This is to certify that the

dissertation entitled

THE EFFECTS OF BUDGET DEFICITS
ON INTERNATIONAL FINANCIAL MARKETS
UNDER CURRENCY SUBSTITUTION

presented by

Thomas Patrick Bundt

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in ECONOMICS

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Major professor

Date JULY 24, 1985

THE EFFECTS OF BUDGET DEFICITS ON INTERNATIONAL FINANCIAL MARKETS UNDER CURRENCY SUBSTITUTION

By

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A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Economics

1985

ABSTRACT

THE EFFECTS OF BUDGET DEFICITS
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The purpose of this dissertation is to investigate the short-run effects of large United States budget deficits on international financial markets in an open portfolio model amended to formally include currency substitution. The model developed within extends the open macroeconomic literature in a number of ways including a different approach used to model the rational expectations hypothesis, as well as to test the model using time series data for France, the United States, and the Federal Republic of Germany.

The main implication of the model is that currency substitution may serve as a transmission mechanism of international financial shocks. Here, under flexible exchange rates, international currency substitution, it is argued, will augment the effectiveness of monetary policy while weakening the effectiveness of debt financed fiscal policy. We also argue that there exist possible significant cross-country impact effects of large United States budget deficits resulting from international portfolio behavior. Using this analysis we verify the existence of significant cross-country effects of United States deficits arising through the value of the dollar.

To the Bundt Family

ACKNOWLEDGEMENTS

I owe much credit to my dissertation chairman, Professor Robert Rasche, whose insights and comments were essential for the completion of the research. Professor Steven Matusz has also provided essential suggestions to the body of theory contained in this dissertation. I would also like to thank Professor Warren Samuels for his generous help and support. In addition, Professor Timothy Lane has provided valuable comments and suggestions. Finally, I owe much of my personal and professional development to my dear friend and colleague, Nimal Gunatilleke.

Any errors in this study are the sole responsibility of the author.

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Chapter I: INTRODUCTION

This dissertation integrates two separate branches of the open macroeconomic literature; the open portfolio approach to exchange rate determination and the theory of currency substitution. It does so by analyzing the possible international effects of recent large federal budget deficits in the United States. Specifically the purpose of this dissertation is to investigate the short-run effects of large United States deficits on international financial markets in an open portfolio model with formal inclusion of currency substitution.

The model developed is a generalization of the portfolio framework developed by Tobin [1969] and amended to the small open economy by Branson [1977] and Branson, Halttunen and Masson [1977]. In order to be able to consider the case of the United States the Branson model is extended to a dual large country framework consisting of two money and bond markets. This allows both the foreign and domestic rate of interest to be determined by the model. Deficits are modeled by including a formal discrete-time dynamic government financing constraint for each country. This dynamic asset accumulation framework allows discussion of wealth effects induced by the deficits in each country. The major innovation to the open portfolio model is a respecification of the demand for domestic money to include a component determined by foreign residents, known in the literature as currency substitution. To model the impact of budget deficits on portfolio behavior concerning the currency composition of international cash portfolios requires considerable attention to how expectations of the exchange rate are formed. Here we use a limited information version of the rational

expectations hypothesis first proposed by Muth [1961], amended to a non-stochastic framework.

Some of the issues discussed in solving the model concern the role of currency substitution in the transmission of deficit effects to international money markets under flexible exchange rates. Similarly, what are the cross-country effects of budget deficits? How well empirically does the proposed open portfolio model explain short-run changes in the domestic and foreign rates of interest as well as the exchange rate? Concerning the policy implications of currency substitution we shall look into the issue of crowding-out arising from large budget deficits in the open portfolio model. Second, how does the demand for money behave under currency substitution and flexible exchange rates? What are the consequences of currency substitution with respect to the effectiveness of monetary and fiscal policies under flexible exchange rates? What are the implications for the conduct of monetary policy by the Federal Reserve System? These are some of the policy issues that stem from the inclusion of currency substitution into the open portfolio model.

The theoretical literature on currency substitution, notably the work of McKinnon [1982, 1984], is characterized by assumptions of perfect capital mobility and asset substitutability so that the interest rate parity relation plays a critical role in the models. The contribution of this dissertation is to model the effects of currency substitution in an open portfolio framework. Hence, the model developed here is characterized by imperfect asset substitutability between foreign and domestic assets which implies that interest rate parity ceases to characterize short-run asset market equilibrium. Finally,

unlike McKinnon, the model treats exchange rate expectations as endogenous thus allowing discussion of the linkage between disturbances in the domestic deficit and international money markets through currency substitution arising from changes in exchange rate expectations. Hence exchange rate expectations drive currency substitution in the model forcing us to emphasize the generation of expectations in the model. The expectations specification presented is somewhat novel and represents an attempt to model a 'limited information' version of the rational expectations hypothesis.

The open portfolio approach to exchange rate determination is characterized by the absence of price and income effects and instead relies on conditions of short-run equilibrium in financial markets to determine the exchange rate. The model within extends this literature in both emphasis and substance. First, in substance, the open portfolio model is amended to formally include currency substitution. Second the portfolio model is reformulated into a two large-country framework which eliminates the common small country assumptions such as fixed foreign asset prices and perfectly elastic foreign demand for domestic debt. Thus we seek, for policy purposes, to study the large country case relevant to the United States. In emphasis, the model inquires into the international effects of large budget deficits in the open portfolio model. Here the merging of currency substitution into a large two-country portfolio model with 'limited information' rational expectations allows modeling the role of currency substitution in transmitting deficit effects to international money markets. Finally, we shall present empirical test results on the model developed and discuss the results relative to tests of other portfolio models.

Chapter II: LITERATURE REVIEW

1). Introduction.

To establish a background on the issues central to this dissertation we shall first survey the relevant literature. Since the dissertation is essentially an exercise in modeling we shall focus on the literature concerning approaches to exchange rate determination and open models that include a government financing constraint. Therefore the purpose of this survey is to review some of the basic concepts as well as to trace the development of the literature which will give the reader some perspective on the potential contribution of this research.

2). Closed Models with a Government Financing Constraint.

Before we review the literature on open models with a government financing constraint we begin by noting the extent and development of the closed literature. The seminal article, by Christ [1968], formally introduced the government financing constraint in a static Keynesian fixed price model that ignored government issue of debt. His results indicated what many economists had feared, that the generally accepted policy multipliers were incorrect due to neglect of the inherent dynamics involved with the financing of government fiscal policies. Later, Christ [1969] generalized his earlier results in a model which considered both Keynesian and Classical cases along with the issue of government debt. A notable extension of Christ, Brunner and Meltzer [1972] explore the stock and flow aspects surrounding the transmission of monetary and fiscal policies through domestic asset markets under a formal government financing constraint.

In a widely quoted article which extended Christ's work by modeling the implications of the flow of interest payments on outstanding government debt, Blinder and Solow [1973] conclude, contrary to Brunner and Meltzer, that the long-run fiscal policy multiplier, when bond financed, exceeds the comparable monetary policy multiplier. Similarly, Turnovsky [1975] re-examine Blinder and Solow's work by incorporating interest payments into a discrete-time model with wealth effects consistent with the aggregate private sector budget constraint. In another extension of Blinder and Solow, Pyle and Turnovsky [1976] examine a dynamic model of inflation and capital accumulation with a formal government financing constraint.

In a different approach, commonly known as the monetary growth and inflation literature, Dornbusch [1977] inquires into the implications of budget imbalance on the real capital stock and the rate of inflation. Similarly, Turnovsky [1978] shows how inclusion of a government financing constraint severely modifies the results of previous monetary growth models. Finally Martin Feldstein [1980] looks at the relation between deficits, inflation and capital formation in a dynamic model that includes taxes on capital income. He finds that any increase in the deficit financed only by additional borrowing will increase inflation and reduce capital intensity, even though the growth of real money balances is unchanged.

Generally one will find that the closed literature has progressed much faster in integrating models with the government financing constraint than has the open literature. However, the emphasis of this dissertation is on the open model, particularly the relationship between the government financing constraint and the interest rate and the

exchange rate. Therefore we now move to a review of the open literature which is facilitated by grouping the literature by approach used to model the exchange rate.

3). The Flow Approach to Exchange Rate Determination.

The first category of models we denote as the open flow approach because these models have in common that the exchange rate is determined by conditions for equilibrium in markets for the flow of funds, notably the foreign exchange market, rather than by conditions for equilibrium in the markets for stocks of assets.

The classic articles that form a foundation of this literature began with Fleming [1962] and Mundell [1963] who extend the IS-LM model to the open economy. In a small country model with fixed prices and static exchange rate expectations they show that debt financed fiscal policy is ineffective in raising output under flexible exchange rates and perfect capital mobility. Their model assumptions, which are quite common to this literature, are that capital movements are flow specified and the exchange rate is determined by the balance of payments flow constraint. Formally we can see how the exchange rate is determined in this class of models by reference to Sohmen [1967] who generalizes the Mundell-Fleming model to take into account changes in the terms of trade and differing degrees of capital mobility. Sohmen's balance of payments constraint under flexible exchange rates is specified as;

$$1) \quad [X(e) - (1/e)M(Y,e)] + K(r) = 0$$

where;

X = Exports

M = Imports

Y = Real GNP

r = The domestic nominal interest rate

e = The exchange rate; value of home currency in terms of foreign currency

This equation is characteristic of the flow approach to exchange rate determination and displays a fundamental ambiguity under debt financed fiscal policy because of two competing effects. First the effect of rising interest rates on capital inflows tends to pull the exchange rate up while the effects of increased income tend to push the exchange rate down. Mundell and Fleming, by assuming perfect asset substitutability and perfect capital mobility, short cut this ambiguity by forcing the exchange rate to be dominated by movements in the domestic rate of interest relative to the fixed foreign rate of interest.

In a model similar to Mundell-Fleming, Krueger [1965] generalizes their results and shows that the method of financing the increase in government expenditure will determine the ultimate impact on real income. An extension of the Mundell-Fleming model to a flexible price model was done by Casas [1977], who finds the fiscal policy multiplier is positive but the effect on the average price level is indeterminant. Here if capital flows are highly interest sensitive, the interest induced capital inflow will exceed the income induced increase in imports, and the exchange rate will rise, resulting in a lower price of the imported good. In this case, the average price level may drop

even though the price of domestically produced goods is rising, especially if imports are heavily weighted in the cost of living index.

