

THE STRUCTURE AND SIMULATION PROPERTIES OF OECD'S INTERLINK MODEL

Pete Richardson

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INTRODUCTION

In line with current trends in macroeconometric modelling, the OECD international macroeconomic model, INTERLINK, has undergone an important transition over the last five to six years. It has gone from being a model which could then be described as being essentially "short-term" and "demand-oriented" to being one which is richer in theoretical and empirical content and able to tackle a range of short- and medium-term macroeconomic questions in a wider and more realistic policy framework. Rigorous testing and active use of the system for simulation and forecasting have also provided an important basis for critical assessment and improvement and INTERLINK has come to play an increasingly important role in the work of the OECD Secretariat; in the construction, co-ordination and analysis of short- and medium-term multi-country projections and related simulation studies.

This paper reviews recent developments in the INTERLINK model and its simulation properties. The material presented is intended to provide a general overview of model structure and properties and the key mechanisms involved. In doing so it draws upon a number of recent OECD studies and updates and augments much of the material given in previous OECD international linkage studies, in particular that of Larsen et al. (1983b).

The paper is in four parts. The first reviews the general background to the INTERLINK model, its overall structure and design criteria, and also recent developments. Part II then considers the results of selected simulations for the single-country sub-models of each of the seven major OECD economies, those predominantly affected by recent model developments. Part III extends this analysis to a multi-country context with a series of simulations which examine the role and quantitative importance of the international linkage aspects of the model. The final part provides a summary assessment of the recent evolution of model properties, drawing attention to a number of behavioural features that have emerged and their policy implications, and also outlines a number of key areas where future development work is likely to be concentrated.

I. MODEL STRUCTURE AND RECENT DEVELOPMENTS

A. Background to the INTERLINK system

The OECD INTERLINK model is a representation of the world economy which combines a set of small to medium-sized semi-annual macroeconomic models, one for each OECD Member country, with reduced-form trade and balance of payments relationships for six non-OECD country groupings'. It treats the world economy as a coherent and integrated whole, with developments in individual domestic economies, international trade, exchange rates and financial flows determined simultaneously and on a globally-consistent basis. The model and its associated data systems have been developed as operational tools. They play important roles in the day-to-day macroeconomic work of the OECD's Economics and Statistics Department, notably so in the construction, co-ordination and analysis of short- and medium-term multi-country projections, related macro-policy analyses and simulation studies, presented regularly in the OECD Economic *Outlook* and related OECD publications. A detailed discussion of the general background, role and functions of INTERLINK in the work of the OECD is given by Llewellyn *et al.* (1985).

The model's origins are essentially those of a world trade model which has been steadily extended by the addition of separate domestic country blocks to "explain" essential relationships in the determination of demand, output supply, factor demands, wages and prices, public and private sector balances, and key financial variables – monetary aggregates, interest rates and exchange rates. An important and continuing feature of these developments has been an emphasis on international economic linkages and the consistency conditions necessary in obtaining a coherent global view of the world economy. Recent work in this respect has been in the areas of commodity prices, international financial linkages and international investment income flows.

A number of early versions of INTERLINK relied for the most part on original country sources – national authority and research institute models and empirical studies – as a basis for setting key economic parameters in individual "schematic" country models (see, for example, OECD, 1979 and 1980). Although providing a useful starting point for a world model, an important limitation of this approach is the extent to which available "consensus" evidence is able to meet the developing needs of international economic analysis in a world of changing policy environment and economic structure. Over the last five to six years, therefore, there has been a steady movement towards the incorporation of empirical evidence based on OECD studies. This reflects both the perceived need to strengthen the relevance and explanatory power of the model in areas of policy interest and, more generally, the orientation of the OECD's work programme towards the quantitative study of policy-relevant

economic relationships. A discussion of the essential relationship between the development of the INTERLINK model and policy issues is given by Llewellyn and Richardson (1985).

The broad approach to model development has been that of adding to and improving the model on a block-by-block rather than country-by-country basis, and this reflects a combination of factors. Firstly it exploits as far as possible the advantage of an international organisation in the field of comparative international studies, a factor which is also reflected in the structure and organisation of the OECD Economics and Statistics Department. For a world model to be generally manageable and available for use on a continuous basis, there is also a clear need for a degree of standardization in structure across countries; otherwise, there would be a tendency for the size and complexity of the model and its database to increase rapidly beyond the scope of individual users and model managers. Thus in the original design of INTERLINK a deliberate choice was made, as far as possible, to confine main differences in country model specifications to major institutional features and testable differences in estimated parameters². For individual model users and researchers, this has the advantage that the reasons for differences in country responses are more transparent and better understood in terms of the behavioural assumptions of the model. This also avoids major differences in model properties being the result of different research strategies which might otherwise be adopted, in isolation, by different country researchers. Considerable reliance is nonetheless placed on country-specific expertise and information in the specification of structural forms, the choice of appropriate variables and the analysis of the plausibility of individual country model results.

The model is not regarded as a research vehicle but as an ongoing repository for empirical evidence and views on key macroeconomic relationships relevant to the analysis of world economic developments. As such, it provides a consistent framework for the organisation of thought and use of empirical evidence and brings to bear the considerable power of system-wide identities and empirical relationships on a range of relevant issues. The limitations of quantitative economic models in the area of forecasting and policy analysis are well-acknowledged; the model is therefore intended not to replace but to complement other forecasting and analytic methods, including the judgemental use of additional information by country and subject specialists. It formalises thinking, performs time-consuming computations and provides a necessary starting point for quantitative economic analysis and the imposition of consistent views and judgements.

In the context of the OECD's regular economic forecasting exercises, the INTERLINK system performs a variety of functions. Primarily it helps ensure the co-ordination and smooth functioning of data flows for several thousand economic time series, including historical updates and revisions to future projections. The system therefore allows for the submission and dissemination of information to a large group of economists within the Department. The model is also used by the

country and subject specialists in the construction of individual country forecasts and globally-consistent trade projections. An important starting point to every forecasting round is the preliminary revision, through model simulation, of the previous set of projections for changes in exogenous assumptions, for example those relating to fiscal and monetary policies, exchange rates, the non-OECD countries and commodity market conditions. This "climate" exercise is followed by further rounds of revisions and refinements, taking account of recent data, new information and revised judgements. The model thus provides a focal point for information flows and a framework for the discussion of specific economic relationships and forecasting issues.

For medium-term analyses, the model is now used routinely in the extension of short-term projections over a five- to six-year period. The OECD's overall approach to conditional forecasting is nonetheless pragmatic, with model-based projections modified in the light of expert views with respect to structural change, factors which are thought to be missing or poorly specified in the model and information from a wider set of economic indicators than those included in the model's structure, such as business surveys, stock-market assessments and leading indicators. Model-based simulation analyses are also important in providing a ready basis for the production of variant projections and the analysis of the influence of specific factors, such as alternative exchange rates and policy assumptions. Extensive references to the use and development of INTERLINK for a range of applications are given in the bibliography.

Given the wide range of uses which INTERLINK serves, the criteria for its form and development have evolved in fairly specific ways. In general, it has been necessary to recognise an important balance between goodness-of-fit and theoretically plausible behaviour. Thus simulation tests play an important part in the way in which new research is vetted and equations are selected for inclusion in the model³. Sometimes this means that some sacrifice has to be made with respect to "pure" forecasting accuracy, in order to achieve consistent and robust simulation properties. It also implies that little direct use can be made of leading indicator variables and that the model is relatively conservative with respect to the use of polynomial time trends and equation specifications which feature irregular dynamics. With the model used increasingly for medium-term applications, simulation testing has naturally extended beyond the short term and, as described in the following section, rather more emphasis is placed on the specification of single equations and equation sub-blocks which incorporate well-defined equilibrium properties.

B. Recent developments and model structure

The detail of the individual country models within INTERLINK varies broadly with data availability and country size. A summary of model size by country is given

Table 1. Summary of model size by country

Country/Region	Equations	Exogenous variables ¹
United States	264	86
Japan	236	82
Germany	237	82
France	237	81
United Kingdom	234	83
Italy	238	82
Canada	230	81
Australia	172	93
Austria	153	77
Belgium-Luxembourg	158	79
Denmark	175	80
Finland	148	73
Greece	146	75
Iceland	136	72
Ireland	147	76
Netherlands	182	90
New Zealand	138	73
Norway	153	80
Portugal	136	72
Spain	154	79
Sweden	154	77
Switzerland	149	74
Turkey	136	72
Non-OECD regions	59	41
Commodities	10	6

1. These include linkage variables, i.e. those determined outside of the individual country model in question. The average OECD Member country model involves 44 linkage variables, whilst the non-OECD regional blocks involve 37 linkage variables. With the exception of time trends, all variables exogenous to the commodities block are determined elsewhere in the system.

in Table 1. The models for the larger OECD Member countries commonly involve 200 to 250 equations (of which up to 100 are behavioural), whilst those for the smallest Member countries contain 130 to 150 equations (of which up to 50 are behavioural). All country models are semi-annual in frequency and there is a strong degree of structural commonality in their design, reflecting the practical uses of the system. An important common denominator is the degree of trade and balance of payments disaggregation, with main structural differences here reflected in differences in parameter values and adjustment speeds, as well as differences in the composition and patterns of trade implied by the underlying trade matrices. The broad coverage of the OECD country models largely reflects the basic requirements

for the national accounts breakdown of real and nominal GNP, factor demands, inflation, financial conditions and the public and private sector appropriation accounts, associated with the structure of *OECD Economic Outlook* projections.

In general, the larger country models include a more detailed treatment of expenditure components, price deflators and also the government sector. The coverage and sophistication of the equation blocks determining financial conditions, exchange rates and international investment income flows vary with country size and data availability, as well as structural and institutional features of the individual economies in question. With respect to recent developments, an important structural distinction should also be made with respect to the models for the seven major economies, which now feature production function and supply-based elements in the determination of output, prices and factor demands.

Table 2 provides a summary of the main structural characteristics of the individual country models, classified by broad sectoral differences. A detailed guide to the most recent developments in the structure of INTERLINK is given by Richardson (1987b) and OECD (1988). Principal changes which have been influential in the recent evolution of model properties include:

- **Consumption** – extending previous findings for a number of larger countries to include the influences of interest rates and inflation on private consumption, with emphasis given to the specification of stock/flow equilibria;
- **Supply** – combining, within a consistent three-factor production function framework, the joint determination of factor demands (for capital, energy and labour), output supply and producer prices;
- **Money and finance** – providing insights into the behaviour of key monetary variables and thereby the implications of alternative monetary and fiscal policy assumptions;
- **Commodity prices** – providing essential information relevant to the price and activity linkages between the OECD countries and the rest of the world;
- **Investment income** – providing a system for the consistent treatment of asset stocks and international investment income flows on a world basis. This fills a previously "missing" dynamic element in the model's balance of payments accounts, one which is of increasing importance at a time of large current-account imbalances and major fluctuations in interest rates and exchange rates;
- **Exchange rates** – although limited in its ability to explain recent exchange rate movements, the model provides a consistent framework for the analysis of expectational factors in the functioning of international currency markets.

Table 2. Structural characteristics by country

Country model	Supply block	Monetary block	Fiscal block	Exchange rates	Investment income
Major seven countries	1	1	1	1	1
Australia	2	2	1	1	1
Austria	2	2	2	1	1
Belgium-Luxembourg	2	4	1	1	1
Denmark	2	2	1	1	1
Finland	2	2	2	1	1
Greece	2	3	2	2	2
Iceland	2	3	2	2	2
Ireland	2	2	2	1	1
Netherlands	2	2	1	1	1
New Zealand	2	3	2	2	2
Norway	2	2	2	1	1
Portugal	2	3	2	2	2
Spain	2	2	2	1	2
Sweden	2	2	2	1	1
Switzerland	2	2	2	1	2
Turkey	2	3	2	2	2

Supply block	(1) 3-factor CES production function, integrated factor demand, output supply and price system, labour supply endogenous. (2) Independent investment and employment functions, labour supply exogenous.
Monetary block	(1) Money demand and long-term interest rate endogenous, short-term interest rate exogenous but may be endogenised via policy targeting. (2) Short-term interest rate reaction function, long-term interest rate endogenous, money supply determined through identity. (3) Short- and long-term interest rates exogenous. (4) As (1) but also including a short-term interest rate reaction function.
Fiscal block	(1) Detailed. (2) Less detailed.
Exchange rate	(1) Consistent expected and actual exchange rate determination. (2) PPP-based nominal or effective exchange rate rules.
Investment income	(1) Asset stocks, rates of return and income flows separately distinguished for credits and liabilities. (2) Net assets approach for rates of return and income flows.

Each of these areas is discussed in more detail in the following paragraphs, which summarise the principal features of the model by sector and the associated research studies.

1. The *expenditure account*

Two broad categories of domestic expenditure are distinguished in the model – consumption and investment – which are further subdivided into various private- and public-sector components. The consumption function specifications are based on the theoretical considerations set out by Holtham and Kato (1986). They typically assume consumption/income and wealth/income ratios to be stable functions of inflation and real interest rates, with implicit wealth effects subsumed in these terms. A summary of the relevant equation estimates for the larger OECD economies is given in Richardson (1987b). Further work using explicit measures of wealth and financial asset stocks is currently under study.

Private investment expenditures are generally divided into three main components – business fixed investment, residential construction and stockbuilding. For the seven major economies, business investment is determined within a factor demand system which is based on an explicit production function approach, as described later. For the smaller economy models, flexible accelerator functions involving private-sector output and long-term real interest rates are used. The model treats the relatively volatile category of residential construction as a function of disposable income and real interest rates, with a wage-cost supply component also included for some countries. The empirical results for this category of investment are not, however, robust and further estimation work is being carried out using an alternative stock-adjustment approach, involving population trends, disposable income, mortgage interest rates and house prices. A prototype version of this equation is currently included in the U.S. country model. For the seven major economies, stockbuilding plays a buffer role between the demand and supply of business output and is therefore determined through the output supply equation. For a number of medium-sized economies, stockbuilding is determined explicitly in a standard stock/sales adjustment type equation.

Government non-wage expenditures are divided into consumption and investment components and are treated as being exogenous in nominal terms. For a variety of applications, however, the corresponding categories of government expenditure in real terms can be held unchanged through the specification of appropriate policy targeting rules. Government wage expenditure in nominal terms is determined as the product of exogenous government employment and endogenous government wage-rate variables.

2. *Supply*

The development and form of the business sector supply blocks for the major economies are described by Helliwell et al. (1986) and, more recently, Jarrett and Torres (1987). These combine three-factor (capital, energy and labour) production functions with equations for consistent factor demands, labour supply and output supply. Production function parameters, factor shares and measures of potential

output also enter directly into the price block to determine the business sector output price, the key domestic input into the expenditure price deflator system.

A core element of the supply block is the aggregate business production function. These functions are of a three-factor, two-stage form, involving constant elasticities of substitution. The inner capital/energy function allows also for a vintage element to the capital stock. Technical progress is assumed to be Harrod-neutral. "Normal output", which plays an important role in the block, is measured as the value of output given by the production function at existing factor input levels. A key element in the determination of actual factor demands is the level of planned output which is defined by a forward extrapolation of actual and normal output levels, modified also by profitability and labour supply influences. For given levels of planned output, optimal factor inputs are determined by cost minimisation rules, taking into account labour, energy and capital costs. Actual factor demands are then modelled as adjusting towards these desired levels, subject to short-run profitability and excess demand effects.

The business output supply function takes the form of a factor utilization rate equation, determining the ratio of actual to normal output levels. This "utilization rate" is determined as a function of demand – the ratios of sales and stocks to normal output – and also supply factors, in the form of profitability and real interest-rate terms. In the short run, the output supply equation serves to split the effects of demand and supply shocks into changes in output and inventories, given the levels of expenditure determined elsewhere in the system. Actual output is therefore determined as the product of "normal output" and the utilization rate, with stockbuilding determined residually by identity. The supply blocks are completed by labour supply equations in which population growth, unemployment rates, demand pressure, the after-tax wage, real non-wage income and transfers are the main determining variables.

Supply blocks for the smaller OECD countries are currently being studied with a view to using a related but simpler two-factor production function approach. The existing blocks for these countries are relatively limited, with investment and employment determined independently. Dependent employment is typically modelled as a function of GNP, with a less than unit elasticity, real labour costs and some allowance for trend productivity growth. Labour supply and trend output are assumed to be exogenous, as is stockbuilding for the smallest economies. Supply effects in these country models therefore operate through the influence and interaction of labour and goods market pressures on wages and prices, with output determined through the more conventional income accounting framework.

3. Wages and prices

The empirical work underlying the model's most recent private sector wage equations is summarised by Chan-Lee *et al.* (1987), building on the earlier work of

Coe (1985). The equations for private-sector wage earnings per employee are generally in the form of an orthodox expectations-augmented Phillips curve. Inflation expectations are assumed to be adaptive and, in most cases, the coefficient on prices is close to unity, implying a near vertical long-run Phillips curve. For some countries, the terms of trade and trend productivity growth are also found to be important. The unemployment rate is used as a proxy for excess demand in the labour market, with the specific choice between linear, log-linear and inverse functional forms based on detailed specification tests. Implicit elasticities with respect to the unemployment rate vary widely, between -0.1 and -1.8 , for the Federal Republic of Germany and Japan, respectively. For the United Kingdom, unemployment enters as the difference between the current rate and its lagged four-year average value, implying only a transitory unemployment effect. This result, associated with the hypothesis of hysteresis, receives strong empirical support. Government sector wage rates are modelled as adjusting with a lag to movements in private sector wage rates.

Prices are generally modelled as a mark-up on costs, assuming imperfect competition in product markets. For the major economies, the domestic price equations are based on the supply-block-consistent estimates reported by Stiehler (1987). These entail the linking of individual expenditure deflators to the business value-added deflator, determined on the basis of production-function measures of factor mix, factor costs and competitor prices. The key price equation is that for the business sector non-energy value-added deflator, which is related through an error-correction formulation to short- and long-run costs, the terms of trade, competitor prices and demand pressure. Long-run homogeneity with respect to a weighted average of costs and world prices is imposed and excess demand is measured in terms of the deviation of business sector output from a production-function-based measure of potential. Within this system, short-run movements in domestic prices are primarily determined by domestic costs but, given a relatively large weight for competitor prices and overall system properties, there is a strong tendency towards a "proportionate law of one price" in the longer run. The producer price system is completed by an equation for the domestic energy value-added deflator, a function of imported energy prices and domestic costs. For given producer prices, the domestic expenditure deflators are then determined through a set of linking equations, also taking account of energy and import prices.

For the smaller countries, consumer prices and other expenditure deflators are determined as a mark-up on labour and other costs, distinguishing energy and non-energy material costs and import content, and also allowing for trend developments in productivity. In general the mark-up process is variable, reflecting fluctuations in product market conditions as measured by the "gap" between actual output and an exogenous measure of potential output.

4. *Appropriation accounts*

The appropriation accounts for household, government and business sectors are constructed for each country by identifying the principal sources of income, expenditure, savings and net lending. Household income consists primarily of the wage compensation of employees, self-employment income and transfers. Property and other income are modelled as lagged functions of business income and interest flows. Household taxes and transfers are modelled separately in terms of the appropriate nominal bases and corresponding marginal tax and transfer rates. Social security payments and receipts are modelled as functions of the unemployment rate, prices and wage compensation levels.

Business sector taxes are modelled as a function of business income, with allowance for the lags between accruals and payments. The remaining components of the business appropriation account are derived as residuals; business income as GNP less the income of the household, government and overseas sectors, and business net lending as the difference between the foreign balance and net lending in the two other domestic sectors.

Given the frequency of changes in fiscal and government expenditure regimes, emphasis has been placed in the design of the fiscal blocks on the provision of adequate marginal properties for simulation, as opposed to average properties for tracking. The block nonetheless provides a clear and relatively standardised identity framework for projection purposes, although the specific details of the government accounts do vary across countries. For the United States a full disaggregation of revenues and expenditures is made as between Federal and State and Local accounts, with wage and non-wage expenditures also split between defence and non-defence spending. For the other major economies a relatively standardised total general government approach is adopted, whilst for some smaller economies there is a less detailed treatment of transfers, subsidies and property income. For a number of countries, allowance is also made for revenues and tax receipts from sectors of specific importance, for example oil and gas.

