatively, it might be thought more reasonable to choose a cyclically "normal" year as the appropriate criterion. Reference to the OECD "Historical Statistics" (1983) does not provide a conclusive result on this matter. The cycle of industrial production and GDP was roughly on trend in France and the UK in 1970 which happens to be a mid-year of the sample period. Germany and Italy were a little above. In 1971 the situation was reversed. Factor shares moved little between the two years, so it could be argued that 1970 is not a bad approximation to a normal and convenient mid year. Clearly, the list of possible variants is virtually without limit, and unfortunately the final results will depend in principle on the final choice.

Over the whole period, the share of profits in money value added has not remained constant. In all four countries, there is a strong negative trend over most of the period as Table 4 below indicates. A mid-year, average of some years, 'normal' year, or some such formulation is in one sense no less arbitrary than a conventional initial base year weighting method. However, in

Table 4

Share of Gross Profits in Gross Value Added %

	Total Industry			
	1960	1970	1973	1981
France	37.3	34.4	32.5	25.6
Germany	40.6	35.1	32.1	28.3
Italy	45.5	36.6	34.3	36.5
UK	31.3	28.6	32.3	35.7

entirely presentational terms, to see how factor inputs and productivity evolves if factors are assumed to be paid in accordance with starting or first year marginal valuations has a simple intuitive appeal.

Although calculations were made using 1960, 1970 and 1973 factor shares, in the commentary here, the first year in each of the two sub periods, namely 1960 and 1973 is used (5).

One potentially troublesome issue in the use of factor income shares can arise because of self-employment income. In the case of these activities, often it is impossible to make a distinction between genuine wage and profit elements. One does not know how to impute to entrepreneurs a true element of labour income for example. National Accounts statisticians make efforts to estimate these effects but the problem

(5) The other estimates are available from the author on request. It is worth noting that Kendrick (1981) compares 1960-73 with 1973-79 using 1973 factor shares as weights throughout. The year 1973 in fact is very much off-trend and this qualifies some of the points made above.

remains. How important this might be for the exercise here depends of course upon the importance of self-employment in the sectors examined. Most self employment income is derived in the private services sector, the distributive trades, construction and agriculture. The industrial and manufacturing sectors are thought less likely to be affected to the same extent. Whilst this does not eliminate the problem it is believed that its seriousness will certainly be diminished.

Finally with four Community countries, up to six sectors, net and gross capital and output formulations, different bases and sample periods, there is a problem of what and what not to present for discussion. Unless stated otherwise, the rather arbitrary choice made here is that emphasis is placed on gross output and capital stock estimates. In summary, the sample periods for the most part are 1960-73 and 1973-81 the bases being factor shares in 1960 and 1973. Capital and output are expressed as being gross of depreciation.

IV. Empirical Results

(1) Overview

We start initially with some estimates of total factor productivity growth (TFP) over the whole sample period 1960-81 based on equation 3 in Section II and using the 1960 profit share for S_{π} Here, both gross and net formulations are made so as to provide an early comparison; the results are set out in Table 5.

In most cases we see that the net of depreciation estimates tend to be rather larger than the gross figures. This is what one would normally expect since S_{π} on a net basis usually is a good deal smaller than S_{π} gross.

For all sectors, France has the highest rate of growth of TFP, Italy could be regarded as next in line with the UK, despite Energy Products, being the least successful in this respect. The ranking therefore follows exactly that given for output-growth per head in manufacturing and total industry in Table 3, Section I.

Concentrating attention at the aggregate level on the manufacturing sector, together with all industry, we can go behind the TFP estimates using the basic growth accounting formulations given by equations (1) and (3). These enable one to make a distinction between TFP and total factor input (TF1) in the contribution overall to growth of real output. At the same time, within the neo-classical model which underlies this scheme of thinking we can break the growth of output per head into its TFP and factor substitution components. Thus, the TFP term in say (3) corresponds to movements or shifts in the underlying production function. The term S_{π} (Kg - Lg) indicates movements along this function, or the amount of factor substitution which occurs.

Table 5

Total Factor Productivity Growth 1960-1981 %

	France		Germany		Italy		UK	
	Gross	Net	Gross	Net	Gross	Net	Gross	Net
Intermediate Goods	2.72	3.42	2.05	2.65	2.53	3.12	1.52	1.48
Energy Products	4.26	6.66	1.50	2.24	0.11	-0.49	4.27	4.91
Equipment	1.95	2.13	1.70	1.82	1.50	1.59	0.81	0.93
Consumption Goods	4.37	4.66	1.88	2.48	3.53	4.22	1.12	0.92
Manufacturing	3.48	3.75	2.43	3.01	3.06	3.68	0.91	0.84
Total Industry	2.96	3.29	1.97	2.49	2.13	2.57	1.27	1.19

Table 6

Contribution bo the Growth of Total Factor Productivity, 1960-81 (1)

%

Manufacturing Sector

	France	Germany	Italy	UK
Vg	5.31	3.74	5.50	0.83
TFPg	3.48	2.43	3.06	0.91
TFIg	1.83	1.31	2.44	- 0.08
$\left(\frac{V}{L}\right)$ g	5.15	4.18	4.53	2.40
$S_{\pi} \left(\frac{K}{L}\right)$ g	1.67	1.75	1.47	1.49

Total Industry

	France	Germany	Italy	UK
Vg	4.90	3.35	4.63	1.20
TFPg	2.96	1.97	2.13	1.27
TFIg	1.94	1.38	2.50	- 0.07
$\left(\frac{V}{L}\right)$g	4.64	3.82	3.98	2.80
$S_{\pi} \left(\frac{K}{L}\right)$g	1.68	1.85	1.85	1.53

Note :

(1) 1960 Factor share weights using gross output and capital stock figures.

Table 6 sets out estimates of the components of the two identities given by equations (1) and (3). In all but one instance one finds that the growth of TFP explains a greater part of real output growth than does the growth of total factor inputs (TFI). Indeed, in the case of the United Kingdom, it appears that the contribution of TFIg over the whole period was marginally negative. In other words, the growth of TFP is seen to be explaining or accounting for all of real output growth.

The other identity which accounts for the growth of output per head suggests here that for three of the four countries, between a third and one half of this growth is explained by movements along the implied aggregate production frontier; namely, the process of capital/labour substitution. The exception is the United Kingdom, where the proportion is rather greater and closer to 60 per cent.

Moving behind these estimates, Table 7 shows how both employment and the stock of fixed assets have evolved in the Manufacturing and Industrial Sectors.

Table 7

Growth of Employment and Real Stock of Capital 1960-1981 %

Manufacturing Sector

	France	Germany	Italy	UK
Lg	0.16	- 0.44	0.97	- 1.57
Kg	4.94	4.00	4.32	3.00

Total Industry

	France	Germany	Italy	UK
Lg	0.25	- 0.53	0.99	- 1.59
Kg	4.65	4.06	4.62	3.28

Over the two decades, employment growth on average was static or negative. In Italy only, was there any appreciable positive evolution of job creation. The stock of fixed assets, however, grew at an annual average rate of between 3.0 and 5.0 per cent. Capital per employee, therefore, rose at a compound rate of between 3.5 and 4.9 per cent per annum. The general impression is one where Italy, France and Germany appear to have been able to transform rather smaller increases in capital per employee into substantially greater increases in output per head than has the UK. At this level of aggregation, however, what emerges as the most significant feature is the apparent inability of all four countries to transform a varying growth of both capital and output per head into net job creation. It is this aspect of economic performance in the industrial sectors of the countries considered which is particularly interesting and disturbing.

Growth of total factor productivity over the twenty-one years was by no means even. The general pattern as measured from the base year 1960 is one of moderate acceleration up to the late 1960's and early 1970's followed by much more modest progress thereafter. Table 8 illustrates this evolution for some selected sub-periods using the same definitions as in Table 6.

Table 8

Total Factor Productivity Growth in the Industrial Sector %

	1960-65	1960-68	1960-73
France	4.04	4.18	4.32
Germany	2.50	2.36	2.52
Italy	1.38	3.32	2.95
UK	1.68	2.31	2.13

Although the figures are not shown here, the growth of output per employee followed the same pattern.

(ii) Pre and Post 1973 Experience

Although the year 1973 is taken here to be a convenient dividing line in the sample period, the development of economic activity as described in Tables 1 and 8, indicates that there was no sudden or concentrated break in growth. What does seem to have happened is that growth in both real output and real output per employee accelerated up to end 1968. There was a slight easing up to 1973 - more in some countries than in others - but after this date, progress certainly slowed down. The break point used here, therefore, is justified partly by the statistical trend but is chosen also because it happens to be the year of the first oil shock and has been selected also by a number of other investigators in the field.

Continuing with the Industrial Sector in aggregate, Table 9 provides estimates over the two sub-periods 1960-73 and 1973-80 for the main variables of interest. Differences in percentage point terms are given in the third part of the Table.

France, which experienced the most buoyant growth of both output and productivity up to 1973, suffered the biggest decline, followed next by Italy. The contribution of total factor input, the factor share weighted sum of labour and capital was most important in Italy, where it accounted for roughly one half of the growth in real output. In France and Germany the contribution of TFIg was rather less than this and in the UK it was less than one quarter over the period up to 1973.

In the first sub-period, Table 9 shows also that factor substitution, or movements around the implied aggregate production frontier, accounted for one third to one half of the measured growth in output per head. In the second sub-period, the contribution of capital deepening, if anything, increased, with the UK providing an extreme case where capital/labour substitution accounted for virtually the whole of the increase in output per employee.

Table 9

1960-73 and 1973-91 Compared: Industrial Sector %

1960-73

	France	Germany	Italy	UK
Vg	7.09	4.69	6.17	2.65
TFPg	4.32	2.52	2.95	2.02
TFIg	2.77	2.17	3.22	0.63
$\left(\frac{V}{L}\right)g$	5.85	4.56	5.08	3.43
$S_{\pi}\left(\frac{K}{L}\right)g$	1.53	2.04	2.13	1.41

1973-81

	France	Germany	Italy	UK
Vg	1.42	1.20	2.17	- 1.09
TFPg	1.06	1.43	1.18	0.04
TFIg	0.36	- 0.23	0.99	- 1.13
$\left(\frac{V}{L}\right)g$	2.74	2.65	2.22	1.80
$S_{\pi}\left(\frac{K}{L}\right)g$	1.68	1.22	1.04	1.76

Difference 1973-81 minus 1960-73

	France	Germany	Italy	UK
Vg	- 5.67	- 3.49	- 4.00	- 3.74
TFPg	- 3.26	- 1.09	- 1.77	- 1.98
TFIg	- 2.41	- 2.40	- 2.23	- 1.76
$\left(\frac{V}{L}\right)g$	- 3.11	- 1.91	- 2.86	- 1.63
$S_{\pi}\left(\frac{K}{L}\right)g$	+ 0.15	- 0.82	- 1.09	+ 0.35

The net result is given in the third part of the Table, where it can be seen that factor substitution in both France and the UK served, to some extent, to offset the decline in total factor productivity. In other words, the overall view is one where despite the marked decline in the growth of output, output per head, total factor input and total factor productivity, there remained in the four countries a considerable amount of capital deepening.