In a model whose structure resembles Mundell-Fleming modified to incorporate the stocks of domestic securities held by foreign residents, Rodriguez [1979] explores the long-run implications of induced changes in the level of the service account in an open model. Since a capital outflow is equivalent to a positive rate of acquisition of foreign securities the net asset position of the economy tends to improve with a monetary expansion, and conversely, to deteriorate with a fiscal expansion. Rodriguez assumes that, in the long-run, if the system is stable, portfolio holders will be satisfied with the level and composition of their assets, and capital flows will cease. At that point, given the world interest rate, the service account is fully determined by the net asset position of the country. In the case of a fiscal expansion, the long-run effect of a transitional period of induced capital inflows is to deteriorate the long-run service account while the induced capital outflows due to expansionary monetary policy would improve it. Since in the long-run the capital account is assumed to be zero, the service account must be equal to the trade balance surplus and therefore it follows that, on account of the induced capital flows, the long-run effect of expansionary fiscal policy is to improve the trade balance while expansionary monetary policy deteriorates the trade balance. Since the trade balance is one of the determinants of aggregate demand, the question arises as to whether in the long-run a monetary expansion which deteriorates the trade balance may not actually induce a fall in income and employment; similarly, to the extent that expansionary fiscal policy works toward an improved long-run trade

balance, it may be able to increase income in the long-run in spite of short-run ineffectiveness.

The contribution of Oates [1966] and McKinnon and Oates [1966] was to treat the government budget imbalance like the trade imbalance in that both imply a change in outside wealth of the private sector. Indeed, Branson [1976] claims that the dual role of the government budget and the balance of payments is to allow for national expenditures to differ from national income. The implication is that in the open system, depending on the nature of equilibrium, it is no longer necessary for the government budget to be balanced for equilibrium. Oates also compares the size of the open economy fiscal multipliers with those for a closed model with a government financing constraint obtained by Christ [1968]. Oates finds that for an open economy, with the exception of the limiting case of zero capital mobility, the value of the fiscal multiplier will be less than the inverse of the marginal tax rate which is the Christ result for the simple closed model. The difference results from a worsening trade balance as income rises.

Finally, in a model that extends Blinder and Solow to the open economy, Allen [1977] looks at both the stock and flow aspects of bond financing by including domestic purchases of foreign bonds in disposable income and net tax receipts. She finds that there are long-run steady state ambiguities under either method of financing which can be traced to the effects on tax revenues of changes in interest payments from foreigners, which implies that a rise in these interest payments reduces the need for a rise in real income in order to balance the budget. Bond financing of a budget deficit has an ambiguous effect on interest income from foreigners, because a bond financed deficit implies both a rising

interest rate and rising household wealth, with conflicting effects on the demand for foreign bonds, which is the flow approach ambiguity once again. By contrast, money financing of a budget deficit always causes interest income from foreigners to rise, because a money financed deficit implies a falling domestic interest rate along with rising household wealth, both of which increase the demand for foreign debt.

The key problem of the open flow approach is the use of the balance of payments accounting identity to determine the equilibrium exchange rate and the logical implications that follow. For example, Floyd [1969] argues that the analysis of international capital movements should be reformulated in the context of portfolio adjustment. He claims the main problem with the Mundell-Fleming approach is a confusion between continuous capital flows and portfolio adjustments. Here, Mundell, by neglecting to treat international capital movements as a consequence of the portfolio decisions of the public, fail to take account of the fact that an international capital movement changes the non-monetary wealth of the community and thereby shifts the demand function for money. Hence these changes in the level of money stocks do not lead to continuous flows of capital per unit of time in the way the open flow literature implies, they instead lead to once-and-for-all changes in the net debtor or creditor positions of the countries. Kouri [1976] argues that it is inconsistent to assume that portfolio equilibrium is obtained instantaneously and yet view the exchange rate as the price that equilibrates balance of payments flows. Kouri claims this is invalid because the assumption of continuous portfolio equilibrium implies that demand equations cannot be defined in terms of changes in desired asset holdings, hence the balance of payments flow

constraint is simply an ex-post accounting identity which cannot be interpreted as an ex-ante equilibrium condition.

4). The Monetary Approach to Exchange Rate Determination.

The next class of models we refer to as the Monetary approach to exchange rate determination. These models are characterized by the 'small country' assumptions of perfect capital mobility and perfect substitutability between domestic and foreign securities. As a result these models stress the role of the money market and the use of Purchasing Power Parity and Interest Rate Parity relations to determine the equilibrium exchange rate.

For an overview of the open monetary literature it is instructive first to see how the monetary approach under flexible exchange rates has evolved from the monetary approach to the balance of payments under fixed exchange rates. Early authors such a Mussa [1976] and Frenkel [1976] stress that the exchange rate should be viewed as the relative price of different national monies and determined such that the stock of the two monies, in the bilateral case, are willingly held. Under flexible exchange rates, the required adjustment in money balances cannot be accomplished through official reserve flows. Here the adjustment of actual money balances to their desired levels is accomplished by changes in domestic prices and the exchange rate. According to this approach, a balance of payments disequilibria or exchange rate movement reflects a disparity between actual and desired money balances.

A common way to model the monetary approach is to use the Purchasing Power Parity relation. This relation implies that

internationally traded goods are not discriminated with respect to price across borders. The use of Purchasing Power Parity (PPP) provides a convenient linkage between the exchange rate and the stock of the two national monies in the bilateral case. For example, Bilson [1979] describes the analysis of Frenkel and Mussa by use of the following simple three equation model;

$$2) \quad M/P = L(i,Y)$$

$$3) \quad M^*/P^* = L^*(i^*,Y^*)$$

$$4) \quad P = eP^*$$

where:

$M(M^*)$ = The domestic (foreign) money stock.
$P(P^*)$ = The domestic (foreign) price level.
$i(i^*)$ = The domestic (foreign) interest rate.
$Y(Y^*)$ = The domestic (foreign) level of real Gross National Product.
e = The bilateral exchange rate, expressed in units of domestic currency per unit of foreign currency.

Under flexible exchange rates the first two equations determine the domestic and foreign price levels and the third equation therefore determines the exchange rate. The reduced form solution of the model is;

$$5) \quad e = [ML^*(i^*,Y^*)]/[M^*L(i,Y)]$$

While this approach may be acceptable as a long-run description of the determinants of the exchange rate, Bilson claims the model has major deficiencies as a short-run model of exchange rate determination. Dornbusch and Krugman [1976] and Niehans [1981] have demonstrated that Purchasing Power Parity may not hold in the short-run. Also the assumption that the short-run nominal interest rate is exogenous is unrealistic. Hence the open monetary literature began to focus on the Interest Rate Parity relation to determine the exchange rate in the short-run.

A major contributor to the open monetary literature, Dornbusch [1976] moved to a model that distinguished short-run effects of policies, sustained by price rigidities and expectations errors, from long-run effects, where all markets clear and Purchasing Power Parity holds for traded goods. Because arbitrage of traded goods prices and goods market equilibrium is attained only over time, the exchange rate in the short-run is determined by conditions for equilibrium in the asset markets under the Interest Rate Parity relation. Here, with perfect capital mobility, asset holders would find themselves indifferent between holding domestic or foreign assets provided they carry the same yield, that is, provided the interest differential matches the anticipated rate of depreciation. Formally;

$$6) \quad i - i^* = [(e^e/e) - 1]$$

where;

i = The domestic interest rate.

i^* = The foreign interest rate.

$[(e^e/e) - 1]$ = The expected rate of depreciation of the domestic currency.

We can rewrite equation (6) to yield the reduced form for the spot rate;

$$7) \quad e = e^e/[1 + i - i^*]$$

This equation argues that movements in the spot rate are due to either changes in interest differentials, given expectations, or to changes in expectations.

Specifically, an increase in the home interest rate will lead to an appreciation, while the anticipation of depreciation, given interest rates, will lead to an immediate depreciation in the same proportion. The convenience of using Interest Rate Parity is that all that is now needed to close the model is a theory of nominal interest rate determination and a theory of how exchange rate expectations are formed.

This new monetary approach soon began to challenge the conclusions of Mundell and Krueger who argued that a transition to a flexible exchange rate regime would increase the effectiveness of monetary policy. For example, Niehans [1975], by introducing a distinction between the actual and permanent exchange rate, shows that after a monetary expansion, under Interest Rate Parity, the domestic interest rate will be below the world rate in the short-run and the exchange rate will depreciate, overshooting the long-run rate. Here, as required by Interest Rate Parity, the domestic currency depreciates so much that

speculators begin to expect a later appreciation which balances the relative decline in the domestic interest rate. If trade flows are slow to respond to interest rate changes there arises a possibility of an initial trade deficit following the monetary expansion. The presumption here is that in the short-run, before output expands significantly and expectations adjust, the trade balance could worsen with the increase in absorption which, in turn, would require a corresponding capital inflow. In the long-run, the adjustment of output and expectations over time serves to raise interest rates and adjust trade flows until the Mundell-Fleming equilibrium is attained. In the adjustment process the trade balance will turn from an initial deficit to an ultimate surplus.

Another Dornbusch work, [1976], has become a widely referenced model in the open monetary literature. This paper presents a model of exchange rate determination under perfect capital mobility, slow adjustment of goods markets relative to asset markets, and consistent expectations. The perfect foresight path is derived and it is shown that along that path a monetary expansion causes the exchange rate to depreciate. An initial overshooting of the spot exchange rate relative to the long-run exchange rate is shown to result from differential adjustment speeds of markets. Similarly, in a move towards a more general approach, Driskill [1981] extends Dornbusch to the case of imperfect asset substitutability. He demonstrates that, under rational expectations, a generalization of the Dornbusch model may predict exchange rate undershooting rather than overshooting.

