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A Revised Supply Block for the Major Seven Countries in INTERLINK

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BY

Peter Jarrett and Raymond Torres

Growth Studies Division

April 1987

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

While the philosophy behind the supply block has not changed since its initial version, each of the block's behavioural equations as well as the parameters of the production functions have been substantially modified. These modifications have been motivated, in general, by a wish to improve the consistency of the block and to relax some of the constraints imposed. Consistency has been improved via a minor modification to the procedure for estimating the parameters of the production function, as well as from the inclusion of a measure of "normal" inventory growth in the demand term in the output equation. In the new version, the equilibrium stock/output ratio is no longer treated as a constant; tax considerations and domestic price effects are now included in the business energy price equations, and the dynamic adjustment of the factor demand equations has been made more general. Finally, some research on potential output, based on the revised production model, is reported.

* * *

Quoique les principes généraux à la base du bloc d'offre n'aient pas été modifiés depuis leur version initiale, les équations de comportement, ainsi que les paramètres des fonctions de production ont subi de profonds changements. Ces modifications ont été motivées notamment par un souci d'amélioration de la cohérence de l'ensemble du bloc et d'allégement des contraintes pesant sur les équations. La cohérence a bénéficié de l'adoption d'une procédure d'estimation des paramèters des fonctions de production légèrement modifiée, ainsi que de l'incorporation d'une mesure de la variation "normale" des stocks aux équations d'offre. Des contraintes ont été supprimées, notamment, en ne contraignant plus le rapport stock/production d'équilibre à être constant, en généralisant la dynamique de l'ajustement dans les équations de demande de facteurs et en incorporant les effets de la fiscalité et des prix intérieurs aux équations de prix de l'énergie. Enfin, on présentera une recherche sur la production potentielle basée sur le nouveau modèle d'offre.

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A REVISED SUPPLY BLOCK FOR THE MAJOR SEVEN COUNTRIES IN INTERLINK*

I. INTRODUCTION

For some years now the OECD macroeconomic model of the world economy, INTERLINK, has contained supply blocks for the seven largest country sub-models. In their first version (see Artus (1983)) the blocks were based on aggregate, three-factor production functions and derived, consistent factor demand equations. The gap between actual and potential output (derived from the production function) was used as a cyclical proxy in price equations, but actual output was still demand-determined. The second version (see Helliwell et al., 1986) modelled actual output as endogenous, subject to both supply (profitability) and demand (sales) influences, and allowed the gap to feed back onto factor demands.

Research on supply-side influences in INTERLINK is an on-going activity at the OECD, and this paper discusses the third version of the blocks. This new version allows not only for data revisions, but also explicitly models the equilibrium stock-output ratio as a function of expected real interest rates, time and the level of normal output itself. It also takes account of domestic determinants of business energy prices (both in terms of value-added prices and net indirect taxes) and of the simultaneity of factor demands. Importantly, in addition, it respecifies the investment equation to guarantee capital stock equilibrium.

The paper begins with a brief recapitulation of the basic structure of the supply blocks. Section III then describes the re-estimation of the production function. This is followed by sections on the respecification of the output supply equations, the factor demand equations and the business energy price equations. Sections VII and VIII deal with relative price effects on factor demands and the calculation of potential output. The paper concludes with some proposals for future research.

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* Efficient research assistance was provided by Gérard Salou, Mark Keese and Sylvie Cimper. Helpful comments were received from John Martin and Pete Richardson.

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dynamic adjustment equations with imposed long-run homogeneity of actual with respect to optimal inputs. Business fixed investment is determined by an identity, given current and lagged values of the capital stock and the exogenous scrapping rate. There are also profitability effects as well as intensity-of-factor utilisation effects: the higher are profitability and net excess demand for output, the greater is factor demand. Business energy demand is modelled in a similar fashion. It adjusts dynamically toward the vintage capital stock's business energy requirement which is calculated by means of a cost-minimization assumption.

There is also an equation in the block for the business sector energy price. This is specified as a function of import prices of energy, a proxy for the burden of indirect taxation and a measure of the margin applicable to domestic value added in the energy sector (everything from coal mining to oil refining to the price of hydroelectric power). The latter is proxied by the business sector value-added deflator. Homogeneity has been imposed in all cases.

The final equation in the block -- that for the labour force -- has remained largely unchanged since the previous version. Separate equations are specified for male and female participation rates in each of the major seven models, except that of Canada. Explanatory variables include cyclical proxies such as the unemployment rate and IFU, the real after-tax wage, real non-wage income per working-age person and real government transfers per working-age person. Other social/demographic factors were included in the estimation in order to avoid bias, but had to be omitted from the model version, because they are not present in the INTERLINK model.

III. PRODUCTION FUNCTION RE-ESTIMATION

The production functions have been re-estimated for the major seven countries to take account of new and revised historical data, rebasing in the national accounts for some countries and a new data source on business sector energy use in Canada. The International Energy Agency is now the source of energy data for all seven countries. Moreover, for consistency, the estimation procedure relative to the inner production function has been modified slightly. The energy demand equation used to estimate the inner production function parameters (1) in the new version of the model has the same specification as the behavioural equation for energy demand as such. Otherwise the methodology is exactly as it was described in Helliwell <u>et al.</u>, (1986). Table 1 compares the estimated parameters of the inner and outer production functions for the previous and current versions of the model.

On average, the vintage structure has become more putty-clay, since the mean retrofitting parameter (XR1) has been reduced from 29 per cent to 14 per cent. The model is now completely putty-clay for the United Kingdom and Canada, as the retrofitting parameter is zero. On the other hand, the mean elasticity of substitution between capital and energy (XSIGMA) remains unchanged at 0.60. However, even for this parameter, the new results do show some major reordering among countries: the Japanese model now manifests the highest elasticity of substitution between energy and capital, while the models for the four European economies are at the other extreme.

The elasticity of substitution in the outer production function (XTAU) is determined jointly with the modelled labour efficiency index (ELEFF). This index is specified according to a catch-up hypothesis, except for the United States which is designated as the "frontier" country. This catch-up hypothesis implies that there is a process of international convergence of growth rates of labour efficiency over time to that of the most efficient country.

With the rebased and revised U.S. national accounts data, an initial estimate of the growth rate of the U.S. labour efficiency index (ELEFUS) was only 0.5 per cent per year rather than the 1.2 per cent in the previous version. It was therefore decided to adjust the calculation of ELEFUS so that it would grow at a rate equal to that of observed labour efficiency, PIM (the actual residual from the production function (2)), and, as a result, a constant annual growth rate of 1 per cent was obtained. For the other countries, as in Helliwell et al. (1986), the estimates of ELEFF are based on an equation where the growth rate of technical progress is positively related to the level difference between the United States and the country concerned, as well as to a cyclical proxy. Compared to the previous version of the model, there are some major differences in the estimated values of the catch-up parameter, and their significance has increased. The rate of catch-up has increased considerably in Canada and especially in Japan (3), while it has been substantially reduced in the United Kingdom. In the case of the other three countries, the catch-up parameter has increased only slightly. The implied modelled (purged of cyclical variations) and observed labour efficiency indices are shown in Chart 2.

XTAU is estimated via labour productivity equations by assuming that the marginal product of labour is equal to the real product wage. In contrast to the (inner) elasticity of substitution between capital and energy, XTAU has declined on average from 0.84 to 0.65 (4). Indeed, excluding Japan which is an outlier, the mean across the other six countries is 0.71 with almost no dispersion. For these six countries, the estimated elasticities of substitution between the capital/energy bundle and labour are similar to those reported in other studies (see for example Pindyck, 1979). Other estimates for Japan also show low values for XTAU.

IV. OUTPUT SUPPLY EQUATION

The output supply equation is based on Helliwell's "factor utilisation model" (see Helliwell et al., 1986 and Helliwell and Chung, 1986) in which producers choose the intensity of factor utilisation (IFU). He has recently demonstrated (Helliwell, 1986) that this model encompasses the Keynesian and New Classical models of output determination, and that it dominates these models as well as unstructured vector autoregressive models for several of the major seven countries. The "factor utilisation" model embodies three principal effects. First, output will be lower than normal when profitability is low. Second, it will be higher than normal when normal demand relative to normal output (QBSV) is high. QBSV is that level of output that was expected in the past by employers to be profitable enough to justify assembling fixed factors to be used at their normal rates, whereas NQBV is a proxy for ex-post normal sales. Hence, the ratio of NQBV/QBSV is a measure of the error in past expectations. Third, output is a negative function of the ratio of beginning-of-period stocks relative to normal output.

a) Respecification of the equation

One rationale for the respecification was to define a new sales variable to include normal inventory growth (NIG); deviations of actual stockbuilding from its normal rate could not influence the demand (sales) variable in the previous version. In addition, instead of being constant as was previously the case, the equilibrium stock/output ratio is now an explicit function of a set of economic variables. Finally, the new specification allows for more flexible dynamics in the equation.

NIG has been defined so that the balanced growth stock-output ratio is a constant. Along the balanced growth path, output grows at a constant growth rate g. As in the previous version of the model, g is proxied by the annual growth rate of the labour force in efficiency units over the previous five-year period. Thus, in equilibrium, NIG=g*STOCKV (where STOCKV is the end-of-period value of inventories in constant prices) and normal stocks grow at the same rate as output (6). The new demand variable (NQBV) is defined as QBV-ISKV+NIG (where QBV is actual output and ISKV is actual inventory change); it is equal to actual output in equilibrium, since NIG equals ISKV and actual output equals normal output.

Having defined normal inventory growth, the equilibrium value of the stock/output ratio is that value which is consistent with IFU being equal to unity and is hypothesised to be a function of: i) the expected long-term real interest rate, as a proxy for the opportunity cost of stockholding; ii) the expected long-run rate of inflation, via expected capital gains on inventories; and iii) output itself, reflecting possible scale economies in stockholding. Time trends have also been added so as to remove problems encountered with the stock data in the national accounts (7). Thus, equilibrium stock/output ratios will depend on this group of variables, denoted as Z (8).

The list of regressors also includes (inverse) profitability (CQB), as in the previous version of the blocks, the new demand variable (as defined above) and the actual beginning-of-period stock/output ratios. This leads to the following (simplified) equation:

$$\ln(IFU) = a_0 + a_1 \ln(CQB) + a_2 \ln(NQBV/QBSV) + a_3 \ln(STOCKV(-1)/QBSV) + f(Z) + u$$

which can be rearranged as:

$$\ln(IFU) = a_1 \ln(CQB) + a_2 \ln(NQBV/QBSV) + a_3 [\ln(STOCKV(-1)/QBSV) - E] + u$$

where $E = \exp(-(a_0+f(Z))/a_3)$ is the equilibrium stock/output ratio. The last term on the right-hand side measures deviations of actual from desired stock/output ratios, and forces IFU to unity with a speed of adjustment depending crucially on the coefficient a_3. In a sense, this latter coefficient a_3 proxies the costs of changing activity levels.

b) Estimation results (Table 2 and Chart 3)

The estimation method was OLS, as in initial estimation OLS estimates proved very similar to 2SLS estimates. The results seem encouraging in several respects. First, adding a one-period lag to all the independent variables, by enriching the dynamics of the equation, has substantially improved the equation fit (see Chart 3, where the actual IFU and the predicted values using the new equations are graphed). Second, the end-of-sample (1983) equilibrium stock/output ratio is closer to the actual value than is the historical mean (which it was constrained to equal in the previous version) (Chart 4) which is desirable, especially in forecasting mode. Such a constraint was clearly questionable for some countries such as France where the end-of-sample observation of the stock/output ratio differs substantially from its mean, and, as a result, considerable positive or negative stockbuilding could be generated in forecasting mode.

The stock/output coefficient is now larger in all cases and is generally more significant. Thus, the speed of adjustment of actual to desired stock/output ratios, and consequently of IFU to unity, is faster in the new version of the model. Moreover, a comparison of the stock/output coefficients across countries shows that the Japanese private sector benefits from the lowest costs of adjusting production, with the French private sector at the other extreme. Altogether, the total effect of changes in QBSV can be derived from the sum of the coefficients on the sales terms and the inventory stock variables (i.e., $a_3 + a_4 + a_5 + a_6 + a_7 + a_8$). As required, the freely estimated long-run elasticity of QBV with respect to QBSV ranges between zero and unity for all countries (Table 2), except in France, where a unit constraint has been imposed via the a_7 parameter.

In every country, the equilibrium stock/output ratio is a function of linear or higher-order trends. It also depends on the anticipated long-term real interest rate for Germany and Italy, and on normal output itself for all countries except Japan. In general, there is little evidence of scale economies in stockholding. While the sum of the QBSV coefficients ($a_7 + a_8$) is positive for the United States and Germany, it is, in fact, negative for the United Kingdom, Italy and Canada. In the case of the French equation, it was constrained in order to prevent the long-run partial QBSV elasticity from being greater than unity.

In comparison with the previous model (see Table 2 versus Table 7a) the new sales effects are virtually identical in the U.S. and German models. On the other hand, demand effects are weaker for Japan and France, while they are larger for the United Kingdom, Italy and Canada. The larger the sales term parameter, the smaller is the buffer role for inventory stocks. Thus, the buffer effect is greatest in the French and Japanese equations and, in the first semester, in the Canadian equation and least in the Italian, U.S. and U.K. cases.

A profitability term enters the output equation. In one sense, it can be thought of as representing an economy with a spectrum of firms, some of which are operating at the margin; thus, falling profitability results in closures of marginal firms. On the other hand, if one thinks in terms of an aggregate economy with a single firm, variations in profitability might generate changes in scrapping rates of the capital stock the scrapping rate is exogenous in the model) and thus might result in movements in capacity (9).

In all cases except Germany the profitability effect (through current and lagged values of CQB) is weaker and less significant than in the previous version of the model (10). Finally, for the United Kingdom, it proved impossible to generate a negative CQB elasticity estimate.