In fact, during the earlier sub-period, the capital/labour ratio in all four countries grew at an annual average rate of between 4.0 and 5.0 per cent (6). During the second sub-period, however, there were some noticeable differences. In both Italy and the UK, the rate of growth exceeded 5.0 per annum, whereas in Germany and Italy, the figures were 3.8 and 2.8 per cent respectively. Nevertheless, in all four countries, growth of the capital stock exceeded the rate of growth of real output. Capital productivity thus fell and this helped to pull down even more the growth of total factor productivity.

Between 1973 and 1981, the growth of numbers employed in the industrial sector of the four largest Community countries turned sharply negative or, as in the case of Italy, was virtually zero. The biggest decline occurred in the UK, where the figure was 2.9 per cent. The relatively poor performance measured in terms of net new job creation during the earlier sub-period, therefore, was greatly accentuated. Continuing accumulation of fixed capital, although assisting to maintain some - albeit much weaker - growth in real output per employee, did not spill over into additional job creation. Looked at in terms of the crude growth accounting framework used here, a good deal of the first period and very much of the second was characterised by movements along the implied production frontier in a capital intensive direction.

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(6) See Annex Tables 1 A to D.

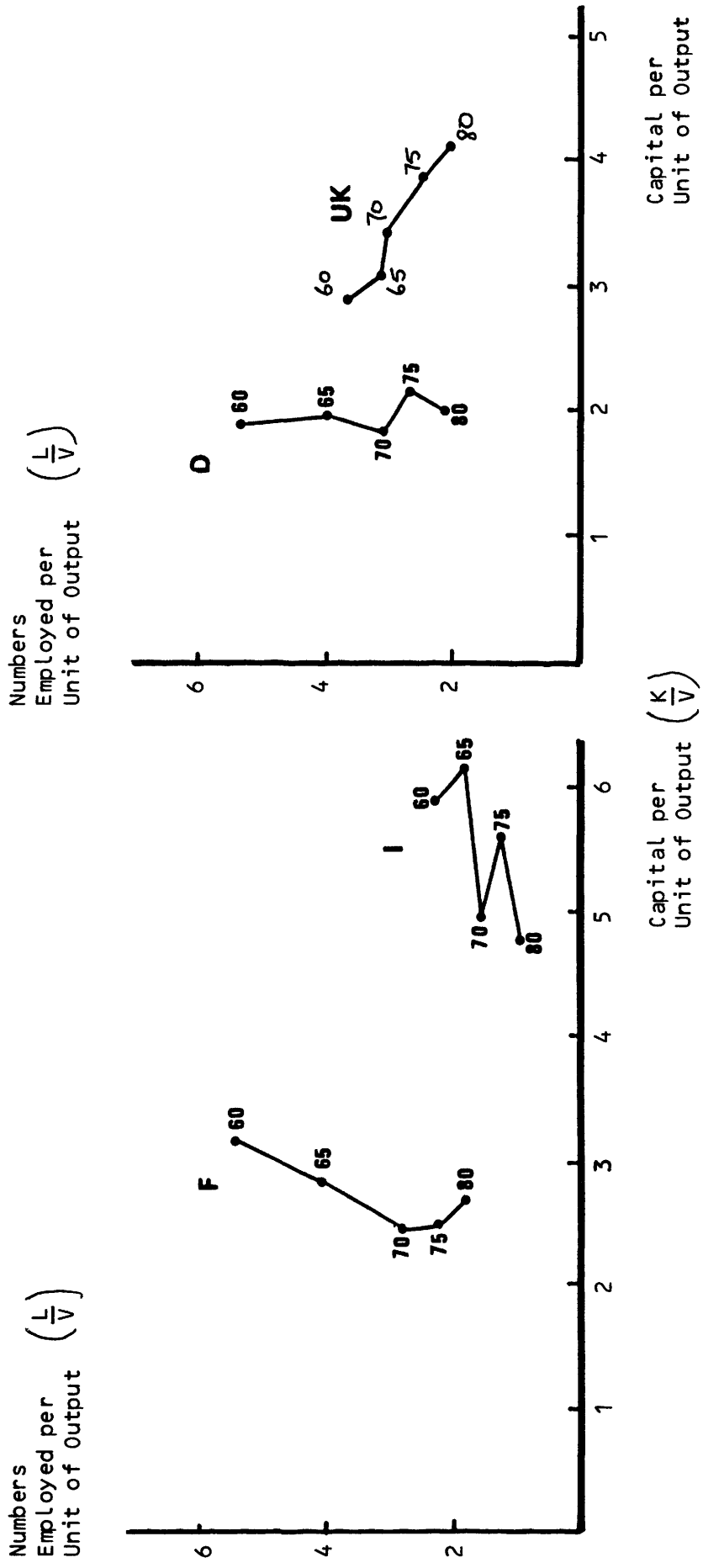
This process is illustrated in Chart 1, where the two factor inputs, labour and capital, each normalised per unit of real output, define the axes. Looked at over the complete twenty year period, what we observe is a mixture of movements both inwards towards the origin and in a south-easterly or more capital intensive direction. A shift inwards can be interpreted unambiguously as a gain in total factor productivity or technical progress. Three of the countries, France, Italy and Germany, show something of both kinds of movement. Nevertheless, the capital bias is noticeable. The UK remains as the unusual case insofar as there is little in the way of any movement other than in a capital deepening direction.

At this point, it must be noted that capital deepening as defined here does not imply that technical advance is absent. An increase in the capital labour ratio will almost certainly embody improvements to equipment and other means of production and may also reflect the presence of scale economies. Neither of these possibilities are included, or "accounted for" in the basic formulation as set out in Section II where the underlying assumptions are that constant returns prevail and that technical advance is of the disembodied kind. More will be said about these issues in subsequent Sections of this paper.

In passing one might note that the estimates given in Table 9 are close to those derived by other researchers in this general area, although there are some differences between the sample periods chosen, countries included and so on. Table 10 provides a comparison of some recent studies where the figures correspond to a form such as that used in equation (3).

CHART I

Numbers Employed and Gross Fixed Assets per Unit of Output, Industrial Sector 1960–1980



(5)

Table 10

Alternative Estimates of Growth Differences (1)

	Lindbeck	Kendrick	Aberg	Todd
	1973-78	1973-79	1973-80	1973-81
	1960-73	1960-73	1960-73	1960-73
Output per Head	-2.3	-2.7	-2.4	-2.4
Total Factor Productivity	-2.2	-2.4	-1.2	-2.1
Capital/Labour Substitution	-0.1	-0.3	-1.2	-0.3

(1) Components of the change in growth of output per head.

Source : Economic Journal, March 1983 and Table 8

Notes : The Lindbeck, Kendrick, Aberg estimates are an average for Western Europe, whereas the figures from Todd are an arithmetic average of the four largest Community countries given in Table 9.

(III) Sectoral Comparisons

A sectoral analysis of differences in the components of growth in output per head corresponding to those in the lower part of Table 9 are given in Table 11 (7). The distribution of the deceleration is brought out where one sees the retarding influence of the energy sector in France, Germany and particularly Italy. Associated with this is the sharp drop in growth of output per head in the intermediate goods sector where the energy factor is an important input. The contrast with the United Kingdom which benefited greatly from North Sea oil supplies is emphasised.

(7) The estimates for the two sub-periods 1960-73 and 1973-81 on which Table 10 is based are given in Annex Tables 1 A-D and 2 A-D.

Table 11

1960-73 and 1973-81; Sectoral Comparison (1)

	Difference : 1960-73 minus 1973-81 (%)					
	Intermediate Goods	Energy Product	Equip-ment	Consumption Goods	Manufac-turing	Total Industry
			FRANCE			
Vg	-6.48	-3.75	-6.04	-4.11	-5.88	-5.67
TFPg	-4.38	-4.63	-2.78	-2.27	-3.48	-3.26
TFIg	-2.08	+0.88	-3.26	-1.84	-2.40	-2.41
$\left(\frac{V}{L}\right)_g$	-4.31	-4.96	-2.54	-2.41	-3.41	-3.11
$S_\pi \left(\frac{K}{L}\right)_g$	+0.08	-0.33	+0.24	-0.18	+0.06	+0.15
			GERMANY			
Vg	-3.80	-1.90	-3.66	-2.57	-3.53	-3.49
TFPg	-2.02	-3.13	-0.35	-0.39	-0.84	-1.09
TFIg	-1.78	+1.23	-3.32	-2.18	-2.69	-2.40
$\left(\frac{V}{L}\right)_g$	-2.97	-4.02	-1.15	-1.46	-1.91	-1.91
$S_\pi \left(\frac{K}{L}\right)_g$	+0.95	-0.89	-0.80	-1.07	-1.07	-0.82
			ITALY			
Vg	-5.48	-7.18	-3.29	-3.29	-4.46	-4.00
TFPg	-2.91	-4.67	-1.32	-1.59	-2.04	-1.77
TFIg	-2.57	-2.51	-1.97	-1.70	-2.42	-2.23
$\left(\frac{V}{L}\right)_g$	-4.17	-7.35	-2.15	-2.29	-2.93	-2.86
$S_\pi \left(\frac{K}{L}\right)_g$	-1.26	-2.58	-0.83	-0.70	-0.89	-1.09
			UNITED KINGDOM			
Vg	-1.58	+5.02	-5.54	-4.94	-5.10	-3.74
TFPg	-1.05	+2.91	-3.58	-2.84	-2.67	-1.98
TFIg	-0.53	+2.11	-1.96	-2.10	-2.43	-1.76
$\left(\frac{V}{L}\right)_g$	-0.06	+2.13	-3.08	-2.48	-2.43	-1.63
$S_\pi \left(\frac{K}{L}\right)_g$	+0.99	-0.78	+0.50	+0.24	+0.24	+0.35

(1) See Annex Tables 2 A-D.

Within the energy products sector, total factor input growth increased between the two sub-periods in all countries except France. In Germany and Italy however, this increase was not of a scale sufficient enough to offset the drop in total factor productivity growth with the result that real energy output fell.

France and Italy which experienced the biggest decline in total industrial output between the two periods, fared relatively badly in all sectors. In all four countries, the decline in manufacturing provdes an indicator of the "de-industrialisation" trend, with the German economy holding up best in this particular respect. Indeed generalising this, the impression overall is that the German industrial sector absorbed the effects of the post-1973 world recession rather more successfully than did France and Italy which experienced rapid growth during the 1960's.

The complete detailed estimates covering five sectors of total industry for the two decades plus the two sub-periods are given in Annex Tables 1 A-D.

Considering the growth of real output first of all, we notice that broadly speaking, around one third of this growth is accounted for over the whole twenty year period by total factor input growth. This approximate view fits closest in the economies of France and Germany. There is a fair amount of variation however, with total factor input growth accounting for sixty per cent of real output growth in the Equipment Goods sector but around twenty per cent in Energy products.

In Italy, the Energy sector experienced a very substantial growth of total factor input where this accounted for virtually the whole of real output growth. The major influencing factor was growth in the capital stock of over six per cent per annum over the whole sample period. On average, the growth of the labour and capital unputs accounts for a greater proportion of real output growth in Italy than in the other three countries.

The United Kingdom is the unusual case where all but one sector, total factor input growth has been margirally negative. This leaves the growth of real output to be explained or 'accounted for' in these terms entirely by the growth of total factor productivity.