On the subject of fiscal policy, Mathieson [1977] extends Dornbusch [1976] to include a variety of expectations structures. He assumes, like Dornbusch, a small country model with perfect capital mobility and

goods markets that adjust slowly, whereas in the asset markets continuous portfolio equilibrium is maintained by interest rate and exchange rate movements. Under monetary policy with rational expectations, his model, like Dornbusch's exhibits saddle point behavior. In the case of fiscal policy, since the goods market adjusts slowly, any initial impact of an increase in government spending must be generated through a change in expectations. The 'smallness' assumptions of perfect capital mobility and a fixed world rate of interest, together with his specification of money market equilibrium requires that the long-run effect of increased government spending financed by the issuance of debt will be a higher price of the domestic good and an appreciation of the exchange rate. However, his short-run results under rational expectations bring into question issues of causality when using Interest Rate Parity and 'small country' assumptions. For example Mathieson argues, with reference to a debt financed increase in government spending; "Since a significant proportion of these bonds will be sold on the world bond market, the resulting capital inflows will create expectations of an appreciation of the exchange rate. This expected appreciation will generate portfolio adjustments that will initially drive the domestic interest rate below the world interest rate, thereby stimulating the demand for money. With a fixed nominal money supply, however, this excess demand for money can be satisfied only if the general price level declines in order to increase the real money supply. Since the price of the domestic good will not respond immediately to a change in demand, the general price level will decline only if there is a discrete appreciation of the exchange rate." The point is that due to the 'smallness' assumptions this type of behavior

concerning the expected exchange rate and the domestic interest rate may be implausible for the study of the deficit in the large country case of the United States. Hence, we question whether the rigid assumptions used in the application of Interest Rate Parity are inappropriate for policymakers in the large country case of the United States.

The set of models due mainly to Turnovsky; Turnovsky [1977], Turnovsky and Kingston [1977] and Turnovsky and Kingston [1979] are some of the most sophisticated models of this class. They examine both the short-run and the steady state in a dynamic model of asset accumulation that introduces the rate of inflation and its associated dynamics. In Turnovsky's book he assumes Keynesian type expenditure functions that determine output endogenously by means of a flow equilibrium relationship in the product market, and a Phillips curve relationship augmented to allow for inflation expectations. He pays particular attention to the relationship between stocks and flows in the system which implies modeling the wealth effects of the government budget imbalance and the balance of payments. The two key assumptions which dictate the comparative static results are perfect capital mobility along with perfect foresight exchange rate expectations. In this small country model with perfect capital mobilty the domestic government can continue to issue debt indefinitely. This debt will be absorbed by the rest of the world, with no feedback on the domestic economy, ignoring the service of this debt. The short-run results are that fiscal policy is expansionary, but in this model expansionary fiscal policy increases the rate of exchange rate depreciation whereas monetary policy lowers the rate of exchange rate depreciation. Here, while the traditional Mundell-Fleming static model looks at exchange rate levels, this model

looks at rates of exchange rate depreciation via the Interest Rate Parity relationship. Thus a fiscal expansion increases the domestic interest rate and the rate of depreciation of the domestic currency, since the two are equal up to a parametric constant.

In sum, we note that the open monetary literature has made many refinements in the theory of exchange rate determination. The models that characterize this literature have discussed the role of expectations and capital movements with emphasis on money markets, viewing the exchange rate as the relative price of national monies and determined such that existing stocks are willingly held. Common to models in this literature one finds the use of arbitrage parity relations to determine the exchange rate, both in the short-run and the long-run, largely as a consequence of the 'small country' and perfect asset substitutability assumptions.

However the use of Interest Rate Parity and Purchasing Power Parity for models of exchange rate determination has some problems. First the perfect asset substitutability assumptions are unrealistic and overly restrictive. In the open-economy optimal portfolio literature, Roll and Solnik [1977], Frankel [1979], and Fama and Farber [1979] have all demonstrated theoretically that the interest rate differential will be a biased predictor of the subsequent change in the spot exchange rate. According to Roll and Solnik the bias is caused by exchange risk and depends on the covariances between the spot rate in question and other countries spot rates. Fama and Farber point out how there can be discounts or premiums in forward exchange rates which do not imply the existence of exchange risks that make real returns on a given security different for the residents of different countries. This premium or

discount in the forward rate is traceable to the differential risks in the money supplies of the two countries. Finally Niehans [1981] looks into deviations from Purchasing Power Parity originating from monetary factors. His main conclusion from the analysis, even in the case of monetary disturbances, is that there is no reason for equilibrium exchange rates to correspond to Purchasing Power Parity. This implies that deviations from Purchasing Power Parity may occur in the short-run. The point is to bring into question the reliance on parity relations for exchange rate determination which characterizes the open monetary literature.

A final criticism of the open monetary approach is particular to this dissertation in that it concerns currency substitution. As pointed out by Ingram [1978], the absence of currency substitution is inconsistent with the assumptions of perfect bond substitutability, and therefore the presence of currency substitution is a necessary refinement of exchange rate theory.

5) The Portfolio Approach to Exchange Rate Determination.

The final class of models are widely known as the open portfolio literature. The portfolio approach models imperfect asset substitutability by separate demand and supply functions for each asset and hence the absence of classical parity relations. Here the exchange rate is simultaneously determined such that all asset markets clear given the existing stocks of wealth and outside financial assets. Thus, in the short-run, the exchange rate is determined by financial market equilibrium, not relative prices.

The classic open portfolio model was developed by Branson, Halttunen, and Masson [1977] and Branson [1977] and is formally;

$$8) \quad M = m(r,r^*)W$$

$$9) \quad B = b(r,r^*)W$$

$$10) \quad eF = f(r,r^*)W$$

$$11) \quad W = M + B + eF$$

where;

M = The domestic money stock.

B = The stock of domestic country government debt.

F = Domestic country holdings of foreign debt.

r = The domestic interest rate.

r^* = The foreign interest rate.

e = The exchange rate, measured as the home currency price of foreign exchange.

Similar models by Isard [1978], Henderson [1977], Murphy and Van Duyne [1980] and Marston [1980] all have this common structure. Conveniently, the essence of the open portfolio approach can be seen graphically in the diagram below which describes the Marston model. Here HH is the locus of points where the market for domestic securities is in equilibrium. An increase in the exchange rate (appreciation of the foreign currency) increases the wealth of the domestic public (measured in home currency) and reduces the foreign

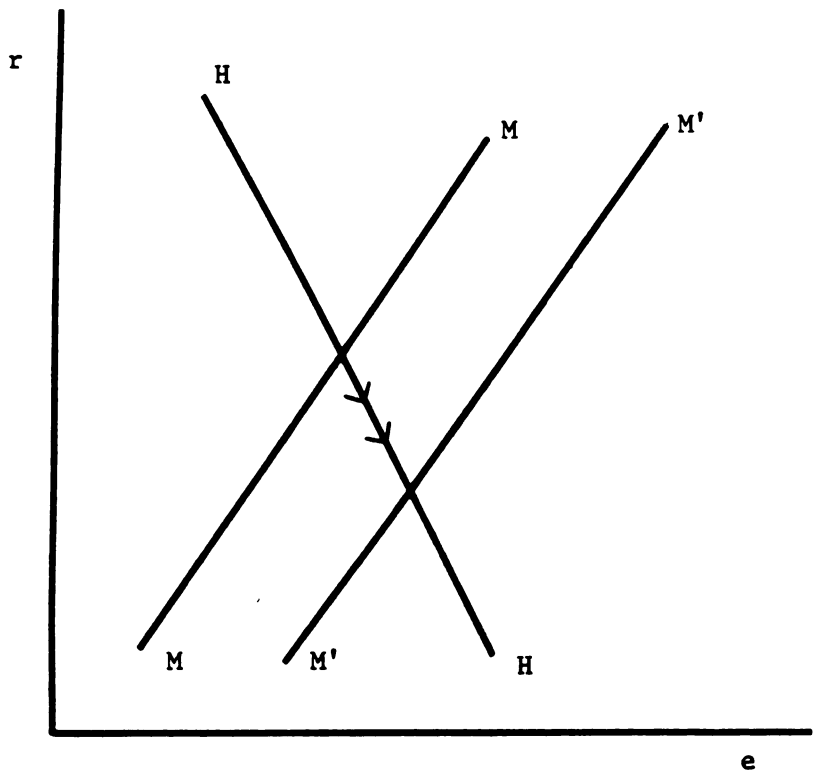

FIGURE 1: Graphical Representation of the Simple Portfolio Model

currency value of foreign holdings of domestic securities. For both reasons, the demand for domestic securities increases. To restore equilibrium in the securities markets, the interest rate must fall and thereby reduce the demand for domestic securities. Hence HH is downward sloping. Similarly, MM represents equilibrium in the home currency or money market. Here a rise in the exchange rate increases the domestic demand for money because it induces an increase in domestic wealth. Hence a higher interest rate on home securities is needed to restore this market to equilibrium. A simple comparative static result of this model occurs under a monetary expansion which shifts the MM schedule to M'M' and hence depreciates the value of the domestic currency and lowers

the domestic interest rate. All of this occurs under imperfect asset substitutability with Interest Rate Parity serving only as a limiting case for these models.

Unlike conventional approaches in which a fiscal expansion leads to an appreciation of the domestic currency, Isard [1978] points out that debt financed fiscal policies can generate pressures on exchange rates that have escaped attention in previous models. For example if the new public debt is denominated in domestic currency units and if private asset holders want to diversify additions to their portfolios between domestic and foreign currency assets, the result will be downward pressure on the value of the domestic currency. Moreover, the downward pressure due to this diversification effect will continue over time as long as the debt issue occurs. Isard concludes that because the diversification and current account effects put continuing downward pressure on the value of the domestic currency, in contrast to the one-time upward push provided by the conventional flow model, there is reason to believe that in the long-run a fiscal expansion financed by debt will depreciate the value of the domestic currency.

Similarly, Dornbusch [1980] argues that a persuasive role for portfolio effects arises in the context of imperfect asset substitutability. With assets being imperfect substitutes and therefore having uncertain real returns, portfolio diversification gives rise to determinant demands for the respective currencies. Using this portfolio approach Dornbusch attempts an explanation of the unanticipated appreciation in the Deutsche Mark in the late seventies which is poorly accounted for by current account and cyclical fluctuations. He argues; "The system of flexible exchange rates and the macroeconomic policies

and disturbances have created an incentive for portfolio diversification, and that the Mark would occupy a large share in an efficiently diversified portfolio, and that the resulting portfolio shifts or capital flows account for some of the unanticipated appreciation." Thus in its simplest form the portfolio model implies a relationship between wealth, asset supplies, and the exchange rate. Finally, relevant to this dissertation, Dornbusch adds; "This model introduces a potential link between deficit finance and the exchange rate through the relative supply of outside financial assets."

In summary, the open portfolio model, while gaining favor in the literature, has some areas that require further research. First the common use of 'small country' assumptions to formulate portfolio models must be generalized. These assumptions include perfect capital mobility, perfect asset substitutability, and fixed prices of international assets. On this subject, Bisignano and Hoover [1982] claim that both theoretical and empirical ambiguities have plagued these models, partly resulting from the theoretical specification of a small country bilateral exchange rate model. They claim that it is not clear, via the use of causality tests, that the often used and theoretically important small country assumptions can be justified empirically, specifically the assumption of a fixed foreign rate of interest. Thus the emphasis of research today is in extending the open portfolio model to a multicountry world.

