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EXCHANGE-RATE REGIMES FOR A SMALL ECONOMY IN A MULTI-COUNTRY WORLD

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1 INTRODUCTION

A small country is confronted with a number of options regarding exchange-rate policy. It may tie its currency to the currency of a large country such as the U.S. dollar, Japanese yen, or German mark; it may tie its currency to a basket of currencies; or it can allow its currency to float. Each of these options has potential benefits and costs that depend on factors such as the shocks facing the economy, the form of wage setting within the economy, or the exchange-rate arrangements between the major countries.

The purpose of this study is to examine these issues in a theoretical framework and then to provide some empirical measure of the implications of alternative regimes for output and inflation. Chapter 2 presents a theoretical three-country model in which one country is small relative to the two large countries. Chapter 3 uses the model to examine the consequences of different assumptions about exchange-rate arrangements and wage setting for the transmission of various real and monetary shocks. It focuses on the impact effects of shocks with sticky prices and then on the long-run effect of shocks with full price adjustment. Chapter 4 describes the MSG2 model of the world economy, a dynamic general-equilibrium model, which is used to determine the magnitudes of the results identified in Chapter 3 and to describe the dynamics of adjustment between the extremes of short-run and long-run adjustment examined in the theoretical model. Chapter 5 re-examines the different assumptions about wage setting and exchange-rate arrangements in the more complicated dynamic model. The theoretical analysis gives the major insights into the implications of alternative regimes but throws up ambiguous results in many cases. The more complete empirical model gives some idea of the sizes of major differences and describes a more complicated adjustment process than is possible in the theoretical model. Chapter 6 summarizes our conclusions.

As in most of this literature, we focus on the performance of exchange-rate regimes in the face of real and monetary disturbances that may originate in the small country or in larger foreign countries. In addition, we examine the importance of wage-setting arrangements, especially as they interact with the exchange-rate regime.

2 A THEORETICAL THREE-COUNTRY MODEL

Consider three countries. One country (A) is small, and the others (B and C) are large and identical.[1] We assume that the small country has no macroeconomic impact on the two large countries and therefore model those countries as if the small country did not exist. This parallels conventional two-country modeling. In addition, we have a model of a small open economy that is strongly affected by what happens in the two large economies.

The model is set out in Table 1. It comprises nine behavioral equations, three for each country. Each country has an equation representing the real demand for goods, an equation representing the real supply of goods, and a money-market equation. Perfect asset substitution is assumed, so there is a single interest rate in equilibrium that is common to all three countries. The demand for money is equal to the supply, and the real demand for goods is equal to the real supply. The model is in log form, except for the interest rate. Definitions of the variables used in the model are in the box on the facing page.

Equations (1) to (3) represent the three countries' real demands for goods. Real demand is a function of foreign output, the country's real exchange rate, and the common interest rate. In addition, each country is exposed to a real disturbance μ. Note again that demands in countries B and C impact on each other and on country A, but demand in A has no impact on B and C.

Equations (4) to (6) are conventional money-demand equations. Real money demand is a positive function of domestic output and a negative function of the interest rate. Each country is also exposed to a money-demand disturbance ϵ.

Equations (7) to (9) are the countries' aggregate supply equations. Aggregate supply is a negative function of the real wage defined in terms of home-produced goods. Nominal wages are either fully indexed to the consumer price index (which includes import prices) or are assumed to be fixed (together with prices). The import price in A is a weighted sum of prices of imports from B and C.

Equation (10) defines the exchange rate between A and C as the residual cross rate. The real effective exchange rate for A is a weighted sum of A's two real bilateral rates, as defined in equation (11). Assuming a floating

[1] The inspiration for this concept comes from an important paper by Marston (1984).

