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Monetary Policy in the OECD INTERLINK Model

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Monetary and Fiscal Policy Division

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* Respectively Principal Administrator, Consultant, Administrator and Statistical Assistant. The views expressed are those of the authors and do not necessarily represent the opinions of the OECD or its Member governments. The authors are grateful to John Helliwell for initial suggestions on the approach and to other members of the OECD Secretariat for helpful comments. Pete Richardson's guidance in implementing the new system was invaluable.

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CONTENTS

I. INTRODUCTION

The international financial linkage block of the OECD Secretariat's multi-country model, INTERLINK, is based on a portfolio balance model of exchange rate determination. International consistency is ensured by cross country restrictions on parameters imposed during estimation (1). However, in an earlier version of the model, the specification of the domestic financial sector for each country was too rudimentary for simulation analysis under alternative monetary policy assumptions. The main element missing from this version of the model was an explicit formulation of the money demand and supply process (2). This gap has been filled in the version of the model reported in this study, which opens the way for a more comprehensive set of alternative policy regimes under which the model can be run, notably: non-accommodating monetary policy; managed floating; fixed exchange rates; and floating with accommodating monetary policy. These will be elaborated upon in more detail below.

In a preliminary study money demand equations for all aggregates (M1, M2, and M3), and for alternative assumptions about price expectations, were estimated with single equation techniques for the seven major OECD economies (3). Lagged adjustment of the observed money supply to demand was assumed, since wealth holders' expectations about income and interest rates are uncertain and adjustment costs may be important. The equations were subjected to a wide variety of tests concerning their stability and predictive power. The main findings of this study were:

- -- where instabilities arose for particular aggregates they were often associated with changes in the techniques of monetary control, particularly the use of quantitative ceilings;
- -- financial innovations seem to have affected the stability of M2 and M3 in Canada and M3 in the United States, but otherwise do not seem to be an important explanation of instability;
- -- it proved possible to identify a stable demand function for all the major seven OECD economies: M2 in the United States and France, M3 in Germany, M1 in Japan, the United Kingdom and Italy, and M1A in Canada;
- -- autoregressive price expectations were important explanatory variables in the United States and Japan, but not in other countries; and
- -- the restriction implied by the Koyck lag structure was tested against a general alternative and was found to be acceptable.

Before inclusion into the INTERLINK model, however, it was decided to extend this single equation approach on two grounds. First, a fully flexible model that can be simulated under alternative policy regimes requires both money demand and supply equations to be made explicit. Second, a purely technical problem of simultaneous equations bias (alluded to in the earlier paper) may arise in estimation. In addition to factors influencing demand, the observed money stock is also influenced by policy reactions of the authorities (4). To the extent that such supply side influences are important, at any point in time, one may observe monetary disequilibrium.

Attempts to estimate money demand equations with single equation techniques may lead to biased estimates.

The approach adopted here is to normalise the supply policies of the authorities on the interest rate. Put another way, the money demand equation is estimated simultaneously with an interest rate reaction function. These equations directly affect other variables in the financial sector, notably the term structure of interest rates and the exchange rate, and, through these, other variables in the INTERLINK system. This approach allows a uniform model structure to be maintained for each OECD country -- an important operational consideration for the INTERLINK system -- while country specific differences in the approach to monetary policy can still be captured by variations in the configuration of arguments assumed to influence policy reactions.

The main aims of this study are twofold. First, to provide consistent estimates of both money demand equations and interest rate reaction functions for major countries in the OECD INTERLINK model. Second, to examine the properties of the revised model under alternative assumptions about monetary policy. It is shown that with the new financial sector monetary policy has a much more powerful role in the OECD INTERLINK system. In Section II the money demand and money supply functions of the authorities are discussed. Section III presents Full Information Maximum Likelihood (FIML) estimates of the money demand and supply functions. Dynamic simulations of the monetary sectors are examined in Section IV. Section V examines properties of the full model in response to a government spending shock under four alternative monetary policy regimes. Finally, in Section VI, some concluding remarks are made.

II. STRUCTURE OF THE FINANCIAL SECTORS

A. The money demand equations

The specification of money demand follows that initially investigated and tested in (BRZ) Blundell-Wignall, Rondoni and Ziegelschmidt (1984). A first order (Koyck) partial adjustment of the real money supply towards long-run real demand $(M/P)^D$ of the form:

$$DlnM = \alpha[\ln(\frac{M}{p})^D - \ln(\frac{M}{p})_{-1}] + Dlnp \qquad (1)$$

$$\ln(\frac{M}{p})^D = \ln k_o + \beta_1 \ln y + \beta_2 \ln(1+r) + \beta_3 Dlnp^e$$

is postulated, where M is the money stock, p is the price level, r the short-term domestic interest rate, and p^e is the expected price level. D = d/dt, expected signs are $0 < \alpha \leq 1$; $\beta_1 > 0$; β_2, $\beta_3 < 0$, and a zero subscript denotes a constant term.

The treatment of the opportunity cost arguments of money demand to a large extent follow the findings of BRZ (1984). The equation is estimated in logarithms, and the constant term is assumed to capture the joint effects of the own rate of return on money, including the non-pecuniary return from bank services. Autoregressive (AR) and random walk (RW) price expectations are also tested as before. Some attempt was also made to test for the influence of opportunity cost arguments related to the external sector. These include risk premium arguments (the cumulated current account), exchange rate expectations (related to PPP) and foreign interest rates. The inclusion of such terms would be consistent with the form of the asset demand functions related to substitution between domestic and foreign interest bearing debt assumed in the determination of exchange rates. However, in virtually all cases the results were disappointing and such terms have been ignored. The seeming unimportance of these external sector terms may be suggestive of some segmentation of the domestic money market from the international market for interest bearing debt. It is more likely that econometric errors in variables and/or collinearity problems in estimation are responsible.

In another paper, Masson and Blundell-Wignall (1984), the effect of a constructed wealth variable was also tested in the money demand equations. In most cases wealth and income were highly colinear, so that independent transactions and wealth motives for holding money balances could not be separately identified. Given the difficulties of measuring wealth, the income term was preferred. In the present model the income form is interpreted as capturing both motives, and is not intended as a pure transactions demand which otherwise might justify experimentation with expenditure terms.

B. The money supply functions

The second half of the 1970s and the early 1980s have seen a greater emphasis on controlling monetary aggregates in the fight against inflation. In particular, most major OECD economies have adopted explicit intermediate targets for the rate of growth of the money supply. At the same time, the authorities have shown a greater willingness to permit the exchange rate to move in order to achieve these targets. However, where monetary policy has taken a strongly anti-inflationary stance, some countries have seen their exchange rates rise to apparently unsustainably high levels. While this has contributed to the desired reduction of inflation, it has frequently placed a large part of the cost of such a policy on industries most exposed to international competition, leading to bankrupcies and sometimes to irreversible losses of shares in world trade. Conversely, when the authorities have permitted monetary growth to accommodate nominal GNP developments, depreciation and rising import prices can quickly lead to even faster increases in domestic prices. In both instances the previous stance of the authorities with respect to the money supply has frequently been reversed.

This process whereby the authorities have attempted to maintain control of the growth of monetary aggregates but, at the same time, have not always been prepared to see the exchange rate move freely, is suggestive of a complex money supply function. Moreover, the intensity with which the authorities have pursued money supply and exchange rate objectives varies between countries and, over time, within the same country. For example, some central banks have permitted base drift in achieving their targets, have defined target ranges (making the explicit point target unclear), or have simply abandoned targets for considerable periods of time. Similarly, some authorities have been concerned to smooth short-run movements in the exchange rate, while others have been more interested in achieving specific or implicit targets for the nominal or real exchange rate.

The assumption of time invariant parameter values is well known to be problematic when estimating policy reaction functions. To go some way towards reducing these problems the sample period has been chosen to avoid estimating over periods during which fundamentally different policy regimes were in operation: the sample period for each country commences during the quarter in which it switched to floating exchange rates from the previous commitment to fixed parities under the Bretton Woods system. The money supply function is normalised on the interest rate, and in its most general form (prior to zero parameter restrictions) is given by:

$$\begin{aligned} Dr = {} & \gamma_1(r_w - r_{-1}) + \gamma_2(D\ln M - \lambda_1) + \gamma_3 \ln(M/M_o e^{\lambda_1 t}) \\ & + \gamma_4 D\ln E + \gamma_5 D\ln F + \gamma_6(D\ln p - D\ln p_w) + \gamma_7 \ln(E/E_o) \\ & + \gamma_8 \ln(Ep/p_w) \end{aligned} \tag{2}$$

Where r_w is the foreign short term interest rate, E is the effective exchange rate (foreign currency per unit of domestic currency), F is the level of foreign exchange reserves, p_w is the foreign price level, and t is time. Expected signs are $0 < \gamma_1 \leq 1$; $\gamma_2, \gamma_3, \gamma_6, \lambda_1 > 0$; and $\gamma_4, \gamma_5, \gamma_7, \gamma_8 < 0$.

The first argument of equation (2) suggests that other things being given, a change in foreign interest rates will have a direct positive impact on domestic rates as the authorities will react to forestall future exchange rate pressures. For example, it has frequently been argued that high U.S. interest rates in 1981 and the first half of 1982 were a prime cause of tighter monetary policies in Europe. The authorities in these countries wished to avoid potential currency depreciation that would have had adverse consequences for inflation. The adjustment will be partial, however, as they may well wish to avoid fully importing foreign monetary policy, a principal cause of the breakdown of the fixed exchange rate system in the first place.

The second and third arguments of equation (2) relate directly to the domestic money supply objective. In the absence of other influences, the authorities would adjust interest rates to correct deviations in the rate of growth of the money supply from its target level λ_1 (5). In some instances, however, the money stock has drifted away from levels implied by the target rate of growth. This had often led to "base drift", whereby the authorities simply redefine the base for new targeting periods to encompass previous "overshooting". Such behaviour would be consistent with the finding that $\gamma_3 = 0$. However, in some instances the authorities have made persistent attempts to offset base drift in formulating their monetary policies, other domestic and external considerations permitting. An attempt is made to allow for this possibility in the third term of equation (2).

