DOMESTIC AND INTERNATIONAL EFFECTS OF GOVERNMENT SPENDING UNDER RATIONAL EXPECTATIONS

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CONTENTS

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INTRODUCTION

Large fiscal deficits in the United States have been at the centre of economic policy debate recently, both in that country and internationally. There is wide disagreement among economists about the impact on national economies and on the world economy of fiscal policy. To some extent, the disagreement concerns how to evaluate the current stance of fiscal policy; here it is clearly necessary to look behind figures for the actual deficit to measure the ***structural*** deficit, corrected for cyclical factors and for the inflation premium in interest payments made on government debt [see Muller and Price (1984) for a discussion of these issues]. Equally important, however, is disagreement about the transmission mechanism linking the stance of fiscal policy to economic activity, asset prices and inflation.

The term "fiscal policy" generally includes a wide range of measures that have both micro- and macro-economic consequences. Tax and subsidy measures can directly affect relative prices as well as income distribution, for example; and both can also have important macro-economic repercussions. Government spending can stimulate particular sectors as well as increase aggregate demand taken globally. Finally, the way increased government spending is ***financed*** may influence its macro-economic effects: if financed by money, it can be expected to be more expansionary than if either debt-financed or tax-financed.

The difference, if any, between the effects of debt financing and tax financing depends on a series of institutional arrangements and also behavioural factors, the latter being strongly influenced by expectations of future taxes and their effect on the behaviour of those currently living [see Barro (1974)]. If the amount of government debt does have economic significance, then an evaluation of how a deficit affects asset prices because of the resulting change in the stock of debt must consider the degree of substitutability between government debt and other assets [see for instance Friedman (1978)]. If government debt is a perfect substitute for other domestic private securities and for foreign bonds, then a change in the relative supplies of these assets will not be expected to affect their relative rates of return.

The complexity of the linkages involved makes it difficult to assess whether certain stylised facts about the world economy – a high exchange value for the dollar and high real interest rates, in particular – could have resulted from fiscal policy in the United States or are more likely related to other causes. But perhaps more important than this question of what caused this constellation of financial prices is the question of whether U.S. fiscal policy could be effective in altering it. To shed some light on this question we isolate one channel – fiscal policy working through aggregate demand – and analyse effects of discretionary changes in U.S. government spending, both domestically and its transmission to the rest of the world, in an empirically-based model whose private agents correctly anticipate the future effects of those policies. The assumption of "rational expectations" – and we emphasize that this is an assumption, for which we do not present any empirical corroboration – is important because it implies that asset prices respond quickly and strongly to new information about the fiscal policy stance. This channel linking government spending increases to stimulation of economic activity and, with unchanged monetary targets, higher short-term interest rates – what B. Friedman (1978) has called "transactions crowding out" – is a reason why a shift towards larger U.S. structural budget deficits might be associated with high real interest rates and dollar appreciation, and one that does not involve relative asset supplies and risk premiums on government debt. Furthermore, if the fiscal stance is expected to persist, short-term interest rates expected for the future will be higher, with all that implies for current long-term bond rates.

Our simulation results suggest that the channel described above is an important one: a permanent reduction in government spending in the United States by $50 billion (1982 dollars) could produce a 4 per cent fall immediately in the effective exchange rate of the dollar and an immediate fall in long-term interest rates of 180 basis points, through this channel alone. The framework does not allow an answer to the question of whether an equivalent tax increase would produce results of a comparable magnitude or much smaller effects. This depends on the relative effects of the different fiscal policy actions on the propensity to spend, including those associated with changes in expectations about the future. Nevertheless, the simulations provide a counter-argument to those who, by pointing to absence of evidence of direct effects of debt on asset prices, argue that U.S. fiscal policy cannot be the cause of high interest rates in the United States and abroad. Our simulations suggest that even if the stock of debt is not important in itself, government spending may still have powerful effects on asset prices, especially assets whose prices have a forward-looking element, like exchange rates and long-term bond rates.

