

REPRESENTING RECENT POLICY CONCERNS IN OECD'S MACROECONOMIC MODEL

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INTRODUCTION

Most international linkage models reflect their demand-side origins, although there are some notable exceptions¹. Furthermore, it seems likely that they will continue to do so, because the international transmission of demand impulses is likely to remain an important phenomenon which will need to be taken into account by policymakers, individually and collectively, when analysing and forecasting the behaviour of their economies.

Over the last decade, however, the concerns of policymakers in many countries have shifted, in some cases quite fundamentally. At the moment there are perhaps four main areas of concern in which it is felt that models, national and international alike, are inadequate. These are:

- The representation of financial markets and, in particular, the floating exchange rate regime that has been operating since end-1971;
- The modelling of expectations and, especially, effects that so-called rational expectations on the part of economic agents may have on economic behaviour;
- The modelling of the interactions of the OECD area with developing economies, particularly as regards the latter's debt situation;
- The modelling of the way in which the supply side of economies operates, including the role of profitability in output decisions.

Each of these four questions is being looked at in the OECD Secretariat, with the results in turn reflected in the **OECD** Secretariat's world economic model, INTERLINK. The first – exchange rate determination – is self-evidently an issue which needs to be examined in a consistent international framework. Likewise, the study of rational expectations is proving, as might be expected, to have a potentially important international dimension, in significant part because of the highly integrated nature of the modern world's international financial markets. The third area of concern, the interdependence of the developing economies and the OECD economies, is quintessentially international in character. The fourth area of concern – the modelling of the supply side – does not quite so obviously require an international modelling effort, at least at the beginning: clearly some very interesting work can go on, and has been, at the level of economies considered individually. But there are a number of areas of policy concern, such as the supply side consequences

of large changes in the price of internationally-traded oil, where a supply-side shock is transmitted internationally, with world-wide implications for productive potential. Again, an international model is needed.

While the basic structure of INTERLINK, and its properties, have been reasonably fully documented², there is relatively little information on the most recent developments, and even that is dispersed. It is intended that a number of explanatory articles should be written over the coming months, to be published in *Economic Studies* and the Economics and Statistics Department Working Paper series. In advance of those articles, this note provides a broad non-technical review of the most recent developments.

I. THE MODELLING OF INTERNATIONAL FINANCIAL LINKAGES

To accommodate the reality of the floating rate regime under which the world economic system now operates, a set of international financial linkages – dubbed FINLINK – was added to an experimental version of INTERLINK about three years ago. A description of that version of the system, at the stage to which it had evolved about a year ago, is given by Holtham (1984). In order to focus proper attention on the international consistency conditions required in the modelling of international financial markets it was convenient, at least in the first instance, to specify and model a system of relationships for capital flows rather than exchange rates. Hence the original FINLINK system determined exchange rates not through an explicit exchange rate equation as such, but rather through a set of key relationships which can be summarised thus:

- Countries' current accounts are basically functions of the level of activity, at home and abroad, and of international competitiveness;
- Net capital flows, equal and opposite in sign to current accounts (except to the extent that reserve changes are permitted), are essentially determined by a portfolio allocation of wealth on the basis of international short-term interest rate differentials and actual and expected exchange rates;
- Countries' short-term interest rates [which are now determined by a somewhat less rudimentary method than that in place when Holtham (1984) was written] could optionally be determined either by a set of reaction function relationships, responding to domestic and foreign supplies and demands for money, inflation and exchange rate movements, or inverted demand for money relationships, given appropriate money supply rules, as described in Blundell-Wignall *et al.* (1984);

- Appropriate weighting schemes are employed for interest rates, capital flows, and exchange rates which, together with parameter restrictions on the set of capital flow (**or** exchange rate) functions, ensure that international consistency of flows is respected. Due allowance is also made for consistent financing flows to the non-OECD regions, though these are not modelled as resulting from portfolio adjustments of wealth holders;
- With goods prices proximately determined in domestic goods and labour markets, and interest rates proximately determined in domestic money markets, exchange rates are determined as the set of prices for countries' currencies which for **given** currency reserve positions achieve equilibrium in the balance of payments.

