THE WORLD ECONOMY FROM 1979 TO 1988: RESULTS FROM THE MSG2 MODEL

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ABSTRACT

This paper examines the role played by divergent macroeconomic policies in the major industrial economies in causing the large swings in asset prices and global trade imbalances experienced during the 1980s. Using the MSG2 model of the world economy, it is found that the observed and expected changes in fiscal and monetary policies in the major industrialised economies, as well as the OPEC oil price shocks and cessation of lending to the developing countries, can explain the 1980s experience reasonably well. The results also suggest that coordination of monetary policies alone, will do little to solve the current imbalances.

TABLE OF CONTENTS

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1. Introduction

Between 1979 and 1985 the U.S. dollar appreciated by over 40 percent in real terms relative to other major currencies. The U.S. dollar then depreciated by close to 50 percent relative to the same currencies between 1985 and 1988. The U.S. current account deficit rose from approximately zero in 1979 to 3.6 percent of GNP in 1987 while over the same period the current account surpluses of Japan and Germany grew from close to zero to 3.7 and 3.9 percent of own GNP respectively. There are many possible explanations of these wild swings in the world economy. These include divergent fiscal policies in the main countries, divergent monetary policies, trade frictions, flight to the U.S. "Safe Haven", cessation of lending to developing countries, and shifts in productivity between countries, to name the popular examples.

The purpose of this paper is to use the MSG2 model of the world economy to examine the role played by monetary and fiscal policies in the major industrialized countries in explaining the 1980s. As well as providing some evidence on the factors responsible for the large swings, this exercise also indicates how the MSG2 model tracks the recent decade and is a valuable form of model validation. Of course, evidence of a good performance in tracking the 1980s using only changes in monetary and fiscal policies, exogenous oil price shocks and lending to developing countries does not mean that the model necessarily captures the actual factors but it is encouraging evidence.

Section 2 of the paper examines the behaviour of key macroeconomic variables for the major regions of the world economy during the 1980s. The MSG2 model is then introduced in section 3. The properties of the model are examined in section 4 using multipliers for exogenous changes in policy. The tracking performance is assessed in section 5. Section 6 summarizes the major results of the paper and discusses the policy implications of the analysis including the appropriate policy mix in the major economies to redress the large imbalances which continue to threaten economic stability in the world economy.

We find that changes in macroeconomic policy explain a substantial part of the experience up to 1985. The exact timing of the turn around in the U.S. dollar is not completely explained by the model. The appreciation of the U.S. dollar relative to the Deutschemark from the end of 1984 to the first months of 1985 appears to be an overshoot. The size of the decline in the U.S. dollar during 1986 and 1987 is

difficult to explain by observed policy actions alone, although once anticipated policies are considered, such as an anticipated relaxation of U.S. monetary policy and tightening of Japanese and German monetary policy, the model tracks the experience reasonably well.

2. The World Economy 1978 to 1987

Table 1 shows the swings in real exchange rates from 1978 to 1987. It must be pointed out that the exchange rate data is an average of daily rates for the year in question and understates some of the major swings within years. To supplement this table we present end of period real exchange rates in Table 1a. The general trend in the data is quite clear. The U.S. dollar appreciated from mid 1980 to early 1985 against all major currencies. Since 1985 the dollar has depreciated against all major currencies. Despite the general trend there are some interesting differences between currencies. The dollar appreciated against the yen almost continually from 1979 to 1982. It then stabilized (on an annual average basis and relative to the earlier swings) from 1982 to late 1984 before depreciating substantially from 1985 to 1988. The Deutschemark on the other hand, appreciated relative to the dollar during 1979 and 1980 before a substantial depreciation from mid-1980. This depreciation then continued to 1985. The Deutschemark has followed the yen in appreciating against the dollar during 1986 and 1987.

Table 2 clearly shows the shift in current account balances over the recent decade. The U.S. economy has moved from approximate balance in 1978-79 to a large deficit in 1987. Correspondingly, Japan and Germany have moved further into surplus with the other major countries contributing very little. The overall current account balance of the OECD has remained virtually unchanged.

The dynamics of adjustment of the current account is worth examining closely. The U.S. current account balance began deteriorating in 1982 and the deterioration accelerated during 1983. Japan on the other hand began moving towards surplus from 1981, while the German surplus did not accelerate until 1984.

Table 3 shows the change in fiscal policies in each of the major regions.[1] The measure used in the table is the general government fiscal position as defined by the OECD. It therefore includes both state and local government. From this table it can be seen that the U.S.

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[1] The appropriate measure of fiscal stance would be an inflation adjusted structural fiscal deficit. We present the actual deficit because this is the relevant concept for the tracking exercise and it does provide some evidence on fiscal stance. In a full model simulation the inflation and cyclical adjustment is implicitly accounted for.

Table 1 : Real Bilateral Exchange Rates vis-a-vis $US
(average of period exchange rates)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
U.S.	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
JAPAN	1.000	0.909	0.837	0.810	0.686	0.698	0.681	0.667	0.937	1.059
GERMANY	1.000	1.048	1.016	0.776	0.708	0.669	0.590	0.565	0.769	0.922
CANADA	1.000	0.985	1.000	0.986	0.978	0.991	0.939	0.891	0.878	0.935
FRANCE	1.000	1.074	1.104	0.873	0.757	0.690	0.650	0.622	0.826	0.949
U.K.	1.000	1.163	1.402	1.232	1.083	0.952	0.841	0.832	0.960	1.086
% change from 1978										
JAPAN		-9.1	-16.3	-19.0	-31.4	-30.2	-31.9	-33.3	-6.3	5.9
GERMANY		4.8	1.6	-22.4	-29.2	-33.1	-41.0	-43.5	-23.1	-7.8
CANADA		-1.5	0.0	-1.4	-2.2	-0.9	-6.1	-10.9	-12.2	-6.5
FRANCE		7.4	10.4	-12.7	-24.3	-31.0	-35.0	-37.8	-17.4	-5.1
U.K.		16.3	40.2	23.2	8.3	-4.8	-15.9	-16.8	-4.0	8.6

Sources : OECD Economic Outlook, no. 43, Table R21.
OECD Quarterly National Accounts, no. 1, 1988, p. 166.
Relative prices defined in terms of GDP deflators.

Table 1a : Real Bilateral Exchange Rates vis-a-vis $US
(end of period exchange rates)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
U.S.	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
JAPAN	1.000	0.769	0.864	0.751	0.672	0.660	0.596	0.734	0.918	1.147
GERMANY	1.000	1.010	0.858	0.707	0.658	0.571	0.485	0.615	0.783	0.953
CANADA	1.000	1.027	1.018	1.037	1.021	1.020	0.957	0.905	0.919	0.992
FRANCE	1.000	1.053	0.957	0.765	0.685	0.584	0.526	0.685	0.821	0.989
U.K.	1.000	1.151	1.356	1.103	0.944	0.859	0.689	0.882	0.910	1.172
% change from 1978										
JAPAN		-23.1	-13.6	-24.9	-32.8	-34.0	-40.4	-26.6	-8.2	14.7
GERMANY		1.0	-14.2	-29.3	-34.2	-42.9	-51.5	-38.5	-21.7	-4.7
CANADA		2.7	1.8	3.7	2.1	2.0	-4.3	-9.5	-8.1	-0.8
FRANCE		5.3	-4.3	-23.5	-31.5	-41.6	-47.4	-31.5	-17.9	-1.1
U.K.		15.1	35.6	10.3	-5.6	-14.1	-31.1	-11.8	-9.0	17.2

Sources : OECD Economic Outlook, no. 43, Table R21.
OECD Quarterly National Accounts, no. 1, 1988, p. 166.
Relative prices defined in terms of GDP deflators.

Table 2 : Current Accounts of Major Regions (% GNP)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	change 78/79 to 1987
U.S.	-0.7	0.0	0.1	0.2	-0.3	-1.4	-2.8	-2.9	-3.3	-3.6	-3.3
JAPAN	1.7	-0.9	-1.0	0.4	0.6	1.8	2.8	3.7	4.4	3.6	3.2
GERMANY	1.4	0.7	1.7	0.5	0.8	0.8	1.6	2.6	4.2	3.9	2.9
EEC-GERMANY	–	0.0	1.1	0.8	0.5	0.0	0.3	0.2	0.4	-0.2	-0.2
CANADA	-2.0	-1.7	-0.4	-1.7	0.8	0.8	0.8	-0.2	-1.8	-1.7	0.2
Smaller OECD Countries	-0.4	-1.2	-2.6	-1.7	-1.2	-0.1	0.9	0.8	0.6	0.1	0.9
LDC's (1)	-12.7	-14.8	-16.6	-21.1	-17.3	-9.2	-5.2	-5.7	-2.5	1.1	14.9
OPEC (1)	-0.8	24.0	31.2	15.5	-3.7	-10.2	-3.6	2.0	-19.2	-1.5	-13.1
Total OECD	0.2	-0.3	-0.8	-0.3	-0.3	-0.3	-0.7	-0.6	-0.2	-0.4	-0.4

Sources : OECD Economic Outlook, no. 43, Tables 30 and R20.
World Economic Outlook, April 1988 and April 1986, Table A35.
Main Economic Indicators, Gross Domestic Product at current prices.

(1) expressed as percent of exports.

Table 3 : General Government Financial Balances (% GNP)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	change 78/79 to 1987
U.S.	0.0	0.5	-1.3	-1.0	-3.5	-3.8	-2.8	-3.3	-3.5	-2.4	-2.4
JAPAN	-5.5	-4.7	-4.4	-3.8	-3.6	-3.7	-2.1	-0.8	-1.1	-0.2	5.3
GERMANY	-2.4	-2.5	-2.9	-3.7	-3.3	-2.5	-1.9	-1.1	-1.2	-1.7	0.7
CANADA	-3.1	-2.0	-2.8	-1.5	-5.9	-6.9	-6.6	-7.0	-5.5	-4.6	-1.5
FRANCE	-1.9	-0.7	0.0	-1.9	-2.8	-3.2	-2.7	-2.9	-2.9	-2.3	-0.4
U.K.	-4.2	-3.3	-3.5	-2.8	-2.5	-3.4	-3.9	-2.9	-2.7	-1.4	2.8
Smaller OECD Countries	-2.3	-2.7	-2.9	-4.3	-4.8	-5.1	-4.1	-4.0	-3.4	-2.6	-0.3
Total OECD	-2.3	-1.9	-2.5	-2.8	-4.1	-4.2	-3.5	-3.4	-3.4	-2.5	-0.2

Source : OECD Economic Outlook, no. 43, Tables 9 and R13.

fiscal deficit increased in two distinct stages. The first in 1980 and 1981 and the second, more dramatic, from 1982 to 1987. The first is primarily due to a slowing U.S. economy while the second period is due to a change in the stance of fiscal policy as well as a recession. This is discussed in more detail below where the fiscal policy announcements are discussed. As shown later, the first period of rising fiscal deficits was forecast by the OECD while the second was not.

In contrast, the Japanese fiscal deficit fell continually from 5.5 percent of GNP in 1978 to 0.2 percent of GNP in 1987. Germany on the other hand experienced an increasing deficit to 1981 which peaked at 3.7 percent of GNP. The German deficit then declined from 1982 onwards to 1.7 percent of GNP in 1987.