Definitions of Variables Used in Text and Tables

e_b^a	= A's exchange rate rate relative to B's (units of A per unit of B)
e_c^a	= A's exchange rate rate relative to C's (units of A per unit of C)
e_c^b	= B's exchange rate rate relative to C's (units of B per unit of C)
e^f	= A's effective exchange rate
m^i	= money supply in country i, where i = a, b, c
p^f	= import price facing A (in A's currency)
p^i	= price of home output in country i
r	= world interest rate
w^i	= wage rate in country i
y^i	= output in country i
α_1	= $1/(1 - \Omega_1 + \Omega_2)$
β_1	= $1 - \phi_1 - \phi_2$
β_2	= A's exports to B as a share of total exports
β_4	= Marshall-Lerner condition
ϵ^i	= monetary disturbance in country i (a rise in the demand for money)
μ^i	= real disturbance in country i (a rise in real aggregate demand)
ϕ_1	= A's exports to B as a share of GNP
ϕ_2	= A's exports to C as a share of GNP
Ω_1	= marginal propensity to spend out of output
Ω_2	= marginal propensity to import

Note: All variables are defined as logarithms except for the interest rate.

exchange rate, we can substitute equation (10) into equations (1) and (7), which gives nine equations to solve for the nine endogenous variables: y^a, y^b, y^c, p^a, p^b, p^c, e_b^a, e_c^b, and r.

What does a float mean in this context? If disturbances originate in A, the exchange rate between the large countries (e_c^b) will clearly be unchanged; then, from equation (10), $e_c^a = e_b^a$. If disturbances originate in B or C, a new exchange rate e_c^b will be reached. Since e_c^b is exogenous to A, we can use the model to determine e_b^a and e_c^a.

In addition to the floating-exchange-rate regime, we also consider various fixed-exchange-rate regimes. Country A can peg its exchange rate to B ($\Delta e_b^a = 0$), it can peg its exchange rate to C ($\Delta e_c^a = 0$), or it can fix the effective exchange rate ($\Delta e^f = 0$).

TABLE 1

MODEL EQUATIONS

Demand for Goods

(1) $y^a = \alpha_1\phi_1 y^b + \alpha_1\phi_2 y^c - \alpha_5 r + \alpha_6\mu^a$

$- \alpha_1\beta_4(\phi_1+\phi_2)[p^a - \beta_2(e_b^a+p^b) - (1-\beta_2)(p^c + e_c^a)]$

(2) $y^b = \alpha_7 y^c - \alpha_8(p^b - e_c^b - p^c) - \alpha_9 r + \alpha_{10}\mu^b$

(3) $y^c = \alpha_{11} y^b + \alpha_{12}(p^b - e_c^b - p^c) - \alpha_{13} r + \alpha_{14}\mu^c$

Money Markets

(4) $m^a = \alpha_{15} y^a - \alpha_{16} r + p^a + \epsilon^a$

(5) $m^b = \alpha_{17} y^b - \alpha_{18} r + p^b + \epsilon^b$

(6) $m^c = \alpha_{19} y^c - \alpha_{20} r + p^c + \epsilon^c$

Aggregate Supply

(7a) $y^a = \alpha_{21}\ (p^a - w^a)$

(7b) $w^a = \beta_1 p^a + (1 - \beta_1) p^f$ or $w^a = 0$

(7c) $p^f = \beta_2(p^b + e_b^a) + (1 - \beta_2)(p^c + e_c^a)$

(7) $y^a = \alpha_{21}(1 - \beta_1)[p^a - \beta_2(p^b + e_b^a) + (1 - \beta_2)(p^c + e_c^a)]$

(8a) $y^b = \alpha_{22}\ (p^b - w^b)$

(8b) $w^b = \beta_5 p^b + (1 - \beta_5)(p^c + e_c^b)$ or $w^b = 0$

(8) $y^b = \alpha_{22}(1 - \beta_5)[p^b - (p^c + e_c^b)]$

(9a) $y^c = \alpha_{23}\ (p^c - w^c)$

(9b) $w^c = \beta_6 p^c + (1 - \beta_6)(p^b - e_c^b)$ or $w^c = 0$

(9) $y^c = \alpha_{23}(1 - \beta_6)[p^c - (p^b - e_c^b)]$

Exchange-Rate Definition

(10) $e_c^a = e_b^a + e_c^b$

(11) $e^f = \beta_2 e_b^a + (1 - \beta_2) e_c^a$

3 ALTERNATIVE SCENARIOS

In this chapter we focus on the interaction between wage setting and the exchange-rate regime in the theoretical model. Two wage assumptions are examined: fixed nominal wages as in the standard Mundell-Fleming model, and flexible nominal wages and prices where wages are assumed to be indexed to the consumer price index. The first assumption is more appropriate for short-run adjustment, the second for long-run adjustment.