Secondly the open portfolio approach must be extended to include a role for currency substitution, which has been commonly omitted from the current literature. This dissertation seeks to remedy this by examining in detail a portfolio model which formally includes currency

substitution. Arguments on the macroeconomic implications of currency substitution will be the subject of the next chapter.

Chapter III: THE MACROECONOMIC IMPLICATIONS OF CURRENCY SUBSTITUTION

1) The Theory of Currency Substitution.

The currency substitution hypothesis argues that under flexible exchange rates economic agents will have a portfolio motive to diversify their liquid cash balances.[1] In a portfolio model, money is demanded for services it provides as a 'store of value' as well as a medium of exchange. Hence the existence of currency substitution implies that foreign currency may serve as a 'store of value' for domestic wealth. The incentive arises from the fact that foreign currency held by domestic residents is perfectly liquid and thus has a well developed secondary market as well as earning a potential return due to favorable swings in the exchange rate. On this point Miles and Stewart [1980] argue that according to the modern theory of finance, flexible exchange rates should imply an incentive to diversify liquid assets so as to reduce uncertainty in purchasing power. Similarly, Calvo and Rodriguez [1977] argue that currency substitution arises because the same arguments of portfolio diversification and transactions costs, which are used to justify the domestic demand for domestic money are also applicable to foreign exchange. This brings into question whether the traditional demand for money literature, which presumed that the services of money could be provided only by the 'own country' currency, is misspecified.

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1. George von Furstenberg (IMFSP 1981) points out that for U.S. investors to accept advice to diversify their cash balances implies the forward market must not be efficient, where efficiency is the combination of rational expectations, risk neutrality and competitive markets with no transactions costs.

Criticism leveled at the currency substitution hypothesis is generally of two types. First the theoretical issue of whether or not foreign currency would be dominated by foreign interest earning assets in any reasonable portfolio. The argument asks why domestic residents would hold foreign currency balances when foreign currency cannot be used for domestic transactions as well as yielding no explicit interest return. For instance, Goldstein and Haynes [1984] argue; "Aside from compensating balances, sophisticated multinational concerns are unlikely to hold significant amounts of transactions balances in any currency if these balances yield either zero or small explicit interest returns. Such transactors might well choose to go long or short in a given currency for speculative reasons, but in so doing they would prefer to acquire interest-earning assets." In a theoretical response to this argument, Levy and Sarnat [1978], using portfolio theory, examine the composition of selected efficient portfolios for the period 1970-1973. They find in all periods studied, foreign currency holdings comprised a significant proportion of the efficient portfolios of U.S. investors in spite of the availability of foreign equities. Similarly, Brillembourg and Schadler [1979] argue; "Here the wealth holder will hold foreign currency as well as foreign bonds even though the former has a lower expected return because it has the offsetting advantage of being less risky." Finally von Furstenberg [1981] has shown the profitability of currency diversification during the first seven years of floating exchange rates. It is the position of this dissertation that the theoretical arguments for the existence of currency substitution under flexible exchange rates merit a theoretical examination on the effects of currency substitution in the macroeconomy.

The second criticism of the currency substitution hypothesis concerns the empirical significance of currency substitution. Here skeptics argue that while a theoretical case for currency substitution can be made under flexible exchange rates, the empirical evidence does not confirm its real world importance. Specifically Spinelli [1983] argues that the evidence on significant currency substitution is controversial and not easy to detect. Similarly Batten and Hafer [1984] argues; "When the possible impact of such currency substitution was subjected to empirical investigation, it generally was found to be statistically insignificant. In the two countries (Canada and Germany) where currency substitution was found to have a significant effect, the magnitude of the effect on real money holdings was minimal. Thus, contrary to recent arguments, it does not appear that currency substitution significantly compromises monetary independence in a system of flexible exchange rates." In a different approach, Bordo and Choudhri [1982] find that the expected change in the exchange rate was not a significant factor in the Canadian demand for money. The conclude; "These results are in sharp contrast with Miles [1978] who reported a high degree of currency substitution in Canada." On the other hand, some tests which support the relevance of currency substitution include Miles [1978], Miles and Stewart [1980] and Miles [1981] who use a CES production function for money services to estimate the U.S.-Canadian and U.S.-German elasticities of substitution. In all cases they find the elasticities stable and significant during the floating subperiod. Similarly, Brillembourg and Schadler [1979] assess the impact of currency substitution on exchange rate determination by comparing the size of the cross semi-elasticities with the size of the

own-semielasticity in the same equation. Of 56 such comparisons, only 14 are relatively large, most frequently for the pound Sterling, the Canadian Dollar, and the Swiss Franc. They conclude that the demand for the U.S. dollar is relatively unaffected by changes in the rate of return on U.S. dollars. Finally Brittain [1981] finds that the addition of foreign portfolio variables improve estimates of the German demand for money, however, the foreign variables do not fully explain the problematic shifts in the U.S. money demand since 1971. In sum the evidence on the significance of currency substitution is rather mixed and needs further research. This dissertation will attempt no direct test of currency substitution but rather will attempt to explore its implications in an open portfolio model which in turn will be tested for the United States, France, and Germany.

2) Policy Implications of Currency Substitution.

To understand the policy ramifications of the currency substitution hypothesis we must first examine the role of currency substitution in the open macroeconomy. Basically to model currency substitution requires a respecification of the demand for money to include a component which is determined by foreign residents. Thus currency substitution enters the macro model through the money market. The outcome therefore is to expose the domestic country money market to disturbances arising from shifts in international currency demand or international monetary disturbances.[2]

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2. Spinelli [1983] correctly points out that currency substitution is a sufficient not a necessary condition for the absence of monetary independence in the open economy. He shows that only 'a fairly extreme' set of assumptions can produce an open economy that can insulate itself from foreign monetary shocks.

Traditional models that ignore currency substitution ignore the mechanism of portfolio behavior relative to currencies as a means by which asset market equilibrium may be influenced by international financial shocks. The argument here is that currency substitution represents a potential transmission mechanism of international financial disturbances to the domestic economy through the domestic money market. Note also that currency substitution may transmit domestic policy shocks overseas and then back to the domestic economy through the domestic money market in a fashion which has not been discussed in the open portfolio literature. On this point, Wihlborg [1982] argued that changes in relative currency risk may influence currency substitutability and hence effect the results of monetary and fiscal policies. Girton and Roper [1981] have shown that currency substitution behavior reacting to exchange rate expectations may produce exchange rate instability. Similarly, von Furstenberg [1981] argues; "Any broadening of the inclination to acquire speculative holdings of foreign currencies may alter relations between broadly defined concepts of the national money supply and economic activity in the United States and elsewhere."

The policy issues discussed in this dissertation relate to the role that currency substitution plays in transmitting international financial disturbances to the domestic country money market. Since the nature of the currency substitution literature is largely empirical, the major theoretical discussions center around the work of McKinnon.[3] Central to

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3. Here we refer mainly to the issues raised by McKinnon in: "Currency Substitution and Instability in the World Dollar Standard," AER 1982, and "An International Standard for Monetary Stabilization," Policy Analyses in International Economics, #8, March 1984, Institute for International Economics.

McKinnon's work is the issue of whether foreign exchange considerations or observed growth in money supplies of other countries should influence the conduct of monetary policy by the United States. His hypothesis is that the national monies of an inner group of industrial countries are highly substitutable in demand according to expected exchange rate movements. McKinnon then argues that, because of non-sterilized intervention by foreign central banks and the Fed, currency substitution translates into a loss of control over the world money supply.[4] This leads McKinnon to argue for international monetary cooperation among central banks. McKinnon's point is that in the 1980's, it seems questionable for the U.S. to pursue a purely nationalistic monetary rule irrespective of whether money supplies of other convertible currencies were sharply expanding or contracting or irrespective of whether the dollar was rising or falling on the foreign exchange market.

Similarly, McKinnon [1984] argues that Monetarists view control over the U.S. money supply, without reference to the exchange rate as a target variable, sufficient to stabilize the U.S. economy. But, McKinnon argues that what Monetarists don't realize is that the underlying stability of the demand for money in the U.S. in the 50's and 60's was peculiar to a fixed exchange rate world and to the absence of competing international reserve currencies. He argues; "After 1970, the absence of officially fixed exchange parities, and of any firm commitment to international monetary coordination, led to moves of

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4. McKinnon argues that foreign central banks intervene to partially peg their currencies without sterilization of their monetary bases. Since these banks prefer to keep foreign exchange reserves in short term U.S. debt there is passive sterilization by the United States. The result is that currency substitution may translate into a loss of control over the world money supply.

international currency speculation. According to their changing assessments of future inflation and political stability, international investors; multinational firms, Arab sheiks, central banks in LDC's, and so on, continually shifted their portfolio preferences among Sterling, Mark, Yen, Swiss Franc, and Dollar assets. Such portfolio shifts and associated exchange rate changes destabilized the demand for each national money and led to self-fulfilling prophecies of inflation or deflation." Hence McKinnon argues; "The American cycle of boom and bust the past dozen years is primarily due to instability in the demand for dollar assets and the failure of the Fed to accommodate these demands by adjusting U.S. money growth toward stabilizing the dollar exchange rate."

Besides emphasizing currency substitution, this dissertation extends the open portfolio literature by examining the effects of budget imbalances on international asset markets in a large, two country model. This enables us to model the impact of domestic fiscal disturbances on foreign bond and money markets thus tracing the path of fiscal disturbances through international asset markets. Emphasis is given to the effect of an increase in the domestic deficit, under alternative means of financing, on the foreign rate of interest and the dollar exchange rate. Note that all of these issues disappear under the traditional 'smallness' assumptions.