Table 4 gives an overall summary of the main features we are attempting to explain. The table contains results for the U.S., Japan and West Germany for output, inflation, short and long nominal interest rates, trade balances, fiscal deficits and real and nominal exchange rates for the period 1978 to 1987. The general trends in the data are clear from this table: slowing world inflation, a rise in world interest rates to 1981 and subsequent falling, a growing U.S. trade deficit and Japanese and German trade surpluses, a large real appreciation then depreciation of the U.S. dollar and divergent real growth relative to trend, with the U.S. contracting until 1983 and then growing strongly and Germany and Japan consistently growing below trend.

In undertaking the tracking exercise in a forward looking model such as the MSG2 model we have to make assumptions about the expected future stance of exogenous policy. The problem of dealing with expected policy is dealt with simply in this paper. There are various sources of information available on fiscal deficits such as the Congressional Budget Office forecasts and Administration forecasts for the U.S. or OECD forecasts for a broader range of countries. The OECD forecasts are the most convenient to use, both because of coverage and availability. The procedure followed here is to use the two-year forecasts for fiscal deficits contained in the "OECD Economic Outlook". Past the two-year period we assume that the deficit is unchanged as a percent of GNP from the last forecast (except where noted for the Gramm-Rudman simulation).

Table 5 contains the budget deficit forecasts for the U.S., Japan and Germany given by the OECD since 1979. This table is constructed using the December Economic Outlook for each year. The first column of the table gives the year that the forecast was published. For each country there are two columns. The first column gives the expected fiscal outcome for the year of the forecast as well as the following year. The second column gives the actual outcome. For example, in 1980 the forecast for the U.S. deficit was 1 percent of GNP in 1980 and 0.6

Table 4 : Macroeconomic Experience of the Group of Three, 1978-87

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
United States										
GNP growth	5.3	2.5	-0.2	1.9	-2.5	3.6	6.8	3.0	2.9	2.9
Output Gap (trend=2.5)	0.0	0.0	-2.7	-3.3	-8.3	-7.2	-2.9	-2.4	-2.0	-1.6
Inflation	7.7	11.2	13.5	10.4	6.1	3.2	4.3	3.5	1.9	3.7
Long nominal interest rate	8.4	9.5	11.5	14.0	13.0	11.1	12.5	10.6	7.7	8.4
Short nominal interest rate	7.2	10.1	11.6	14.1	10.7	8.6	9.6	7.5	6.0	5.8
Trade balance (1)	-1.3	-1.0	-0.9	-0.9	-1.4	-2.1	-3.3	-3.5	-3.9	-3.8
Fiscal deficit (1)	0.0	-0.6	1.3	1.0	3.5	3.8	2.8	3.3	3.5	2.4
Japan										
GNP growth	5.2	5.3	4.3	3.7	3.1	3.2	5.1	4.9	2.4	4.2
Output gap (trend=4.2)	-1.1	.0	0.1	-0.4	-1.5	-2.5	-1.6	-0.9	-2.7	-2.7
Inflation	3.8	3.6	8.0	4.9	2.7	0.9	2.2	2.1	0.4	-0.2
Long nominal interest rate	6.4	7.7	9.2	8.7	8.1	7.4	6.8	6.3	4.9	4.2
Short nominal interest rate	4.3	5.9	10.9	7.4	6.9	6.4	6.1	6.5	4.8	3.5
Trade balance (1)	1.9	-0.6	-1.1	1.0	0.7	1.8	2.7	3.4	4.2	3.4
Fiscal deficit (1)	5.5	4.8	4.4	3.8	3.4	3.5	2.1	0.8	0.9	1.2
Real exchange rate (2)	0.0	-9.1	-16.3	-19.0	-31.4	-30.2	-31.9	-33.3	-6.3	5.9
Nominal exchange rate (2)	0.0	-4.0	-7.2	-4.6	-15.5	-11.4	-11.4	-11.8	24.9	31.3
Germany, Fed. Rep. of										
GNP growth	3.3	4.0	1.5	0.0	-1.0	1.9	3.3	2.0	2.5	1.7
Output gap (trend=2.5)	-1.5	0.0	-1.0	-3.5	-7.0	-7.6	-6.8	-7.3	-7.3	-8.1
Inflation	2.7	4.2	5.4	6.3	5.3	3.3	2.4	2.2	-0.2	0.2
Long nominal interest rate	6.4	7.4	8.5	10.4	9.0	7.9	7.8	6.9	5.9	5.8
Short nominal interest rate	3.7	5.6	7.8	10.6	8.0	5.6	5.6	5.0	3.9	3.3
Trade balance (1)	3.2	1.6	0.6	1.8	3.2	2.5	3.1	4.0	5.8	5.8
Fiscal Deficit (1)	2.4	2.7	2.9	3.7	3.2	2.5	1.9	1.1	1.2	1.7
Real exchange rate (2)	0.0	4.8	1.6	-22.4	-29.2	-33.1	-41.0	-43.5	-23.1	-7.8
Nominal exchange rate (2)	0.0	9.6	10.5	-11.1	-17.2	-21.3	-29.4	-31.8	-7.5	10.5

Note: Nominal exchange rates in terms of US dollars per domestic currency; real exchange rates in terms of GDP deflators; exchange rates are expressed as percentage change from 1978.
(1) Percent of GDP
(2) Average of period

Source: OECD Economic Outlook (various issues)

Table 5 : Forecasts For General Government Budget Deficits (% GNP)

		U.S.		Japan		Germany	
		Expected	Actual	Expected	Actual	Expected	Actual
December '79							
	1979	0.4	-0.6	-4.9	-4.8	-3.1	-2.7
	1980	-0.8		-4.7		-3.0	
December '80							
	1980	-1.0	-1.3	-4.5	-4.4	-3.3	-2.9
	1981	-0.6		-3.7		-3.5	
December '81							
	1981	-0.7	-1.0	-3.6	-3.8	-4.4	-3.7
	1982	-1.3		-2.0		-4.0	
December '82							
	1982	-3.7	-3.5	-3.4	-3.6	-4.1	-3.3
	1983	-4.4		-3.3		-4.1	
December '83							
	1983	-3.8	-3.8	-3.4	-3.7	-3.1	-2.5
	1984	-3.7		-2.5		-2.5	
December '84							
	1984	-3.2	-2.8	-2.2	-2.1	-1.7	-1.9
	1985	-3.6		-0.8		-0.9	
December '85							
	1985	-3.9	-3.3	-1.7	-0.8	-1.2	-1.1
	1986	-4.0		-1.1		-0.9	
December '86							
	1986	-3.4	-3.4	-1.5	-1.1	-1.0	-1.3
	1987	-2.3		-1.4		-0.9	
December '87							
	1987	-2.4	-2.3	-1.7	-0.3	-1.7	-1.7
	1988	-2.4		-1.1		-2.3	
December '88							
	1988	-1.7	-1.7	-0.2	-0.2	-2.0	-2.0
	1989	-1.5		-0.2		-1.2	

Source: Each forecast is from the indicated year of the OECD Economic Outlook.
The actual values used are from the OECD Economic Outlook December 1988.

percent of GNP in 1981. The actual outcome for 1980 was a deficit of 1.3 percent of GNP and for 1981 was a deficit of 1.0 percent of GNP.

It can be seen that the rise in the U.S. deficit in 1980 was a little larger than forecast in 1979. The deficit in 1982 was a large surprise from the point of view of 1981; the forecast being 1.3 percent of GNP and the outcome 3.5 percent of GNP. The actual outcomes from 1983 to 1986 were less expansionary than forecast in each year. In the case of Japan, the gradual decline in deficits was forecast one year ahead, although the forecast deficit tended to be smaller than the outcome between 1980 and 1983 and larger than the outcome between 1984 and 1987; Japanese deficits fell slightly more slowly than forecast in the earlier period and faster than forecast in the later period. The opposite pattern emerges for Germany. From 1980 to 1984, the projected deficit was well above the actual outcome. For example in 1981 the deficit for 1982 was forecast to be 4 percent of GNP and the actual outcome was 3.3 percent. Similarly in 1982 the deficit for 1983 was forecast to be 4.1 percent of GNP while the actual outcome for 1983 was 2.5 percent of GNP. This suggests that either German fiscal policy was surprisingly tight or the economy grew surprisingly fast in these years. Since 1985, the forecast deficit has been smaller than the outcome.

Table 6 gives a very rough guide to the general setting of policy as discussed in the OECD Economic Outlook corresponding to the relevant year. Obviously, this table is very subjective but it does give some guidance as to the interpretation of policy stance at the time as well as expected policy changes. For example, in 1980 there was discussion of fiscal cuts in Japan as well as discussion of possible U.S. tax cuts from 1981. Monetary policy was described as easing in major countries except the U.S. which was following a tight monetary policy (however interpreted).

The discussion of policy stance and direction of fiscal forecasts give some guidance to the assumed expectations used in the tracking exercise in section 5.

3. The MSG2 Model

The MSG2 model can be described as a dynamic general equilibrium model of a multi-region world economy. In the present paper the regions modelled are the United States, Japan, Germany, the rest of the EMS (denoted REMS), the rest of the OECD economies (denoted ROECD), non-oil developing countries (LDCs), and the Oil Exporting Countries (OPEC). The model is of moderate size (about three dozen behavioral equations per industrial region). It is distinctive relative to most other global models in that it solves for a full intertemporal equilibrium in which agents have rational expectations of future variables. In theoretical conception, therefore, the model is close in

Table 6 : Summary of OECD Description of Policy Stance In Major Countries

Year	Country	Monetary Policy	Fiscal Policy
1979	U.S.	tight	
	Germany	tight	spending cuts
	Japan	stable	spending cuts
1980	U.S.	tight	tax cuts possible in 1981
	Germany	easing	
	Japan	easing	spending cuts
1981	U.S.	very tight	tax cuts announced to be implemented 8/81, 7/82 and 7/83
	Germany	very tight	spending cuts
	Japan	very tight	spending cuts
1982	U.S.	eased	loose
	Germany	eased	spending cuts
	Japan	tight	spendingcuts
1983	U.S.	stable	concern over large deficit
	Germany	stable	spending cuts
	Japan	stable	spending cuts
1984	U.S.	stable	loose
	Germany	stable	spending cuts
	Japan	stable	spending cuts
1985	U.S.	loose	Gramm-Rudman adopted in 8/85
	Germany	tight	tax cuts announced for 1/86
	Japan	tight	spending cuts
1986	U.S.	loose	deficit improves
	Germany	easing	stable
	Japan	easing	stable
1987	U.S.	stable	Gramm-Rudman reinforced
	Germany	stable	tax cuts announced
	Japan	stable	spending expansion

design to intertemporal dynamic models of fiscal policy in Lipton and Sachs (1983) and Frenkel and Razin (1988). Those studies, like the present model, examine fiscal policy in an intertemporal perfect-foresight environment, with considerable attention given to intertemporal optimization and intertemporal budget constraints.

The MSG2 model relies heavily on the assumption that economic agents maximize intertemporal objective functions. This idea is very similar to the class of models known as Computable General Equilibrium (CGE) models[2] except that the concepts of time and dynamics are of fundamental importance in the MSG2 model. The various rigidities that are apparent in macroeconomic data are taken into account by allowing for deviations from the fully optimizing behavior. As with any modelling project that purports to describe reality, the tradeoff between theoretical rigor and empirical regularities is unavoidable.

The model has a mix of Keynesian and Classical properties by virtue of a maintained assumption of slow adjustment of nominal wages in the labor markets of the U.S., Germany, the REMS and the ROECD (Japan is treated somewhat differently, as described below).

The model is solved in a linearized form, to facilitate policy optimization exercises with the model, and especially to use linear-quadratic dynamic game theory and dynamic programming solution techniques[3]. We have experimented with the full non-linear model and found that the properties of this model correspond closely to those of the linearized model, particularly over the initial years of any shocks. The global stability of the linearized model can be readily confirmed by an analysis of the model's eigenvalues.