V. FACTOR DEMAND EQUATIONS

Within the supply block framework, factor demands are determined simultaneously through the cost-minimizing behaviour of firms (11). Thus, for a given planned future output (QBSTAR), the desired demands for labour (EBSTAR) and for capital (KBSTAR) are functions of expected relative factor prices. Effective demands for labour (ETB) and capital (KBV) are related to their desired levels by a partial adjustment mechanism. Business sector energy demand (ENBV) is handled similarly: ENBV adjusts toward EBSV, the business sector energy required by the actual capital stock, subject to given relative prices. There are also profitability effects on factor demand -- CQB terms in the ETB equation and PROFR terms in the KBV equations (12) -- as well as demand pressure (IFU) effects. While this still remains the general rationale underlying the factor demand equations, some major modifications have been implemented in the new version of the model:

i) While planned output is, as previously, defined as a weighted average of normal and actual output, modified by an imposed profitability effect and grossed up for expected real growth, as proxied by the labour force in efficiency units, the weights 1-W on normal and W on actual output are now freely estimated -- rather than being imposed -- via a simultaneous estimation of ETB and KBV. As a result, the estimated weight W attached to actual output has been substantially reduced in all equations. In the previous version of the supply block, QBSTAR was too sensitive to actual output movements, thereby resulting in an overestimation of the indirect IFU effects on factor demands.

ii) The new adjustment mechanism is more general than its predecessor: factor demands adjust gradually to their desired levels, whereas only more restrictive error-correction models were utilised in the former version of the blocks. The only constraint on the coefficients in the present version is long-run homogeneity.

iii) For consistency with the change in the adjustment process, the investment equation is now specified as a capital stock equation with investment defined by the appropriate identity. As a result, the new specification allows for clearer adjustment of the capital stock to its desired level. Altogether, these changes have contributed to an increase in the estimated speeds of adjustment for ETB and KBV and to an improvement of the statistical properties of all the equations.

a) Labour demand equations (Table 3 and Chart 5)

As was found by Helliwell (1987), the estimation results show the speed of adjustment of actual to desired employment to be very fast for the Canadian and the U.S. models, intermediate in those of the European countries and slowest in the Japanese model, as reported below (13):

Speed of adjustment of employment

(median lag in semesters)

	Previous model	Current model
United States	0	0
Japan	20	10
Germany	5	1
France	4	4
United Kingdom	3	1
Italy	4	1
Canada	20	0

Adjustment is more rapid than in the previous model, implying smaller changes in short-run labour productivity. The dynamics of the Japanese, British and Italian equations, though subject to no restrictions, prove to be of the error-correction form with a larger effect -- relative to the former equation -- of EBSTAR growth on ETB. In the case of Germany, the year-over-year (rather than semestrial) EBSTAR growth rate implicitly appears on the right-hand side of the equation; thus, there is an implicit error-correction term, ensuring ETB is equal to its desired level in the long run, through the deviations of ETB with one lag from EBSTAR with two lags. The same type of error correction mechanism appears in the U.S. and French equations, in the difference between EBSTAR (-1) and ETB (-1).

IFU effects on employment are present in all equations, except for that of Japan, as was previously the case (Table 7b). However, the IFU effect in the French equation disappears in the long run (14). Profitability effects are again significant in the equations for Germany and the United Kingdom as well as for the United States in the shorter run. Standard errors of estimate average 0.44 per cent compared to 0.55 per cent in the previous version of the model; the fit of the employment equations is fairly good, (see Chart 5, where the predicted values from the new equations are graphed against the actual values). The Canadian equation has been adjusted to allow for first-order serial correlation and, as a result, is now essentially a first-difference equation; there is no indication of any residual autocorrelation elsewhere (15).

b) Capital stock equations (Table 4 and Chart 6)

A dynamic specification similar to that of the employment equation was used for the capital stock equation by assuming that the actual capital stock adjusts gradually to its desired level. In the previous specification of the equation, it was impossible to insure that actual and desired capital stocks were equal in long-run equilibrium, for in no case did the freely estimated coefficient on the error correction term (KBSTAR(-1)/KBV(-1)) have the right sign. Therefore, this term was omitted in the previous version of the model, and equilibration occurred only very indirectly through a term in KBSTAR(-1)/IBV(-1). The equation has therefore been re-specified in terms of the capital stock, with business fixed investment (IBV) derived from the appropriate identity.

Besides the homogeneity constraint ensuring the optimality of factor demand in the long run, profitability (PROFR) and cyclical (IFU) variables are added as before, leading to the following general capital stock equation:

$$\ln(KBV) = f(\ln(KBV(-i), \ln(KBSTAR), PROFR, IFU)$$

Lagged values of the independent variables were also included. Homogeneity was imposed via the usual linear constraint on one of the parameters of the lagged KBV terms. PROFR is a proxy for the supranormal rate of return on capital and is defined such that its sample mean is zero.

Thus, the capital stock equation captures some of the neo-classical determinants of investment as well as allowing for cyclical effects. The desired level of the capital stock is derived from a cost-minimizing framework, so that it depends on <u>planned output</u> and on <u>relative</u> factor prices, but on the other hand, planned output itself is influenced by, among other things, profitability, so that the desired level of capital depends partly on <u>real</u> factor prices, as implied by a pure neo-classical model. The derived investment function is therefore an eclectic one. Finally, allowing for dynamic adjustment of factor demands is in line with a strong body of theoretical and applied research which emphasizes the key role of adjustment costs. Dynamic adjustment can be influenced by the rate of return on capital (PROFR), which can be regarded as a proxy for Tobin's q, on the assumption that current profits are a good proxy for the valuation of the aggregate firm (see Chan-Lee (1986)) (16), although PROFR does not directly include expectations on the market value of the firm.

The results are relatively satisfactory. For the U.S. equation some convergence problems were encountered in the systems estimation, and the weight W had to be imposed. Also, the effect of KBSTAR in the Italian equation was essentially equal to zero in free estimation, and the coefficient a_2 was therefore increased to an arbitrary small positive value. PROFR is significant only in the Japanese, the U.K. and Italian equations (Table 4), whereas, in the previous version of the model (Table 7c), it was significant in the investment equations for all countries except the United States. Direct cyclical (IFU) effects, beyond what is implicitly captured by QBSTAR (17), are present for all countries except the United States, although those for Japan and Italy disappear in the long run. Previous problems of significant first-order serial correlation in the U.S. and Japanese equations are no longer present. For Canada a Cochrane-Orcutt correction is required. The three equations where PROFR is significant (Japan, United Kingdom, Italy) are those with the lowest initial effect of desired capital stock; thus short-term profitability considerations appear to compete with longer-term expected output and relative factor price effects in these cases.

Median and mean lags (in semesters) are as follows (18):

Speed of adjustment of capital stock

	Median lag	**Mean lag**
United States	6	n.a.
Japan	11	15
Germany	19	30
France	9	13
United Kingdom	24	35
Italy	28	39
Canada	11	14

In all cases, capital stock adjustment is slower than labour input adjustment, although for Japan the difference is small. The most rapid adjustment occurs in the U.S. equation, followed by the French, Canadian and Japanese equations.

The U.S. mean lag is not available because it is the only equation which overshoots its long-run equilibrium (by up to 21 per cent in the 35th period). Every effort was made to minimize this overshooting. It begins in the 17th semester and may therefore not be too serious, since we rarely simulate beyond that horizon. Finally, a large number of dummy variables were required (19), (20).

c) Energy demand equations (Table 5 and Chart 7)

In contrast with the other factor demand functions, in theory, business energy use (ENBV) can be adjusted to its "optimal" level (EBSV) without delay. EBSV is the energy input required by the existing and partially retrofitted vintage capital stock, when this vintage capital stock is used at its normal level. It is defined by the cost-mininmizing relationship between energy and capital. However, actual energy demand may deviate from required energy inputs because of abnormal factor utilisation rates. Hence, energy demand is specified as follows:

$$\ln\ (ENBV/ENBV(-1)) = a_1 \ln(EBSV/EBSV(-1)) + a_2\ \ln(IFU/IFU(-1)) + u$$

This is similar to the previous specification of the energy demand equation, but it allows for lags. Whereas an instantaneous response of actual energy demand to changes in energy requirements was imposed in the previous version of the model, the new equation allows ENBV to adjust gradually to its desired level. This arises not because of the usual adjustment lags, which are excluded in the theoretical development of the model, but in response to the cost-minimizing definition of the vintage business energy requirements. EBSV depends on the expected price of business energy relative to the user cost of capital (PENB/UCC). In the supply block, we assume static expectations for this ratio. But, if relative price expectations are a function of current and past relative prices, ENBV would be a function of current and lagged EBSV. Finally, note that the old equation included a constant by mistake, so that actual and required energy demand were not equal in long-run equilibrium.

These modifications have improved the fit of the equations in all cases (see Chart 7). A comparison of Table 5 with Table 7d shows that serial correlation has been removed by the inclusion of lagged adjustment of relative price expectations. The IFU effect is now larger in all equations. Current EBSV effects are weaker except for the Japanese and U.K. equations where they remain unity: in the other equations, there is a gradual adjustment of ENBV to EBSV, with the impact effect of EBSV ranging from 0.62 in France to 0.88 in Italy. For these five countries, the weight of current relative factor prices in expectations formation is fairly large, although it remains significantly different from unity. In the Japanese and Canadian equations, dummy variables had to be included. The Canadian shift is likely due to the shifting of energy-intensive activities to Canada, especially by multinational corporations, in order to take advantage of the low domestic energy prices during this period. The Japanese dummy may be due to energy-saving technical progress not allowed for in our Harrod-neutral approach. Finally, the U.K. equation has been purged of a negative trend influence which implies unexplained energy-saving.

VI. ENERGY PRICE EQUATIONS

In the previous version of the supply block, PENB was a weighted average of the price of imported energy in local currency (PME) and of the price of domestically produced and consumed energy (PDE), with weights ß (a proxy for the import share of domestic energy consumption) attached to PME and (1-ß) to PDE. This specification produced serious data problems because PDE could not be updated regularly. Besides, this equation imposed a large effect of foreign prices on domestic prices: ß was almost equal to one for several countries resulting in an immediate reaction to foreign prices and, in the long run, ß was equal to unity in all cases. The old specification also neglected the role of both taxes and domestic value added in energy price determination.

A more general form of the equation was therefore specified, allowing for effects from imported energy prices, domestic price influences and tax considerations (proxied by total net indirect taxes -- in the absence of energy-specific net indirect tax data -- divided by total domestic demand). The business sector value-added deflator (PGDPB) was chosen to represent domestic prices since it outperformed cost variables in econometric tests and because, contrary to alternative variables, PGDPB does not move directly with energy prices (21). This results in the following log-linear specification:

$$PENB = a(\Pi\, b_i PENB(-i))\ (\Pi\, c_i PME(-i))\ (\Pi\, d_i\ TAX(-i))\ (\Pi\, e_i PGDPB(-i))$$

Finally, a unit homogeneity constraint was imposed on the equation. The estimated long-term elasticities of PENB with respect to its arguments are as follows (22):

E	TAX	PGDPB
43	0.08	0.49
55	0.45	0.00
44	0.12	0.44
22	0.78	0.00
28	0.24	0.48
23	0.00	0.77
32	0.21	0.48
35	0.27	0.38

estimated long-run elasticity of PENB with respect to unity, and the average is about one-third. The taxes varies substantially across countries: the ranges from zero in Italy to 0.78 in France, with a Likewise, the long-run domestic price elasticity e Japanese and French equations to 0.8 in the Italian ge of 0.38 per cent. Finally, several equations are serial correlation of the residuals; thus, Durbin-h ignificantly different from zero.

TIVE PRICE EFFECTS ON FACTOR DEMANDS

relative price shock produces two effects: (i) a ulting in changes in optimal factor proportions; and lting in changes in levels of desired factor demands.

fect varies across countries as follows (23):

tive factor price elasticities

abour		Capital-Energy bundle	
el	Current model	Former model	Current model
	-0.27	-0.66	-0.47
	-0.09	-0.43	-0.22
	-0.27	-0.65	-0.46
	-0.23	-0.46	-0.50
	-0.27	-0.16	-0.50
	-0.13	-0.58	-0.50
	-0.26	-0.66	-0.39
	-0.22	-0.51	-0.43

The price elasticities for labour are fairly similar for five of the seven countries: only in the cases of Japan and, to a lesser extent, of Italy is this elasticity lower than -0.2 to -0.3, probably because of low values of the outer substitution elasticity (XTAU). In all countries, the own-price elasticity of the capital-energy bundle (relative to CKE, its dual cost) is larger than that of labour relative to its price WSSE/ELEFF.

On the other hand, given the parameters of the outer production function, the partial scale elasticity -- the elasticity of optimal labour demand and of optimal capital-energy demand relative to QBSTAR -- is equal to unity. However, the magnitude of the total scale effect is hard to determine. In order to assess this, simulations were undertaken. Three different shocks were administered to the model in single-country mode, using the standard version of INTERLINK when this work was undertaken, with and without the revised supply block: (i) a world energy price shock with fixed exchange rates and accommodatng money (increase PXED and PMED by 10 per cent); (ii) a wage-rate shock with fixed exchange rates and accommodating money (increase WR by 10 per cent); and (iii) a short-term interest-rate shock with fixed exchange rates (increase IRS by one percentage point). The results are given in Table 6.

With the new supply block, increases in energy prices yield weaker scale as well as substitution effects. The new specification of the PENB equations, allowing for an import-price elasticity of one-third -- rather than unity -- is responsible for smaller negative changes in energy demand. In the Japanese model, capital and energy are substitutes, as in the previous version of the supply block; in the Italian model this result appears with the new block. Thus, it is only in these two countries that the energy price shock has an expansionary effect on the capital stock. Finally, the employment effects show little change between the two versions of the block.

The wage shock produces weaker substitution effects in all countries except the United Kingdom; this reflects the new values for XTAU. The revised Japanese block has the weakest substitution effect of wages on labour demand. Despite the fact that the positive impact on KBSTAR is less than in the previous version -- except in the United Kingdom -- the substitution effects of the wage shock on the capital stock are larger than for labour; on the other hand, only in the Japanese model does the scale effect (negative) outweigh the substitution effect (positive) in capital demand. The expansion of energy use is now larger except for the Japanese and Italian models -- where energy and labour are substitutes -- and the German model in the long run.