The fourth and fifth arguments of equation (2) relate to short-term exchange market pressure. In a world of "managed floating" short-term exchange rate pressure can manifest itself in appreciation or depreciation and/or foreign exchange reserve gains or losses. Girton and Roper (6) argue that it is appropriate to define exchange market pressure as the sum of the proportional rate of change of the exchange rate and international reserves. However, there is no compelling reason why the two variables should be weighted equally, so that both terms may be included with separate parameters. Only where the data do not reject the hypotheses of equal weights is this restriction imposed in the results reported below. The reaction function assumes that if exchange rates and/or international reserves are rising the authorities may attempt to offset such short-run pressures by easing their monetary policies in order to maintain "orderly" financial markets. Conversely, falling exchange rates and/or international reserves may lead to some short-run tightening of policy. The sixth argument of equation (2), the inflation differential, relates to expected depreciation, and may be important in countries where domestic inflation has persistently exceeded that of major trading partners. Exchange rate level objectives are incorporated in the final two arguments of equation (2). The authorities may attempt to achieve a nominal exchange rate target. They may also be concerned to offset shifts in the real exchange rate.

III. FINANCIAL SECTOR ESTIMATION RESULTS

The above financial sector is estimated with FIML techniques over the period of floating exchange rates for each of the major 7 OECD countries (7). FIML estimates, asymptotic t-values, various simultaneous equation fit statistics, and root mean square errors by equation are reported for each country in Tables 1-7 of the Annex to Parts III and IV. The results for each country are discussed in turn.

A. The United States

FIML estimates and full model fit statistics for the United States monetary sector are reported in Table 1. The money demand equation follows that of the earlier study BRZ (1984). Its parameters have the expected a priori signs, and all are significant at the 1 per cent level. The interest rate reaction function has rates being adjusted towards a weighted average foreign rate, to control the rate of growth of the money supply, and to correct for over or under valuations of the real exchange rate. These parameters have the expected a priori signs, and all terms are significant at the 1 per cent level. It is interesting that the coefficient on the rate of growth of the money supply is large and well determined. This reflects the importance of monetary targeting in the second half of the sample period: this result, which is a desirable feature for forecasting and simulations during the 1980s, required a dummy variable in the first half of the sample period when such objectives did not receive a uniform priority (see note to Table 1).

B. Japan

FIML estimates and full model fit statistics for Japan are reported in Table 2. In the earlier study, BRZ (1984), M1 demand was found to be more stable than M2 when both equations were estimated with OLS techniques. It was hypothesized, however, that a more stable demand for broad money might be identified if the interest rate reactions of the authorities were taken into account during estimation. This hypothesis was supported in the case of Japan. Consequently, the equation for M2+CD, which is the aggregate officially targeted by the Japanese authorities, is adopted in the model. All coefficients have the correct sign and all are significant at the 1 per cent level. The AR price expectations term used in the OLS M1 equation is dropped for the FIML M2 equation. Interest rate reactions are assumed to be in response to changes in the weighted average foreign rate, to maintain domestic monetary control, and to offset exchange rate pressure (the sum of the rate of change of the exchange rate and the rate of change of foreign reserves). All coefficients have the expected sign and all are significant at the 1 per cent level, with the exception of the foreign interest rate differential, which is significant at the 5 per cent level.

C. Germany

The M3 equation remains the most satisfactory aggregate for which a demand function can be identified when estimated simultaneously with the interest rate reaction function. All coefficients of the money demand function have the expected a priori sign, and all are particularly well determined. The interest rate reaction function assumes partial adjustment towards the foreign rate, in order to forestall potential exchange rate pressures, and changes in rates to maintain domestic monetary control. No other exchange rate or exchange rate pressure term proved to be important in the case of Germany. The dummy variable included relates to the two periods when Lombard credit was suspended forcing interest rates to abnormally high levels. All behavioural coefficients of the interest rate equation have the expected a priori signs, and all are significant at the 1 per cent level. Like the United States, the coefficient on domestic monetary growth in the reaction function is large and well determined. This reflects the continual importance given to domestic monetary control in order to contain inflation by the German authorities.

D. France

The results for France, presented in Table 4, show similar estimates for money demand compared to those obtained with single equation techniques. The interest rate reaction function is particularly interesting because it reflects the emphasis given to the exchange rate in formulating monetary policy. Rates are adjusted partially to close the gap with the foreign interest rate, to smooth fluctuations in the exchange rate (volatility), and to target the level of the nominal exchange rate. The data suggest that the reserves variable in the exchange market pressure argument has a zero weight. Consistent with the attempt to maintain monetary control in France, the rate of growth of the money supply is also included in the equation. All coefficients have the expected a priori signs and all, with the exception of the exchange rate smoothing argument, are significant at the 5 per cent level.

E. United Kingdom

Simultaneous estimation of money demand with the interest rate reaction function did not enable a plausible equation to be estimated for sterling M3. Consistent with earlier findings, the M1 equation proved superior in the results reported in Table 5. All coefficients of money demand have the expected signs, but the income elasticity remains poorly determined. As with France, the interest rate reaction function reflects concern both with domestic monetary control and with the exchange rate. However, important differences should be noted. Rates are partially adjusted to maintain long-run parity with foreign rates, but in the short-run may be changed to offset exchange rate pressure (the sum of the rate of change in the exchange rate and international reserves) and to counter unwanted movements in the real exchange rate. The domestic monetary control argument relates the level of the money supply to its implicit (estimated) trend desired level. All coefficients of the interest rate reaction function seem particularly well-determined.

F. Italy

FIML estimates for the Italian monetary sector are reported in Table 6. As with the United Kingdom, it did not prove possible to estimate a dynamically stable demand for broad money. This may be due to the use of credit ceilings in Italy which are more likely to affect broader aggregates; the private sector is able to adjust more easily towards their demand for narrower aggregates such as currency or M1 deposits. M1 was chosen in the present model, and all the coefficients of its demand function are significant at the 1 per cent level. The interest rate reaction function reflects concern with the foreign rate, with exchange rate pressure, with expected depreciation (the inflation differential), and with domestic monetary control. The inflation differential term was particularly important for obtaining stable dynamic simulations of the interest rate. This is because Italy's inflation rate has been persistently higher than that of major trading partners which, in the absence of interest rate responses, would lead to even greater pressure on the nominal exchange rate. It did not prove possible to identify satisfactory coefficients for the level of the nominal or real exchange rate.

G. Canada

All coefficients of the M1A demand equation are significant at the 1 per cent level for the results reported in Table 7. The interest rate reaction function reflects concern with movements in the foreign rate, which is strongly dominated in the weighting matrix by movements in U.S. rates, and the level of the nominal effective exchange rate. As with the United Kingdom, the domestic monetary control argument relates to the level of the money supply in relation to (estimated) implicit long-term trend target level. All coefficients have the correct sign and are reasonably well determined.

H. General remarks

The reduced form monetary sectors corroborate the data well, as can be seen by the overall fit statistics reported in each table. In relation to the OLS results, the FIML estimates of money demand parameters are similar (see Table 8). The main differences are that speeds of adjustment are noticeably quicker for the FIML parameters in the cases of the United States, Germany, France and Italy. The inflation elasticity is smaller in the United States and the interest rate elasticities are smaller for Germany and Italy. For the United Kingdom the speed of adjustment is a little slower, the income elasticity is smaller, and the interest elasticity is somewhat larger. Taking account of simultaneity with private portfolio behaviour seems to be particularly important for estimating the policy reaction functions. OLS estimates of the identical equations give rise to considerably less plausible results. In particular, the coefficient on the domestic monetary growth variable was frequently of an incorrect sign.

IV. DYNAMIC SIMULATION RESULTS

To examine the predictive power of the simultaneous money demand and interest rate equations, dynamic simulations over the full sample period were conducted for each country. Root mean square error statistics by equation are presented in Table 9, and charts for the simulation of velocity and the level of the interest rate are shown in Chart 1. These suggest that the movements of velocity are captured reasonably well by the models. The policy reaction functions do not seem to exhibit any important evidence of dynamic instability. There is some tendency to understate the sharpness of the monetary squeeze during 1981 in the United States. However, the sharp increases in interest rates in 1979 and 1980 are captured well by the U.S. model, as is their subsequent decline in 1982. For all other countries interest rate developments are "tracked" particularly well in dynamic simulations, with some tendency slightly to under predict the peak of interest rates in 1980 (Japan, Germany, United Kingdom) and 1981 (Germany, France).

