POLICY ANALYSIS WITH THE MSG2 MODEL

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ABSTRACT

This paper uses a dynamic intertemporal macroeconomic model of the world economy to examine the macroeconomic consequences for a small economy, such as Australia, of shocks in the world economy The model, called the MSG2 (McKibbin-Sachs Global) model, is based on the assumption that agents maximise objective functions subject to intertemporal budget constraints. Allowance is also made for the existence of various rigidities in labour markets and imperfections in the ability of agents to borrow and lend. The model is parameterized based on techniques from computable general equilibrium models and standard macroeconomic models. It is used to examine the impact on Australia of fiscal and monetary policies in the U.S. and Japan as well as the transmission of policy changes within the Australian economy.

TABLE OF CONTENTS

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1. Introduction

This paper focusses on the consequences for a small open economy, such as Australia, of macroeconomic policies in the rest of the OECD. The analysis in this paper uses a dynamic intertemporal general equilibrium model to calibrate the macroeconomic linkages in the world economy. This model, which is called MSG2, is a further development of the MSG model that has been used in earlier studies.[1] The new MSG2 model is a six region macroeconomic model of the world economy with several dozen behavioural equations per region. It is a familiar macroeconomic model yet is derived using principles usually associated with computable general equilibrium models.[2] It is distinctive in solving for a full intertemporal equilibrium, with agents having rational expectations of future variables, particularly in the asset markets.[3]

An overview of the model is given in section 2. The version of

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1. See Sachs and McKibbin (1985), McKibbin and Sachs (1986), Ishii, McKibbin and Sachs (1986).

2. For example see Dixon et al (1982) and Deardorff and Stern (1986). This differs from the standard macroeconomic model approach taken by most macroeconomic modellers. Further details can be found in McKibbin (1986) and McKibbin and Sachs (1987).

3. The use of rational expectations in the foreign exchange market has also recently been implemented in an Australian model by Murphy (1986) in the AMPS model. The crucial role of expectations is also recognised in the RBII model (Jonson et al)(1976)) which assumes expectations are driven by signals contained in changes in buffer stocks, such as monetary disequilibrium.

MSG2 used in this paper also includes a new module for Australia.[4] In section 3, the model is used to examine the domestic and international transmission of monetary and fiscal policy. It is also used to examine the implications of the Gramm-Rudman budget reduction package on the world economy and on Australia in particular. Section 4 contains a summary and conclusions.

2. The MSG2 Model of the World Economy

The MSG2 model incorporates the explicit behaviour of firms, households and governments which is based on dynamic intertemporal optimisation theory. Important rigidities are introduced into the model in a move towards more conventional macroeconomic models. The first is that nominal wage setting procedures differ in the major regions so that the firms labour demand curve determines the level of employment. The second is the assumption that some proportion of households and firms are liquidity constrained and therefore cannot behave according to the intertemporal optimisation results. By virtue of these assumptions the model has a mix of Classical and Keynesian properties.

The world economy is defined as six regions: the U.S., Japan, Australia, the rest of the OECD (hereafter denoted ROECD), OPEC and the developing countries (hereafter denoted LDC's). Each region produces a good which is an imperfect substitute in the consumption and production decisions of other regions. The industrialized regions produce consumer goods which are consumed by all regions. The LDC's and OPEC produce goods which are intermediate inputs into the production process of the industrialized regions. The internal

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4. The reader is referred to McKibbin and Siegloff (1987b) for further detailed development of the Australian module.

macroeconomic structure of the U.S. , Japan, Australia and the ROECD is modelled, although only the foreign trade and financial aspects of the LDC's and OPEC are incorporated.

The discussion will concentrate on the structure of the Australian economy since it is similar to that for the U.S., ROECD and Japan apart from the different assumed parameters. Note that in referring to each region, the following country symbols are used: U.S. (U); ROECD (R); Japan (J); Australia (A); OPEC (O); and LDC (L). All variables will be written in labour efficiency units.

a. Households

Households are assumed to have an infinite time horizon and grow at rate n. They consume a basket of goods consisting of a public good, domestically produced (Australian) goods and goods produced by the U.S., Japan and the ROECD. They choose a path for consumption by maximising an intertemporal utility function subject to their lifetime wealth budget constraint. Utility in any period is assumed to be a simple additive log function of consumption of private goods and the public good. Consumption of the private goods is a CES function of the basket of these goods. By nesting the consumption in this way, it is convenient (for purposes of presentation) to solve the consumption decision for aggregate consumption first and then solve for the composition of aggregate consumption, although in practice the decision is made simultaneously. Written formally, the consumers problem is the following.

Maximise:

$$(1.1) \qquad \int_0^{\infty} [U(C_t)+V(G_t)]\ e^{-(\theta-n)t}\ dt$$

subject to:

$$(1.2) \qquad dF/dt = (r-n)F_t + w_t L_t(1-\tau_1) - p^c{}_t C_t$$

where:

F_t is the stock of real financial wealth at the start of period t;

C is per capita real consumption of private goods;

w is the real wage;

L is employment in efficiency units;

p^c is the relative price of the consumption good bundle (in terms of the price of the domestic good) at the start of period t. Note $p^c=P^c/P$;

r is the real interest rate on financial assets;

θ is the rate of time preference of the representative agent;

n is the rate of growth in efficiency units;

Setting up the Hamiltonian for this problem, assuming U(C)=logC, and solving gives the familiar first order conditions:

$$(1.3) \qquad p^c{}_t \mu_t = 1/C_t$$

$$(1.4) \qquad d\mu_t/dt = (\theta-r)\mu_t$$

where μ is the shadow value of consumption.

Solving these gives:

$$(1.5) \qquad dp^cC/dt = (r-\theta)p^c{}_t C_t$$

This implies that if $r=\theta$, per capita real consumption is constant in the steady state.

The budget constraint given in equation (1.2) can be integrated and written as:

$$(1.6) \qquad \int_0^{\infty} p^C{}_t C_t \; e^{-(r-n)t} \; dt - H_0 = F_0$$

where H_0 is real human wealth in period 0 and is defined:

$$(1.7) \qquad \int_0^{\infty} w_t L_t (1-\tau_1) \; e^{-(r-n)t} \; dt = H_0$$

Real human wealth is the present discounted value of the entire future stream of real labour income.

From the first order condition given in (1.5), we find:

$$(1.8) \qquad \int_0^{\infty} p^C{}_t C_t \; e^{-(r-n)t} \; dt = p^C{}_0 C_0 / (\theta-n)$$

This can be substituted into (1.6) to give:

$$(1.9) \qquad C_t = (\theta-n) \; \{F_t + H_t\} / p^C{}_t$$

and rewriting the human wealth condition gives:

$$(1.10) \qquad dH_t/dt = (r-n)H_t - w_t L_t (1-\tau_1)$$

Define real financial wealth as:

(1.11) $$F_t = M_t + B_t + q_t K_t + A_t$$

where B is real government debt, qK is equity wealth and A is the net holdings of foreign assets.

Aggregate consumption is a function of total wealth. To derive the demand for the composition of total consumption, aggregate consumption of goods is assumed to be the following CES function of domestic goods and foreign goods:

(1.12) $$C = \{\beta_2 (C^{d\ \beta 3}) + (1-\beta_2)(C^{m\ \beta 3})\}^{(1/\beta 3)}$$

$$\sigma_1 = 1/(1-\beta_3)$$

where c^m is consumption of the imported good and c^d is consumption of the domestic good. Given aggregate consumption, we can now find how the consumer allocates consumption of goods between domestically produced and imported goods. The problem of allocation is to maximise:

(1.13) $$C = \{\beta_2 (C^{d\ \beta 3}) + (1-\beta_2)(C^{m\ \beta 3})\}^{(1/\beta 3)}$$

subject to:

(1.14) $$PC^d + P^m C^m \leq P^C C$$

P is the price of domestic goods and P^m is the import price in domestic currency units. P^C is an index for the price of the consumption bundle (note that $p^C = P^C/P$). Solving this problem gives:

(1.15) $$PC^d = P^C C \ / \ (1 + \Omega_1 \beta_6)$$

and

$$(1.16) \qquad P^{m}C^{m} = P^{C}C \ (\Omega_1\beta_6)/(1 + \Omega_1\beta_6)$$

where:

$$\beta_6 = [(1-\beta_2)/\beta_2]^{\sigma_1}$$

$$\Omega_1 = (P_m/P)^{(1-\sigma_1)}$$

and

$$(1.17) \qquad P^{c(1-\sigma_1)} = \beta_2\sigma 1 \ P^{(1-\sigma 1)} + (1-\beta_2)\sigma 1 \ P^{m(1-\sigma_1)}$$

The demand for domestic goods and imports are given in equations (1.15) and (1.16), respectively. Both demands are a function of total consumer spending and relative prices of domestic and imported goods. The consumer price index is given by equation (1.17).

Using a similar technique to that above, we assume that consumption of foreign goods is then a nested CES function of Japanese, U.S. and ROECD goods. Demand functions for each component of imports is then derived.