In the most recent version of INTERLINK, the capital flow relationships defined above have been renormalized as explicit equations for the effective exchange rate, with net capital flows now obtained from the balance-of-payments identity. Use of this new system for **fixed** exchange rate application therefore necessarily involves the "targetting" of official reserves, as an integral part of the model solution process, in both single-country and fully-linked mode.

There are, at present, relatively few international models with functioning exchange rate-determining mechanisms, and hence there are few results with which to compare those obtained from INTERLINK. For this reason, as well as the intrinsic difficulty of this part of the subject, most results in this field, whether obtained using INTERLINK or other models, should be regarded as markedly more tentative than more "standard" results which stem from the international interaction of comparatively well-attested domestic relationships. But while the international results being considered here are preliminary, a number of them are interesting, and warrant consideration. Key features include:

- i) The size of exchange rate changes needed to clear markets depends critically in the model on the elasticity of capital flows with respect to changes in interest rates and the expected exchange rate. This almost certainly reflects reality, but the phenomenon is not at all easy to quantify;
- ii) Equally, simulated exchange rate changes in the model depend importantly upon the modelling of expected exchange rates. But establishing how exchange rate expectations are formed is a problem. Until recently three approaches had been used by the OECD Secretariat in modelling expected exchange rates. Each consisted of trying to model actual exchange rates in a reduced-form manner and then using the resulting equation, together with the information available to agents at time t , to generate an expected exchange rate for time $t + 7$. The three approaches were: a univariate time-series ARIMA model; a much simplified unrestricted reduced form of INTERLINK itself; and an **ad hoc** equation specifying a form of long-run purchasing power parity. In spite of the

wealth of empirical work supporting the view that **ARIMA** models may provide statistically the best **one-step-ahead** predictor of the exchange rate, such an approach is singularly unhelpful to the macroeconomic analyst. In effect, it implies in a macroeconomic model an expectation for the exchange rate, and thereby an outcome, which is invariant to changes in current economic conditions. However, this seems unlikely to correspond to reality. Furthermore alternative, and perhaps more plausible, representations of the way in which expectations are formed can significantly alter the way in which key parts of the system operate. For example when, as described below, a form of rational or forward-looking expectations is introduced, expected exchange rate movements and thereby simulated actual exchange rates move relatively quickly in response to domestic monetary and real disturbances. When the purchasing power parity approach is used, the expected exchange rates change relatively sluggishly in response to domestic disturbances, although the ultimate effect is much the same. The current version of **INTERLINK** retains a partial adjustment purchasing power parity approach to determine an internationally-consistent set of expected effective exchange rates, but there may well be further changes in due course;

- iii)* Achieving a degree of stability of the system in the face of simulated domestic disturbances comparable to those actually observed has not proved a particular problem. This in part reflects the specification of the expectations function, but more importantly the relatively high degree of capital mobility implied by the estimated elasticities and (more recently) the responsiveness of interest rates to real and monetary disturbances;
- iv)* Another interesting and potentially important result, which may or may not prove robust when subjected to further analysis and testing, concerns **Mundell/Fleming** export crowding out. In a number of other international linkage models, a simulated fiscal expansion results, under the assumption of unchanged monetary growth, in a current balance effect on the exchange rate which dominates the effect of increased capital flows resulting from induced higher domestic interest rates. As a result, the exchange rate falls and, at least in the short run, imparts an additional stimulus to demand by way of the induced change in the real trade balance. In **INTERLINK** a relatively high responsiveness of capital movements to interest and exchange rate movements causes the capital account effect to dominate and the currency to appreciate. For two countries, the United States and Germany, this has been true in all versions of the model, but recent respecification of domestic monetary sectors has made interest rates more sensitive to activity and has extended the result to other countries.