Interest rate shocks have fairly similar real output effects with both versions of the block, except in the revised Japanese block where they are much smaller, whereas substitution effects have been reduced. As a result of the decline in the elasticities of substitution between labour and the capital-energy bundle, changes in KBSTAR and IBV are smaller. While the energy requirement (EBSV) decline is still very small, energy use is now reduced more substantially except in the German, U.K. and Italian blocks. Finally, employment changes, though less important than in the previous version of the model, are still fairly small.

In sum, the main results of these shocks are as follows:

(i) Substitution effects are weaker than in the previous version of the model, except in the case of the U.K. model, where XTAU is greater than before.

(ii) Changes in factor demands are less pronounced in the new version because changes in scale effects do not outweigh the reduction in substitution effects; once again the U.K. model is an exception in this respect.

(iii) Capital and energy are now substitutes in the Japanese and Italian models and complements elsewhere.

(iv) The wage shock has the biggest negative real output effect in the Japanese model as a result of a decline in the capital stock due to the low value of XTAU; in the new block this is only true in the Japanese case.

(v) The new specification of the energy price equations is responsible for a decline in the impact of energy price shocks on factor demands.

(vi) Interest rate shocks have similar real output effects in both versions of the block.

VIII. POTENTIAL OUTPUT

In the previous price block, the ratio of actual output (QBV) to normal output (QBSV) -- IFU -- was used as the proxy for excess demand. However, QBSV proved to be too cyclically sensitive, rendering IFU very insensitive to simulated shocks. Remember that QBSV is the output obtained through the production function with actual factor inputs used at "normal" intensity, and not potential output as such. As current levels of employment fluctuate largely with levels of activity, the main requirement in order to derive a measure of potential output that is less subject to cyclical influences is to define a level of potential employment. Potential employment (EPOT) is taken to be cost-minimizing labour demand based on the supply block production function, given the actual capital-energy bundle (KEBSV) and expected relative factor prices. It is therefore defined as:

$$\frac{EPOT}{ELEFF*KEBSV} = (CKELRA)^{XTAU}$$

where CKELRA is the expected relative factor price, taken to be an eleven-semester moving average of relative factor prices (24).

For the purposes of this definition, the labour efficiency index (ELEFF) has been modified for all countries except Germany and France. Indeed, while potential output depends largely on the path of the labour efficiency index, some large differences were revealed in all countries except Germany and France when measured (PIM) was compared to the modelled (ELEFF) values of this index (see Chart 2). Therefore, an alternative labour efficiency index (ELEFF2) was defined for these five countries. For the United States, the United Kingdom and Canada, the alternative index is identical to ELEFF until a first kink, at which point no further growth is allowed until a second kink, at which point growth resumes at 0.7 per cent per annum. The second kink has been set at 1983S1 for all three; the first kink is at 1973S2, 1979S2 and 1979S2 for the United States, the United Kingdom and Canada, respectively. For Japan, a steeper path (relative to ELEFF) of the efficiency index is assumed: a higher growth before OPEC 1, a more pronounced slowdown between 1973 and 1979, and a renewal of higher growth thereafter. Finally, in the case of Italy, zero labour efficiency growth was assumed between OPEC 2 and 1984. Growth rates of ELEFF and ELEFF2 are as follows:

Labour Efficiency Growth

	1966S2-1973S1		1973S1-1979S1		1979S1-1983S1		1983S1-1988S2	
	ELEFF	ELEFF2	ELEFF	ELEFF2	ELEFF	ELEFF2	ELEFF	ELEFF2
USA	1.0	1.0	1.0	0.0	1.0	0.0	1.0	0.7
JAP	4.7	7.7	2.9	2.2	2.1	2.6	1.7	2.6
GER	3.6	n.a.	2.5	n.a.	2.0	n.a.	1.7	n.a.
FRA	5.2	n.a.	2.8	n.a.	2.0	n.a.	1.5	n.a.
UKM	1.3	1.3	1.1	1.1	1.0	0.0	1.0	0.7
ITA	4.5	4.5	2.8	2.8	2.1	0.0	1.7	1.4
CAN	1.8	1.8	1.3	1.3	1.2	0.0	1.1	0.7

However, without any further constraint, EPOT might imply an unreasonably low or even negative rate of unemployment. This was, in fact, the case in recent years for all countries. Therefore, the cost-minimizing level of employment was bounded by a maximum feasible employment. This was proxied by a minimum unemployment rate -- provided by the Desks in the Department's Country Studies Branch -- which ranged from 2 per cent in Japan to 5 per cent in Canada. The need for such a labour constraint might nevertheless be consistent with the cost-minimizing definition of potential employment, since the existing capital stock might be greater than its cost-minimizing level, implying chronic excess capacity (Hall, 1986). Indeed, according to the recent industrial organisation literature (Krugman, 1986), excess capacity might be crucial for ensuring monopoly power.

The resulting potential output growth rates and implied capacity utilisation rates (IFU2) are graphed in Chart 8 together with the current IFU. In general, actual output exceeded estimated potential for all the countries, at least until the first oil shock. The gap in the current period is less pronounced than that implied by IFU. Finally, potential output growth is quite smooth and close to the figures presented by the IMF (Adams *et al.*, 1987) in a recent study. The IMF estimates of potential output for the major seven are based on:

i) the estimation of a Cobb-Douglas production function with two factors (labour and capital) and a time trend as a proxy for total factor productivity. Factor inputs are cyclically adjusted to take into account labour hoarding and capacity utilisation.

ii) The estimation of a natural rate of unemployment: this is the rate prevailing when actual and expected inflation are equal and cyclical factors are absent. Hence, it is the unemployment rate towards which the economy will converge in the absence of stocks.

iii) Potential output determination is based on the estimated production functions, with potential inputs, the factor inputs which prevail when unemployment is at its natural rate.

Actual historical and IMF and OECD forecast of potential output growth over the period 1966-86 are given below:

Potential Output Growth
(average annual growth rates in percentages)
and rates of capacity utilisation (25)

	1966-73				1974-85				1986-88			
	IMF		OECD(26)		IMF		OECD		IMF		OECD	
	pog*	capu**	pog	capu	pog	capu	pog	capu	pog	capu	pog	capu
U.S.	3.4	1.03	3.8	1.08	2.3	0.98	2.9	0.97	2.7	0.99	3.2	0.95
Japan	8.5	0.99	9.7	1.02	3.8	0.97	3.8	0.99	3.6	0.98	4.2	0.97
Germany	4.3	0.98	4.0	1.01	1.9	0.99	2.4	1.00	2.6	0.96	2.7	0.96
France	5.4	0.98	6.0	1.01	2.2	0.99	2.8	0.98	2.8	0.98	2.4	0.95
U.K.	2.8	0.98	1.9	1.03	1.1	1.00	1.7	0.99	2.2	1.00	1.9	1.00
Italy	5.1	0.99	6.3	1.01	2.2	1.00	2.1	0.99	2.6	0.94	3.0	1.00
Canada	5.2	0.98	4.9	1.01	2.9	0.99	4.1	1.00	3.0	0.95	2.9	0.97

* potential output growth; ** rates of capacity utilisation

For the first sub-period, the IMF and OECD figures on potential output growth are fairly similar, except for the United Kingdom, where the OECD figure is significantly lower, and for Japan and Italy, where the opposite occurs. On the other hand, the OECD potential output growth rates exceed the IMF estimates on average over the second period, probably due to the fact that the scrapping rate was arbitrarily increased after each of the two oil shocks in the IMF calculations. Only for Japan and Italy do both studies give similar results. For 1986-88, while the OECD is relatively optimistic concerning the Japanese projections -- largely because of a strong labour efficiency growth assumption (about 2.6 per cent per annum) -- as well as the U.S. outlook, both the IMF and the OECD provide similar forecasts for the other major countries.

In general, the rates of capacity utilisation derived from the OECD estimates are greater than the IMF's in the historical period, especially prior to the first energy shock. Moreover, in all countries except the United States, the IMF figures suggest that this rate is less than unity, thereby supporting the idea of chronic excess capacity. However, while the OECD estimates show higher levels of capacity utilisation for the first sub-period, the IMF and the OECD give similar results for 1974-85. Finally, both sets of forecasts for 1986-88 indicate that there is significant "room for manoeuvre" in Germany and Canada, in the sense that output might grow faster than forecasted without risks of increasing inflation. For the other major countries there is also evidence of some gap, except for the United Kingdom and perhaps for Italy.

IX. PROPOSALS FOR FUTURE RESEARCH

There are a number of outstanding issues concerning the revised supply blocks for the seven major countries, as well as the development of supply-side modelling for the other OECD countries. One possibility is to implement a simplified version of the supply block for some of the other OECD countries, since for many countries capital stock series are now available. A two-factor production function could be envisaged, in which technical progress would be proxied by time trends -- instead of the more sophisticated catch-up hypothesis.

The production function parameters will be re-estimated on the basis of a new data set (updated until 1985) with substantially revised data for energy prices and volumes (27). An improved user costs of capital variable (UCC) would also be desirable. While the UCC identity is coded to include corporate tax considerations, there are currently no such data in the model. More generally, the whole approach to the estimation of the parameters of the production function and the labour efficiency index needs to be examined with a view to its possible simplification as well as to the question of embodiment of technical progress in the capital stock (already rejected in Helliwell et al., 1986). Most importantly, in the medium term a way must be found to eliminate the dual versions of the labour efficiency index in the model. In addition, some theoretical and empirical basis for the minimum unemployment rate term in the calculation of potential output growth must be found. A promising approach would be to derive estimates of the natural rate from a reduced-form equation of the unemployment rate, as was done by Adams et al., (1987).

Some further changes to the IFU equation concerning the consistency of the block might be implemented. Indeed, if in equilibrium normal output failed to grow at the same rate as normal stocks, i.e. if the QBSV balanced growth rate were to be different from the NIG growth rate, the demand term ((QBV-ISKV+NIG)/QBSV) and consequently IFU, might deviate permanently from unity. In other words, the equilibrium stock/output ratio resulting from the equation -- the one ensuring that IFU is equal to unity in equilibrium -- might not be equal to the equilibrium stock/output ratio along the balanced growth path. The former varies with real interest rates, output itself and time trends, and is consistent (by definition) with a unitary IFU, whereas the latter, as said before, may imply permanent deviations of IFU from unity. In order to overcome this inconsistency, normal inventory growth could be redefined so as to equalise the growth rates of normal stocks and normal output; this would force the stock/output ratio to be constant along the balanced growth path. On the other hand, an alternative way of dealing with this problem might be to estimate an explicit inventory equation, based perhaps on a production smoothing model (28).

As regards the labour and capital inputs for the major countries, the idea that the intensity of their utilisation is identical for the two factors is one which warrants further investigation. To deal with this issue, some statistical research on sources and data on average hours worked would need to be undertaken.

The pair of equations for the simultaneous estimation of employment and investment does not currently estimate the profitability parameter nor the equilibrium output growth horizon in the implicit planned output identity. Despite potential convergence problems, these parameters should be estimated, whereas they are currently imposed at 0.3 and four semesters, respectively for all countries. Moreover, as suggested by Nadiri and Rosen (1969), cross effects could be included in these equations: deviations of actual employment from its desired level might influence investment demand, and deviations of the actual capital stock from its desired level could affect labour demand decisions.

A third possible improvement of capital -- and eventually labour -- equations is related to uncertainty. The link between investment and uncertainty might be captured through the inclusion of a competitiveness term (to include exchange rate uncertainty) and/or of a proxy for the uncertainty of profits (such as a moving variance of PROFR) in the capital stock equations. As suggested in a recent article by Malinvaud (1986), expected profitability might be supplemented by a measure of uncertainty about future sales; such a measure may be obtained from business surveys or surveys of investment intentions.

NOTES

1. For every pair of values for the retrofitting parameter (XR1) and the inner elasticity of substitution (XSIGMA), we can generate a "business energy requirement" (EBSV). We choose the pair (XR1, XSIGMA) which maximizes the fit of an equation which determines actual business energy demand (ENBV), given EBSV.

2. PIM is defined by inverting the production function with actual output (QBV) as follows:

$$PIM = (QBV^{-r} - XOGAMA.KEBSV^{-r})^{1/r}/ETB.$$

where XOGAMA is a scale parameter, KEBSV the vintage capital-energy bundle, ETB employment and r is equal to one minus the inverse of the outer elasticity of substitution (XTAU).

3. Because the Japanese ELEFF series showed what was thought to be an excessive rate of deceleration, a larger catch-up coefficient was imposed at a value one standard error higher than its freely estimated value. This problem was again encountered when the question of potential output was broached. See below Section VI.

4. In general, the whole sample period was used for estimating the production function parameters. However, in such estimations the outer elasticity of substitution proved to be fairly small for Japan and Canada (about 0.3 in each case). In order to test the robustness of these results, the production function structure was estimated for these two countries over a sample period which excluded the 1960s. As a result, the Canadian outer elasticity of substitution increased substantially to 0.64, and this value was retained in the new version of the model. On the other hand, in the case of Japan, the preliminary value of XTAU proved to be very robust to changes in the sample period.

5. See Artus and Peyroux (1981), for example.

6. In the German, French and Japanese equations, problems were encountered with perverse coefficient estimates and/or sample mean values of NIG considerably greater than those of ISKV. In these cases, an autoregressive model of inventory change was estimated and NIG was defined as the predicted value of that equation.

7. As can be seen in Chart 4, the past behaviour of the stock/output ratio in some countries is very difficult to explain on *a priori* theoretical grounds. This is particularly true for the French ratio, which increases monotonically throughout the sample period.

8. No inflation effects were found in estimation, and this variable was deleted from Z.

9. Recent studies point to the possibility of inventories serving to smooth production in the face of randomly varying costs and profitability rather than demand, in which case production may be more variable than sales (see Blinder, 1986 and West, 1986).