To summarize, aggregate consumption of private goods is derived to be a function of total household wealth where real wealth is defined to include human wealth, government debt of their own country, specific holding of foreign assets (described below), real money balances and claims to capital in their own country. Households do not hold claims to foreign capital. Given the allocation of aggregate consumption between consumption of goods and consumption of the public good, the consumer then allocates consumption of private goods between domestically produced and

imported goods. Demands are a function of total consumer spending and relative prices of domestic and imported goods. A similar result applies to the lower level nesting of consumption where demands for individual country goods are a function of total imports and the relative price of those goods.

Empirical work, especially the results of Hayashi (1982), suggests that current disposable income as well as wealth explains a large part of the behaviour of aggregate consumption. This suggests that liquidity constrained households are an important determinant of consumption. To capture this, aggregate consumption is written as a linear combination of wealth and disposable income.

$$C = \beta_{19}\,(\theta-n)(H + F)/P^{C} + (1-\beta_{19})(Y+rB-T) \tag{1.18}$$

In the experiments undertaken in this paper we arbitrarily set $\beta_{19}=0.1$.

b. Firms

Firms in each of the industrialized regions behave according to the assumptions behind a "representative firm". These use factor inputs to produce domestic goods in the country in which they are located.

The approach followed here for domestic firms is based on Hayashi (1983). It is assumed that price-taking firms choose factor inputs to maximize the value of the firm.

$$V_0 = \int_0^{\infty} [(1-\tau_2)(Q_t - w_t L_t - p^n{}_t N_t - iM_t/P_t) - p^I{}_t I_t]\; e^{-(r-n)t} dt \tag{1.19}$$

where $Q = Q\{Z, M/P\}$

$Z = Z\{K, L, N\}$

$N = N\{N^a_o, N^a_p\}$

The firm's production technology is a function of a produced good (Z) and real money balances (M/P). Money is assumed to be a factor of production. This framework was justified by Levhari and Patinkin (1968) based on the argument that money facilitates the satisfaction of the double coincidence of wants and therefore acts as a necessary factor in the production process. Empirical support for the inclusion of money balances in the production function has been provided by Subrahmanyam (1980). Firms produce a good (Z) using the primary factors, but households can only consume the good after it has been purchased, or combined with money. Alternatively, firms are assumed to rent the money balances from the households with a total cost of iM. Money then becomes part of household wealth. The produced good is a function of capital (K), labour (L), and intermediate inputs (N) which are imported from OPEC (N^a_p) and LDC (N^a_1) countries. Labour and intermediate inputs are assumed to be variable in the short run. Capital is assumed to be costly to adjust. Specifically we assume:

$$(1.20) \qquad dK_t/dt = J_t - (\beta_{14}+n)K_t$$

$$(1.21) \qquad I_t = J_t(1+.5\beta_{15}(J_t/K_t))$$

Equation (1.20) gives the accumulation of the capital stock as gross fixed capital formation (J) adjusted by depreciation of the existing capital stock. The relationship between investment expenditure (I) and capital formation is given in (1.21). A dollar of investment

expenditure leads to less than a dollar of capital accumulation due to the cost of adjustment, assumed here to be quadratic in gross accumulation. By assuming that capital is costly to adjust, in the spirit of Lucas (1967) and Treadway (1969), the model delivers a theory of investment which is related to Tobin's "q" theory.

The firms optimization of (1.19) subject to (1.20) and (1.21) can be solved. The first order conditions are given in (1.22) to (1.26).

$$(1.22) \qquad Q_L = w \ , \qquad (w=W/P)$$

$$(1.23) \qquad Q_N = p^n \ , \qquad (p^n=P^n/P)$$

$$(1.24) \qquad Q_{M/P} = i \ ,$$

$$(1.25) \qquad \lambda = p^I(1+\beta_{15}J/K) \ , \qquad (p^I=P^I/P)$$

$$(1.26) \qquad d\lambda_t/dt = (r+\beta_{14})\lambda_t - (1-\tau_2)Q_K - .5p^I\beta_{15}(J/K)^2$$

where λ is the shadow value of investment. Equation (1.26) can be integrated to find:

$$(1.27) \qquad \lambda_0 = \int_0^\infty (1-\tau_2)Q_K + .5p^I\beta_{15}(J/K)^2] \ e^{-(r+\beta 14)t} \ dt$$

λ is therefore the increment to the value of the firm from a unit increase in investment. It has a similar interpretation to Tobin's q theory. Further to this, if we assume $q = P^I\lambda/P$, we can rewrite (1.25) as:

$$(1.28) \qquad J/K = (q-1)/\beta_{15}$$

If $q>1$ then it pays to increase investment and similarly if $q<1$ it

pays to run down the capital stock.

The result of the optimization problem for the representative firm is a set of factor demand functions for the variable factors as well as an investment demand function. The functional form of Q, Z, and N are chosen to be CES for Q and Cobb-Douglas for Z and N. The CES specification proves to be convenient for Q because the demand for money becomes a familar money demand function where real money balances depend on output and interest rates. The income elasticity of money demand will be unity, but the interest elasticity will be a function of the chosen elasticity of substitution between money and Z. We can therefore choose an elasticity of substitution based on our priors of the interest elasticity of the demand for money.

A further assumption we make is that investment in each region is made up of domestic as well as foreign goods. The proportion of each good in total investment is assumed fixed. The price of investment goods is then assumed to be a linear combination of the prices of each of the goods.

Empirical tests of the q theory of investment have generally found that it performs poorly in explaining movements in aggregate net investment data. To allow for this it is assumed that investment is undertaken by a proportion of optimising firms following the q approach as well as a proportion of liquidity constrained firms, investing out of current profit. Investment is written as a linear combination of q and current profits.[5]

$$J = \beta_{26}(q-1)K/\beta_{15} + (1-\beta_{26})(Q-wL-p^{n}N) \tag{1.29}$$

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5. Empirical evidence also supports this specification for Australia. See McKibbin and Siegloff (1987a).

$$(1.30) \qquad I = \beta_{26}(q-1)(1+.5(q-1))K/\beta_{15} + (1-\beta_{26})(Q-wL-p^{n}N)$$

In the experiments undertaken in this paper we assume β_{26}=.2 and β_{15}=8.

c. Labour Markets

Wages are assumed to be set by labour contracts[6]. The procedure adopted here is to assume that wages are set a period in advance and hold for one period. Different assumptions are made in each region. In the U.S. and Australia, we build in some nominal wage rigidity where nominal wages are set based on the current wage, expected price changes and the gap between actual employment and potential employment.

$$(1.31) \qquad dW_t/dt = \beta 25 \; {}_t\pi^{c}_{t+1} + (1-\beta_{25}) \; \pi^{c}_{t} + 0.1(L-L_0)$$

When forecasting the future inflation, wage earners are assumed to use a weighted average of the rational expectations predictions of inflation next period (i.e. forward looking), and the current inflation as the predictor of the expected future inflation (i.e. backward looking). In Australia and the U.S. the weights are β_{25}=0.5. In the ROECD we assume that wage setting is similar to that in the U.S., although we build hysteresis into the labour market by assuming that wages also adjust to the gap between actual and potential labour demand where potential labour demand adjusts very slowly to actual labour demand. In Japan we assume that wage setters select the nominal wage based on the expected price in the following

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6. See Fischer (1985) and Taylor (1980) for the implication of alternative assumptions about wage contracts. The assumption for wages and the labour market are very important for the effect of policies.

period in addition to the condition that the labour market clears in expected terms in the following period. In this case anticipated shocks lead to a market clearing real wage but unanticipated shocks lead to a temporary change in the real wage. As pointed out by Argy and Salop (1978), the assumption about wage setting is crucial for many of the effects of fiscal and monetary policy.

d. Government

The governments in each region levy taxes on households and firms to finance the provision of a public good that enters into the private agents utility function. Taxes consist of income taxes on consumers (at rate τ_1), company taxes (at rate τ_2) and a lump-sum tax levied on consumers (T_4). Any changes in interest rates or the quantity of debt is assumed to be met by a change in the lump-sum tax so the budget deficit remains unaffected by shocks to these variables.

$$T_4 = r_0(B_t - B_0) + B_0(r_t - r_0) \tag{1.32}$$

Real government debt accumulates according to the following equation:

$$DB/dt = (r_t - n)B_t + DEF_t \tag{1.33}$$

where DEF is the primary real deficit and is defined

$$DEF = G - T \tag{1.34}$$

$$T = \tau_1 wL + \tau_2(Q - wL - p^n N) + T_4 \tag{1.35}$$

Equation (1.33) can be integrated to give the intertemporal budget constraint facing the government:

$$B_0 = \int_0^{\infty} [T_t - G_t]\, e^{-(r-n)t}\, dt \tag{1.36}$$

This intertemporal budget constraint on the government implies that government debt is the present value of future primary budget surpluses; debt must be eventually financed by taxes.