In fitting the model to macroeconomic data we adopt a mix of standard CGE calibration techniques and econometric time series results. In CGE models, the parameters of production and consumption decisions are determined by assuming a particular functional form for utility functions and production functions and by assuming that the data from an expenditure share matrix or an input-output table represent an equilibrium of the model. For example, if utility is assumed to be a Cobb-Douglas nesting of the consumption of different goods, then the parameters of the utility function and therefore the demand functions

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[2] Such models are the basis of the work by Dixon et.al. (1982), Whalley (1985) and Deardoff and Stern (1986).

[3] In general, quantity variables are linearized around their levels relative to potential GDP, while price variables are linearized in log form.

for different goods are given by the expenditure shares found in the data. In this example, the demand function for each good in the system will have price and income elasticities of unity. In most cases the data will determine the parameters of the model although in some cases additional econometric analysis is required. The question of calibrating the model is discussed further in McKibbin and Sachs (1988b).

The model has several attractive features which are worth highlighting. First, all stock-flow relationships are carefully observed. Budget deficits cumulate into stocks of public debt; current account deficits cumulate into net foreign investment positions; and physical investment cumulates into the capital stock. Underlying growth of Harrod-neutral productivity plus labor force growth is assumed to be 3 percent per region. Given the long-run properties of the model, the world economy settles down to the 3 percent steady-state growth path following any set of initial disturbances.

A second attractive feature is that the asset markets are efficient in the sense that asset prices are determined by a combination of intertemporal arbitrage conditions and rational expectations. By virtue of the rational expectations assumption and the partly forward-looking behavior of households and firms, the model can be used to examine the effects of anticipated future policy changes, such as the sequence of future budget deficit cuts called for by the Gramm-Rudman legislation in the U.S. Indeed, one of the difficulties of using the MSG2 model is that every simulation requires that the "entire" future sequence of anticipated policies be specified. In practice, forty year paths of policy variables, or endogenous policy rules, must be specified.

A third attractive feature of the model is the specification of the supply side. There are several noteworthy points here. First, factor input decisions are partly based on intertemporal profit maximization by firms. Labor and intermediate inputs are selected to maximize short-run profits given a stock of capital which is fixed within each period. The capital stock is adjusted according to a "Tobin's q" model of investment, derived along the lines in Hayashi (1979). Tobin's q is the shadow value of capital, and evolves according to a rational expectations forecast of future post-tax profitability.

Another point of interest regarding the supply side is the specification of the wage-price dynamics in each of the industrial regions. Extensive macroeconomic research has demonstrated important differences in the wage-price processes in the U.S., Europe, and Japan, and these differences are incorporated in the model. In particular, the U.S. and the ROECD (including Canada) are characterized by nominal wage rigidities arising from long-term nominal wage contracts based on the work of Taylor (1980). In Japan, on the contrary, nominal wages

are assumed to be renegotiated on an annual, synchronized cycle, with nominal wages selected for the following year to clear the labor market on average. In the ROECD, nominal wages are assumed to be more forward looking than in the U.S., though real wages adjust slowly to clear the labour market. In Germany and the REMS we assume a form of "hysteresis" where a rise in unemployment leads to a rise in the natural rate of unemployment which persists for a substantial period of time.

Consumption is determined partly by wealth and partly by current disposable income where wealth includes human wealth which is defined as the present value of expected future after-tax labor income. This approach is consistent with the empirical evidence in Hayashi (1982) and Campbell and Mankiw (1987).

A more detailed derivation of the model can be found in McKibbin and Sachs (1988b).

4. Simulation Properties

This section presents policy multipliers for fiscal and monetary policies in the U.S., Japan, and Germany.[4] It examines both unanticipated and anticipated policy changes. As with any policy change in a rational expectations model, we must be careful to specify precisely the entire future path of policies.

i. Fiscal Policy Transmission

In this section we examine the effects of fiscal expansions in the U.S., Japan and Germany. In implementing a change in fiscal policy, it is important that tax and spending policies in any country be consistent with the intertemporal budget constraint facing each government. The actual policy change is a permanent increase in the level of government expenditure with taxes only rising due to endogenous changes in tax receipts resulting from changes in economic activity. Over time, taxes on labour income are also assumed to rise to cover the increasing interest burden of a rising stock of public debt. The overall fiscal deficit remains permanently higher although the primary fiscal spending (defined as spending net of interest repayments minus total taxes) eventually turns to a surplus to prevent the explosive growth of government debt.

We examine two alternative fiscal expansions. The first is a permanent

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[4] More detailed results for a wider range of shocks can be found in McKibbin and Sachs (1988b).

increase of 1 percent of GNP in the level of government expenditure. The second is an announced gradual expansion of fiscal spending equal to one percent of GNP in the first year, two percent of GNP in the second and then permanently 3 percent of GNP from the third year onwards. The announced policy is assumed to be perfectly credible to the private sector.

Table 7 contains the results for the case of a permanent 1 percent of GNP increase in real government expenditure in the U.S.. All variables are expressed as deviations from an initial baseline. GDP is recorded as a percentage deviation from the initial baseline (e.g. 0.56 percent of GDP in year 1). The budget deficit and the trade balance are reported as deviations from baseline in percent of potential GDP. Thus, in year 1, the fiscal deficit rises relative to the baseline by 0.79 of one percent of U.S. potential GDP. Inflation and interest rates are reported as deviations in percentage points relative to the baseline (rather than as deviations as a percent of their baseline values). Thus, inflation is seen to fall by 0.11 percentage points in year 1, while short-term interest rates increase by 1.17 percentage points (i.e. 117 basis points). The four U.S. bilateral exchange rates are reported as a percentage change from baseline values. Note that a negative value for the exchange rates indicates an appreciation of the U.S. dollar.

Now, let us consider the simulation results for the U.S. fiscal expansion. What should we expect from theory? From the Mundell-Fleming model, we should expect that a bond-financed fiscal expansion in the presence of perfect substitutability of home and foreign financial assets should result in a rise in domestic income and an appreciation of the U.S. dollar exchange rate. Indeed, GDP rises by 0.56 percentage points in the first year, while the dollar appreciates by 5.0 percent vis-a-vis the yen, 4.5 percent vis-a-vis the Deutschemark and the REMS currency (called ems) and 4.0 percent vis-a-vis the ROECD currency (called roec). The rise in output and the appreciation of the dollar produces a large trade deficit in the U.S., equal to 0.39 percent of GDP in the first year of the fiscal expansion. Note that there is some slight crowding out of private investment and private consumption in the U.S.. The rise in real interest rates dominate the effects of a stronger economy. The effect on consumption is ambiguous as the forward looking component falls due to higher interest rates while the proportion driven by current disposable income rises. The effect on investment is also ambiguous. The share market falls because the higher real interest rate dominates the effect of higher output on the valuation of future profitability.

Importantly, the Mundell-Fleming model teaches that the transmission effect of a U.S. fiscal policy expansion on foreign output is ambiguous, for the reasons already alluded to. On the one hand, world interest rates rise, which tends to depress foreign income. On the other hand, U.S. demand for foreign products rises, which tends to raise foreign

Table 7 : Sustained 1% GNP U.S. Fiscal Expansion
(Deviation from Baseline)

		1	2	3	4	5
U.S. Economy						
GDP	%Y	0.56	0.43	0.30	0.17	0.06
Trade Balance	%Y	-0.39	-0.35	-0.34	-0.33	-0.33
Budget deficit	%Y	0.79	0.83	0.86	0.90	0.94
Inflation	D	-0.11	0.03	0.10	0.14	0.15
Nom Int Rate (short)	D	1.17	1.11	1.10	1.14	1.21
Nom Int Rate (long)	D	1.31	1.32	1.34	1.35	1.37
Japanese Economy						
GDP	%Y	0.18	0.01	-0.01	-0.03	-0.05
Trade Balance	%Y	0.43	0.32	0.28	0.27	0.26
Budget deficit	%Y	-0.03	0.03	0.03	0.04	0.05
Inflation	D	0.27	0.43	0.11	0.08	0.07
Nom Int Rate (short)	D	0.44	0.89	1.02	1.10	1.16
Nom Int Rate (long)	D	1.13	1.19	1.21	1.23	1.24
Exch Rate $/yen	%	-4.99	-4.26	-4.05	-3.96	-3.92
Real Exch Rate	%	-4.85	-3.75	-3.55	-3.54	-3.58
German Economy						
GDP	%Y	0.21	0.13	0.02	-0.07	-0.14
Trade Balance	%Y	0.37	0.30	0.25	0.22	0.19
Budget deficit	%Y	-0.05	-0.02	0.02	0.04	0.07
Inflation	D	0.26	0.25	0.19	0.14	0.12
Nom Int Rate (short)	D	0.56	0.81	0.94	1.02	1.10
Nom Int Rate (long)	D	1.11	1.16	1.18	1.20	1.22
Exch Rate $/dm	%	-4.45	-3.83	-3.54	-3.37	-3.25
Real Exch Rate	%	-4.29	-3.51	-3.15	-2.98	-2.90
REMS Economies						
GDP	%Y	0.29	0.18	0.06	-0.03	-0.10
Trade Balance	%Y	0.36	0.30	0.25	0.22	0.20
Budget deficit	%Y	-0.05	-0.01	0.02	0.05	0.08
Inflation	D	0.31	0.27	0.20	0.15	0.12
Nom Int Rate (short)	D	0.56	0.81	0.94	1.02	1.10
Nom Int Rate (long)	D	1.11	1.16	1.18	1.20	1.22
Exch Rate $/ems	%	-4.45	-3.83	-3.54	-3.37	-3.25
Real Exch Rate	%	-4.28	-3.47	-3.10	-2.93	-2.84
ROECD Economies						
GDP	%Y	0.17	0.09	-0.01	-0.09	-0.15
Trade Balance	%Y	0.40	0.31	0.26	0.24	0.22
Budget deficit	%Y	-0.04	-0.02	0.01	0.03	0.05
Inflation	D	0.24	0.22	0.17	0.13	0.10
Nom Int Rate (short)	D	0.50	0.78	0.92	1.01	1.09
Nom Int Rate (long)	D	1.11	1.16	1.19	1.22	1.23
Exch Rate $/roe	%	-4.03	-3.35	-3.03	-2.84	-2.71
Real Exch Rate	%	-3.91	-3.06	-2.67	-2.50	-2.42

income through a spurt in exports. As described in Bruno and Sachs (1985, chapter 6), and in Oudiz and Sachs (1984), the transmission is more likely to be negative if foreign wages and prices rise rapidly in response to the depreciation of the foreign currencies vis-a-vis the dollar following the U.S. fiscal action. If foreign wages and prices are fixed, then the U.S. fiscal expansion will tend to be positively transmitted.

As can be seen from Table 7, the effect of the permanent fiscal expansion is positive transmission to each region. The positive transmission is almost dissipated after the first year in Japan although output in other regions stays above baseline for a number of years. Wages adjust slowly in Europe whereas they adjust very quickly in Japan. As is evident from the table, the negative effects on foreign consumption and investment resulting from higher interest rates start to dominate the expansionary effects of greater exports to the U.S. as soon as the second year for Japan. Note that inflation is increased throughout the world following the U.S. fiscal expansion. Most of the inflationary effect abroad arises because the foreign currencies depreciate against the dollar after the U.S. fiscal expansion.