Portfolio behavior inherent in currency substitution represents another potential international transmission mechanism of domestic fiscal disturbances thus affecting the degree of crowding out that is associated with large budget deficits. In the traditional portfolio model the deficit transmission mechanism is related to direct wealth and

outside asset supply effects, which increase domestic wealth and the domestic interest rate, hence leading to pressure for an appreciation of the domestic currency. An additional link occurs under currency substitution where exchange rate expectations play a crucial role in transmitting domestic deficit effects. Depending on how it is financed, the increase in the domestic budget deficit will alter exchange rate expectations which may realign international bond and currency portfolios thus affecting the exchange rate as well as interest rates. Thus by inquiring into the relationship between domestic budget deficits and the exchange rate we may uncover how fiscally induced changes in the exchange rate may produce crowding in or crowding out in export industries. This may be termed exchange rate induced crowding in or crowding out. This issue appears as a central part of the classic Mundell model in which debt financed fiscal policy produced complete crowding out. In this model government expenditure induced shifts in the IS curve are completely offset by interest induced appreciation of the exchange rate which sends the current account into a deficit in equal magnitude to the fiscal injection. Crowding out is complete because all mutual adjustments of aggregate demand and the exchange rate must occur within the IS equation. What I seek to do here is to discuss the crowding out issue within a model that emphasizes the portfolio effects that may occur in the presence of currency substitution.

On this point McKinnon [1984] refers to two cases in recent history in which budget deficits were projected to sharply increase. These were the projected deficits occurring in France in early 1981 with the Mitterrand election, and in 1981 and 1982 in the United States, when Reagan tax cuts and defense buildup were not matched by sufficient

spending reductions. McKinnon argues that the effect on the exchange rate depends critically on expectations regarding the method of financing the deficit. If money financed, the Mitterrand case, then the result was that the Franc came under immediate downward pressure in early 1981, correctly indicating, argues McKinnon, that the Bank of France should have restricted the money supply. If no monetization of the deficit is expected, the Reagan case, there will be an anticipated sharp increase in the inflow of foreign exchange from abroad. McKinnon argues; "In the Reagan case, the projected unmonetized deficits increased real rates of interest on dollar assets and contributed to (but by no means were the only cause of) the great upward pressure on the U.S. dollar in 1981 and 1982. Again, the exchange rate clearly signaled that the Federal Reserve should have expanded the U.S. money supply to prevent the dollar from appreciating so sharply thus mitigating the recession in the United States in 1982." In sum, we are seeking to explore the implications of currency substitution behavior in the open macroeconomy. Our goal shall be to discuss the transmission mechanism of deficit effects in international asset markets with emphasis on policy issues surrounding large budget deficits.

Chapter IV: THE MODEL

1) Model Specification.

The model of international financial markets developed in this dissertation is an extension of the simple open portfolio model of exchange rate determination. The following characteristics distinguish the model from the current literature:

1. The model is cast in a two-large-country setting. This represents an improvement over the traditional use of 'small country' assumptions such as fixed foreign asset prices. Hence, in our discussion of budget deficits we shall focus on the large country case.

2. The model formally introduces currency substitution into the portfolio model by allowing foreign residents to hold domestic money balances. Emphasis is given to the role of currency substitution as a transmission mechanism for deficit effects under flexible exchange rates.

3. A government financing constraint is formally included for each country.

4. Wealth aspects of deficits are emphasized by modeling wealth as endogenous. Hence wealth constitutes an important transmission mechanism of deficit effects.

5. Exchange rate expectations play a key role in the portfolio decisions of world residents. The proposed model links expectations to the deficit, and how it is financed, by the use of limited information rational expectations, which is a generalization of rational expectations. This allows currency substitution to operate as a transmission mechanism linking deficit effects to the money market outside of wealth effects.

Since the model developed here is cast in a twin large country setting it consists of four asset markets; domestic money, domestic debt, foreign money and foreign debt. The analysis is conducted in a dynamic discrete time 'beginning of period' stock model. The following variables appear in the model. Note that the absence of a subscript implies observation in the current period.

M = Domestic demand for Domestic money

M^* = Foreign demand for Domestic money

M^t = Domestic monetary base

B = Domestic demand for Domestic debt

B^* = Foreign demand for Domestic debt

B^t = Supply of Domestic government debt

DEF = Domestic country budget deficit

N^* = Foreign demand for Foreign money

N^t = Foreign monetary base

F = Domestic demand for Foreign debt

F^* = Foreign demand for Foreign debt

F^t = The supply of Foreign debt

DEF^* = The Foreign country budget deficit

W = Domestic private sector wealth

W^* = Foreign private sector wealth

z = The expected rate of depreciation of the Domestic currency

r = The Domestic rate of interest

r^* = The Foreign rate of interest

e = The exchange rate, measured as the Domestic price of Foreign currency

g = Parameter measuring the sensitivity of z to the difference between this and last periods observed exchange rate

h = Parameter measuring the sensitivity of z to the limited information rational expectations component of the expectations formation specification

CURR = Domestic country current account

ORH^* = Foreign official holdings of Domestic currency reserves

ORH = Domestic official holdings of Foreign currency reserves

The demand for domestic money by domestic residents can be modeled as the share of domestic wealth held in domestic money balances;

12) $M = m(r,r^*+z)W$

Here the domestic currency return on domestic and foreign debt represent the opportunity cost of holding domestic money balances.[5]

In the open portfolio model currency substitution arises because both foreign and domestic money balances may fulfill the store of value function of money which is the major motive for holding cash balances in a pure asset model. This requires us to specify a foreign demand for both domestic and foreign cash balances. Noting that currency

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5. Here m( ) is known as a share function and is a number between zero and one that gives the share of domestic wealth that is held in domestic money balances. Note also that we retain the commonly used specification of asset demand functions which are homogeneous of degree one in wealth. See portfolio models of Branson, Halttunen and Masson [1977] and Dooley and Isard [1982].

substitution is modeled in an asymmetric fashion,[6] we formally specify the demand for domestic currency by foreign residents as;

$$13) \quad M^* = m^*(r-z, r^*, z)W^*$$

Equation 13) constitutes the major innovation of the model. Its existence reflects currency substitution which has been neglected in the specification of previous open portfolio models. Here the share of foreign wealth held in domestic money balances depends on the opportunity costs borne by foreign residents when they hold domestic currency balances which are the foregone interest return on domestic and foreign bonds. The incentive of foreign residents to hold domestic cash balances comes from a possible return due to favorable swings in the exchange rate in the short-run, as well as from their desire to diversify their cash portfolios to manage purchasing power risk. Hence their decision to purchase domestic balances depends partly on their view of expected movements in the exchange rate. Thus, z enters the foreign money share functions specifically to serve as a link between exchange rate expectations and currency substitution. Hence exchange rate expectations constitute a potential transmission mechanism by which deficit effects may influence the exchange rate through currency substitution.

Equilibrium in the domestic money market therefore requires that the sum of domestic and foreign demands absorb the current supply;

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6. This is done for simplification in discussing the comparative static results of the model. This assumption does not fundamentally change any of the results of the model but allows a more illustrative graphical examination of the model.

14) $M^t = M + eM^*$

Since M^* is valued in foreign currency units it must be premultiplied by the exchange rate to convert to domestic currency units.[7]

Debt securities by both governments are traded internationally and are assumed to be one-period, zero coupon securities. Therefore the domestic demand for domestic government debt is specified as;

15) $B = b(r, r^*+z)W$

Similarly, the foreign demand for domestic debt is given by;

16) $B^* = b^*(r-z, r^*)W^*$

Hence, the domestic bond market is in equilibrium when;

17) $B^t = B + eB^*$

The domestic country supply of debt is governed by the domestic country financing constraint;

18) $DEF = M^t - M^t_{t-1} + B^t - B^t_{t-1}$

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7. The assumption implicit here is that foreign residents make portfolio decisions based on own currency valued variables. For example it argues that a Frenchman will decide how many Francs he wants to hold as dollars.

Here the flow of deficit spending, which is exogenous in this model, must be financed by additions to the stocks of domestic money and/or debt. Note that the emphasis here is on the very short-run since we are ignoring all feedback effects from domestic interest rate to the domestic budget deficit.

Completing our specification of the foreign demand for money under currency substitution, the foreign demand for foreign money is given by;

$$19) \quad N^* = n^*(r-z, r^*, z)W^*$$

Here changes in expectations, z, induce currency substitution as shown by the adding-up constraint: $n_z^* + m_z^* = 0$. Since the foreign money supply is exogenous, the foreign money market is in equilibrium when;

$$20) \quad N^t = N^*$$

Equation 21) specifies the share of domestic wealth held in foreign debt, and equation 22) specifies the share of foreign wealth held in foreign debt;

$$21) \quad F = f(r, r^*+z)W$$

$$22) \quad F^* = f^*(r-z, r^*)W^*$$

The foreign bond market is in equilibrium when;

$$23) \quad F^t = F/e + F^*$$

The supply of foreign debt is governed by the foreign government financing constraint;

$$24) \quad DEF^{*} = F^{t} - F^{t}_{t-1} + N^{t} - N^{t}_{t-1}$$

The following equations specify the relative balance sheet constraints characteristic of a discrete time 'beginning of period' stock model.

$$25) \quad W = M + B + F$$

$$26) \quad W^{*} = M^{*} + B^{*} + F^{*} + N^{*}$$

Equation 25) and 26) define domestic and foreign private sector wealth and are simply accounting identities.[8] Note therefore equations 25) and 26) are not independent within the model.

Before we introduce the expectations specification we shall first discuss what role it will play in the model. One of our goals of the model is to link currency substitution behavior to budget deficits. This requires that changes in the deficit in each country induce changes in exchange rate expectations which, in turn, induce portfolio substitution concerning currency as well as debt. To achieve this we use a version of the Rational Expectations Hypothesis, which was originated by Muth [1961]. The particular specification introduced here is known as 'limited information' rational expectations, referring to

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8. Note that by definition of the share function: $m(\ ) + b(\ ) + f(\ ) = 1$, and $m^{*}(\ ) + b^{*}(\ ) + f^{*}(\ ) + n^{*}(\ ) = 1$.

restrictions concerning the information set available to economic agents for the formulation of exchange rate expectations relative to the assumptions characteristic of perfect foresight rational expectations. Limited information rational expectations was first discussed by Shiller [1978] who argued; "What we are likely instead (of rational expectations) to see, in many cases, are models that involve some sort of incomplete rationality... These might be models in which some expectations are rational and others formed by people with less information are not. Or they might be models in which all expectations are conditioned on a small subset of the information comprised by the exogenous variables in the model, or linear forecasts based on the subset." Using Shiller's hypothesis we construct a specification which accomplishes the goals of our model and is consistent with perfect foresight rational expectations in long-run equilibrium.