Turning to the two sample sub-periods, the relationship between growth of total factor inputs and growth of real output is summarised in Chart 2. Although for each country, five sectors plus the total for all industry are available, the pattern of observations between the two periods is revealing. In the earlier period 1960-73, there is a broadly positive association between the two variables as one would normally expect. This association would appear to be broadly comparable in the four countries except that for France and Italy, the levels are higher as compared with Germany and the United Kingdom. Indeed, the generally weaker post-war performance of the United Kingdom is again highlighted in this respect.

From 1973 onwards, the profiles change, in some cases considerably. There is a marked drop in the growth of both total factor input in all four countries and a corresponding fall in real output growth. The limited set of observations seems to indicate that Italy, unlike the other three countries became less efficient in transforming inputs into outputs; the association being if anything negative. During this period, employment in Italian industry fell hardly at all, and the capital stock grew at about 3.0 per cent per annum. In the Italian Energy Products sector, the growth of factor inputs is particularly noticeable with employment between 1973 and 1981 increasing at an annual average rate of 1.7 per cent. The capital stock rose at a rate of 4.9 per cent over this same period. Energy output however, rose at less than 0.5 per cent per annum. The net result is that total factor input growth in the Energy sector was much faster than the growth of output which implies a rapid fall in the "residual" total factor productivity component of real output growth.

Chart 3 summarises the apparent association between the growth of real output per head and growth of capital per head and is thus a graphic analogue of equation (3). This emphasises clearly the extent to which the increase in capital deepening generated growth in output per head to varying degrees. In France and the United Kingdom, the general impression across the sectors is that a given growth in capital per head yielded much less in terms of growth in real output per head. For Italy and Germany on the other hand, a summary description is that growth in the capital/ labour ratio fell substantially and also, that any given ratio resulted in slower growth of real output per employee.

(6)

CHART 2 : Growth of Real Output and Total Factor Input (per cent)

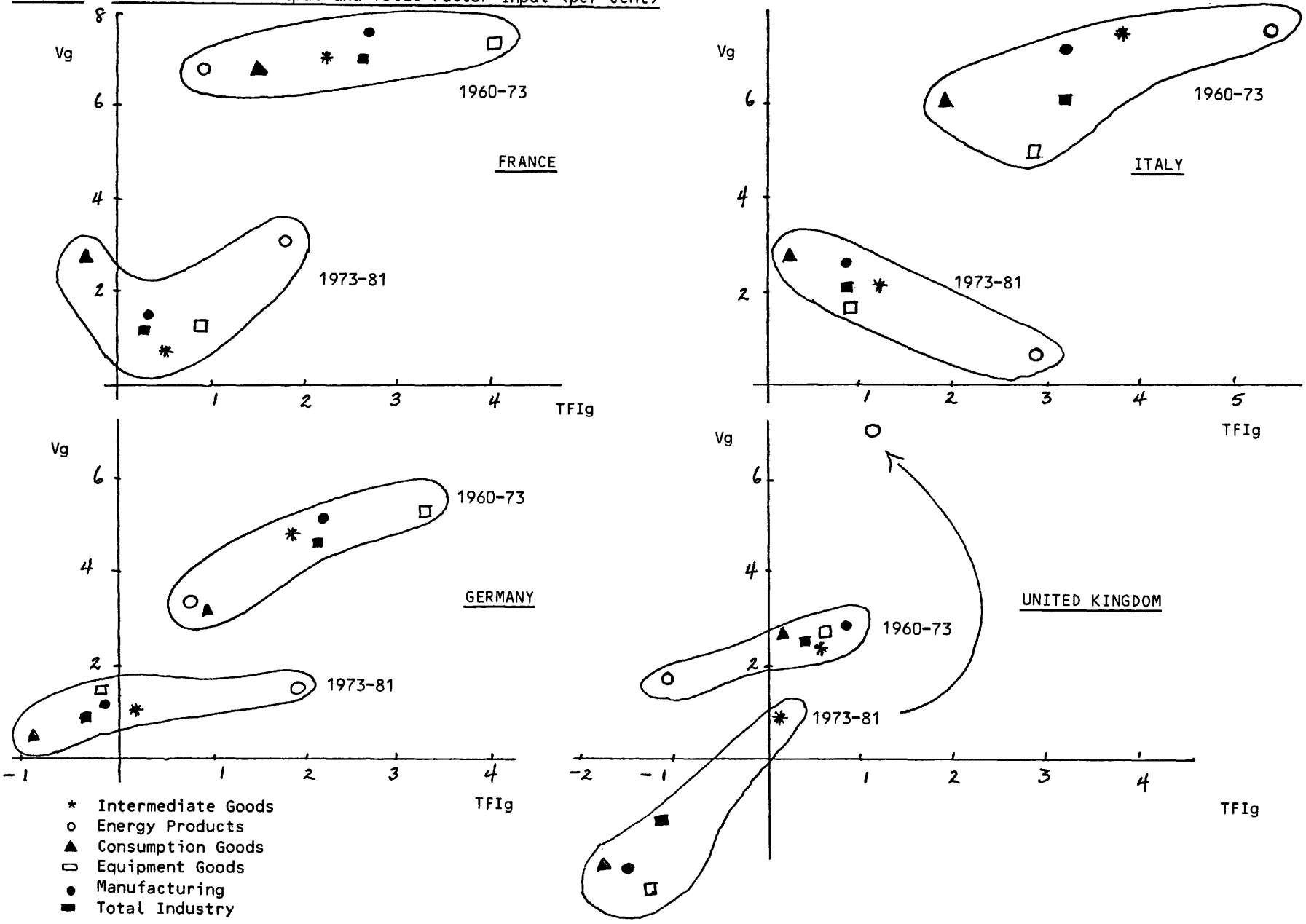
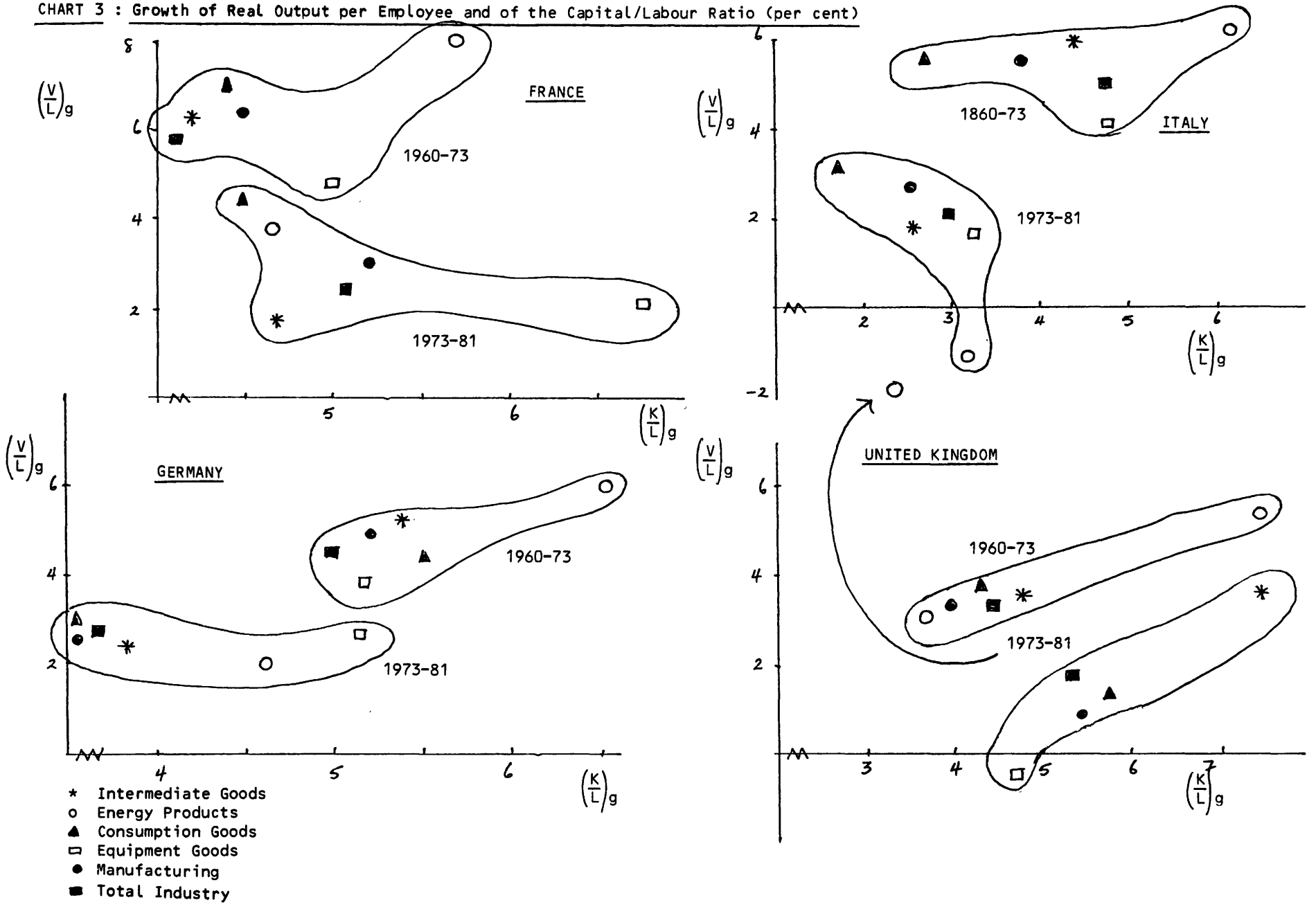


CHART 3 : Growth of Real Output per Employee and of the Capital/Labour Ratio (per cent)



V. Some Extensions to the Analysis

In this Section, consideration is given to two of the more important restrictions on which calculations resulting from an application of equation (3) are based. Interest centres on the constant returns to scale assumption in the light of various pieces of empirical evidence on the subject and the way in which capital/labour substitution is treated. In addition, some comments are made on the apparent measured decline in the average productivity of capital. At various stages some adjustments to the broad estimates given in Table 9 are suggested. Although these have what must be described as an illustrative role, they do nevertheless serve to add a note of caution when it comes to interpreting the basic results in terms of economic behaviour.

(i) Returns to Scale

The growth accounting method used as a basis for the computations discussed so far assumes that constant returns to scale obtain in all four countries. Whilst this is a convenient assumption for many theoretical and computational purposes, one must recognize that at several different levels, there is a range of evidence which would support the existence of increasing returns to scale in many activities. In particular, such evidence points to increasing returns in the manufacturing and industrial sectors, the areas of interest here.

Empirical work at the plant, enterprise and industry level, for the most part, indicates that the scope for potential unit cost reductions as capacity increases, can be substantial. These are the so-called static economies. In a more dynamic growth context, the existence of "Verdoorn" and "Kaldor"-type effects which suggest a strong and positive relationship between the growth of output per head and output growth in the manufacturing sector would appear to be widespread.

If we accept this, since $S_\pi + S_w > 1$, one cannot use S_π (or S_w) as a weighting factor in the basic formulations used here. This implies that use of the term S_π will bias the estimates of total factor productivity growth and of the factor substitution term also.

Within the basic formulation a crude and very simple method of making some allowance for the possibility of increasing returns is to assume that the underlying production function in equation (3) is Cobb-Douglas. When making comparisons between the sample periods as we do here, strictly speaking this is not correct since we allow the factor share S_π to change according to which base year is being used. This violates the constant factor share assumption.