The current receipts of the government sector are in general defined as the sum of direct taxes on household and business sectors, indirect taxes, social security and other transfer receipts, and interest/property income. Indirect taxes are typically modelled as a function of weighted expenditure components, combined with corresponding marginal tax elasticities. Social security and other transfer receipts are linked directly to the corresponding household sector payments variables, whilst property income is assumed to grow broadly in line with nominal GNP.

Current disbursements in nominal terms are made up of government current expenditures, transfer and subsidy payments, and interest payments. For the major economies, the latter item is modelled with an implicit stock approach, as a function of interest rates (appropriately weighted), the implicit level of outstanding debt and an assumed fixed rate of rollover. Government net lending is then defined as current

savings less investment, capital consumption and miscellaneous capital transactions. The stock of government net financial liabilities is obtained by the cumulation of net lending from given benchmark values and subject to statistical discrepancy terms.

5. *The domestic monetary sector*

As indicated in Table 2, the specific details of the domestic monetary sectors, dealing with the determination of monetary aggregates and interest rates, vary between specific groups of countries. Original QECD work in this area is reported by Blundell-Wignall *et al.* (1984a and b), with the more recent estimates currently used in the model described in Richardson (1987b).

For the major economies, money demand functions are included, relating a range of broad and narrow monetary aggregates to GMP, the price level, the inflation rate, and the level of short-term interest rates⁴. Homogeneity with respect to prices is imposed and real income elasticities range between 1.0 and 1.5. Corresponding interest rate semi-elasticities are on average -1.5 . Although a considerable amount of research has been carried out with respect to policy reactions and short-term interest rates, the reaction-function approach has been found to be relatively unsatisfactory for the major economies. Instead, short-term interest rates are formally exogenous in these models, but may be endogenised through specific policy targeting options. A policy regime involving fixed monetary targets can, for example, be achieved through the inversion of the money demand equations with interest rates set as the market-clearing instrument. Alternatively, short-term rates can be used as instruments to achieve exchange rate targets, through the exchange rate equation system, or to maintain unchanged long-term real rates.

The models for the smaller QECD countries do not in general include money demand equations and money supply is determined, through identity, as domestic credit adjusted for unsterilized changes in reserves. Short-term interest rates for these countries are modelled as a function of weighted foreign short-term rates and money velocity. As for the major economies, a variety of alternative policy assumptions can be substituted in simulation and forecasting applications.

Long-term interest rates provide the principal direct link between monetary and real sectors, through their influence on consumption, investment and supply decisions⁵. The term structure of interest rates is determined through an equation linking long rates to short rates, subject to the influence of inflation acceleration and the ratio of the government deficit to GNP. The equation structure is generally of an error-correction form, implying a long-run unitary coefficient on the short-rate. The mean lags involved are however relatively long, implying only a partial adjustment of long rates over a two- to three-year period. Forward-looking expectations are not

formally treated in the standard version of the model, although some experimentation has been carried out with "model-consistent" expectations generation, as reported by Masson and Richardson (1983) and Masson *et al.* (1984).

6. *International economic linkages*

Chart A illustrates the principal areas of international linkage featured in the model; those concerned primarily with international trade, commodity markets, investment income flows and exchange rates.

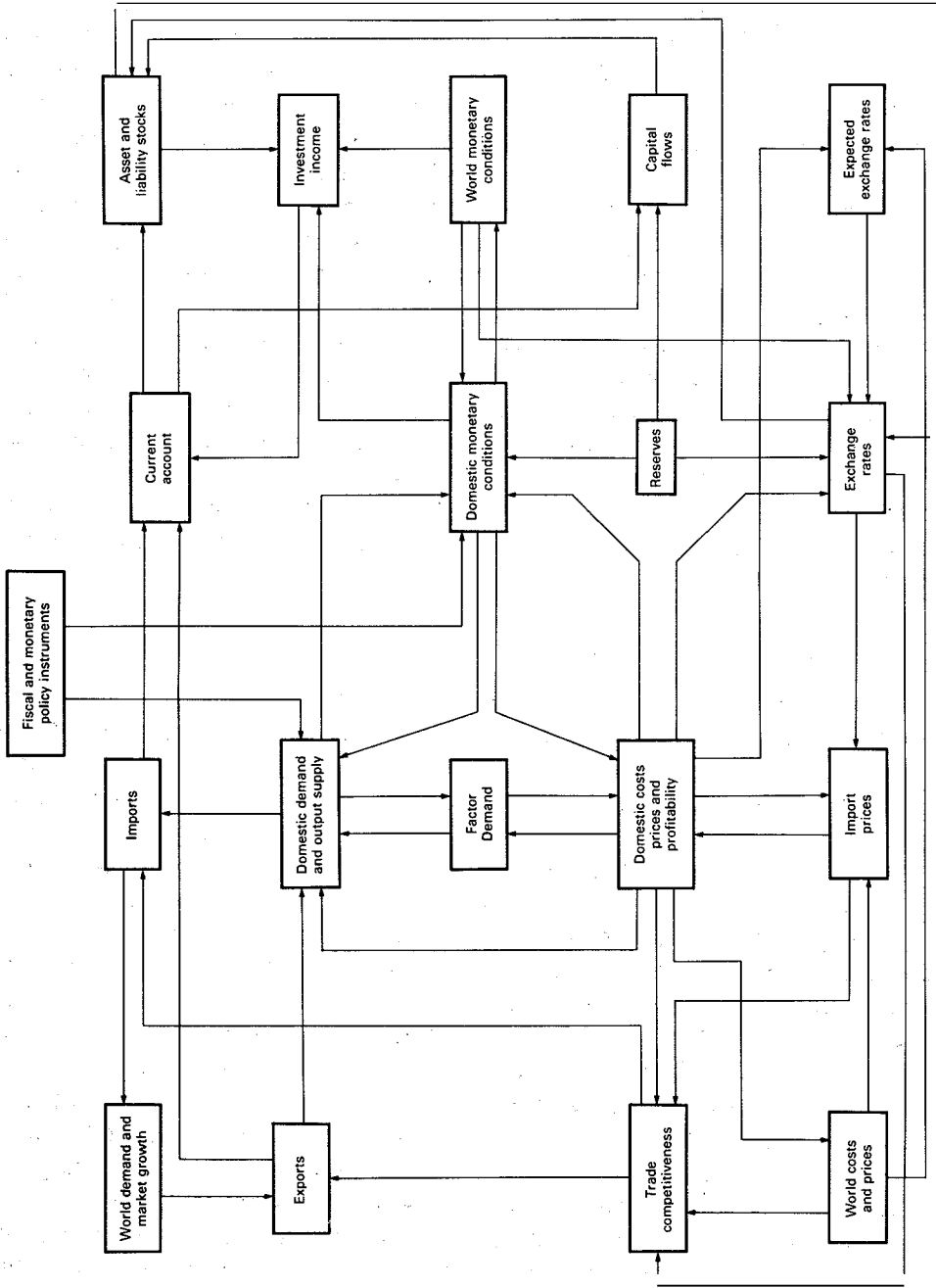
The trade volume and price relationships provide the most direct channels of international transmission for economic activity and prices. For an individual country, import volumes are related to weighted expenditure demands and price competitiveness. Allowing for the relative importance of individual markets to individual exporters, global import demands are then allocated through a set of export volume share equations taking into account the pattern of market growth, world trade elasticities and price competitiveness. Global consistency between import and export volumes is broadly enforced by parameter restrictions across the set of export volume equations. The presence of global discrepancies in the underlying international trade data sometimes makes further consistency adjustments necessary in simulation and these are made on an export shares basis.

Export prices for manufactured goods and non-factor services are related to domestic and imported costs and competitor prices, whilst food and basic raw material prices are linked directly to OECD export-weighted world commodity price indices, with some influence also coming from domestic cost levels⁶. As described by Holtham and Durand (1987), world market prices for selected OECD and non-OECD weighted aggregate commodity groups are modelled as functions of the general OECD price level, oil prices, interest rates, exchange rates and activity, measured in terms of OECD real GNP growth. In simulation, world energy prices are normally assumed to be fixed in relation to the world price of manufactures. Import prices are then related by country and commodity to corresponding "shadow" import price measures, constructed on the basis of market-weighted export prices. For manufactures and non-factor services, weight is also given to the influence of domestic prices in the importing country on profit margins, subject to a cross-equation global consistency constraint. More recent work in this area is reported by Herd (1987).

International investment income flows, exogenous in earlier published versions of the model, are now determined on the basis of the various relationships described in Coe *et al.* (1987). The principal features of this system, based largely on portfolio investment considerations, involve the determination of the effective yields on the asset and liability stocks of individual countries, taking into account portfolio composition and currency denomination, as well as domestic and foreign short- and long-term interest rates. Asset and liability stocks are determined on the basis of

CHART A

TRADE AND FINANCIAL LINKAGES IN THE INTERLINK MODEL



capital flows, cumulated from benchmark estimates, allowing also for the effects of currency-related revaluations.

In addition to the investment income system, a principal element of financial linkage in the model relates to exchange rates. The exchange-rate system currently incorporated in INTERLINK is, in most respects, identical to earlier OECD work reported by Holtham (1984). The expected exchange rate is driven primarily by a purchasing-power-parity relationship, with the deviation of actual from expected effective exchange rates determined by the differential between domestic and weighted foreign short-term interest rates and by the cumulative stock of net foreign assets. The current system therefore permits the consistent determination of effective and bilateral exchange rates for the majority of OECD countries, taking into account international interest rate differentials, relative price developments and current-account performance. Exchange rates for some of the smallest OECD countries are determined outside of this consistent portfolio-based system, on the basis of explicit real and nominal exchange rate rules. In fixed-exchange-rate mode, the relevant effective exchange-rate relationships can be targeted to determine the required levels of exchange market interventions or, alternatively, appropriate interest rate differentials. For the smaller countries a further element of financial linkage relates to short-term interest rates which are determined through estimated reaction-function relationships, adjusting to movements in weighted foreign short-term rates.

7. Non-OECD area models

The non-OECD countries are represented in INTERLINK in the limited form of trade and service account models for six country groupings⁷. The content of these area blocks is the same as that of the OECD country trade blocks, with differences between areas reflected largely in terms of different parameter values, lag structures on import functions and underlying differences in the structure of trade.

Non-OECD exports of goods and services are determined by commodity within the same overall framework as OECD exports, responding to changes in market growth and price competitiveness. Imports by commodity are determined as functions of export revenues, adjusted for net transfers, with spending coefficients and the associated speeds of adjustment varying across country groups. Revenues are in general assumed to be fully spent over two and a half years, with the quickest speeds of adjustment being those for the low- and middle-income developing countries and the slowest speeds those for the low-absorptive OPEC countries. In simulation this generally implies only a transitory influence of shocks on the non-OECD current-account balance. With debt interest payments accounting for a high proportion of the current-account deficits of many non-OECD countries, the recent inclusion of the investment income block provides an important strengthening of links between monetary conditions in the OECD countries and non-OECD

behaviour. Further empirical work, however, remains to be done on the limiting influence of the debt burden and supply factors on net imports.

Export prices for basic materials are linked directly to the commodity price sector, adjusting proportionately to movements in exporter-weighted average UNCTAD commodity price indices. For manufactures, non-OECD producers are assumed to be price takers, with export prices moving broadly in line with the corresponding average OECD manufacturing price levels. Energy prices are also assumed to be constant in relation to manufacturing prices. Non-OECD import prices are based entirely on the "shadow import price" approach, moving with exporters' prices weighted by the relative importance of individual suppliers to non-OECD markets.

II. SINGLE-COUNTRY MODEL SIMULATION PROPERTIES

This section reviews the unlinked, single-country simulation properties of the major seven economy models within INTERLINK, drawing on the more detailed analysis given by Richardson (1987c)⁸. The simulation shocks considered – standardized changes in fiscal and monetary policy variables – are clearly of policy relevance but the main emphasis here is on the specific model mechanisms involved rather than the feasibility or desirability of the various changes in macroeconomic policy. In this respect, the shocks are all uniform and arbitrary in direction. The orders of magnitude are sufficiently small and the model sufficiently symmetric for the relevant signs of shocks and results to be reversed without significant loss of accuracy. Given the influence of non-linearities in the model, extrapolations to shocks of larger magnitudes are, however, likely to be less reliable.

A. Fiscal multipliers under alternative monetary policy assumptions

Detailed results for a set of standardized fiscal shocks to each of the major seven country models are presented in Table 3. These simulations are based on sustained increases in real government non-wage expenditures worth 1 per cent of baseline GNP, assuming unchanged growth rates of broad monetary aggregates and endogenous exchange rates. In order to demonstrate the importance of the associated monetary assumptions to the results, the simulations were also carried out for a range of alternative monetary policy and exchange rate assumptions and, for comparative purposes, the main differences in output and price responses are illustrated in Chart B.

Table 3. Singlecountry effects of an increase in government expenditures with unchanged broad money supplies and floating exchange rates'

Percentage differences from baseline levels

		UNITED STATES	JAPAN	GERMANY	FRANCE	UNITED KINGDOM	ITALY	CANADA
Real GDP/GNP	1983	1.1	1.1	0.9	0.6	0.9	0.9	0.8
	1984	0.8	1.2	1.0	0.9	0.8	1.0	1.1
	1985	0.5	0.9	0.7	1.1	0.4	0.9	0.6
	1986	0.5	0.3	0.4	1.0	0.3	0.7	0.2
	1987	0.4	0.0	0.5	0.9	0.3	0.6	-0.0
Private consumption	1983	0.3	0.4	0.3	0.1	0.2	0.1	0.3
	1984	0.4	0.7	0.4	0.2	0.3	0.3	0.5
	1985	0.3	0.6	0.4	0.3	0.3	0.3	0.2
	1986	0.4	0.3	0.3	0.4	0.3	0.2	-0.1
	1987	0.4	0.2	0.4	0.4	0.3	0.1	-0.4
Total private investment	1983	1.0	1.2	0.9	0.9	0.7	1.7	0.4
	1984	-0.2	1.0	1.1	1.7	0.6	1.7	1.2
	1985	-0.8	-0.5	0.8	2.2	-0.7	1.1	1.4
	1986	-0.7	-1.9	0.2	2.0	-1.8	0.3	1.0
	1987	-1.1	-2.5	-0.1	1.3	-2.3	-0.4	0.3
Stockbuilding ²	1983	0.1	-0.2	0.0	-0.3	0.1	0.0	-0.1
	1984	0.0	0.0	0.1	-0.1	0.2	0.1	0.2
	1985	-0.1	0.1	0.0	0.1	-0.1	0.0	-0.1
	1986	-0.1	0.0	-0.2	0.2	-0.1	0.0	-0.2
	1987	-0.1	0.0	-0.1	0.2	0.0	0.0	-0.3
Real foreign balance ²	1983	-0.3	-0.2	-0.4	-0.3	-0.5	-0.4	-0.3
	1984	-0.4	-0.4	-0.6	4.5	-0.6	-0.4	-0.6
	1985	-0.5	-0.5	-0.6	-0.6	-0.5	-0.4	-0.7
	1986	-0.6	-0.5	-0.6	-0.7	-0.5	-0.4	-0.6
	1987	-0.6	-0.4	-0.7	-0.8	-0.5	-0.4	-0.6
GDP/GNP deflator	1983	0.3	-0.2	0.1	0.0	0.0	0.1	0.0
	1984	1.0	0.2	0.4	0.1	0.1	0.1	0.5
	1985	1.5	0.5	0.4	0.2	0.3	0.3	1.3
	1986	2.1	0.8	0.3	0.4	0.4	0.6	2.0
	1987	2.7	0.9	0.2	0.6	0.5	1.0	2.7
Wage rate	1983	0.6	0.3	0.4	0.0	0.0	0.2	0.2
	1984	1.3	0.8	0.6	0.2	0.3	0.5	0.9
	1985	2.0	1.1	0.5	0.3	0.6	0.8	1.7
	1986	2.7	1.1	0.2	0.5	0.8	1.3	2.6
	1987	3.4	1.1	0.2	0.8	0.9	1.9	3.3
Total employment	1983	0.5	0.2	0.2	0.1	0.3	0.1	0.4
	1984	0.5	0.2	0.5	0.3	0.6	0.2	0.8
	1985	0.2	0.2	0.5	0.4	0.6	0.2	0.5
	1986	0.1	0.1	0.3	0.4	0.4	0.2	0.2
	1987	0.0	0.1	0.2	0.5	0.4	0.2	0.0

Table 3 (contd)

		UNITED STATES	JAPAN	GERMANY	FRANCE	UNITED KINGDOM	ITALY	CANADA
Unemployment rate ³	1983	-0.4	0.0	-0.2	-0.1	-0.2	-0.1	-0.3
	1984	-0.5	0.0	-0.4	-0.2	-0.5	-0.2	-0.7
	1985	-0.2	0.0	-0.4	-0.2	-0.5	-0.2	-0.5
	1986	-0.1	0.0	-0.3	-0.3	-0.4	-0.2	-0.2
	1987	-0.1	0.0	-0.2	-0.3	-0.4	-0.2	-0.1
Effective exchange rate	1983	0.1	0.4	0.4	0.2	0.5	0.0	0.2
	1984	-0.1	1.1	0.8	0.5	1.0	0.0	0.6
	1985	-0.6	1.3	0.7	0.9	1.0	-0.2	0.4
	1986	-1.3	0.7	0.3	0.9	0.7	-0.4	-0.1
	1987	-1.7	0.0	0.2	0.9	0.5	-0.7	-0.7
Short-term interest rate ³	1983	0.6	0.7	0.9	0.5	0.9	0.3	0.4
	1984	1.0	1.8	1.5	1.0	1.5	0.3	1.6
	1985	1.1	1.8	1.0	1.4	1.2	0.4	1.9
	1986	1.3	1.3	0.4	1.7	1.1	0.5	2.1
	1987	1.6	0.8	0.5	1.9	1.3	0.6	2.2
Government financial balance ⁴	1983	-0.8	-1.0	-0.9	-1.3	-1.0	-1.4	-0.9
	1984	-0.8	-1.0	-0.8	-1.6	-1.0	-1.7	-1.2
	1985	-1.1	-1.1	-1.0	-1.9	-1.3	-2.1	-1.6
	1986	-1.4	-1.3	-1.1	-2.1	-1.7	-2.5	-2.2
	1987	-1.6	-1.6	-1.3	-2.5	-2.1	-2.9	-2.8
Current balance (US\$ billion) ³	1983	-11.3	-2.1	-2.4	-1.7	-2.3	-1.6	-0.9
	1984	-13.9	-2.8	-3.0	-2.5	-3.1	-2.0	-2.0
	1985	-15.4	-3.3	-3.3	-3.4	-3.0	-2.1	-2.4
	1986	-18.6	-3.8	-4.9	-4.9	-3.6	-2.3	-2.7
	1987	-22.1	-4.1	-5.6	-5.7	-4.2	-2.4	-3.1

1. An increase in government non-wage expenditures equivalent to 1 per cent of baseline real GNP/GDP.

2. Per cent of baseline real GNP/GDP.

3. Level deviation from baseline.

4. Percentage deviation from baseline GNP/GDP.

Before discussing individual results, it is useful to outline the relevant channels operating in the model, noting in particular the interaction between demand and supply elements, and the influence of alternative monetary policy assumptions. The overall description also provides background information relevant to the shocks considered in later sections.