We examine the performance of four exchange-rate regimes in the face of six potential disturbances, three real and three monetary. The four exchange-rate regimes facing the small country are:

1. Country A can tie its currency to B's currency.
2. Country A can tie its currency to C's currency.
3. Country A can tie its currency to a basket of B's and C's currencies.
4. Country A can float its currency.

The different assumptions used in the theoretical model are set out in Table 2. In addition to the exchange-rate regimes for the small economy, we also consider three alternative exchange-rate regimes for the world economy. These are global floating and two types of fixed-rate regimes operating between the large countries. One of the fixed-rate regimes is of the "gold standard" variety, where the two large countries allow their money supplies to respond to balance-of-payments outcomes (in other words, there is no sterilization on the part of either central bank); this implements a well-known proposal by McKinnon (1984) for symmetrical adjustment. The other involves asymmetrical adjustment (a dollar-exchange-standard system). In this case, we suppose that one of the large countries (the United States) automatically sterilizes, while the other country (say Japan) does not sterilize.[1]

Official reserves may be held in three forms: as dollar deposits with the U.S. Federal Reserve System, as dollar deposits with the U.S. commercial banks, and in short-term U.S. government securities. One can readily demonstrate that, in the first case, the cash base in the United States will change in line with developments in the balance of payments, a deficit (surplus) reducing (increasing) the cash base; in the second case, the cash base will not change but the ownership of deposits will normally switch from U.S. residents to foreign central banks, so that the money supply changes only by the amount of the change in the balance of payments without any mul-

[1] On symmetrical and asymmetrical adjustment, see Swoboda (1978).

TABLE 2

ALTERNATIVE ASSUMPTIONS IN THE THEORETICAL MODEL

Exchange-rate regime:
Small economy (A):
Peg to B (regime 1)
Peg to C (regime 2)
Peg to a basket of B and C (regime 3)
Float (regime 4)
World (B and C):
Floating exchange rates
McKinnon Rule
Dollar standard
Nominal wages:
Small economy:
Fixed
Indexed to the consumer price index
World economy:
Fixed
Indexed to the consumer price index
Shocks:
Real shock:
In A
In B
In C
Monetary shock:
In A
In B
In C

tiplier effects; finally, in the third case, there is no change in the money supply or in the cash base. Most of these reserves are in fact held in the form of securities, so whereas there is virtually automatic sterilization in the United States, in the rest of the world an explicit policy decision has to be made about whether or not to sterilize. Thus there is an asymmetry in this case. We deal with it in the next chapter.

As is common in much of this literature, most of our evaluation of performance in the theoretical model is based on output variability. In principle, of course, governments will also be concerned about variability in prices, the real exchange rate, and real interest rates, but these are not explicitly taken into account in the theoretical analysis (but see Argy, 1986). The empirical chapter will focus more on these other targets.

There are many combinations of assumptions to be examined. For convenience, we take each regime for exchange rates in the world economy as given and then examine the results first under fixed wages and prices and then under flexible wages and prices.

