APPENDIX B
CEPG ACCOUNTS AND MODEL

The system for analysis and projection used to construct the tables in Appendix A and to provide data for Chapter 1 and other articles of this *review* is briefly described below.[1] The system consists of a set of precisely defined variables for which annual data have been obtained (mainly from national accounts) covering at least the period from 1960 to 1975, together with a set of functional relationships between the variables which are either identities or technical and behavioural hypotheses.

The variables of the system have been chosen and defined to permit a simple but comprehensive description of the key short and medium-term objectives, instruments, exogenous conditions and structural relationships which constrain macro-economic policy in the UK. The accounting definitions differ from those adopted in official statistics in some important respects, discussed in the first section below.

The model classifies variables into four groups:

(a) exogenous variables assumed to be determined either by government policy or by external circumstances which we do not seek formally to explain.

(b) endogenous variables determined by identities.

(c) endogenous variables determined by behavioural relationships for which explicit hypotheses are provided. These hypotheses embody key assumptions about how the economy functions as an interdependent system. The econometric procedure used to determine them and the principal *a priori* assumptions they incorporate are discussed in some detail below (sections 2 and 3).

(d) semi-endogenous variables. These variables are regarded as being determined in part by external circumstances and in part by other variables of the system. For example, a mainly exogenous variable might be assumed to adjust in money terms to general price inflation. Formally such variables are treated in the same manner as fully endogenous variables of type (c) above, but the behavioural hypotheses are expected only to provide a partial explanation of their movement over time.

The model, thus defined, is our representation of the economic system. It can be used both to interpret the causes of past developments and to obtain conditional predictions of the effects, past or future, of alternative policies and external circumstances. Its structure is verified in two main ways. First, the actual past values of variables predicted by behavioural hypotheses are compared with the values which would be predicted by the equations, taken one at a time, in the absence of disturbances or 'residual errors'. This test is strongest when applied for data which have not been used to estimate any parameters in the equations, and we generally reserved 1975 data for this purpose. The second kind of check on the model is to examine its properties as a complete system – for example, the response to an increase in export demand – to ensure that the overall behaviour of the model is in reasonable accord with what might be inferred from past experience. This is an important check, because a set of hypotheses each of which seems plausible on its own may easily give implausible results when the hypotheses are combined.

To obtain conditional predictions for future years from the model some extra specifications are needed. The record of residuals in behavioural equations must be considered to see whether current residuals are likely to persist in future years; the trend values of 'semi-endogenous' variables must be specified for each future year; and assumptions must be provided to define the future values of exogenous variables.

The system for analysing the model permits any subset of exogenous variables to be defined as instruments whose values in each year are to be determined so that a subset of an equal number of endogenous variables attain target values in that year. Thus, for example, taxes on consumption may be determined so as to achieve a given target current balance of payments or public sector deficit, the sterling exchange rate may be determined so as to achieve a given level of cost competitiveness, or wage settlements may be determined so as to achieve a given rate of inflation. The possibility of defining a set of instruments to achieve given targets is of course limited by the structure of the model itself, because certain combinations of targets may not be feasible with the defined set of instruments.

When the results of projections are used in this *Review* we often indicate the most important uncertainties and give a measure of the sensitivity of the predicted outcome to a change in assumptions. The projections are also conditional on behavioural hypotheses, some of which would be disputed by some other macro-economists. We have not investigated the sensitivity of the results to changes in the main behavioural hypotheses, and the whole analysis is therefore clearly dependent on our view about how the economy works.

Alternative projections presented in this *Review* have been made comparable by employing the same assumptions in each, except for those differences which directly and explicitly stem from the definition of the economic strategy illustrated in each projection.

The figures in tables in the first chapter of the *Review* and in Appendix A are derived from past data and future projections after some re-aggregation and extensive rebasing of series to express variables in terms of 1975 values.

[1] A full specification will soon be available from the DAE in mimeographed form.