The immediate effect of increased government expenditure is to raise *ex ante* demand through the standard income-expenditure relationships which, allowing for import leakages, tends to raise output in the short term. In the model, the extent to which increased demand is met by higher output is determined by the business

CHART B

**PRICE AND INCOME RESPONSES FOR GOVERNMENT
EXPENDITURE SHOCKS UNDER ALTERNATIVE
MONETARY ASSUMPTIONS**

- Fixed money supply, floating exchange rate
- Fixed money supply, fixed exchange rate
- - - Fixed interest rate, floating exchange rate
- Fixed interest rate, fixed exchange rate

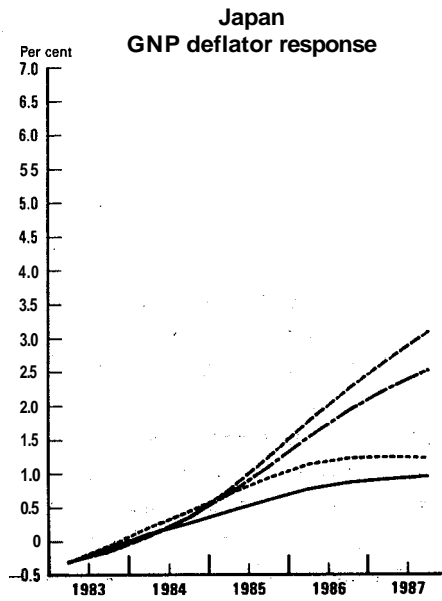
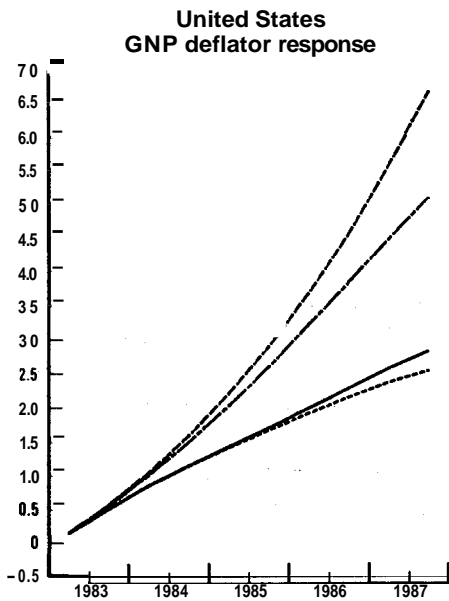
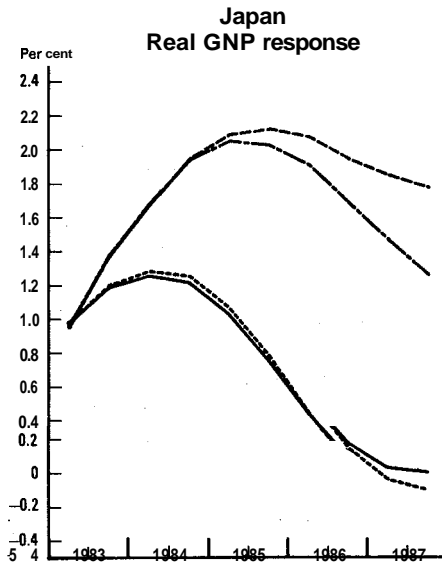
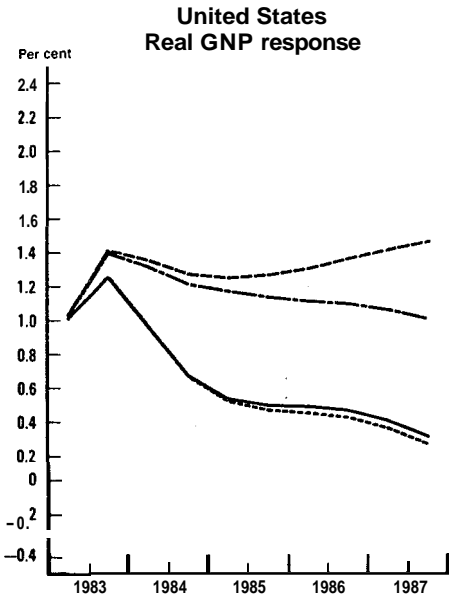
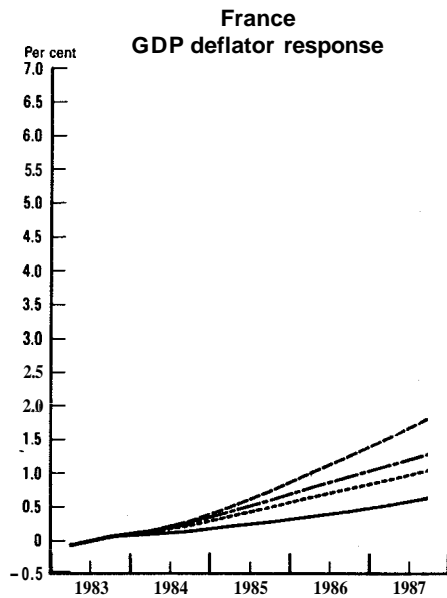
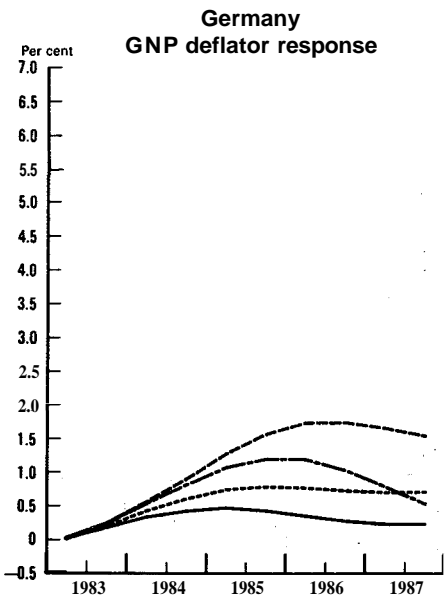
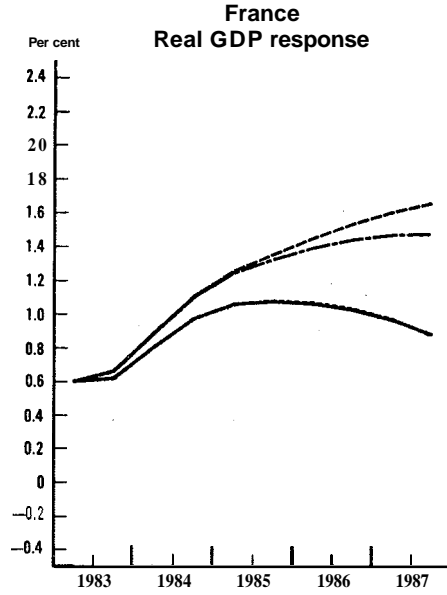
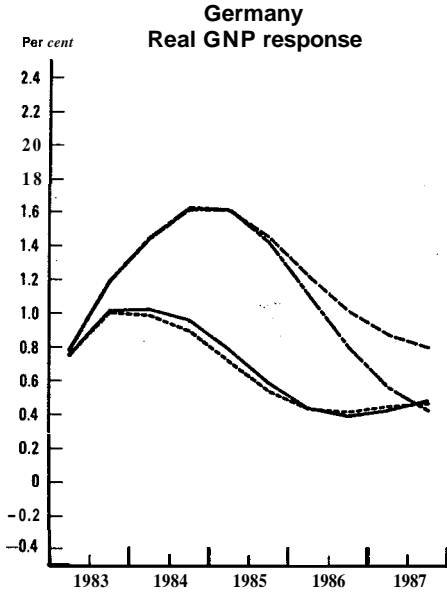


CHART B (continued)

PRICE AND INCOME RESPONSES FOR GOVERNMENT EXPENDITURE SHOCKS UNDER ALTERNATIVE MONETARY ASSUMPTIONS

- Fixed money supply, floating exchange rate
- Fixed money supply, fixed exchange rate
- - - Fixed interest rate, floating exchange rate
- - - Fixed interest rate, fixed exchange rate



CHARTB (continued)

PRICE AND INCOME RESPONSES FOR GOVERNMENT EXPENDITURE SHOCKS UNDER ALTERNATIVE MONETARY ASSUMPTIONS

- Fixed money supply, floating exchange rate
- Fixed money supply, fixed exchange rate
- - - Fixed interest rate, floating exchange rate
- - - Fixed interest rate, fixed exchange rate

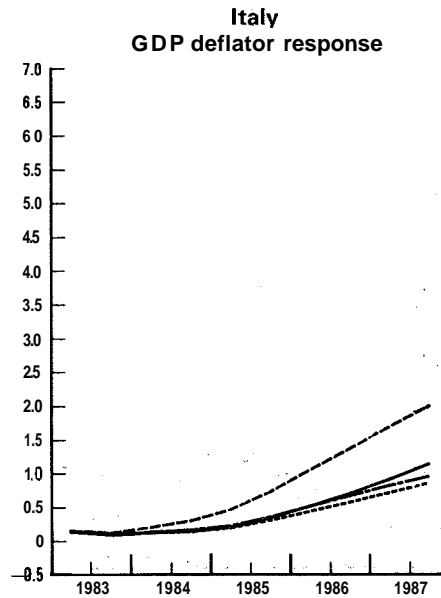
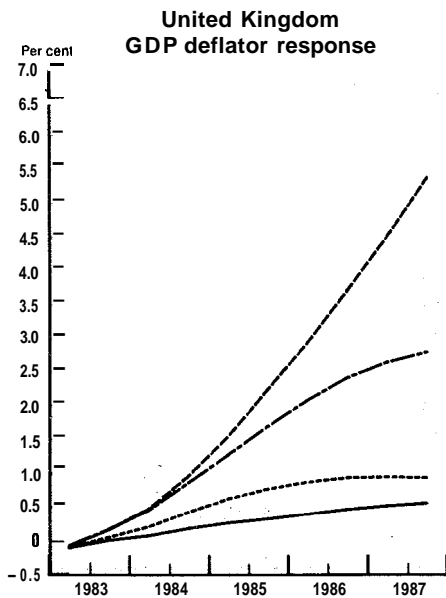
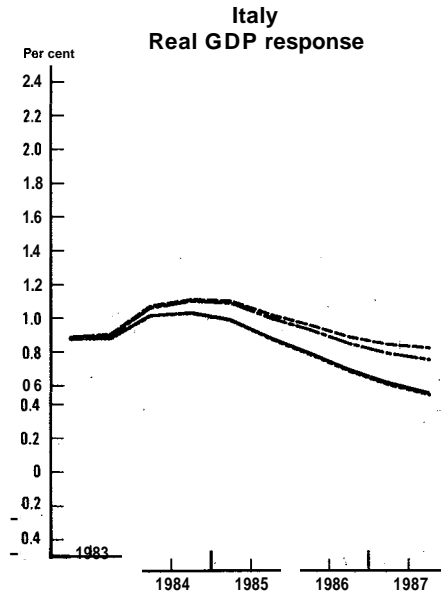
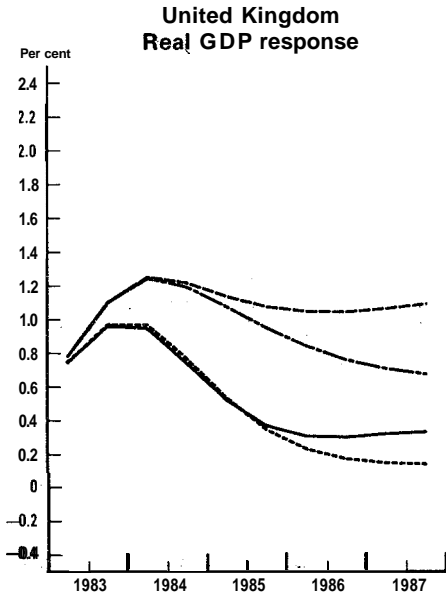
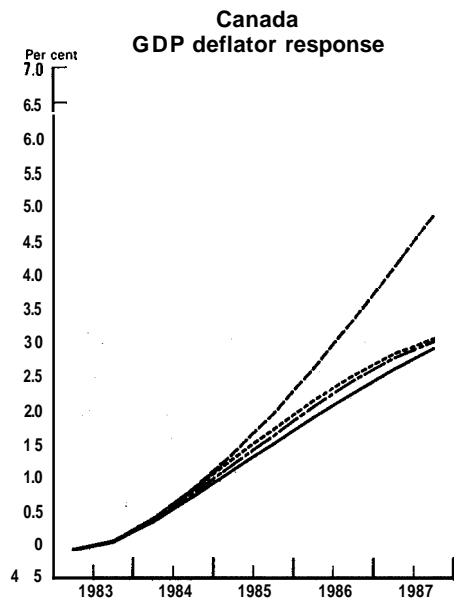
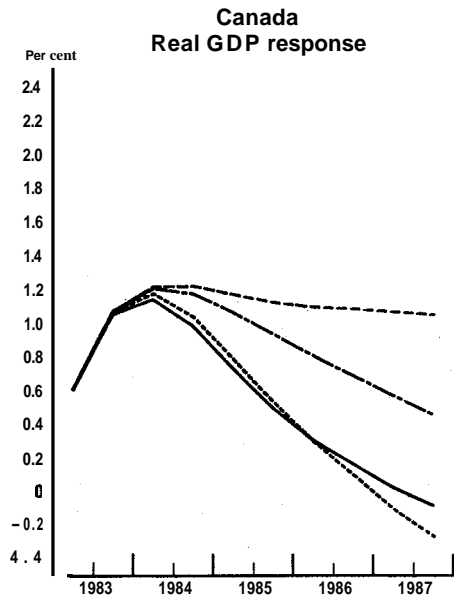


CHART B (continued)

PRICE AND INCOME RESPONSES FOR GOVERNMENT EXPENDITURE SHOCKS UNDER ALTERNATIVE MONETARY ASSUMPTIONS

- Fixed money supply, floating exchange rate
- Fixed money supply, fixed exchange rate
- - - Fixed interest rate, floating exchange rate
- . - Fixed interest rate, fixed exchange rate



sector supply equation, which also takes into account profitability, the stock-output ratio and the level of "normal" output – that given by the production function at existing levels of factor inputs. To the extent that these factors – labour, capital and energy – are slow to adjust, some combination of a higher rate of factor utilization and run-down of inventories will occur, with the balance between these movements depending on the elasticity of factor utilization with respect to the normal sales to output ratio. The closer this elasticity response is to unity, the greater is the actual output adjustment to demand and the smaller the amount of destocking. Beyond the first period, the strength of stock-adjustment response is also important in determining the rate at which output adjusts to restore normal stock levels.

For given factor prices and profitability, higher ex *ante* demand and output raise the demand for factors of production through the influence of current output on expected future output. The adjustment of factor demand towards these desired levels in turn increases aggregate demand directly, in the form of business fixed investment, and indirectly, through the influence of higher employment and factor incomes on disposable income, consumption and housing investment. The model's multiplier-accelerator mechanism is therefore significantly influenced by the characteristics of the business supply sector, with the short-run constraint of the supply block attenuating the effects of a demand shock on output. At the same time, potential output and supply are also influenced in the longer run by demand, insofar as factor demands and, thereby, normal output also adjust.

The short-term situation outlined above is primarily one of disequilibrium in money, goods and labour markets, given the constraints of a fixed path for monetary aggregates, the production function and fixed factor supplies. As a result, it is very much the responses of the relevant "prices" – interest rates, product prices and wages – and the longer-term influences of inflation, profitability, competitiveness and the cost of capital, which determine the speed with which these excess demands are eliminated.

With respect to wages, the initial effects of a fiscal shock are those coming through labour market tensions, as employment begins to adjust to an increased desired level and unemployment falls. To the extent that labour supply is endogenous and also responds partly to increased demand, the effect of higher employment on the unemployment rate will also be modified by "discouraged" and "added" worker effects. For Japan, for example, the former effect is particularly strong and gives significantly damped unemployment responses to demand-side shocks. The additional influence of goods market disequilibrium on producer prices enters primarily through the effects of movements in output in relation to potential, with the latter adjusting relatively slowly to movements in factor prices. Producer prices in combination with import prices drive the expenditure deflator system, and the interaction of the expectations-augmented Phillips curve then gives further cumulative movements in wages and prices. The form of the wage equations and the relative lags in wage and price responses are generally such that there is some

tendency towards a higher real wage over a five-year period following an exogenous increase in expenditures.

The emergence of higher prices and costs over time has, in turn, a number of longer term **real-side** effects. For the trade sector, higher domestic prices and costs will, for a given exchange rate, reduce domestic competitiveness and, with a lag, reinforce the negative effects on the real trade and current-account balances, although with a floating exchange rate this becomes less important over time. With relative factor prices moving in favour of capital, as real wages rise and expected real interest rates fall, there will also be some relative shift from labour to capital. Output supply and fixed investment responses will also be dampened as short-term increases in profitability from higher labour productivity are progressively eroded over time. The tendency for real wages to rise and real interest rates to fall would, *ceteris paribus*, tend to raise consumer spending further, but for most countries this effect is offset by the influence of inflation on consumption, representing an implicit wealth effect. The overall presumption, therefore, is that even with fixed nominal interest rates, inflation effects **will** be sufficiently powerful to erode the GNP multiplier, shifting over time the split of higher nominal demand from real activity to prices.

With broad monetary aggregates assumed to be unchanged, the money demand equations are effectively inverted to determine the market-clearing levels of short-term interest rates. For given increases in GNP and prices, the extent to which interest rates need to increase to keep money demand at the target money supply value is determined by the relevant income, price and interest rate elasticities. Given the form of the yield curve relationships, these immediate increases in short-term interest rates are gradually passed through to the long-term rate, which in turn feeds directly into the cost of capital and related cost and profitability measures in the supply block.

The primary effect of higher nominal interest rates on supply is to dampen and progressively reverse the positive effect of the demand stimulus on investment and the capital stock. Short-term increases in normal output will be eroded as higher interest costs reduce profitability, so that increases in output supply and factor utilization rates tend to diminish over time. An increase in the price of capital relative to labour also implies some relative substitution towards labour, but the overall employment response is dominated by the declining effects of actual and expected output. Higher real interest costs and smaller increases in disposable income also act to reduce the positive response of consumption and housing investment to higher demand. Over a **four-** to five-year period, the overall effect on the private sector of endogenising interest rates is to give a significant degree of crowding-out of the positive effects of higher government expenditures. For prices, the effects of higher capital costs caused by higher interest rates are relatively slow to feed through and the dominant influence on inflation is that coming from activity, which declines progressively over the period.

Dominated by a demand-led decline in real net exports, the overall effects of the fiscal shock on the current-account balance will be negative, cumulatively so for the investment income balance as the net foreign asset stock is eroded. The modifying effects of higher interest rates, through progressively lower income multipliers and smaller domestic price effects, will tend to give a smaller real decline in the trade and non-factor services balance. The effects on investment income flows depend on the relative composition of assets and liabilities as between domestic and foreign short- and longer-term interest-bearing securities but are generally too small to significantly modify the results for the external balance.

The nominal exchange rate is subject to two opposing influences. On the one hand, higher domestic prices and the deterioration in the external balance exert downward pressure on the expected and actual exchange rates; on the other, higher domestic interest rates increase the attractiveness of domestic assets and therefore exert upward pressure. The equilibrium level of the exchange rate will therefore tend to be higher than that obtained under fixed interest rate assumptions although, depending on the relative strength of the above influences, it may rise or fall in relation to baseline. In the case of an overall appreciation, price responses will tend to be more damped, implying stronger consumption but a weaker real trade balance, and for the external balance as a whole will result in some further decline.

For the government balance, higher levels of output, expenditure and employment tend to raise direct and indirect tax yields whilst reducing transfer payments, offsetting at least part of the cost of the expenditure increase. Inflationary effects, on the other hand, raise the nominal value of both payments and receipts, with the net effect depending on their precise composition, the degree of indexation and the relevant payments lags, whilst the effects of cumulative debt will be important in determining public sector interest payments. In general, the positive effects of the short-run increases in revenue due to higher activity rates will be eroded in the longer run both by progressive decreases in the multiplier and the influence of cumulative debt. As interest rates rise, the effect on the government balance becomes significantly more negative, with the income response being crowded-out and interest payments on new and existing public sector debt increasing over time.

Turning to the specific country results shown in Table 3, some clear patterns emerge. For the given monetary and exchange rate assumptions, the real **GNP/GDP** multipliers for the major economies follow broadly similar profiles, tending to rise during the first year or so to a peak in the second year and falling steadily thereafter. The largest short-term multipliers are those for Japan and the United States and in part reflect smaller marginal propensities to import and also above-average consumption responses to income changes⁹. The multiplier for France is atypically low in the first year and remains stable over time at around unity. This reflects two specific factors: a relatively low sales elasticity in the output-supply equation, implying a large supply "buffer" effect on stocks, and a relatively low stock-

adjustment effect thereafter. In the case of the French model, the output-supply equation redistributes the output response over time. On a semi-annual basis, most countries experience destocking in the first semester, but the lagged stock-adjustment is in general sufficiently strong to give a rebound thereafter. The supply equations for both Japan and Canada also have relatively low short-term sales elasticities and experience significant destocking in the first semester. For Japan, this is offset by a particularly large stock-adjustment term. For Canada, a lagged sales term comes into effect in the second semester.