Equation 27) specifies the generation of exchange rate expectations under the limited information rational expectations hypothesis:

$$27) \quad z = g[e - e_{t-1}] + h[\ln[(M^t/M^t_{t-1})/(B^t/B^t_{t-1})] - \ln[(N^t/N^t_{t-1})/(F^t/F^t_{t-1})]]$$

The essence of the specification is to base expectations on observation of the current exchange rate and the relative outside asset supplies relative to last period. The first component of equation 27), $g[e - e_{t-1}]$, argues that expectations will be partially based on observations of the current exchange rate relative to last period's exchange rate. The parameter g is assumed to be positive. The second term involving the parameter h involves relative outside financial asset

supplies. The particular algebraic specification used is based on the notion that changes in the expected rate of exchange rate depreciation should be based on the rate of growth in relative outside asset stocks.[9] Intuitively we are basing exchange rate expectations on asset stocks which drive the model both in the short-run and the long-run. Note also that in the short-run agents will react to current deficits and how they are financed. However, these agents expectations may not be realized in the short-run. In the appendix to this chapter we show that, with appropriate restrictions on the parameters g and h, equation 27) will generate exchange rate expectations which are realized in the long-run, or steady-state, equilibrium.[10]

In relation to rational expectations the limited information rational expectations hypothesis focuses on what economic agents are assumed to know about the economy and what they observe. Hence I argue

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9. Here expectations of the exchange rate in the short-run depend on the method of financing and magnitude of the deficit in each country. Hence expectations depend on relative outside financial asset supplies of the two countries. There is some precedent in the open literature for linking exchange rate expectations to the relative supply of outside financial assets. Specifically, Dornbusch [1980] and Frankel [1979] argue that what matters for expectations concerning eminent depreciation are the relative supplies of outside assets denominated in the two currencies.

10. In this sense the limited information rational expectations specification is similar to the 'semi-rational' expectations hypothesis developed by Mathieson [1977] who argued; "The semi-rational expectations structure is based on the hypothesis that market participants may have some estimate of the long-run effects of a change in a policy instrument but are uncertain about the expected path that the economy will follow to the long-run equilibrium." Mathieson went on to model this hypothesis by basing expectations on the set of policy instruments. Our specification in equation 27) is similar in that expectations are based on the stocks of relative outside assets which are the policy instruments in this model since the deficits are exogenous in each period.

that limited information rational expectations are simply rational expectations in the sense of Muth but with an information set restricted as follows:

a) Economic agents are assumed to know only the long-run properties of the model and thus the long-run effects of a change in a given policy instrument. Here, because of imperfect knowledge and incomplete information, the information set they use as a basis for expectations formation is limited in the short-run. They are therefore unaware of the exact path that the economy will travel to the new long-run equilibrium. Hence expectations may prove to be unfulfilled in the short-run. However, as we show in the appendix to this chapter, when agents know the restrictions imposed on the parameters g and h in long-run equilibrium, their expectations become equivalent with those of perfect foresight rational expectations.

b) Agents base expectations solely on the observation of changes in relative outside financial asset supplies and the exchange rate, relative to last period. Hence, they are assumed to observe the current deficits and how they are financed and base expectations on these observations.[11]

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11. Here, given the experience in the United States under the Reagan Administration, public exposure to figures concerning the size of the deficit and its possible effects was widespread in both electronic and print media. Hence this 'limited information' specification contains an alternative notion of 'reality' in the sense that it may represent expectations formation behavior which may be 'rational' in the sense of Muth but does not satisfy the rigid mathematical criteria of rational expectations that characterizes the modern rational expectations literature.

Outside of the limited information set the 'limited information' specification embodies some of the classic characteristics of the rational expectations hypothesis:

a) Information on the size of the deficit and how it is financed is not wasted in the economic system. This is consistent with the original idea of rational expectations exposed by Muth, even though the information may be incorrect. We use this to argue that expectations should be based on observations of current trends in international asset stocks as well as the exchange rate. Another aspect of rational expectations as argued by Muth is that economic agents are forward looking and use relevant economic theory in making their forecasts. We use this notion in forming the algebraic specification of equation 27). Here economic agents are assumed to know some of the potential impacts of budget deficits in the short-run. While these expectations may be unfulfilled, nevertheless, it allows us to link portfolio behavior to budget deficits in the short-run.

b) Under certain restrictions, the limited information structure is consistent with exchange rate behavior in the steady state. Using the reduced form solution of the model, under alternative specifications of the steady state, we can show that the limited information specification generates expectations consistent with the long-run equilibrium of the model. In this sense we argue that expectations are self-fulfilling or realized in the long-run.[12]

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12. Proof that the limited information specification in equation 27) will generate, in the steady state, expectations consistent with perfect foresight rational expectations can be found in the appendix to this chapter. Here we will uncover some of the restrictions which may be

Hence expectations turn out to be realized in the same sense as Dornbusch and Fischer's [Macroeconomics, 1st ed] perfect foresight expectations in which inflation expectations depend on the rate of growth of the money supply. Since their long-run equilibrium is one where the rate of inflation is governed by the rate of growth of the money supply, inflation expectations are realized and hence judged to be perfect foresight or rational expectations. Hence we argue that the limited information structure performs the same role as rational expectations but is less restrictive since rational expectations amount to perfect foresight in the deterministic model.

Finally, to close the model, equation 28) is the balance of payments identity, assuming the current account is exogenous.

$$28) \quad [e(M^{*} - M^{*}_{t-1} + B^{*} - B^{*}_{t-1}) - (F - F_{t-1})] + CURR + [e(ORH^{*} - ORH^{*}_{t-1}) - (ORH - ORH_{t-1})] = 0$$

Here the incremental change in the domestic demand for foreign debt is at the same time a supply of domestic currency to foreign residents. Similarly the incremental demand for domestic denominated assets by foreign residents is also a supply of foreign exchange to domestic residents. Equation 28) ensures that flows of capital across countries must balance in value terms. As pointed out by Kouri [1976] and others,

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imposed on the parameters g and h to produce this result in the steady state. Note, in accordance with 'rationality' implying that expectations are made with the use of 'relevant theory,' the steady state restrictions on the parameter h are essentially the reduced form coefficients of the model in the steady state.

equation 28) is an ex-post accounting identity and not an equilibrium condition.

In sum, the complete model has seventeen equations with fifteen endogenous variables, noting that only fifteen of the equations are independent. The model shall be restated here for convenience in reference.[13]

a)	$M = m(r, r^*+z)W$	Domestic demand for Domestic money
b)	$M^* = m^*(r-z, r^*, z)W^*$	Foreign demand for Domestic money
c)	$M^t = M + eM^*$	Domestic money market equilibrium condition
d)	$B = b(r, r^*+z)W$	Domestic demand for Domestic debt
e)	$B^* = b^*(r-z, r^*)W^*$	Foreign demand for Domestic debt
f)	$B^t = B + eB^*$	Domestic bond market equilibrium condition
g)	$DEF = M^t - M^t_{t-1} + B^t - B^t_{t-1}$	Domestic government financing constraint
h)	$N^* = n^*(r-z, r^*, z)W^*$	Foreign demand for Foreign money
i)	$N^t = N^*$	Foreign money market equilibrium condition
j)	$F = f(r, r^*+z)W$	Domestic demand for Foreign debt
k)	$F^* = f^*(r-z, r^*)W^*$	Foreign demand for Foreign debt
l)	$F^t = F/e + F^*$	Foreign bond market equilibrium condition

13. The behavioral assumptions of the model are given by the following assumptions concerning the partial derivatives of the share functions: m_r, m_{r^*+z}, m^*_{r-z}, $m^*_{r^*}$, m^*_z, b_{r^*+z}, $b^*_{r^*}$, n^*_{r-z}, $n^*_{r^*}$, f_r, and f^*_{r-z} are all negative. b_r, b^*_{r-z}, n^*_z, f_{r^*+z}, $f^*_{r^*}$, g, and h are all assumed to be positive.

m) $DEF^* = F^t - F^t_{t-1} + N^t - N^t_{t-1}$ Foreign government financing constraint

n) $W = M + B + F$ Domestic private sector wealth

o) $W^* = M^* + B^* + F^* + N^*$ Foreign private sector wealth

p) $z = g(e - e_{t-1}) + h[\ln[(M^t/M^t_{t-1})/(B^t/B^t_{t-1})] - \ln[(N^t/N^t_{t-1})/(F^t/F^t_{t-1})]]$ Expected Rate of Depreciation of the Domestic currency

q) $[e(M^* - M^*_{t-1} + B^* - B^*_{t-1}) - (F - F_{t-1})] + CURR + [e(ORH^* - ORH^*_{t-1}) - (ORH - ORH_{t-1})] = 0$ Balance of Payments

The model determines the following endogenous variables:

$M, M^*, B, B^*, B^t, N^*, F, F^*, F^t, W, W^*, r, r^*, e, z$

The exogenous and predetermined variables are all of the lagged variables, variables with t-1 subscripts, and the following:

M^t, DEF, N^t, DEF^*, CURR, ORH^*, ORH

The variables measured in domestic currency units are:

M, M^t, B, B^t, DEF, F, W, CURR, ORH

The variables measured in Foreign currency units are:

$M^*, B^*, N^*, N^t, F^*, F^t, DEF^*, W^*, ORH^*$

The adding-up constraints implicit in a portfolio model of this type are derived from the definition of the share functions. Since the domestic share functions must sum to unity we have the following domestic country adding-up constraint:

29) $\partial m(\ )/\partial j + \partial b(\ )/\partial j + \partial f(\ )/\partial j = 0$

where $j = r, r^{*}+z$

Similarly we have the following foreign country adding-up constraints:

$$30) \quad \partial m^{*}(\ )/\partial i + \partial b^{*}(\ )/\partial i + \partial f^{*}(\ )/\partial i + \partial n^{*}(\ )/\partial i = 0$$

where $i = r-z, r^{*}$

and concerning currency substitution:

$$31) \quad m_z^{*} + n_z^{*} = 0$$

which is rather restrictive in that any change in z leaves the total foreign demand for money unchanged.

By revaluing foreign wealth, equation 26), in domestic currency units and summing with domestic wealth we have the consolidated world balance sheet constraint:

$$32) \quad W + eW^{*} = (M^{t} + B^{t} + eF^{t} + eN^{t})$$

By using the definition of foreign and domestic wealth, equation 32) may be rewritten as;

$$33) \quad (M + B + F) + e(M^{*} + B^{*} + F^{*} + N^{*}) = (M^{t} + B^{t} + eF^{t} + eN^{t})$$

rearranging we have:

$$34) \quad [M^{t} - (M + eM^{*})] + [B^{t} - (B + eB^{*})] + eF^{t} - (F + eF^{*})] + [eN^{t} - eN^{*}] = 0$$

Equation 34), a form of Walrus Law for the model, shows that only three of the four asset markets are independent. Hence this constraint will allow us to drop one of the four markets from the analysis. The market we shall drop is the foreign money market.