It can be seen that if consumers were only using wealth as the determinant of consumption, a change in the debt-tax mix, or a change in the temporal timing of taxes, would have no effect on consumer behaviour because both consumers and the government use the same discount rate to evaluate the future stream of returns. For instance, if the government cut taxes today and financed the resulting deficit by issuing debt, consumer wealth would not change. Human wealth would fall by the amount of extra bonds in the agents portfolio. Consumers would realize that only the temporal timing of taxes had changed because the debt issued today must be repaid by future taxes and consumption would not change[7]. This property of the model is diluted by assuming some proportion of liquidity constrained consumers who base consumption on current disposable income rather than wealth

e. Open Economy Aspects

Regions in this model are linked via flows of goods and assets. A current account deficit by one country would lead to an increase in the net asset holdings of another country. For example, the current account (defined as a surplus) of Australia is:

$$(1.37) \qquad CA^a = TB^a - r^u A$$

where A is rest of the world claims against Australia (and is assumed to be subject to the U.S. interest rate) and TB^a is the trade balance

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7. This is Barro's so-called Ricardian equivalence hypothesis.

(defined as a surplus). Foreign assets accumulate according to:

(1.38) $$dA/dt = -TB^{a}_{t} + (r_t - n)A_t$$

As with the government debt accumulation equation, this can be integrated to find:

(1.39) $$A_0 = \int_0^{\infty} TB_t \, e^{-(r-n)t} \, dt$$

Equation (1.36) gives the intertemporal budget constraint for the balance of payments. The current debt is the present discounted value of all future trade balance surpluses; foreign debt must eventually be repaid. The assumption of perfect asset substitutability implies that only the net position matters. This approach is generalized in the model to allow for the multilateral financing of trade imbalances.

We introduce the external accounts of OPEC and LDCs by making some simplifying assumptions. The value of total imports into OPEC and the LDCs is assumed to be divided between each of the other regions' goods on the basis of constant expenditure shares. This gives the price of OPEC and LDC goods as a variable markup over the consumption bundle of U.S., Japanese, ROECD and Australian goods. The current accounts of the industrial regions are determined by savings and investment decisions in these regions. We make simplifying assumptions about the determinant of the OPEC and LDC current accounts. The fundamental assumption is that foreign borrowing of the LDCs is determined by the supply of loans rather than the demand for loans. For reasons described in many theoretical studies of debt repudiation, this form of credit rationing results from the risk of debt repudiation by the LDCs. New foreign financing

is written as a function of the lagged current account balance (since there is inertia in the quantity of net lending), and as an decreasing function of the existing debt/exports ratio. Creditors adjust loans to reach a desired debt export ratio.

In postulating the OPEC current account, we assume that OPEC adjusts its consumption of goods from the rest of the world to reach a target ratio of wealth to income.

f. The Model Closure

The model is closed by assuming money and goods market clearing in the industrialized regions. The full set of equations which have been discussed in this section are available from the author by request.

g. Calibration

The model is parameterized using a mix of CGE techniques and standard macroeconomic model techniques. Where possible, by combining assumed functional form of various equations and using actual shares in 1986 data, (eg trade shares, asset shares, factor shares etc.) we can derive parameters in the production and consumption equations. Other parameters, such as elasticities of substitution in production and consumption, can be found by referring to other research in the literature on price elasticities of supply and demand.[8] Given shares and price elasticities we can find the implied elasticities of substitution.

The procedure of relying on other researchers' estimates for key parameters represents, in our opinion, a healthy division of labour between those with expertise in general equilibrium modelling, and

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8. More detail is given in McKibbin (1986) and McKibbin and Sachs (1987b).

those with expertise in econometric estimation.

Model validation is a problem in an MSG-style model because of the presence of forward-looking variables. Our approach is the following. In developing the model, we first choose what seem to be reasonable single equation estimates for parameters. We then shock the model and compare the simulation results with the experience of recent history when large shocks were experienced. An example is the consequence of sharp swings in U.S. fiscal policy in the early 1980's. We then vary parameters to get some indication of the sensitivity of results to key parameters. Standard model validation, by comparing simulated with actual data over a period of history, proves to be a very difficult exercise in a rational expectations model. The expectation of any shocks which occurred over the period must be specified. It makes a difference whether shocks were perceived to be permanent or transitory. The actual data ex-post, is not necessarily the expected result ex-ante. Also, in attempting to make the model generate actual values in 1986 (the base year for data), the standard technique of adding constant term adjustments to equations cannot be used because of the presence of forward-looking variables. The value for the exchange rate in 1986 depends on the entire future paths of monetary and fiscal policies in all countries and therefore need not equal (and cannot simply be made to equal) the actual value in 1986. An alternative attempt to generate a baseline is being investigated and has yielded some promising results. However, currently the MSG2 model is mainly suitable for policy simulation, concerning deviations of variables given shocks, rather than being useful for forecasting a baseline.

h. Model Solution

The model is derived in non-linear form, but then solved in a linearized version, which can readily be used for dynamic programming optimization exercises and for the study of the strategic "gaming" interactions across countries. The algorithm for solving the model with and without the dynamic game theory is a modification of a dynamic programming algorithm in Oudiz and Sachs (1985). It is written for quick solution on a personal computer. The reader is referred to McKibbin (1987) for more details.

i. Summary

Compared with other medium and large-scale models of the global economy (e.g. the Federal Reserve Board's MCM model, and the Japanese Economic Planning Agency model), the MSG2 model has several attractive features. Firstly, all stock-flow relationships are carefully observed. Budget deficits cumulate in debt stocks, current account deficits cumulate into net foreign investment positions, and physical investment cumulates into the capital stock and the long-run properties of the model deliver a long-run balanced growth path for the world economy. Secondly, asset markets are efficient. Exchange rates, long-term interest rates, and equity prices, are determined according to intertemporal arbitrage conditions based on rational expectations of the future path of the global economy. Thirdly, the supply side of the model in the various regions is specified in detail to allow for different wage-price dynamics in line with the conclusions of comparative macroeconomic analyses of the U.S., Japan, and the ROECD. In particular, the U.S. and Australia are characterized by nominal wage rigidities arising from long-term nominal wage contracts. In Japan, the nominal wage is selected for

the following year in order to clear the Japanese labour market in expectation in the following year. In the ROECD, wages are set with a high effective degree of indexation, and the non-inflationary threshold level of unemployment shifts over time in response to the historical path of unemployment. This is the so-called hysteresis effect, discussed in Sachs (1986) and Blanchard and Summers (1987).

By virtue of the rational expectations assumption, and the forward-looking behaviour of households and the firms, the model can examine the effects of anticipated future changes in policy such as the effects of the Gramm-Rudman deficit reduction targets. Indeed, in the MSG2 model it is necessary to specify an entire future anticipated path of policies as a prelude to simulation exercises.

3. Interdependence in the MSG2 Model

The principal goal of the MSG modelling project is to better understand the international transmission of macroeconomic policies, and to design policies for global economic coordination consistent with the results on interdependence. One of the things which has been impressed on us in the development of the model is our tenuous knowledge of key magnitudes in international transmission of macroeconomic policies. Seemingly innocent changes in parameter values can even change transmission of policies from being positive to negative across countries.

It must be stressed that one of the major reasons for doubts on the direction of interdependence effects is that for many policies, there are several conflicting channels of effects on other countries. As a well known example, a U.S. fiscal expansion tends to raise interest rates in Europe (contractionary), depreciate the European

real exchange rate (expansionary), and directly increase European exports to the U.S. because of fiscal-led growth in the U.S. (expansionary). The sum total effect of these channels is ambiguous theoretically, and somewhat elusive empirically. Nonetheless, we make some concrete observations about the sign and magnitude of international transmission effects.

While theoretical papers typically focus on the sign of interdependence effects, considerations about policy coordination or domestic economic planning require information on the magnitudes of effects. Indeed, one of the purported lessons of Oudiz and Sachs (1984) and McKibbin and Sachs (1986) is that the degree of interdependence among the major economies appears to be too limited to require an intricate degree of international policy coordination.

Let us now turn to various aspects of macroeconomic interdependence. We begin with fiscal policies, and then turn to monetary policies.

a. Fiscal Policy Transmission

Various simulation results for fiscal policies in the U.S., Australia and Japan, are shown in Tables 1 to 5. Before discussing the results, it is crucial to understand the experiment that is being undertaken in the tables.

In line with rational expectations models, policy experiments must define an entire future path of policies, and not just a change in an initial year, or even the changes over the time interval of interest in the simulations (1986-1990). In the case of fiscal policy, it is important that permanent changes in government spending be matched at some well-defined point in the future by increases in taxes in order to pay for the government spending. In particular,

starting from any initial stock of public debt, the discounted value of current and future government taxes must be equal to the present discounted value of future spending plus the initial outstanding stock of public debt.