CHART 1

DYNAMIC SIMULATIONS OF VELOCITY AND INTEREST RATES

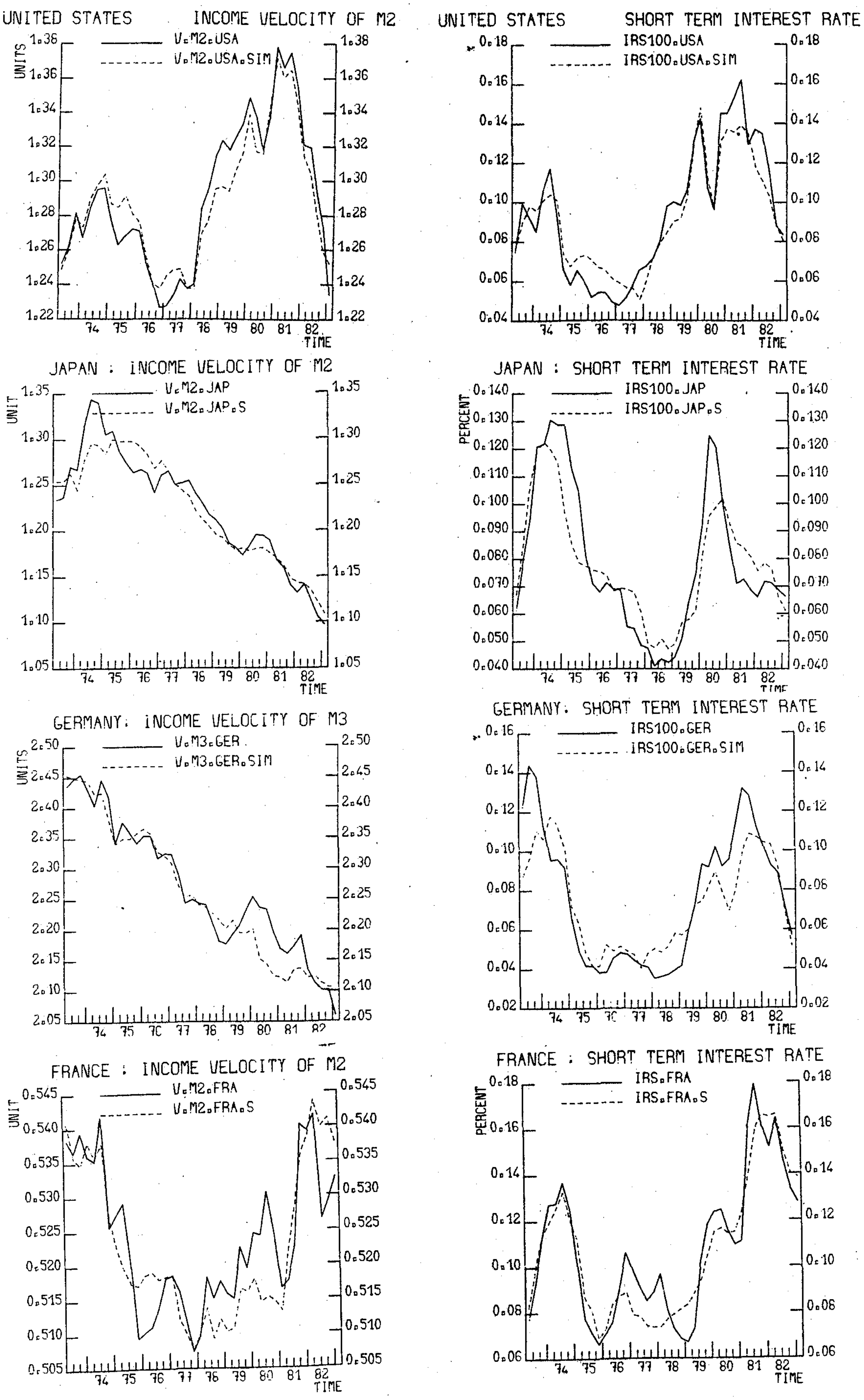
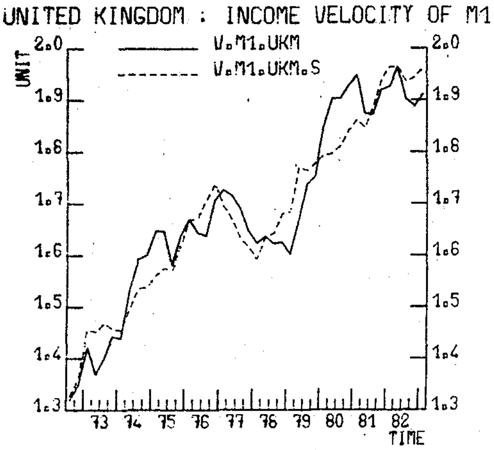
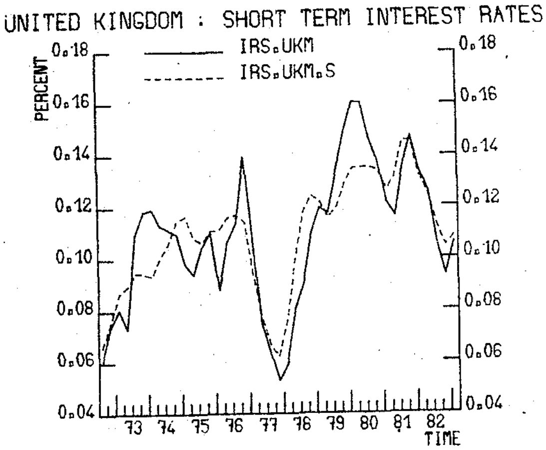
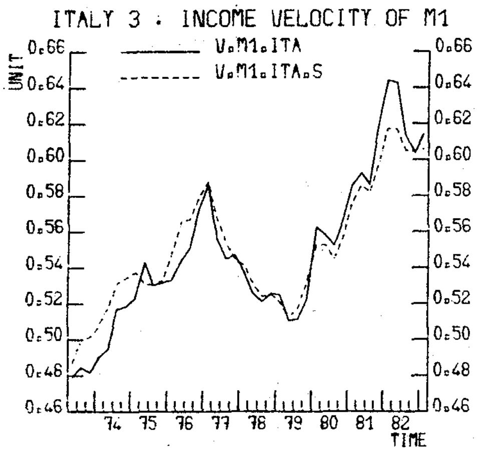
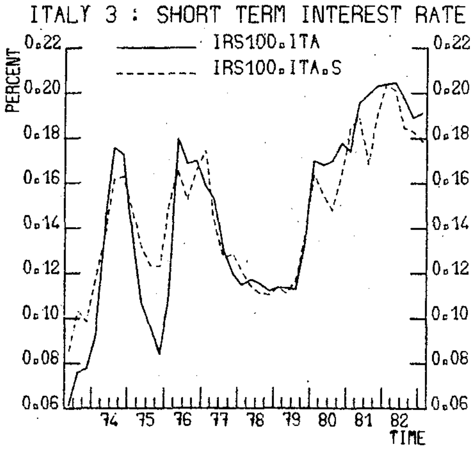


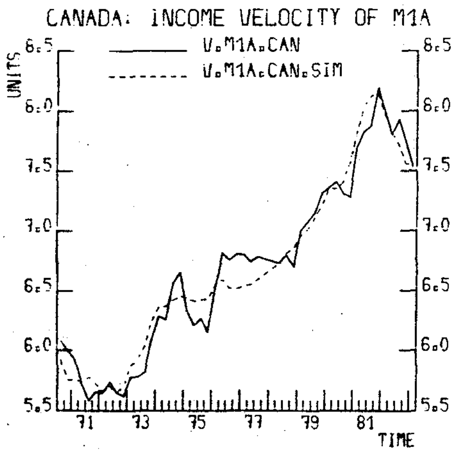
CHART 1 (continued)

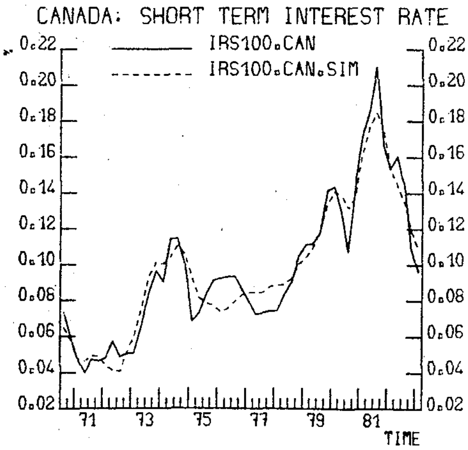












ANNEXES TO PARTS III AND IV

DETAILED TABLES OF ESTIMATION RESULTS AND STABILITY TESTS

Table 1

DOMESTIC MONETARY SECTOR: UNITED STATES(a)

$$D\ln M = const_1 + \alpha[\beta_1 \ln y + \beta_2 r + \beta_3 D\ln p^e - \ln(\tfrac{M}{P})_{-1}] + D\ln p$$

$$Dr = const_2 + \gamma_1(r_w - r_{-1}) + \gamma_2(D\ln M - \lambda_1) + \gamma_3 \ln(M/M_o e^{\lambda_1 t}) + \gamma_4 D\ln E + \gamma_5 D\ln F$$

$$+ \gamma_6(D\ln p - D\ln p_w) + \gamma_7 \ln(E/E_o) + \gamma_8 \ln(Ep/p_w) + \gamma_9 DUMMY$$

Paramters	FIML Estimates	Asymptotic t-values	Overall Fit Statistics
$Const_1$	0.0165	0.03	--Carter-Nagar System R-Square Statistic of Over-identified model:
α	0.4104	5.74	
β_1	0.9956	21.64	0.8638
β_2	-0.8926	6.78	-- Carter-Nagar Chi-square statistic of
β_3	-1.1747	4.89	Over-identified model:
$Const_2$	-0.0308	2.31	507.494
γ_1	0.3689	2.97	with 9 degrees of freedom.
γ_2	1.6243	2.67	The hypothesis that this model is not
γ_3	-	-	consistent with the data must be rejected
γ_4	-	-	if the Chi-square statistic exceeds the
γ_5	-	-	critical value in the region of the upper
γ_6	-	-	tail.
γ_7	-	-	-- Root mean Square Error Statistics:
γ_8	-0.0781	3.14	Equation 1. 0.0059
γ_9	0.0309, 0.0163	4.52, 3.00	Equation 2. 0.0091
λ_1	-	-	

(a) Sample period 1973.Q2-1983.Q1, money supply M2. The first dummy alters the constant term for half the sample period: = 1.0, 1973.Q2-1974.Q4; = -1.0, 1975.Q1-1977.Q4. High interest rates associated with the squeeze of 1974, the first oil shock, wage and price control removal are followed by a change of Administration, investment of the OPEC surplus in dollar assets, and a period of low interest rates. The second dummy accounts for the variability of interest rates in late 1979 and during 1980: = 1.0, 1979.Q4-1980.Q1; = -1.0, 1980.Q2-1980.Q3; = 1.0, 1980.Q4. The introduction of the new operating procedure was followed by the use of credit ceilings and their subsequent removal.

Table 2

DOMESTIC MONETARY SECTOR: JAPAN(a)

$$DlnM = const_1 + \alpha[\beta_1 lny + \beta_2 r + \beta_3 Dlnp^e - ln(\frac{M}{P})_{-1}] + Dlnp$$

$$Dr = const_2 + \gamma_1(r_w - r_{-1}) + \gamma_2(DlnM - \lambda_1) + \gamma_3 ln(M/M_o e^{\lambda_1 t}) + \gamma_4 DlnE + \gamma_5 DlnF + \gamma_6(Dlnp - Dlnp_w) + \gamma_7 ln(E/E_o) + \gamma_8 ln(Ep/p_w) + \gamma_9 DUMMY$$

Paramters	FIML Estimates	Asymptotic t-values	Overall Fit Statistics
$Const_1$	-3.2119	4.38	-- Carter-Nagar System R-Square Statistic of Over-identified model:
α	0.2199	4.05	
β_1	1.4434	24.31	0.8388
β_2	-1.0171	2.75	-- Carter-Nagar Chi-square statistic of Over-identified model:
β_3	-	-	
$Const_2$	-0.0210	3.91	416.332
γ_1	0.1030	2.10	with 9 degrees of freedom.
γ_2	0.7178	3.86	The hypothesis that this model is not
γ_3	-	-	consistent with the data must be rejected
γ_4	-0.0636	2.89	if the Chi-square statistic exceeds the
γ_5	-0.0636	2.89	critical value in the region of the upper
γ_6	-	-	tail.
γ_7	-	-	-- Root mean Square Error Statistics:
γ_8	-	-	Equation 1. 0.0091
γ_9	0.0145	2.76	Equation 2. 0.0078
λ_1	-	-	

(a) Estimation period: 1973.Q2-1983.Q1, money supply M2. Dummy variable = 1.0, 1980.Q1-1980.Q4. The sharp rise in interest rates in the United States and a depreciating yen led to an abnormally high interest differential in favour of Japan.