Tables 8 and 9 show the effects of permanent fiscal expansions in Japan and Germany, respectively. Note the following important point. The Japanese and German fiscal expansions have almost no effect on U.S. GDP, as a result of the fact that these economies are considerably smaller than the U.S. A one percent of GDP Japanese bond-financed fiscal expansion is seen to appreciate the yen by 6.65 percent, and to worsen the Japanese trade balance by about 0.84 percent of Japanese GDP. Overall, the call for a Japanese fiscal expansion can be seen to have very mixed merit. U.S. output is unlikely to change much, and could even decline in response to a Japanese expansion. The U.S. trade balance would improve by only 0.09 percent of U.S. GDP (less than $4 billion) for each increase in Japanese government spending of 1 percent of GDP. On the other hand, the Japanese trade surplus would fall substantially with an increase in Japanese public spending. For Germany, these remarks hold even more strongly. Germany (without the REMS) is simply too small to have any major effect on the rest of the industrial economies.

Table 10 shows the same experiment for an announced gradual increase in fiscal expenditure in the U.S.. The experiment is a rise in fiscal expenditure of 1 percent of GDP in year 1, 2 percent of GDP in year 2 and 3 percent of GNP from year 3 onwards. Since this simulation involves an anticipated sequence of future deficit increases in the U.S., the forward-looking properties of the assets markets in the MSG2 model

Table 8 : Sustained 1% GNP Japanese Fiscal Expansion
(Deviation from Baseline)

		1	2	3	4	5
U.S. Economy						
GDP	%Y	-0.01	-0.05	-0.11	-0.15	-0.18
Trade Balance	%Y	0.09	0.08	0.07	0.07	0.07
Budget deficit	%Y	0.02	0.04	0.06	0.07	0.08
Inflation	D	0.19	0.20	0.16	0.11	0.07
Nom Int Rate (short)	D	0.10	0.26	0.40	0.50	0.56
Nom Int Rate (long)	D	0.49	0.52	0.54	0.55	0.56
Japanese Economy						
GDP	%Y	0.34	-0.01	-0.03	-0.05	-0.06
Trade Balance	%Y	-0.84	-0.77	-0.70	-0.66	-0.64
Budget deficit	%Y	0.82	0.93	0.94	0.94	0.95
Inflation	D	-0.28	0.27	-0.02	0.03	0.04
Nom Int Rate (short)	D	0.82	0.74	0.64	0.64	0.66
Nom Int Rate (long)	D	0.70	0.70	0.69	0.70	0.70
Exch Rate $/yen	%	6.65	5.93	5.46	5.21	5.07
Real Exch Rate	%	6.46	5.86	5.22	4.88	4.70
German Economy						
GDP	%Y	-0.01	-0.06	-0.10	-0.13	-0.16
Trade Balance	%Y	0.09	0.06	0.05	0.04	0.03
Budget deficit	%Y	0.01	0.03	0.04	0.05	0.06
Inflation	D	0.18	0.14	0.11	0.09	0.07
Nom Int Rate (short)	D	0.07	0.20	0.34	0.44	0.51
Nom Int Rate (long)	D	0.46	0.50	0.52	0.53	0.54
Exch Rate $/dm	%	0.08	0.11	0.17	0.24	0.29
Real Exch Rate	%	0.06	0.05	0.08	0.13	0.20
REMS Economies						
GDP	%Y	-0.05	-0.09	-0.11	-0.14	-0.18
Trade Balance	%Y	0.09	0.07	0.05	0.04	0.03
Budget deficit	%Y	0.02	0.04	0.04	0.05	0.06
Inflation	D	0.16	0.14	0.11	0.09	0.07
Nom Int Rate (short)	D	0.07	0.20	0.34	0.44	0.51
Nom Int Rate (long)	D	0.46	0.50	0.52	0.53	0.54
Exch Rate $/ems	%	0.08	0.11	0.17	0.24	0.29
Real Exch Rate	%	0.06	0.05	0.08	0.13	0.19
ROECD Economies						
GDP	%Y	-0.03	-0.06	-0.09	-0.11	-0.13
Trade Balance	%Y	0.09	0.08	0.09	0.08	0.08
Budget deficit	%Y	0.01	0.02	0.03	0.04	0.05
Inflation	D	0.13	0.12	0.10	0.08	0.06
Nom Int Rate (short)	D	0.09	0.22	0.35	0.45	0.52
Nom Int Rate (long)	D	0.47	0.50	0.53	0.54	0.55
Exch Rate $/roe	%	0.30	0.31	0.36	0.41	0.46
Real Exch Rate	%	0.28	0.24	0.24	0.27	0.31

Table 9 : Sustained 1% GNP German Fiscal Expansion
(Deviation from Baseline)

		1	2	3	4	5
U.S. Economy						
GDP	%Y	-0.00	-0.03	-0.05	-0.07	-0.08
Trade Balance	%Y	0.07	0.06	0.05	0.05	0.05
Budget deficit	%Y	0.01	0.02	0.02	0.03	0.03
Inflation	D	0.12	0.09	0.06	0.03	0.02
Nom Int Rate (short)	D	0.11	0.19	0.24	0.20	0.28
Nom Int Rate (long)	D	0.25	0.26	0.26	0.27	0.27
Japanese Economy						
GDP	%Y	0.01	-0.02	-0.02	-0.02	-0.03
Trade Balance	%Y	0.07	0.06	0.05	0.05	0.04
Budget deficit	%Y	0.01	0.01	0.01	0.02	0.02
Inflation	D	0.10	0.08	0.02	0.02	0.01
Nom Int Rate (short)	D	0.10	0.18	0.22	0.25	0.27
Nom Int Rate (long)	D	0.24	0.25	0.25	0.25	0.26
Exch Rate $/yen	%	-0.11	-0.09	-0.08	-0.07	-0.06
Real Exch Rate	%	-0.12	-0.10	-0.13	-0.13	-0.12
German Economy						
GDP	%Y	0.22	0.23	0.26	0.28	0.29
Trade Balance	%Y	-0.87	-0.77	-0.71	-0.68	-0.66
Budget deficit	%Y	0.89	0.89	0.88	0.87	0.87
Inflation	D	-0.21	-0.14	-0.06	-0.02	0.00
Nom Int Rate (short)	D	0.60	0.41	0.35	0.32	0.32
Nom Int Rate (long)	D	0.35	0.33	0.33	0.33	0.33
Exch Rate $/dm	%	3.00	2.52	2.29	2.19	2.13
Real Exch Rate	%	2.93	2.24	1.89	1.72	1.64
REMS Economies						
GDP	%Y	-0.63	-0.33	-0.23	-0.20	-0.20
Trade Balance	%Y	-0.12	0.01	0.06	0.07	0.07
Budget deficit	%Y	0.19	0.11	0.08	0.07	0.07
Inflation	D	-0.64	-0.26	-0.07	0.00	0.03
Nom Int Rate (short)	D	0.60	0.41	0.35	0.32	0.32
Nom Int Rate (long)	D	0.35	0.33	0.33	0.33	0.33
Exch Rate $/ems	%	3.00	2.52	2.29	2.19	2.13
Real Exch Rate	%	2.45	1.53	1.16	1.01	0.96
ROECD Economies						
GDP	%Y	0.15	0.03	0.00	-0.00	-0.00
Trade Balance	%Y	0.09	0.05	0.03	0.03	0.03
Budget deficit	%Y	-0.03	0.00	0.01	0.01	0.01
Inflation	D	0.21	0.04	0.00	0.00	0.00
Nom Int Rate (short)	D	0.28	0.26	0.26	0.27	0.28
Nom Int Rate (long)	D	0.27	0.27	0.28	0.28	0.28
Exch Rate $/roe	%	0.94	0.77	0.70	0.67	0.66
Real Exch Rate	%	0.91	0.76	0.65	0.60	0.58

Table 10 : Anticipated U.S. Fiscal Expansion (3% of GNP over 3 years)
(Deviation from Baseline)

		1	2	3	4	5
U.S. Economy						
GDP	%Y	-0.53	0.66	1.66	1.06	0.54
Trade Balance	%Y	-0.58	-0.79	-1.03	-1.00	-0.98
Budget deficit	%Y	1.12	1.71	2.36	2.54	2.70
Inflation	D	-1.11	-0.43	0.59	0.69	0.68
Nom Int Rate (short)	D	-2.05	-0.28	2.74	3.03	3.36
Nom Int Rate (long)	D	3.22	3.64	3.96	4.05	4.14
Japanese Economy						
GDP	%Y	-0.23	-0.00	-0.04	-0.08	-0.14
Trade Balance	%Y	0.82	0.93	0.91	0.85	0.81
Budget deficit	%Y	0.13	0.07	0.09	0.12	0.14
Inflation	D	0.18	0.55	1.24	0.41	0.33
Nom Int Rate (short)	D	-0.69	0.48	2.42	2.92	3.28
Nom Int Rate (long)	D	3.06	3.36	3.59	3.68	3.74
Exch Rate $/yen	%	-10.24	-11.61	-12.37	-12.05	-11.94
Real Exch Rate	%	-9.38	-9.98	-10.23	-10.27	-10.57
German Economy						
GDP	%Y	-0.27	-0.03	0.20	-0.14	-0.43
Trade Balance	%Y	0.78	0.88	0.85	0.73	0.64
Budget deficit	%Y	0.13	0.07	0.00	0.11	0.21
Inflation	D	0.11	0.46	0.86	0.70	0.55
Nom Int Rate (short)	D	-0.75	0.29	2.00	2.57	3.00
Nom Int Rate (long)	D	2.94	3.24	3.48	3.59	3.67
Exch Rate $/dm	%	-9.32	-10.62	-11.19	-10.45	-9.99
Real Exch Rate	%	-8.51	-9.12	-9.58	-8.89	-8.60
REMS Economies						
GDP	%Y	-0.18	0.02	0.30	-0.05	-0.33
Trade Balance	%Y	0.89	0.98	0.88	0.76	0.66
Budget deficit	%Y	0.15	0.11	0.03	0.14	0.23
Inflation	D	0.21	0.52	0.92	0.74	0.58
Nom Int Rate (short)	D	-0.75	0.29	2.00	2.57	3.00
Nom Int Rate (long)	D	2.94	3.24	3.48	3.59	3.67
Exch Rate $/ems	%	-9.32	-10.62	-11.19	-10.45	-9.99
Real Exch Rate	%	-8.52	-9.09	-9.48	-8.75	-8.43
ROECD Economies						
GDP	%Y	-0.38	-0.06	0.19	-0.12	-0.36
Trade Balance	%Y	0.66	0.80	0.88	0.77	0.71
Budget deficit	%Y	0.13	0.03	-0.04	0.05	0.13
Inflation	D	-0.02	0.37	0.81	0.64	0.50
Nom Int Rate (short)	D	-0.89	0.19	1.89	2.51	2.97
Nom Int Rate (long)	D	2.94	3.25	3.50	3.62	3.71
Exch Rate $/roe	%	-8.12	-9.28	-9.75	-8.90	-8.38
Real Exch Rate	%	-7.38	-7.95	-8.35	-7.57	-7.24

are important in the analysis.[5] The policy announcement leads to a rise in long interest rates and a fall in short interest rates. The U.S. dollar appreciates against the other major currencies which leads to a fall in U.S. exports. The long interest rate rise leads to a fall in domestic demand which together with the fall in exports, lowers GDP in the first year. Over time as the spending increases take effect GDP rises until the fourth year when conventional crowding out begins to take hold. Interpreted in terms of the Gramm-Rudman package, the announcement of the future fiscal cuts raises output currently, mainly by reducing long-term real interest rates and depreciating the dollar upon the announcement of the policy. Later on, as the fiscal deficits are actually cut, then the negative demand effects on the economy of the fiscal contraction show up in reduced output and employment.