In our case, a permanent fiscal expansion has the following characteristics. Government spending rises permanently by one percent of potential GDP. The government spending is distributed over domestic goods and imports, in the same proportions as with private spending. Initially, the tax schedule remains unchanged, with taxes increasing only to the extent that the fiscal expansion raises output and thereby induces an increase in tax collections. In general, the one percent of GDP fiscal expansion causes the public deficit to worsen initially by about 0.9 of one percent of GDP. The deficit is financed entirely by the issuance of public debt, with the money stock (both base money, and implicitly M1) remaining unchanged. Over time, the debt stock will rise, so that interest servicing will also increase. If the tax schedule is not altered, then the debt will grow explosively fast, and the government's budget constraint will be violated. To prevent this, we assume that taxes rise each period by enough to cover the increasing interest costs on the increasing public debt. In this way, the overall deficit remains fairly constant at about 0.9 percent of GDP, though the primary deficit (i.e. government spending net of interest payments, minus total taxes) eventually turns to a surplus as is necessary to prevent an explosive growth in debt. The fact that the deficit is permanently increased does not lead to an ever increasing debt-GDP ratio because GDP is itself increasing in the long run at the potential growth rate (assumed to be 3 percent in the model for all

of the regions in the world economy). Thus, a permanent increase in the deficit of 0.9 percent of GDP leads asymptotically to a rise in the debt of 0.9/0.03 percent of GDP, which is a rise of the 30 percent of GDP.

Consider first the permanent U.S. fiscal expansion, shown in Table 1. To read the table, note the following points. All variables are expressed as deviations from an initial baseline. Output is recorded as a percentage deviation from the initial baseline (e.g. 0.60 percent of GDP in 1986). Consumption, investment, exports, imports, and the trade balance are all reported as deviations from baseline in percent of potential GDP. Thus, in 1986, private consumption rises relative to the baseline by 0.08 of one percent of U.S. potential GDP. Labour demand (i.e. total manhours in the economy) is reported as a percentage deviation from the baseline (e.g. a rise of 0.32 percent in 1986). 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 in 1986 is seen to fall by 0.31 percentage points in 1986, while short-term interest rates increase by 0.53 percentage points (i.e. 53 basis points). The three 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

Table 1: World Model
Sustained U.S. Fiscal Expansion (1% GNP)

		1986	1987	1988	1989	1990
U.S. Economy						
Output	%	0.60	0.65	0.60	0.50	0.39
Priv Consumption	%GNP	0.08	0.11	0.06	-0.02	-0.10
Priv Investment	%GNP	-0.19	-0.17	-0.18	-0.20	-0.23
Govt Consumption	%GNP	1.00	1.00	1.00	1.00	1.00
Exports	%GNP	-0.19	-0.18	-0.18	-0.19	-0.19
Imports	%GNP	0.10	0.11	0.10	0.09	0.08
Trade Balance	%GNP	-0.29	-0.28	-0.28	-0.28	-0.27
Labour Demand	%	0.32	0.47	0.42	0.31	0.19
Inflation	D	-0.31	-0.08	0.02	0.06	0.09
Int Rate (short)	D	0.53	0.49	0.42	0.36	0.33
Exchange Rate						
$/ecu	%	-3.09	-2.99	-2.94	-2.89	-2.82
$/yen	%	-3.39	-3.27	-3.28	-3.28	-3.26
$/aus	%	-2.91	-2.78	-2.71	-2.64	-2.57
ROECD Economies						
Output	%	0.03	-0.14	-0.27	-0.37	-0.44
Priv Consumption	%GNP	-0.07	-0.17	-0.25	-0.31	-0.35
Priv Investment	%GNP	-0.19	-0.22	-0.25	-0.27	-0.29
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.28	0.23	0.19	0.15	0.13
Imports	%GNP	-0.01	-0.03	-0.04	-0.05	-0.06
Trade Balance	%GNP	0.28	0.25	0.23	0.21	0.20
Labour Demand	%	0.26	0.04	-0.12	-0.23	-0.30
Inflation	D	0.22	0.17	0.10	0.06	0.04
Int Rate (short)	D	0.43	0.43	0.37	0.30	0.24
Japanese Economy						
Output	%	0.06	-0.14	-0.17	-0.20	-0.23
Priv Consumption	%GNP	-0.09	-0.19	-0.21	-0.23	-0.25
Priv Investment	%GNP	-0.21	-0.25	-0.25	-0.26	-0.27
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.36	0.29	0.27	0.27	0.26
Imports	%GNP	0.00	-0.02	-0.02	-0.02	-0.02
Trade Balance	%GNP	0.36	0.31	0.29	0.29	0.28
Labour Demand	%	0.25	-0.00	-0.00	-0.00	-0.00
Inflation	D	0.18	0.24	-0.01	-0.02	-0.01
Int Rate (short)	D	0.41	0.49	0.43	0.35	0.29
Australian Economy						
Output	%	0.06	-0.13	-0.29	-0.41	-0.48
Priv Consumption	%GNP	0.11	-0.03	-0.15	-0.23	-0.28
Priv Investment	%GNP	-0.19	-0.21	-0.23	-0.24	-0.25
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.10	0.04	-0.02	-0.07	-0.09
Imports	%GNP	-0.04	-0.07	-0.11	-0.13	-0.14
Trade Balance	%GNP	0.14	0.11	0.08	0.06	0.05
Labour Demand	%	0.27	0.02	-0.22	-0.38	-0.46
Inflation	D	0.19	0.19	0.13	0.08	0.04
Int Rate (short)	D	0.40	0.41	0.36	0.29	0.24

and an appreciation of the U.S. dollar exchange rate. Indeed, output rises by 0.60 percentage points in the first year, while the dollar appreciates by 2.9 percent vis-a-vis the Australian dollar, and by 3.4 percent vis-a-vis the Yen and 3.1 percent vis-a-vis the ECU (where the ECU signifies the currency basket of the ROECD). The rise in output and the appreciation of the dollar produces a trade deficit, equal to 0.29 percent of GDP in the first year of the fiscal expansion. Note that there is a small fall in private investment, and a small rise in private consumption, in the U.S. The consumption behaviour reflects the forward looking nature of the consumers in this model. The implied future taxes from the permanent fiscal expansion leads to an intertemporal substitution from present to future consumption. Households increase their saving in the present period, in order to finance the future taxes implied in the issue of debt. If all consumers were forward looking, consumption would fall by 1 percent of GDP, exactly matching the rise in government spending. Crowding out would be instantaneous. The assumption that a proportion of the consumers also consumer out of current income, implies that the crowding out takes much longer to be achieved.

The transmission of the U.S. fiscal shock to the different regions, including Australia, is perhaps surprising at first sight. Importantly, the Mundell-Fleming model teaches that the transmission effect of a U.S. fiscal policy expansion on foreign (Australian) output is ambiguous, for the reasons already alluded to. On the one hand, world interest rates rise, which tends to depress Australian income. On the other, the demand expansion in the U.S. tends to raise foreign exports which filters through to foreign income. 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. In this model, Australian wage setters are partially forward looking and adjust wage claims for expected changes in consumer prices.

As can be seen from Table 1, the effect of the permanent fiscal expansion is negligible transmission in the first year of the expansion, but then a negative transmission thereafter. 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. by the second year for Japan and the ROECD and Australia. 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. By the second year in Australia, Europe and Japan, the U.S. fiscal expansion has a net stagflationary effect, by lowering output while at the same time raising inflation.

Table 2 shows the effects of permanent fiscal expansion in Japan. Note the following important point. The Japanese fiscal expansion has a very small effect on the U.S. trade balance, as a result of the fact that Japan is considerably smaller than the U.S. A one percent of GDP Japanese bond-financed fiscal expansion is seen to appreciate the Yen by about 3.9 percent, and to worsen the Japanese trade balance by about 0.6 percent of Japanese GDP. Overall, the current U.S. bargaining strategy of pressuring a Japanese fiscal

Table 2: World Model
Sustained Japanese Fiscal Expansion (1% GNP)