1. Accounting definitions

The CEPG system differs from official statistics in four main respects. First, production sectors are classified into 'North Sea', 'public services' and the 'business sector'. Second, disposable income is divided between three branches of the private sector – 'household grants', 'wages and salaries', and 'property income' (the latter includes all private rents and income from self-employment as well as company profits, interest etc.). Third, indirect taxes and subsidies are divided into two categories – those which are specific to different kinds of final expenditure (i.e. taxes on consumption, investment, imports, etc.) and those which feed into business costs generally, such as rates and subsidies to public corporations. This analysis forms the basis of a distinction between expenditures valued at market prices and at 'full cost' – the latter includes net taxes on primary inputs[2] but excludes taxes and subsidies on outputs. Tables B1, B2 and B3 at the end of this appendix provide data for reconciliation of CEPG definitions with national accounts.

The quantitative results presented in this *Review* involve a further set of definitions (not required in the model itself) to express output, income and expenditure at constant (1975) values (i.e. abstracting from inflation). The method of calculation of £1975 values may be summarised as follows:

(*a*) real domestic final expenditures (at the available level of disaggregation), originally measured at 1970 factor cost,[3] are rebased on their 1975 market price values.

(*b*) a 1975-based market price domestic expenditure deflator is derived from the aggregate series at current and £1975 values.

(*c*) the balance of payments on current account is deflated by this domestic expenditure deflator and added to £1975 domestic expenditure itself to obtain real national income (at £1975 market prices, and after deducting net current transfers abroad).

(*d*) disposable private income (including capital grants but before deduction of taxes on capital) is deflated by the equivalent private expenditure deflator.

(*e*) disposable household grants and wages and salaries are deflated by the consumers' expenditure deflator[4] to obtain their £1975 values, which are then subtracted from total private income to obtain real disposable property income.

(*f*) disposable public sector income at £1975 values is obtained by subtracting private income from national income.

(*g*) net income from abroad and net income from the North Sea are deflated by the domestic expenditure deflator and subtracted from real national income to obtain income from domestic output.

(*h*) business output and public services output at 1970 factor cost are rebased on 1975 market price values to obtain £1975 domestic output. The difference between this series and income from domestic output is the terms of trade effect.[5]

2. Econometric methodology

The general form of behavioural relationships specified in the model is:

$$g(y) = \alpha_o+\alpha_1 t+f(p,x)+u \;;\; g(y) = y \text{ or } g(y) = \ln y$$

where y is the dependent variable, α_0 and α_1 are 'trend' parameters, t is a linear time trend, f is a (non-linear) function of parameters p and current or lagged values of other variables, x, and u is a disturbance term.

The values of structural parameters p are assigned *a priori*, generally on the evidence of time-series estimation conducted separately.[6] The values of the trend parameters α_0 and α_1 are obtained as OLS estimates of

$$g(y)-f(p,x) = \alpha_o+\alpha_1 t+u$$

over a uniform time-period (1962–74).[7]

In projections the disturbances, u, are either assumed zero or carried forward by a serial correlation process, starting from the latest past value (1975), with *a priori* coefficients. In the case of semi-endogenous variables (and, where there are evident reasons for so doing, in the case of one or two fully endogenous variables) the trend may be modified, or the entire term

$$\alpha_o+\alpha_1 t+u$$

may be overwritten for future years.

Two main advantages derive from incorporating linear trends into the specification of all behavioural relationships. First, it permits a convenient display of off-trend past behaviour in which, writing an asterisk for trend values, the values of each dependent variable can be analysed as

$$g(y)-g^* = [f(p,x)-f^*]+u$$

A quick check is then possible of the extent to which the structural hypothesis f(p,x) explains past fluctuations about the trend of g(y).