At the aggregate industry level, as Table 4 shows, between 1960 and 1981 the share of gross profits in gross value added fell steadily in France and Germany, rather less so in Italy and rose in the United Kingdom. The adjustment proposed would therefore be wholly valid only if a 1960 base year factor share is used throughout. What follows is thus an approximation on the basis of an - "as if the various economies followed a Cobb-Douglas evolution" - variety (see footnote (5) on page 23).

Within the basic formulation we can allow for the possibility of increasing returns by writing $S_\pi + S_w = R$, where R is a scale factor in the assumed Cobb-Douglas production function (8). Then equation (3) becomes :

$$TFP_g = V_g - S_\pi K_g - (R - S_\pi)L_g \qquad (5)$$

or

$$TFP_g = V_g - S_\pi(K_g - L_g) - RL_g \qquad (6)$$

Comparing (6) with equation (3) we have a difference between the two estimates of total factor productivity growth equal to a factor $L_g(R-1)$. In other words, the bias from assuming constant returns depends on the scale parameter R and the rate of growth of the labour input L_g.

The next question concerns the value or values which might be attached to the scale parameter R. Here, there is potentially an enormous range of possibilities arising from empirical work and hence a high degree of uncertainty. Typically, estimates of Verdoorn-type equations yield implied dynamic returns to scale of the order of 20-50 per cent and greater, which is substantial (9). At the same level of aggregation, direct production function estimates are often difficult to interpret. Frequently researchers have resorted to constraining returns to scale to be constant in order to obtain useable estimates of say the elasticity of substitution. When all parameters are freely estimated, the results often produce estimates which vary over a very wide range also.

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(8) Thus we have $V = \left[AL^{\alpha}K^{1-\alpha}\right]R$

(9) See the Symposium on Kaldor's Growth Laws, Journal of Post-Keynesian Economics, Vol. V No. 3, Spring 1983.

Research at the micro level tends on average to produce estimates of potential scale economies which are more modest, although many such studies suggest that within the manufacturing and industrial sectors they are widespread. For the United Kingdom, Pratten (1971) for example argues convincingly that this is the case. Albach (10) for the German economy produces rather smaller estimates, perhaps below 10 per cent. A recent study by Owen (1983), although confined largely to the motor vehicles and "white goods" industries in the four largest EEC countries, provides evidence of technical scale economies of around the 10 per cent mark.

In interpreting the various estimates there is the important problem of distinguishing between genuine technical economies of scale, technical progress, learning and other effects. The more dynamic elements are in principle included in the Verdoorn/Kaldor approach, but the conceptual problem remains nevertheless. Thus the neo-classical growth accounting methodology may allow for some longer run dynamic scale effects included already in the total factor productivity term.

Whilst it seems somewhat unrealistic to assume the existence of generally available massive scale economies, it is likely that there will be some which have yet to be realized. In some sectors these may well be of importance. It is likely also that the depressed level of activity since 1973 has constrained much of industry from progressing along its expected expansion path. It seems sensible therefore to acknowledge some adjustment to the estimates in Table 9 in order to allow for the existence of economies of scale on the one hand, and the loss of output arising from these not being realized to a certain extent in the second period. Since there is insufficient reliable information for one to make country specific adjustments, a general illustrative adjustment is made here; this is more in order to see how sensitive the estimates are to a scale adjustment than to imply that a single value is relevant to actual country specific experience.

It is assumed rather arbitrarily therefore, that the scale adjustment takes the form : $RLg = 0.20\ Lg$ 1960-73

$RLg = 0.10\ Lg$ 1973-81

where the fall of 10 per cent between the two periods is a concession towards a weakening in scale potential. The underlying and probably

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(10) See Owen (1983).

unrealistic assumption therefore is that scale potential in industry is much the same in the four countries considered.

The allowance for shortfall of potential scale economies could be interpreted also as a capacity output effect. From 1973 onwards there has been an increase in the amount of excess capacity in the European and wider OECD economies. Reference to OECD published statistics certainly indicates that the amplitude of the cycles in industrial real output has been much greater since 1973 and the recession phases more pronounced (11). As Lindbeck (1983) has pointed out however, an adjustment for capacity utilization based on this evidence alone might be misleading.

The longer a recession, the more time employers have in which to shake-out labour, adjust plant operations and so on. This raises all of the various problems related to adjustment of the capital stock and labour input for capacity effects. No direct prior adjustments have been made to the series as used here which is a limitation. On the other hand, over a period as long as twenty years or so, cyclical factors have their importance reduced somewhat so that the estimates for the whole sample period 1960-1981 might be less affected. The comparisons between the sub-periods however are a different matter for the reasons stated earlier.

The organization and availability of the data at the sectoral level examined here does not permit readily a capacity adjustment to the main variables. However, one could think of the scale effects as being an adjustment which to some extent incorporates an allowance for capacity shortfall. This shortfall is not to be identified as organizational or X-inefficient effects; rather it is more of a demand constraining effect which prevents realization of potential unit cost reductions. Again, the entirely illustrative nature of the adjustment must be stressed.

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(11) See OECD "Historical Statistics" 1983 op. cit.

(ii) Factor Substitution

The estimates of capital deeping given in Table 9, as we have seen, suggest that approximately one third of the growth in output per head is accounted for by increases in real capital per head over the period 1960-73. This contribution increased to around one half during 1973-81 but the contribution to the slowdown between the two periods was more varied. The main feature however, is that the role played by increases in capital per employee in accounting for the reduction in the growth of output per employee appears to be relatively small when compared with the influence of total factor productivity.

It is of course very easy to criticize the basis of such estimates. The most obvious and central weakness rests on the implication that capital deepening does not generate technical advance. All technical progress is assumed to be entirely disembodied. In common-sense terms one would expect gross investment to contribute to improvements in technical production conditions; the newer vintages of capital equipment making the biggest marginal contribution and, in effect, setting the pace of technical advance. This approach includes both net investment and replacement investment, where the latter is not to be confused with pure or economic depreciation. Simple replacement will nearly always involve some improvements to existing capacity and thus enhance the growth of potential output (12). It is likely therefore, that use of a fixed base profits or gross wage share to act as an estimate of the elasticity of output per head with respect to factor substitution will understate the true effect.

One possible way of trying to make some allowance for embodiment effects is to compute a relationship between the growth of output per employee and the growth of capital per employee directly from cross-section information. This permits variability due to different countries having different growth rates of capital per head.

Kendrick (1981), using a cross-section of OECD countries, obtains an estimated coefficient (the elasticity) on $\left(\frac{K}{L}\right)_g$ of 0.82 for the period 1960-73, and 0.63 for 1973-79. Lindbeck, using similar cross-country data,

(12) Scott (1976 and 1978) develops these arguments in some detail.

finds a coefficient of around 0.6. At the industry level for the German economy over the period 1970-81, Todd (1984) finds a value of 0.81. Such figures are about double those yielded by the factor share estimates themselves and use of the higher figure will increase the estimated effect of factor substitution in favour of capital and correspondingly reduce the total factor productivity estimates. It is likely, however, that the estimated elasticity in crude relationships such as these will pick up the effects of other factors also, including such effects as changes in quality of the labour force, some R and D effects, organizational improvements in combining labour and capital, and possibly some scale effects also.

In order to try and take some account of these more general effects it is assumed that the elasticity S_π is 0.7 for 1960-73 and 0.5 for 1973-81. The first of these on average is roughly 80 per cent higher than the actual profit share, the second about 30 per cent larger.

(iii) Adjusted Estimates

Adjusting the estimates in Table 9 for both scale and capital deepening effects in the manner described produces the figures in Table 12.

Table 12
Adjusted Differences

	France	Germany	Italy	United Kingdom
$\left(\frac{V}{L}\right)_g$	- 3.11	- 1.91	- 2.86	- 1.63
$TFPg_1$	- 2.42	- 0.08	- 0.68	- 1.25
$S_\pi \left(\frac{K}{L}\right)_{g_1}$	- 0.69	- 1.83	- 2.18	- 0.38

The separate adjustments to the factor substitution (and hence to the total factor productivity terms) are given below (13).

(13) Reference here is made to the points made on page 22. If a 1960 profit share weight is used throughout, all of the estimates of TFPg in Table 12 and 13 are reduced by approximately 0.15 of a percentage point; $S_\pi \left(\frac{K}{L}\right)_g$ rises by the same amount.

Table 13

Adjustment Factors to Capital/Labour Substitution Growth and Growth of Total Factor Productivity

	France	Germany	Italy	United Kingdom
		1960-73		
Scale	+ 0.25	+ 0.03	+ 0.36	- 0.16
Capital Deepening	+ 1.36	+ 1.73	+ 1.16	+ 1.58
Adjusted $S_{\pi}\left(\frac{K}{L}\right)_{g_1}$	3.14	3.80	3.65	2.83
Adjusted $TFPg_1$	2.71	0.76	1.43	0.60
		1973-81		
Scale	- 0.13	- 0.15	- 0.05	- 0.29
Capital Deepening	+ 0.90	+ 0.90	+ 0.48	+ 0.98
Adjusted $S_{\pi}\left(\frac{K}{L}\right)_{g_1}$	2.45	1.97	1.47	2.45
Adjusted $TFPg_1$	0.29	0.68	0.75	- 0.65

The negative scale effects for the United Kingdom in the earlier period and for all four countries in the second is a reflection of the fact that the growth in numbers employed in the industrial sector was negative.

We see in Table 13 that the role of capital/labour substitution in accounting for the fall in growth of output per head between the two periods is increased a good deal. In corresponding fashion the influence of total factor productivity is reduced. The relative influence of these arbitrary adjustments, however, does not change as one would expect, since the only factor which has been permitted to vary is growth of labour supply. In relative terms this affects the estimates for the United Kingdom and German economies the most where employment declined significantly, particularly in the second sample period.

The average capital/labour substitution effect on the adjusted basis is 1.3 percentage points which is about one half of the fall in real output per head of 2.4 percentage points. This is a little above the adjusted estimate of rather more than one third made by Lindbeck for an average of the Western European countries as a whole.

VI. The Capital Stock and Capital Productivity

The numerical estimates produced here rely heavily on official estimates of the stock of real assets. On this basis, what we observe is an annual average increase in the capital stock over the twenty year period of around 4.0 per cent. The largest increase was in France and Italy, with the United Kingdom having the slowest evolution. The estimates are set out in Table 14.

Table 14

Growth of the Capital/output Ratio - Industrial Sector %

	France	Germany	Italy	United Kingdom
			1960-73	
Vg	7.10	4.69	6.17	2.65
Kg	5.34	5.16	5.78	3.74
$\left(\frac{K}{V}\right)_g$	-1.76	0.47	-0.39	1.09
			1973-81	
Vg	1.41	1.21	2.17	-1.10
Kg	3.83	2.36	2.98	2.55
$\left(\frac{K}{V}\right)_g$	2.42	1.15	0.81	3.65
			1960-81	
Vg	4.89	3.35	4.63	1.21
Kg	4.77	4.08	4.71	3.28
$\left(\frac{K}{V}\right)_g$	-0.12	0.73	0.08	2.07

There was a noticeable deceleration in the growth of the capital stock between the two sample periods when in the second of these, capital accumulation proceeded at roughly one half the rate of the earlier evolution. Output growth however, fell even more with the net result that the capital/output ratio rose; in France by 4.2 percentage points and in the United Kingdom by 2.5 percentgae points. Italy and Germany experienced more modest increases.