Higher nominal demand has the effect of driving up short- and long-term interest rates through the incipient increases in money demand. For short rates, the largest increases are those for the United Kingdom, Japan, and the Federal Republic of Germany, countries for which the slopes of the LM curve are relatively steep. Averaged over the seven major economies, short rates rise by **100** to **125** basis points over the period. The degree of interest-rate-induced crowding-out can be judged from Chart 5. For all countries, GNP multipliers are seen to be significantly reduced beyond the second year, with near to full crowding-out for Japan, Canada and the United Kingdom by the fifth year. Averaged over the seven countries, the GNP multiplier reaches a peak of **1.0** in the second year, falling evenly thereafter to **0.3** in the fifth year. Given higher capital costs and real interest rates, the most significant contributions to this process come from private fixed investment and stock building. For a number of countries, the employment effect remains relatively stable in the short term, but falls generally over time with lower output effects failing progressively to offset the effects of higher labour costs. By the fifth year, the highest multiplier is that for France, at **0.9**, although for this country interest rates rise substantially given the relatively buoyant nominal income response and the lowest overall money demand semi-elasticity with respect to interest rates. From Chart B it can be seen that the degree of crowding-out in the French model is nevertheless substantial, but the general upward profile of the GNP multiplier obtained with fixed interest rates (a fifth-year multiplier of **1.5**) and the absence of significant inflation and interest rate effects on consumption imply a much slower process than for the other major economy models.

For wages and prices, the largest short-term responses are those for the United States, reflecting a relatively fast employment-output adjustment and an above-average wage elasticity with respect to the unemployment rate. The failure of inflation to choke off demand more quickly in part reflects a comparatively small consumption response to inflation. Thus, although the U.S. employment response is damped by a markedly higher real wage, real consumption stays on a level path over the period. Given both a large and rapid employment adjustment and also a relatively high wage elasticity with respect to unemployment, the Canadian model too has above-average wage and price responses, but over time these feed back fairly strongly onto employment, consumption and investment. In spite of significant movements in employment and unemployment levels, the lowest overall wage and

price responses are those for the Federal Republic of Germany, France and the United Kingdom. In the latter case, the "hysteresis" form of the wage equation heavily attenuates the effect of reduced unemployment over time. For France and the Federal Republic of Germany, the wage/unemployment elasticities are relatively low. For all seven countries there is some tendency towards a higher real consumption wage, notably so for the United States and Japan. For the Federal Republic of Germany, the real wage also reflects the cyclical influences on labour productivity growth. Thus the real wage response is strong at the beginning, but weakens at a later stage, when output is being distributed among an increased number of employees.

The results for exchange rates fall into two general categories: for some countries, the exchange rate tends to depreciate progressively over the period, reflecting either relatively large price movements (as in the case of the United States) or relatively small interest rate movements (as in the case of Italy); for others, the interest rate responses are sufficiently strong to offset the effect of a lower expected exchange rate, thereby giving an appreciation for most, if not all, of the period. The Canadian model shows a mix of the two responses, with a minor appreciation over the first three years followed by a minor depreciation.

In spite of steady reductions in GNP multipliers over the period, the decline in the real foreign balance tends to stabilize from the second year. This reflects the failure of exchange rates to compensate for the loss of price and cost competitiveness, the effects of higher levels of domestic interest rates on outward flows of investment income and the cumulative effects of a worse current balance on the net stock of foreign assets. In U.S. dollar terms, current balances decline steadily through the period, as do government financial balances.

Comparing the various real fiscal multipliers summarised in Chart B, a fairly consistent ranking of multiplier and price responses emerges. With the exception of the Italian model, the impact of monetary non-accommodation is clearly quite significant in reducing output and price responses. For Italy, interest rate movements are small given a relatively high semi-elasticity of money with respect to interest rates. The largest GNP and price responses are in general those that result from assuming fixed interest rates and floating exchange rates. In this case, monetary accommodation in the form of faster growth of the money supply permits a higher level of output, with multipliers averaging $1\frac{1}{4}$ to $1\frac{1}{2}$, whilst driving up prices and costs, by an average $3\frac{1}{2}$ per cent by the fifth year. With exchange rates driven essentially by purchasing-power-parity considerations, a floating rate assumption tends to perpetuate the inflationary spiral, working through higher import costs.

With a fixed money supply assumption, the differences between results for fixed and floating exchange-rate regimes are relatively minor, certainly by comparison with those for the fixed interest rate case. The main reason is that with higher interest rates and more moderate price movements, the effects on exchange rates are relatively small. The more important contrast is that of the impact of

alternative monetary policy assumptions under floating exchange rates. These results show the most striking difference in the outturns for activity and prices for all countries, reflecting the strong interaction of interest rate and exchange rate assumptions. With fixed interest rates, the exchange rate depreciation arising from inflationary pressures is relatively substantial and tends to sustain both activity and inflation responses. With fixed money, higher interest rates limit or reverse the extent of currency depreciation, whilst substantially reducing the overall output response through the effects of higher capital costs primarily on investment. The combination of these two factors gives major reductions in price and wage responses, by reducing both import costs and pressure of demand effects on the goods and labour markets.

B. Monetary conditions

The influence of monetary conditions is examined with a 100-basis-point reduction in short-term interest rates. A summary of relevant results obtained with floating exchange rates is given in Table 4, whilst Chart C provides a comparison of **GNP** and price results under alternative floating and exogenously fixed exchange rate assumptions. In both cases, government expenditures in real terms are maintained at baseline levels.

The principal mechanisms involved in these simulations are those outlined in earlier paragraphs. A reduction in short-term rates feeds through gradually into long-term rates and thereby reduces capital costs and the cost of consumer borrowing, and increases short-term profitability. These increase consumption and investment demand, raising ex ante sales, normal output and, through the output supply equation, the level of production. Employment is affected by two countervailing forces – those coming from factor substitution, given a lower relative cost of capital, and those coming from output, reflecting higher demand and improved profitability. Consumption is raised by a combination of higher income and lower interest costs. With fixed exchange rates and higher demand, the real trade balance is adversely affected. For wages and prices, increases in output relative to potential output and lower unemployment exert upward pressure, although these are partially damped through the impact of lower interest costs and modified by changes in productivity. Given lower interest payments and higher activity rates, the net effects on the government balance are positive.

With floating exchange rates, the combination of lower short-term interest rates, higher prices and a decline in the current account gives a steady depreciation. This in turn helps offset the decline in the real trade balance, reinforcing the real **GNP** response, but adding to inflationary pressures on prices and wages through higher import costs. Given the positive effects of improved short-run competitiveness on net exports, the current balance effects will be less negative in the longer term.

Table 4. Single-country effects of a 1 percentage point decrease in short-term interest rates with floating exchange rates

Percentage differences from baseline levels

		UNITED STATES	JAPAN	GERMANY	FRANCE	UNITED KINGDOM	ITALY	CANADA
Real GDP/GNP	1983	0.2	0.2	0.2	0.1	0.1	0.1	0.1
	1984	0.7	0.5	0.5	0.2	0.4	0.2	0.3
	1985	0.8	0.9	0.7	0.3	0.5	0.4	0.5
	1986	0.8	1.2	0.7	0.4	0.6	0.5	0.5
	1987	0.8	1.3	0.7	0.6	0.7	0.6	0.6
Private consumption	1983	0.0	0.1	0.1	0.0	0.1	0.0	0.0
	1984	0.1	0.3	0.1	-0.1	0.2	-0.1	0.1
	1985	0.1	0.5	0.1	-0.1	0.2	-0.2	0.2
	1986	0.0	0.7	0.1	-0.1	0.2	-0.3	0.2
	1987	-0.1	0.8	0.1	0.0	0.1	-0.3	0.1
Total private investment	1983	1.3	0.7	0.4	0.2	0.7	0.4	0.1
	1984	3.1	1.8	1.1	0.7	1.7	1.7	0.5
	1985	3.5	2.7	1.8	1.3	2.7	3.3	1.0
	1986	3.8	3.4	2.1	2.1	3.8	5.1	1.6
	1987	4.5	4.0	2.1	2.8	4.7	6.5	2.1
Stockbuilding ¹	1983	0.1	0.0	0.1	0.0	0.0	0.0	0.0
	1984	0.2	0.0	0.3	0.0	0.1	0.0	0.1
	1985	0.1	0.0	0.3	0.0	0.1	0.1	0.1
	1986	0.1	0.0	0.3	0.0	0.0	0.1	0.1
	1987	0.0	0.0	0.2	0.1	0.0	0.0	0.1
Real foreign balance'	1983	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
	1984	-0.1	0.0	0.0	0.1	0.0	0.1	0.0
	1985	0.0	0.0	0.0	0.1	0.0	0.1	0.0
	1986	0.0	0.0	0.0	0.1	-0.1	0.0	0.0
	1987	0.1	-0.1	0.0	0.0	-0.1	0.0	0.0
GDP/GNP deflator	1983	0.1	0.0	0.1	0.0	0.1	0.1	0.0
	1984	0.6	0.1	0.4	0.2	0.6	0.5	0.1
	1985	1.4	0.5	0.9	0.5	1.5	1.2	0.4
	1986	2.4	1.0	1.3	0.8	2.5	1.9	0.8
	1987	3.8	1.4	1.4	1.0	3.8	2.3	1.3
Wage rate	1983	0.1	0.1	0.1	0.0	0.1	0.1	0.0
	1984	0.7	0.4	0.5	0.3	0.5	0.5	0.1
	1985	1.6	0.9	0.9	0.6	1.4	1.2	0.4
	1986	2.9	1.5	1.2	0.9	2.4	1.9	0.8
	1987	4.4	2.1	1.2	1.1	3.6	2.3	1.3
Total employment	1983	0.1	0.0	0.1	0.0	0.0	0.0	0.0
	1984	0.5	0.1	0.4	0.0	0.2	0.0	0.2
	1985	0.6	0.2	0.7	0.1	0.3	0.0	0.2
	1986	0.6	0.2	1.0	0.1	0.4	0.0	0.2
	1987	0.5	0.3	1.3	0.1	0.4	0.0	0.2

Table 4 (contd)

		UNITED STATES	JAPAN	GERMANY	FRANCE	UNITED KINGDOM	ITALY	CANADA
Unemployment rate ²	1983	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0
	1984	-0.4	0.0	-0.3	0.0	-0.1	0.0	-0.1
	1985	-0.5	0.0	-0.6	0.0	-0.2	0.0	-0.1
	1986	-0.5	0.0	-0.9	-0.1	-0.3	0.0	-0.1
	1987	-0.4	0.0	-1.1	-0.1	-0.3	0.0	-0.1
Effective exchange rate	1983	-0.7	-0.6	-0.6	-0.6	-0.7	-0.7	-0.6
	1984	-1.5	-1.1	-1.2	-1.2	-1.6	-1.4	-1.1
	1985	-2.2	-1.7	-1.9	-1.7	-2.7	-2.3	-1.5
	1986	-3.8	-1.9	-2.0	-1.8	-3.8	-2.8	-2.4
	1987	-5.2	-2.3	-2.1	-2.0	-5.3	-3.0	-2.6
Broad money supply	1983	0.7	0.7	0.5	0.4	0.3	1.3	0.6
	1984	1.6	1.5	1.5	0.8	0.8	2.9	1.3
	1985	2.6	2.5	2.5	1.3	1.5	4.4	2.0
	1986	3.7	3.5	3.4	1.7	2.3	6.0	2.7
	1987	4.8	4.3	3.9	2.0	3.2	7.2	3.5
Government financial balance ³	1983	0.1	0.1	0.1	0.1	0.1	0.3	0.2
	1984	0.4	0.2	0.3	0.2	0.2	0.6	0.4
	1985	0.7	0.3	0.5	0.3	0.5	1.0	0.7
	1986	0.9	0.5	0.8	0.4	0.7	1.3	0.9
	1987	1.0	0.7	0.9	0.6	0.9	1.7	1.1
Current balance (US\$ billion) ²	1983	-2.9	-0.6	-0.7	-0.2	-0.2	-0.1	0.1
	1984	-3.7	-0.9	-1.2	0.0	-0.3	-0.1	0.1
	1985	-2.5	-1.2	-1.2	0.2	-0.2	-0.2	0.2
	1986	-1.0	-1.5	-0.9	0.3	0.0	-0.4	0.4
	1987	0.0	-2.7	-0.9	0.0	0.3	-0.9	0.5

1. Per cent of baseline real GNP/GDP.

2. Level deviation from baseline.

3. Percentage deviation from baseline GNP/GDP.

The stimulus to private investment from lower interest rates, shown in Table 4, is quite substantial over the period, with real GNP rising by an average $\frac{3}{4}$ per cent by the fourth year. The largest overall investment response is that for the Italian model, followed by the United States, the United Kingdom and Japan. The U.S. model shows the quickest response, maintaining a generally higher increase over the first three years. For the Federal Republic of Germany the rise in private fixed investment is generally below-average, but this is supplemented by the relatively strong influence of lower real interest rates on output supply, giving an above-average increase in stockbuilding.

CHART C

PRICE AND INCOME RESPONSES FOR
INTEREST RATE SHOCKS UNDER ALTERNATIVE
EXCHANGE RATE ASSUMPTIONS

--- Fixed exchange rate
— Floating exchange rate

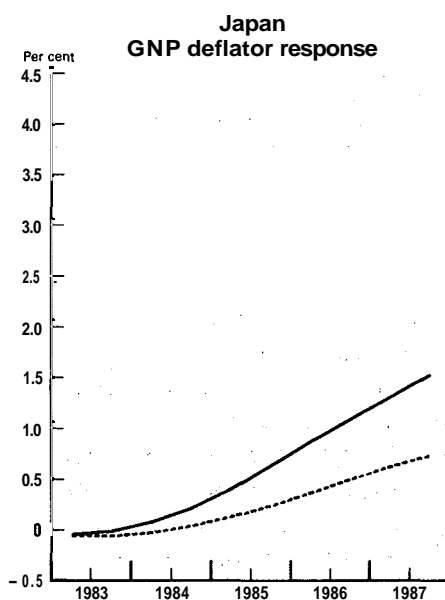
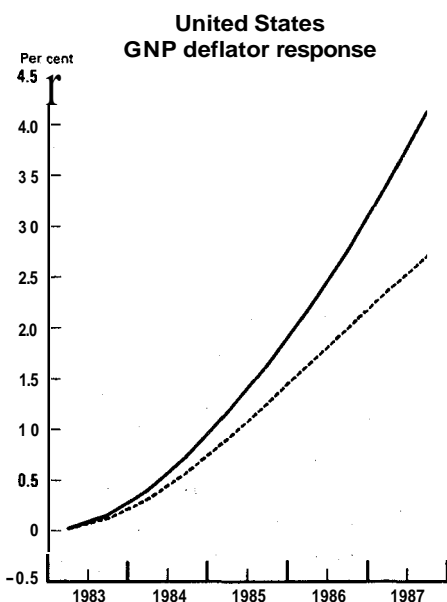
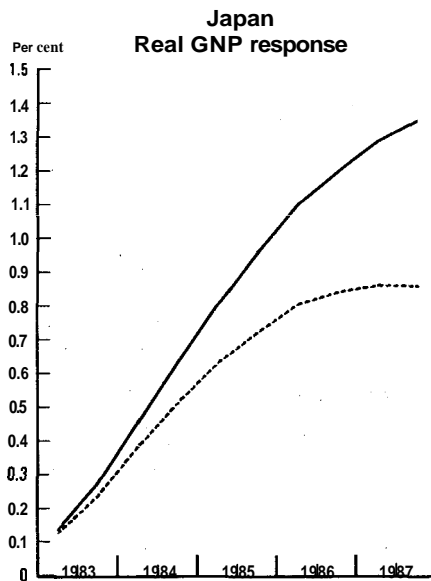
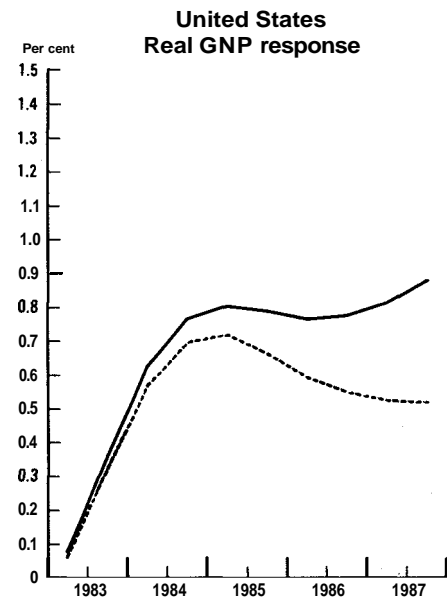


CHART C (continued)

PRICE-AND INCOME RESPONSES FOR INTEREST RATE SHOCKS UNDER ALTERNATIVE EXCHANGE RATE ASSUMPTIONS

--- Fixed exchange rate
— Floating exchange rate

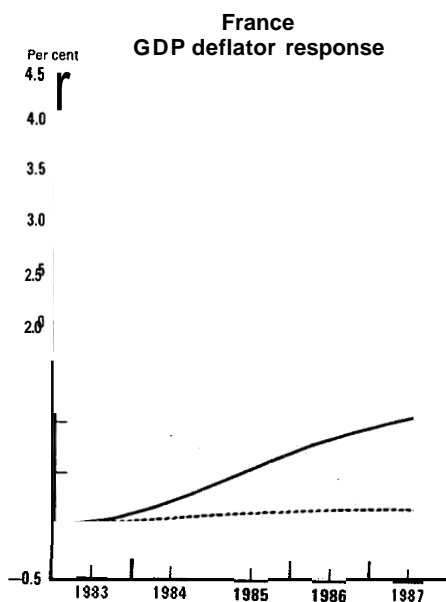
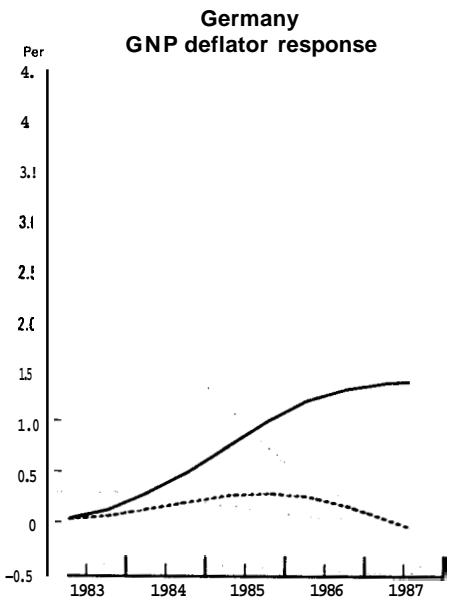
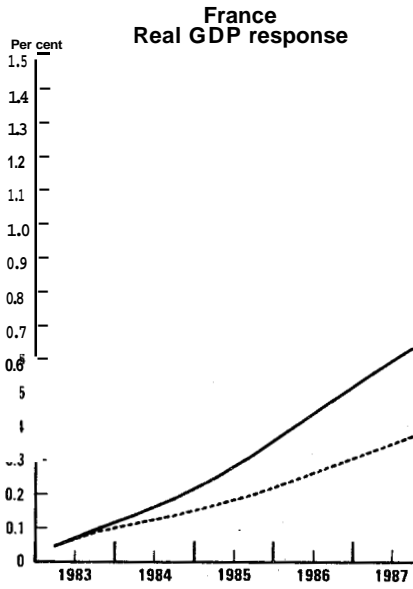
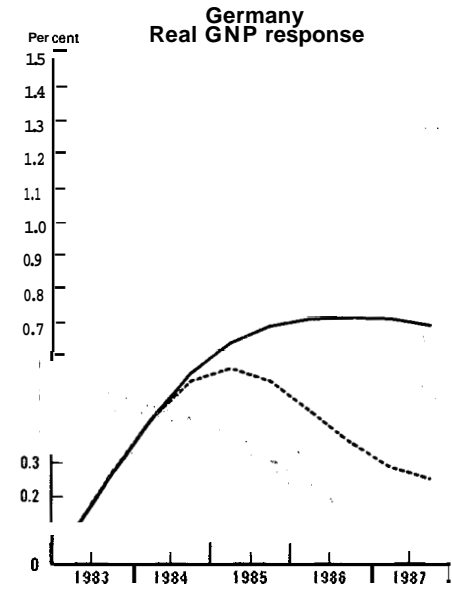
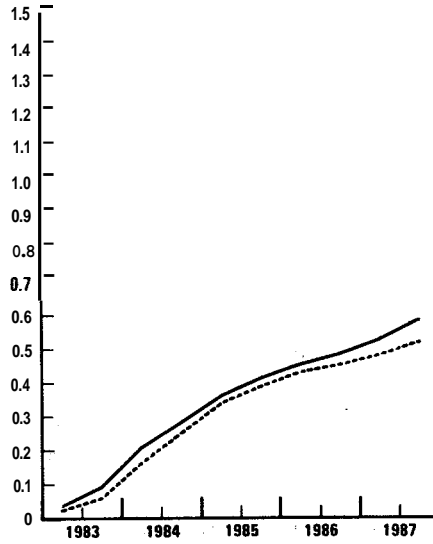
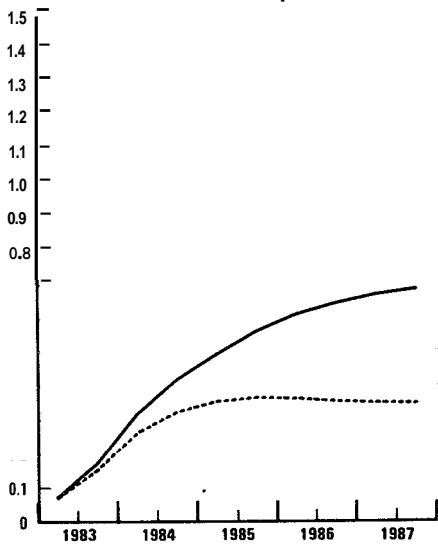