II. THE FORMATION OF EXPECTATIONS

The way in which economic agents form their expectations is far from clear. By its very nature this is a difficult issue to investigate, but quite properly has become an important area of theoretic and also policy concern. One recent strand of OECD work in this area, undertaken by Masson, Blundell-Wignall and Richardson (1984) (hereafter MBWR) has considered the possible implications, nationally and internationally, of 'rational' or 'consistent' expectations in financial markets, where the likelihood of their existence would appear to be the greatest. This work compares the consequences of the rational expectations assumption with the more conventional alternative (at least for large-scale macro modellers) in which expectations are presumed to be determined by current and past realised values of the variables under consideration – called here "adaptive expectations".

Thus MBWR consider two fairly extreme cases. In the adaptive expectations case they take the long-term interest rate to be a distributed lag function of *past* short rates: in the consistent expectations case the long rate is taken to be a function of expected *future* short rates. Similarly for the exchange rate, the current expectation of next period's rate is assumed to be correct.

The question at issue is what differences the two assumptions make to the way that policy changes are simulated to affect the economy. In order to address this, it is necessary first to have a way of deriving forward-looking expectations; MBWR use the techniques of Blanchard and Kahn (1980) to do this in a fashion consistent with the solution properties of INTERLINK. In effect it is assumed that market participants form their expectations by simulating INTERLINK – or something like it – in their heads. Computationally, the problem is complicated; the procedure followed by MBWR involves building and running a scaled-down version of INTERLINK, called MINILINK, from which it is possible to calculate within reasonable computation time an explicit foresight solution several periods ahead. It is, of course, fairly arbitrary to assume that market participants form their expectations as if they were informed by the model, but that is only an assumption of convenience. The key point for the work so far is not *what* expectations are formed, but rather the *differences* that result when expectations are presumed to be formed in a consistent, forward-looking manner.

A comparison of simulations made under the two assumptions suggests that the specification of the way in which expectations are formed in financial markets does have an empirically important effect upon the way in which policy changes appear to affect an economy. For example, in response to a hypothetical fiscal tightening in the United States, the simulated U.S. long-term bond rate declines quickly and substantially under the consistent expectations assumption: this contrasts significantly with the result obtained under the assumption of adaptive expectations, in which the long rate, being a distributed lag function of *past* rates,

changes by much less. Thus in response to a hypothetical fiscal cut of \$50 billion, bond rates fall under the adaptive expectations assumption by just 10 basis points in the first year, and fall further to 70 basis points below base line after five years: under the consistent, forward-looking expectations assumption the long-term bond rate declines by more than **180** basis points in the *first* year.

In turn there is a larger depreciation of the dollar under the consistent expectations version than under the assumption of adaptive expectations. Hence the simulated decline in U.S. output is smaller under the assumption of forward-looking expectations because of lower interest rates and a lower dollar. Correspondingly, the effects on other countries too are significantly different under the assumption of forward-looking expectations. Ignoring the question of interest rate risk premia, which are not part of the story here, international interest rate parity for short rates implies in turn interest rate parity for long rates, so these drop sharply, in line with the fall in long rates in the United States. This in turn reduces the output reductions outside the United States compared with the adaptive expectations case, where interest rates change little and the relatively sharp U.S. output contraction induces a relatively sharp reduction in other countries' exports and thereby their activity.

This work is at an early stage, and hence it would not yet be appropriate to attempt to draw quantitative policy conclusions from it. There are many unresolved questions. For example, while it does seem clear that the way in which expectations are formed can have an important effect on the way that policy operates upon an economy, it is not clear how in fact expectations *are* formed by market participants. Is the process essentially forward-looking, backward-looking, or something in between? And, either way, are most market participants implicitly using much the same model to trace through the consequences of their expectations, or do they have widely differing views about how the economic system operates? Further, are expectations being formed in a forward-looking way only in financial markets, or does the process extend also to goods markets and the determination of money wage rates? Clearly much empirical work remains to be done in this area, and it will not be easy, not least because evidence on how expectations are actually formed is by its very nature extremely difficult to establish.