It is this decline in capital productivity which assisted in pulling down the growth in total factor productivity. This can be seen if we rearrange equation (2) to write :

$$TFPg = S_w\left(\frac{K}{L}\right)_g + \left(\frac{K}{V}\right)_g$$

For the average of the four countries, the rise in the capital/labour ratio of 4.3 per cent per annum throughout the whole period weighted by an average wage share of 0.63 gives a value of $S_w\left(\frac{K}{L}\right)_g = 2.7$ per cent. The fall in capital productivity of 0.7 per cent produces the average growth of total factor productivity of 2.00 per cent. In other words, the unweighted average decline in capital productivity accounted for one third of the average decline in total factor productivity growth.

Between the four countries there was a lot of variability however. In France, capital productivity was marginally positive and thus added to the growth of total factor productivity. At the other extreme, the declining growth of capital productivity of over 2.0 per cent in the United Kingdom, exceeded the rise in total factor productivity by 0.75 per cent. In both Germany and Italy, slightly declining productivity of capital retarded the growth of TFP.

The use of stock series for the capital input acts as a proxy for the flow of capital services and it is this aspect which raises a number of questions. It is now accepted that the sharp rise in energy prices will have reduced the present value of that part of the capital which is energy-specific. This lowers the productive worth or efficiency of the available stock and thus leads to a fall in factor productivity(14). It is doubtful, indeed highly unlikely, that such relative price-induced effects are allowed for in the official estimates as used here. Presumably revisions will take place in due course.

Having said this, there is some evidence that asset service life assumptions are being revised downwards by national accounts statisticians (Paccoud 1983, Blades 1983) which would tend to reduce the size of the stock and thus reduce the measured decline in capital productivity.

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(14) See Baily (1981).

Table 15

Ratio of Net to Gross Capital Stock - Industrial Sector

	France	Germany	Italy	United Kingdom
1960	0.568	0.610	0.595	0.598
1965	0.589	0.581	0.599	0.633
1968	0.593	0.563	0.578	0.633
1970	0.596	0.561	0.573	0.631
1973	0.597	0.561	0.570	0.618
1975	0.591	0.545	0.568	0.615
1978	0.578	0.524	0.541	0.602
1980	0.572	0.517	0.531	0.590
1981	0.572	0.514	0.532	0.583

A second set of issues is concerned with the degree to which the quality of the capital stock might have changed. On this there is very little evidence. A very crude indicator is provided by changes in the ratio of the net to gross stock of capital. Thus, if one assumes that net new capital embodies the more up-to-date technical knowledge and thus adopts the vintage embodiment view mentioned earlier, a rise in this ratio would indicate an improvement in quality(15). An increase in the quality of the stock would be expected to improve the growth of output per head.

If one follows a different line and argues that all investment including physical replacement contributes to growth in output per head, movements in the ratio of net to gross capital stock would be less informative on this issue.

Table 15 which gives the ratio of net to gross capital stock for the industrial sector provides a somewhat ambiguous view of events. In France, the ratio appears to have varied little over the two decades, yet

(15) In DIW (Berlin) terminology this is the "Modernitätsgrad" indicator; see Kengel et al. (1982).

this country experienced the biggest decline in the growth of both output per man and total factor productivity. In Germany and Italy, the ratio of net to gross capital stock declined fairly evenly over the period by around eight percentage points. Italy experienced the second biggest slowdown in the growth of output per head, with Germany the least affected of the four. In the case of the United Kingdom, the ratio changes little but with reference to France, it experienced a moderate slowdown in productivity growth.

Considering capital productivity in somewhat more detail, the official estimates of the capital stock, as we have seen, leave one with the strong impression that over the whole period, capital productivity growth has been either negative or at best, improved little. Annex Tables 1 A-D show that between 1960 and 1981, in France only could it be said that growth of capital productivity rose on a fairly broad basis. Even here however, the equipment goods sector shows a marked decline of 2.0 per cent per annum over the period.

Comparing the two sub-periods yields mixed results. In Germany, output per unit of capital declined throughout and in some sectors tended to accelerate in 1973-81. France experienced a pronounced increase in capital productivity during the first period 1960-73 of almost 2.0 per cent per annum. In the period 1973-81 there was a sharp decline which yielded a turnround between the two sub-periods of over 4.0 percentgae points. In Italy, the experience is mixed but the general picture is one of a decline in growth. The United Kingdom, like Germany, was characterised by falling capital productivity in all sectors which, with the exception of energy, accelerated in 1973-81. The end result produced a further worsening of around 3.5 percentage points between the two periods.

Table 16 shows differences in the behaviour of labour productivity, capital productivity and capital per employee between 1960-73 and 1973-81 for manufacturing and total industry.

Looked at in these terms we see that in France and the United Kingdom, the fall in capital productivity made a greater contribution to the decline in the growth of output per head than did changes in the evolution of capital per employee. In Italy, the reverse is mildly the case with Germany strongly so. In comparing France and the United Kingdom, what is interesting to observe once again is that a strong tendency towards factor substitution

Table 16

Labour and Capital Productivity and Capital per Employee Growth Differences (1973-81 minus 1960-73)

	FRANCE		GERMANY		ITALY		UNITED KINGDOM	
	Manufact.	Total	Manufact.	Total	Manufact.	Total	Manufact.	Total
$\left(\frac{V}{L}\right)_g$	-3.41	-3.11	-1.91	-1.90	-2.93	-2.86	-2.43	-1.63
$\left(\frac{V}{K}\right)_g$	-4.13	-4.17	+0.07	-0.68	-1.55	-1.19	-3.97	-2.56
$\left(\frac{K}{L}\right)_g$	0.72	1.06	-1.98	-1.22	-1.40	-1.67	1.54	0.93

generated quite different results in terms of employment growth. On the one hand, there is the argument that in the absence of capital deeping of this scale the fall in output per head would have been worse. On the other hand, the benefits as noted have not appeared in the form of employment growth, particularly so in 1973-81. For Italy and Germany, capital deepening has not been so pronounced and the decline in this between the two periods appears to have made a bigger contribution to the fall in output per employee than does the decline in capital productivity.

Where accumulation is concerned therefore, the impression overall is that there has been a marked decline in the marginal efficiency of investment. Between the two sample periods, this suggests that the marginal product of capital has been declining relative to the average product. If we decompose the elasticity of gross value added with respect to the capital stock we can see that this is likely to have been the case. Thus for the four countries, Table 17 compares differences in the growth of the average product of capital with differences in the return on capital where the latter is taken to be an indicator of the marginal product.

With the marginal exception of France, it would appear that there has been much bigger decline in the rate of return (marginal product) than in the average product.

Table 17

Capital Productivity and the Rate of Return
Total Industry (per cent)

	France	Germany	Italy	U.K.
Rate of Return (16)				
1960-73	13.2	11.8	8.8	9.2
1973-81	9.3	9.8	5.4	5.7
Difference	3.9	2.0	3.4	3.5
Average Product				
Difference	4.1	0.7	1.2	2.5
(see Annex Tables 1 A-D)				

Why such a decline in the capacity of capital to generate more output, employment and profits is not easy to say. The post-war reconstruction period provided conditions which favoured an unusually rapid accumulation and it is hardly likely that this could be sustained. Returns at the margin begin to fall as the stock of investment opportunities declines. We see some evidence of this in the decline in capital accumulation in the second sub-period.

Another strand in this argument is that suggested by Sargent (1982). He sees the practice of introducing generous investment incentives in most European countries as a means of deriving temporary increases in the growth of output per head by accelerating the growth of the capital stock. Again, this expansion must come to a halt which creates a slowdown in growth as the economy adjusts to a more normal evolution of output per head with respect to capital per employee.

Associated with the observed rise in both the capital stock and capital per employee, there has, as noted at several points in the discussion, been a very poor evolution of employment. This suggests that the investment which has occurred, particularly in the second sample period has tended to

(16) The figures here are from Mortensen (1984).

be of a more labour saving variety. A simple way of drawing attention to this possibility is that provided by Chart 4. Here, for each of the six sectors considered, the growth of the capital/labour ratio is plotted against the growth of the capital stock. If all of the points were to rest on the 45 degree line, the growth of employment would match that of the capital stock. Points to the right of this line would denote a greater emphasis on labour using capital investment.

What we see, is that in most instances there is a movement between the two periods towards the left of the 45 degree line. In other words, one inference which could be drawn in that labour saving investment has become more predominant through the period under consideration. This is yet another way of appreciating the poor employment performance of the European Community (17).

As to precisely why this particular factor mix has occurred is undoubtedly a difficult and complicated issue. Recent discussions have included numerous relevant factors and the various arguments are not repeated here. Over the longer period however, it is difficult to escape from a view that the course of capital costs relative to labour costs has had some part to play.

Good evidence is not easy to assemble as a consistent basis but a variety of what might be termed fragments of information do move in a consistent direction. Namely, that across the Community, own product real employment costs have tended to rise relative to the costs of providing capital (18). There are two aspects of this which are worth emphasising. One is the increase in the willingness and ability of labour to bid for a larger share of money output. The other is the long-run tendency for governments to increase non-wage labour costs to the employer on the one hand, whilst subsidising capital on the other.

The rise in non-wage costs has been associated in particular with the financing of social security benefits. To the employer however, they are

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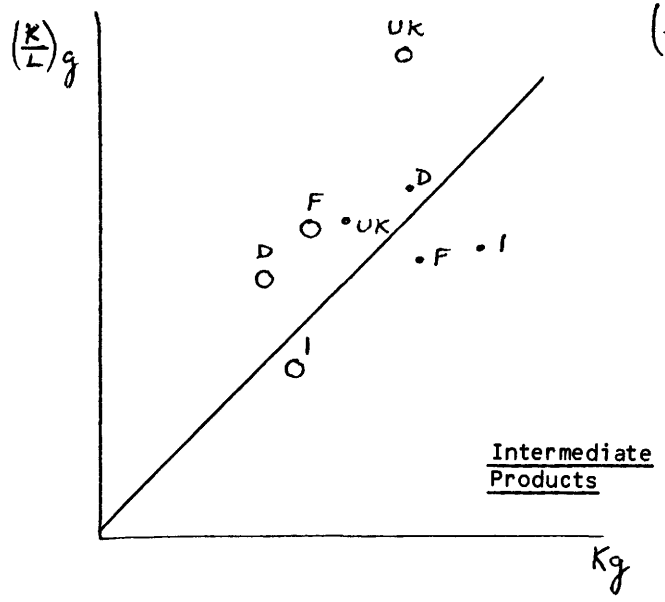
(17) A recent discussion of labour using and labour saving investment is that by Scott (1978).

