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The Role of Exchange Rate Movements in Transmitting International Disturbances*

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Abstract

This study reviews the theory of how exchange rate movements affect the transmission across industrial countries of monetary and fiscal policies and of shifts in portfolio preferences. It argues that questions such as whether policies are transmitted positively or negatively under floating rates and whether effects are greater or smaller than when exchange rate movements are offset cannot be determined a priori. The paper reviews the evidence on such effects from large econometric models and presents simulations with a small two-country model. It concludes that the effects predicted by the Mundell-Fleming model do not apply consistently in practice.

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I. Introduction

The postwar period has been characterized by a high degree of interdependence among the industrial countries. Not only have policy changes in the large countries (most notably the very broad swings in monetary and fiscal policies in the United States) had important repercussions on other countries, there have also been large external shocks (especially the massive increases and subsequent decline in oil prices) that have affected individual countries quite differently and that thereby have altered the economic relationships among them. Since the advent of generalized exchange rate floating in 1973, shifts in exchange rates among industrial countries have come to play a central role in bringing about the required adjustment to such shocks. This paper builds on a large theoretical literature and a more limited empirical literature in order to try to clarify that role.

The question addressed in this paper--What are the effects of exchange rate movements in transmitting economic disturbances across countries?--is more complex than it at first appears. The difficulty is that exchange rates are to a large extent endogenous; even when they are a deliberate instrument of policy, changes must be accommodated by other policy instruments. The way these changes are implemented has a crucial bearing on the macroeconomic outcome.

There are two ways to clarify this question. The first method--which we employed in a recent paper--is to consider the effects of a given exchange rate change under a variety of assumptions about the factors that caused it to change. For example, a given depreciation of the U.S. dollar could be brought about by U.S. monetary expansion, fiscal restriction, or an independent shift in portfolio preferences by the general public. Changing the source can make a difference as important as whether U.S. output will be expected to rise or fall.

A complementary approach--which is the methodology of this paper--is to ask how economies respond to various shocks, first when exchange rates respond freely to those shocks and then when national authorities act to stabilize exchange rates. The difference between the two outcomes may be regarded as the effect of the exchange rate change. This method requires a subsidiary assumption on how exchange rates are being stabilized in the alternative scenario. A Bretton Woods system of fixed exchange rates may have quite different implications from those of a regime in which monetary policy reacts in a less systematic way so as to offset undesired changes. This paper focuses on the latter, because the intention is to isolate the effects of exchange rate movements in a floating-rate world, rather than to compare exchange rate systems.

This approach raises problems of implementation, because--as first argued by Lucas (1976)--econometric models with fixed parameters are not well suited for analyzing how economies might respond under alternative

policy strategies. Ideally, one would need to know not only how the multipliers of a model would differ under alternative policy shocks, but also how its parameters would change in response to a shift in regime. Unfortunately, the development of a methodology for studying possible parameter shifts is still in a primitive stage, and this study is forced to sweep a lot of difficulties under the econometric carpet. It may be argued, however, that parameter shifts are less likely to be a problem in comparisons of alternative reaction functions (which are known by market participants only indirectly and with uncertainty) than in comparisons of explicit policy regimes. Consequently, the Lucas critique may not be especially serious for the purposes of this paper. This subject is discussed further below, in Section IV.

Section II of this paper reviews a number of recent theoretical developments that have called into question some of the conventional presumptions as to the signs of the effects of exchange rate changes. Section III examines recent empirical evidence from simulations with large econometric models, in order to try to nail down the signs--and, where possible, the magnitudes--of these effects. Section IV presents additional evidence based on a small econometric model recently developed by two of the authors of this paper. This model is especially well suited for tests of the role of expectations in altering the response of the economy to various shocks. Finally, Section V summarizes the main conclusions of the paper.

II. Theoretical Considerations

Transmission with zero capital mobility

There is a long literature on the international transmission of monetary and fiscal policies. 1/ In the immediate postwar period, this topic was examined in the context of fixed nominal wage rates and zero capital mobility (Meade, 1951). It was assumed that trade in private claims did not occur, so that the current account either was always in balance (with flexible exchange rates) or corresponded to changes in reserves (with fixed exchange rates).

Monetary or fiscal expansion in the home country, under fixed exchange rates, would increase aggregate demand and imports from foreign countries, leading to a rise in output abroad. Thus expansion at home would spill over to foreign countries, limiting to some extent the domestic effects of expansion, but both regions would see a rise in output.

1/ See Mussa (1979) for early references; more recent articles have included Argy and Salop (1979), Branson and Buiter (1983), Corden and Turnovsky (1983), and Corden (1985).

In terminology that has come to be accepted, this would constitute positive transmission of the output effects from both monetary and fiscal policies.

In contrast, under flexible exchange rates, zero capital mobility and an absence of exchange market intervention imply a balanced current account at all times. Consequently, they isolate a country from the effects of other countries' monetary and fiscal policies. A fiscal expansion in the home country would affect the economy in much the same way as if it were a closed economy: it would tend to increase output and interest rates, the rise in the latter partially crowding out the fiscal expansion. A money supply increase would lead to a decline in interest rates and a consequent rise in output, at least in the short run. Neither policy would affect foreign economies: instead of transmission of policies, there would be macroeconomic independence. 1/

The Mundell-Fleming model

Mundell (1962) and Fleming (1962) were the first to draw the implications of high capital mobility for the transmission of monetary and fiscal policies. In their framework, there is perfect capital mobility, defined to mean that capital flows are perfectly elastic at the prevailing world nominal interest rate. Consequently, any current account imbalance can be financed at that interest rate. They also assume that capital flows tie the domestic interest rate to the foreign rate, making the two equal: implicitly, exchange rate expectations are assumed to be static, and domestic and foreign bonds are assumed to be perfect substitutes.

In the Mundell-Fleming model, monetary and fiscal policies have quite different effects than in the case of zero capital mobility. Their results also depend crucially on the nature of equilibrium in money markets, so it is necessary to be specific on the form of the demand for money function. They assume that money demand depends on real GNP, a short-term interest rate (equal to the world rate), and the GNP deflator. Since wages are exogenous, so is the GNP deflator. A small country will not be able to affect the world interest rate, so the interest rate also can be taken as exogenous. Monetary equilibrium requires money demand to equal money supply; therefore the remaining argument in the money demand equation, real output, cannot change unless the money supply has changed.

The well known consequences of this specification of monetary equilibrium are that for a small country with a floating exchange rate, fiscal policy is completely ineffective as a way of affecting output,

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1/ This result depends on the assumption that domestic expenditure does not respond to changes in the terms of trade. The contrary case is discussed by Laursen and Metzler (1950).

while monetary policy is very powerful. A fiscal expansion in the home country, increasing domestic demand, brings about an appreciation of the exchange rate that reduces foreign demand by enough that the output effects are zero. A monetary expansion, on the other hand, directly affects money market equilibrium. The increase in the supply of money relative to demand stimulates output and depreciates the exchange rate. The increase in output is greater than when capital is immobile, because in the case of capital immobility an increase in the money supply involves an incipient decline in domestic interest rates, a smaller depreciation, and a movement to the left along the LM curve which partially offsets the rightward shift in that curve.

These conclusions are qualified somewhat for large countries that can affect the world interest rate. In this case, a fiscal expansion will increase world aggregate demand and the world rate of interest; both countries will move up their LM curves and experience higher output. Thus, fiscal expansion will have some effect, and its output effects will be transmitted positively--but clearly fiscal policy is much less effective than when capital is immobile. Monetary expansion will tend to lower the world rate of interest, somewhat reducing the required domestic output increase necessary for monetary equilibrium. Abroad, a movement along an unchanged LM curve will associate a decline in interest rates with a decline in output: this occurs because of the appreciation of the foreign currency against the home currency, switching demand away from foreign goods and toward home goods. Thus, the Mundell-Fleming model produces the conclusion that monetary policy is transmitted negatively to the rest of the world: a monetary expansion stimulates output at home and reduces it abroad. If output fluctuations were caused by monetary shocks, the model would not provide a reason for business cycles to be synchronized across countries.