The anticipated fiscal expansion is now negatively transmitted to each region through large rises in long real interest rates throughout the world.

ii. Monetary Policy Transmission

In this section we examine the consequences of a sustained monetary expansion. Both a one-off increase in the rate of growth of money (i.e. a rise in the level of money balances) and a permanent increase in the anticipated rate of growth of money are examined.

As with fiscal policy, the international transmission of monetary policy has a theoretically ambiguous sign. A domestic monetary expansion tends to depreciate the home exchange rate and to reduce world real interest rates. The exchange rate depreciation shifts demand away from other countries and towards the home country, while the reduction in world real interest rates tends to raise demand in the rest of the world. In the simple Mundell-Fleming model, in which output prices and nominal wages are fixed in the other countries, the exchange rate effect dominates, so that foreign output falls when the home country increases the money supply. Home monetary expansion is then beggar-thy-neighbour. In more elaborate models with wage price dynamics, either the exchange rate channel or the interest rate channel might dominate.

Monetary policy is also ambiguous with respect to the effect on the domestic trade and current account balances. Higher domestic money improves international competitiveness by depreciating the home exchange rate. Assuming that the standard Marshall-Lerner conditions hold (as they do in the MSG2 model), this effect tends to improve the

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[5] Given the linearity of the model, by reversing the signs of the results this can be interpreted as the result of a credible Gramm-Rudman deficit reduction package.

trade balance and current account. On the other hand, the fall in interest rates tends to raise investment demand and to lower savings, thereby worsening the trade and current account balances. The overall effect is ambiguous.

Finally, note the magnitude of the effect of a monetary expansion on the nominal exchange rate. It is well known from the Dornbusch (1976) model that the exchange rate will depreciate upon a permanent, once-and-for-all increase in the money supply, but that the size of the impact depreciation may exceed ("overshoot") or fall below ("undershoot") the long-run change in the nominal rate, which just equals the proportionate change in the money stock. If the effect of the exchange rate on domestic demand is large (through the effect on the trade balance), and if the effect of domestic demand on money demand is large (through the income elasticity of demand for money), and if the exchange rate depreciation causes a rapid rise in domestic prices, then it can be shown that home nominal interest rates will tend to rise after the money expansion, and the home exchange rate will tend to undershoot its long-run change. If on the other hand, one or all of these three channels is weak, then domestic nominal interest rates will tend to fall after the money expansion, and the exchange rate will tend to overshoot its long-run change.

Let us now examine these effects in the MSG2 model. As seen in Table 11, a one percent U.S. monetary expansion raises U.S. output by 0.42 percent in the first year, and causes the exchange rate to depreciate by 1.5 percent, overshooting its long run level of 1 percent. Previous studies using this model found almost no overshooting. The reason for the current result is the assumption that import prices in the U.S. do not adjust fully to exchange rate changes in the short run. This is in line with in line with the empirical results of Baldwin and Krugman (1986) and Mann (1987). U.S. inflation increases by one-third of a percent, which is far more inflation per unit of demand stimulus than for fiscal policy, because of the opposite direction of effect on the exchange rate (i.e. for fiscal policy, the dollar appreciates, tending to reduce inflation; while for monetary policy, the dollar depreciates, tending to increase inflation). Remarkably, there is almost no international transmission of U.S. monetary policy to the output of the other countries. Moreover, the U.S. trade balance remains virtually unchanged.

Consider the effects on the direction of trade flows. The U.S. sells more to the rest of the world and buys more from the rest of the world. The other regions divert their own export sales from the non-U.S. market to the U.S. market. Total imports in the rest of the world remain unchanged, but shift in composition to a higher share of imports from the U.S. Total exports in the rest of the world also

Table 11 : Sustained 1% U.S. Monetary Expansion
(Deviation from Baseline)

		1	2	3	4	5
U.S. Economy						
GDP	%Y	0.42	0.27	0.15	0.07	0.02
Trade Balance	%Y	0.03	0.01	0.00	0.00	-0.00
Budget deficit	%Y	-0.13	-0.08	-0.05	-0.02	-0.01
Inflation	D	0.33	0.25	0.18	0.13	0.08
Nom Int Rate (short)	D	-0.46	-0.29	-0.17	-0.08	-0.02
Nom Int Rate (long)	D	-0.07	-0.03	-0.01	-0.00	0.00
Money	%	1.00	1.00	1.00	1.00	1.00
Japanese Economy						
GDP	%Y	-0.05	-0.00	-0.00	-0.00	0.00
Trade Balance	%Y	-0.05	-0.01	0.00	0.01	0.01
Budget deficit	%Y	0.01	-0.00	-0.00	-0.00	-0.00
Inflation	D	-0.06	-0.05	0.04	0.04	0.03
Nom Int Rate (short)	D	-0.12	-0.16	-0.10	-0.05	-0.01
Nom Int Rate (long)	D	-0.02	-0.01	0.00	0.01	0.01
Exch Rate $/yen	%	1.50	1.16	1.03	0.96	0.93
Real Exch Rate	%	1.15	0.49	0.21	0.05	-0.04
German Economy						
GDP	%Y	-0.08	-0.04	-0.00	0.01	0.01
Trade Balance	%Y	-0.04	-0.01	0.01	0.01	0.01
Budget deficit	%Y	0.02	0.01	0.00	-0.00	-0.00
Inflation	D	-0.06	-0.03	0.01	0.03	0.03
Nom Int Rate (short)	D	-0.20	-0.19	-0.13	-0.07	-0.02
Nom Int Rate (long)	D	-0.03	-0.02	-0.00	0.01	0.01
Exch Rate $/dm	%	1.35	1.09	0.98	0.94	0.93
Real Exch Rate	%	0.99	0.44	0.15	0.01	-0.06
REMS Economies						
GDP	%Y	-0.11	-0.05	-0.01	0.00	0.00
Trade Balance	%Y	-0.02	0.00	0.02	0.02	0.02
Budget deficit	%Y	0.03	0.01	0.00	-0.00	-0.00
Inflation	D	-0.07	-0.03	0.01	0.03	0.03
Nom Int Rate (short)	D	-0.20	-0.19	-0.13	-0.07	-0.02
Nom Int Rate (long)	D	-0.03	-0.02	-0.00	0.01	0.01
Exch Rate $/ems	%	1.35	1.09	0.98	0.94	0.93
Real Exch Rate	%	0.97	0.43	0.14	0.00	-0.06
ROECD Economies						
GDP	%Y	-0.06	-0.02	0.00	0.01	0.01
Trade Balance	%Y	-0.07	-0.02	0.00	0.01	0.01
Budget deficit	%Y	0.02	0.01	-0.00	-0.00	-0.00
Inflation	D	-0.09	-0.02	0.02	0.03	0.03
Nom Int Rate (short)	D	-0.17	-0.18	-0.13	-0.07	-0.03
Nom Int Rate (long)	D	-0.03	-0.02	-0.00	0.01	0.01
Exch Rate $/roe	%	1.38	1.09	0.98	0.94	0.93
Real Exch Rate	%	1.02	0.43	0.14	0.00	-0.06

remain virtually unchanged, but shift to supply the growing U.S. market, and away from third, non-U.S. markets.

The same pattern of proportionate depreciation of the exchange rate, with no effect on the trade balance of the expanding country, or the outputs of the foreign countries, holds for a monetary expansion in the other OECD regions shown in tables 12 and 13. This general conclusion is a key one, for it says that floating exchange rates effectively insulate the output of countries from the monetary policies abroad. The U.S. would benefit little on the output side from discount rate cuts in Europe and Japan.

Compare in Tables 11 and 12 the output effects of a monetary expansion in the U.S. and in Japan. In the U.S. case, output rises relative to the baseline for more than five years. In the Japanese case, on the other hand, output rises in the year of the fiscal policy change, but then falls to close to the baseline level in the following years. The difference in behavior stems from the assumed difference in wage setting patterns in the two countries. In the U.S., nominal wages are set according to a partially backward looking indexation mechanism, which imparts nominal wage sluggishness in the model. In Japan, on the other hand, wages are set in an annual wage cycle, with the wages for the following year targeted, with rational expectations, to hit the labor-market clearing level. In a given year, the labor market can be jolted away from full employment because of unanticipated shocks that occur in the year, but in expectation, the labor market always clears in later years.

Table 14 presents the results for a permanent 1 percent increase in the rate of growth of money in the U.S.. Again the policy raises real output as wages take time to adjust to the higher underlying inflation rate. The nominal exchange rate depreciates by 3.1 percent in the first year but quickly converges to the steady state rate of depreciation of 1 percent a year. Nominal interest rates rise in this case because the expected price movements more than offset the short term liquidity effect of the monetary expansion. Inflation eventually settles down to 1 percent above the baseline. The transmission of the policy change is again small although in this case it is now more stimulative for the rest of the world.

iii. OPEC Oil Price Rise

Table 15 contains the results for an increase in OPEC oil prices. The actual simulation is a shift in OPEC supply which, without any demand response, would double world oil prices. In fact demand does respond and the price of oil only rises by 75 percent. The result is stagflation in each of the major economies. The yen and Deutschemark depreciate in

Table 12 : Sustained 1% Japanese Monetary Expansion
(Deviation from Baseline)

		1	2	3	4	5
U.S. Economy						
GDP	%Y	-0.00	0.01	-0.00	-0.01	-0.01
Trade Balance	%Y	-0.00	-0.00	0.00	0.00	0.00
Budget deficit	%Y	-0.00	-0.00	0.00	0.00	0.00
Inflation	D	-0.03	0.02	0.01	0.01	0.00
Nom Int Rate (short)	D	-0.02	-0.01	-0.00	0.00	0.00
Nom Int Rate (long)	D	-0.00	0.00	0.00	0.00	0.00
Japanese Economy						
GDP	%Y	0.42	0.01	0.01	0.01	0.01
Trade Balance	%Y	0.13	0.01	0.00	0.00	-0.00
Budget deficit	%Y	-0.12	-0.00	-0.00	-0.00	-0.00
Inflation	D	0.33	0.63	0.02	0.01	0.00
Nom Int Rate (short)	D	-0.53	-0.04	-0.02	-0.00	0.00
Nom Int Rate (long)	D	-0.05	-0.01	-0.01	-0.01	-0.01
Exch Rate $/yen	%	-1.55	-1.04	-1.01	-0.99	-0.99
Real Exch Rate	%	-1.24	-0.07	-0.03	-0.02	-0.01
German Economy						
GDP	%Y	0.00	0.00	-0.00	-0.00	-0.01
Trade Balance	%Y	0.00	0.00	0.00	0.00	-0.00
Budget deficit	%Y	-0.00	-0.00	0.00	0.00	0.00
Inflation	D	-0.03	0.01	0.01	0.01	0.00
Nom Int Rate (short)	D	-0.00	-0.01	-0.01	-0.00	0.00
Nom Int Rate (long)	D	0.00	0.00	0.00	0.00	0.00
Exch Rate $/dm	%	0.01	-0.01	-0.00	0.00	0.00
Real Exch Rate	%	0.02	-0.01	-0.01	-0.00	0.00
REMS Economies						
GDP	%Y	0.01	0.00	-0.00	-0.00	-0.01
Trade Balance	%Y	0.00	0.00	0.00	0.00	-0.00
Budget deficit	%Y	-0.00	-0.00	0.00	0.00	0.00
Inflation	D	-0.03	0.01	0.01	0.01	0.00
Nom Int Rate (short)	D	-0.00	-0.01	-0.01	-0.00	0.00
Nom Int Rate (long)	D	0.00	0.00	0.00	0.00	0.00
Exch Rate $/ems	%	0.01	-0.01	-0.00	0.00	0.00
Real Exch Rate	%	0.02	-0.01	-0.01	-0.00	0.00
ROECD Economies						
GDP	%Y	0.00	0.00	-0.00	-0.01	-0.01
Trade Balance	%Y	0.00	-0.00	0.00	0.00	0.00
Budget deficit	%Y	-0.00	-0.00	0.00	0.00	0.00
Inflation	D	-0.03	0.02	0.01	0.01	0.00
Nom Int Rate (short)	D	-0.02	-0.01	-0.01	-0.00	0.00
Nom Int Rate (long)	D	-0.00	0.00	0.00	0.00	0.00
Exch Rate $/roe	%	-0.00	-0.01	-0.00	0.00	0.01
Real Exch Rate	%	-0.00	-0.01	-0.00	0.00	0.00