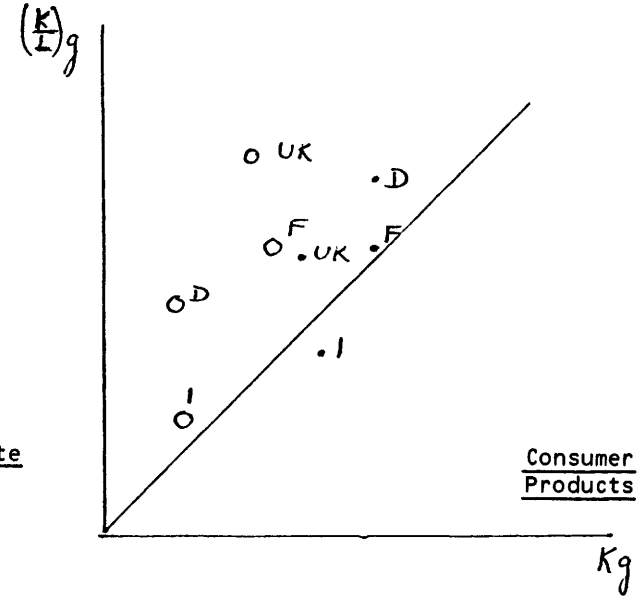
(18) Some relevant pieces of empirical work relating to Europe and the United States are summarised in Todd (1984).

Chart 4 : Sectoral Growth of the Capital Labour Ratio and the Capital Stock (O - 1973/81; . - 1960/73)

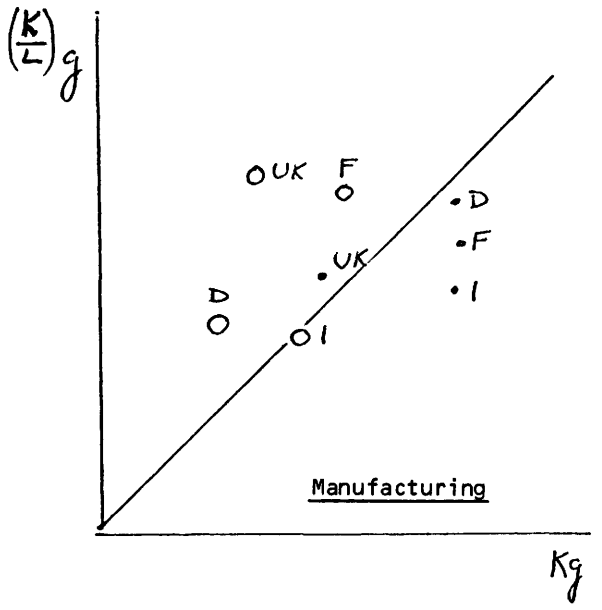
(per cent)



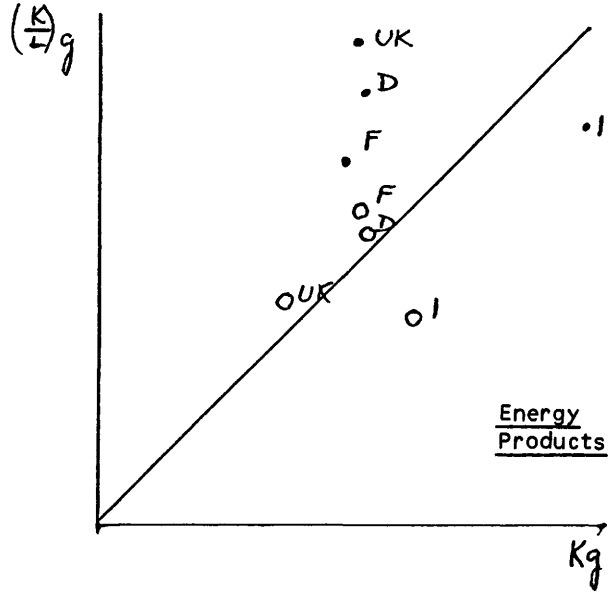
Intermediate Products



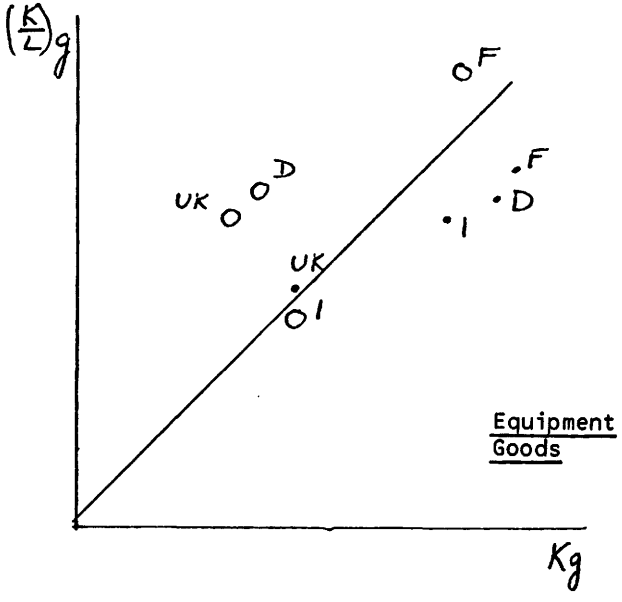
Consumer Products



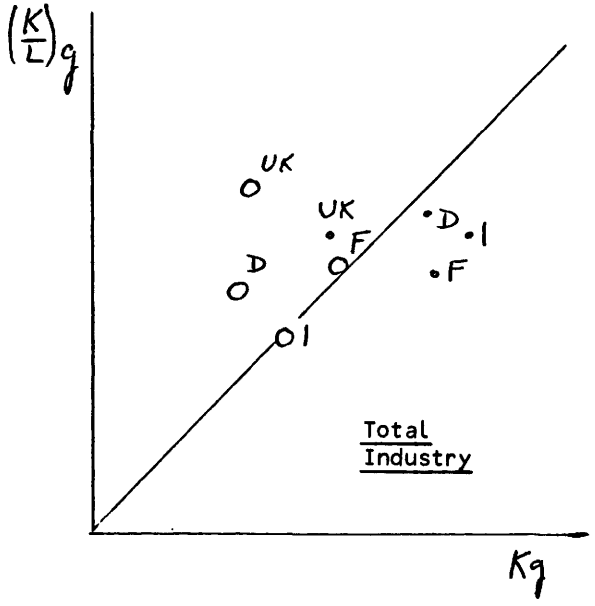
Manufacturing



Energy Products



Equipment Goods



Total Industry

a cost and directly equivalent to a tax on labour. Across Europe, this tax equivalent has risen on average by around one half of a percentage point per year over the past two decades. The non-wage element now represents something of the order of 20-25 per cent of total employment costs (19).

On the capital incentives side, the matter is a good deal more complicated due to the fact that investment subsidies exist in such a complex and bewildering array of forms. Nevertheless, there would seem to be little doubt that the effect of lowering the cost of capital to the entrepreneur can be considerable depending on type of asset, type of incentive, depreciation provisions, inflation and so on. Kopits (1981) offers some calculations which suggest that the subsidy arising from tax incentives alone can be as high as 16 per cent of the asset price. For equipment and machinery, the average subsidy for six Community countries is of the order of 6 per cent, ranging from zero for electrical machines in Germany, to 13.0 per cent in the United Kingdom.

There are of course very good reasons why one would wish to subsidise certain kinds of new investment and a discussion of these issues would demand another paper. It is questionable nevertheless whether the pattern of relative factor rewards which we have observed has been appropriate for the generation of employment. It may well be the case that the "deadweight loss" element in capital projects has been greater than expected. When coupled with a running down in the growth of new investment opportunities, this suggests that some growing part of investment has taken place in areas where the return otherwise would not have been acceptable. Those benefits which may have emerged do not seem to have been translated readily into improved returns on capital, capital productivity or net new employment.

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(19) See Steinherr (1983).

VII. Concluding Comments

The analysis and discussion here has concentrated on certain particular aspects only of factor productivity growth in the four major EEC countries. Obviously important elements such as the role of government demand policies, changing competitiveness, changes in the structure and quality of the labour force, capacity utilization, the energy factor and so on have not been considered. The intention is to try and see what some readily available information on output and factor inputs can tell us about growth and productivity performance. The results are summarised below in Table 18.

Table 18

Growth Averages of 4 EEC Countries Total Industry
(Differences : 1973-81 minus 1960-73) (per cent)

V_g	TFP_g	TFI_g	$\left(\frac{V}{L}\right)_g$	$S_\pi\left(\frac{K}{L}\right)_g$	K_g	L_g	$\left(\frac{K}{L}\right)_g$
-4.2	-2.0	-2.2	-2.4	-0.4	-2.0	-1.9	-0.1

Within a simple growth accounting framework, the analysis suggests that on average, about one half of the decline in output growth between the periods 1960-73 and 1973-81 has been due to a fall in the growth of total factor inputs. The other half is accounted for by a decline in total factor productivity growth.

Looking at the contribution to the fall in growth of output per employee, the simple arithmetic averages in Table 18 suggest that the decline in growth of factor substitution has played a relatively minor part. Various admitedly illustrative adjustments however serve to raise the significance of this component to around one half of the difference. Even so, between the two periods, the growth of the capital/labour ratio was virtually unchanged. Yet, despite this more or less continuous capital deepening process, the change in employment growth has been strongly negative. In many respects, this is the most depressing aspect of growth performance over the past twenty years or more. Whilst many factors bear upon this observation, it seems likely that the nature of capital accumulation has had some effect.

The decline in capital productivity, rise in capital per head and fall in the rate of return all suggest that the efficiency of investment has for some reason been declining.The United Kingdom is the most extreme example. This may be due to a combination of reduced investment opportunities and an unfavourable factor price mix. Certainly, the latter will not have helped the employment generating process.

One can argue that energy price shocks reduced the worth of the existing capital stock and that this contributed to the decline in productivity growth. This is likely to have been the case and there is now evidence which supports this view. Yet, in some countries, one detects evidence of a weakening long before 1973. In France and Italy, industrial employment grew at an annual average rate of just over 1 per cent between 1960 and 1973. In Germany however, such growth was virtually zero and in the United Kingdon it was negative.

The general impression therefore is that investment has not generated the benefits expected and that some investment resources must have been channelled into areas where the returns would otherwise have been judged inappropriate.

NOTES ON DATA AND DEFINITIONS

Classification

The basic industrial grouping followed for all countries and which corresponds to the ESA convention is as follows :

Intermediate Goods :	Mining and Quarrying
	Coal and Petroleum Products
	Chemicals and Allied
	Industries
	Metal Manufacturing
	Other Metal Goods
	Bricks, Pottery, Glass, Cement
	Paper, Printing and Publishing
	Other Manufacturing
	Gas, Electricity and Water
Energy Products :	Coal Mining
	Petroleum and Natural Gas
	Other Mining etc.
	Coal and Petroleum Products
	Gas, Electricity and Water
Equipment :	Instrument Engineering
	Mechanical Engineering
	Electrical Engineering
	Shipbuilding and Marine Engineering
	Vehicles
	Construction
Consumption Goods :	Food, Drink and Tobacco
	Textiles
	Leather Goods etc.
	Clothing and Footwear
	Timber, Furniture etc.

Manufacturing : All of the above with the exception of Coal and Petroleum Products, Coal Mining, Petroleum and Natural Gas, Other Mining, Gas, Electricity, Water.

Thus, Equipment goods include Construction, as does Total Industry, that is Manufacturing, all Mining and Quarrying, Construction, Gas, Electricity and Water.

FRANCE

All data is based on 1970 and with the exception of the capital stock and depreciation are published by INSEE. These two latter variables come from unpublished INSEE sources.