		1986	1987	1988	1989	1990
U.S. Economy						
Output	%	-0.14	-0.21	-0.25	-0.29	-0.31
Priv Consumption	%GNP	-0.12	-0.17	-0.20	-0.23	-0.24
Priv Investment	%GNP	-0.07	-0.10	-0.12	-0.13	-0.14
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.04	0.03	0.03	0.03	0.02
Imports	%GNP	-0.02	-0.03	-0.04	-0.04	-0.05
Trade Balance	%GNP	0.06	0.06	0.07	0.07	0.07
Labour Demand	%	-0.01	-0.10	-0.15	-0.18	-0.20
Inflation	D	0.13	0.10	0.07	0.06	0.04
Int Rate (short)	D	-0.02	0.03	0.07	0.11	0.15
Exchange Rate						
$/ecu	%	-0.11	-0.08	-0.05	-0.02	0.01
$/yen	%	3.90	3.79	3.69	3.59	3.50
$/aus	%	0.86	0.91	0.95	0.98	1.00
ROECD Economies						
Output	%	-0.13	-0.18	-0.21	-0.23	-0.24
Priv Consumption	%GNP	-0.13	-0.16	-0.17	-0.18	-0.18
Priv Investment	%GNP	-0.07	-0.09	-0.11	-0.12	-0.13
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.06	0.05	0.05	0.04	0.04
Imports	%GNP	-0.01	-0.02	-0.02	-0.03	-0.03
Trade Balance	%GNP	0.08	0.07	0.07	0.07	0.07
Labour Demand	%	-0.03	-0.09	-0.12	-0.14	-0.15
Inflation	D	0.10	0.07	0.06	0.05	0.04
Int Rate (short)	D	-0.04	-0.01	0.04	0.08	0.12
Japanese Economy						
Output	%	0.40	0.33	0.31	0.29	0.27
Priv Consumption	%GNP	0.09	0.03	0.00	-0.03	-0.05
Priv Investment	%GNP	-0.05	-0.07	-0.08	-0.09	-0.10
Govt Consumption	%GNP	1.00	1.00	1.00	1.00	1.00
Exports	%GNP	-0.61	-0.60	-0.59	-0.57	-0.55
Imports	%GNP	0.03	0.02	0.02	0.02	0.02
Trade Balance	%GNP	-0.64	-0.63	-0.61	-0.59	-0.57
Labour Demand	%	0.06	0.00	0.00	0.00	0.00
Inflation	D	-0.32	0.09	0.04	0.04	0.04
Int Rate (short)	D	0.09	0.13	0.17	0.21	0.24
Australian Economy						
Output	%	-0.12	-0.16	-0.16	-0.16	-0.16
Priv Consumption	%GNP	-0.18	-0.18	-0.17	-0.15	-0.13
Priv Investment	%GNP	-0.07	-0.09	-0.10	-0.11	-0.11
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.11	0.08	0.07	0.06	0.06
Imports	%GNP	-0.03	-0.03	-0.03	-0.03	-0.03
Trade Balance	%GNP	0.13	0.11	0.10	0.10	0.09
Labour Demand	%	-0.04	-0.10	-0.11	-0.11	-0.10
Inflation	D	0.09	0.07	0.04	0.03	0.02
Int Rate (short)	D	-0.06	-0.01	0.04	0.09	0.13

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 0.06 percent of U.S. GDP (about $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.

Compare in Tables 1 and 2 the employment effects of a fiscal expansion in the U.S. and in Japan. In the U.S. case, labour demand rises relative to the baseline for three years. In the Japanese case, on the other hand, labour demand rises in the year of the fiscal policy change, but then falls to exactly the baseline level in the following years. The difference in behaviour 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 labour-market clearing level. In a given year, the labour market can be jolted away from full employment because of unanticipated shocks that occur in the year, but in expectation, the labour market always clears in the out years.

Table 3 shows the results for a permanent Australian fiscal expansion. Output rises by 0.67 percent in the first year and then follows a familiar hump shape, declining to zero by 1995. Interest rates rise in 1986 which leads to an appreciation of 2.3 percent and then a gradual depreciation over a very long horizon. The slow rate of depreciation of the currency reflects the small interest

Table 3: World Model
Sustained Australian Fiscal Expansion (1% GNP)

		1986	1987	1988	1989	1990
U.S. Economy						
Output	%	-0.00	-0.01	-0.01	-0.02	-0.02
Priv Consumption	%GNP	-0.00	-0.01	-0.01	-0.01	-0.01
Priv Investment	%GNP	-0.01	-0.01	-0.01	-0.01	-0.01
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.01	0.01	0.01	0.01	0.00
Imports	%GNP	-0.00	-0.00	-0.00	-0.00	-0.00
Trade Balance	%GNP	0.01	0.01	0.01	0.01	0.01
Labour Demand	%	0.01	-0.00	-0.00	-0.01	-0.01
Inflation	D	0.01	0.01	0.01	0.01	0.00
Int Rate (short)	D	0.01	0.01	0.02	0.02	0.02
Exchange Rate						
$/ecu	%	0.01	0.01	0.01	0.01	0.01
$/yen	%	0.03	0.03	0.03	0.03	0.02
$/aus	%	2.29	2.08	2.00	1.97	1.97
ROECD Economies						
Output	%	-0.00	-0.01	-0.01	-0.01	-0.01
Priv Consumption	%GNP	-0.01	-0.01	-0.01	-0.01	-0.01
Priv Investment	%GNP	-0.01	-0.01	-0.01	-0.01	-0.01
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.01	0.01	0.01	0.01	0.01
Imports	%GNP	-0.00	-0.00	-0.00	-0.00	-0.00
Trade Balance	%GNP	0.01	0.01	0.01	0.01	0.01
Labour Demand	%	0.01	0.00	-0.00	-0.00	-0.01
Inflation	D	0.01	0.01	0.01	0.01	0.01
Int Rate (short)	D	0.01	0.01	0.02	0.02	0.03
Japanese Economy						
Output	%	-0.01	-0.01	-0.01	-0.01	-0.01
Priv Consumption	%GNP	-0.01	-0.01	-0.01	-0.01	-0.01
Priv Investment	%GNP	-0.01	-0.01	-0.01	-0.01	-0.01
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.02	0.01	0.01	0.01	0.01
Imports	%GNP	0.00	0.00	0.00	0.00	0.00
Trade Balance	%GNP	0.01	0.01	0.01	0.01	0.01
Labour Demand	%	0.01	-0.00	-0.00	-0.00	-0.00
Inflation	D	0.02	0.00	0.00	0.00	0.00
Int Rate (short)	D	0.01	0.01	0.02	0.03	0.03
Australian Economy						
Output	%	0.67	0.84	0.87	0.83	0.75
Priv Consumption	%GNP	0.24	0.33	0.32	0.27	0.20
Priv Investment	%GNP	-0.03	0.00	0.01	0.01	-0.00
Govt Consumption	%GNP	1.00	1.00	1.00	1.00	1.00
Exports	%GNP	-0.31	-0.23	-0.20	-0.20	-0.22
Imports	%GNP	0.22	0.26	0.26	0.25	0.23
Trade Balance	%GNP	-0.54	-0.49	-0.46	-0.45	-0.45
Labour Demand	%	0.22	0.60	0.69	0.62	0.50
Inflation	D	-0.58	-0.25	-0.06	0.04	0.08
Int Rate (short)	D	0.22	0.10	0.04	0.03	0.02

differential which emerges after the first year. Long interest rates rise in the first year but short rates move around reflecting short run changes in demand. Uncovered interest parity holds in this model. [9] The trade balance deteriorates by slightly more than 0.5 percent of GNP reflecting both a loss in export receipts, due to the stronger currency, and higher imports, due to the lower relative price of foreign goods and higher aggregate demand in Australia. Inflation (defined in terms of the consumer price index) initially falls due to the appreciation and due to little change in domestic prices reflecting cheaper imported goods in the production process. Both aggregate supply and aggregate demand increase in response to the shock. The domestic goods price then adjusts to lead to equilibration. In principle, prices can actually fall if the supply response is large than the demand response.

Tables 4 and 5 show the importance of specifying whether a shock is permanent, temporary or anticipated. In table 4, results are presented for a temporary 1 percent increase in government expenditure in Australia. The policy change is assumed to be credibly announced as a rise in government expenditure for three years from 1986. Comparing table 4 with table 3, several interesting points should be noted. Consumption rises by 0.37 percent in the case of the temporary shock. This is more than for the permanent shock because the forward-looking consumers due not need to increase saving to pay for future tax increase. In fact, to finance the deficit, interest rates must now rise by much more because households

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9. These results differ substantially from other Australian models such as the RBII model (Edey, Kerrison and Menzies(1987)) and the NIF88 model (Simes (1987), although they are similar in scale to the AMP model discusssed in Murphy (1986).