SIMULATING FISCAL POLICY CHANGES IN A MODEL OF THE U.S. VS. THE REST OF THE WORLD

Simuiations of U.S. fiscal policy changes were performed with an empirical two-country model for the United States versus the rest of the world, called MINILINK, which is a condensed version of the OECD's INTERLINK model [see OECD (1983)]. It is described in more detail in an Annex. MINILINK provides a minimum macro-economic framework for examining the effects of government expenditure under alternative assumptions about expectations. It approximates the aggregate response of INTERLINK as it was obtained by simulation of the latter. It is nonetheless very much simplified, as whole sectors are compressed and the Rest of the World model is an aggregation of 22 country models and 8 non-OECD regional models. This simplification of the structure and the linearity of the resulting model have the advantage of permitting an explicit perfect foresight solution to be calculated, using the formula derived by Blanchard and Kahn (1980).

MINILINK contains equations describing the determination of aggregate demand, short- and long-term interest rates (assuming an exogenous monetary aggregate target) and the rate of inflation, for the United States on the one hand and the aggregate rest of the world on the other. In addition, there are equations for the bilateral current balance and the exchange rate linking the two countries. Stock effects on portfolio equilibrium are omitted in this model, and the choice as between

Table 1. **MINILINK Simulation of a $50 billion reduction in U.S. Government spending starting in 1984 S1, with rational and static expectations[a]**

Percentage deviations from baseline

		1984 S1	1984 S2	1985 S1	1985 S2	1986 S1	1986 S2	1987 S1	1987 S2	1988 S1	1988 S2
United States											
Effective exchange rate	R	–3.86	–3.70	–3.54	–3.47	–3.48	–3.52	–3.59	–3.66	–3.73	–3.79
	S	–0.56	–1.10	–1.60	–2.05	–2.47	–2.84	–3.18	–3.49	–3.76	-4.02
interest rates[b]											
Short-term	R	–0.95	–0.86	-0.75	-0.69	-0.68	-0.72	-0.79	-0.87	-0.96	–1.06
	S	–1.32	–1.40	–1.46	–1.53	–1.63	–1.75	–1.90	–2.07	–2.27	–2.50
Long-term	R	–1.81	–1.85	–1.90	–1.95	–2.02	–2.09	–2.16	–2.23	–2.30	–2.36
	S	-0.06	-0.13	-0.19	-0.25	-0.32	-0.39	-0.46	-0.34	-0.62	-0.71
Real output	R	–1.75	–1.39	–1.11	-0.92	-0.80	-0.73	-0.70	-0.69	-0.67	-0.64
	S	–2.11	–2.05	–1.99	–1.92	–1.85	–1.79	–1.74	–1.70	–1.67	–1.64
Inflation rate[b]	R	0.26	-0.07	-0.14	-0.18	-0.22	-0.24	-0.28	-0.31	-0.34	-0.37
	S	0.04	–0.16	-0.24	-0.32	-0.20	-0.48	-0.56	-0.64	-0.70	-0.79
Rest of world											
interest rates[b]											
Short-term	R	-0.62	-0.54	-0.61	-0.69	-0.77	-0.83	-0.93	–1.01	–1.10	–1.19
	S	-0.21	-0.32	-0.46	-0.62	-0.80	–1.00	-1.22	–1.46	–1.72	–1.99
Long-term	R	–1.84	–1.90	–1.97	–2.04	-2.11	–2.17	-2.24	–2.30	-2.37	–2.43
	S	–0.01	-0.03	-0.05	-0.07	-0.11	-0.15	-0.20	-0.26	-0.33	-0.41
Real output	R	-0.17	-0.14	-0.11	-0.06	0.00	0.05	0.11	0.15	0.19	0.21
	S	-0.31	-0.34	-0.39	-0.45	-0.52	-0.58	-0.63	-0.68	-0.73	-0.76
inflation rate[b]	R	-0.83	-0.36	-0.34	-0.34	-0.34	-0.35	-0.35	-0.35	-0.35	-0.35
	S	-0.12	-0.22	-0.30	-0.37	-0.45	-0.52	-0.60	-0.66	-0.73	-0.81

a) For exchange rates and long-term bond rates: denoted R and S, respectively.

b) Annual interest rate or inflation rate, in per cent, minus the rate in the baseline simulation.

tax and bond financing is not made explicit. This departs from the structure of the full INTERLINK model, which does contain these features.