10. The profitability effect in the previous model was generally regarded as too strong.

11. While the factor demand equations are inspired by the interrelated factor demand theory, they do depart from it in one major way: there are no explicit cross effects in either of the factor demand equations.

12. The (inverse) profitability variable CQB is defined as the ratio of costs to receipts and is normalised so that the sample mean of CQB is unity. The profit rate variable PROFR is defined as the ratio of profits (receipts minus costs) to gross capital stock at replacement cost.

13. Both the reduction relative to the old version of the model in the weight of actual output in planned output and the allowance for gradual adjustment mechanisms explain the decline in median lags in the labour demand equations.

14. Nevertheless, it would not be desirable to delete the IFU terms entirely, because they do strengthen the equilibration process of actual to normal output. For the same reason, an IFU term for Canada was retained, even though the effect is not observable at the beginning of the estimation period.

15. Note that the constant term in the labour demand equations can be interpreted as the difference between desired and actual employment. Indeed, the sample mean of the CQB and IFU terms are zero, and consequently the average of the ratio of actual to desired employment is equal to the exponential of the constant term. In all the countries, with the exception of Japan, the estimated constant is negative, although often insignificant.

16. PROFR is the ratio of current profits to the capital stock at replacement costs, whereas Tobin's q is equal to the market value of the aggregate firm divided, once again, by the capital stock at replacement costs.

17. $QBSTAR = QBV^{w} \cdot QBSV^{(1-w)} \cdot LFG^{4} \cdot (PQB/CKEL)^{0.3}$, where LFG is the average semi-annual growth of the labour force in efficiency units over the preceding five years; PQB is the business sector gross output deflator; CKEL is the cost dual coming out of the production structure; and w is an estimated parameter. It can be rewritten as $QBSTAR = QBSV \cdot IFU^{w} \cdot LFG^{4} \cdot (PQB/CKEL)^{0.3}$

18. Median and mean lags could be derived from the old investment equations, where no error correction term, as such, was present.

19. Despite the use of these dummy variables, some of the equations -- especially those for Japan and the United Kingdom -- still track poorly (see Chart 6), as is generally the case for investment equations. We hope that future work on investment and uncertainty, along the lines described below, will contribute to the improvement of the fit of these equations.

20. As in the employment equations, the constant term can be regarded as the difference between desired and effective capital stock. In all countries except the United States, the constant term is positive and insignificant.

21. Eventually, the deflator for value-added in the domestic energy sector (which was added to the model after this work was completed) will be added to the list of regressors.

22. In the French and Italian equations, the homogeneity constraint was not supported by the data. Instead of imposing such a constraint and re-estimating, the estimated parameters were reduced in proportion. Two possible reasons why homogeneity may not be observed are as follows: (1) the inability of market forces to compete away monopoly profits in the energy sector in the short run in a period of rising energy prices; (2) a tendency for net indirect taxes on energy to have increased more quickly than in aggregate.

23. The own-price elasticities of labour demand (e_L) and of the capital-energy bundle (e_k) are as follows:

$e_L = -XTAU*MPK^{1-XTAU}$ where MPK is the marginal product of the capital-energy bundle

$e_k = XTAU*MPL^{1-XTAU}$ where MPL is the marginal product of labour.

The sum of e_L and e_K is the outer elasticity of substitution.

24. CKELRA was taken to be an eleven-semester moving average of relative factor prices by analogy with the definition of planned output. QBSTAR is, among other things, a function of the average semi-annual growth rate of the labour force in efficiency units over the preceding ten semesters. This is about the length of an average business cycle in the OECD area.

25. In both the IMF and the OECD calculations the gap is the ratio of a measure of actual business output to potential output; the OECD business output measure includes energy consumption, while the IMF study uses business value added and thus does not include energy consumption. However, for 1986-88, given that no business value added -- and consequently no gap -- was forecasted by the IMF, a gap was nevertheless obtained through the IMF projections for GDP. The OECD data for the 1986-88 period are based on internal projections done during the course of <u>Economic Outlook 41</u>.

26. Concerning the OECD calculations, the Japanese and Canadian data begin in 1971, the French in 1968 and the British and Italian in 1967.

27. It is hoped that the new energy data will resolve homogeneity problems encountered in the French and Italian energy price equations.

28. An alternative approach would be to rewrite the IFU equation with the stock/output ratio as the dependent variable, as follows:

$$\frac{STOCKV}{QBSV} = \exp\{f\} - \frac{QBV-STOCKV}{QBSV} + u$$

where f contains the same set of explanatory variable as in the IFU equation, namely profitability, normal sales and actual and equilibrium stock/output ratios. Normal sales might incorporate a proxy for normal inventory growth compatible with equilibrium stock/output ratios along the lines explained above. By setting normal inventory growth equal to the product of the growth rate of QBSV times STOCKV(-1), normal inventories would be forced to grow at the same rate as QBSV.

REFERENCES

Adams, C., P.R. Fenton and F. Larsen (1987), "Potential output in the major industrial countries", IMF Staff Studies for the World Economic Outlook, forthcoming.

Artus, P. and C. Peyroux (1981), "Fonction de production avec facteur energie", Annales de l'INSEE, No. 44, octobre-décembre, pp. 3-39.

Artus, P. (1983), "Capital, energy and labour substitution: The supply block in OECD medium-term models", OECD/ESD Working Paper No. 2.

Baumol, W.J. (1986), "Productivity growth, convergence, and welfare: What the long-run data show, American Economic Review, 76(5), December, pp. 1072-1085.

Blinder, A. (1986), "Can the production smoothing model of inventory behaviour be saved?", Quarterly Journal of Economics, Vol. CI, No. 3, August, pp. 431-453.

Chan-Lee, J.H. (1986), "Pure profit and Tobin's q in nine OECD countries", OECD Economic Studies, No. 7, Autumn, pp. 205-232.

Coen, R.M. and B.G. Hickman (1970), "Constrained joint estimation of factor demand and production functions", Review of Economics and Statistics, No. 52(3), August, pp. 287-300.

Hall, R. (1986), "Chronic excess capacity in U.S. industry", National Bureau of Economic Research Working Paper No. 1973.

Helliwell, J.F. (1986), "Supply-side macro-economics", Canadian Journal of Economics, 19 (4), November, pp. 597-625.

Helliwell, J.F. (1987), "Some comparative macroeconomics of the United States, Japan, and Canada", Conference on U.S. - Canadian Trade and Investment with Japan, University of Michigan, Ann Arbor, April.

Helliwell, J.F. and A. Chung (1986), "Aggregate output with variable rates of utilization of employed factors", Journal of Econometrics, 33(1/2), October/November, pp. 285-310.

Helliwell, J., P. Sturm, P. Jarrett and G. Salou (1986), "The supply side in the OECD's macroeconomic model", OECD Economic Studies, No. 6, Spring, pp. 75-137.

Jorgenson, D.W. (1963), "Capital theory and investment behaviour", American Economic Review, 53(2), May, pp. 247-259.

Krugman, P. (1986), "Industrial organisation and international trade", National Bureau of Economic Research Working Paper No. 1957.

Malinvaud, E. (1986), "Jusqu'où la rigueur salariale devrait-elle aller?", Revue Economique, No. 2, mars, pp. 181-205.

Nadiri, M.I. and S. Rosen (1969), "Interrelated factor demand functions", American Economic Review, 59(4), September, pp. 457-471.

Pindyck, R. (1979), "Interfuel substitution and the industrial demand for energy: an international comparison", Review of Economics and Statistics , 61(2), May, pp. 169-179.

West, K. (1986), "A variance bounds test of the linear quadratic inventory model", Journal of Political Economy, 94(2), April, pp. 374-401.

GLOSSARY

CKE	Dual cost, capital-energy (C.E.S. inner function)
CKELRA	Expected relative factor price (labour relative to capital-energy)
CQB	Business sector inverse profitability variable
EBSTAR	Optimal business sector employment
EBSV	Business sector energy requirement
ELEFF	Modelled labour efficiency index
ELEFF2	Alternative modelled labour efficiency index
ELEFUS	U.S. modelled labour efficiency index
ENBV	Energy used by business sector
ETB	Business sector employment
EPOT	Potential employment
IBV	Gross fixed investment by the business sector, volume
IFU	Intensity of factor utilisation, index
ISKV	Inventory change, volume
IRLRE	Expected long-term real interest rate
KBSTAR	Optimal business sector fixed capital stock, volume
KBV	Business sector fixed capital sstock, volume
KEBSV	Vintage capital-energy bundle (C.E.S. inner function), volume
LF	Labour force, total
MESV	Imports of energy, volume
MGSV	Imports of goods and services, volume, N.A. basis
NIG	Normal inventory growth
NQBV	Normal demand
PDE	Price of domestically produced and consumed energy
PENB	Deflator for energy used by business sector
PGDPB	Deflator for business value added
PIB	Deflator for business fixed investment
PIM	Observed labour efficiency index
PME	Price of imported energy in local currency terms
PMED	Price of imported energy in dollar terms
PQB	Deflator for business gross output
PROFR	Profit rate
PXED	Price of exported energy in dollar terms
QBSTAR	Business sector planned gross output, volume
QBSV	Normal business sector gross output, volume
QBV	Business sector gross output, volume
RSCRB	Business sector scrapping rate of fixed capital
SALES	Final sales, (final domestic demand plus exports)
STOCKV	Total stock, volume
T	Time trend
TAX	Ratio of total net indirect taxes to total domestic demand
TIND	Indirect taxes
TSUB	Subsidies
UCC	User cost of capital

PARAMETERS

XR1	Retrofitting parameter
XIBETA	Energy scale parameter in the inner function
XIGAMA	Capital scale parameter in the inner function
XSIGMA	Elasticity of substitution between capital and energy
XTAU	Elasticity of substitution between labour and capital-energy bundle
XOBETA	Labour scale parameter in the outer function
XOGAMA	Capital-energy bundle scale parameter in the outer function

Table 1

PARAMETER VALUES OF THE AGGREGATE PRODUCTION FUNCTIONS

Country	OUTER CES FUNCTION						INNER CES FUNCTION							
	Elasticity of Substitution		Scale Parameters: Labour		Scale Parameters: Capital/Energy Bundle		Elasticity of Substitution		Retrofitting Parameter		Scale Parameters: Energy		Scale Parameters: Capital	
	XTAU		XOBETA		XOGAMA		XSIGMA		XR1		XIBETA		XIGAMA	
	Former Model	Current Model	Former Model	Current Model	Former Model	Current Model	Former Model	Current Model	Former Model	Current Model	Former Model	Current Model	Former Model	Current Model
United States	1.01	0.74	0.710	0.016	0.35	0.43	0.5	0.40	0.45	0.06	0.87	0.88	0.003	0.001
Japan	0.70	0.32	0.001	4E-11	0.31	0.85	0.8	0.95	0.68	0.15	0.77	0.80	0.109	0.173
Germany	0.99	0.73	0.597	0.013	0.34	0.48	0.5	0.40	0.29	0.31	0.82	0.79	0.005	0.002
France	0.80	0.72	0.048	0.012	0.38	0.38	0.8	0.58	0.16	0.30	0.86	0.85	0.053	0.009
United Kingdom	0.60	0.77	0.002	0.046	0.65	0.48	0.3	0.67	0.05	0.00	0.78	0.79	7E-5	0.038
Italy	0.80	0.64	0.019	2E-4	0.25	0.30	0.5	0.77	0.37	0.18	0.77	0.74	0.005	0.078
Canada	1.01	0.64	0.708	4E-3	0.35	0.68	0.9	0.40	0.05	0.00	0.89	0.84	0.065	4E-4
Mean	0.84	0.65					0.61	0.60	0.29	0.14				
Coefficient of Variation	0.18	0.22					0.33	0.33	0.73	0.84				
Coefficient of Variation excluding Japan	0.17	0.07					0.35	0.27	0.67	0.92				

Table 2

OUTPUT SUPPLY EQUATIONS

$$\ln(QBV/QBSV) = a_0 + a_1\ln(CQB) + a_2\ln(CQB(-1)) + a_3\ln(NQBV/QBSV) + a_4\ln(NQBV(-1)/QBSV(-1)) + a_5\ln(STOCKV(-1)/QBSV) + a_6\ln(STOCKV(-2)/QBSV(-1)) + a_7\ln(QBSV) + a_8\ln(QBSV(-1)) + a_9 IRLRE + a_{10}T + a_{11}\,1/T + a_{12}T^2 + u$$

Country Estimation period	USA S1 1961-S2 1983	JAP S1 1967-S2 1983	GER S1 1962-S2 1983	FRA* S2 1964-S2 1983	UKM S1 1964-S2 1983	ITA S2 1962-S2 1983	CAN S1 1961-S2 1983
a_0	-5.4222 (4.65)	-0.2203 (3.24)	-5.4559 (2.33)	-12.1677 (15.60)	1.5640 (1.60)	3.1646 (0.86)	0.5970 (1.70)
a_1	-0.1000 (2.41)	-0.0605 (0.96)		-0.1093 (2.73)			
a_2			-0.1512 (2.86)			-0.0836** (1.55)	-0.1920 (3.48)
a_3	0.8361 (10.29)	0.6967 (7.59)	0.7631 (8.85)	0.5390 (12.08)	0.8472 (9.69)	0.9392 (10.51)	0.5502 (5.75)
a_4	0.1584 (2.24)		0.1495 (1.73)		0.2637 (2.72)		0.4706 (4.07)
a_5	-0.1989 (4.78)	-0.4102 (4.59)	-0.2034 (3.32)	-0.0981 (4.07)			
a_6					-0.2346 (3.73)	-0.3074 (5.44)	-0.1354 (3.15)
a_7	0.1830 (4.61)		0.1913 (2.27)	0.4410 (i)	0.8472 (9.69)	0.3792 (1.90)	
a_8					-0.9166 (11.22)	-0.4960 (2.70)	-0.0307 (1.98)
a_9			-0.1031E-1 (1.63)			-0.0178E-2 (4.51)	
a_{10}		-0.4229E-2 (4.51)	-0.1668E-2 (2.04)	-0.2976E-2 (5.60)		0.6034E-2 (2.73)	
a_{11}		-3.8304 (5.83)	0.2651 (1.78)	1.7994 (7.31)	-0.5221 (2.87)	0.5515 (2.65)	-0.1076 (3.38)
a_{12}	-0.5263E-4 (3.89)						
<u>Regression Statistics:</u>							
$\bar{R}^2$	0.9933	0.9638	0.9122	0.9233	0.9569	0.9255	0.9765
SEE	0.0038	0.0052	0.0071	0.0047	0.0069	0.0094	0.0070
DW	1.45	1.97	2.10	2.02	2.00	1.60	1.93
Long run QBSV elasticity	0.39	0.71	0.48	1.00	0.05	0.25	0.08

* Also includes dummy variable with values of 1 in S1 1968 and -0.48 in S2 1968 with coefficient -0.0182 (t = 4.10).