Table 4: World Model
Temporary (3 Yr) Australian Fiscal Expansion (1% GNP)

		1986	1987	1988	1989	1990
U.S. Economy						
Output	%	0.01	0.00	-0.00	-0.02	-0.02
Priv Consumption	%GNP	0.00	-0.00	-0.01	-0.01	-0.01
Priv Investment	%GNP	-0.01	-0.01	-0.01	-0.01	-0.01
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.01	0.01	0.01	0.00	-0.00
Imports	%GNP	-0.00	-0.00	-0.00	-0.00	-0.00
Trade Balance	%GNP	0.01	0.01	0.01	0.00	0.00
Labour Demand	%	0.02	0.01	0.01	-0.02	-0.02
Inflation	D	0.01	0.02	0.02	-0.01	-0.01
Int Rate (short)	D	0.03	0.05	0.08	0.04	0.03
Exchange Rate						
$/ecu	%	0.03	0.04	0.04	0.02	0.01
$/yen	%	0.04	0.05	0.06	0.01	0.00
$/aus	%	2.16	1.76	1.25	0.19	0.34
ROECD Economies						
Output	%	0.01	0.01	0.02	-0.01	-0.01
Priv Consumption	%GNP	0.00	0.01	0.02	-0.00	-0.00
Priv Investment	%GNP	-0.01	-0.01	-0.01	-0.01	-0.01
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.01	0.01	0.01	-0.00	-0.00
Imports	%GNP	-0.00	0.00	0.00	-0.00	-0.00
Trade Balance	%GNP	0.01	0.01	0.01	-0.00	-0.00
Labour Demand	%	0.01	0.02	0.03	-0.01	-0.01
Inflation	D	0.01	0.01	0.02	-0.00	-0.00
Int Rate (short)	D	0.02	0.05	0.10	0.05	0.04
Japanese Economy						
Output	%	-0.00	-0.01	-0.00	-0.01	-0.01
Priv Consumption	%GNP	-0.00	-0.01	0.01	0.00	-0.00
Priv Investment	%GNP	-0.01	-0.01	-0.01	-0.01	-0.00
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.02	0.01	0.00	-0.00	-0.00
Imports	%GNP	0.00	0.00	0.00	0.00	0.00
Trade Balance	%GNP	0.01	0.01	0.00	-0.00	-0.00
Labour Demand	%	0.01	-0.00	-0.00	-0.00	-0.00
Inflation	D	0.02	0.02	0.05	-0.05	0.00
Int Rate (short)	D	0.02	0.04	0.13	0.05	0.04
Australian Economy						
Output	%	0.76	0.97	1.09	-0.30	-0.54
Priv Consumption	%GNP	0.37	0.49	0.56	-0.27	-0.42
Priv Investment	%GNP	-0.08	-0.05	-0.03	-0.04	-0.07
Govt Consumption	%GNP	1.00	1.00	1.00	0.00	0.00
Exports	%GNP	-0.29	-0.19	-0.13	-0.07	-0.17
Imports	%GNP	0.24	0.28	0.31	-0.07	-0.12
Trade Balance	%GNP	-0.53	-0.47	-0.44	0.00	-0.05
Labour Demand	%	0.36	0.83	1.11	-0.49	-0.96
Inflation	D	-0.54	-0.13	0.22	0.70	0.33
Int Rate (short)	D	0.42	0.57	1.14	-0.11	0.03

are reluctant to save at the original interest rate. Notice also that consumers import more in the case of the temporary fiscal shock because of the desire to maintain consumption in the face of a temporary shock. The current account deteriorates by more because it is used for buffering in this case.

Table 5 presents results for a permanent fiscal expansion in Australia, anticipated in 1986 to occur in 1987. This simulation further highlights the role of forward-looking behaviour. The exchange rate appreciates on the announcement and then appreciates further when the policy is implemented. Long term interest rates rise in Australia, but the short rate initially fall reflecting the inial fall in aggregate demand. The differential in short interest rates, determine the path of the exchange rate and therefore shows why the exchange rate does not fully appreciate in 1986; the relatively lower Australian interest rates in 1986 imply an expected appreciation of the exchange rate. Consumers perceive the future taxes implied by the announcement and therefore cut consumption in 1986. Note also that imports decline in the case of the anticipated shock because the shock is known to be permanent consumers do not attempt to buffer the fall in consumption by borrowing from abroad where they did in the case of the temporary shock. Since the government spending has not come on line in 1986, aggregate demand falls by the fall in consumption. Once the policy is implemented the economy booms with higher short interest rates and output higher than the case in table 3, when policy was not announced in advance.

Table 5: World Model
Anticipated Australian Fiscal Expansion (1% GNP)

		1986	1987	1988	1989	1990
U.S. Economy						
Output	%	-0.02	-0.01	-0.01	-0.02	-0.02
Priv Consumption	%GNP	-0.01	-0.01	-0.01	-0.01	-0.01
Priv Investment	%GNP	-0.01	-0.01	-0.01	-0.01	-0.01
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.00	0.01	0.00	0.00	0.00
Imports	%GNP	-0.00	-0.00	-0.00	-0.00	-0.00
Trade Balance	%GNP	0.00	0.01	0.01	0.01	0.01
Labour Demand	%	-0.03	-0.00	-0.01	-0.01	-0.02
Inflation	D	-0.01	0.01	0.01	0.01	0.01
Int Rate (short)	D	-0.04	-0.00	-0.00	0.01	0.01
Exchange Rate						
$/ecu	%	-0.02	-0.00	0.00	0.01	0.01
$/yen	%	-0.01	0.02	0.02	0.02	0.02
$/aus	%	0.94	1.96	1.78	1.74	1.76
ROECD Economies						
Output	%	-0.03	-0.01	-0.01	-0.01	-0.02
Priv Consumption	%GNP	-0.03	-0.01	-0.01	-0.01	-0.01
Priv Investment	%GNP	-0.01	-0.01	-0.01	-0.01	-0.01
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.00	0.01	0.01	0.01	0.01
Imports	%GNP	-0.00	-0.00	-0.00	-0.00	-0.00
Trade Balance	%GNP	0.00	0.01	0.01	0.01	0.01
Labour Demand	%	-0.04	-0.00	-0.01	-0.01	-0.01
Inflation	D	-0.00	0.01	0.01	0.01	0.01
Int Rate (short)	D	-0.07	-0.01	-0.00	0.00	0.01
Japanese Economy						
Output	%	-0.04	-0.01	-0.01	-0.01	-0.01
Priv Consumption	%GNP	-0.03	-0.01	-0.01	-0.01	-0.01
Priv Investment	%GNP	-0.01	-0.01	-0.01	-0.01	-0.01
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.00	0.01	0.01	0.01	0.01
Imports	%GNP	-0.00	0.00	0.00	0.00	0.00
Trade Balance	%GNP	0.00	0.01	0.01	0.01	0.01
Labour Demand	%	-0.04	-0.00	-0.00	-0.00	-0.00
Inflation	D	-0.00	0.01	-0.00	0.00	0.01
Int Rate (short)	D	-0.07	-0.00	-0.00	0.00	0.01
Australian Economy						
Output	%	-0.40	0.95	1.12	1.13	1.05
Priv Consumption	%GNP	-0.35	0.42	0.51	0.49	0.42
Priv Investment	%GNP	0.01	0.01	0.05	0.05	0.04
Govt Consumption	%GNP	0.00	1.00	1.00	1.00	1.00
Exports	%GNP	-0.14	-0.20	-0.11	-0.10	-0.11
Imports	%GNP	-0.09	0.28	0.32	0.32	0.30
Trade Balance	%GNP	-0.06	-0.49	-0.43	-0.42	-0.41
Labour Demand	%	-0.76	0.78	1.16	1.19	1.05
Inflation	D	-0.23	-0.66	-0.26	-0.04	0.07
Int Rate (short)	D	-1.06	0.18	0.04	-0.02	-0.03

b. Monetary Transmission

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 simplified 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 neighbor. 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 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 depreciation on impact 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 that 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 6, a one percent U.S. monetary expansion raises U.S. output by 0.58 percent in the first year, and causes the exchange rate to depreciate by one percent relative to the Yen but by less relative to the ECU and Australian dollar. 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). There is a slight negative 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

Table 6: World Model
Sustained U.S. Monetary Expansion (1%)

		1986	1987	1988	1989	1990
U.S. Economy						
Output	%	0.58	0.43	0.31	0.21	0.13
Priv Consumption	%GNP	0.45	0.34	0.25	0.18	0.12
Priv Investment	%GNP	0.15	0.10	0.06	0.03	0.01
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.06	0.05	0.04	0.02	0.01
Imports	%GNP	0.07	0.05	0.03	0.02	0.01
Trade Balance	%GNP	-0.01	-0.00	0.00	0.00	-0.00
Labour Demand	%	0.87	0.61	0.43	0.28	0.16
Inflation	D	0.27	0.21	0.18	0.14	0.10
Int Rate (short)	D	-0.23	-0.14	-0.05	0.03	0.06
Exchange Rate						
$/ecu	%	1.04	1.02	1.02	1.01	0.98
$/yen	%	1.20	1.15	1.14	1.11	1.07
$/aus	%	0.85	0.87	0.89	0.91	0.90
ROECD Economies						
Output	%	-0.06	-0.01	0.02	0.02	-0.00
Priv Consumption	%GNP	-0.06	-0.02	0.01	0.01	0.01
Priv Investment	%GNP	-0.01	-0.01	-0.01	-0.02	-0.02
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.00	0.02	0.03	0.02	0.01
Imports	%GNP	-0.01	-0.00	-0.00	-0.00	-0.00
Trade Balance	%GNP	0.01	0.02	0.03	0.02	0.01
Labour Demand	%	-0.13	-0.04	0.01	0.02	-0.01
Inflation	D	-0.06	-0.01	0.03	0.05	0.05
Int Rate (short)	D	-0.21	-0.13	-0.03	0.06	0.10
Japanese Economy						
Output	%	-0.05	0.02	0.02	0.01	0.01
Priv Consumption	%GNP	-0.02	0.02	0.03	0.04	0.04
Priv Investment	%GNP	-0.01	-0.01	-0.02	-0.02	-0.02
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.03	0.00	0.00	-0.00	-0.01
Imports	%GNP	-0.01	-0.00	-0.00	-0.00	-0.00
Trade Balance	%GNP	-0.02	0.00	0.00	-0.00	-0.01
Labour Demand	%	-0.11	-0.00	-0.00	-0.00	-0.00
Inflation	D	-0.06	-0.04	0.07	0.06	0.03
Int Rate (short)	D	-0.18	-0.13	-0.02	0.07	0.11
Australian Economy						
Output	%	-0.15	-0.09	-0.03	0.00	0.01
Priv Consumption	%GNP	-0.23	-0.16	-0.09	-0.04	-0.01
Priv Investment	%GNP	0.00	-0.00	-0.01	-0.01	-0.01
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.03	0.04	0.05	0.05	0.03
Imports	%GNP	-0.04	-0.03	-0.02	-0.01	-0.00
Trade Balance	%GNP	0.07	0.07	0.07	0.06	0.03
Labour Demand	%	-0.18	-0.11	-0.01	0.04	0.05
Inflation	D	0.01	-0.01	0.00	0.02	0.03
Int Rate (short)	D	-0.25	-0.16	-0.05	0.04	0.09

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 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 little 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. This general conclusion is a key one, for it says that in fact 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 and may even be hurt.