Table 1 illustrates the importance of the expectations assumption in simulations of MINILINK. The line "R" presents the effect relative to baseline of a reduction in government real consumption spending in the United States, when expectations of next period's effective exchange rate and long-term bond rates in the U.S. and ROW are formed rationally so that, in the absence of further shocks, they are equal to next period's value. The line "S" refers to simulations where those expectations are static – that is, equal to last period's values. Both simulations are performed under the assumption that domestic and foreign bonds are perfect substitutes, so that uncovered interest parity holds exactly and there is no risk premium. As mentioned above, government bonds do not appear in net wealth in MINILINK; there are no asset supply effects in these simulations. Thus only the aggregate demand effects of fiscal policy operate here; under rational expectations, Table 1 shows that they nevertheless strongly affect long-term interest rates, which fall by 180 basis points at the time the permanent expenditure reduction of $50 billion (1982 dollars) takes place (the change in fiscal policy is assumed not to have been anticipated before it was implemented, in 1984 semester 1). Thus, even without direct effects of budget deficits on interest rates, bond rates may decline substantially in response to spending cuts. Since the long bond rate is, in the model, the average of future short rates, and since aggregate demand in each succeeding period is weaker, then, given the money supply, future short rates must be lower. The long bond reflects these future developments now. Since in the model it is the long bond rate that affects spending, changes in the latter take place more quickly than in conventional models.

As goods prices adjust downward, the real output effects diminish gradually; in the long run, since potential output is exogenous in the model, real output returns to its baseline value, with the government's decreased contribution to demand compensated by stronger private domestic spending, brought about by lower interest rates (both nominal and real). The exchange rate initially depreciates (in the notation used, this corresponds to a decline in the exchange rate) by around 3.9 per cent, but the depreciation is gradually reversed through time; subsequently, the gradual decline in the price level relative to foreign prices implies that a given nominal depreciation corresponds to a larger and larger real depreciation. In fact, foreign prices also fall relative to baseline, and in the long run both U.S. and foreign price levels are lower. Because of stickiness of goods prices, the adjustment of the price path to its equilibrium level requires time. In the meantime, the nominal effective exchange rate will depreciate in response to fiscal contraction, even if the long-run effect on the real exchange rate is zero.

Though the long run effects are the same, simulation results are quite different for the first 5 years if expectations are not forward looking, but are equal to the last realized values of the financial variables under consideration. In this case, the spending cut produces only modest initial effects on the exchange rate and long bond rates, but much greater and more persistent impacts on output and prices (see line *"S"* in Table 1). The model now embodies in effect a traditional term structure relationship that makes the long rate a distributed lag function of ***past*** short rates, instead of a weighted average of expected ***future*** short rates. Even though the short rate changes even more on impact under the static expectations model than under rational expectations, long rates respond initially by only 6 basis points, and after 5 years by 70 basis points, which is significantly less than the initial impact under rational expectations. Exchange rate movements are also muted, initially, though they build up to a 4 per cent depreciation after 5 years. A spending cut produces a much larger drop in U.S. output under static expectations. Output effects are still substantial after 5 years: in fact, they are still almost as large as the peak effect under rational expectations, which occurs in the first period.

There is a dramatic difference in the transmission to the rest of the world of the assumed change in US. fiscal policy under the two assumptions about expectations. In both cases output declines on impact, but less so in the rational case; furthermore, after 3 years output effects become positive in the rational case. The larger appreciation here has implied a much greater downward adjustment in the price level. Though in both cases short-term interest rates decline only modestly at the beginning of the simulation, long rates decline little in the static case but very sharply – as much as in the U.S. – in the rational case. This illustrates the point that uncovered interest parity (the equivalent of the interest differential and the expected rate of change of the exchange rate) for ***short*** rates implies comovement of *long* rates, provided there has been no change in long-run inflation differentials and that expectations of interest rates are forward looking.