Table 3

DOMESTIC MONETARY SECTOR: GERMANY(a)

$$D\ln M = const_1 + \alpha[\beta_1 \ln y + \beta_2 r + \beta_3 D\ln p^e - \ln(\tfrac{M}{P})_{-1}] + D\ln p$$

$$Dr = const_2 + \gamma_1(r_w - r_{-1}) + \gamma_2(D\ln M - \lambda_1) + \gamma_3 \ln(M/M_o e^{\lambda_1 t}) + \gamma_4 D\ln E + \gamma_5 D\ln F$$
$$+ \gamma_6(D\ln p - D\ln p_w) + \gamma_7 \ln(E/E_o) + \gamma_8 \ln(Ep/p_w) + \gamma_9 DUMMY$$

Paramters	FIML Estimates	Asymptotic t-values	Overall Fit Statistics
$Const_1$	-3.3477	2.77	-- Carter-Nagar System R-Square Statistic of Over-identified model:
α	0.1758	3.02	
β_1	1.6603	14.74	0.8115
β_2	-1.0502	2.74	-- Carter-Nagar Chi-square statistic of
β_3	-	-	Over-identified model:
$Const_2$	-0.0347	3.66	344.513
γ_1	0.2723	2.61	with 8 degrees of freedom.
γ_2	1.3020	3.05	The hypothesis that this model is not
γ_3	-	-	consistent with the data must be rejected
γ_4	-	-	if the Chi-square statistic exceeds the
γ_5	-	-	critical value in the region of the upper
γ_6	-	-	tail.
γ_7	-	-	-- Root mean Square Error Statistics:
γ_8	-	-	Equation 1. 0.0087
γ_9	0.0159	2.54	Equation 2. 0.0106
λ_1	-	-	

(a) Sample Period 1973.Q2 to 1983.Q1, money supply M3. Dummy variable = 1.0 for 1973.Q2 to 1974.Q4, and 1981.Q1 to 1982.Q1, zero elsewhere, for periods when Lombard credit was not available.

Table 4

DOMESTIC MONETARY SECTOR: FRANCE(a)

$$D\ln M = const_1 + \alpha[\beta_1 \ln y + \beta_2 r + \beta_3 D\ln p^e - \ln(\frac{M}{P})_{-1}] + D\ln p$$

$$Dr = const_2 + \gamma_1(r_w - r_{-1}) + \gamma_2(D\ln M - \lambda_1) + \gamma_3 \ln(M/M_o e^{\lambda_1 t}) + \gamma_4 D\ln E + \gamma_5 D\ln F$$
$$+ \gamma_6(D\ln p - D\ln p_w) + \gamma_7 \ln(E/E_o) + \gamma_8 \ln(Ep/p_w) + \gamma_9 DUMMY$$

Paramters	FIML Estimates	Asymptotic t-values	Overall Fit Statistics
$Const_1$	0.2993	0.48	-- Carter-Nagar System R-Square Statistic of Over-identified model.
α	0.2178	2.25	
β_1	0.9940	8.11	0.8310
β_2	-1.1533	2.94	-- Carter-Nagar Chi-square statistic of
β_3	-	-	Over-identified model:
$Const_2$	-0.0283	1.74	393.353
γ_1	0.4379	5.07	with 9 degrees of freedom.
γ_2	1.1972	2.42	The hypothesis that this model is not
γ_3	-	-	consistent with the data must be rejected
γ_4	-0.1370	1.67	if the Chi-square statistic exceeds the
γ_5	-	-	critical value in the region of the upper
γ_6	-		tail.
γ_7	-0.0655	2.45	-- Root mean Square Error Statistics:
γ_8	-	-	Equation 1. 0.0082
γ_9	-	-	Equation 2. 0.0094
λ_1	-	-	

(a) Estimation period: 1973.Q2-1983.Q1, money supply M2.

Table 5

DOMESTIC MONETARY SECTOR: UNITED KINGDOM(a)

$$D\ln M = const_1 + \alpha[\beta_1 \ln y + \beta_2 r + \beta_3 D\ln p^e - \ln(\frac{M}{P})_{-1}] + D\ln p$$

$$Dr = const_2 + \gamma_1(r_w - r_{-1}) + \gamma_2(D\ln M - \lambda_1) + \gamma_3 \ln(M/M_o e^{\lambda_1 t}) + \gamma_4 D\ln E + \gamma_5 D\ln F + \gamma_6(D\ln p - D\ln p_w) + \gamma_7 \ln(E/E_o) + \gamma_8 \ln(Ep/p_w) + \gamma_9 DUMMY$$

Paramters	FIML Estimates	Asymptotic t-values	Overall Fit Statistics
$Const_1$	0.6577	0.32	-- Carter-Nagar System R-Square Statistic of Over-identified model:
α	0.1228	3.81	
β_1	0.7420	1.16	0.7850
β_2	-5.8574	3.82	-- Carter-Nagar Chi-square statistic of Over-identified model:
β_3	-	-	
$Const_2$	-3.1460	4.46	313.963
γ_1	0.1719	2.65	with 9 degrees of freedom.
γ_2	-	-	The hypothesis that this model is not
γ_3	0.1362	4.58	consistent with the data must be rejected
γ_4	-0.1488	5.26	if the Chi-square statistic exceeds the
γ_5	-0.1488	5.26	critical value in the region of the upper
γ_6	-	-	tail.
γ_7	-		-- Root mean Square Error Statistics:
γ_8	-0.0328	2.23	Equation 1. 0.0172
γ_9	-	-	Equation 2. 0.0095
λ_1	0.0292	21.35	

(a) Estimation period: 1972.Q3-1983.Q1, money supply M1.

Table 6

DOMESTIC MONETARY SECTOR: ITALY(a)

$$DlnM = const_1 + \alpha[\beta_1 lny + \beta_2 r + \beta_3 Dlnp^e - ln(\frac{M}{P})_{-1}] + Dlnp$$

$$Dr = const_2 + \gamma_1(r_w - r_{-1}) + \gamma_2(DlnM - \lambda_1) + \gamma_3 ln(M/M_o e^{\lambda_1 t}) + \gamma_4 DlnE + \gamma_5 DlnF + \gamma_6(Dlnp - Dlnp_w) + \gamma_7 ln(E/E_o) + \gamma_8 ln(Ep/p_w) + \gamma_9 DUMMY$$

Paramters	FIML Estimates	Asymptotic t-values	Overall Fit Statistics
$Const_1$	-0.2614	0.18	-- Carter-Nagar System R-Square Statistic of Over-identified model:
α	0.3018	4.99	
β_1	1.0612	6.55	0.8146
β_2	-2.7975	6.01	-- Carter-Nagar Chi-square statistic of Over-identified model:
β_3	-	-	
$Const_2$	-0.0068	0.96	351.512
γ_1	0.2049	3.76	with 10 degrees of freedom.
γ_2	0.0944	0.64	The hypothesis that this model is not
γ_3	-	-	consistent with the data must be rejected
γ_4	-0.2120	2.94	if the Chi-square statistic exceeds the
γ_5	-0.0730	1.68	critical value in the region of the upper
γ_6	0.6328	4.25	tail.
γ_7	-	-	-- Root mean Square Error Statistics:
γ_8	-	-	Equation 1. 0.0129
γ_9	-	-	Equation 2. 0.0140
λ_1	-	-	

(a) Estimation period: 1973.Q2-1983.Q1, money supply M1.

Table 7

DOMESTIC MONETARY SECTOR: CANADA(a)

$$DlnM = const_1 + \alpha[\beta_1 lny + \beta_2 r + \beta_3 Dlnp^e - ln(\frac{M}{P})_{-1}] + Dlnp$$

$$Dr = const_2 + \gamma_1(r_w - r_{-1}) + \gamma_2(DlnM - \lambda_1) + \gamma_3 ln(M/M_o e^{\lambda_1 t}) + \gamma_4 DlnE + \gamma_5 DlnF + \gamma_6(Dlnp - Dlnp_w) + \gamma_7 ln(E/E_o) + \gamma_8 ln(Ep/p_w) + \gamma_9 DUMMY$$

Paramters	FIML Estimates	Asymptotic t-values	Overall Fit Statistics
$Const_1$	2.2973	2.28	-- Carter-Nagar System R-Square Statistic of Over-identified model:
α	0.2115	4.22	
β_1	0.5089	3.17	0.8976
β_2	-2.3407	3.79	-- Carter-Nagar Chi-square statistic of Over-identified model:
β_3	-	-	
$Const_2$	-3.8428	4.32	894.425
γ_1	0.5469	6.05	with 10 degrees of freedom.
γ_2	-	-	The hypothesis that this model is not
γ_3	0.1669	4.31	consistent with the data must be rejected
γ_4	-	-	if the Chi-square statistic exceeds the
γ_5	-	-	critical value in the region of the upper
γ_6	-		tail.
γ_7	-0.0677	1.60	-- Root mean Square Error Statistics:
γ_8	-	-	Equation 1. 0.0178
γ_9	0.0167	3.06	Equation 2. 0.0094
λ_1	0.0231	13.58	

(a) Sample Period 1970.Q2 to 1983.Q1, money supply M1A. Dummy variable = 1.0 for 1981.Q1 to 1981.Q4, zero elsewhere, for periods of large purchases of foreign oil companies, resulting in unually large capital outflows, and higher interest rates to avoid depreciation from this source.

Table 8

COMPARISON OF SPEED OF ADJUSTMENTS AND LONG-TERM ELASTICITIES OF MONEY DEMAND FROM OLS AND FIML RESULTS(a)

	Speed of Adjustment	Income Elasticity	Interest Elasticity	Inflation Elasticity
UNITED STATES M2				
OLS	.36	.95	-.07	-.11
FIML	.41	1.00	-.06	-.09
JAPAN M1				
OLS	.28	1.44	-.06	-
FIML	0.22	1.44	-.08	-
GERMANY M3				
OLS	.11	1.62	-.11	-
FIML	.18	1.66	-.07	-
FRANCE M2				
OLS	.18	.99	-.11	-
FIML	.22	.99	-.11	-
UNITED KINGDOM M1				
OLS	.16	.87	-.49	-
FIML	.12	.74	-.58	-
ITALY M1				
OLS	.22	1.13	-.42	-
FIML	.30	1.06	-.36	-
CANADA M1A				
OLS	.22	.56	-.24	-
FIML	.21	.51	-.21	-

a. OLS results are taken from Blundell-Wignall, Rondoni and Ziegelschmidt (1984). Long-term interest and inflation elasticities are evaluated at sample means.