Rational exchange rate expectations: the Dornbusch model

One of the crucial building blocks in the Mundell-Fleming model is the assumption that capital mobility requires that foreign and domestic interest rates be equal. However, expectations that the exchange rate will change will affect expected returns from holding foreign securities; under flexible exchange rates, it is unrealistic to suppose that investors never expect a change in the exchange rate. Dornbusch (1976) replaces the assumption of equality of nominal interest rates with uncovered interest parity, equating the domestic interest rate to the foreign rate plus the expected rate of appreciation of the foreign currency. Furthermore, he assumes that expectations of appreciation are consistent with the model's predictions, and that goods prices, though no longer fixed, are less flexible than asset prices, namely the interest rate and the exchange rate. Price adjustment depends on a gap between actual output, given by demand, and potential output, which is exogenous.

The implication of these changes is that the money market equilibrium condition and the goods market equilibrium condition are no longer dichotomized. Fiscal expansion by a small country can change the domestic interest rate, at least in the short run; therefore, it can be associated with a rise in output even if prices in the short run are sticky. In addition, the model now involves an interesting dynamic adjustment process. A monetary expansion by any country will initially depreciate its exchange rate, but subsequently the exchange rate will appreciate, as the domestic price level slowly rises. Since exchange rate expectations are consistent with the model, therefore, after the initial (unexpected) depreciation, the expected appreciation will drive a wedge between domestic and foreign interest rates. Over some adjustment period, domestic rates will be lower by the expected rate of appreciation. The behavior of the exchange rate will thus involve overshooting in response to a monetary shock, an initial real depreciation, and stimulus to domestic output; in the long run the real exchange rate returns to its initial level and output to potential.

In a two-country extension of the Dornbusch model, it is now no longer necessarily true that monetary policy is transmitted negatively to the rest of the world under flexible exchange rates: a permanent money supply increase at home may increase home demand for foreign goods and lead to a rise of foreign output. Given an unchanged foreign money supply and sticky prices in the short run, money market equilibrium would require an increase in foreign interest rates, and this could occur even though interest rates decline at home, because of the expected appreciation of the home currency.

A permanent increase in government expenditure can be expected to raise demand both at home and abroad and thus to be positively transmitted to the foreign country, though this is not the only possible outcome. A fiscal expansion at home appreciates the exchange rate and raises the domestic interest rate. However, foreign interest rates could decline if the initial exchange rate appreciation gives rise to the expectation of a sizable subsequent depreciation. With an unchanged money supply, this decline could be effected only with a fall in foreign output. 1/

Another important difference between the Dornbusch and Mundell-Fleming models is that in the former, expectations of future policy moves matter, which is not the case for Mundell-Fleming. A policy change which is expected to be reversed has quite different effects from one that is

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1/ In the conventional framework, the direct rise in demand shifts the IS curve to the right, while the exchange rate movement works in the opposite direction.

permanent. In addition, policy changes can have effects before they are implemented if they are correctly anticipated. This has far-reaching implications for interpreting empirical evidence concerning changes in policies and observed output fluctuations in different countries. For instance, it is quite possible that the announcement of a future government spending decrease will depreciate the currency and stimulate output on impact in the home country. In this case, the (short-run) output effects in the home country will go in the same direction as a contemporaneous fiscal expansion, but the exchange rate effects will be opposite (Masson and Blundell-Wignall 1985). In the foreign country, output is likely to fall because of the loss of competitiveness. If so, output will move in opposite directions in the two countries, contrary to the positive transmission that is expected for contemporaneous fiscal expansion. Since expectations are unobservable, the nature of the international transmission mechanism is difficult to uncover from historical data.

Dependence of money demand on the exchange rate

In the Mundell-Fleming model, the demand for money depends on the GNP deflator; an alternative hypothesis would be that money balances are deflated by a consumer price index where both domestic and foreign goods appear (Argy and Salop 1979, Branson and Buiter 1983). Through this channel the exchange rate affects the demand for money, and provides a link between goods market and money market equilibrium conditions, even under static exchange rate expectations. Therefore, a fiscal expansion under flexible exchange rates and perfect capital mobility would, by appreciating the exchange rate, lower the consumer price index and raise real balances, allowing some increase in output at home. In the foreign country, the exchange rate movement would have the opposite effect: by raising the CPI, it would lower real balances and require, ceteris paribus, a fall in output. Thus, this channel in itself makes negative transmission of fiscal policy more likely. Monetary expansion, by depreciating the currency, would tend to raise the CPI in the home country, tending to offset the expansionary effect; in the foreign country, the fall in the CPI would raise real balances and would allow output to rise, other things being equal. Thus positive transmission of monetary policy would be made more likely by this change to the model.

Supply effects

Another feature of the model that deserves elaboration is the supply side of the economy. In the Mundell-Fleming model it does not appear explicitly; in Dornbusch, potential output, or aggregate supply, is exogenous. Several authors have analyzed the likely implications of modeling aggregate supply for the transmission mechanism. Hamada and Sakurai (1978), Argy and Salop (1979), Sachs (1979), Corden and Turnovsky (1983), Corden (1985), and Bruno and Sachs (1985) consider the effect of the terms of trade on wage formation and hence on the supply of output. Central to these articles is the difference between the real consumption

wage, which is relevant to the supply of labor, and the real product wage, which affects the demand for labor. The former is equal to the nominal wage deflated by the CPI; the latter is the nominal wage deflated by the price of domestic output. Therefore, the terms of trade drives a wedge between these two measures: an exchange rate appreciation lowers the CPI and increases the consumption wage, while the product wage is not directly affected. An appreciation may permit a fall in the nominal wage, and, other things equal, this will tend to increase employment and aggregate supply.

Argy and Salop (1979) consider a medium-term, static model of a small open economy with varying degrees of money illusion in wage setting. They show that the effects of monetary and fiscal policies involve shifts in aggregate supply as well as in aggregate demand. An increase in government spending shifts the IS curve to the right and increases aggregate demand; in addition, by revaluing the exchange rate, it lowers nominal wages (by an extent that depends inversely on the degree of money illusion). For a given price of domestic output, lower nominal wages increase aggregate supply. The rightward shift in the aggregate supply curve will stimulate output and may actually lead to lower domestic product prices.

The aggregate supply curve shifts in the opposite direction in response to a monetary expansion. In this case, the exchange rate depreciates, raising nominal wages except in the limiting case of full money illusion. For given product prices, higher nominal wages lead to lower supply; the shift to the left of the supply curve tends to offset the stimulatory effect on output. In the other limiting case of no money illusion, output does not increase at all, and wages and domestic prices increase proportionately with the exchange rate.

The effect on aggregate supply will depend crucially on wage behavior. Hamada and Sakurai (1978) assume that the home and foreign countries each are governed by Phillips curves that relate wage changes to expected changes in consumer prices and to output deviations from potential, while goods prices are determined in competitive markets: this makes nominal wages depend positively on the exchange rate. They show that in this model, with adaptive expectations of inflation, a recession at home tends to be transmitted abroad as stagflation--temporary declines in output and increases in inflation. Take for instance a monetary contraction at home; this appreciates the home currency, lowers the rate of nominal wage increase, and leads to some offset to the contractionary output effects. In the foreign country, higher import prices lead to higher inflation and to larger nominal wage increases. The depreciation of the foreign currency stimulates demand for the foreign good, but supply effects may lower output if product prices rise less than nominal wages, because higher real product wages make production less profitable. Thus, in the Hamada and Sakurai model, in which each country is specialized in the

production of one good (which is also assumed in all of the models we have considered up to this point), supply effects tend to produce positive transmission of the output effects of both monetary and fiscal policies--not the negative transmission of monetary policy implied by the Mundell-Fleming model.