The second advantage is that projections of the behavioural relationships for future years will generally be rather robust, in that they will not be very sensitive to the exact values specified for p. This is demonstrated by the following algebraic theorem:

(1) Define $\alpha_o(\beta)$, $\alpha_1(\beta)$ as OLS estimators of

$$[y_t-\beta x_t] = \alpha_o+\alpha_1 t \;(t\epsilon T_o)$$

and $\hat{y}_t(\beta) \equiv \alpha_o(\beta)+\alpha_1(\beta)t+\beta x_t \;(t\epsilon T_1)$

(2) Also define γ_o , γ_1 as OLS estimators of

$$x_t = \gamma_o+\gamma_1 t \;(t\epsilon T_o)$$

and $x^*_t = \gamma_o+\gamma_1 t \;(t\epsilon T_1)$

Then (3) $\hat{y}_t(\beta_1)-\hat{y}_t(\beta_2) = (\beta_1-\beta_2)(x_t-x^*_t) \;(t\epsilon T_1)$

In particular if $x_t = x^*_t$, then $\hat{y}_t(\beta_1) = \hat{y}_t(\beta_2)$.

Although this property is convenient for projections, not too much should be made of it. In particular, it has no relevance at all to comparisons between

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[2]For the business sector net taxes on primary inputs comprise rates, protective duties on imports, royalties on North Sea supplies of oil and gas, less subsidies to public corporations.

[4]Excluding the small relative price effect mentioned in n. 3.

[5]This therefore covers trade with the North Sea as well as foreign trade.

[6]These estimates are often based on more complex stochastic specifications (e.g. first or second order serial correlation or moving-average disturbances) and may also make use of additional specification of the function f, which is not incorporated in the model because of its limited relevance or cost in terms of adding extra variables.

[7]In some cases (e.g. North Sea prices) shorter series have to be used.

alternative projections for the same future year, for which purpose reasonably accurate specification of values of structural parameters is essential.

3. Main behavioural relationships of the CEPG model

The main behavioural hypotheses of the model are briefly summarised here. These constitute the most essential, distinguishing feature of the model and hence of the analysis which rests on it.

The overall structure is fairly conventional. Prices and volumes of expenditures determine output and factor incomes, which are then redistributed, mainly via the tax system, as disposable incomes. Private expenditure in money terms is mainly determined by private disposable incomes, public expenditure on goods and services is determined in real terms by government decisions, while imports and exports are determined by demand and relative costs or prices (unless import restrictions are assumed to be in force). Prices are determined by costs and prices of exports and imports are also influenced by the relativity between domestic and world price levels. Labour costs are determined mainly by wage settlements, which are themselves the outcome of a model of the bargaining process discussed in Chapter 2.[8]

This is a fairly complete structure for an aggregate model designed to project over a short to medium-term horizon. The most obvious omission is the lack of explicit behavioural hypotheses about the trend of productivity and industrial capacity.

The following paragraphs describe each of the main hypotheses in turn.

(*i*) *Private expenditure*

The two equations which determine private expenditure on consumption and fixed investment (excluding investment in the North Sea) are of the form

$$e = \alpha_0 + \alpha_1 t + \Sigma \beta_i y_i$$

where e is expenditure at current market prices, and the y_i refer to current and lagged values of the three categories of private disposable income. The consumption equation also contains a term for the effects of hire purchase credit. These equations when aggregated possess the overall property of private expenditure in relation to private income, discussed in Chapter 6, that the coefficients on each category of income sum to approximately unity, although the timing and composition of expenditure are sensitive to the distribution of private income. Specification of the equations in current price terms implies that the overall ratio of private net acquisition of financial assets to disposable income is positively associated with the rate of inflation.

(*ii*) *Stockbuilding*

The hypothesis for stockbuilding is a conventional stock-adjustment mechanism, with total stockbuilding in volume terms depending on changes in real business output in the current and preceding years. There is an implied slow trend decline in the stock–output ratio.