Table 9

DYNAMIC SIMULATION OF THE MONETARY BLOCKS:
FULL SAMPLE PERIODS

	Root-Mean-Square Error	
Countries	Money Supply Level	Interest Rate Level
United States	0.0101	0.0110
Japan	0.0150	0.0124
Germany	0.0151	0.0165
France	0.0116	0.0109
United Kingdom	0.0312	0.0139
Italy	0.0224	0.0166
Canada	0.0231	0.0108

a. Dynamic simulations of the simultaneous 2 equation model for each country are condducted over the periods 1973.Q2-1983.Q1 for the United States, Japan, Germany, France and Italy; 1972.Q3-1983.Q1 for the United Kingdom; and 1970.Q2-1983.Q1 for Canada. Charts corresponding to these RMSE statistics are shown in Chart 1.

V. SIMULATIONS OF A GOVERNMENT SPENDING SHOCK UNDER ALTERNATIVE MONETARY POLICY ASSUMPTIONS

A. Biannualisation of the quarterly monetary sub-model

In order to include the monetary blocks in the OECD international linkage model the quarterly FIML estimates were converted to their bi-annual equivalents -- a process facilitated by the Koyck specification (8). These equations were then simulated dynamically over the full sample period to check the accuracy of the conversion. Root mean square error statistics for these dynamic simulations are shown in Table 10 of the Annex to Part V, and charts for the simulation of velocity and interest rates are shown in Chart 2. These suggest that the conversion of the equations is quite satisfactory. In most cases, errors in the bi-annual simulations are slightly reduced in comparison to the quarterly model (see Table 9). This is suggestive of the presence of "noise" in the quarterly series which is reduced through bi-annualization. This is true for the United States, Japan, Germany, France and Canada. In the cases of the United Kingdom and Italy the errors are slightly increased. In both cases the bi-annualized model tends to exaggerate certain extreme sharp movements in the series around the middle of the simulation period (see Chart 2).

B. Bridging equations for narrow and broad aggregates

In the last three countries discussed above, (the United Kingdom, Italy and Canada) only narrow monetary aggregates proved to have a stable demand function. However, since (i) broader aggregates are targetted in at least two of these countries, and (ii) bank credit expansion, as a counterpart to the broader aggregate, is of interest in its own right, bridging equations reflecting the positive portfolio response of time deposits in relation to interest rate movements are also provided. It was assumed that:

$$\ln \frac{D}{Mn} = \text{const} + a_1 \left(\frac{r + r_L}{2}\right) + a_2 \ln \left(\frac{D}{Mn}\right)_{-1} \qquad (3)$$

Where M refers to the broad monetary aggregate, Mn to narrow money, D to time deposits (= M - Mn) and r_L is the long-term interest rate. An unweighted average of short and long rates is used to capture the own rate payable on deposits of varying maturities. This equation is estimated, for the three countries concerned, on six monthly data over the same sample period used for the FIML sub model. OLS techniques are used. The results, shown in Table 11 of the Annex to Part V, are satisfactory in terms of parameter signs, statistical significance and overall fit.

C. Overall structure of the domestic financial sector

The overall structure of the domestic financial sector including the FIML sub-model discussed above may be written as:

i) Broad Money Supply; M3: Germany, United Kingdom, Italy; M2: United States, Japan, France, Canada.

a. For countries for which a stable broad money demand was identified (United States, Germany, Japan, France)

$$M = M^D(p, y, r, D\ln p^e) \qquad (4)$$

or

b. For countries for which a stable narrow money demand was identified (United Kingdom, Italy, Canada)

$$M = M(M_n, r, r_L) \quad (5)$$

ii) Narrow Money Supply (United Kingdom, Italy, Canada)

$$M_n = M_n^D (p, y, r, Dlnp^e) \quad (6)$$

iii) Short-term Interest Rate Reaction Function

$$r = r(r_w, DlnM, M, t, DlnE, DlnF, Dlnp - Dlnp_w, E, p, p_w) \quad (7)$$

iv) Long-term Interest Rate

$$r_L = r_L (r, Dlnp, NLG) \quad (8)$$

where NLG is government net lending.

v) Domestic Bank Credit Expansion

$$DCE = \Delta M - \Delta F \quad (9)$$

This domestic monetary block has a number of important linkages with the rest of the INTERLINK model. Two are of particular importance. First, short-term interest rate directly impacts upon the portfolio balance determination of the exchange rate.

$$E = E(r, r_w, NFA, E^e) \quad (10)$$

$$E^e = E^e (p, p_w) \quad (11)$$

Where NFA refers to net foreign assets. The exchange rate, in turn, affects trade flows, the current account, and domestic economic activity. It also affects domestic prices. Second, the long-term interest rate directly impacts upon private expenditure and interest payments in the model. The rest of this paper is concerned with examining the nature of the influence of alternative domestic monetary policy regimes on INTERLINK simulation outcomes. It is shown that with the new financial sector monetary policy plays a powerful role in the model.

D. Alternative monetary policy regimes

With the revised domestic financial blocks the INTERLINK model may be run under four main alternative monetary policy regimes when considering, for example, changes in fiscal policy.

i) Non-accommodating monetary policy. This mode is characterized by:

-- fully floating exchange rates;

-- the interest rate is exogenised (implying that the interest rate reaction function is overridden); and

-- the exogenous interest rate is used to target a pre-determined path for the money supply via the demand for money function.

Monetary policy is non-accommodating of a fiscal policy shock in the sense that the interest rate adjusts to force money demand equal to the pre-determined path of the money supply.

ii) Managed floating monetary policy. In this mode model simulations would be characterized by:

-- fully floating exchange rates;

-- the money supply is determined by the demand for money function; and

-- the interest rate is determined by the policy reaction function.

Monetary policy manages the exchange rate in the sense that foreign interest rates, exchange rates and international reserves are arguments of the interest rate reaction function. It does not refer to exchange market intervention, which is not explicitly modelled in this version of INTERLINK. Since the money supply is determined by money demand, monetary policy will generally be partially accommodating of a fiscal policy shock. It is in this mode that the model should be used for forecasting the money supply and interest rates.

iii) Fixed exchange rates. This mode is characterized by:

-- exogenous interest rates (implying that the interest rate reaction function is overridden);

-- the money supply is determined by the demand for money function; and

-- the exogenous interest rate is used to target a constant exchange rate.

In this case the interest rate may be thought of as adjusting to ensure that there are sufficient capital flows to finance the deterioration of the current account in response to a fiscal shock without requiring a change in the exchange rate.

iv) Fully accommodating monetary policy. In this mode use of the model for policy simulations would be characterized by:

-- fully floating exchange rates;

-- the money supply is determined by the demand for money function; and

-- interest rates are exogenous.

In this case interest rates are unaffected by the fiscal policy shock, the money supply accommodates demand, and the exchange rate is permitted to reinforce the impact of government spending on the economy.

Provided that capital flows are relatively mobile and that exchange rate expectations are not too greatly affected by other responses to a fiscal shock (notably inflation), one would expect the multipliers under non-accommodation to be smaller than those under full accommodation, with other regimes lying somewhere between these two extremes. This need not always follow however. The direction of the change in the exchange rate in response to a fiscal shock under non-accommodating monetary policy depends on:

-- the size of the current account effect;

-- the interest rate response (which will tend to be greater the smaller the interest elasticity of money demand);

-- the degree of capital mobility; and

-- the effect of various system responses on exchange rate expectations.

If the exchange rate actually depreciates under non-accommodating monetary policy when fiscal policy is expansionary (e.g. because the current account deterioration is large, the interest elasticity of money demand is high and capital mobility is low) then higher interest rates and lower output multipliers would result from attempts to adjust monetary policy to fix the exchange rate.

The above monetary policy regimes may also be used for the simulation of real and pricing shocks other than those associated with fiscal policy. Other regimes are also possible. For example, the authorities may attempt to fix both interest and exchange rates while permitting the money supply to accommodate demand. However, in the rest of this paper the effect of a sustained increase in real government spending equal to 1 per cent of real GDP under the four monetary policy regimes outlined above is considered.