Corden and Turnovsky (1983) consider different hypotheses concerning wage rigidity in a static two-country, two-good model, in which both countries produce the two goods. They argue that in the usual single-sector macro-model, in which each country is specialized in one of the goods, terms of trade effects will necessarily favor positive transmission of disturbances, including monetary policy, but that this need not be true in a two-sector model. They also introduce asymmetry in wage behavior, which reflects a widespread view that wages are more flexible in the United States than in Europe: they assume that nominal wages are fixed in the United States while real consumption wages are fixed in Germany.

A U.S. monetary expansion will raise output in the United States, but may reduce it in Germany, in Corden and Turnovsky's model with flexible exchange rates. They show that the effect on German employment (and output) can be decomposed into two multiplicative effects: the effect of the U.S. monetary expansion on the German terms of trade (ratio of the price of its exportable good to the price of its importable good), and the effect of the terms of trade on total employment in the two industries in Germany. Both effects can be either positive or negative, and positive transmission occurs only when both have the same sign.

A U.S. monetary expansion raises the prices of both goods, but their ratio (the terms of trade) will depend on whether the excess demand for for the U.S. exportable good (i.e. the German importable) rises or falls. If the share of the U.S. exportable good in U.S. consumption is large, then the German terms of trade is likely to fall. As for the employment effect, the normal case is assumed to be that an improvement of the German terms of trade brings about an increase in employment in Germany. This is less likely, the higher is the share of Germany's exportable in German consumption: in the limiting case in which that share is one, the real product wage in terms of the exportable is fixed (since it is equal to the real consumption wage in this case). Therefore, employment will not change in this industry, while employment in the importable industry will decline due to the rise in its product wage. The signs of the terms of trade and employment effects also depend on the degree of specialization of the two countries: the greater the extent to which each country is specialized in the production of its exportable good, the more likely it is that the employment and terms of trade effects are positive, implying that a U.S. monetary expansion produces an increase in output in Germany. Again assuming that nominal wages are fixed in the United States but real

consumption wages are fixed in Germany, an increase in U.S. government expenditure will either increase or decrease employment in Germany depending on whether the expenditure falls on the U.S. importable or exportable good, respectively.

Implications for the transmission of recent U.S. policies

The extensions to the Mundell-Fleming model that we have discussed add considerable ambiguity to the clear-cut conclusions concerning transmission of monetary and fiscal policies. The qualifications do throw light on the interpretation of recent economic events, in particular the policy mix of tight money and easy fiscal policy in the United States during the early years of this decade. According to the Mundell-Fleming predictions, this mix should be unambiguously positive for output in Europe and Japan, as fiscal policy is positively transmitted and monetary policy is negatively transmitted. More generally, if welfare is a function both of output and of rates of inflation, then even if output rose outside of the United States in response to U.S. policies, it would not be unambiguously favorable as the appreciation of the U.S. dollar would add to upward pressure on price levels abroad. In any case, the extensions to the Mundell-Fleming model throw doubt on whether the output consequences are necessarily positive, given the depreciation of other currencies against the dollar. Higher consumer prices abroad lead to lower real balances and hence to a combination of higher interest rates and lower output. If the real consumption wage is sticky, then a rise in real product wages will also result, which may bring about a fall in aggregate supply.

The importance of negative effects of the U.S. policy mix on an individual country are likely to be greater, the more sticky are real consumption wages in that country, the more its consumption price increases as a result of U.S. policies, and the less U.S. spending falls on the goods of that country. Empirical work by Bruno and Sachs (1985) and Branson and Rotemberg (1980) suggests that real wages tend to be sticky in Europe, much more so than in the United States, while evidence for Japan is somewhat mixed. As for the effect of depreciation in lowering real balances and causing a monetary contraction, this presupposes unchanged nominal money supply targets. In practice, the authorities have allowed themselves considerable flexibility in setting targets and revising them upward or downward. Therefore, it seems likely that this contractionary effect would, if recognized, be offset by the monetary expansion. As for the mix of trade, as discussed in Corden and Turnovsky (1983), if the home country expenditure increase falls on goods of which the foreign country is a net exporter, then transmission effects are more likely to be positive. This linkage would tend to favor Japan, a large exporter of manufactures to the U.S., over European countries, whose trade is more balanced, both geographically and with respect to types of goods. Therefore, of the three key linkages, two of them go in the

direction of output effects that are likely to be more negative for Europe than for Japan. In fact, Europe continues to suffer from high unemployment and only moderate growth rates; unemployment in the Federal Republic of Germany is currently around 8 percent, and output growth has averaged 2.3 percent per year over the past three years. In contrast, the rate of unemployment in Japan is currently 2.9 percent; real GNP grew at an average rate of 4.3 percent during 1983-85. The asymmetries discussed above may explain why criticism of U.S. policies in recent years has been much more vocal in Europe than in Japan.

III. Evidence From Large Models

The preceding section raises two specific questions that once appeared to be settled on the basis of theoretical models but that must in fact be tested empirically. First, is monetary policy transmitted negatively across countries in a world of floating exchange rates, and fiscal policy positively? Second, is monetary policy more powerful, and fiscal policy less powerful, under freely floating exchange rates than when exchange rate changes are offset through unsterlized intervention? In addition, it raises a general question that, while it cannot be tested very rigorously, can at least be examined through model simulations: what role do expectations play in transmitting policies under floating exchange rates?

Ideally, one would want to be able not only to answer these empirical questions but also to understand which of the various factors discussed earlier were important in producing a given outcome. For example, the Mundell-Fleming model predicts that monetary policy will be transmitted negatively, but several lines of analysis point to the possibility of positive transmission: Dornbusch's emphasis on expectations, Argy and Salop's introduction of consumer prices as a determinant of money demand, and several models in which the terms of trade affects the supply side of the model. Unfortunately, if a particular large-scale empirical model is characterized by positive transmission of monetary policy, it is generally quite difficult (and impossible without being able to modify the model in order to run comparative simulations) to sort out the influence of these various factors. The objectives of this section will therefore be relatively modest.

In recent years, a number of papers have been published that report model simulations that shed light on these various issues. For the most part, however, these tests relate only to the first of the three questions that have been posed: what is the direction of transmission under floating exchange rates? On the second question, concerning the power of monetary and fiscal policies under different reaction-function regimes, the evidence is much less extensive, because of the difficulty in many

models of testing alternative processes determining exchange rates. 1/ Similarly, the question of the role of expectations requires a model that is specifically designed to incorporate alternative assumptions about the expectations process. That question therefore will be postponed until the next section.

Available evidence is quite mixed on the question of whether monetary policy is transmitted positively or negatively to output in other countries. As shown in Table 1, three of the major linked model systems give conflicting answers regarding the transmission of U.S. policy to Japan and the Federal Republic of Germany. For this exercise, each model was simulated with a one-point decrease in a short-term interest rate (allowing the money supply to rise endogenously); short-term interest rates in the other countries were fixed at baseline levels. In response to this shock, the "Multi-Country Model" (MCM) of the Federal Reserve Board shows negative transmission to Japan, and also to Germany by the third year of the simulation; the Japanese EPA model shows positive transmission to Japan, and also to Germany by the fourth year; and the OECD's INTERLINK model shows small positive effects throughout. All three models indicate that monetary policy changes in Japan and Germany have only negligible effects on the other two countries.