Table 7 contains the results for a permanent 1 percent increase in the money supply in Australia. In contrast to the U.S. monetary expansion, the exchange rate overshoots its long-run value and depreciates by 1.5 percent in the first year. Output rises by 0.5 percent in the first year and then is gradually crowded out by rising inflation and interest rates. In this case the trade balance improves slightly because the stimulus to exports from the depreciation tends to dominate the stimulus to imports from the rise in aggregate demand.

The results for an anticipated monetary expansion in Australia, believed in 1986 to occur in 1987 and be permanent thereafter, are shown in table 8. The exchange rate depreciates on the news by 0.6 percent and then further depreciates, overshooting its long run value, once the policy is implemented. Output rises before the

Table 7: World Model
Sustained Australian Monetary Expansion (1%)

		1986	1987	1988	1989	1990
U.S. Economy						
Output	%	-0.00	-0.00	0.00	0.00	0.00
Priv Consumption	%GNP	-0.00	-0.00	0.00	0.00	0.00
Priv Investment	%GNP	0.00	0.00	0.00	0.00	0.00
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.00	-0.00	-0.00	-0.00	0.00
Imports	%GNP	0.00	0.00	0.00	0.00	0.00
Trade Balance	%GNP	-0.00	-0.00	-0.00	-0.00	-0.00
Labour Demand	%	-0.01	-0.00	-0.00	0.00	0.00
Inflation	D	-0.01	-0.00	-0.00	0.00	0.00
Int Rate (short)	D	-0.01	-0.01	-0.01	-0.01	-0.01
Exchange Rate						
$/ecu	%	-0.00	-0.00	-0.00	-0.00	-0.00
$/yen	%	-0.00	-0.00	-0.00	-0.00	-0.00
$/aus	%	-1.47	-1.29	-1.18	-1.10	-1.05
ROECD Economies						
Output	%	-0.00	-0.00	-0.00	0.00	0.00
Priv Consumption	%GNP	-0.00	-0.00	-0.00	-0.00	-0.00
Priv Investment	%GNP	0.00	0.00	0.00	0.00	0.00
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.00	-0.00	-0.00	-0.00	0.00
Imports	%GNP	-0.00	-0.00	0.00	0.00	0.00
Trade Balance	%GNP	-0.00	-0.00	-0.00	-0.00	0.00
Labour Demand	%	-0.01	-0.00	-0.00	-0.00	-0.00
Inflation	D	-0.01	-0.00	-0.00	0.00	0.00
Int Rate (short)	D	-0.01	-0.01	-0.01	-0.01	-0.01
Japanese Economy						
Output	%	0.00	0.01	0.00	0.00	0.00
Priv Consumption	%GNP	0.00	0.00	0.00	-0.00	-0.00
Priv Investment	%GNP	0.00	0.00	0.00	0.00	0.00
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.01	-0.00	-0.00	-0.00	0.00
Imports	%GNP	-0.00	-0.00	-0.00	-0.00	-0.00
Trade Balance	%GNP	-0.00	-0.00	-0.00	0.00	0.00
Labour Demand	%	-0.01	0.00	0.00	0.00	0.00
Inflation	D	-0.01	-0.00	0.00	0.00	0.00
Int Rate (short)	D	-0.01	-0.01	-0.01	-0.01	-0.01
Australian Economy						
Output	%	0.52	0.34	0.22	0.14	0.09
Priv Consumption	%GNP	0.34	0.22	0.15	0.10	0.07
Priv Investment	%GNP	0.09	0.06	0.04	0.02	0.01
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.21	0.13	0.08	0.05	0.03
Imports	%GNP	0.11	0.07	0.05	0.03	0.02
Trade Balance	%GNP	0.09	0.06	0.03	0.02	0.01
Labour Demand	%	1.05	0.66	0.41	0.25	0.15
Inflation	D	0.35	0.23	0.15	0.10	0.06
Int Rate (short)	D	-0.19	-0.13	-0.09	-0.06	-0.04

Table 8: World Model
Anticipated Australian Monetary Expansion (1% from 1987)

		1986	1987	1988	1989	1990
U.S. Economy						
Output	%	-0.00	-0.00	0.00	0.00	0.00
Priv Consumption	%GNP	-0.00	-0.00	0.00	0.00	0.00
Priv Investment	%GNP	0.00	0.00	0.00	0.00	0.00
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.00	-0.00	-0.00	0.00	0.00
Imports	%GNP	0.00	0.00	0.00	0.00	0.00
Trade Balance	%GNP	-0.00	-0.00	-0.00	-0.00	-0.00
Labour Demand	%	-0.00	-0.00	0.00	0.00	0.00
Inflation	D	-0.00	-0.01	-0.00	-0.00	0.00
Int Rate (short)	D	-0.00	-0.01	-0.01	-0.01	-0.01
Exchange Rate						
$/ecu	%	0.00	-0.00	-0.00	-0.00	-0.00
$/yen	%	0.00	-0.00	-0.00	-0.00	0.00
$/aus	%	-0.64	-1.29	-1.13	-1.04	-0.99
ROECD Economies						
Output	%	0.00	-0.00	0.00	0.00	0.00
Priv Consumption	%GNP	0.00	-0.00	-0.00	0.00	0.00
Priv Investment	%GNP	0.00	0.00	0.00	0.00	0.00
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.00	-0.00	-0.00	0.00	0.00
Imports	%GNP	0.00	-0.00	0.00	0.00	0.00
Trade Balance	%GNP	-0.00	-0.00	-0.00	-0.00	0.00
Labour Demand	%	0.00	-0.00	0.00	0.00	0.00
Inflation	D	-0.00	-0.01	-0.00	-0.00	0.00
Int Rate (short)	D	0.00	-0.01	-0.01	-0.01	-0.01
Japanese Economy						
Output	%	0.00	0.01	0.00	0.00	0.00
Priv Consumption	%GNP	0.00	0.00	0.00	-0.00	-0.00
Priv Investment	%GNP	0.00	0.00	0.00	0.00	0.00
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.00	-0.00	-0.00	-0.00	0.00
Imports	%GNP	-0.00	-0.00	-0.00	-0.00	0.00
Trade Balance	%GNP	-0.00	-0.00	-0.00	0.00	0.00
Labour Demand	%	0.00	0.00	0.00	0.00	0.00
Inflation	D	-0.00	-0.01	0.00	0.00	0.00
Int Rate (short)	D	0.00	-0.01	-0.01	-0.01	-0.01
Australian Economy						
Output	%	0.23	0.36	0.18	0.08	0.02
Priv Consumption	%GNP	0.16	0.23	0.12	0.05	0.02
Priv Investment	%GNP	0.04	0.06	0.03	0.01	0.00
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.09	0.14	0.07	0.03	0.00
Imports	%GNP	0.05	0.08	0.04	0.02	0.01
Trade Balance	%GNP	0.04	0.06	0.03	0.01	-0.00
Labour Demand	%	0.47	0.71	0.34	0.13	0.02
Inflation	D	0.15	0.38	0.23	0.13	0.07
Int Rate (short)	D	0.65	-0.18	-0.11	-0.06	-0.03

implementation of the policy because of the improvement in the trade balance due to the depreciation. Interest rates actually rise in anticipation of the shock due to the expected inflationary consequences of the shock and the fall in savings which pushes up real interest rates. The interest differential in Australia's favor reflects the depreciation expected once the monetary expansion takes place.

c. The Gramm-Rudman Package

There is a great deal of evidence that the large U.S. fiscal deficits of the 1980's is responsible for the large trade imbalances in the world economy. The purpose of this section is to examine the implications of a Gramm-Rudman style deficit reduction package announced in the U.S. in 1986 and assumed to be credible. This illustrates the usefulness of using a model such as the MSG2 model, to examine policies which are have long time horizons before implementation.