The importance of expectations of future policy stance is examined with the aid of a simulation of a change in fiscal policy to occur in a year's time, but announced (and believed) now. Table 2 presents such a simulation of a cut in U.S. government spending in the first half of 1985. The effects on the exchange rate in 1984 S1, at which time the policy change is announced, but not implemented, are substantially the same as for a cut in spending that is implemented immediately (Table 1): instead of a depreciation of 3.9 per cent, they suggest an immediate depreciation of 2.6 per cent. The long term bond rate also declines substantially in the two cases. The immediate effects of the fiscal policy change on other variables are quite different from long run effects, however. The negative impact on aggregate demand of lower spending does not occur until 1985; since the real value of the dollar and real long-term bond rates decline now, the model implies a short run ***stimulation*** of aggregate demand. As a consequence, real output and short-term interest rates are actually higher until 1985 S1, at which time the lower spending produces a similar pattern to what has been reported in Table 1 (line "R"), starting in 1984 S1. The real output effects are, however, attenuated by having been announced beforehand. Both competitiveness and real interest rates affect demand in the model with a lag;

Table 2. **MINILINK simulation of a $50 billion reduction in U.S. Government spending starting in 1985 S1, but announced in 1984 S1**

Percentage deviations from baseline

	1984		1985		1986		1987		1988	
	S1	s2	S1	s2	S1	s2	S1	s2	S1	s2
United States										
Effective exchange rate	−2.61	−2.92	−3.31	−3.24	−3.23	−3.26	−3.33	−3.41	−3.49	−3.58
Interest rates[a]										
Short-term	0.30	0.49	-0.63	-0.57	-0.52	-0.52	-0.55	-0.60	-0.66	-0.72
Long-term	−1.43	−1.51	−1.62	−1.66	−1.72	−1.78	−1.84	−1.91	−1.97	−2.04
Real output	0.29	0.57	−1.30	−1.10	-0.96	-0.89	-0.85	-0.84	-0.82	-0.80
Inflation rate[a]	0.18	0.13	0.18	0.00	-0.06	−0.10	-0.14	-0.18	-0.21	-0.25
Rest of world										
Interest rates[a]										
Short-term	0.30	0.49	-0.63	-0.57	-0.52	-0.52	-0.55	-0.60	-0.66	-0.72
Long-term	−1.57	−1[redacted]	−1.70	−1.76	−1.81	−1.88	−1.94	−2.00	−2.06	−2.13
Real output	0.12	0.16	-0.11	-0.07	-0.03	0.03	0.07	0.12	0.15	0.18
inflation rate[a]	-0.56	-0.29	-0.31	-0.26	-0.26	-0.26	-0.26	-0.26	-0.27	-0.27

a) Annual interest rate or inflation rate, in per cent, minus the rate in the baseline simulation.

both have had time in 1984 to change in a direction that partially offsets the fiscal contraction.

The short-run stimulatory effect of a future spending cut merits further discussion. It occurs in the model because financial markets have rational expectations for the exchange rate and for long term bond rates. The same is not true of goods markets. In particular, goods price expectations are formed adaptively, and aggregate demand does not depend on expected future demand. The latter would occur if, for instance, investment plans were based on expectations about the strength of demand a few years hence. If these effects were present, they would moderate the immediate stimulatory effect. It is unlikely they would eliminate it completely. Consumers are typically not easily able to shift consumption intertemporally because of borrowing constraints, especially relative to future wage income. To the extent that consumers are liquidity constrained [see Tobin and Dolde (1971)], a fall in the mortgage rate, for instance, will free up cash for those refinancing existing mortgages and will stimulate new housing construction by making ownership affordable for additional households. A cash flow effect may also operate for some businesses. Thus it is possible that the effect of announced future government spending reduction may be to stimulate output now, if only by a small amount. These considerations also suggest that raising taxes would produce qualitatively similar effects to a spending cut since a tax measure may tighten these liquidity constraints and inhibit spending even when expectations are for lower future tax liabilities. The model sheds no light on relative magnitudes, however.