A comprehensive survey of transmission effects in existing multi-country models was undertaken recently in connection with a conference organized by the Brookings Institution (see Bryant and others, 1986). For this conference, twelve internationally linked model systems were subjected to a similar set of simulations involving various policy changes and external shocks. Two of these simulations examined the effects of an increase in U.S. monetary growth. In one case, monetary growth was held unchanged in all other countries; in the other, foreign interest rates were fixed. In both simulations, all models show a depreciation of the U.S. nominal effective exchange rate, and most show a real effective depreciation as well, over at least a three-year period. However, the effects on the current account balance are mixed, because in some models the relative price effect (which would strengthen the current account) is dominated by the stimulus imparted to domestic demand by monetary expansion (which weakens it). Most models show negative transmission to both Japan and Germany, but several show (or at least imply) positive transmission to smaller industrial countries. Consequently, roughly half of the models show negative transmission to the other industrial countries as a group, with the remainder showing positive transmission.

1/ In addition, as noted in the Introduction, it is difficult to analyze this question empirically, because parameters may not be invariant with respect to the nature of the reaction function.

Table 1. Effects of Changes in Short-term Interest Rates on Real GNP in Other Countries

(Percentage deviations from baseline) 1/

United States: Federal Reserve Board Multicountry Model 2/

Country Decreasing Interest Rate

Impact on GNP in:	United States			Germany			Japan		
	U.S.	Germany	Japan	U.S.	Germany	Japan	U.S.	Germany	Japan
Year 1	0.2	0.1	-0.2	-0.0	0.2	-0.0	-0.0	-0.1	0.3
2	0.6	0.0	-0.6	-0.0	0.6	-0.0	0.0	-0.1	1.2
3	1.0	-0.1	-0.7	-0.1	0.8	-0.0	0.1	-0.1	2.0
4	1.2	-0.2	-0.9	-0.1	0.9	-0.0	0.1	-0.0	2.7

Japan: Economic Planning Agency World Model 3/

Country Decreasing Interest Rate

Impact on GNP in:	United States			Germany			Japan		
	U.S.	Germany	Japan	U.S.	Germany	Japan	U.S.	Germany	Japan
Year 1	0.4	-0.2	0.0	0.0	0.5	-0.0	-0.0	-0.0	0.1
2	0.7	-0.2	0.1	0.0	1.3	0.0	-0.0	-0.0	0.2
3	0.5	-0.1	0.1	0.0	2.0	0.1	-0.0	-0.0	0.3
4	0.1	0.2	0.1	0.1	2.3	0.1	-0.0	-0.0	0.4

OECD: INTERLINK Model 4/

Country Decreasing Interest Rate

Impact on GNP in:	United States			Germany			Japan		
	U.S.	Germany	Japan	U.S.	Germany	Japan	U.S.	Germany	Japan
Year: 1	0.3	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.4
2	0.6	0.1	0.1	0.0	0.3	0.1	0.0	0.1	0.9
3	0.6	0.1	0.1	0.0	0.5	0.1	0.0	0.1	1.2
4	0.6	0.1	0.0	0.0	0.7	0.0	0.0	0.0	1.5

1/ Simulated effects for a 1 percentage-point decrease in interest rates. "Germany" refers to the Federal Republic of Germany.

2/ Obtained by communication with the staff of the Federal Reserve Board early in 1986; simulations were performed using the then-standard version of the MCM. The four- to six-month commercial paper rate was decreased in the case of the United States, the call money rate for Japan, and the three-month treasury bill rate for Germany.

3/ Source: Helliwell and Padmore (1985), Table 4.1.

4/ Obtained by communication with OECD staff early in 1986; simulations were performed using the then-standard version of INTERLINK.

The finding that monetary expansion in the United States might have a negative effect on output growth in Germany while stimulating growth in other European countries raises questions of consistency. The degree of economic integration is fairly high throughout Europe, and the portion of total trade that is done with the United States is similar across countries. It may be that the modeling of smaller countries has been less successful than that of the large countries, in which case the negative transmission to Japan and Germany may be more widely applicable than has been found in these studies. Nonetheless, there is enough variety in the evidence--even for these two countries--to warrant a certain caution in concluding that negative transmission is likely to prevail. A safer view would be to conclude that whatever the sign of the effect, it is unlikely to be either sizable or reliable. In any event, since in the absence of changes in exchange rates the transmission of monetary policy should be unambiguously positive, it is clear that the effect of exchange rate movements is to dampen that process considerably and to help isolate monetary effects within the originating country.

This conclusion must be modified somewhat when account is taken of price movements as well as output. With exchange rates prevented from changing, the main channel by which monetary expansion would raise prices abroad (assuming no change in monetary growth in those countries) would be through the general pull of excess demand. Empirical evidence--see, for example, the survey by Helliwell and Padmore (1985)--suggests that this channel would generally produce only negligible increases in prices outside the originating country. But with exchange rates appreciating abroad, price inflation could be significantly reduced. In fact, virtually all of the models included in the Brookings project show a net decrease in prices (relative to baseline) in other industrial countries in response to monetary expansion in the United States, regardless of what they show happening to output. For a sustained 4 percent rise in M1, these decreases in most cases ranged from 1/2 of 1 percent to about 1 percent. Thus the general implication of this evidence is that allowing exchange rates to adjust to the monetary shock effectively insulates other countries from the output effects but introduces a substantial negative price effect.

Evidence on the second question--whether the domestic effects of monetary and fiscal policies are more or less powerful when exchange rates are allowed to float freely--has been offered in three recent papers, by Chan-Lee and Kato (1984), Yoshitomi (1984), and Helliwell and Padmore (1985). The first of these examines ten unlinked models 1/

1/ An unlinked model is one that omits feedback from changes in other countries that are induced by a shock in the home country.

maintained by the authorities of the countries concerned; the other two papers provide evidence from the Japanese EPA model, and Helliwell and Padmore also look at simulations with a version of the Canadian RDX2 model that incorporates linkages with the United States derived from the Federal Reserve Board's MPS model. As noted above, all of these studies are predicated on the assumption that behavioral parameters are unaffected by changes in the reaction functions of the authorities; the conclusions thus should be interpreted cautiously.

The evidence for monetary policy broadly supports the basic Mundell-Fleming conclusion: effects on domestic output are larger with exchange rate flexibility. Chan-Lee and Kato show (Table 12, p. 131) that this relation holds over at least a three-year horizon in six of the seven countries that they examined. 1/ Helliwell and Padmore report that simulations with the EPA model indicate that exchange rate flexibility roughly doubles the four-year output multipliers in most large industrial countries, although the U.S. multipliers are about 30 percent smaller. 2/ They also report similar results for Canada (output multipliers 2 1/2 times larger than with fixed rates) using the RDX2-MPS system.

Comparison of fiscal policy effects is much less clear. The unlinked national models examined by Chan-Lee and Kato generally show relatively greater effects when exchange rates are flexible, but tests with the EPA model and the RDX2-MPS system show that effects depend little on the exchange rate regime. Yoshitomi also indicates that fiscal multipliers with the EPA model change very little between the fixedrate and flexible-rate regimes. The reason for this finding is essentially that fiscal policy has little effect on exchange rates in that model. For example, Yoshitomi's tables imply that a sustained increase in U.S. government spending equal to 5 percent of GNP (which is roughly the magnitude of the shift in U.S. fiscal policy from 1980 to 1985, although the shift in practice was primarily on the tax side) would generate less than a 2 percent appreciation of the dollar's effective exchange rate.

1/ The six countries are the United States, Japan, France, the United Kingdom, Australia, and New Zealand; the exception is the Netherlands. By the seventh simulation year, this pattern was reversed in several cases, but it should be noted that the models were not all constructed with long-run properties as a major objective.