Global Floating

Fixed Wages and Prices

Domestic shocks. First consider disturbances that originate in A. These cases are fairly straightforward because these disturbances have no impact on countries B or C. Foreign output (y^b, y^c), world interest rates, and the exchange rate between the large countries' currencies (e_c^b) are all unchanged (so that the value of A's currency relative to both B and C will be the same, that is, $e_b^a = e_c^a$). Fixing any one of these exchange rates implies that the other must also be fixed. With fixed exchange rates (regimes 1, 2, and 3), the money supply in A is endogenous and we can use equations (1) and (4) to solve for the small country's money supply and output. The solutions are the same for the three fixed-rate regimes. With flexible exchange rates (regime 4), money supply in A is fixed, and we can use equations (1) and (4) to solve for the small country's exchange rate e_b^a ($= e_c^a$) and output. The results are shown in Table 3.

For a monetary disturbance in the small country (ϵ^a), all fixed-rate regimes provide perfect insulation, while a flexible rate affects both output and the exchange rate. For a real disturbance in the small country (μ^a), a flexible rate is a perfect insulator because it adjusts in such a way as to crowd out private expenditure. For example, an increase in expenditure leads to a real appreciation, which reduces spending on tradables by both residents

TABLE 3

SOLUTIONS FOR DISTURBANCES ORIGINATING IN COUNTRY A

	Real	Monetary
Fixed-rate regimes (1, 2, 3)	$\Delta y^a/\Delta\mu^a = \alpha_6$	$\Delta y^a/\Delta\epsilon^a = 0$
Floating-rate regime (4)	$\Delta y^a/\Delta\mu^a = 0$	$\Delta y^a/\Delta\epsilon^a = -1/\alpha_{15}$

and foreigners. This is the well-known Mundell-Fleming result. In contrast, a real disturbance has some effect on output under all fixed-rate regimes.

Foreign shocks. Now consider disturbances that originate in the large countries B or C.[2] For convenience, we assume that B and C are identical in size and the structural coefficients in B and C are identical. We use equations (2), (3), (5), and (6) to solve for the large countries' outputs, the interest rate, and the exchange rate e_c^b. We then turn to the equations for A to find the impacts on the small country under the four exchange-rate regimes. The solutions are given in Table 4.

TABLE 4

SOLUTIONS FOR DISTURBANCES ORIGINATING IN COUNTRIES B AND C

$\Delta y^b/\Delta\mu^b$	$= (\alpha_{10}\alpha_{18})/2[\alpha_{18}(1-\alpha_7)+\alpha_{13}]$
$\Delta e_c^b/\Delta\mu^b$	$= -\{(\alpha_{10}\alpha_{18}/\alpha_{12})[(1-\alpha_7)+(\alpha_{13}/\alpha_{18})]\}/2[\alpha_{18}(1-\alpha_7)+\alpha_{13}]$
$\Delta y^b/\Delta\epsilon^b$	$= -[\alpha_{18}(1-\alpha_7)+2\alpha_{13}]/2[\alpha_{18}(1-\alpha_7)+\alpha_{13}]$ *
$\Delta e_c^b/\Delta\epsilon^b$	$= -(1+\alpha_7)/2\alpha_{12}$
$\Delta r/\Delta\mu^b$	$= \alpha_{10}/2[\alpha_{18}(1-\alpha_7)+\alpha_{13}]$
$\Delta y^c/\Delta\mu^b$	$= \alpha_{10}\alpha_{18}/2[\alpha_{18}(1-\alpha_7)+\alpha_{13}]$
$\Delta r/\Delta\epsilon^b$	$= (1-\alpha_7)/2[\alpha_{18}(1-\alpha_7)+\alpha_{13}]$
$\Delta y^c/\Delta\epsilon^b$	$= \alpha_{18}(1-\alpha_7)/2[\alpha_{18}(1-\alpha_7)+\alpha_{13}]$ *

* Note that $(\Delta y^b + \Delta y^c)/\Delta\epsilon^b < 0$, as indicated in the text. By assumption: $\alpha_7 = \alpha_{11}$, $\alpha_8 = \alpha_{12}$, $\alpha_9 = \alpha_{13}$, $\alpha_{17} = \alpha_{19} = 1$, $\alpha_{18} = \alpha_{20}$, $\alpha_7 < 1$.