CHART C (continued)

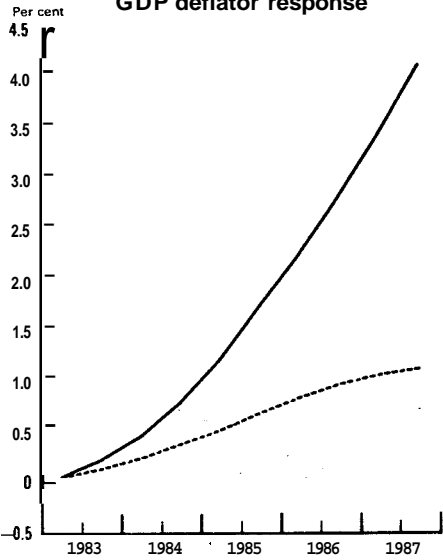
PRICE AND INCOME RESPONSES FOR INTEREST RATE SHOCKS UNDER ALTERNATIVE EXCHANGE RATE ASSUMPTIONS

--- Fixed exchange rate
— Floating exchange rate

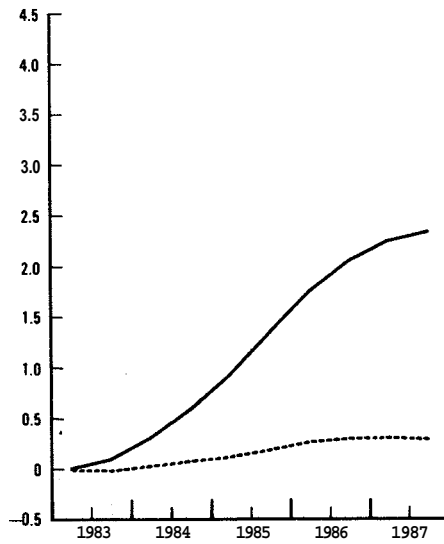
United Kingdom
Real GDP response



United Kingdom
GDP deflator response

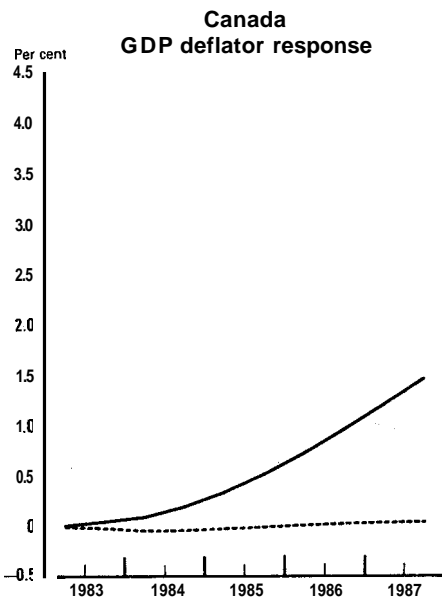
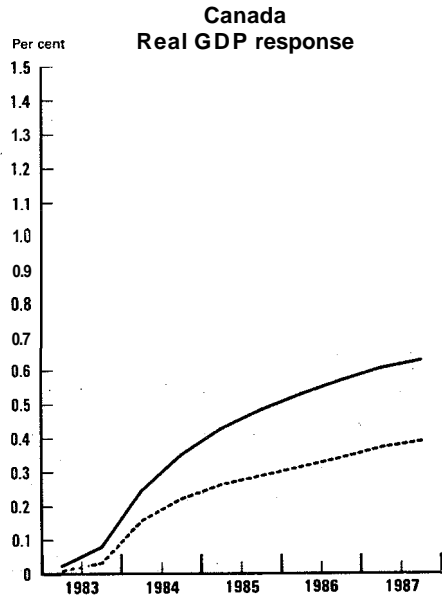


Italy
GDP deflator response



**PRICE AND INCOME RESPONSES FOR
INTEREST RATE SHOCKS UNDER ALTERNATIVE
EXCHANGE RATE ASSUMPTIONS**

--- Fixed exchange rate
— Floating exchange rate



With fixed exchange rates, lower interest rates and higher activity provide some additional stimulus to consumption. With a floating exchange rate, the induced increase in consumer prices, through higher import costs and the consequent reduction in real wages, significantly dampen, and in some cases reverse, the consumption response. Given a smaller and more gradual effect of import prices on domestic prices and a more stable real wage, this is generally not the case for Japan.

For prices, Chart C provides some important contrasts. For a number of countries, notably Canada, France and Italy, significant price responses are more or less absent with fixed exchange rates. This largely reflects the lack of a significant overall employment response, with the effects of higher output being only just sufficient to offset the substitution effects between labour and capital. For the Federal Republic of Germany, the direct influence of productivity growth on wages tends to offset upward price pressures from higher activity levels. With floating exchange rates, the rate of currency depreciation, due to both the effects of inflation on expectations and the reduction in short-term interest rates, is sufficient to give significant increases in wage and price levels for all countries. The feedback of import costs to prices and then exchange rates is also influential in determining the speed and extent of wage and price adjustments over time. Thus, larger degrees of depreciation are given for those countries which experience the largest domestic cost and price movements under fixed rates – the United States, the United Kingdom and Japan.

The exchange rate mechanism in INTERLINK is therefore seen to play an important role in the transmission of monetary effects to output and prices – a result similar to most other open-economy macroeconomic models. For the simple average of the major seven countries, the increase in the **GNP** deflator by the fifth year is around 2 per cent with floating rates compared with $\frac{3}{4}$ per cent with fixed exchange rates.

The results for other main macroeconomic aggregates are broadly consistent with normal presumptions. In general, the impact on the current balance is negative, although for some countries in the case of floating exchange rates there are some overall increases as short-term reductions in trade competitiveness are reversed. Money demand rises steadily over the period, particularly with floating rates, where both **GNP** and price increases are larger. The combination of higher activity and lower interest costs have a positive influence on the government balance over the period, with increased activity responses in the floating rate case giving marginally greater increases in later years.

III. MULTI-COUNTRY MODEL PROPERTIES

The single-country model properties described in the preceding section are by assumption conditional on unchanged circumstances outside the individual economies considered. The extension of the analysis to multi-country properties essentially concerns the endogenisation of "the rest of the world", allowing for both the spill-over of simulated effects for each individual country onto its trading partners and the further feedback from these to the country in which the shock originates. International linkage effects are also of particular importance to the analysis of common shocks, where they may significantly amplify or reduce the role of specific mechanisms identified as being of importance to single-country results. Principal references to the linkage and comparative properties of earlier versions of INTERLINK are given by Larsen *et al.* (1983b) and Bryant *et al.* (1988a).

A. Fiscal policy linkages

Fiscal policy multipliers obtained in multi-country mode are reported for each of the major seven economies in Annex Tables 1 to 3, based again on increases in government real non-wage expenditures equivalent to 1 per cent of GNP. The precise direction of these shocks is essentially arbitrary and has no implications for the analysis of model properties. Two cases are considered for each country: the first assumes unchanged broad monetary aggregates and a floating exchange rate – corresponding to a "pure" fiscal shock; the second assumes unchanged short-term interest rates and exogenously fixed exchange rates – implying a mix of fiscal and monetary policy actions.

With respect to real GNP, the "own-country" multipliers obtained in multi-country solution are in general higher than the corresponding unlinked values discussed earlier, but by relatively small amounts – the maximum difference is 0.3 per cent, and this only occurs in one or two instances for the United States and the Federal Republic of Germany. Higher activity and import demand in the country taking action stimulates world activity and thereby the imports of trading partner countries, which are in turn export markets for that country. Hence the size of the net import leakage for a country taking fiscal action is marginally reduced relative to the single-country case.

For the larger countries, the domestic price responses also tend to be larger, reflecting the international transmission of demand and price pressures to other countries and world commodity markets. To the extent that the additional effects of linkage on domestic and foreign prices are of the same orders of magnitude, competitiveness is not in general reduced, and for those country models where price

and costs are relatively less sensitive to demand pressure, notably for Japan and the Federal Republic of Germany, some relative improvements occur. The impact of linkage on the current external balance of the country taking action is generally positive, reflecting the nature of the trade volume feedbacks.

Given higher levels of output and prices, the overall effect on the monetary sector is to strengthen the pressures on money demand and, with an unchanged money supply, larger increases in interest rates are required to choke off the excess demand for money. The overall effect on exchange rates in multi-country mode again depends on the balance of relative movements in interest rates and relative prices, with the present results implying marginally greater degrees of currency appreciation for each of the major economies except the United States.

The corresponding price and GNP cross-multiplier effects on other OECD countries, grouped into sub-area regional categories, are also shown in Annex Tables 1 and 2. Depending, as they do, on the scale of import demand and the relative orders of magnitude of movements in prices, interest rates and total final expenditure in the countries taking action, the spill-over effects onto activity and prices in other countries are found to be generally smaller in the case of non-accommodated fiscal shocks. Thus, for a U.S. expansion, the simulated fifth-year effect on the real GNP of other OECD countries is 0.2 per cent with an unchanged money supply, compared with a value of 1.0 per cent obtained with monetary accommodation. Indeed, for a number of the smaller countries, the combination of higher short-term interest rates and appreciation against the dollar, in the non-accommodated case, exerts a negative spill-over effect on prices and real GNP in the longer run.

With the exception of the United States, the linkage effects of fiscal action by the individual major countries on other OECD members as a group are relatively small – no more than 0.1 per cent for real GNP and 0.3 per cent for prices. Within their own specific "spheres of influence", however, the effects on close trading partners are often quite significant, as for example with the response of the smaller European economies with respect to fiscal action by the larger European countries.

Given the relative importance of size considerations in the determination of linkage effects, a more revealing comparison is that between the simulated effects of fiscal action by the United States and those obtained for fiscal action by the other six major economies acting as a **group**¹⁰. A summary of results for the corresponding non-accommodated fiscal expansion, assuming exchange rates also to be endogenously determined, is given in Table 5. On the whole, these two sets of results reveal considerable degrees of symmetry as between the influence of the United States and other major economies on each other and also the smaller OECD Member countries. Principal differences in response lie in the relative size of the U.S. price response and also the relative weakness of its trade performance. The effects of fiscal stimulus on U.S. wages and prices are roughly double those for the other major economies. For the U.S. model, this implies larger incipient competitiveness

losses and, given generally higher import demand elasticities, a somewhat larger decline in real trade and current-account balances. The combination of larger import leakages, higher prices and above-average sensitivity to higher interest rates tends to give a somewhat faster rate of crowding-out in the U.S. model than for other major economies as a group. In both cases, smaller simulated increases in nominal U.S. interest rates and a sharper increases in relative prices combine to give an effective dollar depreciation.

Table 5. Government expenditure multipliers for the United States and the other major economies as a group¹
Percentage differences from baseline levels

	A. Increase in other major seven expenditures					B. Increase in U.S. expenditures				
	1983	1984	1985	1986	1987	1983	1984	1985	1986	1987
USA										
Real GNP	0.2	0.3	0.2	0.2	0.1	1.2	1.0	0.6	0.6	0.5
GNP deflator	0.0	0.2	0.5	0.8	1.2	0.3	1.1	1.8	2.5	3.3
Employment	0.0	0.2	0.1	0.1	0.1	0.5	0.6	0.3	0.2	0.1
Current balance ²	2.7	5.0	5.9	6.4	7.7	-9.8	-10.8	-12.1	-16.1	-19.9
Short-term interest rate ³	0.1	0.2	0.4	0.5	0.6	0.6	1.1	1.2	1.6	1.9
Effective exchange rate	-0.3	-0.9	-1.2	-0.9	-0.7	0.0	-0.6	-1.1	-1.4	-1.8
Other major seven										
Real GNP	1.1	1.4	1.1	0.6	0.4	0.2	0.4	0.4	0.2	0.1
GNP deflator	0.0	0.4	0.8	1.3	1.7	0.1	0.1	0.2	0.3	0.5
Employment	0.3	0.5	0.5	0.4	0.3	0.1	0.2	0.2	0.1	0.1
Current balance ²	-6.4	-6.5	-6.8	-8.3	-9.4	6.3	9.6	11.9	13.5	23.3
Short-term interest rate ³	0.7	1.8	2.1	2.0	2.0	0.2	0.6	0.7	0.8	1.0
Other OECD										
Real GNP	0.3	0.5	0.5	0.4	0.3	0.2	0.3	0.3	0.2	0.1
GNP deflator	0.0	0.1	0.3	0.6	0.8	0.0	0.0	0.0	0.1	0.1
Employment	0.1	0.2	0.2	0.2	0.2	0.0	0.1	0.1	0.1	0.1
Current balance ²	1.7	2.7	3.2	4.5	5.2	1.0	1.7	1.9	2.6	3.2
Short-term interest rate ³	0.3	0.6	0.6	0.6	0.7	0.2	0.4	0.5	0.6	0.8
Total OECD										
Real GNP	0.6	0.8	0.6	0.4	0.3	0.6	0.6	0.5	0.4	0.3
GNP deflator	0.0	0.3	0.6	1.0	1.3	0.1	0.5	0.8	1.2	1.6
Employment	0.2	0.4	0.4	0.3	0.2	0.2	0.3	0.2	0.1	0.1
Current balance ²	-2.0	1.2	4.1	6.4	7.0	-2.4	0.4	2.2	5.2	6.6
Short-term interest rate ³	0.4	0.8	1.0	1.0	1.1	0.3	0.7	0.8	1.0	1.2

The simulated trade volume spill-over effects from the United States to the other major countries are proportionately larger than the reverse flow. Thus fiscal action by the United States gives a lower "own-country" multiplier and a higher "linkage" multiplier for the other major economies, compared to the effects of fiscal action by the latter group. Given higher average "own-country" multipliers for the non-U.S. major economy group and the underlying patterns of trade, the reverse is true for the effects on the smaller OECD economies, with a maximum real GNP effect of 0.5 per cent compared with 0.3 per cent in the case of the U.S. shock. Differences in the GNP responses for the total OECD area are largely confined to the second and third years.

B. Monetary policy linkages

The importance of monetary linkages to INTERLINK's simulation properties arises more from the interaction between different monetary policy assumptions for individual countries than the simple spill-over effects from any single country's policy actions. Thus with a simulated 100-basis-point reduction in the short-term interest rates for a single major country, the **spill-overs** to other OECD countries, given independent monetary policies and endogenous exchange rates, are relatively small and the differences in "own-country" results for linked and unlinked solutions are negligible. With interdependent monetary and exchange rate policy assumptions, however, the model shows policy shocks for the major economies as exerting quite significant spill-over effects on other OECD countries.

To illustrate the consequences of monetary interdependence, two simulations are considered, each featuring a 100-basis-point reduction in U.S. short-term interest rates. In the first case, the monetary authorities of the other major economies are assumed to exactly match the movement in U.S. short-term rates, thereby maintaining baseline interest rate differentials and allowing exchange rates to adjust freely. In the second case, they are assumed to attempt to maintain exchange rates at baseline levels, through the influence of the money supply on short-term interest rates¹¹. This assumption contrasts importantly with that of exogenously fixed exchange rates considered in earlier unlinked simulations. Though similar in general orientation, these two simulations, summarised in Table 6, differ insofar as exchange rates are determined in the model by inflation and current balance considerations, as well as international interest-rate differentials.

In the first case, the assumed simultaneous reduction of interest rates by the major countries removes the dominant influence of **currency** depreciation on the simulation results, so that the direction and extent of movements in individual exchange rates for the larger countries are determined directly by relative price and trade performance. **For** given world prices this implies a relative dampening of inflationary pressures and the main forces acting on the major country models more

closely resemble those for unlinked solutions with fixed rather than floating exchange rates. But they are also overlaid with a trade-induced stimulus to activity and prices. For inflation, both of these additional factors tend to work in the same upward direction. Given the relatively slow speeds of adjustment of domestic prices to higher demand and also relatively small short-term price spill-overs, however, the direct influence of smaller or reversed exchange rate movements tends to dominate, leading to lower overall price responses.

Table 6. Effects of lower short-term interest rates under alternative monetary assumptions
Percentage differences from baseline levels

	A. 100 basis point reduction in major seven short-term interest rates					B. 100 basis point reduction in U.S. short-term interest rates with exchange-rate targets ¹				
	1983	1984	1985	1986	1987	1983	1984	1985	1986	1987
USA										
Real GNP	0.2	0.6	0.8	0.7	0.8	0.1	0.6	0.7	0.6	0.6
GMP deflator	0.1	0.4	1.1	2.1	3.2	0.0	0.4	1.0	1.8	2.7
Employment	0.1	0.4	0.6	0.5	0.5	0.1	0.4	0.5	0.4	0.4
Current balance ²	-3.4	-4.6	-4.7	-5.8	-6.7	-3.6	-4.9	-5.0	-6.3	-7.6
Broad money supply	0.7	1.5	2.5	3.4	4.5	0.7	1.5	2.4	3.2	4.1
Effective exchange rate	-0.1	-0.4	-1.0	-1.6	-2.4	0.0	0.0	0.0	0.0	0.0
Other major seven										
Real GNP	0.2	0.5	0.7	0.9	1.1	0.2	0.6	0.9	1.4	1.6
GNP deflator	0.0	0.1	0.3	0.6	0.9	0.0	0.1	0.3	0.7	1.2
Employment	0.0	0.1	0.2	0.4	0.5	0.0	0.1	0.3	0.6	0.8
Current balance ²	-1.6	-1.7	-1.4	-1.6	-1.9	-1.7	-2.8	-3.7	-5.7	-9.2
Short-term interest rate ³	-1.0	-1.0	-1.0	-1.0	-1.0	-1.1	-1.4	-1.8	-2.0	-2.4
Broad money supply	0.6	1.3	2.0	2.6	3.2	0.6	1.6	2.8	4.2	5.8
Other OECD										
Real GNP	0.0	0.1	0.2	0.3	0.3	0.1	0.2	0.5	0.7	1.0
GNP deflator	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.3	0.6
Employment	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.3
Current balance ²	0.0	0.5	0.8	0.8	0.7	-0.2	0.2	0.5	0.6	0.8
Short-term interest rate ³	-0.4	-0.6	-0.8	-0.9	-1.0	-0.6	-1.0	-1.2	-1.6	-1.9
Total OECD										
Real GNP	0.1	0.5	0.7	0.7	0.8	0.1	0.5	0.8	0.9	1.1
GNP deflator	0.0	0.2	0.6	1.1	1.7	0.0	0.2	0.6	1.1	1.7
Employment	0.0	0.2	0.3	0.4	0.4	0.0	0.2	0.4	0.4	0.5
Current balance ²	-4.9	-5.8	-5.3	-6.6	-7.9	-5.5	-7.4	-8.2	-11.4	-15.9
Short-term interest rate ³	-0.8	-0.9	-0.9	-0.9	-1.0	-0.7	-1.1	-1.3	-1.5	-1.8

1. Short-term interest rates in the non-U.S. major seven countries are used to target unchanged effective exchange rates.