2/ See their Table 4.1, pp. 1127-1130. The version of the EPA model used for those simulations appears to have some properties that are quite hard to understand and that may cast some doubt on the consistency of the results. For example, after four years (with floating exchange rates), a change in the U.S. discount rate is shown to have a greater effect on output in Canada and Italy than it has on U.S. output.

Before concluding that exchange rate changes associated with fiscal policies are of little practical consequence, it is worth examining the evidence a bit more closely. After all, U.S. fiscal policy clearly was a sizable contributor to the 60 percent real effective appreciation of the dollar that occurred from late 1980 to the first part of 1985 (see Knight and Masson, 1986). It is well known that the ability of econometric models to explain movements in exchange rates is poor, and it is probable that the models examined here have failed to capture fully the channels by which fiscal policies affect exchange rates. In particular, at least part of the difficulty appears to stem from the failure of either reduced-form exchange rate equations or large-scale models to account for term-structure effects. Implicitly, most empirical studies assume that a change in short-term interest rate differentials leaves long-term differentials unchanged. In contrast to real shortterm differentials, which most tests show exert about a one-for-one effect on exchange rates, real long-term differentials may exert an effect that is nearly proportional to the maturity of the assets concerned. 1/ Thus a shift of 5 percentage points on ten-year bonds could cause up to a 50 percent movement in the exchange rate, or about ten times what most models would predict. Until the empirical validity of this point can be adequately tested, the relevance of tests of the international effects of fiscal policy will remain difficult to interpret.

IV. Evidence from MINIMOD

This section presents the results of several simulation experiments performed with MINIMOD, a small macroeconomic model developed recently at the IMF (Haas and Masson, 1986). These simulations have been designed to answer the three questions raised in the last section: Are changes in monetary and fiscal policies transmitted positively or negatively between countries when exchange rates float freely; does exchange rate flexibility enhance or diminish the efficacy of policy within a country; and what role do expectations play in the policy transmission process?

MINIMOD can be described briefly as a relatively small simulation model of two economies: the United States and its major trading partners. The structural parameters of the model were determined through simulations with much larger models, principally the Federal Reserve Board's MCM. The model eclectically embodies modern economic theories and pays particular attention to long-run considerations. Because it can be simulated in

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1/ This point is developed in U.S. Council of Economic Advisors (1984) and in Shafer and Loopesko (1983). The extreme case of proportionality requires the assumptions of perfect substitutability between assets of all maturities denominated in different currencies and of perfect-foresight expectations.

either an adaptive expectations mode or in a "model-consistent" expectations mode, MINIMOD is particularly useful in assessing the role of expectations. When model-consistent expectations--often imprecisely referred to as rational expectations--are employed, the model is solved iteratively until the expected values for the exchange rate, inflation rates, and long-term interest rates are equal to their future values as generated by the model.

MINIMOD captures a number of the generalizations of the Mundell-Fleming model discussed in Section II, and thus should shed some light on their empirical importance. Exchange rate expectations drive a wedge between domestic and foreign interest rates; moreover, with model-consistent expectations, a monetary shock produces exchange rate overshooting as in Dornbusch's model. Money demand in MINIMOD depends on an *absorption price, not the GDP deflator, so that exchange rate changes do* affect monetary equilibrium. Finally, supply considerations are captured in the model, albeit in a rudimentary way, as the wage-price block of the MCM has been reduced to a single inflation equation. 1/

There are other features of MINIMOD that also complicate the transmission of monetary and fiscal shocks, including the dynamics of asset accumulation, lags in expenditure equations, and differential movements of short-term and long-term interest rates. It may also be noted that the structure of MINIMOD is sufficiently straightforward to permit analysis of the effects of changes in individual parameters. This possibility is important for problems where it is thought that parameters might change in response to a regime change, such as between fixed and floating exchange rtes. For example, the assumption of perfect substitutability between similar assets denominated in different currencies may be more applicable when exchange rates are fixed than when they fluctuate substantially over time. More generally, the mechanism by which exchange rate expectations are formed may not be invariant with respect to regime changes. Nonetheless, it is difficult to form strong judgments on the extent to which such parameters would change, and no such attempt has been made in this paper.

Several sets of MINIMOD simulations are examined in this section. First, U.S. monetary and fiscal shocks are applied to the adaptive expectations version of the model in which the exchange rate is free to move. Second, the same shocks are again applied to the model but assuming that each non-U.S. country reacts to U.S. policy changes by adjusting its

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1/ This equation captures the response of the demand for employment in the MCM to the real product wage, while wage bargaining reflects expected future absorption prices because of their effect on the consumption wage. Exchange rate changes thus permit output effects, given that they affect the two measures of real wages differently.

money supply by enough to keep the nominal exchange rate constant. Thus comparisons within each set of simulations provide information on how policy might be transmitted between industrial countries for different degrees of exchange rate flexibility, while comparisons of the same shock between the two sets of simulations suggest how the efficacy of a given policy might be affected by varying exchange rate flexibility. A third set of simulations replicates the same shocks with MINIMOD in its model-consistent expectations mode; thus comparisons of the first and third set of simulations are indicative of how policy transmission might be affected by expectations.

Monetary and fiscal policy with adaptive expectations and flexible exchange rates

Table 2 presents the results of four simulations: a contractionary fiscal shock in the United States, an expansionary fiscal shock in the rest of the world (ROW), and expansionary monetary shocks in both the United States and ROW. The fiscal shocks are equal to 1 percent of baseline real GNP and hold monetary aggregates fixed, while the monetary shocks gradually increase narrow money to a level 4 percent above baseline, over a two-year period.

The assumptions for this set of simulations come closest to conforming to the Mundell-Fleming model discussed in Section II: capital flows are perfectly elastic and the exchange rate is free to move. However, this model differs in several important respects: prices--although sticky--do move, each economy is large enough to affect interest rates through policy changes, and expectations are adaptive, not static. Nevertheless, an examination of Table 2 shows that policy is largely transmitted as the Mundell-Fleming model predicts: fiscal policy is transmitted positively between countries, and monetary policy negatively.

The first panel shows the results of a U.S. fiscal contraction. GNP in both economies falls, the dollar slowly depreciates, and interest rates fall in both the United States and the ROW. 1/ The second panel

1/ Ultimately, the dollar must appreciate, not depreciate. A fiscal contraction leads to an increase in claims on foreigners, and, consequently, future investment income inflows that, in turn, will be offset by a lower trade balance in the steady state. Thus eventually the real exchange rate must appreciate by enough to produce that weakening of the trade balance. More generally, if the real interest rate is less than the growth rate of real income, a fiscal contraction today will require a future increase in government expenditure or a decrease in future taxes if the debt-to-income ratio is to be stabilized. Consequently, the short-run and long-run effects of fiscal policy may be opposite in sign (Penati, 1983; Buiter, 1984; Sachs and Wyplosz, 1984). Branson and Buiter (1983) consider some of these issues and the importance of the accumulation of net claims on foreigners for the effects of monetary and fiscal policies.