Table 13 : Sustained 1% German Monetary Expansion
(Deviation from Baseline)

		1	2	3	4	5
U.S. Economy						
GDP	%Y	0.01	0.01	0.01	0.01	0.01
Trade Balance	%Y	-0.01	-0.01	-0.00	-0.00	-0.00
Budget deficit	%Y	-0.00	-0.01	-0.01	-0.01	-0.01
Inflation	D	-0.04	-0.02	-0.00	0.00	0.01
Nom Int Rate (short)	D	-0.03	-0.05	-0.05	-0.05	-0.04
Nom Int Rate (long)	D	-0.04	-0.04	-0.04	-0.03	-0.03
Japanese Economy						
GDP	%Y	0.00	0.00	0.00	0.00	0.00
Trade Balance	%Y	-0.01	-0.01	-0.01	-0.00	-0.00
Budget deficit	%Y	-0.00	-0.00	-0.00	-0.00	-0.00
Inflation	D	-0.04	-0.01	0.00	0.00	0.00
Nom Int Rate (short)	D	-0.02	-0.04	-0.05	-0.04	-0.04
Nom Int Rate (long)	D	-0.03	-0.03	-0.03	-0.03	-0.03
Exch Rate $/yen	%	0.04	0.03	0.02	0.02	0.01
Real Exch Rate	%	0.05	0.04	0.04	0.03	0.02
German Economy						
GDP	%Y	0.49	0.33	0.25	0.22	0.20
Trade Balance	%Y	0.15	0.08	0.04	0.03	0.03
Budget deficit	%Y	-0.15	-0.10	-0.08	-0.07	-0.06
Inflation	D	0.40	0.23	0.11	0.05	0.02
Nom Int Rate (short)	D	-0.33	-0.17	-0.10	-0.06	-0.05
Nom Int Rate (long)	D	-0.08	-0.06	-0.05	-0.05	-0.05
Exch Rate $/dm	%	-1.59	-1.29	-1.17	-1.13	-1.11
Real Exch Rate	%	-1.23	-0.66	-0.42	-0.33	-0.29
REMS Economies						
GDP	%Y	0.52	0.32	0.24	0.22	0.21
Trade Bal	%Y	0.14	0.06	0.03	0.02	0.01
Budget deficit	%Y	-0.15	-0.09	-0.07	-0.06	-0.06
Inflation	D	0.46	0.22	0.09	0.04	0.02
Nom Int Rate (short)	D	-0.33	-0.17	-0.10	-0.06	-0.05
Nom Int Rate (long)	D	-0.08	-0.06	-0.05	-0.05	-0.05
Exch Rate $/ems	%	-1.59	-1.29	-1.17	-1.13	-1.11
Real Exch Rate	%	-1.22	-0.63	-0.40	-0.31	-0.28
ROECD Economies						
GDP	%Y	-0.07	0.00	0.00	-0.01	-0.01
Trade Balance	%Y	-0.03	-0.00	0.00	0.01	0.01
Budget deficit	%Y	0.01	-0.00	-0.00	-0.00	0.00
Inflation	D	-0.12	0.01	0.03	0.02	0.01
Nom Int Rate (short)	D	-0.13	-0.10	-0.07	-0.06	-0.05
Nom Int Rate (long)	D	-0.05	-0.04	-0.04	-0.04	-0.03
Exch Rate $/roe	%	-0.28	-0.18	-0.14	-0.12	-0.11
Real Exch Rate	%	-0.28	-0.21	-0.14	-0.11	-0.09

Table 14 : Sustained 1% increase in U.S. Money Growth
(Deviation from Baseline)

		1	2	3	4	5
U.S. Economy						
GDP	%Y	0.75	0.80	0.73	0.62	0.49
Trade Balance	%Y	0.08	0.07	0.06	0.05	0.04
Budget deficit	%Y	-0.23	-0.24	-0.22	-0.19	-0.15
Inflation	D	0.64	0.91	1.06	1.14	1.17
Nom Int Rate (short)	D	0.53	0.44	0.45	0.52	0.62
Nom Int Rate (long)	D	0.47	0.47	0.47	0.47	0.47
Japanese Economy						
GDP	%Y	-0.07	-0.01	-0.01	-0.00	0.00
Trade Balance	%Y	-0.14	-0.09	-0.07	-0.05	-0.03
Budget deficit	%Y	0.01	-0.01	-0.01	-0.01	-0.01
Inflation	D	-0.11	-0.17	-0.01	0.03	0.05
Nom Int Rate (short)	D	-0.16	-0.36	-0.37	-0.32	-0.25
Nom Int Rate (long)	D	-0.07	-0.06	-0.04	-0.01	0.02
Exch Rate $/yen	%	3.09	3.78	4.58	5.40	6.24
Real Exch Rate	%	2.45	2.06	1.77	1.47	1.18
German Economy						
GDP	%Y	-0.07	-0.07	-0.02	0.02	0.05
Trade Balance	%Y	-0.12	-0.09	-0.05	-0.03	-0.01
Budget deficit	%Y	0.01	0.01	-0.00	-0.01	-0.02
Inflation	D	-0.09	-0.10	-0.06	-0.01	0.02
Nom Int Rate (short)	D	-0.19	-0.35	-0.38	-0.35	-0.29
Nom Int Rate (long)	D	-0.08	-0.07	-0.05	-0.02	0.00
Exch Rate $/dm	%	2.84	3.57	4.35	5.18	6.05
Real Exch Rate	%	2.20	1.92	1.57	1.23	0.93
REMS Economies						
GDP	%Y	-0.12	-0.11	-0.06	-0.01	0.02
Trade Balance	%Y	-0.12	-0.08	-0.04	-0.01	0.01
Budget deficit	%Y	0.02	0.02	0.01	-0.01	-0.01
Inflation	D	-0.10	-0.11	-0.07	-0.01	0.02
Nom Int Rate (short)	D	-0.19	-0.35	-0.38	-0.35	-0.29
Nom Int Rate (long)	D	-0.08	-0.07	-0.05	-0.02	0.00
Exch Rate $/ems	%	2.84	3.57	4.35	5.18	6.05
Real Exch Rate	%	2.19	1.90	1.54	1.20	0.90
ROECD Economies						
GDP	%Y	-0.06	-0.04	0.01	0.05	0.06
Trade Balance	%Y	-0.15	-0.11	-0.08	-0.05	-0.04
Budget deficit	%Y	0.01	0.01	-0.01	-0.02	-0.02
Inflation	D	-0.13	-0.11	-0.06	-0.00	0.04
Nom Int Rate (short)	D	-0.17	-0.34	-0.39	-0.36	-0.30
Nom Int Rate (long)	D	-0.08	-0.07	-0.05	-0.03	0.00
Exch Rate $/roe	%	2.84	3.55	4.32	5.16	6.04
Real Exch Rate	%	2.19	1.88	1.51	1.18	0.91

Table 15 : OPEC Price rise (100%)
(Deviation from Baseline)

		1	2	3	4	5
U.S. Economy						
GDP	%Y	-2.68	-3.87	-4.61	-5.02	-5.19
Trade Balance	%Y	0.01	-0.00	-0.01	-0.02	-0.02
Budget deficit	%Y	0.85	1.22	1.45	1.59	1.65
Inflation	D	2.87	2.03	1.34	0.80	0.42
Nom Int Rate (short)	D	0.35	1.81	2.80	3.42	3.77
Nom Int Rate (long)	D	3.04	3.25	3.37	3.41	3.41
Japanese Economy						
GDP	%Y	-1.91	-2.17	-2.26	-2.36	-2.47
Trade Balance	%Y	0.38	0.32	0.28	0.24	0.19
Budget deficit	%Y	0.67	0.77	0.82	0.87	0.90
Inflation	D	2.53	1.26	0.71	0.48	0.31
Nom Int Rate (short)	D	0.51	1.93	2.77	3.29	3.58
Nom Int Rate (long)	D	2.93	3.12	3.22	3.25	3.25
Exch Rate $/yen	%	-3.32	-3.48	-3.59	-3.56	-3.43
Real Exch Rate	%	-3.84	-4.88	-5.68	-5.99	-5.96
German Economy						
GDP	%Y	-1.53	-2.05	-2.61	-3.13	-3.58
Trade Balance	%Y	0.34	0.17	0.00	-0.14	-0.26
Budget deficit	%Y	0.54	0.72	0.90	1.06	1.21
Inflation	D	1.80	1.58	1.24	0.91	0.65
Nom Int Rate (short)	D	-0.33	1.26	2.36	3.06	3.47
Nom Int Rate (long)	D	2.84	3.09	3.24	3.31	3.32
Exch Rate $/dm	%	-0.78	-0.10	0.45	0.89	1.25
Real Exch Rate	%	-2.19	-2.06	-1.62	-1.03	-0.38
REMS Economies						
GDP	%Y	-2.10	-2.94	-3.63	-4.22	-4.71
Trade Balance	%Y	0.25	-0.04	-0.26	-0.42	-0.54
Budget deficit	%Y	0.69	0.95	1.16	1.33	1.48
Inflation	D	2.52	1.91	1.37	0.95	0.64
Nom Int Rate (short)	D	-0.33	1.26	2.36	3.06	3.47
Nom Int Rate (long)	D	2.84	3.09	3.24	3.31	3.32
Exch Rate $/ems	%	-0.78	-0.10	0.45	0.89	1.25
Real Exch Rate	%	-1.43	-0.86	-0.22	0.46	1.14
ROECD Economies						
GDP	%Y	-2.97	-3.74	-4.24	-4.55	-4.71
Trade Balance	%Y	0.03	0.05	0.03	0.01	-0.03
Budget deficit	%Y	0.91	1.15	1.30	1.40	1.46
Inflation	D	2.31	1.67	1.15	0.75	0.45
Nom Int Rate (short)	D	-0.30	1.31	2.42	3.13	3.54
Nom Int Rate (long)	D	2.88	3.14	3.29	3.35	3.37
Exch Rate $/roe	%	1.06	1.71	2.21	2.60	2.89
Real Exch Rate	%	0.86	1.18	1.50	1.84	2.16

real terms relative to the U.S. dollar because of the relative large U.S. domestic oil industry. Inflation disappears faster in Japan because of the flexibility of the Japanese labour market. Long real interest rates also rise in all countries because of a decline in capital intensity in each region.

iv. Cessation of Lending to Developing Countries

Table 16 contains the results of an exogenous reduction of lending to the LDC's. The reduction is assumed to be an aggregate reduction of 1 percent of U.S. GDP allocated between lending countries based on their share of lending in the 1986 base year.