In order to obtain value added at current prices an estimate of stock appreciation was obtained by multiplying the opening stock of materials by the change in the price index of intermediate consumption of branches; there being no prices at the sectoral level. The opening stock of finished goods plus work in progress was multiplied by the change in the price index of gross output at the branch level. Value added at current prices was then obtained by substracting the two estimates of stock appreciation.

Constant price value added is then the above current price estimate deflated by the price index of value added at the branch level.

GERMANY

The data source is official National Accounts base 1976.

There is a problem in computing a factor cost estimate of value added because of a break in the official series in 1968. Following a suggestion from statistics officials at RWI, the ration of value added at factor cost $\frac{1968 \text{ (revised)}}{1968 \text{ (old)}}$ was applied to the earlier years 1960-67 inclusive in order to derive a complete series.

ITALY

The National Accounts base 1970 is the major source. For value added at factor cost, the series begins at 1970. However, the market price series starts in both current and constant prices at 1960. One can then use the second to obtain an estimate of the first for the years 1960-1969. A problem is that in four branches : Metals, Industrial Machinery, Office Machinery and Electrical Engineering, there is no constant price data for 1960-1969. There is a total for that group plus a current prices series for the four branches. To fill the gap, the same price index for the group of four was used as an approximation.

Value added at factor cost was obtained by working back from 1970 using the rate of change of market price value added in volume terms having applied the price index.

The capital stock series is on a 1975 base which meant that the value added (factor cost) volume series had to be converted from 1970 to 1975 in the usual manner.

UNITED KINGDOM

All of the data used is that in the National Accounts base 1975. For further details on the profit share and other calculations see Reatti (1984) (1).

(1) A. Reatti : "Rate of Profit, Business Cycles and Capital Accumulation in UK Industry 1959-81", DG.II Economic Papers, Brussels (forthcoming).

KEY TO ANNEX TABLES

Vg	Rate of Growth of Real Output
Lg	Rate of Growth of Employment
Kg	Rate of Growth of Real Capital Stock
$\left(\frac{V}{L}\right)_g$	Rate of Growth of Real Output per Employee
$\left(\frac{V}{K}\right)_g$	Rate of Growth of Real Output per unit of real stock of capital
$\left(\frac{K}{L}\right)_g$	Rate of Growth of Capital/Employment ratio
TFIg	Rate of Growth of Total Factor Input
TFPg	Rate of Growth of Total Factor Productivity
$S\pi$	Profit Share
$S\pi\left(\frac{K}{L}\right)_g$	Rate of Growth of "Capital/Labour Substitution"

Annex Table 1 A

Output, Factor and Factor Productivity Growth

per cent

		Vg	Lg	Kg	$\left(\frac{V}{L}\right)_g$	$\left(\frac{V}{K}\right)_g$	$\left(\frac{K}{L}\right)_g$	TFPg	TFIg	$S\pi\left(\frac{K}{L}\right)_g$
	FRANCE					1960-1981				
1.	Intermediate	4.462	-0.098	4.316	4.560	0.146	4.413	2.722	1.741	1.838
2.	Energy	5.432	-1.465	3.913	6.897	1.509	5.378	4.256	1.177	2.642
3.	Consumption	5.213	-0.806	3.597	6.020	1.616	4.404	4.370	0.843	1.649
4.	Equipment	5.013	1.175	6.924	3.838	-1.911	5.749	1.950	3.064	1.888
5.	Manufacturing	5.303	0.155	4.944	5.148	0.359	4.789	3.476	1.827	1.672
6.	Total Industry	4.891	0.254	4.766	4.637	0.124	4.512	2.955	1.935	1 681
						1960-1973				
1.	Intermediate	6.977	0.733	4.961	6.244	2.016	4.228	4.483	2.494	1.761
2.	Energy	6.876	-1.924	3.816	8.800	3.060	5.740	5.981	0.895	2 819
3.	Consumption	6.795	-0.169	4.234	6.964	2.561	4.403	5.315	1.480	1.649
4.	Equipment	7.355	2.523	7.541	4.832	-0.186	5.018	3.184	4.172	1.648
5.	Manufacturing	7.583	1.102	5.616	6.481	1.967	4.505	4.905	2.678	1.576
6.	Total Industry	7.090	1.237	5.344	5.853	1.746	4.107	4.322	2.767	1.530
						1973-1981				
1.	Intermediate	0.501	-1.433	3.276	1.934	-2.775	4.709	0 097	0.405	1.837
2.	Energy	3.127	-0.715	4.071	3.842	-0.944	4.786	1.358	1.770	2.485
3.	Consumption	2.692	-1.834	2.572	4.526	0.120	4.405	3.054	-0.362	1.472
4.	Equipment	1.315	-0.978	5.927	2.293	-4.612	6.906	0.402	0.914	1.892
5.	Manufacturing	1.702	-1.365	3.862	3.067	-2.160	5.226	1.425	0.277	1.642
6.	Total Industry	1.413	-1.324	3.834	2.737	-2.421	5.158	1.058	0.355	1.679

Annex Table 1 B

Output, Factor and Factor Productivity Growth (per cent)

	Vg	Lg	Kg	$\left(\frac{V}{L}\right)_g$	$\left(\frac{V}{K}\right)_g$	$\left(\frac{K}{L}\right)_g$	TFPg	TFIg	$S_\pi\left(\frac{K}{L}\right)_g$
GERMANY					1960-1981				
1. Intermediate	3.374	-0.814	3.992	4.189	-0.617	4.806	2.049	1.326	2.140
2. Energy	2.683	-1.718	4.181	4.401	-1.498	5.900	1.513	1.170	2.888
3. Consumption	2.056	-1.820	2.943	3.877	-0.886	4.763	1.876	0.180	2.001
4. Equipment	3.840	0.503	5.195	3.337	-1.355	4.692	1.702	2.138	1.635
5. Manufacturing	3.745	-0.439	4.006	4.184	-0.261	4.445	2.431	1.313	1.752
6. Total Industry	3.350	-0.469	4.084	3.819	-0.734	4.553	1.973	1.377	1.846
					1960-1973				
1. Intermediate	4.841	-0.494	4.906	5.335	-0.065	5.400	2.931	1.910	2.404
2. Energy	3.409	-2.519	4.153	5.928	-0.743	6.672	2.662	0.747	3.266
3. Consumption	3.044	-1.393	4.127	4.437	-1.083	5.520	2.118	0.926	2.318
4. Equipment	5.252	1.467	6.648	3.787	-1.396	5.181	1.951	3.301	1.836
5. Manufacturing	5.105	0.181	5.393	4.924	-0.288	5.212	2.869	2.236	2.055
6. Total Industry	4.692	0.138	5.161	4.554	-0.469	5.023	2.518	2.175	2.037
					1973-1981				
1. Intermediate	1.035	-1.332	2.524	2.367	-1.489	3.855	0.910	0.125	1.457
2. Energy	1.514	-0.402	4.228	1.916	-2.714	4.631	-0.460	1.974	2.377
3. Consumption	0.472	-2.511	1.047	2.983	-0.575	3.558	1.733	-1.261	1.250
4. Equipment	1.588	-1.051	2.878	2.639	-1.290	5.181	1.606	-0.018	1.033
5. Manufacturing	1.571	-1.439	1.790	3.010	-0.219	3.229	2.025	-0.454	0.985
6. Total Industry	1.206	-1.448	2.358	2.653	-1.152	3.805	1.433	-0.227	1.221

Annex Table 1 C

Output, Factor and Factor Productivity Growth (per cent)

	Vg	Lg	Kg	$\left(\frac{V}{L}\right)_g$	$\left(\frac{V}{K}\right)_g$	$\left(\frac{K}{L}\right)_g$	TFPg	TFIg	$S_\pi\left(\frac{K}{L}\right)_g$
ITALY					1960-1981				
1. Intermediate	5.501	1.162	4.867	4.340	0.634	3.705	2.528	2.973	1.811
2. Energy	4.854	1.554	6.617	3.300	-1.763	5.063	0.107	4.747	3.193
3. Consumption	4.876	0.142	2.508	4.734	2.368	2.366	3.527	1.348	1.207
4. Equipment	3.755	0.669	4.901	3.086	-1.146	4.232	1.505	2.250	1.581
5. Manufacturing	5.504	0.972	4.320	4.533	1.185	3.348	3.060	2.444	1.473
6. Total Industry	4.626	0.650	4.707	3.977	-0.081	4.057	2.130	2.497	1.847
					1960-1973				
1. Intermediate	7.623	1.661	6.061	5.962	1.563	4.399	3.811	3.812	2.151
2. Energy	7.647	1.488	7.702	6.159	-0.056	6.215	2.240	5.407	3.919
3. Consumption	6.143	0.526	3.289	5.617	2.854	2.763	4.208	1.935	1.409
4. Equipment	5.018	1.103	5.920	3.915	-0.901	4.817	2.116	2.903	1.799
5. Manufacturing	7.225	1.555	5.439	5.671	1.787	3.884	3.962	3.263	1.708
6. Total Industry	6.167	1.082	5.783	5.085	0.384	4.702	2.945	3.222	2.140
					1973-1981				
1. Intermediate	2.142	0.356	2.956	1.787	-0.814	2.600	0.895	1.248	0.892
2. Energy	0.469	1.661	4.877	-1.192	-4.407	3.215	-2.429	2.898	1.237
3. Consumption	2.849	-0.479	1.252	3.328	1.597	1.731	2.616	0.233	0.713
4. Equipment	1.734	-0.032	3.266	1.766	-1.531	3.298	0.798	0.936	0.969
5. Manufacturing	2.767	0.031	2.527	2.736	0.240	2.496	1.915	0.852	0.821
6. Total Industry	2.170	-0.048	2.982	2.218	-0.812	3.030	1.179	0.991	1.039

Annex Table 1 D

Output, Factor and Factor Productivity Growth

(per cent)

		Vg	Lg	Kg	$\left(\frac{V}{L}\right)_g$	$\left(\frac{V}{K}\right)_g$	$\left(\frac{K}{L}\right)_g$	TFPg	TFIg	$S_\pi\left(\frac{K}{L}\right)_g$
	UNITED KINGDOM					1960-1981				
1.	Intermediate	1.936	-1.634	4.262	3.570	-2.325	5.896	1.520	0.416	2.051
2.	Energy	3.775	-2.455	3.574	6.230	0.200	6.030	4.267	-0.493	1.963
3.	Consumption	0.691	-2.231	2.681	2.922	-1.990	4.912	1.119	-0.428	1.802
4.	Equipment	0.626	-1.251	2.946	1.857	-2.320	4.177	0.812	-0.186	1.045
5.	Manufacturing	0.825	-1.569	2.993	2.394	-2.168	4.562	0.907	-0.082	1.487
6.	Total Industry	1.207	-1.592	3.282	2.799	-2.075	4.874	1.273	-0.066	1.526
						1960-1973				
1.	Intermediate	2.543	-1.049	3.860	3.593	-1.317	4.910	1.885	0.658	1.708
2.	Energy	1.891	-3.550	4.012	5.440	-2.121	7.561	2.979	-1.088	2.461
3.	Consumption	2.601	-1.291	3.034	3.892	-0.433	4.325	2.305	0.296	1.587
4.	Equipment	2.774	-0.286	3.423	3.060	-0.622	3.709	2.132	0.642	0.928
5.	Manufacturing	2.797	-0.545	3.419	3.342	-0.649	3.964	2.050	0.747	1.292
6.	Total Industry	2.652	-0.783	3.735	3.435	-1.083	4.518	2.020	0.631	1.415
						1973-1981				
1.	Intermediate	0.957	-2.578	4.918	3.534	-3.961	7.495	0.836	0.120	2.698
2.	Energy	6.911	-0.650	2.868	7.562	4.043	3.519	5.885	1.027	1.677
3.	Consumption	-2.337	-3.738	2.111	1.401	-4.448	5.849	-0.531	-1.806	1.932
4.	Equipment	-2.771	-2.749	2.175	-0.021	-4.945	4.924	-1.448	-1.322	1.427
5.	Manufacturing	-2.298	-3.211	2.305	0.913	-4.604	5.517	-0.618	-1.681	1.530
6.	Total Industry	-1.097	-2.894	2.549	1.796	-3.647	5.443	0.036	-1.133	1.760