Table 2. MINIMOD Fiscal and Monetary Shocks Assuming Flexible Exchange Rates and Adaptive Expectations

(Percentage deviations from baseline) 1/

		U.S. Variables						Rest-of-World (ROW) Variables				
		E 2/	GNP	P 3/	PGNP 3/	RS 4/	RL 4/	GNP	P 3/	PGNP 3/	RS 4/	RL 4/
1. U.S. Fiscal Contraction 5/												
Year:	1	0.4	-1.3	-0.0	-0.1	-1.0	-0.1	-0.2	-0.0	-0.0	-0.1	-0.0
	2	0.8	-1.2	-0.2	-0.4	-1.1	-0.1	-0.3	-0.1	-0.1	-0.2	-0.0
	3	1.1	-0.9	-0.4	-0.6	-1.1	-0.2	-0.4	-0.2	-0.1	-0.3	-0.0
	4	1.4	-0.6	-0.7	-0.9	-1.1	-0.2	-0.4	-0.3	-0.2	-0.4	-0.0
	5	1.7	-0.4	-1.0	-1.2	-1.2	-0.3	-0.4	-0.4	-0.4	-0.5	-0.1
	6	2.0	-0.1	-1.2	-1.6	-1.2	-0.3	-0.4	-0.6	-0.5	-0.5	-0.1
2. ROW Fiscal Contraction 5/												
Year:	1	-0.2	-0.1	-0.0	-0.0	-0.1	-0.0	-1.4	-0.0	-0.1	-0.6	-0.0
	2	-0.5	-0.1	-0.1	-0.1	-0.2	-0.0	-1.8	-0.1	-0.3	-0.9	-0.1
	3	-0.8	-0.2	-0.2	-0.1	-0.4	-0.0	-1.9	-0.3	-0.5	-1.0	-0.1
	4	-1.1	-0.2	-0.4	-0.3	-0.5	-0.1	-1.8	-0.6	-0.8	-1.1	-0.1
	5	-1.3	-0.1	-0.6	-0.4	-0.7	-0.1	-1.5	-0.9	-1.1	-1.2	-0.2
	6	-1.4	-0.1	-0.8	-0.6	-0.8	-0.1	-1.1	-1.2	-1.5	-1.2	-0.2
3. U.S. Monetary Expansion 6/												
Year:	1	1.2	0.2	0.1	0.0	-2.8	-0.1	-0.0	-0.1	-0.0	-0.1	-0.0
	2	2.4	0.6	0.3	0.1	-2.6	-0.3	-0.1	-0.1	-0.1	-0.1	-0.0
	3	3.1	0.9	0.5	0.4	-2.0	-0.3	-0.1	-0.2	-0.1	-0.2	-0.0
	4	3.6	1.0	0.8	0.7	-1.6	-0.4	-0.1	-0.3	-0.2	-0.2	-0.0
	5	4.0	1.1	1.2	1.0	-1.3	-0.4	-0.1	-0.3	-0.2	-0.2	-0.0
	6	4.3	1.1	1.6	1.4	-1.0	-0.5	-0.1	-0.4	-0.3	-0.2	-0.0
4. ROW Monetary Expansion 6/												
Year:	1	-1.0	0.0	-0.1	-0.0	-0.1	-0.0	0.0	0.0	0.0	-2.2	-0.1
	2	-1.8	-0.0	-0.2	-0.1	-0.2	-0.0	0.3	0.1	0.1	-2.0	-0.2
	3	-2.2	-0.0	-0.3	-0.2	-0.3	-0.0	0.9	0.2	0.2	-1.6	-0.2
	4	-2.5	0.0	-0.4	-0.3	-0.4	-0.0	1.4	0.3	0.3	-1.3	-0.2
	5	-2.7	0.1	-0.5	-0.4	-0.4	-0.1	1.8	0.5	0.6	-1.0	-0.2
	6	-2.8	0.1	-0.6	-0.5	-0.4	-0.1	2.2	0.8	0.9	-0.7	-0.3

1/ Average of four quarters.
2/ A positive value indicates a U.S. dollar depreciation.
3/ P is the absorption deflator, PGNP is the output deflator.
4/ RS and RL are the short- and long-term interest rates, respectively, and are expressed as percentage point deviations from baseline.
5/ The fiscal shock is a decrease in real government expenditure equal to 1 percent of base real GNP.
6/ The monetary shock is a 4 percent increase in the narrow money stock spread over two years.

shows the results of an increase in government expenditure in ROW. The results differ somewhat quantitatively from the U.S. fiscal shock--the exchange rate and interest rates change by smaller amounts--but not qualitatively. Fiscal policy is transmitted positively.

The third panel presents the results of an expansionary U.S. monetary policy. The dollar monotonically depreciates and interest rates in both economies fall, relative to their baseline values, over the five-year simulation period with the decrease in interest rates being more pronounced in the United States. Output in the United States is up, at least over the five-year period shown, and down (by a smaller amount) in the ROW. Thus monetary policy is transmitted negatively between the United States and the ROW.

The final panel shows the results of an equivalent monetary shock in the ROW. The results are roughly the same as the U.S. monetary shock, but they do require some explanation. First, there is a slight positive transmission of the shock in the first year of simulation. The dollar appreciation causes U.S. consumption prices to fall relative to U.S. output prices. This has the effect of raising U.S. consumption and, consequently, output. This factor is strong enough to delay the negative transmission of expansionary monetary policy in the ROW to the United States. By the end of the simulation, several factors--principally lower long-term interest rates, strong demand from abroad, as well as a favorable movement in the real exchange rate--have combined to raise U.S. output above its baseline level.

Monetary and fiscal shocks with adaptive expectations and an exchange rate reaction function

Table 3 presents the results of 4 simulations identical in all respects to those discussed above except that the exchange rate is kept constant by assuming that each country responds to foreign policy changes by adjusting its money supply enough to exactly offset the movement of the exchange rate that would otherwise result. 1/ A monetary response to nominal exchange rate variability was selected so as to reflect actual practice as closely as possible. In principle any exogenous policy variables could be altered to achieve the same exchange rate effect. The choice of the policy instrument is critical, because different instruments will yield fundamentally different results. This can easily be seen by considering a foreign monetary expansion that, in the absence

1/ The results presented in Table 2 are a limiting case, in that all of the exchange rate response is assumed to be removed by non-sterilized intervention; simulations in which the reaction is less than complete would have values that fall between the results shown in Tables 2 and 3.

Table 3. MINIMOD Fiscal and Monetary Shocks Assuming Fixed Exchange Rates and Adaptive Expectations

(Percentage deviations from baseline) 1/

		U.S. Variables						Rest-of-World (ROW) Variables				
		E 2/	GNP	P 3/	PGNP 3/	RS 4/	RL 4/	GNP	P 3/	PGNP 3/	RS 4/	RL 4/
1. U.S. Fiscal Contraction 5/												
Year:	1	0.0	-1.3	-0.1	-0.1	-1.1	-0.1	-0.1	-0.0	-0.0	-1.1	-0.0
	2	0.0	-1.2	-0.3	-0.4	-1.2	-0.1	-0.2	-0.1	-0.0	-1.2	-0.1
	3	0.0	-0.9	-0.6	-0.7	-1.3	-0.2	-0.0	-0.1	-0.1	-1.3	-0.1
	4	0.0	-0.6	-0.9	-1.1	-1.3	-0.2	0.2	-0.1	-0.1	-1.3	-0.2
	5	0.0	-0.3	-1.2	-1.4	-1.4	-0.3	0.5	-0.2	-0.4	-1.4	-0.2
	6	0.0	-0.1	-1.6	-1.8	-1.5	-0.3	0.8	-0.2	-0.1	-1.5	-0.2
2. ROW Fiscal Contraction 5/												
Year:	1	0.0	-0.1	-0.0	-0.0	-0.6	-0.0	-1.4	-0.0	-0.1	-0.6	-0.0
	2	0.0	-0.0	-0.0	-0.0	-0.9	-0.1	-1.8	-0.1	-0.3	-0.9	-0.1
	3	0.0	0.1	-0.1	-0.1	-1.1	-0.1	-1.9	-0.4	-0.5	-1.1	-0.1
	4	0.0	0.1	-0.2	-0.1	-1.2	-0.2	-1.8	-0.6	-0.8	-1.2	-0.1
	5	0.0	0.2	-0.3	-0.2	-1.3	-0.2	-1.6	-1.0	-1.2	-1.3	-0.2
	6	0.0	0.3	-0.4	-0.2	-1.4	-0.2	-1.2	-1.3	-1.6	-1.4	-0.2
3. U.S. Monetary Expansion 6/												
Year:	1	0.0	0.1	0.0	0.0	-1.7	-0.1	0.0	0.0	0.0	-1.7	-0.1
	2	0.0	0.4	0.0	0.0	-3.0	-0.2	0.2	0.0	0.0	-3.0	-0.2
	3	0.0	0.7	0.1	0.1	-2.5	-0.3	0.7	0.0	0.1	-2.5	-0.2
	4	0.0	1.0	0.2	0.3	-2.3	-0.4	1.4	0.1	0.2	-2.3	-0.3
	5	0.0	1.1	0.4	0.4	-2.0	-0.5	2.1	0.3	0.4	-2.0	-0.4
	6	0.0	1.3	0.6	0.7	-1.7	-0.6	2.7	0.6	0.8	-1.7	-0.4
4. ROW Monetary Expansion 6/												
Year:	1	0.0	0.1	0.0	0.0	-2.3	-0.1	0.0	0.0	0.0	-2.3	-0.1
	2	0.0	0.4	0.0	0.1	-2.2	-0.2	0.3	0.0	0.0	-2.2	-0.2
	3	0.0	0.6	0.1	0.1	-1.7	-0.3	0.8	0.0	0.1	-1.7	-0.2
	4	0.0	0.7	0.2	0.2	-1.4	-0.3	1.3	0.1	0.2	-1.4	-0.2
	5	0.0	0.8	0.3	0.4	-1.1	-0.4	1.8	0.3	0.4	-1.1	-0.3
	6	0.0	0.9	0.5	0.6	-0.8	-0.4	2.1	0.5	0.7	-0.8	-0.3