CONCLUDING REMARKS

The emphasis of the paper has been on examining the conventional aggregate demand effects of government spending in the context of rational expectations, its effects on the exchange rate and its effects on long-term interest rates. Evidence presented in terms of a two-region, global model suggests that such effects may be substantial, Even in the absence of any supply-of-debt effects on long-term interest rates, lower government spending would produce continuing downward pressures on nominal demand, and hence on short-term interest rates. These ongoing effects would, if correctly anticipated, substantially reduce long rates immediately. A permanent government spending decrease would also twist the term structure by initially lowering long rates to a greater extent than short rates. Therefore, even if the deficit does not matter *per se,* there is reason to believe that U.S. fiscal policy changes can have powerful effects on interest rates and exchange rates.

On the other hand, simulations that assume that expectations are determined by the recent past, and do not contain a forward-looking element, imply a much more modest initial change in asset prices in response to government spending changes. Reality probably lies somewhere in between, and the closeness with which the rational expectations solution is approached depends on the credibility of government policy announcements. Individuals must be convinced that policy changes will not be reversed but are in fact permanent, and this conviction may only develop with the passage of time, as individuals observe a continuation of those policies.

An interesting insight resulting from the model simulations is the strength with which fiscal policy effects on long-term interest rates are transmitted internationally. Monetary policy was assumed to be non-accommodating so that monetary growth rates were not affected by the fiscal policy change; in the long run, therefore, inflation rates are not affected either. Consequently, uncovered interest parity implies that nominal interest rates must decline by the same amount eventually, even though in the meantime nominal income, and hence short-term rates, behave quite differently. If long-term interest rates anticipate the eventual convergence of short rates they will move similarly today. This is one important channel for the transmission of U.S. fiscal policy changes, and the substantial interest rate decline helps to offset the negative effects on the net exports component of aggregate demand in the rest of the world.

ANNEX

THE EQUATIONS, PARAMETERS AND VARIABLES OF MINILINK

Equations (1) - (19) below constitute the structure of the two-country model of the United States versus the rest-of-the-world sector. Definitions of variables follow the equations. Parameter values are given in Table A.1.

For several equations – those for the exchange rate and interest rates – the mini-model specifications for the United States are consistent with those already contained within the INTERLINK financial blocks [See Holtham (1984)] so that, subject to appropriate measurement conventions, parameter values can be directly taken from the existing equations. For the more aggregative items – trade balances, output and inflation – a series of partial model simulations was carried out over a period of 5 years for each equation, shocking in turn each of the respective independent variables, whilst holding the remaining independent variables constant. Given the structure of the INTERLINK system, in particular its international consistency properties, this proved to be a relatively straightforward process. Solved in linkage mode any combination of countries or variables can be fully or partially exogenised without interfering with the cross-country consistency of results. With appropriate choice of exogenisation for unwanted feedbacks, therefore, it was possible to administer separate controlled shocks for each independent variable in turn, on the United States and the 'Rest of the World' models, with the latter treated as a cohesive group (referred to as ROW in what follows).

Before discussing the MINILINK system in any detail a word about model dynamics is in order. To constrain the problem within manageable proportions the dynamics of the system have been summarised as parsimoniously as possible using, where necessary, rational lag approximations to the various lag distributions in the system. In effect, where significant dynamics were present in the INTERLINK simulation results these were subsequently modelled in transfer function form with numerator and denominator terms of up to second order, by applying normal estimation techniques to the actual simulation results. That this method was found to be reasonably robust reflects the relatively low order dynamics present in a semi-annual model of this type, compared with one of greater frequency.

In writing the model down, we found it convenient to use additional, synthetic variables for the rational lag functions. This way of writing the model accords with the state space representation necessary for finding its rational expectations solution, except that for that purpose further variables are also necessary when a rational lag polynomial exceeds first order. The rational lag functions reported below are applied to the real exchange rate (or the terms of trade – in this model the two are the same since traded and non-traded goods are not distinguished) and to real interest rates at home and abroad. In each case the rational lag variables are written in such a way that in the long run they take on the value of their driving variable, whether the real exchange rate or the real interest rate. Consequently, the coefficients applied to these variables correspond to long-run effects of the real exchange rate or the real interest rate.

Equation (1) is just the condition for uncovered interest parity to hold. Since here R and *RF* are at annual rates but the time period is semi-annual, the coefficient on their differential is 0.5. A similar adjustment has been made in the calculation of real interest rates in equations (5) and (13). Equation (1) differs from INTERLINK in that in the latter there is a risk premium term that depends on cumulated current account balances.