Consider first a monetary disturbance. We have the result

$$\Delta y^b/\Delta\epsilon^b < 0\ ;\ \Delta y^c/\Delta\epsilon^b > 0\ ;\ \Delta y^b/\Delta\epsilon^c > 0\ ;\ \Delta y^c/\Delta\epsilon^c < 0\ .$$

A rise in the demand for money in B lowers output in B but increases output in C. A parallel result holds for a shock in C. We also note that a money-demand shock will on balance lower world output; that is, $(\Delta y^b + \Delta y^c)/\Delta\epsilon^b < 0$. Exchange-rate effects are also straightforward. A money-demand disturbance in B leads to an appreciation of B's currency ($\Delta e_c^b/\Delta\epsilon^b < 0$). A par-

[2] A similar simple two-country model appeared in Mundell (1964).

allel disturbance in C appreciates C's currency ($\Delta e_c^b/\Delta\epsilon^c > 0$). Finally, the interest rate rises in B and C:

$$(\Delta r/\Delta\epsilon^b > 0 \quad \text{and} \quad \Delta r/\Delta\epsilon^c > 0) .$$

We now examine the impact on A under each exchange-rate regime for a money-demand shock originating in B. Parallel results obtain when the shock originates in C. Note that for each of the fixed-rate regimes the money supply in A is endogenous. In each case, A is faced with a fall in B's output, a rise in C's output, and a higher world interest rate.

In the first case, where A pegs to B's currency, we have $e_c^a = e_c^b$ (since $\Delta e_b^a = 0$). Now substitute the solutions for $e_c^b (= e_c^a)$, y^b, y^c, and r into equation (1) to obtain a solution for y^a. A's currency appreciates relative to C's. On balance, A's output falls because of the higher interest rate and the fall in demand in B (unless C is a much closer trading partner than B).

In the case where A pegs to C's currency, the major difference from fixing to B's currency is that A's currency will depreciate relative to B's. Thus the outcome is less deflationary than when A pegged to B, but it is difficult to determine *a priori* whether A's output rises or falls in absolute terms.

In the case of a fixed effective exchange rate ($\Delta e^f = 0$), equation (11) yields

$$e_b^a = -(1 - \beta_2)e_c^a/\beta_2 .$$

Substituting this into equation (10), we have

$$e_c^a = \beta_2 e_c^b \quad \text{and} \quad e_b^a = -(1 - \beta_2)e_c^b .$$

Country A again faces the same outcomes for foreign outputs (y^b, y^c) and the world interest rate, but B's currency appreciates relative to C's, hence A's currency depreciates relative to B's and appreciates relative to C's. Thus we can drop exchange rates altogether from equation (1).[3] Pegging the effective exchange rate falls somewhere between pegging to either B's or C's currency. As in the case of pegging to B's currency, A's output falls, provided C is not a dominant trading partner.

To sum up, then, for the three fixed-rate regimes, the first is the most deflationary, the second the least deflationary, the third gives an intermediate result.

Under a floating exchange rate, the solution for output is readily obtained directly from A's money-market equation. With m^a and p^a fixed by assumption, we have

$$\Delta y^a/\Delta r = \alpha_{16}'/\alpha_{15}$$

[3] The exchange-rate term is $\alpha_1 b_4(h_1 + h_2)\,[b_2 e_b^a + (1 - b_2)e_c^a]$, where the bracketed expression is of course the effective rate (equation 11).

or from Table 4, using the solution for r,

$$\Delta y^a/\Delta\epsilon^b = \alpha_{16}(1 - \alpha_7)/(2\alpha_{15}[\alpha_{18}(1 - \alpha_7) + \alpha_{13}]) .$$

A higher world interest rate must raise output in A. We can now solve for e^a_b from equation (1), recalling that e^b_c, y^a, y^b, y^c, and r are predetermined, and e^a_c can then be solved out from equation (10). It is easy to demonstrate that A's currency is most likely to depreciate relative to B's.