(*iii*) *Foreign trade volumes*

Imports of goods and services are divided into six categories – food, drink and tobacco, fuels, basic materials, semi-finished manufactures, finished manufactures, and other (mainly services) – and exports into fuels and other exports. Of these, imports of food, drink and tobacco, and services, and exports of fuels, are projected exogenously. For the remainder the general form of equation includes a demand variable and (for exports and both categories of imports of manufactures) a geometric lag term on relative prices or costs. The demand variables are world trade in goods and services in the case of exports, real business sector final sales for imports of finished manufactures, and real business output for imports of fuels, basic materials and semi-finished manufactures. Equations for the latter two also contain a stockbuilding term.

In the export equation the implied elasticity of the UK's share with respect to world trade is −0·22, which together with the effect of a negative trend term implies that world trade growth at 8% per annum would result, with constant cost competitiveness, in a 2·75% per annum decline in the UK's share, and also that world trade would need to fall by nearly 4% per annum in order for the UK's share to increase. The long-run elasticity of exports with respect to the ratio of domestic costs expressed in foreign currency to the world price of manufactures is −1·18, with a mean lag of just over two years.

The long-run elasticity of imports of finished manufactures with respect to the ratio of their price deflator to domestic prices is −1·8, with a mean lag of approximately six months. The elasticity with respect to final sales is 3. The equation implies that a 3% per annum growth of final sales, assuming constant relative prices, would generate a 10% per annum growth of imports of finished manufactures. For imports of semi-finished manufactures the elasticity with respect to business output is 1, with a long-run relative price elasticity of −0·3, and a mean lag of one year.

Taking into account the effects of exchange-rate changes on export and import prices (see (*vii*) below) including the effects on domestic prices of changes in the cost of imported inputs, the implied long-run elasticity of total exports with respect to (effective) exchange-rate changes is −0·87. The corresponding elasticity for total imports is 0·28. A 1% depreciation has the effect of increasing sterling export prices by 0·64%, and sterling import prices by 0·84%, thus implying a terms-of-trade deterioration of 0·2%. Expressed in terms of conventional concepts, the implied elasticity of the total volume of exports of goods and services with respect to export prices expressed in foreign currency terms is −2·4, and of total imports with respect to sterling import prices is −0·33.[9]

(*iv*) *Employment*

The equations determining business employment are of the form

$$\ln e^* - \ln L = \alpha_0 + \alpha_1 t + \beta_1(\ln q - \beta_2 \ln L)$$

$$\ln e - \ln e_{-1} = \lambda(\ln e^* - \ln e_{-1})$$

[8] In projections for the future, wage bargaining has generally been assumed to result in pre-determined money settlements imposed as 'targets' of the model.

[9] These aggregate elasticities are based on 1975 weights; over time the implied aggregate elasticity for total imports would rise with the increase in the share of imports of finished manufactures in the total.

Employment in the business sector, expressed in terms of full-time male equivalents, e , partially adjusts to its desired level, e* , the actual change being 0·6 of the desired change. The long-run elasticity of employment to output is 0·6 and the short-run (i.e. within-year) elasticity is 0·36. The labour supply term enters in such a way that actual productivity in the medium term depends on the pressure of business sector demand for labour. The supply of labour enters into productive potential on a one-for-one basis (that is, $\beta_2 = 1$), and the implied future full capacity growth of business sector labour productivity is 4% per annum. Employment in government services is exogenous, apart from a small component related to the level of unemployment.

(*v*) *Earnings*

The form of the equation for standard money earnings is

$$\ln W = \alpha_0 + \alpha_1 t + \ln[\beta_1 WM + (1-\beta_1)WNM + \beta_2 WCL] - \beta_3 \ln h$$

Standard weekly earnings, W (corrected for changes in normal hours worked, h), depend on a weighted average of current and lagged values of wages at settlement for manual (WM) and non-manual (WNM) employees and on a term representing cost-of-living and threshold payments (WCL). The construction of the weights in the expression for manual employees is described in detail in Chapter 2; they vary as part of the adjustment of wage determination to changes in the rate of inflation, so that an increase in the rate of inflation increases the weight attached to current wage settlements. The implied trend growth of wage drift in the equation is 1·9% per annum.