CHART 2

DYNAMIC SIMULATIONS OF VELOCITY AND INTEREST RATES: BI-ANNUAL EQUATIONS

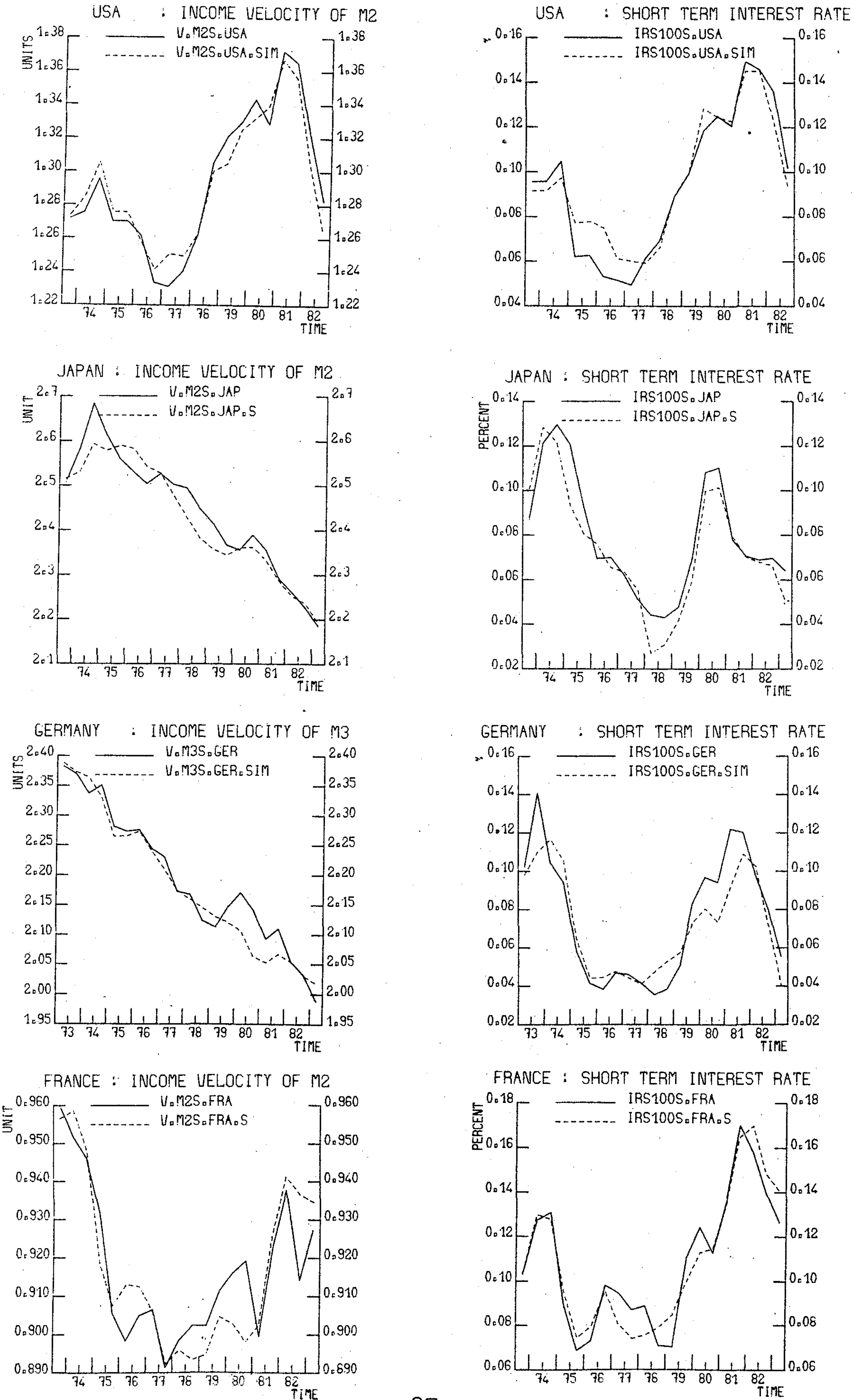
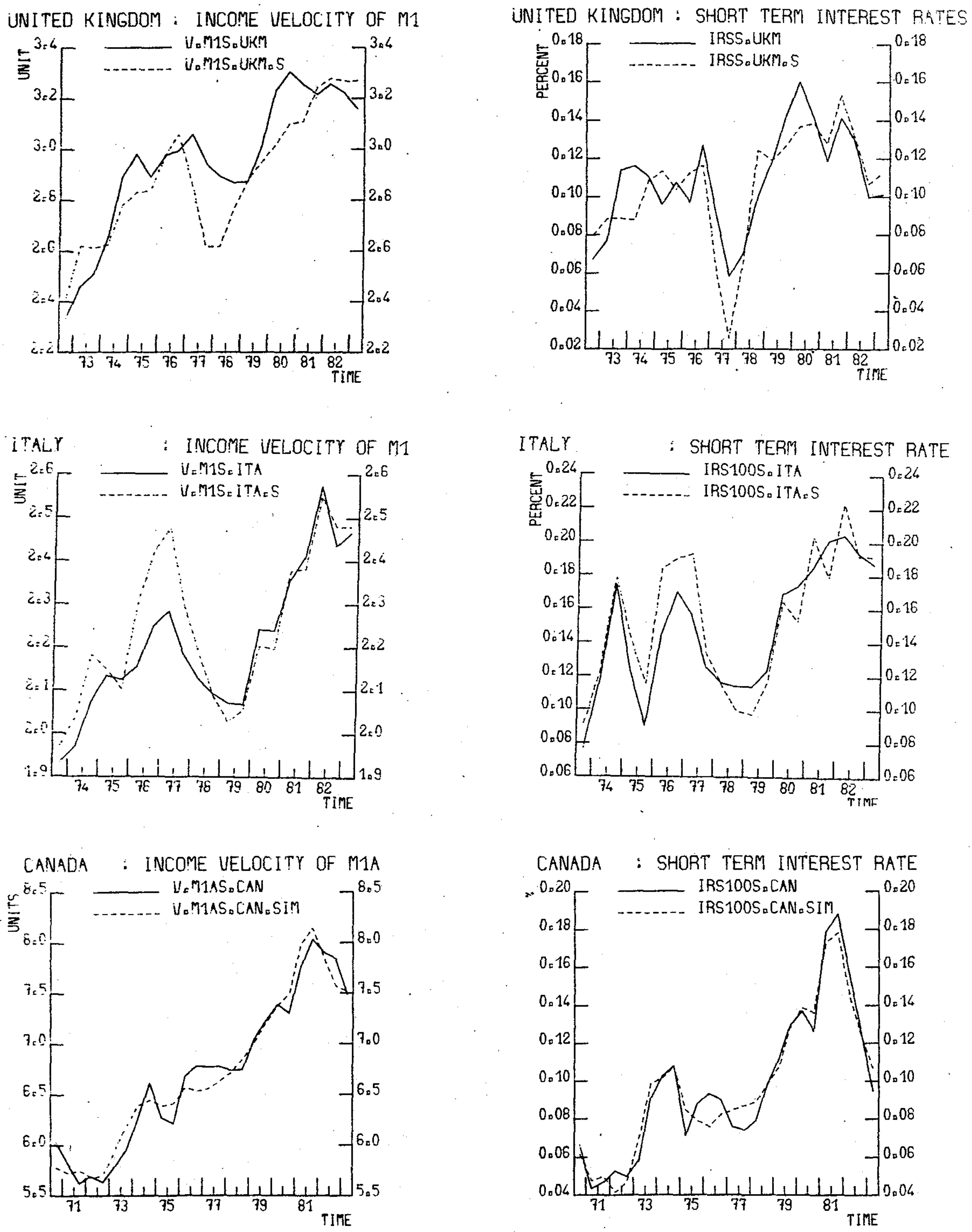


CHART 2 (continued)



* The charts show the dynamic simulations of the two equation monetary sector for each country. The simulated level of the money supply is expressed in the form of velocity in order to give a clearer (non-trended) picture of the main errors. All dynamic simulations are for the full period over which the equation is estimated.

E. Simulation of a one per cent increase in real government spending

United States

Under non-accommodating monetary policy the increase in real government spending, for a given money supply, raises both interest rates and output. The rise in interest rates, to be 113 basis points above baseline in the first year and 182 basis points above it after four years, results from an increase in the demand for money consequent upon higher output. This, in turn, causes long-term interest rates to rise to by 147 basis points after four years, and the exchange rate to appreciate by 0.5 per cent in the first year, rising to be 0.8 per cent above its baseline after 2 years and declining thereafter. Rising interest and exchange rates limit the rise in output, particularly by the fourth year when it is only 0.7 per cent above its baseline solution. A managed float, whereby the U.S. authorities pursue the joint objectives of controlling the money supply and limiting movements of the real exchange rate in their interest rate reactions, leads to less increases in interest rates and a mild appreciation in the first year, followed by some depreciation afterwards. The money supply rises, partially accommodating a somewhat larger increase in output. Adjusting interest rates to maintain fixed exchange rates leads to higher rates than under a managed float in the seond half of the simulation: the period in which the exchange rate would otherwise have depreciated under a managed float. Output increases by more at first, but subsequently declines more sharply. An accommodating float (fixed interest rates) leads to a more substantial increase in output than in any of the other three regimes. Inflation has a similar profile whatever the stance of monetary policy, although it is slightly greater under fixed exchange rates and the accommodating float.

Japan

The real output multipliers for Japan are ranked similarly to those for the United States. Non accommodation leads to a 0.6 per cent increase in output over its baseline after four years, compared to a 2.4 per cent rise under an accommodating float. The managed float and fixed exchange rate multipliers lie between these extremes, although managing as opposed to fixing the exchange rate is considerably more expansionary. This is reflected in a smaller increase in interest rates and a considerable depreciation of the exchange rate. This occurs mainly because the authorities are assumed only to "smooth" the exchange rate in their policy reactions, and not to target its level. The price level rises by 2.4 per cent after four years under non accommodation, all other policies being considerably more inflationary.

Germany

As with the United States and Japan, non accommodation markedly constrains the output multiplier compared to an accommodating float; after four years output is 0.5 per cent above its baseline in the former and more than double this figure in the latter. A managed float, which involves ajdusting interest rates to narrow the interest differential with the rest of the world while also attempting to target the money supply, leads to similar increases in interest rates compared to the case of using monetary policy to fix the exchange rate. The exchange rate, on balance, moves very little, so that output and price multipliers are similar for both exchange rate policies. Inflation is very modest under non-accommodation, and is somewhat higher under exchange rate targeting. An accommodating float is considerably more expansionary than the other three regimes, and leads to much greater increases in prices.

France

In France non accommodation constrains the output multiplier to be 0.5 after four years, and short-term interest rates rise by 248 basis points. The exchange rate appreciates by 0.5 per cent during the first year and thereafter remains above its baseline solution. A managed float leads to more monetary accommodation and exchange rate depreciation, so that the output multiplier is almost double that for the non-accommodation case. However, this is not the case for fixed exchange rates. That the exchange rate depreciates under a managed float implies that the use of monetary policy to fix the exchange rate will lead to higher interest rates. In the fixed rate case the short-term interest rises by 294 basis points, and since the exchange rate is also relatively higher, the real GDP multiplier is more constrained than under a managed float, as is the increase in domestic prices. It is only marginally more expansionary than the non-accommodated multiplier. An accommodating float leads to much greater increases in output and prices.

United Kingdom

In the United Kingdom the simulation of a government spending shock under the assumptions of either non-accommodation or a managed float both lead to similar outcomes for interest rates, output and prices. Output rises to be about 1 per cent over its baseline value after two years and thereafter declines. Prices rise by just over 2 per cent after four years in both cases. This is because the reaction function for interest rates in the United Kingdom puts more stress on controlling the level of the money supply in relation to its target, i.e. avoiding base drift, and, in addition, suggests attempts to resist movements in the real exchange rate. Such reactions under a managed float give rise to small changes in the money supply, making outcomes close to the case of non-accommodation. Since the exchange rate depreciates under both of the previous policies, fixed exchange rates must imply higher interest rates. This in turn, leads to smaller output and price effects. As with all the other countries, an accommodating float is considerably more expansionary.

Italy

The results for Italy have a similar pattern to those for the United Kingdom. Non-accommodating monetary policy and a managed float lead to similar output and price responses; fixed exchange rates imply more restrained output multipliers, and an accommodating float is most expansionary.