The result of cutting funds to the LDC's is a trade balance surplus (or smaller deficit) relative to the baseline in the LDC's which is matched by worsening of trade balances in the industrial countries. The exogenous reduction in lending by the industrial economies leads to an excess of world savings which reduces world real interest rates sufficiently to equilibrate world savings and investment. Output initially falls in the industrialized economies due to the fall in LDC demand for industrial country goods, but the fall in output is offset due to the increase in domestic demand in each country resulting from the fall in real interest rates.

5. Tracking 1979 to 1988

The properties of the model give some indication of the likely performance of the model in tracking the world economy during the 1980s. For example, it has been shown that asset prices can fluctuate substantially, especially for policy changes which involve shifts in expectations about expected future paths of policy.

This section examines the tracking ability of the model given changes in OPEC oil prices, lending to LDC's and fiscal and monetary policies in the major OECD countries. As can be seen from the results in section 4, it is very important to specify the expected future path of policy in simulating the effects of any particular policy change.

The procedure we follow in this paper is iterative. For each period, we first generate expectations of future fiscal policy, based primarily on OECD forecasts of fiscal policy. Monetary policy in each country is then arbitrarily geared towards approximately reaching the realized output gap that occurred in each year as well as attempting to reach observed short term and long term nominal interest rates (working partly on inflationary expectations). Given the output result and the cyclical fiscal deficit which accompanies this, we then adjust the exogenous fiscal instruments until we reach the actual and expected

Table 16 : Cessation of Loans to LDCs (1% U.S. GNP)
(Deviation from Baseline)

		1	2	3	4	5
U.S. Economy						
GDP	%Y	-0.09	0.03	0.15	0.24	0.31
Trade Balance	%Y	-0.32	-0.29	-0.28	-0.27	-0.26
Budget deficit	%Y	0.02	-0.03	-0.06	-0.09	-0.12
Inflation	D	-0.30	-0.29	-0.24	-0.20	-0.15
Nom Int Rate (short)	D	-0.51	-0.72	-0.92	-1.08	-1.20
Nom Int Rate (long)	D	-1.05	-1.09	-1.12	-1.14	-1.14
Japanese Economy						
GDP	%Y	-0.18	0.07	0.09	0.11	0.13
Trade Balance	%Y	-0.32	-0.28	-0.28	-0.27	-0.26
Budget deficit	%Y	0.06	-0.01	-0.02	-0.03	-0.04
Inflation	D	-0.16	-0.37	-0.11	-0.11	-0.09
Nom Int Rate (short)	D	-0.63	-0.85	-0.98	-1.11	-1.22
Nom Int Rate (long)	D	-1.08	-1.11	-1.14	-1.15	-1.15
Exch Rate $/yen	%	-1.31	-1.20	-1.07	-1.01	-0.98
Real Exch Rate	%	-1.24	-1.24	-0.98	-0.83	-0.75
German Economy						
GDP	%Y	-0.25	-0.16	-0.12	-0.08	-0.03
Trade Balance	%Y	-0.28	-0.28	-0.28	-0.26	-0.23
Budget deficit	%Y	0.10	0.07	0.05	0.04	0.02
Inflation	D	-0.09	-0.11	-0.13	-0.13	-0.13
Nom Int Rate (short)	D	-0.75	-0.76	-0.90	-1.05	-1.17
Nom Int Rate (long)	D	-1.09	-1.11	-1.14	-1.16	-1.17
Exch Rate $/dm	%	-2.13	-1.90	-1.86	-1.88	-1.91
Real Exch Rate	%	-2.03	-1.63	-1.48	-1.43	-1.44
REMS Economies						
GDP	%Y	-0.13	-0.08	-0.06	-0.02	0.04
Trade Balance	%Y	-0.26	-0.26	-0.26	-0.24	-0.22
Budget deficit	%Y	0.07	0.05	0.04	0.02	0.01
Inflation	D	-0.04	-0.10	-0.13	-0.14	-0.13
Nom Int Rate (short)	D	-0.75	-0.76	-0.90	-1.05	-1.17
Nom Int Rate (long)	D	-1.09	-1.11	-1.14	-1.16	-1.17
Exch Rate $/ems	%	-2.13	-1.90	-1.86	-1.88	-1.91
Real Exch Rate	%	-1.99	-1.57	-1.42	-1.38	-1.40
ROECD Economies						
GDP	%Y	-0.22	-0.09	-0.01	0.06	0.12
Trade Balance	%Y	-0.30	-0.30	-0.31	-0.30	-0.29
Budget deficit	%Y	0.07	0.03	0.01	-0.01	-0.03
Inflation	D	-0.15	-0.15	-0.16	-0.15	-0.13
Nom Int Rate (short)	D	-0.67	-0.73	-0.88	-1.03	-1.16
Nom Int Rate (long)	D	-1.07	-1.10	-1.13	-1.15	-1.16
Exch Rate $/roe	%	-1.71	-1.55	-1.55	-1.59	-1.64
Real Exch Rate	%	-1.63	-1.38	-1.30	-1.31	-1.35

deficits as well as the term structure. This iterative procedure takes some time to converge. Where major fiscal policy announcements are made, these are taken into account.

Table 17 shows the path for the world economy generated by the model for 1979 to 1991. This is found by starting in 1979 and, given the assumed expectations about future policies, solving the model forward to 2019. The model is then solved starting in 1980, inheriting the results from the 1979 simulation, and taking into account any new information from policy announcements and actual realizations of policy variables. This procedure is then repeated until 1988.

The results in table 17 are levels of variables. It should be pointed out that the model is not solved in level form but is solved in deviations from some level. Each new shock implies cumulative deviations from the underlying baseline. To express the results as levels of variables we add the cumulative deviations of variables to their levels in 1978. Implicitly this assumes that had all nominal variables in each country remained at their 1978 growth rates, the model would have generated a path for the real economies in which all real variables would grow at the underlying real growth rates; variables would not change as a share of GDP. The major difference between this procedure and simulating the model using levels of variables is that it ignores the inherited dynamics from 1978 which would (in principle) have some effect on the path for the following decade. We argue that the size of shocks are such that they dwarf the inherited dynamics. A technique for finding the exact model generated base path has been developed on a small version of the model consisting of 3 regions and in this case we found very little deviation of real variables from the 1978 initial shares of GDP, given no shocks to the world economy from 1979. In future work we intend to further develop this technique.

To read Table 17 remember that GDP is the output gap; that is the cumulative deviation from potential output. To convert this to an actual growth rate the change in output gap should be added to the trend growth rate for each economy (e.g. for the U.S. one could use 2.5 percent). For example a move from -8.2 in 1984 to -6.4 in 1985 is a rate of growth of output over this period of 4.3 percent (2.5 percent plus 1.8 percent). In this case the output gap narrows because the U.S. economy grew faster than trend. The other quantities are expressed as percent of GNP for real variables. The real exchange rate is the percentage change from the 1978 value.

The shocks, apart from monetary policy, that we impose on the model are contained in table 18. This table has fiscal deficits, OPEC oil prices and the change in lending to LDC's. The monetary policy stance was solved out by an iterative technique discussed above where the term structure of nominal interest rates was targeted given the fiscal stance.

Table 17: Tracking Results
(levels of variables)

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
United States													
Output gap	-0.3	-1.9	-3.5	-9.0	-9.1	-8.2	-6.4	-0.5	0.0	0.3	0.6	0.4	0.1
Inflation	9.0	10.8	11.7	6.6	4.7	2.9	2.8	4.2	5.6	6.4	7.3	7.9	8.3
Long interest rate	10.2	13.2	14.3	12.4	11.1	9.6	8.6	8.6	9.4	9.5	9.7	10.0	10.2
Short interest rate	9.3	12.9	12.5	10.3	10.2	9.7	7.0	9.5	6.9	5.4	5.5	6.0	6.7
Trade balance	-0.6	-1.2	-1.2	-3.0	-3.6	-3.8	-3.9	-3.3	-3.1	-3.0	-2.8	-2.7	-2.6
Budget deficit	-1.7	-0.3	0.2	2.8	3.5	3.7	3.5	2.5	2.1	1.7	1.6	1.7	1.8
Japan													
Output gap	-1.1	-1.1	-4.0	-2.4	-1.8	-1.1	-1.0	-0.8	-1.8	-0.6	-0.8	-0.9	-1.0
Inflation	4.9	7.2	5.9	3.0	3.0	1.2	1.5	-1.2	-3.6	-0.8	2.2	2.7	3.5
Long interest rate	7.5	9.5	9.8	9.3	7.4	5.8	4.7	3.7	6.3	6.5	6.8	7.2	7.6
Short interest rate	7.9	11.9	8.7	7.0	6.3	5.4	3.1	3.2	5.5	2.9	3.0	3.8	6.1
Trade balance	1.1	2.3	2.7	3.4	3.0	3.2	3.6	2.6	2.0	2.0	1.9	1.8	1.6
Budget deficit	4.3	4.2	3.8	3.5	3.3	2.3	1.4	1.2	1.8	1.8	2.1	2.5	2.8
Real exchange rate	-0.1	-14.0	-14.6	-37.8	-39.1	-41.9	-43.5	-25.7	-18.8	-20.2	-18.3	-16.6	-14.7
Germany, Fed. Rep. of													
Output gap	-0.7	-1.9	-2.7	-2.7	-3.1	-4.9	-6.5	-5.9	-7.1	-6.2	-5.1	-4.2	-3.9
Inflation	3.9	5.1	5.6	6.5	6.6	5.0	3.1	1.2	0.1	0.8	1.8	2.7	3.1
Long interest rate	8.1	10.3	11.4	11.4	9.9	8.1	6.6	5.5	6.7	6.7	6.8	7.0	7.1
Short interest rate	7.4	8.9	8.7	9.7	10.4	9.5	6.8	7.3	5.6	3.6	3.3	4.2	4.7
Trade balance	2.3	2.4	2.4	4.0	4.4	5.2	4.3	3.3	3.1	3.2	3.2	3.1	3.3
Budget deficit	2.8	3.3	3.5	2.6	1.9	0.5	1.0	1.2	1.6	1.7	1.7	1.8	1.7
Real exchange rate	-1.0	-4.8	-4.6	-30.4	-33.9	-34.8	-27.6	-13.9	-10.4	-11.8	-12.8	-13.2	-13.9
REMS													
Output gap	0.1	-1.4	-2.6	-0.6	-0.9	-1.8	-4.6	-4.1	-4.9	-3.9	-2.9	-2.1	-1.5
Inflation	5.7	7.1	7.6	9.1	8.9	7.2	4.1	1.6	1.0	2.0	3.0	3.9	4.5
Short interest rate	8.6	10.1	9.5	9.9	11.3	4.3	3.0	5.1	11.3	10.1	8.8	7.5	5.3
Trade balance	1.6	1.3	1.4	0.6	0.3	0.5	0.9	0.9	1.0	1.3	1.5	1.6	1.6
Budget deficit	4.0	4.5	4.9	6.6	5.4	4.8	4.7	4.5	4.8	4.4	4.1	3.9	3.7
Real exchange rate	-0.7	-3.8	-3.0	-27.3	-29.7	-29.9	-23.4	-11.0	-8.2	-10.2	-11.5	-12.2	-13.1
ROECD													
Output gap	-0.8	-2.2	-4.2	-4.8	-5.0	-5.9	-6.9	-5.0	-4.1	-3.0	-2.1	-1.5	-1.3
Inflation	7.6	10.1	10.0	11.0	11.1	9.0	7.1	4.6	4.7	5.1	6.0	6.7	7.2
Long interest rate	7.7	9.8	11.0	11.9	10.5	8.8	7.1	5.8	6.5	6.5	6.6	6.7	6.8
Short interest rate	6.2	7.0	7.6	9.9	10.9	11.3	8.1	7.5	5.0	3.5	3.1	3.5	4.1
Trade balance	-2.0	-1.4	-1.9	1.0	0.4	-0.1	-0.5	-1.1	-1.4	-1.5	-1.4	-1.2	-1.2
Budget deficit	3.1	3.6	4.2	3.0	2.8	2.6	2.5	2.1	2.2	1.9	1.6	1.4	1.4
Real exchange rate	-0.2	-4.7	-1.6	-27.8	-29.2	-27.6	-22.5	-11.8	-10.3	-11.5	-12.8	-13.4	-13.8