III. INTERACTION WITH DEVELOPING ECONOMIES

In contrast to earlier decades, economic forecasting and the formulation of economic policy for the OECD economies as a whole is increasingly dependent on taking account of conditions in the non-OECD area – particularly the developing economies – and the feedback effects from the non-OECD countries that actions in

the OECD area can induce. That the non-OECD area should be important to conditioning developments in the OECD countries is perhaps understandable, in the light of the growing importance these countries have assumed in world trade in general, and with the OECD area in particular. Further, some of the major shocks to which the OECD area has been subjected over the last decade have emanated, at least proximately, from the non-OECD countries. The two oil shocks of the 1970s are important examples. Because of the importance of events in the developing economies to the OECD area, an international linkage model, to be complete, must ensure that the channels through which real, price and financial linkages are transmitted are adequately specified. Experience with the OECD's **INTERLINK** system suggests that, by and large, the trade linkages are adequate, though of course there is room for improvement. However, two areas where improvement is needed concern the determinants and consequences of changes in primary commodity prices, and the modelling of the effects of interest rate changes on ldc debt, and thereby on their imports.

The importance of the interaction of OECD countries with the developing economies is exemplified in recent policy concern over the debt problems of the latter. The debt problems of the developing economies had been important for some time, but came to a head in 1982, when it appeared that a number of major developing economies might not be able to meet their international loan repayment schedules. Factors contributing to this situation were on the one hand a combination of sluggish export growth and falling commodity export prices (related to generally weak demand conditions in the OECD area), and to rising interest payments on international debt on the other. The end result was a very sizeable debt service burden, which obliged many developing economies to curtail dramatically their imports from the OECD area. The resulting shortfall – largely unexpected – in OECD area exports was an important contributing factor to the substantial under-prediction of the severity of the recession in OECD countries in 1981-82.

INTERLINK, like most international linkage models, has been concerned primarily with the industrialised economies, which account for the bulk of the world's international trade and payments. Because of their small size, and data limitations, the modelling of developing economies has typically – and certainly within INTERLINK – been limited to a set of reduced-form equations, through which the import potential of these economies is linked to changes in their foreign exchange resources, with appropriate adjustment for terms-of-trade changes. Changes in developing economies' foreign exchange reserves are typically related to export receipts, and also dependent on transfers and capital flows (such as those related to development assistance programmes). Using this apparatus, the probable weakness of developing economies' exports was correctly identified in 1982 as the consequence of depressed demand conditions in the OECD area. But, in retrospect, Secretariat analysis of the prospects of the developing economies did not take adequately into account the extent of the weakness in commodity prices, and the

interaction of a growing stock of debt – the bulk of which is in the form of short-term variable interest rate debt – and rising world interest rates. The growing debt service burden represented, in particular, a pre-emptive claim on foreign exchange resources, which was not at the time explicitly embodied in the forecasting mechanisms. Hence the significant forecasting error for **1982**.

To improve the modelling of commodity prices, aggregate price equations have been derived from a market-clearing model established for food and raw materials commodity groups. There are separate equations for food, agricultural raw materials, metals and minerals, and tropical beverages, distinguished separately by the composition of OECD and non-OECD commodity exports. These "world market prices" are then entered as explanatory variables in the export price equations of each country or non-OECD zone. Import prices are functions of export prices in the system in the usual way of multilateral trade models. This procedure has the effect of making commodity prices and terms of trade react to systemic influences. So far this has been implemented only in an experimental version of the model.

These commodity price equations now link the levels of real prices, i.e. in relation to the general OECD price level, to financial conditions as measured by interest rate levels, and to oil prices. Significant effects were also found both for the level of OECD real activity and its deviation from a capacity trend, but such effects appear both to have diminished somewhat over time and to have become more short-lived.

Work is also being undertaken to endogenise the flow of interest payments in current accounts as a function of interest rates and the stock of debt in each country. Credit availability is also to be modelled, in a reduced-form sense, as depending on the existing debt situation. This work is being carried out in collaboration with the IBRD.