Canada

A non accommodating float implies modest increases in the short-term interest rate above its baseline value, by only 88 basis points after four years, because of the high interest elasticity of money demand. Output rises by 0.8 per cent over the same period, and there is a modest depreciation of the exchange rate after the first year. While the Canadian authorities are assumed to target the level of the nominal exchange rate, other arguments of the reaction function, and lagged adjustment, imply more monetary accommodation and greater depreciation under a managed float. The real output multiplier is therefore higher. Fixed exchange rates, as with the previous two countries, leads to much smaller increases in output in response to a government spending shock. An accommodating float leads to the greatest expansion of output and prices.

ANNEX TO PART V

DETAILED TABLES OF ESTIMATION AND SIMULATION RESULTS

Table 10

DYNAMIC SIMULATION OF THE BI-ANNUALIZED MONETARY BLOCKS: FULL SAMPLE PERIOD(a)

Countries	Root Mean Square Error Money Supply Level	 Interest Rate Level
United States	0.0076	0.0091
Japan	0.0128	0.0106
Germany	0.0099	0.0136
France	0.0084	0.0091
United Kingdom	0.0379	0.0164
Italy	0.0266	0.0185
Canada	0.0196	0.0085

a. Dynamic simulations of the simultaneous equation model for each country are conducted over the periods 1973.S2-1983.S1 for the United States, Japan, Germany, France and Italy; 1972.S2-1983.S1 for the United Kingdom; and 1970.S2-1983.S1 for Canada. Charts corresponding to these RMSE statistics are shown in Chart 2.

Table 11

BRIDGING EQUATIONS BETWEEN NARROW AND BROAD MONEY SUPPLIES

$$\ln(D/M_n) = \text{const} + a_1(r+r_L)/2 + a_2\ln(D/M_n)_{-1}$$

Country	const	a_1	a_2	R^2	h(a)	SEE
United Kingdom ln((M3-M1)/M1)	-0.0516 (1.22)	0.6536 (1.80)	0.9123 (19.56)	0.91	4.73	0.045
Italy ln((M3-M1)/M1)	-0.0655 (1.82)	0.5072 (2.21)	0.8805 (14.78)	0.96	0.25	0.035
Canada ln((M2-M1A)/M1A)	-0.0075 (0.73)	1.1101 (5.92)	0.8747 (34.08)	0.99	2.28	0.022

a. Durbin h statistic for autocorrelation.

Table 12(a)

UNITED STATES: REAL GOVERNMENT SPENDING SHOCK 1 PER CENT OF GDP

(Differences from baseline)

		Short interest rate(b)	Long interest rate(b)	Effective exchange rate(b)	Money Supply M2(c)	Real GDP(c)	GDP Deflator (c)	Current Balance $US Bill
Non-Accommodating float	1981	1.13	0.33	0.53	-	1.02	0.18	-8.38
	1982	1.63	0.83	0.82	-	1.17	0.53	-9.69
	1983	1.77	1.22	0.79	-	0.95	0.87	-10.69
	1984	1.82	1.47	0.64	-	0.67	1.15	-12.21
Managed float	1981	0.48	0.14	0.15	0.42	1.04	0.16	-9.08
	1982	0.56	0.31	-0.04	0.91	1.32	0.53	-10.72
	1983	0.49	0.40	-0.42	1.36	1.31	0.94	-11.87
	1984	0.45	0.43	-0.80	1.77	1.27	1.30	-14.05
Fixed exchange rate	1981	0.25	0.07	-	0.58	1.05	0.16	-9.33
	1982	0.75	0.30	-	0.86	1.35	0.55	-10.50
	1983	1.16	0.62	-	0.93	1.32	0.97	-11.30
	1984	1.47	0.94	-	0.93	1.16	1.33	-13.36
Accommodating float	1981	-	-	-0.14	0.73	1.06	0.15	-9.59
	1982	-	-	-0.53	1.44	1.41	0.54	-11.23
	1983	-	-	-0.96	1.99	1.53	0.99	-12.33
	1984	-	-	-1.35	2.53	1.58	1.40	-14.91

a. The table shows deviations from the model baseline of a counterfactual sustained real government spending increase by 1 per cent of real GDP.

b. Percentage points.

c. Per cent.

Table 13(a)

JAPAN: REAL GOVERNMENT SPENDING SHOCK 1 PER CENT OF GDP

(Differences from baseline)

		Short interest rate(b)	Long interest rate(b)	Effective exchange rate(c)	Money Supply M2+CD(c)	Real GDP(c)	GDP Deflator (c)	Current Balance $US Bill
Non-Accommodating float	1981	2.32	0.76	0.96	-	0.98	0.42	-2.68
	1982	3.53	1.47	1.57	-	1.05	1.29	-3.91
	1983	3.80	1.96	1.46	-	0.86	2.05	-4.70
	1984	3.30	2.15	0.88	-	0.59	2.37	-5.15
Managed float	1981	0.55	0.18	-0.04	0.82	1.06	0.37	-3.26
	1982	1.19	0.46	-0.62	2.01	1.43	1.32	-4.42
	1983	1.63	0.75	-1.54	3.22	1.66	2.55	-4.96
	1984	1.76	0.96	-2.53	4.21	1.74	3.58	-5.60
Fixed exchange rate	1981	0.65	0.21	-	0.79	1.06	0.37	-3.23
	1982	2.23	0.81	-	1.50	1.38	1.35	-4.13
	1983	3.45	1.49	-	1.78	1.41	2.52	-4.53
	1984	4.09	2.09	-	1.53	1.14	3.30	-5.00
Accommodating float	1981	-	-	-0.33	1.07	1.08	0.35	-3.44
	1982	-	-	-1.54	2.85	1.56	1.31	-4.71
	1983	-	-	-3.19	4.94	2.02	2.71	-5.29
	1984	-	-	-4.83	6.96	2.40	4.07	-6.08

a. The table shows deviations from the model baseline of a counterfactual sustained real government spending increase by 1 per cent of real GDP.

b. Percentage points.

c. Per cent.

Table 14(a)

GERMANY: REAL GOVERNMENT SPENDING SHOCK 1 PER CENT OF GDP

(Differences from baseline)

		Short interest rate(b)	Long interest rate(b)	Effective exchange rate(b)	Money Supply M3	Real GDP(c)	GDP Deflator (c)	Current Balance $US Bill
Non-Accommodating float	1981	1.83	0.56	0.90	-	0.79	0.28	-1.66
	1982	1.68	0.73	1.39	-	0.90	0.29	-2.19
	1983	1.18	0.74	1.38	-	0.70	0.19	-2.67
	1984	0.65	0.66	1.07	-	0.47	0.06	-2.86
Managed float	1981	0.58	0.18	0.12	0.55	0.85	0.24	-2.61
	1982	0.69	0.28	0.15	1.08	1.09	0.42	-3.12
	1983	0.56	0.31	-0.03	1.47	1.07	0.55	-3.14
	1984	0.34	0.29	-0.33	1.67	0.92	0.62	-3.06
Fixed exchange rate	1981	0.39	0.12	-	0.63	0.86	0.23	-2.75
	1982	0.62	0.23	-	1.23	1.12	0.44	-3.21
	1983	0.83	0.36	-	1.51	1.10	0.62	-2.94
	1984	0.85	0.45	-	1.47	0.91	0.68	-2.63
Accommodating float	1981	-	-	-0.22	0.78	0.88	0.22	-3.04
	1982	-	-	-0.55	1.68	1.19	0.46	-3.74
	1983	-	-	-0.96	2.39	1.28	0.73	-3.60
	1984	-	-	-1.31	2.82	1.21	0.94	-3.31

a. The table shows deviations from the model baseline of a counterfactual sustained real government spending increase by 1 per cent of real GDP.

b. Percentage points.

c. Per cent.

Table 15(a)

FRANCE: REAL GOVERNMENT SPENDING SHOCK 1 PER CENT OF GDP

(Differences from baseline)

		Short interest rate(b)	Long interest rate(b)	Effective exchange rate(b)	Money Supply M2(c)	Real GDP(c)	GDP Deflator (c)	Current Balance $US Bill
Non-Accommodating float	1981	1.34	0.42	0.47	-	0.73	0.41	-1.91
	1982	1.75	0.70	0.61	-	0.74	0.85	-2.29
	1983	2.11	1.00	0.50	-	0.66	1.35	-2.24
	1984	2.48	1.30	0.30	-	0.52	1.89	-2.12
Managed float	1981	0.48	0.15	-0.10	0.51	0.77	0.42	-2.27
	1982	0.70	0.27	-0.57	1.13	0.89	1.03	-2.62
	1983	0.99	0.44	-1.39	1.92	0.97	1.93	-2.55
	1984	1.30	0.63	-2.40	2.86	0.99	3.09	-2.54
Fixed exchange rate	1981	0.68	0.21	-	0.42	0.76	0.42	-2.19
	1982	1.45	0.53	-	0.60	0.84	1.00	-2.37
	1983	2.29	0.95	-	0.55	0.78	1.71	-2.17
	1984	2.94	1.38	-	0.35	0.59	2.40	-2.03
Accommodating float	1981	-	-	-0.40	0.78	0.79	0.42	-2.47
	1982	-	-	-1.29	1.82	0.98	1.12	-2.84
	1983	-	-	-2.72	3.28	1.17	2.27	-2.84
	1984	-	-	-4.54	5.21	1.36	3.88	-2.99

a. The table shows deviations from the model baseline of a counterfactual sustained real government spending increase by 1 per cent of real GDP.

b. Percentage points.

c. Per cent.