Table 18 : Exogenous Policy Changes and Shocks
(five-year expectations)

		1979	1980	1981	1982	1983
U.S. budget deficit	%Y	-1.7	-1.7	-1.7	-1.6	-1.6
Japanese budget deficit	%Y	4.5	4.5	4.5	4.5	4.6
German budget deficit	%Y	3.8	3.8	3.7	3.7	3.7
Opec oil prices	%	26.7	28.5	30.5	32.5	34.5
Loans to developing countries	%Y	0.0	0.0	0.0	0.0	0.0

		1980	1981	1982	1983	1984
U.S. budget deficit	%Y	-0.3	-0.1	0.1	0.2	0.3
Japanese budget deficit	%Y	4.4	4.0	3.5	3.1	3.1
German budget deficit	%Y	3.3	3.3	3.4	3.5	3.6
Opec oil prices	%	67.1	71.1	74.4	77.3	80.7
Loans to developing countries	%Y	0.0	0.0	0.0	0.0	0.0

		1981	1982	1983	1984	1985
U.S. budget deficit	%Y	0.3	0.5	0.7	0.8	0.9
Japanese budget deficit	%Y	4.0	3.8	3.8	3.8	3.9
German budget deficit	%Y	3.5	3.7	3.8	3.9	4.0
Opec oil prices	%	91.9	95.9	99.9	103.5	107.0
Loans to developing countries	%Y	0.0	0.0	0.0	0.0	0.0

		1982	1983	1984	1985	1986
U.S. budget deficit	%Y	2.8	3.5	3.9	4.1	4.3
Japanese budget deficit	%Y	3.7	3.8	3.9	3.9	4.0
German budget deficit	%Y	2.6	2.6	2.6	2.9	3.1
Opec oil prices	%	72.4	72.7	70.6	68.1	65.7
Loans to developing countries	%Y	0.0	0.0	0.0	0.0	0.0

		1983	1984	1985	1986	1987
U.S. budget deficit	%Y	3.5	3.9	4.2	4.4	4.3
Japanese budget deficit	%Y	3.5	3.7	3.7	3.7	3.7
German budget deficit	%Y	1.9	1.9	1.9	2.1	2.2
Opec oil prices	%	67.5	66.4	63.7	61.3	59.2
Loans to developing countries	%Y	1.0	1.0	1.0	1.0	1.0

		1984	1985	1986	1987	1988
U.S. budget deficit	%Y	3.7	3.9	4.0	3.9	3.7
Japanese budget deficit	%Y	2.5	2.7	2.7	2.7	2.7
German budget deficit	%Y	0.5	0.9	1.0	1.1	1.2
Opec oil prices	%	49.3	47.3	44.5	42.2	39.6
Loans to developing countries	%Y	1.0	1.0	1.0	1.0	1.0

		1985	1986	1987	1988	1989
U.S. budget deficit	%Y	3.5	3.7	3.6	3.5	3.4
Japanese budget deficit	%Y	1.6	1.8	1.7	1.7	1.7
German budget deficit	%Y	1.0	1.2	1.3	1.3	1.3
Opec oil prices	%	41.1	38.7	36.3	33.7	31.1
Loans to developing countries	%Y	1.0	1.0	1.0	1.0	1.0

		1986	1987	1988	1989	1990
U.S. budget deficit	%Y	2.5	2.0	1.6	1.6	1.6
Japanese budget deficit	%Y	1.4	1.5	1.7	2.0	2.3
German budget deficit	%Y	1.2	1.3	1.2	1.1	0.9
Opec oil prices	%	7.9	6.6	5.9	5.7	6.2
Loans to developing countries	%Y	1.0	1.0	1.0	1.0	1.0

		1987	1988	1989	1990	1991
U.S. budget deficit	%Y	2.1	1.7	1.6	1.7	1.8
Japanese budget deficit	%Y	1.9	2.0	2.3	2.7	3.0
German budget deficit	%Y	1.6	1.7	1.7	1.8	1.7
Opec oil prices	%	8.6	7.0	6.9	7.6	8.4
Loans to developing countries	%Y	1.0	1.0	1.0	1.0	1.0

Perhaps the surprising feature of table 17 is how well the model tracks the features outlined in section 2 above. Note that all arbitrage conditions hold ex-ante, but only hold ex-post if there are no surprises in the world economy. In fact in every year there are policy surprises; some of these are quite large.

The path of the world economy generated by the model in the early years is dominated by the rise in OPEC prices from 1979 to 1981. In 1981 and 1982 the world economy is dominated by a global monetary contraction which is particularly severe in the U.S.. The 1982 recession also reflects an expected fiscal expansion in the U.S. as well as Japanese fiscal contraction. From table 10, in the first year of the announced fiscal expansion output actually falls because interest rates rise before the impact of the future spending increase feed through the economy. This, together with the monetary contraction, explains the 1982 recession as well as the strong U.S. dollar. Both tight monetary policy and expected expansionary fiscal policy, appreciate the real exchange rate because they raise the real interest rate. Long-term nominal interest rates have a tendency to rise because of the rise in long term real interest rates which results from the expected fiscal expansion. This is offset by the lower expected inflation rate from the monetary tightness. The fiscal stimulus in the U.S. economy begins to flow into output by 1984, when real growth is close to 3.4 percent. This is less than the outcome of nearly 7 percent; in the model, the strong growth also spills over into 1985, where the average growth over 1984 and 1985 is approximately equal to that experienced. By 1983 the contractionary German fiscal policy adds further to the Dollar's appreciation relative to the Deutschemark.

Up to 1985 the model tracks very well in terms of broad trends in the data.[6] From 1985 the performance of the model is not quite as good. It is not clear if this is due to accumulating errors from the earlier 6 years or if some factors not present in the model become important.

In 1985, it is assumed that a shift in expectations about global monetary policy occurs. Both actual and expected U.S. monetary policy becomes more expansionary while actual and expected German and Japanese monetary policy tightens. This causes a large real and nominal depreciation of the dollar relative to the Deutschemark and yen in 1985,

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[6] Note that in this study, the increases in the U.S. fiscal deficit from 1982 to 1985 are assumed to be permanent. Morris (1988) attempts to track the real exchange rate for the period to 1985 in a small empirical IS/LM model, assuming that fiscal deficits from 1982 were perceived to be temporary and that each year, the continuing U.S. fiscal deficit was a surprise.

1986 and 1987. In the model, the real appreciation of the dollar relative to the yen by 1985 is 10 percent more than experienced. The fall in the dollar relative to both the yen and the Deutschemark during 1986 and 1987, is close to that experienced, although the level of the yen/dollar rate settles at a rate about 10 to 15 percent higher than actually experienced during 1988. The result from the model for the dollar/Deutschemark exchange rate is much closer to the actual. In addition, the German and the Japanese trade imbalances improve by more than experienced over this period. The tracking of the U.S. trade balance is quite good which suggests that the behavior of the ROECD, REMS , LDC or OPEC regions may be causing the excessive improvement of the Japanese and German trade imbalances. There is also a built-in expectation of Japanese fiscal expansion from 1987 which partly explains the Japanese trade balance turn-around in the model.

Global inflation begins to rise gradually from 1986, although the largest rise occurs in the U.S.. The inflation rise in the U.S. is less than the monetary expansion would predict because of the convenient fall in OPEC oil prices in 1986. In Japan, from 1987, there is a steady rise in inflation, reflecting the strong rise in demand. U.S. inflation by 1988 is 6.4 percent, which is above the level experienced.

The results from 1988 on, illustrate that the monetary policy induced depreciation of the U.S. dollar only goes part of the way to reducing the U.S. trade imbalance. The fundamental reason is that, as was shown in the section on policy multipliers, a monetary expansion depreciates the exchange rate and tends to raise exports, but it also stimulates demand and raises imports with very little improvement in the overall trade balance. Any improvement in the U.S. trade balance reflects the partial fiscal adjustment in the U.S.. The net effect is the prospect of very little adjustment of U.S. trade imbalances up to 1991, given the lack of further U.S. fiscal adjustment assumed in the simulation.

It should also be pointed out that the share markets in the model do not experience the scale of the surge of 1986 to 1987 nor the subsequent crash.

Several caveats should be made about the results from 1988 to 1991. First, the results from 1988 on, inherit a good deal of inertia from any errors from earlier periods, since we do not adjust the model for errors accumulated from 1979. These accumulated errors, after a decade, could potentially be quite large. Our intention in this exercise was to put as much burden as possible on the model to explain history without adjusting for errors. Second, the forecasts assume that there are no significant changes in policy from 1987 on. This assumption is only made for convenience because, as shown in McKibbin and Sachs

(1988a), governments are likely to have incentives to change policy, especially if they continue to target the trade imbalances with monetary policy alone or if the recent commodity price surge feeds into inflation, as the OPEC price shock did in 1979-80. A tightening of monetary policy in one major country has a tendency to lead to excessive global tightening due to the international linkages between countries which are commonly ignored by policymakers. The extent of the monetary contraction in 1981-82 in the U.S. surprised many observers because the rest of the world echoed the U.S. policy change which made the global consequences quite severe.

6. Conclusion

This paper has shown that the MSG2 model does a reasonable job in tracking the world economy for the decade of the 1980s, although it fails to pickup the surge and subsequent crash in share markets in 1987. It does this without using any constant adjustments to any equations but uses shocks to OPEC prices (which are assumed to be permanent each time they occur), lending to developing countries and actual and expected fiscal and monetary policies in the major OECD economies. It also illustrates the crucial point that monetary policy alone cannot solve the current trade imbalances in the world economy, even though it can have large effects on nominal exchange rates. In the MSG2 model, it is not possible to target a trade balance for any length of time using monetary policy, even though money has very strong output effects in the short-run.

We find that the major sources of swings in the real exchange rate can be fairly well explained by divergent monetary policies in 1982 and 1986-87 and divergent fiscal policies from 1982. The trade imbalances reflect the fiscal imbalances.

Another interesting result from the exercise is that, in examining the full period simulation, arbitrage conditions appear not to hold; expectations do not appear to be rational, yet they are by assumption. This is because in each period, expectations are assumed to be formed rationally based on all information available at the time. In subsequent periods, large unanticipated shocks occur in the world economy, so that expected variables and their actual outcome differ. This does not imply irrational behavior.

Several notes of caution should be re-iterated regarding the forecast from 1988. These results are based on the assumption that all fiscal policies are stable, in the sense that the ratio of government debt to GDP is stabilized in each region, through changes in tax policy. The smooth path from 1988 is premised on this assumption for fiscal policy and the assumption of no change in monetary policies. Any over-

reaction of monetary tightness by monetary authorities in response to rising inflation can substantially change this path. The reader can get some indication of this by modifying the path in table 17 using the policy multipliers from tables 7 through 16.

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