Equation (2) summarizes current balance responses to relative prices and activity at home and abroad and was obtained by partial simulations of INTERLINK. The lagged response to competitiveness was best captured by the rational lag reported in equation (3). There is a strong J-curve effect, as evidenced by the large

Table A.1 Coefficients of Country Models

USA Model		ROW Model	
Coefficient	Value	Coefficient	Value
A1	0.5		
B1	-0.0412		
B2	0.1125		
B3	-0.1863		
B11	-1.577		
B12	1.936		
B13	0.856		
B14	-0.215		
C1	-0.573	C1F	-0.347
c2	0.285	C2F	0.285
c3	0.633	C3F	0.383
c4	-0.127	C4F	-0.124
C5	0.158	C5F	0.140
C11	0.754	C11F	0.721
c12	0.246	C12F	0.279
C13	0.952	C13F	0.952
C41	1.413	C41F	1.194
C42	-0.657	C42F	-0.447
c43	0.245	C43F	0.253
D1	*0.500*	D1F	0.500
D2	0.0496	D2F	0.0496
D3	0.945	D3F	0.907
F1	0.774	F1F	0.814
F2	0.493	F2F	0.316
F4	0.587	F4F	0.633

The constant terms are not reported.

negative coefficient on current relative prices in (3). The unit coefficient applied to ***NFA*** in (2) reflects the assumption, made for stability reasons, that interest receipts show up one-for-one in higher spending on foreign goods. Equation (2) embodies some asymmetry in the effects of home and foreign activity, with the United States variable having a larger effect on its current account. To some extent this may simply be the result of the relative size of GDP in the United States and in the "Rest of the World". Simulations of INTERLINK produced a response of the current balance that was nearly complete in the current half-year, and hence lags were not needed here.

The aggregate demand equation (4) for the United States, and its counterpart for the ROW, equation (12), explain deviations of GDP from its potential level by real interest rates, real government spending, net foreign assets, competitiveness and foreign output. Real interest rates and competitiveness produced lagged responses of GDP and are modelled as rational lags.

In both equations (4) and (12), the parameters of the rational lag were obtained by OLS fitting of the model to simulation results. The simulation response of output to changes in real rates gave quite similar long-run results for the two areas, but somewhat larger for the United States. Other variables also have similar coefficients, except ***NFA.*** Indeed, the government spending variable produced exactly the same effect for the two areas, when averaged over four half-years. Since all other variables in equations (4) and (12) are in logs or are rates of return, except ***NFA,*** the coefficient of the latter may well differ because of the relative size of the two areas. As for lags, all shocks to the variables appearing in equations (4) and (12) produced some dynamic response in INTERLINK, no doubt resulting from the interaction of multiplier and accelerator, as well as other factors. However, fluctuations were quite small compared to their ultimate effect, and only real interest rates and competitiveness exhibited a long, slow build-up of response.

The long-term bond rate equations (6) and (14) were not obtained from INTERLINK. Instead, they are the result of imposing the arbitrage conditions that expected holding period yields on long-term and on short-term bonds are equal, which should hold if those assets are perfect substututes. If the expected bond rate next period is *RLHAT* and the long bond is a consol, then this implies that:

$$R = RL - (RLHAT - RL)/RL.$$

This equation was then linearised about a value of 10 per cent for RL and RLF, and the capital gain term multiplied by *2* to convert to annual rates.

The equation for rates of inflation and expected inflation, (8) and (9) for the USA and (16) and (17) for the ROW, are the result of estimating equations jointly for each of the big seven countries and for the ROW. The aggregate demand effect on inflation was imposed to take the same value for all countries. For more details, see Masson and Blundell-Wignall (1984).