(*vi*) *Prices*

The price of business sector domestic sales at full cost,[10] p , is predicted as a mark-up on normal historic unit costs, in a form which generalises the normal price hypothesis about price formation in manufacturing to the business sector as a whole:

$$\ln p = \alpha_0 + \alpha_1 t + \ln h$$

The average lag between current costs, c , and historic costs, h , is about one quarter.

$$c = [(lc+dc)q + mc.m]/(q+m)$$

Current costs comprise normal unit labour costs, lc, and other domestic costs, dc , per unit business output, q , together with import costs (mc) per unit of imports to the business sector, m . 'Other domestic costs' per unit normal output include rates, private rents, subsidies to public corporations and farm profits. There is no significant trend in the mark-up of price over cost defined in this way.

(*vii*) *Foreign trade prices*

The prices of exports and of the various categories of imports are all of similar general form:

$$\ln p = \alpha_0 + \alpha_1 t + \beta_1 \ln pf + (1-\beta_1) \ln pf_{-1}$$

The term pf is in each case a geometric weighted average of domestic prices (adjusted for sales taxes on exports and import tariffs) and an appropriate foreign price variable converted to sterling. For exports, and imports of finished manufactures and services, the foreign price variable is an index of world prices of manufactured exports, while for food and basic materials an index of world prices of food and materials is used. Fuels (oil) have their own world price index. A weighted average of the raw material and manufactures indices is used in the equation for the price of semi-finished manufactures. The weights on domestic and foreign prices reflect the extent to which the UK acts as a price-taker in various categories of foreign trade.

The lag, $1-\beta_1$, varies slightly for different categories, being longest (0·5) in the case of food.

(*viii*) *Taxes and transfers*

The model contains a detailed analysis of the behaviour of the tax system in terms of the principal components of direct and indirect tax receipts and grants and transfers, together with relationships to predict payments of net debt interest and receipts from trading income and rent.

(*ix*) *Property income and capital flows in the balance of payments*

Net receipts of profits and transfers from abroad are required to obtain the current account of the balance of payments. These net receipts are the sum of the following separately projected components: profits paid abroad from the North Sea, other post-tax private outflows of interest, profit, dividends and transfers, private inflows, public sector interest on overseas borrowings and government transfers.

(*x*) *North Sea*

The framework for construction of North Sea accounts on a national accounts basis was described in *Economic Policy Review* No. 1 (February 1975), Chapter 4. Future projections take into account the latest available information about the rate of development of oil and gas production, the taxation of North Sea profits, and the likely future share of profits going abroad.

[10]The concept of full cost is defined above (p.93).

Table B.1 Allocation of expenditure to production sectors, 1974 (£ million)

	Blue Book basis	UK business sector	North Sea	Government services	
Consumers' expenditure	51,670	51,670			Consumers' expenditure
Public authorities' current expenditure on goods and services	16,641			10,559	Government services expenditure
		6082			Other public sector current purchases
Public fixed investment	6918	6918			Public fixed investment
Private fixed investment	9329	8984			Private fixed investment in UK business sector
			345		Fixed investment in North Sea
Stockbuilding	661	661			Stockbuilding
Exports of goods and services	22,205	22,205			Exports of goods and services abroad
		103			Business sector exports of capital equipment to North Sea
		24			Business sector exports of services to North Sea
			171		North Sea exports of fuels to UK business sector
Imports of goods and services	26,813	26,547			UK business sector imports of goods and services from abroad
		171			UK business sector imports of fuels from North Sea
			103		North Sea imports of capital equipment from UK
			242		North Sea imports of capital equipment from abroad
			24		North Sea imports of services from UK
			24		North Sea imports of services from abroad
GDP at market prices	80,611	69,929	123	10,559	
Adjustment to factor cost	8407	8386	21	0	
GDP at factor cost	72,204	61,543	102	10,559	