1/ Average of four quarters.
2/ A positive value indicats a U.S. dollar depreciation.
3/ P is the absorption deflator, PGNP is the output deflator.
4/ RS and RL are the short- and long-term interest rates, respectively, and are expressed as percentage point deviations from baseline.
5/ The fiscal shock is a decrease in real government expenditure equal to 1 percent of baseline real GNP.
6/ The monetary shock is a 4 percent increase in the narrow money stock spread over two years.

of any domestic policy response, would lead to an appreciation of the home currency. This appreciation can be offset by a number of different responses, a fiscal contraction and a monetary expansion among them. These two later options share one property--their exchange market consequences--but differ drastically in almost all of their other macroeconomic implications. 1/

In this case--unchanged exchange rates--the transmission of monetary policy should be positive; an increase in monetary growth in one country should lead to an increase in the money supply of the other if the exchange rate is to be unaffected. Therefore output should, temporarily at least, increase in both economies. Fiscal policy, on the other hand, might be transmitted either positively or negatively. A fiscal contraction in one country leads not only to decreased demand for the output of the other but also to lower interest rates which, in turn, contribute to higher aggregate demand abroad.

The four panels of Table 3 bear out these theoretical results. In both fiscal shocks, the transmission is initially positive and then becomes negative as the cumulating effects of interest rate changes come to dominate the more immediate direct demand effect. Similarly, the direct transmission of monetary policy is straightforward and unambiguous.

A comparison of Tables 2 and 3 suggests that the effect of fiscal policy on home-country output is not dependent on the degree of exchange rate flexibility. When exchange rates are held fixed, foreign interest rates fall by more than when exchange rates are flexible. These interest rate declines give rise to foreign activity changes that have approximately the same effect on home demand that exchange rate changes have via relative prices in the flexible exchange rate case. In contrast, monetary policy is most effective in both economies when the exchange rate is flexible, at least over the first several years of simulation. In the United States long-term interest rates have fallen by enough in the fixed-rate case that output is higher than in the flexible rate case in the final two years of simulation.

Fiscal and monetary shocks with flexible exchange rates and model-consistent expectations

Exactly the same shocks described in the preceding two sections were also applied to the model-consistent expectations version of MINIMOD (Tables 4 and 5). In these simulations, the future course of exogenous variables together with the model determine the present value of the

1/ See Boughton and others (1986).

Table 4. MINIMOD Fiscal and Monetary Shocks Assuming Flexible Exchange Rates and Model-Consistent Expectations

(Percentage deviations from baseline) 1/

		U.S. Variables						Rest-of-World (ROW) Variables				
		E 2/	GNP	P 3/	PGNP 3/	RS 4/	RL 4/	GNP	P 3/	PGNP 3/	RS 4/	RL 4/
1. U.S. Fiscal Contraction 5/												
Year:	1	4.1	-0.7	0.2	-0.1	-0.3	-0.3	0.0	-0.2	0.0	-0.1	-0.1
	2	3.9	-0.3	0.1	-0.3	-0.2	-0.3	0.1	-0.1	0.0	-0.0	-0.1
	3	3.7	-0.1	-0.1	-0.4	-0.2	-0.4	0.1	-0.1	0.0	-0.0	-0.1
	4	3.6	0.1	-0.2	-0.6	-0.2	-0.4	0.1	-0.1	0.1	-0.0	-0.1
	5	3.4	0.2	-0.4	-0.8	-0.3	-0.4	0.1	-0.1	0.1	-0.0	-0.1
	6	3.0	0.3	-0.7	-1.0	-0.4	-0.4	0.0	-0.1	0.1	-0.0	-0.1
2. ROW Fiscal Contraction 5/												
Year:	1	-1.2	0.1	-0.1	0.0	-0.1	-0.1	-0.8	0.0	-0.1	-0.4	-0.3
	2	-0.9	0.1	-0.1	0.0	-0.0	-0.1	-0.3	-0.2	-0.3	-0.3	-0.3
	3	-0.7	0.1	-0.1	0.0	-0.0	-0.1	0.1	-0.3	-0.4	-0.2	-0.3
	4	-0.6	0.1	-0.1	0.0	-0.0	-0.1	0.4	-0.5	-0.5	-0.1	-0.3
	5	-0.4	0.1	-0.1	0.0	-0.0	-0.1	0.5	-0.6	-0.7	-0.1	-0.3
	6	-0.3	0.1	-0.1	0.0	-0.0	-0.1	0.6	-0.7	-0.8	-0.2	-0.3
3. U.S. Monetary Expansion 6/												
Year:	1	8.2	0.8	0.6	0.1	-0.4	-0.4	0.1	-0.3	0.0	-0.2	-0.0
	2	7.6	1.4	1.0	0.6	-1.3	-0.4	-0.1	-0.2	0.1	-0.1	-0.0
	3	6.6	1.2	1.5	1.1	-0.8	-0.3	-0.3	0.0	0.2	-0.0	-0.0
	4	5.9	0.9	1.9	1.6	-0.7	-0.2	-0.5	0.2	0.4	-0.0	-0.0
	5	5.2	0.6	2.4	2.1	-0.7	-0.1	-0.7	0.4	0.5	-0.0	-0.0
	6	4.6	0.3	2.7	2.5	-0.7	-0.1	-0.8	0.5	0.6	-0.0	0.0
4. ROW Monetary Expansion 6/												
Year:	1	-6.7	0.2	-0.4	0.0	-0.4	-0.2	0.7	0.3	0.0	-1.7	-0.4
	2	-5.4	0.0	-0.4	-0.0	-0.3	-0.2	2.0	0.2	0.1	-1.3	-0.3
	3	-4.7	-0.0	-0.4	-0.0	-0.3	-0.2	2.6	0.4	0.4	-0.7	-0.2
	4	-4.3	-0.0	-0.4	-0.0	-0.3	-0.2	2.7	0.7	0.8	-0.5	-0.2
	5	-3.9	0.0	-0.3	-0.1	-0.2	-0.2	2.5	1.1	1.2	-0.3	-0.2
	6	-3.7	0.0	-0.3	-0.1	-0.2	-0.2	2.3	1.5	1.7	-0.2	-0.2

1/ Average of four quarters.
2/ A positive value indicates a U.S. dollar depreciation.
3/ P is the absorption deflator, PGNP is the output deflator.
4/ RS and RL are the short- and long-term interest rates, respectively, and are expressed as percentage point deviations from baseline.
5/ The fiscal shock is a decrease in real government expenditure equal to 1 percent of baseline real GNP.
6/ The monetary shock is a 4 percent increase in the narrow money stock spread over two years.