** The inverse profitability term is lagged two periods.

(i) Coefficient imposed.

Table 3

BUSINESS EMPLOYMENT EQUATIONS

$$\ln(ETB) = a_0 + a_1\ln(ETB(-1)) + a_2\ln(ETB(-2)) + (1-a_1-a_2-a_3-a_4)\ln(EBSTAR) + a_3\ln(EBSTAR(-1))$$
$$+ a_4\ln(EBSTAR(-2)) + a_5\ln(CQB(-i)) + a_6\ln(CQB(-i-1) + a_7\ln(IFU(-j)) + a_8\ln(IFU(-k)) + u$$

Country	Estimation Period	Estimated Coefficients (t-statistics)											Regression statistics		
		a_0	a_1	a_2	$1-a_1-a_2-a_3-a_4$	a_3	a_4	a_5	a_6	a_7	a_8	W	$\bar{R}^2$	SEE	DW (h)
United States i=j=1,k=2	1962S1-1983S2	-0.0028 (1.74)	1.2556 (11.93)	-0.3496 (3.39)	0.6815	-0.9764 (8.74)	0.3889 (3.41)	-0.1870 (2.97)	0.1870 (i)	0.1527 (2.21)	-0.1175 (1.72)	0.3634 (i)	0.9991	0.0039	2.04 (-0.18)
Japan	1970S1-1983S1	0.0017 (0.28)	0.9827 (23.96)		0.4105	-0.3932 (5.33)						0.3700 (2.76)	0.9851	0.0042	2.10 (-0.49)
Germany i=0, j=1	1968S2-1983S2	-0.0025 (0.93)	0.9761 (27.15)		0.2667		-0.2428 (4.63)	-0.1220 (7.50)		0.0824 (2.44)		0.4698 (5.87)	0.9920	0.0032	1.86 (0.35)
France j=0, k=2	1966S1-1983S2	-0.0043 (3.07)	1.1977 (10.33)	-0.2443 (2.21)	0.2919	-0.2453 (3.28)				0.0390 (1.12)	-0.0390 (i)	0.3401 (2.43)	0.9570	0.0030	1.76 (0.71)
United Kingdom i=2, j=1	1967S1-1983S2	-0.0159 (7.84)	0.7260 (18.68)		0.4692	-0.1952 (2.07)		-0.0524 (6.55)		0.0787 (3.49)		0.3944 (3.83)	0.9860	0.0040	1.91 (-0.15)
Italy j=1	1966S2-1983S2	-0.0046 (1.01)	0.9462 (20.66)		0.4968	-0.4430 (6.72)				0.0289 (0.89)		0.1626 (1.74)	0.8541	0.0063	1.88 (0.34)
Canada(a) j=1	1967S1-1983S2	-0.1152 (9.83)			0.7280	0.2720 (5.18)				0.2110(b) (2.84)		0.4418 (6.19)	0.9976	0.0061	2.06

(i) Coefficient imposed.

a. Equation includes a first-order autocorrelation coefficient of 0.9079 (19.48)

b. Coefficient interacts with dummy variable equal to unity beginning in 1975S2.

Table 4

Business fixed investment equations

$$IBV = 2(KBV-(1-RSCRB/200)*KBV(-1))$$

$$\ln(KBV) = a_0 + a_1\ln(KBV(-1)) + (1-a_1-a_2-a_3)\ln(KBV(-2)) + a_2\ln(KBSTAR) + a_3\ln(KBSTAR(-1)) + a_4PROFR(-i) + a_5\ln(IFU(-j)) + a_6\ln(IFU(-k)) + u$$

Country	Estimation Period	a_0	a_1	a_2	a_3	a_4	a_5	a_6	W	$\bar{R}^2$	SEE *Mean (KBV/IBV)	DW (h)
		Estimated Coefficients (t-statistics)							Regression Statistics			
USA	1962S1-1983S2		1.9138 (178.6)	0.0894 (16.11)	-0.0865 (14.20)				0.3634 (i)	.999992	.0093	1.94 (0.15)
JAP i=2,j=0 k=2	1970S1-1983S2	0.0143 (3.42)	1.5159 (12.22)		0.0311 (2.42)	0.0633 (2.11)	0.0428 (1.68)	-0.0428 (i)	0.3700 (2.76)	.999893	.0245	1.86 (0.01)
GER j=2	1968S2-1983S2	0.0054 (15.50)	1.6244 (83.33)	0.0655 (9.56)	-0.0555 (i)		0.0143 (3.61)		0.4698 (5.87)	.999993	.0073	1.34 (1.41)
FRA j=0	1966S1-1983S2	0.0050 (4.67)	1.6451 (28.82)	0.0641 (4.81)	-0.0432 (2.88)		0.0367 (3.42)		0.3401 (2.43)	.999988	.0089	1.76 (0.68)
UKM i=0,j=1	1967S1-1983S2	0.0071 (4.13)	1.5167 (14.34)	0.0132 (2.43)		0.0325 (3.09)	0.0150 (2.93)		0.3944 (3.83)	.999957	.0187	2.04 (-0.14)
ITA i=2,j=0, k=1	1966S2-1983S2	0.0067 (4.47)	1.6705 (25.68)	0.0080 (i)		0.0259 (3.55)	0.0594 (7.69)	-0.0594 (7.69)	0.1626 (1.74)	.999979	.0120	1.89 (0.29)
CAN (a) j=2	1967S1-1983S2	0.0043 (3.86)	1.7341 (43.20)	0.0170 (4.45)			0.0061 (1.14)		0.4417 (6.19)	.999995	.0097	2.04 (-0.45)

(i) Coefficient imposed.

a. Equation also includes a first-order autocorrelation coefficient of -0.3918 (2.51).

Notes to Table 4: Country-specific variables

	Description	Non-zero values for dummy variables	Estimated Coefficient	t Value
United States	Dummy variables partly reflecting shifts in corporate tax rates and investment tax credits.	1.0 in 1965S1 and S2 and -1.0 in 1966S2, 1967S1, 1975S2 and 1976S1	0.0014	5.30
	Dummy variables to account for buoyant energy and defence-related sectors.	1.0 in 1981S1 and S2	0.0023	4.94
Germany	Dummy variable for improved business confidence due to continued and strong expansion.	1.0 in 1968S2-1971S2	0.0027	12.82
	Dummy variable for shifts in corporate tax rates on distributed and undistributed income.	1.0 in 1973S2-1979S1	-0.0009	6.32
	Dummy variable for a special business fixed investment grant.	1.0 in 1975S2	0.0011	3.05
	Dummy variable for a programme of incentives for energy-saving investment.	1.0 in 1978S2-1979S2	0.0006	2.65
France	Dummy variable for the events of 1968.	1.0 in 1968S1 and -0.7 in 1968S2	-0.0022	3.44
	Dummy variable for a new programme of price controls.	1.0 in 1975S2-1979S1	-0.0017	4.50
United Kingdom	Dummy variable for the postponement of corporate taxation on stock appreciation, and for the relaxation of price controls.	1.0 in 1974S1-1975S2	0.0016	2.67
	Dummy variable reflecting unusual strength in fixed investment in distribution services.	1.0 in 1982S1 and 0.5 in 1982S2	0.0045	5.39
Italy	Dummy variable to proxy the pattern of investment by public corporations which are not motivated by normal business goals.	1.0 in 1975S1-1976S1 and in 1977S2-1979S1	-0.0025	6.97
Canada	Dummy variable for increases in corporate taxation.	1.0 in 1967S1-1970S1	-0.0007	2.74
	Dummy variable for the profit margin controls under the Anti-Inflation Programme.	1.0 in 1976S1-1978S1 and 0.5 in 1975S2	-0.0020	9.50
	Dummy variable for incentives under the National Energy Programme.	1.0 in 1981S1-1981S2	0.0014	4.58

Table 5
Business energy demand equations

$$\ln(ENBV) = \ln(ENBV(-1)) + a_1\ln(ENBV(-1)/ENBV(-2)) + a_2\ln(ENBV(-2)/ENBV(-3))$$
$$+ (1-a_1-a_2-a_3)\ln(EBSV/EBSV(-1)) + a_3\ln(EBSV(-1)/EBSV(-2)) + a_4\ln(IFU/IFU(-1))$$
$$+ a_5\ln(IFU(-1)/IFU(-2)) + u$$

Country	Estimation Period	Estimated Coefficients (t-statistics)					Regression Statistics		
		a_1	a_2	a_3	a_4	a_5	$\bar{R}^2$	SEE	DW (h)
USA	1961S1-1983S2	0.3327 (2.85)			1.1675 (4.63)		0.9832	0.0246	1.98 (-1.30)
JAP*	1967S2-1983S2	0.5661 (5.73)	-0.5661 (5.73)		0.7033 (2.29)		0.9757	0.0252	1.83 (-0.09)
GER	1961S2-1983S2	0.3060 (2.82)			1.1820 (5.81)		0.9896	0.0220	2.04 (-0.27)
FRA	1965S1-1983S2	0.6200 (3.63)	-0.2395 (2.15)		1.7429 (6.28)	-1.0210 (2.30)	0.9877	0.0204	1.68 (1.15)
UKM**	1963S2-1983S2	0.2857 (2.85)	-0.2857 (2.85)		0.9976 (4.21)		0.9368	0.0234	2.13 (-0.93)
ITA	1962S2-1983S2	0.5168 (3.93)		-0.3949 (1.40)	1.0806 (5.16)	-0.9008 (4.04)	0.9886	0.0235	1.86 (0.81)
CAN***	1961S2-1983S2	0.6430 (5.34)	-0.4834 (4.31)		0.6139 (3.12)	0.5445 (2.52)	0.9974	0.0164	1.84 (-0.26)

* Equation also includes a dummy variable equal to unity for the period 1967S2-1975S1 and 1978S2-1980S2 with coefficient -0.0217 (3.82).

** Equation also includes a time trend (= 1 in 1963S2) with coefficient -0.6380E-3 (4.20).

*** Equation also includes a dummy variable equal to unity for the period 1977S1-1980S1 with coefficient 0.0149 (2.27).

Table 6

EFFECTS OF A 10% INCREASE IN THE WORLD PRICE OF ENERGY

(Fixed exchange rate, Accommodating money)
(Simulated-Baseline in %)

Variable	Year	United States		Japan		Germany		France		United Kingdom		Italy		Canada	
		Former	Revised	Former	Revised	Former	Revised	Former	Revised	Former	Revised	Former	Revised	Former	Revised
IBV	1	-0.3	-0.2	-0.2	-0.2	-0.7	-0.8	-0.8	-0.8	-0.8	-0.4	-0.2	-0.0	-0.2	-0.1
	2	-0.4	-0.8	-0.9	-0.5	-1.6	-1.6	-1.0	-1.3	-0.6	-0.7	-0.5	-0.1	-0.2	-0.4
	5	-0.3	-0.6	-1.6	-0.6	-3.7	-0.7	-1.7	-3.8	-0.7	-0.5	-0.9	-0.1	-0.4	-1.0
ETB	1	0.1	0.1	-0.0	-0.1	0.0	-0.1	-0.0	-0.1	-0.0	-0.1	0.1	0.0	-0.1	-0.1
	2	0.2	-0.1	-0.2	-0.2	-0.1	-0.4	-0.3	-0.3	-0.1	-0.2	0.1	-0.0	-0.3	-0.5
	5	0.1	-0.0	-0.3	-0.2	-0.6	-0.8	-0.9	-0.8	-0.4	-0.5	-0.1	-0.1	-0.4	-0.3
IFU	1	-0.1	-0.1	0.0	-0.2	-0.1	-0.2	-0.4	-0.2	-0.2	-0.2	-0.0	-0.0	-0.2	-0.2
	2	-0.1	-0.2	-0.2	-0.4	-0.2	-0.4	-0.4	-0.5	-0.2	-0.2	-0.1	-0.2	-0.3	-0.3
	5	-0.0	-0.1	-0.2	-0.3	-0.1	0.3	-0.2	-0.8	-0.2	-0.0	-0.2	-0.1	-0.2	-0.4
KBV	1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
	2	-0.0	-0.1	-0.1	-0.0	-0.1	-0.1	-0.1	-0.2	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
	5	-0.1	-0.2	-0.4	-0.2	-0.5	-0.3	-0.4	-0.8	-0.1	-0.1	-0.2	-0.0	-0.1	-0.1
QBV	1	-0.1	-0.1	-0.4	-0.3	-0.3	-0.3	-0.5	-0.3	-0.2	-0.2	-0.1	-0.0	-0.3	-0.2
	2	-0.2	-0.3	-0.9	-0.7	-0.6	-0.7	-0.9	-0.8	-0.4	-0.4	-0.3	-0.2	-0.6	-0.7
	5	-0.2	-0.2	-0.9	-0.8	-1.2	-0.6	-1.4	-1.8	-0.7	-0.5	-0.6	-0.2	-0.6	-0.6
ENBV	1	-1.7	-0.3	-5.9	-1.1	-2.3	-0.4	-2.0	-0.4	-0.3	-0.2	-2.7	-0.2	-0.4	-0.2
	2	-3.3	-0.7	-7.1	-2.8	-3.8	-1.2	-3.9	-1.3	-0.6	-0.3	-4.4	-0.8	-1.1	-0.6
	5	-3.4	-1.2	-9.3	-5.3	-5.3	-1.3	-6.5	-3.4	-1.5	-0.4	-5.6	-1.5	-2.7	-0.9