Notes:
1. All items are measured at current market prices, except that imports, following national accounting conventions, are exclusive of protective duties levied within the sector of destination. That part of total protective duties on imports of finished manufactures which is attributed to North Sea imports of capital equipment from abroad (approx. £10 million in 1974) is treated as levied within the UK and so to the North Sea appears as an indirect tax levied by a 'foreign' sector, and not as a protective duty within the North Sea itself. In the North Sea accounts this item as an import is thus measured inclusive of the duty, which appears in the GDP of the UK business sector.
2. Stockbuilding includes the residual between compromise and expenditure estimates of GDP, and so the GDP figures are on a compromise basis.
3. The adjustment to factor cost for the North Sea consists of royalties on North Sea sales, which are treated as an indirect tax levied behind the ring fence. For government services the adjustment to factor cost has in the past consisted of Selective Employment Tax.

Table B.2 Allocation of disposable incomes, 1974 (£ million)

(i) *Wages and salaries*		
Income from employment in UK business sector	41,442	
Income from employment in government services sector	10,559	
Total income from employment	52,001	
Direct tax and national insurance contributions	12,257	
Disposable income from employment		39,744
(ii) *Household grants*		
Household grants	6941	
Direct tax	275	
Disposable household grants		6666
(iii) *Property income*		
Gross private profits of UK business sector (including stock appreciation)	21,573	
Profits and private transfers from abroad	2921	
Gross profits and private transfers due abroad	1604	
Net receipts of interest and dividends from public sector and overseas	2546	
Grants and transfers from public sector	1744	
Net trading profits from North Sea	31	
Total pre-tax income (including stock appreciation)	27,211	
Direct tax, etc.	4215	
Stock appreciation	5655	
Disposable property income		17,341
(iv) *Public sector*		
Direct taxes	17,117	
Transfers and grants	9006	
Net indirect taxes	8407	
Total net taxes	16,518	
Gross trading surplus of public corporations and other public enterprises (including stock appreciation) plus public sector rent	4493	
Stock appreciation	309	
Net debt interest paid	2902	
Disposable public sector income		17,800
Gross national product at market prices *plus* net transfers from abroad		81,551
Net transfers from abroad	— 412	
Gross national product at market prices	81,963	
(v) *Overseas sector*		
Gross profits and private transfers from UK business sector	1604	
Net trading profits from North Sea	70	
Profits and private transfers due to UK	2921	
Net interest and dividends from UK	356	
Current grants from UK public sector	321	
UK tax on profits from UK business sector	370	
Overseas sector disposable income		— 940
Gross domestic product at market prices		80,611

Notes:
1. GDP and GNP are again defined on a compromise basis; the residual error between compromise and income estimates is allocated to UK business sector profits.
2. All profits from the North Sea are defined *after* direct tax (Petroleum Revenue Tax and Corporation Tax payments, both of which were in fact zero in 1974, though they will not be in future years) to conform with the ring-fence arrangement.
3. Gross private profits of the UK business sector include income from self-employment and private sector rent, as well as trading profits.

Table B.3 Allocation of net indirect taxes, 1974 (£ million)

	Factor cost	Allocation of rates, etc.	Full cost	Allocation of sales taxes	Market prices
Consumers' expenditure	45,208	1478	46,686	4984	51,670
Public authorities' current expenditure on goods and services*	5440	322	5762	320	6082
Investment†	16,162	295	16,457	451	16,908
Exports	21,648	168	21,816	389	22,205
Total taxes		2263		6144	
Protective duties		533			
North Sea royalties		21			
Rates		2991			
Subsidies to public corporations		1282			

* Excluding expenditure on output of government services, which is purely labour and attracts no indirect tax now that SET (which would be classified as a sales tax) has been abolished.
† Total gross domestic capital formation, including stockbuilding.