The demand for money functions, equations (10) and (18), are inverted to endogenize the interest rates *R* and RF. The United States equation was obtained directly, for the M2 aggregate, using data over the period 197302 to 1983 Q1; the coefficients were then converted to their rough semi-annual equivalents by squaring the adjustment parameter. For the ROW, coefficients were obtained by aggregating demand for money functions for individual countries, in particular for the remaining six biggest countries in the OECD. See Blundell-Wignall et *al.* (1984) for estimation details. The coefficients were averaged using as weights those that serve for calculating the effective exchange rate for the United States, though here the weights were rescaled to sum to unity over these six countries. Thus the resulting demand for money function, equation (18), mimics the demand for a weighted average monetary aggregate for the six countries, provided their income, prices and interest rates move together. This equation is further assumed to describe how the interest rates of the remaining countries of the world would respond to income and price fluctuations; hence the variables that appear in the equation apply to an aggregate of all countries, excluding the United States.

As the above description no doubt suggests, the assumptions behind the use of (18) to describe the demand for money function for the rest of the world are heroic. The reader should keep in mind, however, that the purpose here is not to try to model realistically the world demand for money, or even to construct a proper measure of world monetary expansion, but rather to construct a feedback rule for interest rates, if the authorities did strictly target some monetary aggregate. What is assumed here, somewhat arbitrarily, is that the smaller countries follow the big countries in moving their rates. As it is, the variable MF, if data for it were to be calculated, would be hybrid, as it would be comprised of a different component aggregate for each country. The choice of aggregate for each of the big seven countries was based on the stability of its demand function. The aggregates chosen are the following: Japan, M1; Germany, M3; France, M2; United Kingdom, M l; Italy, M l; and Canada, M1A. Trend output has been omitted from the equation: it is netted out from the exogenous money supply variable, for both USA and ROW.

Finally, the simulation model contains reduced-form equations, which are not reported, for the rationally expected variables *EHAT,* RLHAT and RLFHAT, such that they are equal to next period's values *E*(+1), *RL*(+1) and *RLF*(+1). These equations include the current values of the state variables and the discounted future paths of the exogenous variables, namely USA and ROW money supplies and government consumption expenditure. We will not try to argue that the latter is a very good measure of the stance of fiscal policy; however, it does exclude transfer payments, which are more likely to be endogenous. For more details on how the coefficients of the equations for the rationally expected variables were calculated, see Masson and Richardson (1984).

USA EQUATIONS

1. The log of the effective exchange rate:

$$E = EHAT + A1{*}(R - RF)$$

2. The stock of net foreign claims (i.e. the cumulated current account), divided by world wealth:

$$NFA = NFA(-1) + B1{*}COMP(-1) + B2{*}YF + B3{*}Y + B0$$

3. The lagged effects of the real exchange rate on the current balance:

$$COMP = B13{*}COMP(-1) + B14{*}COMP(-2) + B11{*}(E + P - PF)$$
$$+ B12{*}[E(-1) + P(-1) - PF(-1)]$$

(with $B11 + B12 + B13 + B14 = 1$)

4. The log of real output **(GDP)** relative to potential:

$$Y = C0 + C1{*}RR + C2{*}GOV + C3{*}2{*}RBAR{*}NFA(-1) + C4{*}TT + C5{*}YF$$

5. The lagged effect of real interest rates on output:

$$RR = C11{*}RR(-1) + C12{*}(RL - 2{*}INHAT)$$

(with $C11 + C12 = 1$)

6. Long-term bond rate:

$$RL = C13{*}RLHAT + (1 - C13){*}R$$

7. The lagged effect of the real exchange rate on output:

$$TT = C41{*}TT(-1) + C42{*}TT(-2) + C43{*}(E + P - PF)$$

(with $C41 + C42 + C43 = 1$)