Table 5. MINIMOD U.S. Fiscal Shocks With and Without Implementation Lag Assuming Flexible Exchange Rates and Model-Consistent Expectations

(Percentage deviations from baseline) 1/

		U.S. Variables						Rest-of-World (ROW) Variables				
		E 2/	GNP	P 3/	PGNP 3/	RS 4/	RL 4/	GNP	P 3/	PGNP 3/	RS 4/	RL 4/
1. U.S. Fiscal Contraction Without Implementation Lag 5/												
Year:	1	4.1	-0.7	0.2	-0.1	-0.3	-0.3	0.0	-0.2	0.0	-0.1	-0.1
	2	3.9	-0.3	0.1	-0.3	-0.2	-0.3	0.1	-0.1	0.0	-0.0	-0.1
	3	3.7	-0.1	-0.1	-0.4	-0.2	-0.4	0.1	-0.1	0.0	-0.0	-0.1
	4	3.6	0.1	-0.2	-0.6	-0.2	-0.4	0.1	-0.1	0.1	-0.0	-0.1
	5	3.4	0.2	-0.4	-0.8	-0.3	-0.4	0.1	-0.1	0.1	-0.0	-0.1
	6	3.0	0.3	-0.7	-1.0	-0.4	-0.4	0.0	-0.1	0.1	-0.0	-0.1
2. U.S. Fiscal Contraction With Implementation Lag 6/												
Year:	1	1.2	0.1	0.1	0.0	0.2	-0.0	0.1	-0.0	0.0	-0.0	-0.0
	2	1.5	0.3	0.2	0.1	0.4	-0.1	0.2	-0.0	0.0	0.1	-0.0
	3	1.9	0.4	0.4	0.3	0.8	-0.2	0.3	-0.0	0.0	0.1	-0.0
	4	2.3	-0.7	0.7	0.5	0.1	-0.2	0.2	-0.0	0.1	0.1	0.1
	5	2.4	-0.6	0.7	0.4	0.0	-0.3	0.1	-0.0	0.1	0.0	0.1
	6	2.3	-0.5	0.5	0.3	-0.0	-0.3	0.1	-0.0	0.1	0.0	0.1

1/ Average of four quarters.
2/ A positive value indicates a U.S. dollar depreciation.
3/ P is the absorption deflator, PGNP is the output deflator.
4/ RS and RL are the short- and long-term interest rates, respectively, and are expressed as percentage point deviations from baseline.
5/ The fiscal shock is a decrease in real government expenditure equal to 1 percent of baseline real GNP commencing in the first quarter.
6/ The fiscal shock is a decrease in real government expenditure equal to 1 percent of baseline real GNP announced in the first quarter of simulation to be implemented in the 13th quarter of simulation (i.e., three-year implementation lag).

endogenous variables. Thus variables such as the exchange rate and long-term interest rates can move rather more initially than when expectations of their future values are formed adaptively.

A comparison of Tables 2 and 4 suggests that policy transmission can be qualitatively affected by changing the expectations assumption. The first two panels of Table 4 show that fiscal policy, with model-consistent expectations, is negatively transmitted (though only marginally so) between the two economies over the first three years of simulation. Two factors account for this result, which contrasts with the results shown in Table 2. First, the steady-state values of the long-term interest rates have a substantial effect on current long-term interest rates, and consequently on output, in the model-consistent expectations version of MINIMOD. Thus the drop in ROW interest rates brought on by a U.S. fiscal contraction serves to stimulate ROW GNP. Second, the relatively large exchange rate effects in the model-consistent expectations version of the model lead to large impact effects on consumption by directly and immediately affecting the absorption deflator but not the output deflator. Thus the dollar depreciation brought on by a U.S. fiscal contraction causes ROW consumption to rise because consumption prices fall relative to output prices in ROW and this leads to an increase in disposable income and hence consumption demand.

The monetary simulations exhibit the well known property of overshooting that occurs when expectations are forward looking and prices are sticky. The relatively large impact depreciations of the home currency lead to positive consumption effects abroad due to the relative price effect described above. Subsequently monetary policy is in fact transmitted negatively, although, in the case of the ROW monetary expansion, strong feedback effects in the form of lower long term interest rates and strong foreign demand cause U.S. output to rise above its control value at the end of the simulation.

The model-consistent expectations version of MINIMOD permits the examination of another aspect of the role of expectations in transmitting policy. Specifically, it is possible to gauge the effect of expectations generated by a policy change that is announced today but is to be implemented at a future date. In the simulations presented above in Table 4, the policy shocks are assumed to be a surprise when announced and implemented but are correctly foreseen thereafter. If, however, the announcement of a policy change precedes the implementation of the policy—and agents believe the policy will in fact be brought in place as announced--then the exchange rate today will change, bringing forward some of the future policy change.

Of particular interest is the case of an anticipated fiscal policy contraction. In this case the announcement of a future decrease in government expenditures will telegraph to the present some of the future

depreciation of the home currency, while aggregate demand will not be directly affected until the policy is actually implemented. Consequently, home output will show an initial increase. The effects on foreign output are ambiguous; the changes in competitiveness brought on by changed exchange rate expectations tend to cause foreign output to be depressed, while lower interest rates and increased home demand work in the opposite direction.

Table 5 presents the results of an experiment of this type. Panel 1 reproduces panel 1 in Table 4, in which a U.S. fiscal contraction is announced and implemented at the beginning of year 1. Panel 2 shows the results of the same fiscal shock announced at the beginning of year 1 but not implemented until the beginning of year 3. As can be seen from the table, the expectational effect causes U.S. income to rise until the onset of the fiscal shock itself, while ROW income is continuously above its baseline value.

V. Conclusions

This paper has argued that the role of exchange rate changes in transmitting economic disturbances across countries is more complex than it appears to be in conventional models. For the large industrial countries, there is a host of transmission mechanisms, the importance of which is affected by the degree of flexibility of exchange rates. The variety of these linkages renders the direction of policy effects ambiguous. The mechanisms include shifts between domestic and foreign demand induced by relative price shifts, shifts in desired portfolios induced by changes in the level of interest rates, shifts in the demand for money induced by the effect of exchange rate changes on consumer prices, and shifts in the supply of output induced by changes in the terms of trade. Questions relating to both the domestic and the international effects of policy changes in circumstances of exchange rate flexibility thus must be examined empirically.

The empirical evidence presented or reviewed here is based on models that incorporate some but not all of the linkages described above. Although the evidence is by no means uniform, it does lend itself to a few broad conclusions. Specifically, model simulations show, first, that U.S. monetary expansion--with no policy reactions to limit the exchange rate effects--reduces prices abroad but may have only a small negative effect on foreign output. Second, fiscal policy is transmitted positively to both output and prices (i.e., fiscal contraction reduces output and prices both at home and abroad for a period of three years or more), except in cases where the effect of forward-looking expectations weakens the short-run effects of fiscal policies on aggregate demand. In the case where a fiscal contraction is announced today but not implemented

until a future date, the short-run transmission effect is still positive but in the opposite direction (a credible announcement raises output and prices both at home and abroad). Third, exchange rate flexibility is shown to increase the domestic multiplier effects of monetary policy in most industrial countries, but it appears to have little effect on the response to fiscal policies.

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