EFFECTS OF A 10% INCREASE IN THE WAGE RATE
(Fixed exchange rate, Accommodating money)
(Simulated-Baseline in %)

Variable	Year	United States		Japan		Germany		France		United Kingdom		Italy		Canada	
		Former	Revised	Former	Revised	Former	Revised	Former	Revised	Former	Revised	Former	Revised	Former	Revised
IBV	1	2.6	3.2	-1.9	0.5	-1.1	2.7	5.4	4.5	4.9	2.9	0.4	1.0	0.9	0.6
	2	4.9	7.8	-3.9	-2.6	-1.1	3.5	3.4	4.6	5.2	9.7	-0.1	-0.1	1.4	3.3
	5	5.9	6.9	-5.2	-5.8	-0.4	2.5	0.9	4.4	2.9	4.6	1.0	1.5	0.1	7.3
ETB	1	-0.3	-0.6	-0.8	-0.7	-1.6	-1.9	-0.5	-0.9	-0.4	-1.4	-0.4	-0.7	-1.2	-3.2
	2	-0.5	-0.3	-1.1	-0.8	-2.1	-2.5	-0.8	-1.1	-0.5	-1.1	-1.0	-1.0	-0.2	-2.1
	5	-1.2	-1.1	-1.7	-1.6	-3.3	-1.9	-2.0	-1.5	-1.9	-2.5	-2.0	-1.8	-0.4	-3.0
IFU	1	1.3	1.3	-0.2	0.5	0.8	1.0	1.2	0.2	1.5	2.5	0.1	0.5	0.9	2.7
	2	1.8	2.0	-0.5	0.1	1.2	1.6	0.5	0.5	1.0	2.7	-0.5	-0.5	1.8	3.3
	5	1.0	0.8	-0.2	-0.5	0.7	-1.2	0.2	0.4	0.5	0.7	0.0	0.3	0.1	1.4
KBV	1	0.1	0.2	-0.1	0.0	-0.0	0.1	0.3	0.3	0.1	0.1	0.0	0.1	0.0	0.0
	2	0.4	0.6	-0.4	-0.1	-0.1	0.3	0.6	0.7	0.3	0.4	0.0	0.1	0.1	0.2
	5	1.6	2.3	-1.5	-1.3	-0.1	1.2	0.9	1.7	0.8	1.3	0.1	0.3	0.2	1.2
QBV	1	1.1	0.9	-0.8	-0.1	-0.4	-0.4	0.9	-0.4	1.2	1.3	-0.2	-0.1	-0.0	0.2
	2	1.6	2.0	-1.3	-0.5	-0.4	-0.2	0.0	-0.2	0.7	1.9	-1.5	-1.5	1.6	1.6
	5	0.8	0.8	-1.9	-2.1	-1.9	-2.3	-1.2	-0.4	-0.9	-1.0	-1.9	-1.6	-0.2	-0.6
ENBV	1	0.4	1.8	1.6	1.1	0.7	1.7	0.6	0.8	0.6	2.8	0.9	0.7	0.0	2.7
	2	1.2	3.9	2.0	1.6	1.3	3.1	1.0	1.2	0.6	3.4	0.7	-1.4	0.1	6.2
	5	3.0	3.7	-0.1	-1.7	0.9	-0.5	1.6	1.7	0.7	1.7	-0.4	-3.5	0.2	3.2

EFFECTS OF A ONE PERCENTAGE POINT INCREASE IN THE SHORT-TERM INTEREST RATE
(Fixed exchange rate)
(Simulated-Baseline in %)

Variable	Year	United States		Japan		Germany		France		United Kingdom		Italy		Canada	
		Former	Revised	Former	Revised	Former	Revised	Former	Revised	Former	Revised	Former	Revised	Former	Revised
IBV	1	-0.3	-0.4	-0.9	-0.2	-0.5	-0.5	-0.5	-0.2	-0.6	-0.8	-0.5	-0.2	-0.3	-0.1
	2	-1.1	-1.8	-2.4	-1.1	-1.3	-1.2	-1.0	-0.6	-1.2	-1.9	-1.5	-0.9	-0.7	-0.4
	5	-2.2	-3.5	-5.1	-3.2	-3.8	-1.5	-2.3	-2.0	-2.0	-4.0	-4.0	-3.3	-2.1	-2.8
ETB	1	-0.1	-0.1	-0.1	-0.0	-0.1	-0.1	-0.1	0.0	-0.1	-0.0	0.0	0.0	-0.1	0.0
	2	-0.4	-0.4	-0.3	-0.1	-0.3	-0.3	-0.1	0.0	-0.2	-0.1	-0.1	0.0	-0.2	-0.1
	5	-0.3	-0.4	-0.5	-0.2	-0.7	-0.8	-0.3	0.0	-0.3	-0.3	-0.1	0.0	-0.3	-0.1
IFU	1	-0.2	-0.1	-0.3	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	0.0
	2	-0.5	-0.4	-0.6	-0.3	-0.1	-0.2	-0.2	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.2
	5	-0.5	-0.4	-0.8	-0.6	0.1	0.4	-0.3	-0.3	-0.1	-0.2	-0.5	-0.7	-0.4	-0.5
KBV	1	0.0	0.0	-0.1	-0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	-0.1	-0.1	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0
	5	-0.5	-0.8	-1.2	-0.7	-0.5	-0.3	-0.4	-0.4	-0.3	-0.5	-0.7	-0.5	-0.3	-0.3
QBV	1	-0.3	-0.2	-0.5	-0.1	-0.2	-0.1	-0.2	-0.1	-0.2	-0.1	-0.1	0.0	-0.4	0.0
	2	-0.8	-0.7	-0.8	-0.4	-0.3	-0.4	-0.4	-0.1	-0.3	-0.3	-0.3	-0.2	-0.4	-0.3
	5	-0.9	-1.0	-1.5	-0.9	-0.6	-0.3	-0.7	-0.4	-0.5	-0.6	-0.7	-0.8	-0.6	-0.6
ENBV	1	0.0	-0.2	-0.1	-0.1	0.0	-0.1	0.0	-0.1	0.0	-0.1	0.1	0.0	0.0	0.0
	2	0.0	-0.7	-0.2	-0.2	0.0	-0.2	0.0	-0.1	-0.1	-0.3	0.3	0.0	0.1	-0.3
	5	-0.1	-1.2	-0.7	-0.4	0.1	0.8	0.2	-0.2	-0.1	-0.5	0.8	0.8	0.4	-0.8

Table 7 Previous supply block equations

Table 7a Output supply equations

$$ln(QBV/QBSV) = a_0 + a_1\, ln(CQB) + a_2\, ln((SALES - a_4(MGSV\text{-}MESV))/QBSV) + a_3\, ln(STOCKV(-1)/QBSV)$$

Non-linear estimation: *2SLS*

	Estimated coefficients (t statistics)						Regression statistics		
	a_0	a_1	a_2	a_3	a_4	Sample	R^2	DW	SEE
United States	−0.08 (−94.0)	−0.30 (−20.0)	0.96 (i)	−0.05 (i)	0.25 (i)	60S2-82S2	0.98	0.9	0.0055
Japan	−0.21 (−3.4)	−0.25 (−10.3)	0.75 (i)	−0.20 (−3.9)	1.00 (i)	66S1-82S2	0.96	0.7	0.0096
Germany	−0.14 (−1.1)	−0.15 (−1.6)	0.93 (7.1)	−0.14 (−1.3)	0.93 (9.3)	60S2-82S2	0.84	0.9	0.0112
France	−0.12 (−4.0)	−0.24 (−9.0)	0.83 (13.2)	−0.04 (−4.4)	0.40 (3.0)	63S2-82S2	0.94	1.1	0.0060
United Kingdom	−0.15 (−1.5)	−0.13 (−2.4)	0.70 (i)	−0.09 (−0.9)	0.44 (2.8)	63S2-82S2	0.76	0.7	0.0144
Italy*	−0.13 (−22.9)	−0.11 (−4.9)	0.71 (13.4)	−0.05 (i)	1.00 (i)	61S1-82S2	0.85	0.6	0.0123
Canada	−0.26 (−6.2)	−0.32 (−11.2)	0.64 (27.7)	−0.12 (−3.6)	0.25 (i)	60S2-82S2	0.96	1.3	0.0077

(i) Coefficient imposed

a) The Italian equation was actually estimated and these are the results which are given for $a_4 = 0.25$. it was only at the last minute that $a_4 = 1$ was imposed, but no further estimation was subsequently undertaken

Table 7b Business employment equations

$$ln(ETB/ETB(-1)) = a_0 + a_1\, ln(EBSTAR/EBSTAR(-1)) + a_2\, ln(EBSTAR(-1)/ETB(-1)) + a_3\, ln(CQB) + a_4\, ln(IFU) + u$$

	Estimated coefficients (t statistics)						Regression statistics		
	a_0	a_1	a_2	a_3	a_4	Sample	R^2	DW	SEE
United States	−0.01 (−2.8)	0.60 (7.7)	0.20 (3.5)	–	0.09 (2.6)	66S1-82S2	0.77	1.4	0.0055
Japan	–	0.28 (5.2)	0.02 (4.2)	–	–	66S2-82S2	0.38	2.1	0.0049
Germany	−0.01 (−4.4)	0.23 (4.3)	0.13 (3.6)	−0.15 (−6.5)	0.15 (5.3)	66S1-82S2	0.89	1.6	0.0031
France	−0.01 (−3.6)	0.29 (5.2)	0.14 (3.9)	–	0.06 (2.1)	66S1-82S2	0.54	1.8	0.0033
United Kingdom	−0.02 (−4.0)	0.23 (3.9)	0.23 (3.2)	−0.04 (−3.4)	0.06 (1.1)	67S1-82S2	0.80	2.0	0.0045
Italy	−0.1 (7.0)	0.29 (2.8)	0.10 (i)	–	0.10 (i)	67S1-82S2	0.25	1.5	0.0089
Canada	0.00 (0.5)	0.40 (5.0)	0.01 (0.1)	–	0.15 (1.4)	66S1-82S2	0.74	1.2	0.0080

(i) Coefficient imposed.

Table 7c Business fixed investment equations

$$ln(IBV/IBV(-1)) = a_0 + a_1\, ln(KBSTAR/KBSTAR(-1)) + a_2\, ln(KBSTAR(-1)/IBV(-1)) + a_3\, ln(KBSTAR(-1)/KBV(-1)) + a_4\, PROFR + a_5\, ln(IFU) + u$$

	Estimated coefficients (t statistics)							Regression statistics		
	a_0	a_1	a_2	a_3	a_4	a_5	Sample	R^2	DW	SEE
United States	−0.26 (−50.2)	0.74 (3.1)	0.10 (i)	–	–	0.15 (0.8)	66S1-82S2	0.64	0.8	0.026
Japan	−0.56 (−5.1)	0.19 (0.8)	0.28 (5.4)	–	0.97 (7.1)	0.16 (0.7)	66S2-82S2	0.75	1.1	0.029
Germany	–	0.26 (0.6)	4E-3 (1.3)	–	1.14 (2.7)	0.73 (2.6)	66S1-82S2	0.53	1.4	0.035
France	−0.73 (−3.2)	1.16 (3.5)	0.30 (3.2)	–	0.33 (2.0)	–	66S1-82S2	0.49	1.5	0.026
United Kingdom	1.44 (−2.7)	0.94 (3.4)	0.50 (2.7)	–	0.30 (i)	0.02 (0.1)	67S1-82S2	0.49	1.7	0.028
Italy	−0.60 (−3.5)	0.20 (0.9)	0.25 (3.6)	–	0.73 (4.0)	0.49 (1.8)	67S1-82S2	0.62	2.0	0.033
Canada	–	0.27 (1.2)	0.01 (2.0)	–	0.30 (i)	–	66S1-82S2	0.14	1.1	0.039

(i) Coefficient imposed

Table 7d Business energy demand equations

$$ln(ENBV/ENBV(-1)) = a_0 + a_1\, ln(EBSV/EBSV(-1)) + a_2\, ln(IFU/IFU(-1)) + u$$

Country	Estimation period	Estimated coefficients (t statistics)			Regression statistics			
		a_0	a_1	a_2	R^2	SEE	DW	RHO
United States	1960S2 1982S2	0.0009 (0.1)	1 (i)	0.19 (0.5)	0.35	0.023	1.7	0.50 (4.6)
Japan	1965S2 1982S2	−0.0025 (−0.3)	1 (i)	0.49 (1.1)	0.16	0.034	1.5	0.34 (2.2)
Germany	1960S2 1982S2	−0.0068 (−1.2)	1 (i)	0.52 (2.6)	0.31	0.022	1.6	0.43 (3.3)
France	1963S2 1982S2	−0.0031 (−0.4)	1 (i)	0.17 (0.7)	0.27	0.024	1.6	0.49 (3.4)
United Kingdom	1963S1 1982S2	−0.0145 (−1.9)	1 (i)	0.32 (1.4)	0.32	0.025	1.6	0.47 (3.3)
Italy	1960S2 1982S2	0.0072 (−1.3)	1 (i)	0.15 (1.1)	0.32	0.019	1.7	0.51 (4.0)
Canada	1960S2 1982S2	0.0083 (1.0)	1 (i)	0 (0.0)	0.23	0.029	1.3	0.46 (3.6)