2) Model Solution.

Since the model consists of fifteen independent equations and fifteen endogenous variables, it is rather large and complicated to solve. We therefore will collapse the model down to three equations with three endogenous variables.[14] Totally differentiating and reducing the system the complete model may be represented by the following matrix system:

36) $Ax = Cv$

or specifically:

---

14. By some manipulation, the balance of payments identity, equation 28) can be rewritten as:

35) $W - W_{t-1} = CURR + [M^t - M^t_{t-1} + B^t - B^t_{t-1}]$

The importance of equation 35) is that it is used to eliminate domestic wealth in collapsing the model. The strategy is as follows; the market equilibrium conditions contain both domestic and foreign wealth which together account for seven endogenous variables. By using equation 32) we can substitute out foreign wealth thus eliminating the endogenous variables: M^*, B^*, F^* and N^* while introducing F^t, which is also endogenous, thus leaving four endogenous variables. Now, using equation 35) we can substitute out domestic wealth which introduces B^t and hence leaves two endogenous variables: B^t and F^t. However, these endogenous variables are determined upon specification of the policy action. Hence manipulations involving equations 32) and 35) allow us to collapse the model to three endogenous variables; r, r^*, and e.

$$\underset{A}{\begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}} \times \underset{x}{\begin{vmatrix} dr \\ dr^* \\ de \end{vmatrix}} =$$

$$\underset{C}{\begin{vmatrix} m_1 & m_2 & m_3 & m_4 & m_5 & m_6 & m_7 & m_8 & m_9 & m_{10} & m_{11} \\ b_1 & b_2 & b_3 & b_4 & b_5 & b_6 & b_7 & b_8 & b_9 & b_{10} & b_{11} \\ f_1 & f_2 & f_3 & f_4 & f_5 & f_6 & f_7 & f_8 & f_9 & f_{10} & f_{11} \end{vmatrix}} \times \underset{v}{\begin{vmatrix} dM^t \\ dM^t_{t-1} \\ dB^t_{t-1} \\ dN^t \\ dN^t_{t-1} \\ dF^t_{t-1} \\ dDEF \\ dDEF^* \\ dW_{t-1} \\ dCURR \\ de_{t-1} \end{vmatrix}}$$

Where A is the coefficient matrix of the endogenous variables of the model with the following elements:

$$a_{11} = (Wm_r + W^*em^*_{r-z})$$

$$a_{12} = (Wm_{r^*+z} + W^*em^*_{r^*})$$

$$a_{13} = [m^*(\ )(F^t + N^t) + g(Wm_{r^*+z} - W^*em^*_{r-z} + W^*em^*_z)]$$

$$a_{21} = (Wb_r + W^*eb^*_{r-z})$$

$$a_{22} = (Wb_{r^*+z} + W^*eb^*_{r^*})$$

$$a_{23} = [b^*(\ )(F^t + N^t) + g(Wb_{r^*+z} - W^*eb^*_{r-z})]$$

$$a_{31} = (Wf_r + W^*ef^*_{r-z})$$

$$a_{32} = (Wf_{r^*+z} + W^*ef^*_{r^*})$$

$$a_{33} = [f^*(\ )(F^t + N^t) - F^t + g(Wf_{r^*+z} - W^*ef^*_{r-z})]$$

The matrix C is the coefficient matrix of the predetermined and exogenous variables containing the following elements:

$$m_1 = [1 - hQ/M^t - hQ/B^t]$$

$$m_2 = [hQ/B^t - m^*(\ ) + hQ/M^t_{t-1}]$$

$$m_3 = [hQ/B^t - hQ/B^t_{t-1} - m^*(\ )]$$

$$m_4 = [hQ/N^t + hQ/F^t]$$

$$m_5 = -[em^*(\ ) + hQ/N^t_{t-1} + hQ/F^t]$$

$$m_6 = [hQ/F^t_{t-1} - hQ/F^t - em^*(\ )]$$

$$m_7 = [hQ/B^t - m(\ )]$$

$$m_8 = -[hQ/F^t + em^*(\ )]$$

$$m_9 = -[m(\ ) - m^*(\ )]$$

$$m_{10} = -[m(\ ) - m^*(\ )]$$

$$m_{11} = gQ$$

where $Q = (Wm^{*}_{r+z} - W^{*}em^{*}_{r-z} + W^{*}em^{*}_{z})$

$b_1 = -[1 + hK/M^{t} + hK/B^{t}]$

$b_2 = [1 - b^{*}(\ ) + hK/M^{t}_{t-1} + hK/B^{t}]$

$b_3 = [1 - b^{*}(\ ) - hK/B^{t} - hK/B^{t}_{t-1}]$

$b_4 = [hK/N^{t} + hK/F^{t}]$

$b_5 = -[eb^{*}(\ ) + hK/N^{t}_{t-1} + hK/F^{t}]$

$b_6 = -[eb^{*}(\ ) + hK/F^{t} - hK/F^{t}_{t-1}]$

$b_7 = [1 - b(\ ) + hK/B^{t}]$

$b_8 = -[eb^{*}(\ ) + hK/F^{t})$

$b_9 = -[b(\ ) - b^{*}(\ )]$

$b_{10} = -[b(\ ) - b^{*}(\ )]$

$b_{11} = gK$

where $K = (Wb^{*}_{r+z} - W^{*}eb^{*}_{r-z})$

$f_1 = -[hJ/M^{t} + hJ/B^{t}]$

$f_2 = [hJ/M^{t}_{t-1} - f^{*}(\ ) + hJ/B^{t}]$

$f_3 = -[f^{*}(\ ) - hJ/B^{t} + hJ/B^{t}_{t-1}]$

$f_4 = [hJ/F^{t} + hJ/N^{t} - e]$

$f_5 = [e - ef^{*}(\ ) - hJ/N^{t}_{t-1} - hJ/F^{t}]$

$f_6 = [hJ/F^{t}_{t-1} - hJ/F^{t} - ef^{*}(\ ) + e]$

$f_7 = [hJ/B^{t} - f(\ )]$

$f_8 = [e - ef^{*}(\ ) - hJ/F^{t}]$

$$f_9 = -[f(\ ) - f^*(\ )]$$

$$f_{10} = -[f(\ ) - f^*(\ )]$$

$$f_{11} = gJ$$

where $J = (Wf^*_{r+z} - W^*ef^*_{r-z})$

The determinant of the coefficient matrix A is given formally as:

$$37) \quad \text{Det } A = [(a_{11}a_{22}a_{33} + a_{21}a_{32}a_{13} + a_{31}a_{12}a_{23}) - (a_{31}a_{22}a_{13} + a_{32}a_{23}a_{11} + a_{33}a_{12}a_{21})]$$

To solve the model algebraically we shall use Cramer's rule which will require us to sign the determinant in equation 37). Under some reasonable restrictions the determinant of this matrix will be positive. The determinant of the coefficient matrix A can be rewritten as:

$$38) \quad \text{Det } A = [a_{21}a_{32}a_{13} + a_{31}a_{12}a_{23} - a_{31}a_{22}a_{13} - a_{32}a_{23}a_{11}] + [a_{33}(a_{11}a_{22} - a_{12}a_{21})]$$

There are a number of restrictions we could impose to sign this determinant. Conveniently the last term in equation 38) is likely to be very close to zero. Here the coefficient a_{33} is likely to be small. Hence we can avoid restrictions on the sign of a_{33} and on the relative sizes of the products $a_{11}a_{22}$ relative to $a_{12}a_{21}$ and still sign the determinant A. Under these assumptions sufficient conditions for the Det A to be positive are:

$a_{13} > 0$

$a_{23} > 0$

$a_{33}(a_{11}a_{22} - a_{12}a_{21})$ is small

Intuitively for these conditions to be met implies that wealth effects associated with changes in the exchange rate dominate any exchange rate induced expectations effects resulting from the expectations formation specification. Note also a necessary condition for Det A to be positive is that the parameter g is small in magnitude relative to the limited information rational expectations term in equation 27).

Characteristic of open portfolio models of this size the comparative static results are difficult to interpret and sign algebraically. This is due to the richness of the two country specification relative to the small country case. Using Cramer's rule we find the signs of the reduced form coefficients are ambiguous without certain restrictions being imposed. To remedy this situation we shall focus on the domestic country and solve the model graphically as well as algebraically. This graphical approach will allow us to see the nature of the ambiguity involved in signing the reduced form coefficients as well as to concentrate on the role of currency substitution in transmitting cross-country effects to the domestic money market under domestic budget deficits.

The domestic country money and bond market equilibrium loci can be represented graphically in domestic-interest-rate-exchange-rate space as shown in Figure 2.

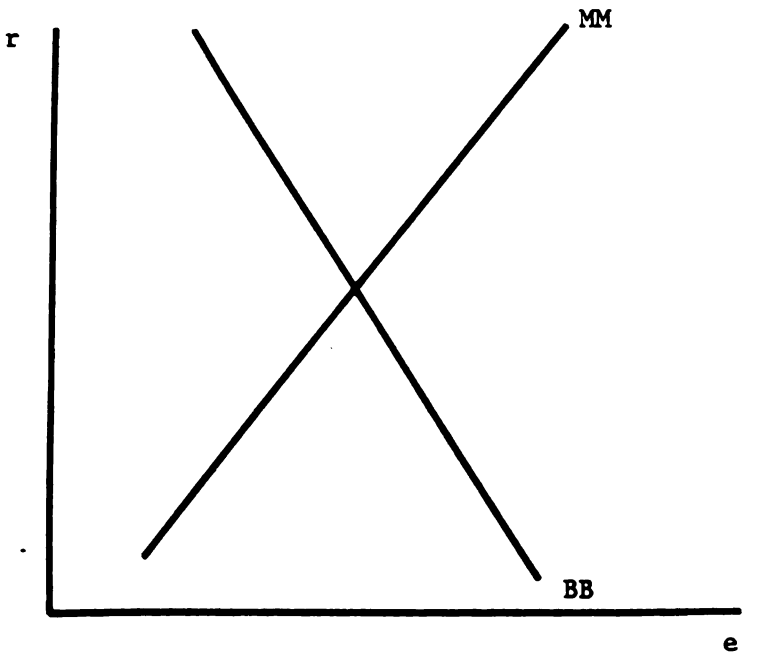

FIGURE 2: Graphical Representation of the Domestic Country

Here MM is the locus of domestic interest rate and exchange rate combinations which are consistent with equilibrium in the domestic country money market. Formally its slope is:

$$39) \quad dr/de_{MM} = \frac{-[m^*(\ )(F^t + N^t) + gQ]}{[Wm_r + W^* em^*_{r-z}]} > 0$$

Here a_{13} is positive by assumption.[15] The intuitive reasoning is that as the domestic currency depreciates the holders of foreign currency

15. Note that Q contains the term $W^* em^*_z$ which measures the sensitivity of changes in the foreign demand for domestic money to changes in exchange rate expectations. Hence the presence of currency substitution may partially flatten the MM schedule relative to its absence. Intuitively as e increases, domestic wealth increases whereas foreign wealth falls which induces a decrease in the foreign demand for domestic money which may require a smaller rise in the domestic rate of interest to maintain domestic money market equilibrium.

denominated assets will experience capital gains and hence domestic wealth will increase. This will induce an increase in the domestic demand for domestic money and hence require a rise in the domestic interest rate to restore domestic money market equilibrium.