8. The semi-annual rate of inflation (as a decimal fraction):

$$IN = D3{*}INHAT + (1 - D3){*}[INF - E + E(-1)] + D2{*}Y$$

9. Expectations of inflation:

$$INHAT = D1{*}[IN(-1) - INHAT(-1)]$$

10. Demand for money (in log form):

$$M = P + F0 - F1{*}R + F2{*}Y + F4{*}[M(-1) - P(-1)]$$

11. Identity relating prices to inflation:

$$P = P(-1) + IN$$

12. The log of ROW output relative to potential:

$$YF = COF + C1F*RRF + C2F*GOVF - C3F*2*RBAR*NFA(-1) - C4F*TTF + C5F*Y$$

13. The lagged effect of real interest rates on ROW output:

$$RRF = C11F*RRF(-1) + C12F*(RLF - 2*INFHAT)$$

14. Long-term bond rate:

$$RLF = C13F*RLFHAT + (1 - C13F)*RF$$

15. The lagged effect of the real exchange rate on ROW output:

$$TTF = C41F*TTF(-1) + C42*TTF(-2) + C43F*(E + P - PF)$$

16. Rate of inflation in ROW:

$$INF = D3F*INFHAT + (1 - D3F)*[IN + E - E(-1)] + D2F*YF$$

17. Expectations of inflation:

$$INFHAT = D1F*[INF(-1) - INFHAT(-1)]$$

18. Demand for money:

$$MF = PF + FOF - F1F*RF + F2F*YF + F4F*[MF(-1) - PF(-1)]$$

19. Identity relating prices to inflation:

$$PF = PF(-1) + INF$$

The definitions of variables are as follows (variables ending in F refer to counterparts for the Rest of the World):

Endogenous variables

E = the log of the effective exchange rate, calculated as a geometric average of bilateral exchange rates against the dollar; See Holtham (1984).

EHAT = expected value for the log of the exchange rate next period.

NFA = net foreign assets divided by world wealth (the latter divided by 1000). Net foreign assets is the cumulated current account in U.S. dollars. World wealth is weighted world GDP in a base year, scaled by the average capital output ratio and cumulated with savings. Both stocks are revalued each period as a function of the GDP deflator.

COMP = a synthetic competitiveness variable (equals the real exchange rate in the long run): captures J-curve.

Y = log of the ratio of actual real GDP to its potential level.

RR = a synthetic variable in output equation, equal to the real interest rate in the long run.

TT = a synthetic variable in output equation (equals the real exchange rate in the long run).

IN = semi-annual rate of inflation (change in log of prices).

INHAT = the expected valued of IN next period.

P = the log of GDP deflator.

R = short-term interest rate.

RL = long-term interest rate.

RLHAT = expected value of RL next period.

Exogenous variables

GOV = the log of the ratio of real government co sumption to potential output.

M = the log of the money supply.

BIBLIOGRAPHY

Barro, Robert J. (1974), "Are Government Bonds Net Wealth?", ***Journal*** of ***Political Economy,*** (November/December), pp.1005-1 117.

Blanchard, Olivier and Charles Kahn (1980), "The Solution of Linear Difference Models Under Rational Expectations", ***Econometrica,*** July, pp. 1305-1311.

Blundell-Wignall, Adrian, M. Rondoni and H. Ziegelschmidt (1984), "The Demand for Money and Velocity in Major OECD Countries", OECD Economics and Statistics Department, ***Working Paper*** No.*13.*

Friedman, Benjamin (19781, "Crowding Out or Crowding In? Economic Consequences of Financing Government Deficits", ***Brookings Papers on Economic Activity,*** (No.3), pp.593-641.

Holtham, Gerald (1984), "Multinational Modelling of Financial Linkages and Exchange Rates", OECD ***Economic Studies*** (Spring), pp.51-92.

Masson, Paul and Peter Richardson (19841, "Exchange Rate Expectations and Current Balances in the OECD INTERLINK System", forthcoming in a volume devoted to the Fourth International Workshop of the Applied Econometric Association, Brussels, December 8-9, 1983.

Masson, Paul and Adrian Blundell-Wignall (19841, "Fiscal Policy and the Exchange Rate in the Big Seven: Transmission of U.S. Fiscal Shocks", presented at the International Seminar on Macro-economics, Perugia, 24th-26th June, 1984, and forthcoming in the ***European Economic Review.***

Muller, Patrice and Robert W.R. Price (1984), "Structural Budget Indicators and the Interpretation of Fiscal Policy Stance in OECD Economies", OECD ***Economic Studies,*** this issue.

OECD (1983), ***INTERLINK System, Structure and Operation,*** Paris.

Tobin, James and Walter Dolde (1971), "Wealth, Liquidity and Consumption", in: ***Consumer Spending and Monetary Policy: the Linkages,*** Federal Reserve Bank of Boston.