2. current balances in US\$ billion.

3. Percentage points.

To the extent that price increases for individual countries are more damped, the reductions in real interest rates and the cost of capital are correspondingly smaller, implying smaller substitution effects and a weaker stimulus to investment. Price moderation will, however, tend to limit the fall in the real wage and lead to some switch towards consumption. The absence of significant currency depreciation tends to worsen trade competitiveness compared with the unlinked case, although overall trade performance is also influenced by higher export demand. Given these diverse factors, the sign of the net effects of linkage on the GNP and current-balance responses varies between individual major country models.

The overall results show a significant moderation in price effects, compared with unlinked results, reflecting the importance of the effects of interest-rate-induced currency depreciation in those results. The gradual downward movement in the U.S. dollar over the period is exactly accounted for by the sharper increases in U.S. prices, reflecting the relatively quicker employment response and higher wage/unemployment elasticity in the U.S. model. Currency movements for the other economies exactly mirror those of the dollar, with the largest appreciations being those for the smaller OECD countries, where interest rates adjust relatively slowly.

Compared with the earlier unlinked results, the real GNP response for the United States changes relatively little, with an increase of $\frac{3}{4}$ per cent from the third year. Its composition is quite different, however, with consumption higher, the real trade contribution negative and the investment response smaller. For the other major economies GNP responses are generally larger, with an average increase of 1.0 per cent in the fourth and fifth years, reflecting the relative strength of spill-over effects from the United States. The effects of smaller price responses in the linked results significantly outweigh those of marginally larger increases in real GNP, giving generally smaller increases in money demand. In the absence of significant improvements in competitiveness, the U.S. current balance declines over the period, whilst for the other major economies the trade multiplier effects tend to outweigh the more adverse movements in competitiveness, giving generally smaller declines in their respective current accounts.

Given significant adjustment lags in the interest rate equations for the smaller countries, the reductions in their interest rates are generally smaller and their currencies tend to appreciate against those of the major economies. The simulated increases in real GNP for the smaller OECD countries therefore tend to be significantly smaller by comparison, at around 0.3 per cent, and slower to emerge. Higher exchange rates do, however, provide an effective barrier to price pressures coming from the major countries and, given higher levels of world trade, the overall effects on their current balances are also positive. For the area as a whole, real GNP increases by $\frac{3}{4}$ per cent by the third year, with prices rising steadily over the period to be 1.7 per cent higher in the fifth year. The combination of higher activity and

lower interest receipts from the non-OECD debtor nations gives a \$5 billion to \$8 billion decline for the total OECD area current balance.

In the second case, interest rates in the other major economies have to match price differentials in order to achieve unchanged effective exchange rates. Given short-term interest yield differential terms which are close to unity in the current set of effective exchange rate equations, movements in interest rate and price differentials are of similar orders of magnitude. Thus the gap between U.S. and non-U.S. interest rates of 100 and 140 basis points shown in the second panel of Table 6 is equivalent to the simulated price differential movements, implying significantly larger reductions in non-U.S. interest rates. Compared with the previous case, the absence of dollar depreciation implies generally smaller price increases, but also marginally smaller increases in real GNP for the United States, reflecting its more adverse trade competitiveness position. Given these factors, the degree of endogenous monetary expansion in the United States is reduced in the longer run.

For the other major economies, the larger reductions in interest rates provide a relative strengthening of investment, and real GNP is higher by an average 1½ per cent in the fourth and fifth years, compared with the earlier value of 1 per cent. For the major seven countries as a group, the smaller overall increase in U.S. real GNP is more than compensated by the larger responses for the other countries. Stronger demand pressure and the absence of currency appreciation also put more upward pressure on prices, and money demand is also significantly higher, given the combined effects of higher activity and prices and lower interest rates. The net effect on their current balances is generally negative, given higher activity rates and larger import leakages.

The smaller OECD countries are subject to larger trade spill-over effects from the major economies and larger reductions in domestic interest rates. For the OECD area as a whole, the activity response is somewhat higher when exchange rates are targeted to remain unchanged, with the level of GNP being 1 per cent higher than baseline in the last two years compared with the previous value of ¾ per cent. The effect on prices for the area is identical in the two cases, reflecting the redistribution of price pressures from the United States to the other OECD countries. The effects of higher activity and larger overall reductions in OECD interest rates combine to give a sharper decline in the current balance for the area as a whole, from \$8 billion to \$16 billion by the fifth year.

C. Multi-country exchange rate properties

Single-country analyses of major currency movements are likely to be misleading, particularly in the case of a major trading nation. A change in country A's

Table 7. The effects of a 10 per cent dollar depreciation under alternative monetary and fiscal policy assumptions

Percentage differences from baseline levels

	A. Interest rates and real non-wage Expenditures unchanged					B. Money supply and real non-wage Expenditures unchanged					C. Money supply and nominal non-wage Expenditures unchanged				
	1983	1984	1985	1986	1987	1983	1984	1985	1986	1987	1983	1984	1985	1986	1987
	USA														
Real GNP	0.5	0.6	0.5	0.5	0.4	0.5	0.3	0.0	-0.1	-0.3	0.4	0.2	-0.2	-0.2	-0.5
GNP deflator	0.3	1.3	2.5	3.9	5.5	0.2	1.2	1.9	2.8	3.5	0.2	1.1	1.7	2.5	3.1
Real trade balance ¹	0.4	0.7	0.7	0.6	0.4	0.4	0.7	0.8	0.8	0.7	0.4	0.8	0.9	1.0	0.9
Terms of trade	-4.7	-3.5	-2.1	-1.5	-0.3	-4.7	-3.5	-2.9	-2.1	-1.4	-4.7	-3.5	-3.0	-2.3	-1.7
Short-term interest rate ²			..	..		0.3	0.8	1.0	1.4	1.7	0.2	0.6	0.8	1.1	1.3
Broad money supply	0.1	0.7	1.5	2.6	3.9										
Current balance ³	-4.3	11.0	14.1	10.5	6.1	-4.1	12.6	17.4	16.1	14.7	-3.0	15.1	20.8	21.1	21.4
Rest of OECD															
Real GNP	-0.1	-0.3	-0.5	-0.7	-0.6	0.2	0.1	0.0	0.0	0.3	0.1	0.1	0.1	0.2	0.4
GNP deflator	-0.3	-1.1	-1.8	-2.5	-3.1	-0.3	-1.1	-1.7	-2.2	-2.7	-0.3	-1.1	-1.7	-2.2	-2.6
short-term interest rate ²			..	..		-0.4	-1.1	-1.3	-1.7	-1.7	-0.4	-1.0	-1.1	-1.4	-1.4
Current balance ³	6.9	-11.0	-12.6	-9.4	-5.8	-6.5	-13.0	-16.9	-16.7	-16.8	5.2	-15.5	-20.1	-21.0	-22.7
Total OECD															
Real GNP	0.2	0.1	-0.1	-0.2	-0.2	0.2	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.1
GNP deflator	-0.1	-0.1	-0.1	0.1	0.3	-0.1	-0.2	-0.3	-0.2	-0.2	-0.1	-0.2	-0.3	-0.3	-0.3
Current balance ³	2.6	0.0	1.5	1.1	0.2	2.4	-0.3	0.5	-0.6	-2.1	2.2	-0.5	0.7	0.1	-1.3
Real GNP															
Japan	-0.1	-0.4	-0.7	-1.0	-1.1	-0.1	-0.1	-0.1	-0.2	-0.1	0.0	0.1	0.1	-0.1	-0.1
Germany	0.2	0.1	-0.6	-1.1	-0.9	0.2	0.5	0.2	0.1	0.6	0.3	0.7	0.5	0.4	0.9
Major seven (excl. U.S.)	-0.1	-0.2	-0.5	-0.6	-0.2	0.0	0.1	0.1	0.1	0.4	0.0	0.1	0.3	0.3	0.6
Other OECD	-0.1	-0.5	-0.7	-0.7	-0.5	-0.1	-0.4	-0.5	-0.5	-0.2	0.0	-0.2	-0.3	-0.2	0.0
Current balance³															
Japan	2.9	-2.3	-2.7	-1.6	-0.1	2.7	-3.2	-4.5	-4.5	-4.6	2.5	-3.7	-4.9	-5.1	-5.5
Germany	1.9	-0.1	-0.9	0.3	0.9	1.9	-0.7	-1.9	-1.2	-1.1	1.7	-0.9	-2.1	-1.6	-1.9
Major seven (excl. U.S.)	8.5	-7.3	-9.6	-5.5	-2.1	7.8	-9.5	-13.3	-13.5	-13.0	7.0	-11.4	-15.5	-16.5	-18.1
Other OECD	-1.3	-3.7	-4.1	-3.9	-3.8	-1.3	-3.4	-3.6	-3.2	-2.9	-1.6	-4.1	-4.6	-4.5	-4.5

1. Real trade balance as percentage of real GNP.

2. Percentage points.

3. Current balances in US\$ billion.

exchange rate *vis-à-vis* other currencies is quintessentially a multi-country issue, exerting divergent influences on both country A and its close trading partners. The more important country A is, as a competitor in home and world markets, the greater will be the degree of international interdependence in relation to the effects of a change in the value of its currency. Such influence is exerted both through direct effects of relative price changes and indirect effects on inflation, profitability and activity, so that the corresponding policy settings will also importantly modify the overall results.

To illustrate model properties with respect to a major currency change, Table 7 provides summary details of the simulated effects of a 10 per cent depreciation of the U.S. dollar against other OECD currencies, under alternative fiscal and monetary policy assumptions. The shift in currency rates is sustained over a five-year period and is assumed to be exogenous, coming from "unexplained" movements in market sentiment rather than being policy-induced. The experiment is therefore flawed by failing to take account of the endogenous influence of policy variables on market expectations and exchange rates. In effect, for a range of policy settings a five-year *exogenous* shift in the value of the U.S. dollar could be self-reversing, with divergent movements being generated in interest rates which are sufficient to offset the original shock¹². In other words, with interest rates being determined by market forces, a sustained shift in a major currency might require a cumulative collapse in market expectations.

Even setting these considerations aside, there is clearly no single answer to the question of what the effects of a change in exchange rates are in the model. The simulated consequences depend on how policies are assumed to behave in all countries. For this reason, three cases are considered involving different combinations of monetary and fiscal policy assumptions, applied on a global basis. The first two cases assume alternatively unchanged short-term interest rates and unchanged monetary aggregates, both with government expenditures fixed in real terms. The third case assumes government non-wage expenditures and money supply to be unchanged in nominal terms and is therefore similar to the main case discussed by Dean and Koromzay (1987).

With unchanged government expenditures in real terms and unchanged short-term interest rates, dollar depreciation is seen to exert a significant downward influence on output and prices in the rest of the OECD region, both directly for close trading partners and indirectly, through the U.S. influence on commodity markets. Given the combination of competitiveness and trade multiplier effects, non-U.S. output is reduced by an average $\frac{1}{2}$ per cent for most of the period. For Japan and the Federal Republic of Germany, the level of real GNP is reduced by up to 1 per cent, given higher overall marginal export response and also a higher weight of net exports in their GNP. Domestic prices outside the United States adjust downwards, by as much as 3 per cent, given substantial reductions in import costs, competitor prices and also commodity prices.

The feedbacks of these changes to the United States are important, with the multiplier effects of lower exports to the United States also reducing indirectly the demand for U.S. goods. With respect to prices, the reduction in non-U.S. costs and prices implies a significant diminution of the short-term increases in U.S. price competitiveness, coming from a lower exchange rate, and also some damping of exchange-rate-induced movements in U.S. import costs. Overall, U.S. real GNP increases by $\frac{1}{2}$ per cent over most of the period whilst prices rise steadily to be $5\frac{1}{2}$ per cent above baseline in the fifth year. Thus, both price and volume linkage effects work in the direction of reducing the increases in U.S. trade. Over the full five-year period, the cumulative positive influence on the U.S. current-account balance of \$38 billion is significantly lower than for unlinked simulations¹³.

Given the divergent movements in prices, the simulated effects on the United States and the rest of the world, when the money supply is unchanged, tend to work in opposite directions. In the United States higher prices tend to force up interest rates, by 100 to 150 basis points, through excess money demand, whilst for the other major economies interest rates fall as the result of disinflationary pressures. For the United States, domestic demand is therefore increasingly squeezed, with the result that the gains to output stemming from trade are progressively offset. By the fifth year, real GNP and prices are, respectively, 0.3 per cent lower and $3\frac{1}{2}$ per cent higher than baseline. At the same time, though, U.S. demand for imports is also reduced. Lower interest rates in the rest of the world provide a positive effect on non-U.S. activity, fully offsetting for the area as a whole the original trade losses associated with lower U.S. imports. This in turn helps restore the original growth in U.S. markets. Even so, the linkage effects operating through the reduction in U.S. imports and competitor prices are significant enough to reduce the overall positive influence on the U.S. trade account relative to single-country simulation values. Over the five-year period the cumulative positive effect on the U.S. current balance is significantly larger, at \$57 billion, than in the previous case.

With the additional assumption of unchanged nominal government expenditures, further stabilizing features emerge, with fiscal policy being squeezed in the United States and relaxed elsewhere, according to overall price movements. For the United States the implied fiscal restriction operating through the usual GNP multipliers gives a larger fall in domestic demand, thereby holding back import demand and further reducing pressure on price levels. By the fifth year, real GNP and prices are, respectively, $\frac{1}{2}$ per cent lower and 3 per cent higher than baseline. Reduced nominal demand, at the same time, eases the degree of monetary restriction and moderates the increase in interest rates. For the non-U.S. economies, the fiscal expansion is slight and provides only a limited stimulus to demand and thereby U.S. exports. The net effect of both these additional influences is to further increase the positive effects on the U.S. current account, which shows a cumulative increase of \$75 billion over the period.

D. Cost and price linkages

An important limitation to the single-country analysis of changes in costs and prices is the extent to which the results are dominated by cost and price competitiveness factors, particularly with respect to activity and employment. Indeed for those earlier versions of INTERLINK which excluded supply and consumption sector responses to inflation and profitability, the effects of increased competitiveness on the real trade balance obtained in single-country analysis tended to offset otherwise negative effects on consumption and investment¹⁴. In the context of a generalized disinflationary shock coming, for example, from a general moderation in wage settlements, the role of trade competitiveness effects is significantly attenuated. Of more importance, in an international context, are the benefits accruing from the global reinforcement of the downward pressures on costs and prices, through the simultaneous reduction of world price levels, and the activity spill-overs associated with higher levels of world trade. In the multi-country case, therefore, the composition of simulated output gains to individual countries arising from disinflationary pressure shifts away from higher net exports towards higher consumption and capital expenditures. As an illustration of the relative importance of these factors, Table 8 reports the results for a simulated 1 per cent *ex ante* reduction in nominal wage rates in all OECD countries, with an unchanged broad money supply assumption.

The most important feature of these results is the strength of the price linkage multipliers, with wages and prices for the major economies falling on average by 2 $\frac{1}{4}$ per cent and 1 $\frac{3}{4}$ per cent respectively over the five-year period. These movements compare with average wage and price responses of 1 $\frac{1}{4}$ per cent and 1 per cent obtained in corresponding unlinked results. Given a quicker pass-through of changes in unit costs to trade prices and sustained downward pressures from competitors' prices, the downward path of the price linkage variables is significantly steeper than that of domestic value-added deflators. Over the five-year period import prices for the major seven economies fall by 2 $\frac{3}{4}$ per cent.

Given a larger simulated fall in prices, reductions in interest rates are also found to be more durable, giving more balanced reductions in factor costs and increases in investment. For most countries the combined influence of lower costs and prices and higher levels of trade on output and employment are sufficient to give larger overall increases in activity and employment. For the combined major seven economies, both real GNP and employment show stable increases of 0.5 per cent from the third year on. The largest net increases are those given for the Federal Republic of Germany, for which the model gives larger relative reductions in wages and prices. In the absence of significant competitiveness gains, the results for real trade and current-account balances are generally less positive compared with unlinked simulations and, with higher domestic demand and lower interest rates, the

Table 8. Effects of a 1 per cent *ex ante* reduction in OECD wage rates with unchanged money supplies

Percentage differences from baseline levels

	UNITED STATES	JAPAN	GERMANY	FRANCE	UNITED KINGDOM	ITALY	CANADA	MAJOR OECD	OTHER OECD	TOTAL OECD
Real GNP										
1983	0.0	0.3	0.3	0.3	0.0	0.1	0.0	0.1	0.0	0.1
1984	0.0	0.9	0.9	0.4	0.3	0.2	0.1	0.3	0.0	0.3
1985	0.2	1.3	1.1	0.6	0.6	0.4	0.3	0.5	0.1	0.4
1986	0.1	1.2	1.1	0.8	0.7	0.4	0.4	0.5	0.2	0.5
1987	0.2	0.8	1.4	1.0	0.8	0.4	0.5	0.5	0.3	0.5
Employment										
1983	0.1	0.1	0.4	0.1	0.1	0.1	0.1	0.2	0.0	0.1
1984	0.1	0.3	1.1	0.2	0.2	0.1	0.1	0.2	0.1	0.2
1985	0.2	0.4	1.7	0.2	0.5	0.2	0.3	0.4	0.1	0.3
1986	0.2	0.4	2.2	0.3	0.7	0.2	0.3	0.5	0.1	0.4
1987	0.2	0.4	2.5	0.3	0.7	0.1	0.3	0.5	0.2	0.4
GNP deflator										
1983	-0.4	-0.8	-0.7	-0.7	-0.7	-0.6	-0.5	-0.6	-0.5	-0.6
1984	-0.9	-1.7	-1.7	-1.3	-1.3	-1.2	-1.0	-1.2	-1.0	-1.2
1985	-1.0	-2.1	-2.6	-1.7	-1.6	-1.6	-1.4	-1.5	-1.5	-1.5
1986	-1.1	-2.1	-3.3	-1.9	-1.7	-1.7	-1.6	-1.6	-2.0	-1.7
1987	-1.2	-1.9	-3.7	-1.9	-1.7	-1.7	-1.7	-1.7	-2.3	-1.8
Wage rate										
1983	-1.0	-1.5	-1.6	-1.3	-1.2	-1.3	-1.0	-1.1	-1.4	-1.1
1984	-1.1	-2.1	-2.5	-1.7	-1.8	-1.8	-1.2	-1.5	-1.9	-1.6
1985	-1.2	-2.3	-3.5	-2.1	-2.1	-2.0	-1.5	-1.7	-2.3	-1.8
1986	-1.3	-2.3	-4.3	-2.2	-2.0	-2.0	-1.7	-1.8	-2.6	-1.9
1987	-1.3	-2.3	-4.6	-2.2	-1.9	-1.7	-1.7	-1.9	-2.9	-2.0
Import prices										
1983	-0.5	-0.5	-0.5	-0.5	-0.5	-0.6	-0.5	-0.5	-0.5	-0.5
1984	-1.2	-1.2	-1.3	-1.2	-1.2	-1.2	-1.0	-1.2	-1.3	-1.2
1985	-1.7	-1.7	-1.8	-1.8	-1.7	-1.7	-1.4	-1.7	-1.8	-1.7
1986	-2.5	-2.6	-2.3	-2.4	-2.2	-2.3	-1.8	-2.5	-2.4	-2.4
1987	-2.8	-3.1	-2.6	-2.6	-2.5	-2.5	-2.1	-2.7	-2.7	-2.7
Short-term interest rate (percentage points)										
1983	-0.2	-1.2	-1.5	-1.9	-0.7	-0.5	-0.8	-1.0	-0.3	-0.9
1984	-0.4	-1.1	-1.6	-2.3	-1.6	-0.5	-1.1	-1.2	-0.5	-1.1
1985	-0.4	-0.5	-1.7	-2.4	-1.7	-0.5	-0.9	-1.1	-0.5	-1.0
1986	-0.5	-0.1	-1.9	-2.2	-1.6	-0.4	-1.0	-1.1	-0.6	-1.0
1987	-0.6	-0.2	-1.5	-2.0	-1.5	-0.3	-0.9	-1.0	-0.6	-0.9
Current external balance (US\$ billion)										
1983	-0.8	-0.7	-0.7	-0.6	-0.6	-0.1	-0.1	-3.5	0.2	-3.3
1984	0.0	-1.7	-2.0	-0.4	-1.3	-0.1	-0.3	-5.8	0.7	-5.1
1985	0.7	-2.1	-1.9	-0.2	-2.0	-0.1	-0.5	-6.1	1.1	-5.1
1986	2.1	-2.7	-1.7	-0.2	-2.5	-0.1	-0.8	-5.9	1.1	-4.8
1987	1.8	-2.3	-1.0	-0.3	-2.8	0.0	-1.1	-5.7	1.0	-4.7

combined current account for the major seven economies declines by \$6 billion per year.