We now consider a real disturbance originating in B. Again, we first solve the model for countries B and C. We know B's currency appreciates relative to C's, output increases in both B and C, and the interest rate rises in B and C (see Table 4).[4]

If A pegs its currency to B (option 1), there will be countervailing forces at work: on the one hand, the increases in output in B and C will put upward pressure on A's output; on the other hand, A's appreciation relative to C and the rise in interest rates will tend to exert downward pressure on output in A.

If A pegs its currency to C (option 2), there will be a depreciation relative to B. The only deflationary force at work will be through the interest-rate effect.

If A pegs its currency to a basket of B's and C's currencies (option 3), the effective rate will be unchanged, and the exchange-rate effect will be neutralized. We now have positive output effects from B and C traded against a higher world interest rate.

If A floats (option 4), we can again read the solution directly from the equilibrium condition in A's money market. It shows directly that output must rise in A. The effect on the exchange rate between A and B (e^a_b) is ambiguous because the increase in output may raise or lower A's interest rate relative to world levels, producing an appreciation or a depreciation of A's currency. If A's currency appreciates relative to B's, it will unambiguously appreciate relative to C's. If A's currency depreciates relative to B's, it may also depreciate relative to C's.

Flexible Wages and Prices

We now turn to the full model, which allows wages and prices to be flexible. Nevertheless, we assume that real wages, as defined in the aggregate supply equations, are fixed, so that all aggregate supply equations become functions of real effective exchange rates. Again we focus on real and monetary shocks. The analysis here may be viewed as encompassing a somewhat longer time horizon than in the model with fixed wages and prices.

[4] Output increases in the same proportion in B and C (see Table 4). The reason can be read directly from the two money-market equations. With $\Delta m^b = \Delta m^c = 0$, $r^b = r^c$, and with identical structural coefficients, the increase in output must be the same.

The outcomes for the independent two-country model are as in Argy and Salop (1983). Two results are important.

First, a monetary disturbance originating in either of the large countries will have a neutral real outcome: interest rates and output do not change, prices change in proportion to the monetary disturbance, and the currency also adjusts in proportion. Each country is totally unaffected by the other country's monetary disturbance because the currency moves in the opposite direction, exactly neutralizing the price change in the country where the shock originates.

Second, a real disturbance will have a beggar-thy-neighbor effect. Given that each aggregate supply is a function of the real exchange rate, an increase in output in one large country must reduce output in the other. Thus, an increase in expenditure in B increases B's output, but this occurs at C's expense.

Domestic shocks. Consider the case where disturbances originate in the small country. Its interest rate cannot change because a monetary shock has neutral effects. With fixed exchange rates there is monetary accommodation, but with flexible exchange rates there are proportionate changes in prices and exchange rates.

A real shock in the small country generates identical real (positive) effects under all exchange-rate regimes. The reason is that the only difference between the flexible- and fixed-rate regimes lies in the amount of money generated. Recall that with flexible exchange rates the money supply is exogenous, but it is endogenous under the fixed-rate regimes. Since money is neutral, real outcomes are the same. The same real appreciation will be associated with the increase in output under both fixed and floating rates. Under fixed rates, prices rise to produce the requisite appreciation of the real exchange rate. Under flexible rates, the nominal rate appreciates by more than prices fall.[5]

In summary, the exchange-rate regime has no real effects when wages and prices are flexible. There are still consequences for inflation, however, and we examine these next.

Foreign shocks. Consider the effects on country A of a monetary disturbance in B (ϵ^b). B's currency appreciates in proportion, prices in B fall in proportion, and interest rates and output are unchanged. In C the real exchange rate, output, prices, and the interest rate are all unchanged. In A the interest rate is unchanged. If A pegs to B (option 1), then from equation (1) for aggregate demand (with y^b, y^c, r, e^c_b, and p^c all fixed) we have

$$y^a = -\alpha_1\beta_4(\phi_1 + \phi_2)\,[p^a - \beta_2 p^b - (1 - \beta_2)e^a_c]\,,$$

and from equation (7) for aggregate supply we have

[5] The latter result is easily obtained from equation (4).