Results are shown in tables 9 and 10. Here the assumption is that the U.S. reduces fiscal deficits by 0.5 percent of GNP from 1986 to 1991 and then maintains a deficit from 1991 onwards which is 3 percent of potential GNP lower than currently expected. The difference between the two tables is that the first shows the impact without any change in U.S. monetary policy. The second assumes that the Fed desires to avoid any unemployment consequences and therefore credibly targets the unemployment rate with monetary policy. The money rule is found using dynamic optimization techniques discussed in further in McKibbin (1987).

Consider table 9 first. Since Gramm-Rudman involves an anticipated sequence of future deficit reductions in the U.S., the

Table 9: World Model
Credible Announcement of Gramm-Rudman Package in U.S.

		1986	1987	1988	1989	1990
U.S. Economy						
Output	%	1.00	0.13	-0.75	-1.59	-2.37
Priv Consumption	%GNP	1.15	0.62	0.09	-0.40	-0.82
Priv Investment	%GNP	0.11	0.08	0.07	0.11	0.19
Govt Consumption	%GNP	-0.50	-1.00	-1.50	-2.00	-2.50
Exports	%GNP	0.31	0.38	0.42	0.43	0.40
Imports	%GNP	0.07	-0.05	-0.17	-0.27	-0.36
Trade Balance	%GNP	0.24	0.43	0.59	0.70	0.76
Labour Demand	%	1.91	0.96	-0.07	-1.08	-2.07
Inflation	D	0.91	1.09	0.99	0.67	0.13
Int Rate (short)	D	3.16	3.49	3.64	3.35	2.25
Exchange Rate						
$/ecu	%	4.24	5.74	7.08	8.10	8.65
$/yen	%	4.82	6.67	8.03	9.05	9.60
$/aus	%	4.96	6.64	8.11	9.17	9.62
ROECD Economies						
Output	%	0.98	1.11	1.22	1.24	1.09
Priv Consumption	%GNP	1.07	1.20	1.32	1.38	1.29
Priv Investment	%GNP	0.10	0.18	0.29	0.44	0.60
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.08	-0.15	-0.25	-0.42	-0.63
Imports	%GNP	0.10	0.13	0.15	0.16	0.16
Trade Balance	%GNP	-0.19	-0.27	-0.40	-0.58	-0.79
Labour Demand	%	1.00	1.14	1.19	1.12	0.82
Inflation	D	0.03	0.18	0.18	0.09	-0.13
Int Rate (short)	D	1.66	2.18	2.66	2.84	2.39
Japanese Economy						
Output	%	0.79	0.31	0.36	0.41	0.47
Priv Consumption	%GNP	0.94	0.76	0.85	0.93	1.01
Priv Investment	%GNP	0.13	0.08	0.18	0.34	0.54
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.21	-0.49	-0.64	-0.81	-1.01
Imports	%GNP	0.08	0.02	0.03	0.04	0.06
Trade Balance	%GNP	-0.29	-0.52	-0.67	-0.86	-1.07
Labour Demand	%	0.80	0.00	-0.00	-0.00	-0.01
Inflation	D	0.01	0.97	0.25	0.06	-0.23
Int Rate (short)	D	1.30	2.11	2.60	2.78	2.49
Australian Economy						
Output	%	1.20	1.58	1.86	1.96	1.74
Priv Consumption	%GNP	1.46	1.81	2.12	2.28	2.12
Priv Investment	%GNP	-0.01	0.07	0.17	0.30	0.45
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.06	0.13	0.09	-0.03	-0.23
Imports	%GNP	0.32	0.43	0.52	0.59	0.59
Trade Balance	%GNP	-0.25	-0.30	-0.43	-0.62	-0.83
Labour Demand	%	1.12	1.68	1.95	1.95	1.53
Inflation	D	-0.35	-0.05	0.05	0.09	0.07
Int Rate (short)	D	1.49	2.05	2.62	2.96	2.74

forward-looking properties of the assets markets in the MSG2 model are important in the analysis. As can be seen, the announcement of the future fiscal cuts, raises output in the first period, mainly by reducing long-term real interest rates and depreciating the dollar upon the announcement of the policy. Short interest rates rise because of the fall in aggregate saving resulting from private sector dissaving before the realization of higher public sector saving. In later periods, 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. In Australia, the fall in long interest rates stimulates domestic demand sufficiently to offset the negative effect of a deteriorating trade balance. Short rates, real and nominal, initially rise due to the strong growth in domestic demand.

In table 10 we assume that the Fed attempts to dampen the effect of the fiscal policy change on employment. The policy which is followed has an initial monetary contraction in the U.S. followed by a continual monetary expansion. This has the effect of reducing the initial depreciation of the U.S. Dollar but increasing the depreciation by 1990. As can be seen, employment is maintained at the baseline level but at the cost of gradually rising inflation. The U.S. trade balance is seen to improve by 0.8 percent of GNP by 1990 but still well below that required to remove the trade imbalance. The Australian economy is also faced with a growing trade deficit and stronger currency without any change in policy. Investment remains flat but consumption is very strong and is responsible for the growth in the economy.

Table 10: World Model
Gramm-Rudman with U.S. Monetary Policy

		1986	1987	1988	1989	1990
U.S. Economy						
Output	%	-0.24	-0.55	-0.77	-0.95	-1.06
Priv Consumption	%GNP	0.31	0.16	0.07	0.04	0.07
Priv Investment	%GNP	-0.29	-0.14	0.06	0.29	0.57
Govt Consumption	%GNP	-0.50	-1.00	-1.50	-2.00	-2.50
Exports	%GNP	0.16	0.30	0.42	0.52	0.58
Imports	%GNP	-0.07	-0.13	-0.17	-0.21	-0.22
Trade Balance	%GNP	0.23	0.43	0.59	0.72	0.80
Labour Demand	%	0.00	-0.00	-0.00	-0.00	-0.00
Inflation	D	0.27	0.92	1.40	1.76	1.99
Int Rate (short)	D	4.58	5.58	6.22	6.58	6.00
Exchange Rate						
$/ecu	%	1.44	3.74	6.55	9.69	13.04
$/yen	%	2.01	4.75	7.62	10.86	14.39
$/aus	%	2.83	5.27	8.11	11.15	14.17
ROECD Economies						
Output	%	1.15	1.21	1.30	1.43	1.44
Priv Consumption	%GNP	1.25	1.34	1.45	1.58	1.59
Priv Investment	%GNP	0.06	0.14	0.27	0.44	0.64
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.02	-0.13	-0.26	-0.41	-0.59
Imports	%GNP	0.13	0.14	0.16	0.18	0.19
Trade Balance	%GNP	-0.15	-0.27	-0.42	-0.59	-0.78
Labour Demand	%	1.38	1.34	1.32	1.32	1.17
Inflation	D	0.22	0.25	0.11	-0.02	-0.23
Int Rate (short)	D	2.28	2.79	3.13	3.29	2.92
Japanese Economy						
Output	%	0.98	0.30	0.37	0.45	0.56
Priv Consumption	%GNP	1.13	0.85	0.95	1.04	1.18
Priv Investment	%GNP	0.09	0.01	0.15	0.32	0.53
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	-0.14	-0.53	-0.69	-0.86	-1.08
Imports	%GNP	0.11	0.03	0.03	0.05	0.06
Trade Balance	%GNP	-0.25	-0.56	-0.72	-0.91	-1.15
Labour Demand	%	1.13	0.00	0.00	-0.00	-0.00
Inflation	D	0.14	1.20	0.11	-0.03	-0.19
Int Rate (short)	D	1.84	2.70	2.99	3.06	2.91
Australian Economy						
Output	%	1.58	1.98	2.22	2.39	2.27
Priv Consumption	%GNP	2.07	2.45	2.69	2.86	2.69
Priv Investment	%GNP	-0.09	0.00	0.12	0.27	0.44
Govt Consumption	%GNP	0.00	0.00	0.00	0.00	0.00
Exports	%GNP	0.02	0.07	0.04	-0.03	-0.15
Imports	%GNP	0.41	0.54	0.63	0.71	0.72
Trade Balance	%GNP	-0.39	-0.47	-0.59	-0.74	-0.87
Labour Demand	%	1.60	2.15	2.32	2.37	2.05
Inflation	D	-0.35	-0.04	0.02	0.07	0.12
Int Rate (short)	D	2.13	2.75	3.21	3.62	3.62

4. Conclusions

The results above are preliminary and are mainly presented to illustrate the usefulness of the approach taken in the MSG project for analysing the Australian economy as part of a global system. The introduction of forward-looking agents provides additional channels of transmission of policy change within the Australian economy and from overseas. Future work will more carefully calibrate the Australian module to the institutional features of the Australian economy. Given this framework, we intend to use techniques of dynamic game theory, as developed and applied in McKibbin and Sachs (1986), to assess the implications for Australia of policy coordination between the major countries of the world economy.

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