In spite of larger overall reductions in prices and wages, the effects on output and employment for the smaller OECD country group are generally smaller, with both GNP and employment rising by $\frac{1}{4}$ per cent by the end of the period. This result tends to reflect the slower overall adjustment of interest rates and also the absence of significant direct effects of profitability and inflation on investment and consumption in the smaller country models. Even so, this group of countries is subject to positive spill-over effects from the major economies through the external balance. For the OECD area in total, real GNP and employment increase by about $\frac{1}{2}$ per cent in the latter half of the period.

E. OECD and non-OECD linkages

In spite of the relatively limited form of the non-OECD models, their general coverage is sufficient to demonstrate the quantitative importance of the interdependence between OECD and non-OECD countries. In this context, Table 9 provides a summary of two relevant simulations. The first examines the effects of a sustained 2 per cent increase in the level of non-OECD import volumes on principal OECD area aggregates; the second examines the reverse flows from a sustained 1 per cent increase in the level of OECD area real GNP¹⁵. In both cases interest rates are assumed to be unchanged⁶.

1. Higher non-OECD imports

The effects of a 2 per cent higher level of non-OECD imports, shown in Table 9, are important for the OECD area, with the level of real GNP raised by 0.3 per cent. The cross-country distribution of GNP effects largely reflects established patterns of trade with the non-OECD countries and the relative shares of exports in GNP. Given higher demand pressure, OECD prices rise steadily, by up to 0.6 per cent in the fifth year, exerting a moderating effect on the GNP response towards the end of the period. The terms of trade between the two regions are, however, relatively unaffected. The OECD area current balance increases by \$10 billion to **\$12 billion** per year.

The overall results also show the feedback effects from the OECD area to be relatively substantial, with OECD import volumes rising by about 0.5 per cent and non-OECD export volumes increasing by 0.8 per cent. As a proportion of the value of the original increase in imports, non-OECD exports improve by approximately 35 per cent, with a correspondingly smaller decline in the current external balance.

Table 9. **OECD/non-OECD linkages**
Percentage differences from baseline levels

	1983	1984	1985	1986	1987
A. Effects of a 2 per cent higher level of non-OECD area imports¹					
Non-OECD area					
Export volumes	0.6	0.8	0.8	0.8	0.7
Import volumes	2.0	2.0	2.0	2.0	2.0
Export prices	0.0	0.1	0.3	0.6	0.9
Import prices	0.0	0.1	0.3	0.5	0.8
Current balance ²	-10.1	-9.2	-9.2	-11.7	-12.1
Total OECD					
Real GNP	0.2	0.3	0.3	0.3	0.3
GNP deflator	0.0	0.1	0.3	0.4	0.6
Employment	0.1	0.1	0.1	0.1	0.1
Export volumes	1.0	1.1	1.0	0.9	0.8
Import volumes	0.4	0.5	0.5	0.4	0.3
Current balance ²	10.1	9.6	9.9	12.1	13.0
Real GMP					
USA	0.1	0.1	0.1	0.1	0.1
Japan	0.4	0.6	0.6	0.6	0.5
Germany	0.4	0.6	0.7	0.5	0.3
Major seven	0.2	0.3	0.3	0.3	0.2
Other OECD	0.3	0.3	0.3	0.3	0.3
Current balance²					
USA	2.5	2.5	2.2	1.7	1.8
Japan	2.7	2.4	2.4	3.1	3.2
Germany	1.5	1.1	1.2	2.3	2.7
Major seven	8.8	8.1	8.2	9.9	10.5
Other OECD	1.3	1.4	1.7	2.2	2.5
B. Effects of a 1 per cent higher level of OECD real GNP¹					
Non-OECD area					
Export volumes	1.5	1.8	2.0	2.1	2.2
Import volumes	0.6	1.2	1.4	1.4	1.4
Export prices	0.1	0.4	0.9	2.0	2.9
Import prices	0.1	0.4	0.9	1.7	2.4
Current balance ²	6.4	4.1	3.0	2.0	2.0
Total OECD					
Real GNP	1.0	1.0	1.0	1.0	1.0
GNP deflator	0.1	0.7	1.3	2.0	2.9
Employment	0.3	0.5	0.5	0.5	0.5
Export volumes	1.5	1.7	1.8	1.9	1.9
Import volumes	1.9	1.9	2.0	2.1	2.1
Current balance ²	-6.3	-4.1	-3.3	-1.7	-2.1
Current balance²					
USA	-5.6	-7.7	-10.1	-13.9	-17.4
Japan	1.0	2.5	3.6	6.0	7.5
Germany	1.2	2.0	2.6	4.5	5.6
Major seven	-5.4	-4.1	-4.3	-4.6	-6.6
Other OECD	-1.0	0.0	1.0	2.9	4.5

1. Short-term interest rates and exchange rates are assumed to be unchanged.

2. Current balances in US\$ billion.

2. Higher OECD GNP

The results for a sustained higher level of GNP in all OECD countries provide some interesting contrasts to the above case. Given the shift in expenditures, OECD import volumes rise directly by 2 per cent, increasing the size of non-OECD export markets by approximately the same amount. The effects of increased revenues from higher exports to the OECD area feed through fairly rapidly. Imports of the non-OECD area rise steadily, by 1.4 per cent in the third year, thereby reducing the positive effects on the trade balance. In nominal terms the increase in imports by the third year is equivalent to 75 per cent of the higher export level and over two-thirds of the initial effect on the non-OECD current balance is subsequently reversed. Given higher demand pressure in the OECD, commodity and traded goods prices rise broadly in line with OECD domestic prices over the period. Having remained relatively stable in the first three years, the non-OECD's terms of trade improve significantly thereafter. This effect is largely compositional and reflects a faster relative growth of energy and commodity prices towards the end of the period.

The distribution of the simulated decline in the OECD area current balance is interesting in that there is a net positive influence for Japan, the Federal Republic of Germany and the smaller OECD countries. This very much reflects the underlying geographical distribution of existing trade, relative price movements and different propensities to import. For the United States a decline is simulated which is greater than that for the total OECD area. The essential point is that given the scale of U.S. imports, a higher-than-average import propensity and a simulated decline in U.S. price competitiveness, the additional import demand greatly exceeds the feasible increase in exports. In effect, the scale of the simulated increases in U.S. imports is sufficiently large to stimulate net exports for both the rest of OECD and the non-OECD countries.

IV. OVERALL IMPLICATIONS

A. The evolution of model properties

In analysing the implications of recent developments in INTERLINK for policy-related analyses, it is useful to consider the general evolution of model properties over a period of time. For this purpose the earlier work of Larsen *et al.* (1983b), based on the 1983 version of the model, provides an important point of reference, with the subsequent modifications and improvements being largely those outlined in Section I.

Evaluating the effects of fiscal policy shocks, a number of interrelated points emerge from a comparison of current and earlier results. Firstly, there has been a

significant increase in price responsiveness for the major country models, largely associated with the evidence of "output-gap" influences on producer prices – essentially a supply-related innovation. For a fiscal expenditure shock equal to 1 per cent of real GNP, with fixed exchange rates and accommodating monetary policy assumptions, the third-year domestic price effect given by the current model is 1.1 per cent, averaged over the major economies, compared with a value of 0.6 per cent reported for the 1983 version. In spite of significant structural changes on the real side, however, the corresponding average real GNP multiplier for accommodated shocks is only slightly modified in a downward direction, as a result of the effects of supply constraints on the production response and, in the longer run, the impact of higher prices on trade competitiveness and consumption. The change in the general multiplier profile is relatively even over time, with the average third-year multiplier reduced from 1.5 to 1.3 in the present model. The distribution of these changes across countries is however fairly uneven, with a significant reduction in the U.S. multiplier, from 1.7 to 1.1, partly offset by increases for Japan and the Federal Republic of Germany, both of the order of 0.2.

For non-accommodated fiscal shocks, a number of additional factors come into play. Firstly, progressive revisions to the money demand equation estimates have implied a significant steepening of the LM curves for the major economy models, associated with lower demand elasticities with respect to interest rates. For given changes in nominal demand, this now implies larger movements in short- and long-term interest rates. At the same time, revisions to consumption and, more importantly, the introduction of the supply and factor demand equations has significantly increased the interest-rate sensitivity of expenditure and output. The combination of these factors has implied a much greater degree of interest-rate-induced crowding-out and, in spite of a lower overall nominal income response to fiscal expansion, higher interest rate levels. Thus with unchanged exchange rates the average third-year real GNP multiplier has fallen from 1.4 to a current value of 0.7, with short-term interest rates now rising by 160 basis points compared with an earlier value of 90 basis points. As for the accommodated case, price responses are also now generally higher, at an average 0.9 per cent in the third year compared with 0.6 per cent.

Although precise comparative figures are not available with the earlier model, the increased responsiveness of interest rates has served to widen the gap between the results for alternative accommodated and non-accommodated fiscal shocks for the equivalent floating exchange rate cases. Higher short-term interest rates given by the present version of INTERLINK imply a more significant offset to expected inflationary pressures in the determination of exchange rates, which now tend to fall rather less or even rise with a positive fiscal shock. In either case, the level of the exchange rate is now significantly higher in non-accommodated shocks, implying lower output and price responses.

Compared with earlier versions of INTERLINK, the current model implies that fiscal policy is somewhat less effective, with generally higher inflationary costs and lower and more transitory increases in real GNP, particularly where monetary policy is non-accommodative. With smaller activity gains and higher levels of prices and interest rates, estimates of the budgetary costs of fiscal expansion given by the present model are also higher, increasingly so over time given the cumulative effects on debt stocks and interest payments.

By contrast, increases in the responsiveness of output and prices to interest rates, through supply and price block revisions, have implied a significant increase in the impact of monetary policies. Whereas results for the 1983 version of the model suggested little or no effect on price levels in the simulation of interest rate changes, the current version implies a significantly negative relationship, with a 100-basis-point reduction in short-term rates, in unlinked mode, giving an average 0.3 per cent increase in prices by the third year. The corresponding effects on real GNP have more than doubled; a third-year average increase of 0.4 per cent compares with an earlier estimate of 0.1 to 0.2 per cent. Similar conclusions hold for the case of multi-country actions. Current estimates of the effects of a global reduction in short-term interest rates by 100 basis points (in Table 6) show a third-year increase in OECD real GNP of 8.7 per cent, compared with an earlier estimate of 0.3 per cent, and an associated price effect of 0.6 per cent, compared with an earlier estimate of 0.1 per cent.

As noted in the previous section, changes in INTERLINK properties with respect to disinflationary supply-side shocks are also significant, reflecting important model changes in the area of supply, factor demand and consumption. Comparisons with earlier results for generalized wage moderation, for example, show very major differences in output responses, with a 1 per cent *ex ante* reduction in wage rates now giving an increase in real GNP of the order of 8.5 per cent, over a three-year period, compared with a net reduction of 0.3 per cent given by the 1983 version. Such a turn-round in results obviously underlines the fragility of policy prescriptions in a world of uncertainty and an often incomplete state of knowledge about the orders of magnitude involved in the relevant economic relationships. Few policy prescriptions are insensitive to relative parameter values and there is thus a need for continuing appraisal of the empirical evidence, in conjunction with model development.

B. Directions for future developments

In forming an overall view of the INTERLINK model and its continuing development, it is also important to reflect on those areas of the model where the current structure might be viewed as being either relatively weak or in need of further investigation. There is always considerable scope within a macroeconomic model

of this size for specific improvement. Three broad areas might be considered as providing the main sources of future changes in model properties.

Firstly, the work programme on supply must be considered as being only partially complete until the present approach is extended to the smaller OECD economies. For the major economies, the empirical results to date have had a major impact on the medium-term properties, and the comparison of results for a number of multi-country simulations suggests that a difference in supply structure is responsible for a number of important differences in results for larger and smaller OECD economies, for example with respect to interest rate and factor price shocks. There is therefore some expectation that a number of results which currently hold for the major economy models will generalize to the models for the smaller countries.

Secondly, the treatment and determination of expectations represents a continuing challenge to economic modellers. Within INTERLINK, progress has already been made in opening up the channels through which expectations might be thought to work, for example with respect to output supply, real interest rates and exchange rates, although further scope remains for a more explicit and consistent treatment. With respect to expectations formation, the model has tended to rely on adaptive rather than forward-looking mechanisms. In a number of areas this reflects the weight of empirical evidence, although in others, for example financial markets, the evidence is rather more fragmentary and a forward-looking orientation would on the whole seem more appropriate. In this area, the combination of two broad analytical approaches might be considered. The first would be an extension of the previous work on "model-consistent expectations", although it is computationally difficult to extend such an approach in a large-scale model system¹⁷. A second approach would be to incorporate explicit reduced-form equations for expected variables based their estimated past relationship to current and past values of other endogenous variables and also future values of exogenous policy variables.

The third area of the model where future research seems likely to have an important impact concerns the non-OECD regional models. These currently constitute the most rudimentary part of INTERLINK and although there have been recent improvements, for example with respect to commodity prices and investment income, some further strengthening now seems appropriate. Future plans centre on the incorporation of debt and debt service payment considerations in the determination of non-OECD imports. In a period of major fluctuations in key interest rates and exchange rates, this continues to be a major uncertainty in the assessment of world economic conditions⁸. The influence of the newly-industrialised countries is also of growing importance. To the extent that these countries now account for a significant share of world production and trade in manufactures, their behaviour in world markets is of major importance and can no longer be assumed to be essentially passive, particularly with respect to product pricing, exchange rates, and competitiveness.

NOTES

1. Strictly speaking, INTERLINK includes models of 23 OECD economies, with those for Luxembourg and Belgium combined.
2. This contrasts with the approach used in a number of other world models, where country expertise and modelling resources are used to dictate entirely the form and structure of individual models. See for example the description of Project LINK in Ball (1973).
3. The tracking performance, simulation properties and revisions to individual relationships and country models are reviewed regularly by a departmental "Technical Working Group", representing the individual country and subject block specialists. Subject to simulation tests, revisions to model structure and parameters are implemented on a regular basis, normally during the intervals between the bi-annual forecasting rounds.
4. The choice of broad aggregate varies across countries. M2 measures are used for the United States and Italy; M2+ for Canada; M2+CD for Japan; M3 for France and the Federal Republic of Germany; and M3 for the United Kingdom. For the United States there is also a narrow money equation for M1.
5. In common with a number of other macroeconomic models, exchange rate determination represents an equally important indirect transmission mechanism.
6. The linking equations for food and basic raw material export prices are described in Holtham et al. (1985).
7. Non-OECD country groupings are currently based on economy characteristics rather than geographic considerations. The six groups featured relate to OPEC, distinguished by low and high absorbers, other oil producers, newly industrialised countries, low- and middle-income developing countries and the Soviet bloc. It is likely that future changes will establish a more geographic grouping, with the fast-growing Asian NICs being identified as a separate group.
8. Unlinked, single-country shocks assume all foreign variables, including prices in foreign currency terms, to be exogenously fixed. The version of the INTERLINK model considered is that of September 1987.
9. Import elasticities with respect to weighted expenditure for the United States are generally higher than those for other countries, but given a lower average import share, the marginal propensity is comparable in size to those for the major European economies.
10. In the period concerned the United States and the other six major economies account for approximately 40 per cent and 45 per cent of OECD GNP, respectively.
11. In effect short-term interest rates are endogenised through the renormalisation of the exchange rate equations, with monetary aggregates being driven by movements in real GNP, prices and interest rates through the corresponding demand-for-money equations.

12. An alternative experiment would be to simulate the effects of an exogenous *ex ante* shift in market expectations, allowing alternative policy settings to determine the actual paths of exchange rates.
13. Comparative results for the equivalent single-country simulation of a change in the U.S. dollar, reported by Richardson (1987c), show a cumulative positive effect of \$62 billion.
14. See, for example, Larsen *et al.* (1983b), Table A8.
15. The level of OECD GNP is assumed to be raised through higher government expenditures. Although the composition effects vary with the use of alternative expenditure components, the actual differences in effects at the OECD area level of aggregation are negligible.
16. The effects of interest rate changes on non-OECD investment income flows and current balances are summarised by Coe *et al.* (1987). Given a sustained 100-basis-point increase in OECD long- and short-term interest rates over the period 1983 to 1987, block simulations show a cumulative decline in the current external account of approximately \$35 billion for the total non-OECD region, assuming no feedback.
17. Earlier OECD work in this area is summarised by Masson and Richardson (1983) and Masson *et al.* (1984).
18. Some OECD analysis of the debt aspects of the linkages between the developing countries and the OECD has been carried out by means of an off-model debt-accounting system, as described by Saunders and Dean (1986).

ANNEX TABLES

Annex Table 1. Price and GNP linkage effects of expenditure increases in the major economies with unchanged broad money supplies and floating exchange rates¹

Percentage differences from baseline levels

Country	Year	UNITED STATES		JAPAN		GERMANY		FRANCE		UNITED KINGDOM		ITALY		CANADA	
		PGNP	GNPV	PGNP	GNPV	PGNP	GNPV	PGDP	GDPV	PGDP	GDPV	PGDP	GDPV	PGDP	GDPV
United States	1983	0.3	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1984	1.1	1.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	1985	1.8	0.6	0.1	0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0
	1986	2.5	0.6	0.2	0.0	0.2	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0
	1987	3.3	0.5	0.3	0.0	0.3	0.0	0.2	0.0	0.2	0.0	0.0	0.1	0.0	0.0
	1983	-0.1	0.3	-0.2	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1984	0.1	0.4	0.2	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Japan	1985	0.2	0.4	0.6	0.9	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
	1986	0.3	0.3	0.9	0.3	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
	1987	0.5	0.3	1.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0
	1983	0.0	0.2	0.0	0.0	0.1	0.9	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0
	1984	0.2	0.4	0.0	0.1	0.4	1.1	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.0
	1985	0.3	0.4	0.1	0.0	0.5	0.7	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
	1986	0.4	0.3	0.2	0.0	0.4	0.4	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0
France	1987	0.6	0.2	0.3	0.0	0.4	0.5	0.2	0.1	0.2	0.0	0.1	0.0	0.1	0.0
	1983	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0
	1984	0.1	0.2	0.0	0.0	0.0	0.1	0.1	0.9	0.0	0.1	0.0	0.1	0.0	0.0
	1985	0.2	0.3	0.1	0.1	0.1	0.1	0.3	1.1	0.1	0.1	0.0	0.1	0.0	0.0
	1986	0.3	0.4	0.1	0.0	0.2	0.1	0.3	1.1	0.1	0.1	0.0	0.1	0.0	0.0
	1987	0.4	0.3	0.2	0.0	0.2	0.1	0.5	1.0	0.1	0.1	0.0	0.1	0.0	0.0
	1983	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
United Kingdom	1984	0.1	0.3	0.0	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0
	1985	0.2	0.3	0.1	0.1	0.1	0.1	0.0	0.1	0.3	0.5	0.0	0.0	0.0	0.0
	1986	0.3	0.4	0.1	0.0	0.2	0.0	0.1	0.0	0.5	0.3	0.0	0.0	0.0	0.0
	1987	0.4	0.3	0.2	0.0	0.2	0.1	0.1	0.0	0.6	0.3	0.1	0.0	0.1	0.0
	1983	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0
	1984	0.1	0.3	0.0	0.1	0.0	0.1	0.0	0.1	0.1	0.9	0.0	0.1	0.0	0.0
	1985	0.2	0.3	0.1	0.1	0.1	0.1	0.0	0.1	0.3	0.5	0.0	0.0	0.0	0.0
Italy	1986	0.4	0.1	0.2	0.0	0.2	0.0	0.1	0.0	0.5	0.3	0.0	0.0	0.0	0.0
	1987	0.5	0.1	0.2	-0.1	0.2	0.1	0.1	0.0	0.6	0.3	0.1	0.0	0.1	0.0
	1983	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.9	0.0	0.0
	1984	0.1	0.3	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.1	0.1	1.0	0.0	0.0
1985	0.3	0.3	0.2	0.0	0.2	0.1	0.1	0.1	0.1	0.0	0.3	1.0	0.0	0.0	
1986	0.6	0.2	0.3	0.0	0.4	0.0	0.2	0.1	0.2	0.1	0.2	0.6	0.8	0.1	0.0