IV. THE MODELLING OF SUPPLY

The fourth area of policy-analytic concern currently under development within INTERLINK concerns the modelling of the supply process. In earlier versions of the system some supply-side effects were of course already present, both at the national and the international level. Within each of the country models, supply-side effects have manifested themselves primarily through the effects of labour market conditions on domestic wages, costs and prices (including export prices). For the seven largest OECD economies factor demand equations for energy, capital and labour are now consistently derived from a postulated three-factor putty-clay aggregate production function. However the underlying model has assumed cost

minimisation (not profit maximisation) by firms so that output remains demand-determined. Moreover, inventory formation and pricing behaviour were not explicitly linked to the production model in the supply block. At the international level, supply-side effects manifest themselves primarily through the effect of variations in demand conditions on international commodity prices, which in turn feed into **OECD** countries' domestic cost and price structures. This is an important area, often overlooked from the vantage point of a forecast or policy analytic exercise of any single country, for the cumulative effects of changes in demand conditions in a number of countries can impart a powerful inflationary impulse. The sensitivity of the price of internationally-traded oil to a change in activity in the **OECD** area, and its repercussions for the **OECD** area inflation rate is, by now, a familiar example of this process. The attention given in recent months to improving further the commodity price determination block of the system has been alluded to **above**. However, the primary thrust of recent development work has been aimed at the supply side of the component country models of INTERLINK. An important reason for conducting the exercise within an international linkage framework is that it enables the various supply-side relationships to interact with the relationships determining aggregate demand, both nationally and as transmitted internationally.

The main features of recent **OECD** Secretariat supply block research are:

- A consistent production function specification has been maintained across countries, involving three factors – labour, capital **and** energy – with capital and energy nested in an inner **CES** function and combining in turn with labour, specified in terms of efficiency units, in an outer **CES** function;
- A flexible vintage structure for the inner **CES** function (combining capital and energy) which includes both putty-putty and putty-clay technologies as special cases. An estimated retro-fitting parameter is used to determine the share of the capital stock which can be recombined with energy in optimal proportions as relative prices change;
- Explicit modelling of the short-term output and capacity utilisation decisions – firms respond to unexpected changes in demand (sales from domestic production), profitability or the inventory-output ratio;
- Factor demand equations consistent with the underlying production function, based on the assumption of cost minimisation, are developed for fixed capital, labour and energy inputs;
- The consistent specification of price equations which depend on unit costs derived as the "dual" of the production function in the long run but on actual unit costs in the short run, and where the activity variable is the dependent variable of the output supply equation itself (capacity utilisation).

So far, a number of interesting features have emerged from this work:

- **As** far as the representation of short-run production decisions is concerned, there is evidence across countries of a tendency for utilisation rates to vary systematically over time; the most significant determinants of the short-run factor utilisation rates are sales and profit margins, although inventory levels relative to potential output also exert some influence consistent with adjustment towards normal **stock/sales** and **sales/output** ratios;
- **As** far as longer-term production plans are concerned, there is reasonable evidence across all countries of substantial lags (two years for labour and four years for capital) in the adjustment of both capital and labour to changes in desired levels;
- Further, there is evidence that most countries have quite high long-run elasticities of substitution between capital and energy (in the range 0.3 to 0.95), with most showing important vintage effects of the **putty/semi-putty** type, whereby capital-energy ratios are variable before capital is put in place but can only be gradually changed thereafter.

Work to implement the latest results from this work in an experimental version of **INTERLINK** is currently under way and will be the subject of a forthcoming simulation study. Preliminary results suggest that this work may result in a reasonably satisfactory integration of supply-side and demand-side influences. For example, as far as the short term is concerned, the adjustment lags involved, particularly in the **output/stock** adjustment mechanism, are such that the model retains – for an underemployed economy – broadly the sort of short-term **GDP/GNP** multipliers that it had previously, and which characterise most short-term **income/expenditure** models. But over the longer term, supply-side developments become potentially important, playing the major role in determining the trend rate of growth of output and employment. This should considerably extend the range of usefulness of the model, while permitting it to retain the influence of changes of demand, nationally and internationally, on short-term economic performance.

NOTES

1. For example, Waelbroek's general equilibrium model,
2. For a detailed exposition of a number of key properties of INTERLINK, see Larsen, Llewellyn and Potter (1983), especially the Annex. For a further description of the structure and operation of INTERLINK, see OECD (1983).

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