Annex Table 2 A

Total Factor Productivity Growth and its Components
Differences (1973-81 minus 1960-73)

	Intermediate Goods	Energy	Equipment	Consumption Goods	Manufacturing	Total Industry
FRANCE			1960-1973			
Vg	6.98	6.88	7.36	6.79	7.58	7.09
TFPg	4.48	5.98	3.18	5.32	4.91	4.32
TFIg	2.49	0.90	4.17	1.48	2.68	2.77
$\left(\frac{V}{L}\right)_g$	6.24	8.80	4.83	6.94	6.48	5.85
$S_\pi\left(\frac{K}{L}\right)_g$	1.76	2.82	1.65	1.65	1.58	1.53
			1973-1981			
Vg	0.50	3.13	1.32	2.69	1.70	1.42
TFPg	0.10	1.36	0.40	3.05	1.43	1.06
TFIg	0.41	1.78	0.91	-0.36	0.28	0.36
$\left(\frac{V}{L}\right)_g$	1.93	3.84	2.29	4.53	3.07	2.74
$S_\pi\left(\frac{K}{L}\right)_g$	1.84	2.49	1.89	1.47	1.64	1.68
			Difference (1973/81 minus 1960/73)			
Vg	-6.48	-3.75	-6.04	-4.11	-5.88	-5.67
TFPg	-4.38	-4.63	-2.78	-2.27	-3.48	-3.26
TFIg	-2.08	+0.88	-3.26	-1.84	-2.40	-2.41
$\left(\frac{V}{L}\right)_g$	-4.31	-4.96	-2.54	-2.41	-3.41	-3.11
$S_\pi\left(\frac{K}{L}\right)_g$	+0.08	-0.33	+0.24	-0.18	+0.06	+0.15

Annex Table 2 B

Total Factor Productivity Growth and its Components
Differences (1973-81 minus 1960-73)

	Intermediate Goods	Energy	Equipment	Consumption Goods	Manufacturing	Total Industry
GERMANY			1960-1973			
Vg	4.84	3.41	5.25	3.04	5.10	4.69
TFPg	2.93	2.67	1.95	2.12	2.87	2.51
TFIg	1.91	0.75	3.30	0.93	2.24	2.18
$\left(\frac{V}{L}\right)_g$	5.34	5.93	3.79	4.44	4.92	4.56
$S_\pi\left(\frac{K}{L}\right)_g$	2.40	3.27	1.84	2.32	2.06	2.04
			1973-1981			
Vg	1.04	1.51	1.59	0.47	1.57	1.21
TFPg	0.91	-0.46	1.61	1.73	2.03	1.43
TFIg	0.13	1.97	-0.02	-1.26	-0.45	-0.23
$\left(\frac{V}{L}\right)_g$	2.37	1.92	2.64	2.98	3.01	2.65
$S_\pi\left(\frac{K}{L}\right)_g$	1.46	2.38	1.03	1.25	0.99	1.22
			Difference (1973/81 minus 1960/73)			
Vg	-3.80	-1.90	-3.66	-2.57	-3.53	-3.49
TFPg	-2.02	-3.13	-0.35	-0.39	-0.84	-1.09
TFIg	-1.78	+1.23	-3.32	-2.18	-2.69	-2.40
$\left(\frac{V}{L}\right)_g$	-2.97	-4.02	-1.15	-1.46	-1.91	-1.91
$S_\pi\left(\frac{K}{L}\right)_g$	+0.95	-0.89	-0.80	-1.07	-1.07	-0.82

Annex Table 2 C

Total Factor Productivity Growth and its Components
Differences (1973-81 minus 1960-73)

	Intermediate Goods	Energy	Equipment	Consumption Goods	Manufacturing	Total Industry
ITALY			1960-1973			
Vg	7.62	7.65	5.02	6.14	7.23	6.17
TFPg	3.81	2.24	2.12	4.21	3.96	2.95
TFIg	3.81	5.41	2.90	1.94	3.26	3.22
$\left(\frac{V}{L}\right)_g$	5.96	6.16	3.92	5.62	5.67	5.09
$S_\pi\left(\frac{K}{L}\right)_g$	2.15	3.92	1.80	1.41	1.71	2.14
			1973-1981			
Vg	2.14	0.47	1.73	2.85	2.77	2.17
TFPg	0.90	-2.43	0.80	2.62	1.92	1.18
TFIg	1.25	2.90	0.94	0.23	0.85	0.99
$\left(\frac{V}{L}\right)_g$	1.79	-1.19	1.77	3.33	2.74	2.22
$S_\pi\left(\frac{K}{L}\right)_g$	0.89	1.24	0.97	0.71	0.82	1.04
			Difference (1973/81 minus 1960/73)			
Vg	-5.48	-7.18	-3.29	-3.29	-4.46	-4.00
TFPg	-2.91	-4.67	-1.32	-1.59	-2.04	-1.77
TFIg	-2.57	-2.51	-1.97	-1.70	-2.42	-2.23
$\left(\frac{V}{L}\right)_g$	-4.17	-7.35	-2.15	-2.29	-2.93	-2.86
$S_\pi\left(\frac{K}{L}\right)_g$	-1.26	-2.68	-0.83	-0.70	-0.89	-1.09

Annex Table 2 D

Total Factor Productivity Growth and its Components
Differences (1973-81 minus 1960-73)

	Intermediate Goods	Energy	Equipment	Consumption Goods	Manufacturing	Total Industry
UNITED KINGDOM			1960-1973			
Vg	2.54	1.89	2.77	2.60	2.80	2.65
TFPg	1.89	2.98	2.13	2.31	2.05	2.02
TFIg	0.66	-1.09	0.64	0.30	0.75	0.63
$\left(\frac{V}{L}\right)_g$	3.59	5.44	3.06	3.89	3.34	3.44
$S_\pi\left(\frac{K}{L}\right)_g$	1.71	2.46	0.93	1.69	1.29	1.42
			1973-1981			
Vg	0.96	6.91	-2.77	-2.34	-2.30	-1.10
TFPg	0.84	5.89	-1.45	-0.53	-0.62	0.04
TFIg	0.12	1.03	-1.32	-1.81	-1.68	-1.13
$\left(\frac{V}{L}\right)_g$	3.53	7.56	-0.02	1.40	0.91	1.80
$S_\pi\left(\frac{K}{L}\right)_g$	2.70	1.68	1.43	1.93	1.53	1.76
			Difference (1973/81 minus 1960/73)			
Vg	-1.58	+5.02	-5.54	-4.94	-5.10	-3.74
TFPg	-1.05	+2.91	-3.58	-2.84	-2.67	-1.98
TFIg	-0.53	+2.11	-1.96	-2.10	-2.43	-1.76
$\left(\frac{V}{L}\right)_g$	-0.06	+2.13	-3.08	-2.48	-2.43	-1.63
$S_\pi\left(\frac{K}{L}\right)_g$	+0.99	-0.78	+0.50	+0.24	+0.24	+0.35

REFERENCES

1. M.N. Baily, "Productivity and the Services of Capital and Labour", Brookings Papers in Economic Activity, No. 1, 1981.
2. M.N. Baily, "The Productivity Growth Slowdown by Industry", Working Paper, the Brookings Institution, October 1982.
3. D. Blades, "Service Lives of Fixed Assets", OECD WorkingPaper No. 4, March 1983.
4. K.E. Boulding, "Some Difficulties in the Concept of Economic Input", in "Output, Input and Productivity Measurement" Studies in Income and Wealth, Vol. 25, NBER, Princeton, 1961.
5. E.F. Dennison, "The Interruption of Productivity Growth in the United States", Economic Journal, March 1983.
6. J.W. Kendrick, "International Comparisons of Recent Productivity Trends" in "Essays in Contemporary Economic Problems", Ed. W. Fellner, American Enterprise Institute, 1981.
7. C. Kennedy and A.P. Thirlwall, "Surveys in Applied Economics : Technical Progress", Economic Journal, March 1972.
8. G. Kopits, IMF Survey, April 1981.
9. R. Krengel et al., "Produktionsvolumen und -Potential", DIW, Berlin, October 1982.
10. A. Lindbeck, "The Recent Slowdown of Productivity Growth", Economic Journal, March 1983.
11. R.C.O. Matthews (ed.), "Slower Growth in the Western World", Heinemann, London 1982.
12. R.C.O. Matthews, C.H. Feinstein and J.C. Odling-Smee, "British Economic Growth 1856-1973", Stanford 1982.
13. J. Mortensen, "Profitability, Factor Prices and Factor Mix in the Community, United States and Japan, 1960-1983", European Economy No. 20, July 1984.
14. R.R. Nelson, "Recent Exercises in Growth Accounting : New Understanding or Dead-End ? ", American Economic Review, June 1973.
15. W.D. Nordhaus, "Economic Policy and Declining Productivity Growth", European Economic Review, 1982.
16. N. Owen, "Economies of Scale, Competitiveness and Trade Patterns within the European Community", Oxford, 1983.
17. Th. Paccoud, "First Report on Fixed Capital Stock", Working Paper, Statistical Office of the European Communities, Luxembourg, December 1982.
18. C. Pratten, "Economies of Scale in Manufacturing", Cambridge University Press, 1971.
19. J.R. Sargent, "Capital Accumulation and Productivity Growth" in Metthews (ed.), 1982.
20. M.F.G. Scott, "Investment and Growth", Oxford Economic Papers, Vol. 28, No. 3, November 1976.

21. M.F.G. Scott, "Can we get back to Full Employment", MacMillan, London, 1978.

22. V. Smith, "Investment and Production", Harvard, 1966.

23. A. Steinherr, "Income Distribution and Employment in the European Communities", Economic Paper No. 23, December 1983, Commission of the European Communities, Directorate General for Economic and Financial Affairs.

24. G.J. Stigler, "Economic Problems in Measuring Changes in Productivity", in "Output, Input and Productivity Measurement" Studies in Income and Wealth, Vol. 25, NBER, Princeton, 1961.

25. D. Todd, "Total Factor Productivity Growth and the Producting Slowdown in the West German Industrial Sector, 1970-1981", Economic Paper, No. 32, April 1984, Commission of the European Communities, Directorate General for Economic and Financial Affairs.

26. D. Todd, "Some Aspects of Industrial Productive Performance in the European Community : An Appraisal", European Economy No. 20, July 1984.

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

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