	1984	1985	1986	1987		1984	1985	1986	1987		1984	1985	1986	1987		1984	1985	1986	1987		1984	1985	1986	1987
Major se em																								
E																								
O Europe																								
OECD Total																								
OECD Total less country taking action																								
	0.2	0.7	0.2	0.7	0.0	0.2	0.7	0.2	0.7	0.0	0.2	0.7	0.2	0.7	0.0	0.2	0.7	0.2	0.7	0.0	0.2	0.7	0.2	0.7
	0.6	0.7	0.6	0.7	0.1	0.3	0.7	0.6	0.7	0.1	0.3	0.7	0.6	0.7	0.1	0.3	0.7	0.6	0.7	0.1	0.3	0.7	0.6	0.7
	1.0	0.5	1.0	0.5	0.2	0.2	0.5	1.0	0.5	0.2	0.2	0.5	1.0	0.5	0.2	0.2	0.5	1.0	0.5	0.2	0.2	0.5	1.0	0.5
	1.4	0.4	1.4	0.4	0.3	0.1	0.4	1.4	0.4	0.3	0.1	0.4	1.4	0.4	0.3	0.1	0.4	1.4	0.4	0.3	0.1	0.4	1.4	0.4
	1.9	0.3	1.9	0.3	0.4	0.0	0.3	1.9	0.3	0.4	0.0	0.3	1.9	0.3	0.4	0.0	0.3	1.9	0.3	0.4	0.0	0.3	1.9	0.3
	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.2
	0.1	0.3	0.1	0.3	0.1	0.1	0.3	0.1	0.3	0.1	0.1	0.3	0.1	0.3	0.1	0.1	0.3	0.1	0.3	0.1	0.1	0.3	0.1	0.3
	0.2	0.3	0.2	0.3	0.2	0.0	0.3	0.2	0.3	0.2	0.0	0.3	0.2	0.3	0.2	0.0	0.3	0.2	0.3	0.2	0.0	0.3	0.2	0.3
	0.3	0.3	0.3	0.3	0.2	0.0	0.3	0.3	0.3	0.2	0.0	0.3	0.3	0.3	0.2	0.0	0.3	0.3	0.3	0.2	0.0	0.3	0.3	0.3
	0.4	0.2	0.4	0.2	0.3	0.0	0.2	0.4	0.2	0.3	0.0	0.2	0.4	0.2	0.3	0.0	0.2	0.4	0.2	0.3	0.0	0.2	0.4	0.2
	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.2
	0.1	0.3	0.1	0.3	0.1	0.1	0.3	0.1	0.3	0.1	0.1	0.3	0.1	0.3	0.1	0.1	0.3	0.1	0.3	0.1	0.1	0.3	0.1	0.3
	0.2	0.3	0.2	0.3	0.1	0.1	0.3	0.2	0.3	0.1	0.1	0.3	0.2	0.3	0.1	0.1	0.3	0.2	0.3	0.1	0.1	0.3	0.2	0.3
	0.3	0.3	0.3	0.3	0.2	0.0	0.3	0.3	0.3	0.2	0.0	0.3	0.3	0.3	0.2	0.0	0.3	0.3	0.3	0.2	0.0	0.3	0.3	0.3
	0.4	0.2	0.4	0.2	0.3	0.0	0.2	0.4	0.2	0.3	0.0	0.2	0.4	0.2	0.3	0.0	0.2	0.4	0.2	0.3	0.0	0.2	0.4	0.2
	0.1	0.6	0.1	0.6	0.0	0.2	0.6	0.1	0.6	0.0	0.2	0.6	0.1	0.6	0.0	0.2	0.6	0.1	0.6	0.0	0.2	0.6	0.1	0.6
	0.5	0.6	0.5	0.6	0.1	0.2	0.6	0.5	0.6	0.1	0.2	0.6	0.5	0.6	0.1	0.2	0.6	0.5	0.6	0.1	0.2	0.6	0.5	0.6
	0.8	0.5	0.8	0.5	0.2	0.2	0.5	0.8	0.5	0.2	0.2	0.5	0.8	0.5	0.2	0.2	0.5	0.8	0.5	0.2	0.2	0.5	0.8	0.5
	1.2	0.4	1.2	0.4	0.3	0.1	0.4	1.2	0.4	0.3	0.1	0.4	1.2	0.4	0.3	0.1	0.4	1.2	0.4	0.3	0.1	0.4	1.2	0.4
	1.6	0.3	1.6	0.3	0.4	0.0	0.3	1.6	0.3	0.4	0.0	0.3	1.6	0.3	0.4	0.0	0.3	1.6	0.3	0.4	0.0	0.3	1.6	0.3
	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.2
	0.1	0.3	0.1	0.3	0.0	0.1	0.3	0.1	0.3	0.0	0.1	0.3	0.1	0.3	0.0	0.1	0.3	0.1	0.3	0.0	0.1	0.3	0.1	0.3
	0.2	0.3	0.2	0.3	0.1	0.1	0.3	0.2	0.3	0.1	0.1	0.3	0.2	0.3	0.1	0.1	0.3	0.2	0.3	0.1	0.1	0.3	0.2	0.3
	0.3	0.2	0.3	0.2	0.2	0.1	0.2	0.3	0.2	0.2	0.1	0.2	0.3	0.2	0.2	0.1	0.2	0.3	0.2	0.2	0.1	0.2	0.3	0.2
	0.5	0.2	0.5	0.2	0.3	0.0	0.2	0.5	0.2	0.3	0.0	0.2	0.5	0.2	0.3	0.0	0.2	0.5	0.2	0.3	0.0	0.2	0.5	0.2

1. An increase in government non-wage expenditures equal to 1 per cent of baseline real GNP.

Note: PGDP = GDP deflator.
 GDPV = real GDP.
 PGNP = GNP deflator.
 GNPV = real GNP.

Annex Table 2. Price and GNP linkage effects of expenditure increases in the major economies with unchanged short-term interest rates and exchange rates¹

Percentage differences from baseline levels

Impact on:	Year	Country taking action													
		UNITED STATES		JAPAN		GERMANY		FRANCE		UNITED KINGDOM		ITALY		CANADA	
		PGNP	GNPV	PGNP	GNPV	PGNP	GNPV	PGDP	GDPV	PGDP	GDPV	PGDP	GDPV	PGDP	GDPV
United States	1983	0.4	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1984	1.3	1.4	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	1985	2.5	1.3	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.1
	1986	4.0	1.3	0.2	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.2	0.1
	1987	5.6	1.3	0.3	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.3	0.1
Japan	1983	0.1	0.3	-0.2	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1984	0.0	0.7	0.2	1.9	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
	1985	0.3	1.0	0.9	2.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1
	1986	0.8	1.3	1.8	1.9	0.1	0.2	0.0	0.1	0.1	0.2	0.0	0.1	0.1	0.1
	1987	1.3	1.5	2.5	1.5	0.2	0.2	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1
Germany	1983	0.0	0.3	0.0	0.0	0.1	1.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0
	1984	0.2	0.6	0.0	0.1	0.7	1.7	0.1	0.2	0.1	0.2	0.0	0.1	0.0	0.0
	1985	0.6	0.9	0.1	0.2	1.3	1.7	0.1	0.3	0.2	0.3	0.1	0.2	0.0	0.1
	1986	0.9	1.1	0.2	0.2	1.3	1.2	0.2	0.3	0.3	0.2	0.1	0.2	0.1	0.1
	1987	1.2	1.1	0.3	0.3	0.9	0.6	0.2	0.3	0.3	0.2	0.1	0.1	0.1	0.1
France	1983	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0
	1984	0.0	0.3	0.0	0.0	0.0	0.1	0.2	1.0	0.0	0.1	0.0	0.1	0.0	0.0
	1985	0.2	0.5	0.0	0.1	0.1	0.2	0.5	1.3	0.1	0.1	0.0	0.1	0.0	0.0
	1986	0.5	0.6	0.1	0.1	0.2	0.2	0.9	1.5	0.1	0.2	0.1	0.1	0.0	0.0
	1987	0.8	0.8	0.2	0.2	0.3	0.2	1.3	1.6	0.2	0.2	0.1	0.1	0.1	0.1
United Kingdom	1983	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.1	1.0	0.0	0.0	0.0	0.0
	1984	0.2	0.4	0.0	0.1	0.1	0.1	0.0	0.1	0.7	1.3	0.0	0.1	0.0	0.0
	1985	0.5	0.5	0.1	0.1	0.2	0.2	0.1	0.1	1.6	1.1	0.1	0.1	0.0	0.0
	1986	1.1	0.5	0.2	0.1	0.4	0.1	0.2	0.1	2.4	0.8	0.1	0.1	0.1	0.0
	1987	1.8	0.5	0.4	0.1	0.5	0.1	0.3	0.1	3.0	0.7	0.2	0.0	0.2	0.0
Italy	1983	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.9	0.0	0.0
	1984	0.1	0.3	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.2	1.1	0.0	0.0
	1985	0.3	0.4	0.0	0.1	0.1	0.2	0.0	0.1	0.0	0.1	0.3	1.1	0.0	0.0
	1986	0.6	0.5	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.6	0.9	0.1	0.0
	1987	1.0	0.5	0.2	0.1	0.3	0.1	0.1	0.1	0.2	0.1	1.0	0.9	0.1	0.0

	1984	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.2
	1985	0.9	0.8	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	1.4	1.0
	1986	1.7	0.8	0.2	0.1	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	2.2	0.7
	1987	2.7	0.9	0.3	0.1	0.2	0.0	0.1	0.0	0.2	0.1	0.1	0.0	2.9	0.5
Major seven	1983	0.2	0.7	0.0	0.2	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1
	1984	0.7	1.0	0.0	0.4	0.1	0.2	0.0	0.1	0.1	0.2	0.0	0.1	0.0	0.1
	1985	1.4	1.0	0.2	0.4	0.2	0.3	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1
	1986	2.3	1.1	0.4	0.4	0.3	0.2	0.2	0.2	0.3	0.2	0.1	0.1	0.2	0.1
	1981	3.4	1.2	0.6	0.4	0.3	0.2	0.2	0.2	0.5	0.2	0.2	0.1	0.3	0.1
EEC	1983	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.2	0.0	0.2	0.0	0.2	0.0	0.0
	1984	0.1	0.4	0.0	0.1	0.2	0.6	0.1	0.3	0.1	0.4	0.0	0.2	0.0	0.0
	1985	0.4	0.6	0.1	0.1	0.4	0.6	0.2	0.4	0.4	0.4	0.1	0.2	0.0	0.0
	1986	0.1	0.7	0.1	0.2	0.5	0.5	0.3	0.5	0.6	0.3	0.2	0.2	0.1	0.1
	1987	1.1	0.8	0.3	0.2	0.5	0.3	0.4	0.5	0.8	0.3	0.3	0.2	0.1	0.1
OECD Europe	1983	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.2	0.0	0.2	0.0	0.1	0.0	0.0
	1984	0.1	0.4	0.0	0.1	0.2	0.5	0.1	0.3	0.1	0.3	0.0	0.2	0.0	0.0
	1985	0.4	0.6	0.1	0.1	0.3	0.6	0.2	0.4	0.3	0.3	0.1	0.2	0.0	0.0
	1986	0.7	0.7	0.1	0.2	0.4	0.4	0.3	0.4	0.5	0.3	0.2	0.2	0.1	0.1
	1987	1.0	0.8	0.3	0.2	0.5	0.3	0.4	0.5	0.7	0.3	0.2	0.2	0.1	0.1
OECD Total	1983	0.1	0.7	0.0	0.2	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0
	1984	0.6	0.9	0.0	0.3	0.1	0.2	0.0	0.1	0.1	0.2	0.0	0.1	0.0	0.1
	1985	1.2	1.0	0.2	0.4	0.2	0.3	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1
	1986	2.0	1.0	0.4	0.4	0.3	0.2	0.1	0.2	0.3	0.2	0.1	0.1	0.2	0.1
	1981	2.9	1.1	0.6	0.4	0.3	0.2	0.2	0.2	0.4	0.2	0.2	0.1	0.3	0.1
OECD Total less country taking action	1983	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1984	0.1	0.5	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
	1985	0.4	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.1
	1986	0.7	0.9	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	1987	1.2	1.0	0.3	0.2	0.3	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.1

1. An increase in government non-wage expenditures equal to 1 per cent of baseline real GNP.

Note: PGDP = GDP deflator.
GDPV = real GDP.
PGNP = GNP deflator.
GNPV = real GNP.

Annex Table 3. Summary results for simulated increases in government non-wage expenditures¹
Percentage differences from baseline levels

	With unchanged money supply and floating exchange rates					With unchanged short-term interest rates and exchange rates				
	1983	1984	1985	1986	1987	1983	1984	1985	1986	1987
Increase in expenditures for:										
United States										
Real GNP	1.2	1.0	0.6	0.6	0.5	1.3	1.4	1.3	1.3	1.3
GNP deflator	0.3	1.1	1.8	2.5	3.3	0.4	1.3	2.5	4.0	5.6
Current balance ²	-9.8	-10.8	-12.1	-16.1	-19.9	-11.4	-14.6	-17.1	-23.2	-29.7
Broad money supply						0.3	1.2	2.2	3.4	4.8
Short-term interest rate ³	0.6	1.1	1.2	1.6	1.9					
Effective exchange rate	0.0	-0.6	-1.1	-1.4	-1.8					
Rest of OECD										
Real GNP	0.2	0.4	0.3	0.2	0.2	0.2	0.5	0.7	0.9	1.0
GNP deflator	0.0	0.1	0.2	0.3	0.5	0.0	0.1	0.4	0.7	1.2
Current balance ²	7.4	11.2	14.3	21.3	26.5	6.8	9.7	13.3	21.1	26.7
Short-term interest rate ³	0.2	0.4	0.6	0.7	0.8					
Increase in expenditures for:										
Japan										
Real GNP	1.1	1.3	0.9	0.3	0.0	1.2	1.9	2.1	1.9	1.5
GNP deflator	-0.2	0.2	0.6	0.9	1.0	-0.2	0.2	0.9	1.8	2.5
Current balance ²	-2.0	-2.4	-2.7	-3.1	-3.4	-2.3	-3.5	-4.4	-5.5	-7.6
Broad money supply						0.3	1.8	3.4	4.7	5.2
Short-term interest rate ³	0.7	1.9	1.9	1.4	0.9					
Effective exchange rate	0.5	1.2	1.4	0.8	0.0					
Rest of OECD										
Real GNP	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.2
GNP deflator	0.0	0.0	0.1	0.2	0.3	0.0	0.0	0.1	0.2	0.3
Current balance ²	0.7	1.3	2.2	3.5	4.2	1.0	2.0	3.0	4.5	5.9
Short-term interest rate ³	0.0	0.1	0.2	0.2	0.2					
Increase in expenditures for:										
Germany										
Real GNP	0.9	1.1	0.7	0.4	0.5	1.0	1.7	1.8	1.2	0.6
GNP deflator	0.1	0.4	0.5	0.4	0.4	0.1	0.7	1.3	1.3	0.9
Current balance ²	-2.1	-2.5	-2.8	-4.0	-4.7	-2.6	-3.7	-4.1	-4.7	-5.0
Broad money supply						0.4	1.7	2.9	3.2	2.7
Short-term interest rate ³	0.9	1.7	1.2	0.6	0.7					
Effective exchange rate	0.4	0.7	0.6	0.2	0.1					
Rest of OECD										
Real GNP	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1
GNP deflator	0.0	0.0	0.1	0.2	0.2	0.0	0.0	0.1	0.2	0.3
Current balance ²	2.4	4.3	5.2	6.5	7.2	1.8	3.1	3.8	4.4	5.0
Short-term interest rate ³	0.1	0.2	0.2	0.2	0.2					
Increase in expenditures for:										
France										
Real GDP	0.6	0.9	1.1	1.1	1.2	0.6	1.0	1.3	1.5	1.6
GDP deflator	0.0	0.1	0.3	0.4	0.6	0.0	0.2	0.5	0.9	1.3
Current balance ²	-1.6	-2.3	-3.1	-4.5	-5.4	-1.7	-2.4	-3.2	-4.5	-5.8
Broad money supply						0.1	0.6	1.1	1.7	2.2
Short-term interest rate ³	0.5	1.0	1.5	1.8	2.2					
Effective exchange rate	0.2	0.5	0.9	1.0	1.1					
Rest of OECD										
Real GNP	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1
GNP deflator	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.1
Current balance ²	1.3	2.2	3.4	5.3	6.5	1.2	1.9	2.6	4.2	5.4
Short-term interest rate ³	0.0	0.0	0.1	0.2	0.2					

Annex Table 3 (contd)

	With unchanged money supply and floating exchange rates					With unchanged short-term interest rates and exchange rates				
	1983	1984	1985	1986	1987	1983	1984	1985	1986	1987
Increase in expenditures for:										
United Kingdom										
Real GDP	0.9	0.9	0.5	0.3	0.3	1.0	1.3	1.1	0.8	0.7
GDP deflator	0.0	0.1	0.3	0.5	0.6	0.1	0.7	1.6	2.4	3.0
Current balance ²	-2.2	-2.8	-2.6	-3.2	-3.8	-2.4	-3.2	-3.3	-4.1	-5.2
Broad money supply						0.2	0.9	1.6	2.2	2.7
Short-term interest rate ³	0.9	1.6	1.3	1.2	1.4					
Effective exchange rate	0.5	1.1	1.1	0.8	0.7					
Rest of OECD										
Real GNP	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
GNP deflator	0.0	0.0	0.1	0.1	0.2	0.0	0.0	0.1	0.1	0.2
Current balance ²	1.9	2.6	2.7	3.4	4.0	1.8	2.7	2.8	3.7	4.7
Short-term interest rate ³	0.0	0.1	0.2	0.2	0.2	..	..	..	..	..
Increase in expenditures for:										
Italy										
Real GDP	0.9	1.0	1.0	0.8	0.6	0.9	1.1	1.1	0.9	0.8
GDP deflator	0.1	0.1	0.3	0.6	1.0	0.1	0.2	0.3	0.6	1.0
Current balance ²	-1.5	-2.0	-2.0	-2.2	-2.3	-1.5	-2.0	-2.2	-2.6	-3.0
Broad money supply						0.3	0.7	1.1	1.6	2.0
Short-term interest rate ³	0.3	0.3	0.4	0.5	0.6					
Effective exchange rate	0.0	0.0	-0.2	-0.4	-0.7					
Rest of OECD										
Real GNP	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1
GNP deflator	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.1
Current balance ²	1.1	1.7	2.0	2.5	2.7	1.0	1.5	1.8	2.4	2.8
Short-term interest rate ³	0.0	0.0	0.1	0.1	0.1					
Increase in expenditures for:										
Canada										
Real GDP	0.8	1.1	0.6	0.2	0.0	0.8	1.2	1.0	0.7	0.5
GDP deflator	0.0	0.5	1.3	2.0	2.7	0.0	0.6	1.4	2.3	2.9
Current balance ²	-0.9	-1.9	-2.3	-2.6	-3.0	-0.9	-1.8	-2.4	-3.1	-4.0
Broad money supply						0.2	1.2	2.3	3.1	3.8
Short-term interest rate ³	0.4	1.6	1.9	2.1	2.2					
Effective exchange rate	0.2	0.6	0.5	0.0	-0.6					
Rest of OECD										
Real GNP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
GNP deflator	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.2
Current balance ²	0.7	1.8	2.4	2.9	3.2	0.7	1.4	2.0	2.5	3.3
Short-term interest rate ³	0.0	0.0	0.0	0.1	0.1	..	..	..	..	..

1. Increase in government real non-wage expenditures equal to 1 per cent of baseline real GNP/GC

2. Current balances in US\$ billion.

3. Percentage points.

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