Table 16(a)

UNITED KINGDOM: REAL GOVERNMENT SPENDING SHOCK 1 PER CENT OF GDP

(Differences from baseline)

		Short interest rate(b)	Long interest rate(b)	Effective exchange rate(b)	Money Supply M1(c)(d)	Real GDP(c)	GDP Deflator (c)	Current Balance $US Bill
Non-Accommodating float	1981	0.20	0.08	-0.03	-	0.84	0.16	-2.13
	1982	0.32	0.15	-0.29	-	0.99	0.57	-2.52
	1983	0.55	0.27	-0.89	-	0.94	1.23	-2.39
	1984	0.69	0.38	-1.71	-	0.74	2.11	-2.01
Managed float	1981	0.09	0.03	-0.10	0.21	0.85	0.16	-2.17
	1982	0.24	0.10	-0.39	0.35	1.00	0.58	-2.55
	1983	0.44	0.21	-1.04	0.48	0.96	1.27	-2.40
	1984	0.61	0.32	-1.89	0.59	0.76	2.19	-2.01
Fixed exchange rate	1981	0.28	0.11	-	-0.09	0.84	0.16	-2.11
	1982	0.78	0.33	-	-0.92	0.97	0.57	-2.38
	1983	1.62	0.75	-	-2.81	0.85	1.19	-2.14
	1984	2.32	1.19	-	-5.47	0.53	1.88	-1.70
Accommodating float	1981	-	-	-0.15	0.36	0.85	0.15	-2.20
	1982	-	-	-0.57	0.91	1.02	0.58	-2.61
	1983	-	-	-1.46	1.85	1.01	1.31	-2.50
	1984	-	-	-2.60	2.97	0.86	2.33	-2.11

a. The table shows deviations from the model baseline of a counterfactual sustained real government spending increase by 1 per cent of real GDP.

b. Percentage points.

c. Per cent.

d. The narrow money supply for which a stable demand function was identified is shown in this table. However, briding equations reflecting the positive portfolio response of time deposits in relation to interest rate movements are also included in the model. The user has the option to target either narrow or broad aggregates.

Table 17(a)

ITALY: REAL GOVERNMENT SPENDING SHOCK 1 PER CENT OF GDP

(Differences from baseline)

		Short interest rate(b)	Long interest rate(b)	Effective exchange rate(b)	Money Supply M1(c)(d)	Real GDP(c)	GDP Deflator (c)	Current Balance $US Bill
Non-Accommodating float	1981	0.46	0.20	0.11	-	1.07	0.11	-2.36
	1982	0.47	0.31	0.10	-	1.16	0.09	-2.41
	1983	0.49	0.38	-0.08	-	1.10	0.17	-2.19
	1984	0.50	0.37	-0.07	-	1.05	0.25	-2.17
Managed float	1981	0.18	0.08	-0.08	0.48	1.08	0.12	-2.40
	1982	0.18	0.12	-0.25	0.83	1.21	0.15	-2.42
	1983	0.23	0.17	-0.47	0.90	1.16	0.25	-2.17
	1984	0.24	0.20	-0.67	0.96	1.11	0.34	-2.15
Fixed exchange rate	1981	0.22	0.09	-	0.19	0.74	0.08	-1.58
	1982	0.32	0.18	-	0.18	0.86	0.09	-1.67
	1983	0.49	0.31	-	-0.12	0.84	0.14	-1.55
	1984	0.59	0.43	-	-0.47	0.80	0.18	-1.59
Accommodating float	1981	-	-	-0.21	0.81	1.10	0.13	-2.42
	1982	-	-	-0.46	1.33	1.24	0.18	-2.43
	1983	-	-	-0.76	1.60	1.21	0.30	-2.18
	1984	-	-	-1.00	1.79	1.16	0.41	-2.13

a. The table shows deviations from the model baseline of a counterfactual sustained real government spending increase by 1 per cent of real GDP.

b. Percentage points.

c. Per cent.

d. The narrow money supply for which a stable demand function was identified is shown in this table. However, briding equations reflecting the positive portfolio response of time deposits in relation to interest rate movements are also included in the model. The user has the option to target either narrow or broad aggregates.

Table 18(a)

CANADA: REAL GOVERNMENT SPENDING SHOCK 1 PER CENT OF GDP

(Differences from baseline)

		Short interest rate(b)	Long interest rate(b)	Effective exchange rate(b)	Money Supply M1A(c)(d)	Real GDP(c)	GDP Deflator (c)	Current Balance $US Bill
Non-Accommodating float	1981	0.39	0.13	0.02	-	0.85	0.24	-1.29
	1982	0.55	0.23	-0.10	-	0.98	0.50	-1.61
	1983	0.70	0.34	-0.32	-	0.92	0.85	-1.76
	1984	0.88	0.47	-0.63	-	0.80	1.26	-1.99
Managed float	1981	0.10	0.03	-0.15	0.31	0.88	0.21	-1.30
	1982	0.21	0.08	-0.40	0.59	1.07	0.49	-1.58
	1983	0.32	0.14	-0.71	0.80	1.08	0.85	-1.72
	1984	0.43	0.21	-1.11	1.00	1.02	1.28	-1.96
Fixed exchange rate	1981	0.38	0.12	-	0.05	0.85	0.24	-1.29
	1982	0.74	0.29	-	-0.18	0.96	0.53	-1.60
	1983	1.18	0.52	-	-0.62	0.83	0.90	-1.77
	1984	1.66	0.81	-	-1.22	0.60	1.31	-2.05
Accommodating float	1981	-	-	-0.21	0.40	0.89	0.20	-1.30
	1982	-	-	-0.46	0.90	1.11	0.48	-1.57
	1983	-	-	-0.76	1.34	1.18	0.83	-1.70
	1984	-	-	-1.00	1.81	1.18	1.28	-1.92

a. The table shows deviations from the model baseline of a counterfactual sustained real government spending increase by 1 per cent of real GDP.

b. Percentage points.

c. Per cent.

d. The narrow money supply for which a stable demand function was identified is shown in this table. However, briding equations reflecting the positive portfolio response of time deposits in relation to interest rate movements are also included in the model. The user has the option to target either narrow or broad aggregates.

VI. CONCLUDING REMARKS

Money demand equations and interest rate reaction functions were estimated simultaneously with a FIML technique, over sample periods that reflect floating exchange rates. These monetary sub models fit the data well, as is reflected in dynamic simulation tests. The estimated equations were coded into the INTERLINK model as a part of the financial sector, and are used to drive other key variables, notably the long-term interest rates, capital flows and exchange rates. These, in turn, influence the level of economic activity and prices in the model.

The role of monetary policy in the OECD INTERLINK model was then illustrated with the counterfactual simulation of an increase in real government spending equal to 1 per cent of real GDP. This simulation was conducted under four alternative monetary policy regimes. First, non accommodation, where the interest rate is adjusted to force money demand equal to a pre-determined path for the money supply. Second, the authorities may pursue a managed float, where some compromise between external objectives and a partial accommodation of domestic money demand is achieved. Third, the authorities may adjust interest rates in order to fix the exchange rate. This, it should be stressed, is not concerned with exchange market intervention. Fourth, the authorities may fix interest rates allowing both the money supply to adjust to demand and the exchange rate to find its own level.

In the cases of the United States, Japan, Germany and France, a fiscal shock that was not accommodated by monetary policy led to the smallest output and price multipliers, while the accommodating float was most expansionary. Output multipliers under fixed exchange rates and the case of a managed float lay somewhere between these two extremes. For the other countries (France, United Kingdom, Italy and Canada) the accommodating float was also the most expansionary. However, fixed exchange rates proved to be more restrictive than non-accommodating monetary policy. This is because the fiscal expansion causes the exchange rate to depreciate, even where monetary policy is non-accommodating. Such an outcome may arise because the current account deterioration is relatively larger and the degree of capital mobility is smaller than is the case in the other economies discussed above. Similarly, there may be different effects of various system responses on exchange rate expectations. Finally, the interest elasticity of money demand may be relatively large, implying a smaller increase in interest rates in response to a fiscal shock. This explanation seems to be the most important, since in each of the three countries concerned a stable money demand function was identified only for the narrow monetary aggregates, and interest rate increases tend to be smaller under non-accommodation than for the other countries. Larger increases in interest rates are required to fix the exchange rate, which reverses the order of the least expansionary monetary policy regime in the face of a government spending shock.

The results reported in this study illustrate that the new financial blocks give a much more important role to monetary policy in the OECD INTERLINK model; outcomes are strongly affected depending on the policy regime under which model simulations are conducted. Future research will aim to improve the structure of the existing model, as well as to extend the approach to some of the smaller OECD economies. The main improvements to structure currently under investigation include foreign exchange market intervention functions, and still further attempts to improve the specification of the money demand equations.

NOTES

1. See Holtham (1984); for a full description of INTERLINK, see OECD (1983).

2. The earlier interest rate equation combined both policy reactions to changes in interest rate differentials with weighted average foreign rates, and the first difference of an inverted money demand equation. However, this mixture tends to be dominated by the foreign rate, so that simulations involving pure floating are not possible.

3. See Blundell-Wignall, Rondoni and Ziegelschmidt (1984).

4. An interesting and influential article discussing this as an explanation of monetary disequilibrium, see Artis and Lewis (1976).

5. Inverting the interest rate reaction function for the money supply growth rule of the authorities, assuming that only one or other of the money supply target terms is pursued, yields:

$$
\begin{aligned}
DlnM = \lambda_1 &+ \frac{1}{\gamma_2} Dr - \frac{\gamma_1}{\gamma_2}(r_w - r_{-1}) - \frac{\gamma_4}{\gamma_2} DlnE - \frac{\gamma_5}{\gamma_2} DlnF \\
&- \frac{\gamma_6}{\gamma_2}(Dlnp - Dlnp_w) - \frac{\gamma_7}{\gamma_2} \ln(E/E_o) \\
&- \frac{\gamma_8}{\gamma_2} \ln(EP/P_w)
\end{aligned}
$$

Where all variables on the RHS of the equation are zero, the money supply will grow at a constant rate. Domestic and external developments, however, will induce deviations from this constant rate with appropriate signs. It should be pointed out that attempts to introduce explicitly published time series for monetary growth targets in place of the assumption of a constant rate, proved disappointing. The assumption of a constant rate over a ten year sample period is in line with the view that there is a single steady-state nominal rate of growth of the economy over such periods. The monetary authorities will eventually be constrained to adjust policy instruments to achieve a rate of growth of the money supply which is consistent with this rate. Published targets, on the other hand are too "vague". Frequently they are couched in terms of target ranges. Moreover, they have often been missed when other factors (such as exchange rate considerations) have been given more priority.

6. See Girton and Roper (1977).

7. Specifically the RESIMUL program developed by C.R.Wymer has been used.

8. Thus, for example, the quarterly specification of the money demand equation:

$$D\ln M = \alpha(\beta_1 \ln y + \beta_2 r - \ln M_{-1})$$

is transformed by altering the quarterly speed of adjustment to be:

$$\alpha + \alpha(1-\alpha) = 1-(1-\alpha)^2.$$

The equation becomes:

$$D\ln M_s = [1-(1-\alpha)^2] (\beta_1 \ln y_s + \beta_2 r_s - \ln M_{s-1})$$

where s subscripts denote half-yearly values of variables.

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