(i) Coefficient imposed

CHART 1

THE SUPPLY BLOCK IN CONTEXT

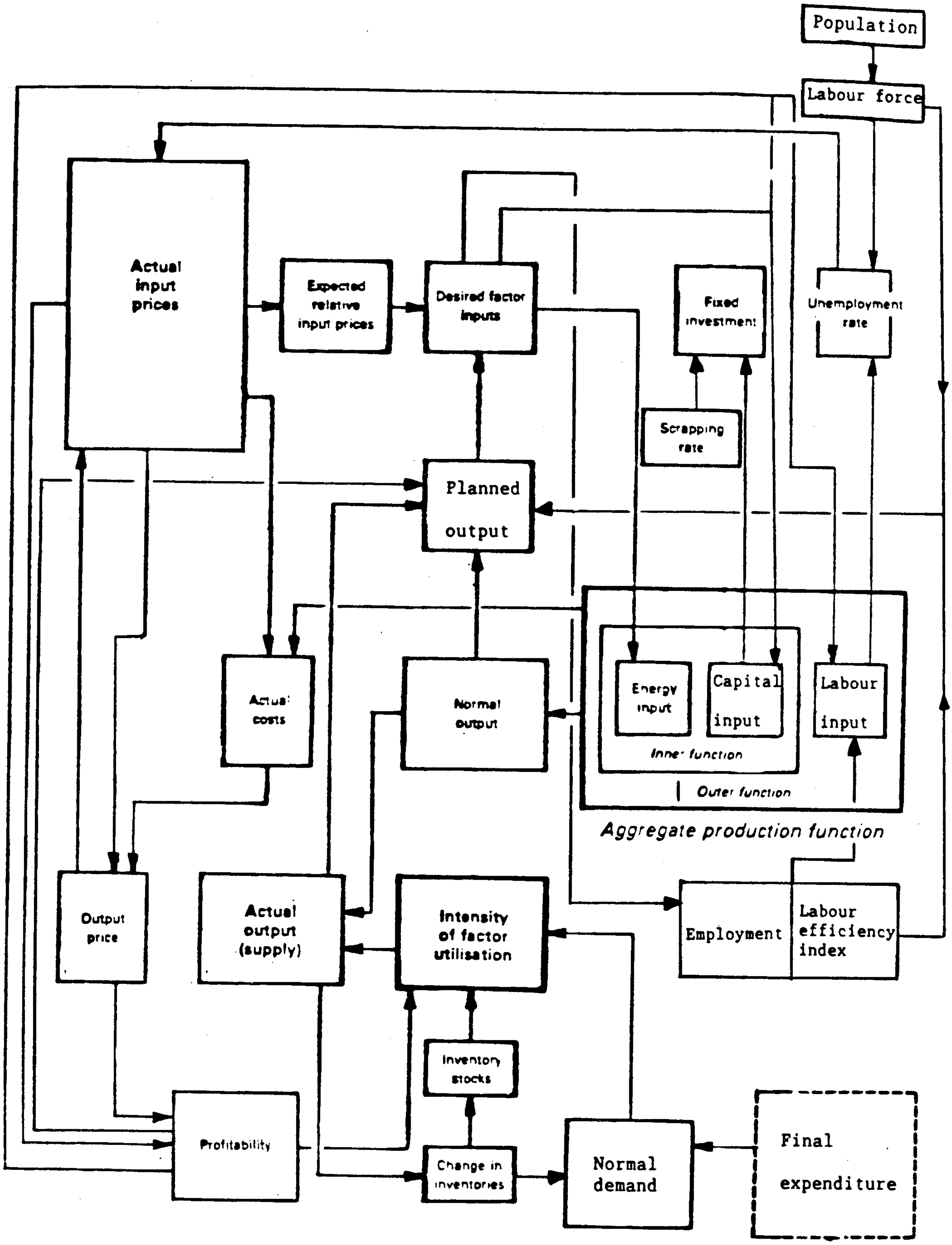


Chart 2

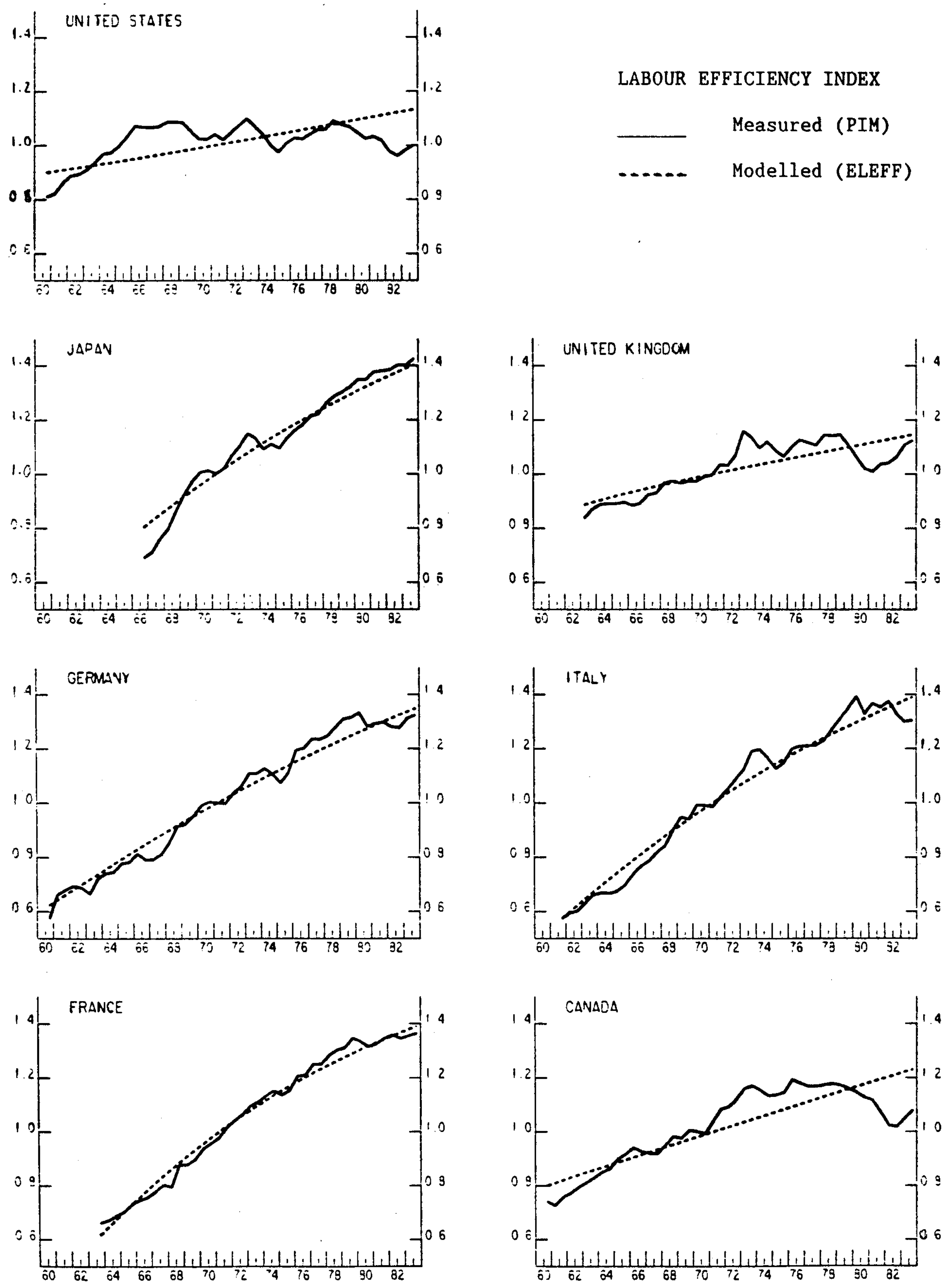

LABOUR EFFICIENCY INDEX
Measured (PIM)
Modelled (ELEFF)
UNITED STATES
JAPAN
UNITED KINGDOM
GERMANY
ITALY
FRANCE
CANADA
1.4
1.2
1.0
0.8
0.6
60 62 64 66 68 70 72 74 76 78 80 82

Chart 3

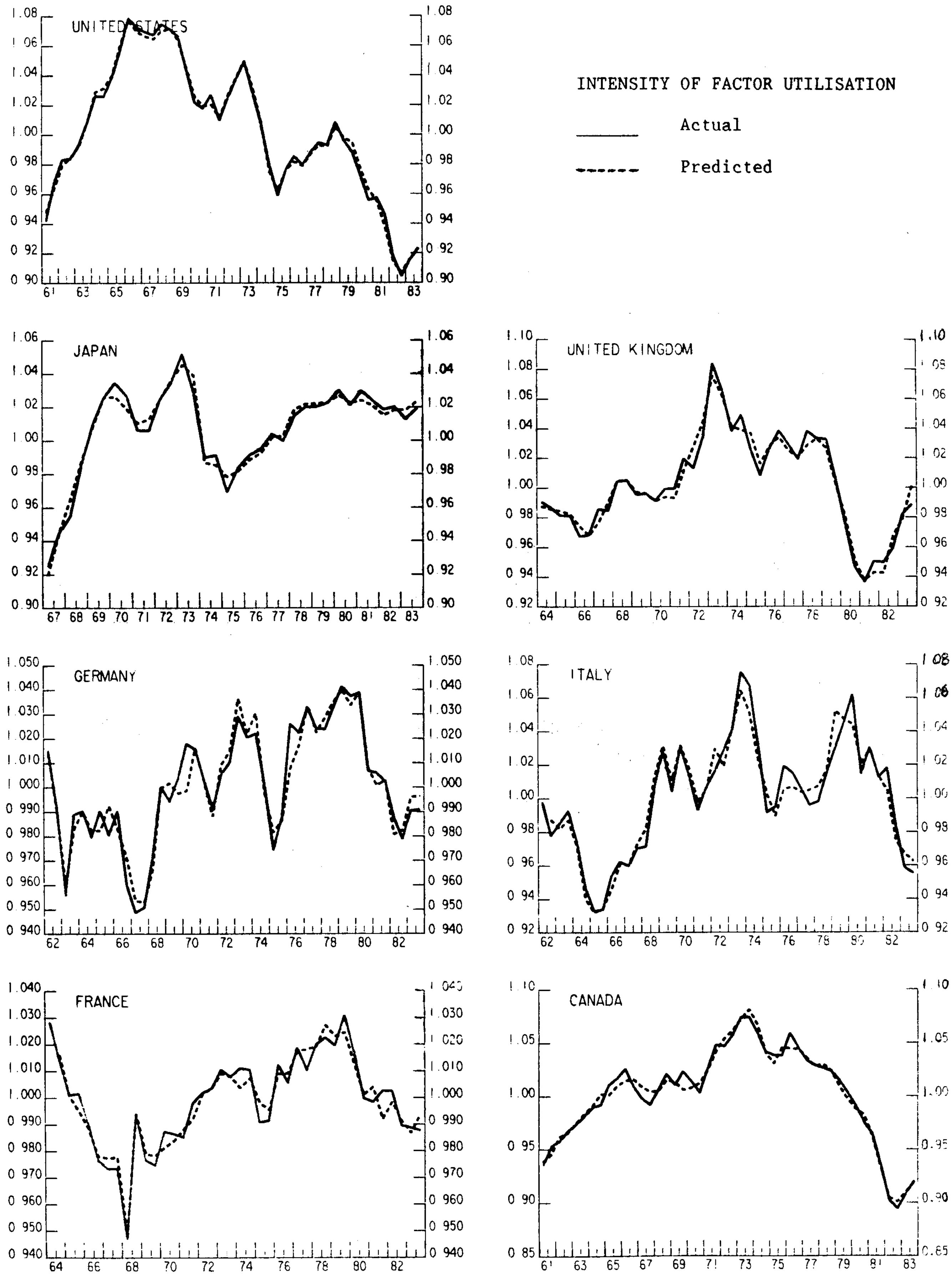

INTENSITY OF FACTOR UTILISATION
Actual
Predicted
UNITED STATES
JAPAN
UNITED KINGDOM
GERMANY
ITALY
FRANCE
CANADA

Chart 4

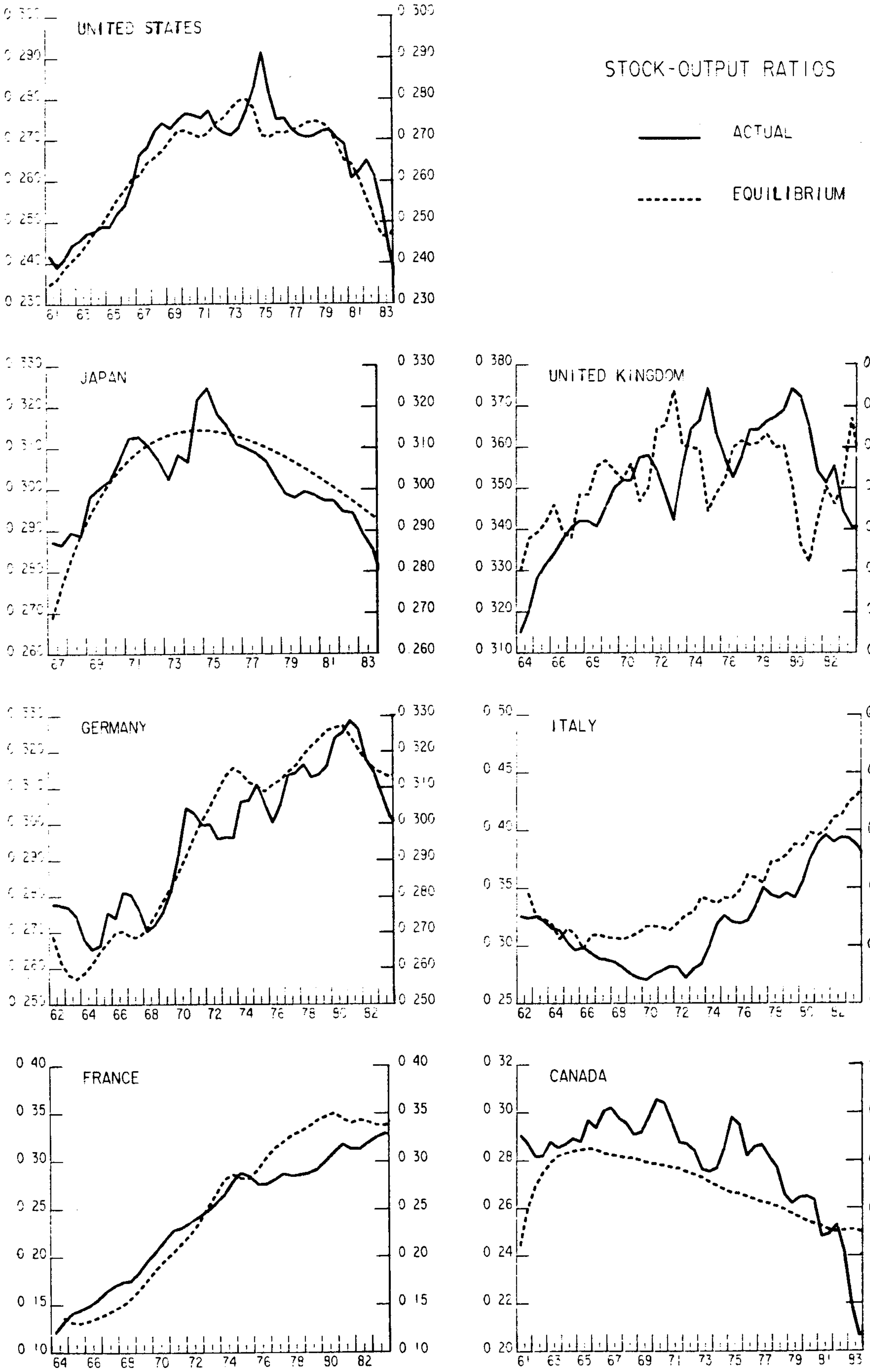
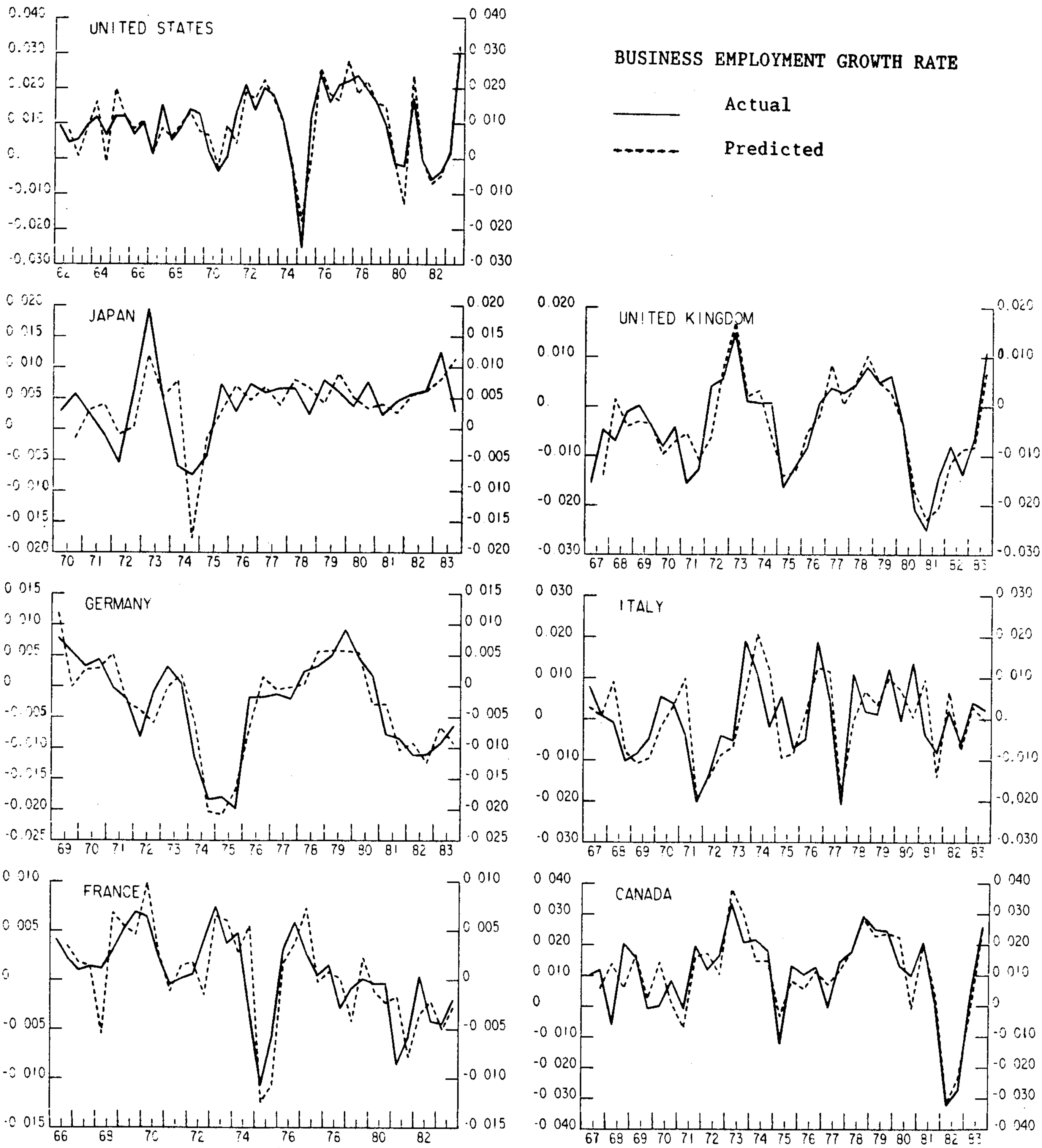

STOCK-OUTPUT RATIOS
ACTUAL
EQUILIBRIUM
UNITED STATES
JAPAN
UNITED KINGDOM
GERMANY
ITALY
FRANCE
CANADA

Chart 5



BUSINESS EMPLOYMENT GROWTH RATE
Actual
Predicted
UNITED STATES
JAPAN
UNITED KINGDOM
GERMANY
ITALY
FRANCE
CANADA

Chart 6

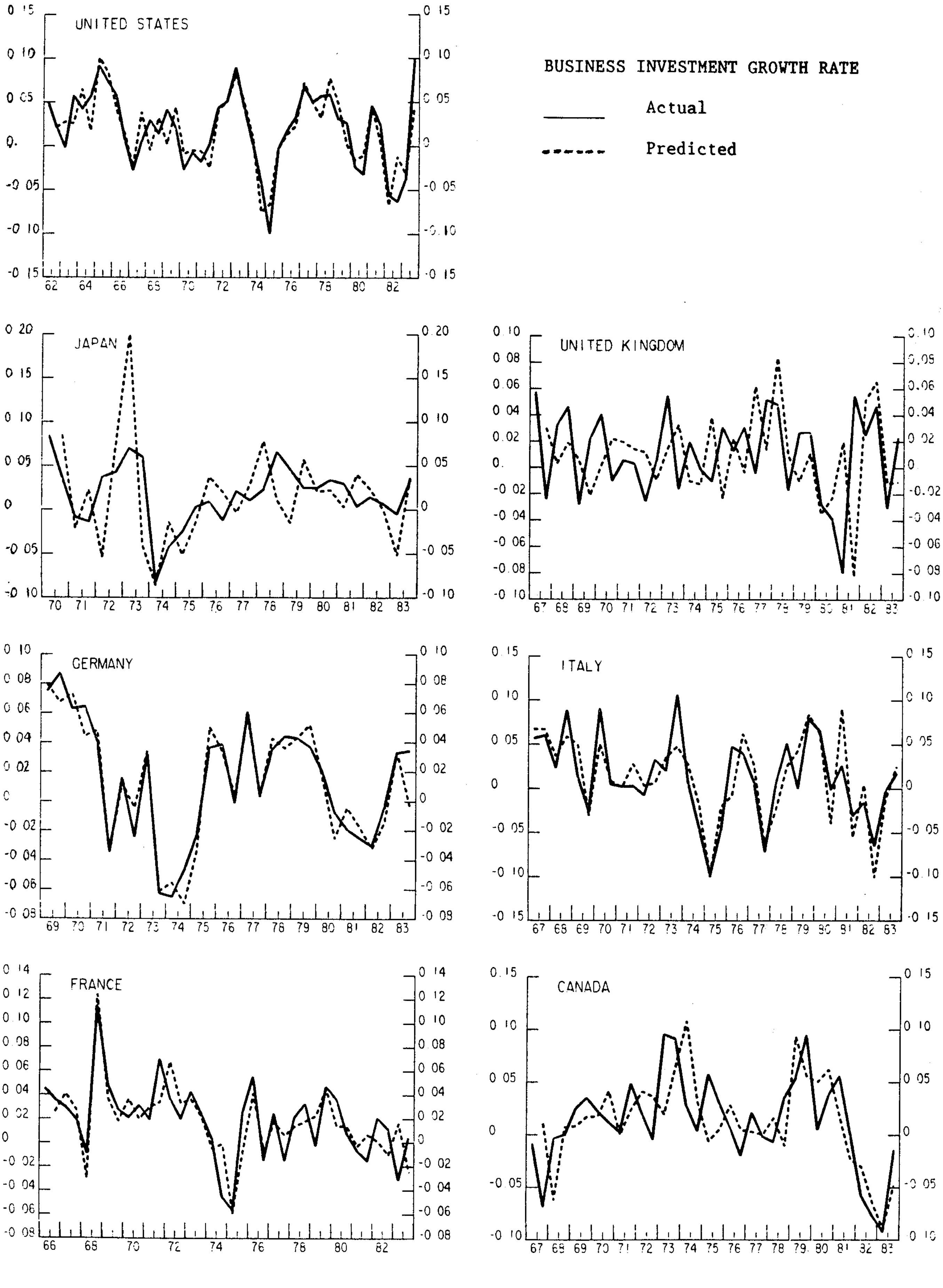

UNITED STATES
BUSINESS INVESTMENT GROWTH RATE
Actual
Predicted
JAPAN
UNITED KINGDOM
GERMANY
ITALY
FRANCE
CANADA

Chart 7

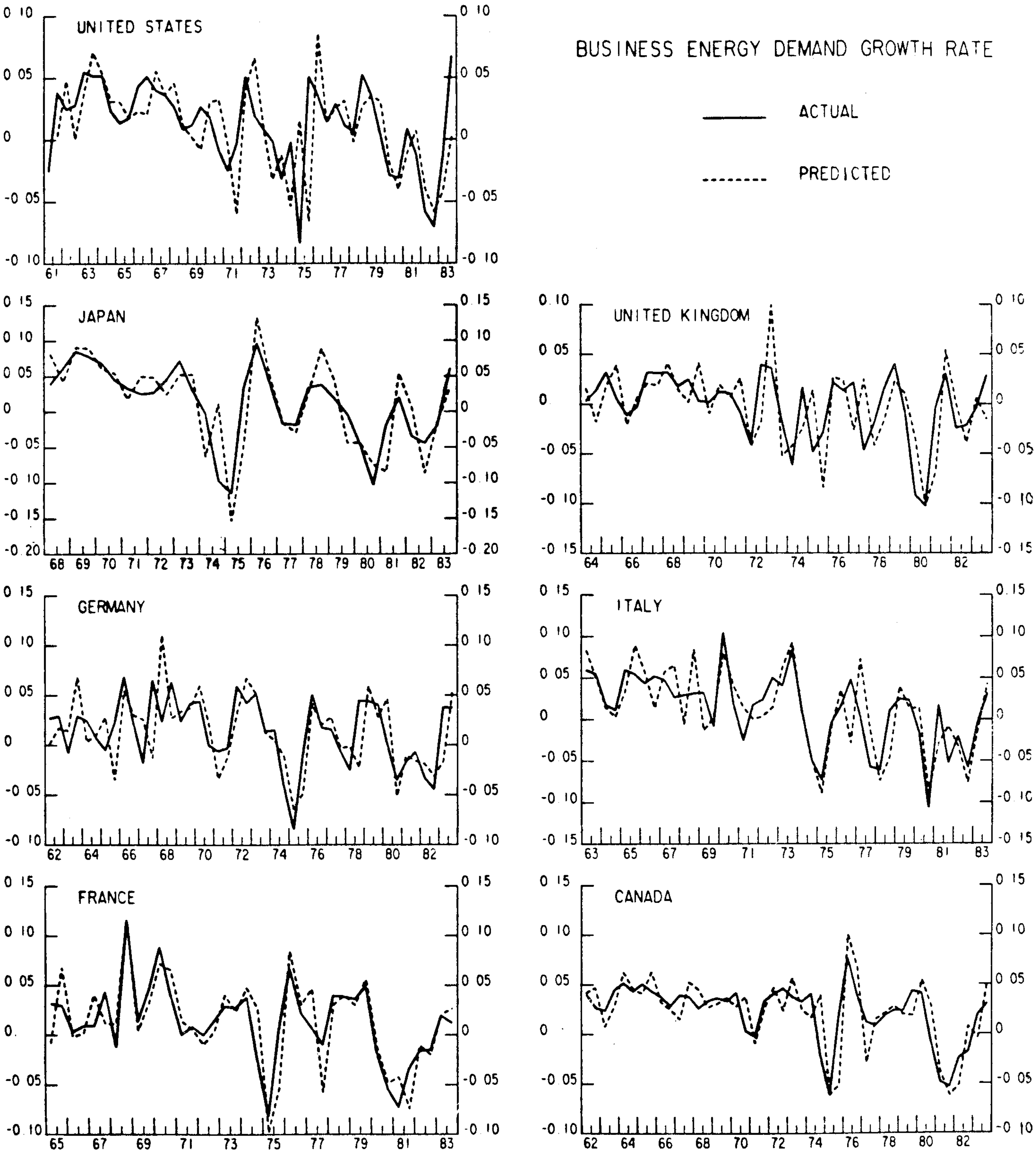

BUSINESS ENERGY DEMAND GROWTH RATE
ACTUAL
PREDICTED
UNITED STATES
JAPAN
UNITED KINGDOM
GERMANY
ITALY
FRANCE
CANADA

Chart 8 Potential output growth and intensity of factor utilisation