Similarly BB is locus of domestic interest rate and exchange rate combinations which are consistent with equilibrium in the domestic country bond market. Its slope is formally:

$$40) \quad dr/de_{BB} = \frac{-[b^*(\ )(F^t + N^t) + gK]}{[Wb_r + W^* eb^*_{r-z}]} < 0$$

Here a_{23} is positive by assumption. Intuitively as the domestic currency depreciates domestic wealth will increase putting upward pressure on domestic bond prices which imply a lower domestic rate of interest to restore equilibrium in the domestic bond market.[16] Using this graphical framework found in Figure 2 we shall now discuss the comparative static results of the model focusing on the domestic country.

16. In this model each country holds some claims that are denominated in the foreign currency, thus a depreciation of the home currency raises the demand for home currency assets. Masson [1981] and others have pointed out that when domestic residents have debts denominated in a foreign currency, a depreciation may have the effect of lowering the domestic currency value of domestic wealth. This effect is absent in this model because all liabilities are denominated in the home currency of the issuing country.

Chapter V: COMPARATIVE STATIC RESULTS AND POLICY IMPLICATIONS

1) Domestic Money Financed Deficits

Since our focus here is on the domestic country we shall assume throughout that the foreign country budget deficit and supplies of outside financial assets remain unchanged. Starting from an initial position of equilibrium we seek to explore the impact on the domestic money and bond market of an increase in the domestic budget deficit which is monetized. Characteristic of open portfolio models the comparative static effects on the domestic interest rate and exchange rate will be determined by the outcome of competing income and substitution effects arising from the deficit and how it is financed. In this model the traditional income and substitution effects are supplemented by currency substitution which is a feedback effect into the domestic money market which has not been previously integrated into the open portfolio literature.

To find the domestic interest rate effects associated with an increase in the domestic country budget deficit which is money financed we require the determinant of the following matrix;

$$41) \quad A_r = \begin{vmatrix} v_1 & a_{12} & a_{13} \\ v_2 & a_{22} & a_{23} \\ v_3 & a_{32} & a_{33} \end{vmatrix}$$

where;

$$v_1 = [1 - hQ/M^t - m(\ )]$$

42) $$v_2 = -[hK/M^t + b(\ )]$$

$$v_3 = -[hJ/M^t + f(\ )]$$

Hence;

43) $$dr/dDEF_{Money} = [\text{Det } A_r \ / \ \text{Det } A] < 0$$

Sufficient conditions for dr/dDEF < 0 are:

44) $$\text{Det } A > 0$$
$$(a_{12}a_{23} - a_{22}a_{13}) \text{ is small}$$

To find the foreign interest rate effects associated with a money financed increase in the domestic country budget deficit we need the determinant of the following matrix;

45) $$A_r^* = \begin{vmatrix} a_{11} & v_1 & a_{13} \\ a_{21} & v_2 & a_{23} \\ a_{31} & v_3 & a_{33} \end{vmatrix}$$

Hence;

46) $$dr^*/dDEF_{Money} = [\text{Det } A_r^*/\text{Det } A] < 0$$

Sufficient conditions for $dr^*/dDEF < 0$ are:

Det A > 0

$a_{11}v_2a_{33}$ is small

To find the exchange rate effects associated with a money financed increase in the domestic budget deficit we require the determinant of the following matrix:

$$47) \quad A_e = \begin{vmatrix} a_{11} & a_{12} & v_1 \\ a_{21} & a_{22} & v_2 \\ a_{31} & a_{32} & v_3 \end{vmatrix}$$

Hence:

$$48) \quad de/dDEF_{Money} = [\text{Det } A_e/\text{Det } A] > 0$$

Sufficient conditions for de/dDEF > 0 are:

$$49) \quad \begin{array}{l} \text{Det A} > 0 \\ a_{11}(a_{22}v_3 - a_{32}v_2) \text{ is small} \end{array}$$

Let us now examine the outcome of domestic money financed deficits graphically. The shift in the MM schedule under money financing is given by;

$$50) \quad dr/dDEF^{MM}_{Money} = \frac{[1 - hQ/M^t - m(\ )]}{[Wm_r + W^* em^*_{r-z}]} < 0$$

Thus an increase in the domestic country monetary base accompanying the deficit will unambiguously shift the MM schedule out and to the right in r-e space. Here, under limited information rational expectations, money financing of the deficit leads to expectation of a depreciation of the domestic currency and hence a fall in the foreign demand for domestic money. Ceteris paribus, the larger this fall, the more significant currency substitution, the greater will be the shift in the MM schedule.[17] On the other hand the larger is the wealth induced increase in the domestic demand for money the less will be the outward shift in the MM schedule. In this case we assume that the asset supply and substitution effects dominate any induced wealth effect on the demand for domestic money.

In the domestic bond market the effect of a domestic money financed deficit is ambiguous. The shift in the BB schedule is given by;

$$51) \qquad dr/dDEF^{\text{BB}}_{\text{Money}} = \frac{-[b(\ ) + h(Wb^{*}_{r+z} - W^{*}eb^{*}_{r-z}]}{[Wb_{r} + W^{*}eb^{*}_{r-z}\ ]} \gtrless 0$$

The nature of the ambiguity is found in the numerator and depends on the relative strengths of income and substitution effects. The term b( ) refers to the wealth induced increase in the domestic demand for domestic debt, an income effect of the deficit. On the other hand, the

17. Algebraically this can be seen by examining the term Q_*. This term will be larger in absolute value the larger is the term $W^{*}em^{*}_{z}$. This term represents the sensitivity of the foreign demand for domestic money to the rational component of exchange rate expectations formation.

term hK represents the substitution effects arising from changes in expectations surrounding the deficit in the domestic country being monetized. Here expectation of a depreciation in the domestic currency makes foreign debt more attractive to both domestic and foreign residents leading to a decrease in the demand for domestic debt. The net shift in the BB schedule depends on which effect, income or substitution is dominant.

In keeping with conventional assumptions we shall assume that wealth effects dominate expectations effects and hence the BB schedule will shift down and to the left under money financed domestic deficits. The potential market outcome under these assumptions is given in Figure 3 below.

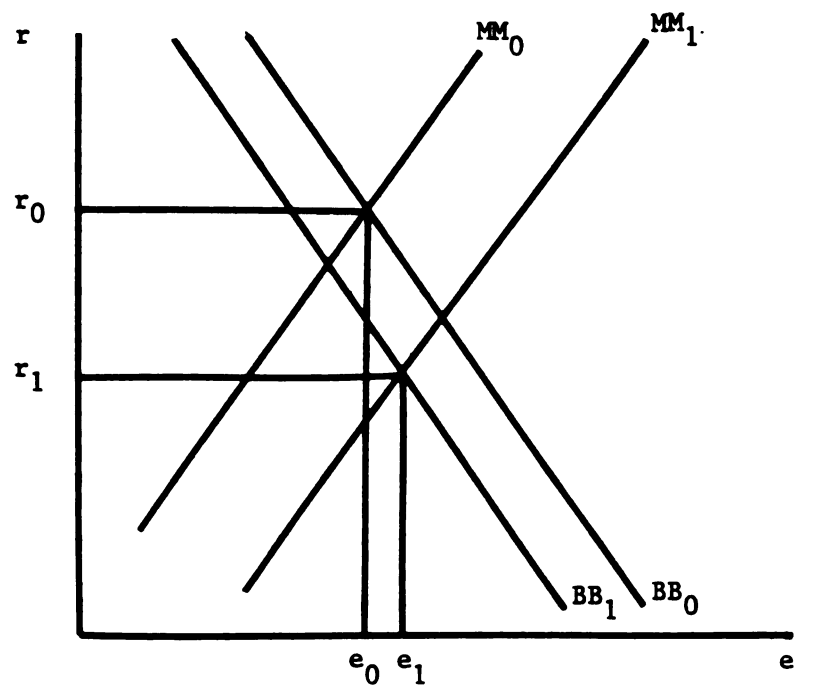

FIGURE 3: Impact of Domestic Money Financed Deficits on the Domestic Country

Characteristic of open portfolio models of this size a menu of relative slopes and shifts will deliver a menu of different outcomes. For instance Figure 3 assumes that the deficit generated excess supply in the domestic money market exceeds the wealth induced excess demand in the domestic bond market. Hence under money financing of domestic deficits the short-run outcome will be a fall in the domestic rate of interest and a depreciation in the value of the domestic currency.

The role of currency substitution, which relative to its absence amounts to a qualitative change in the model, can be seen in the numerator of equation 50) where Q contains the term representing the sensitivity of the foreign demand for domestic money to exchange rate expectations. Graphically, under rational expectations, money financed deficits generate expectations of a depreciation of the domestic currency which leads to a decrease in the foreign demand for domestic money. The more pronounced and powerful this decrease in foreign demand for domestic money the relatively greater will be the outward shift in the MM schedule and hence greater may be the potential stimulative effect to the domestic economy coming from international and domestic financial markets in the short-run. Here, under flexible exchange rates, currency substitution acts to expose the domestic money market to feedback effects originating from foreign residents but in reaction to domestic policy actions. In this case the presence of currency substitution produces a larger decline in the demand for domestic money than in its absence. Hence one of the possible effects of currency substitution may be to favor the potential effectiveness of money

financing relative to debt financing and possibly monetary policy relative to fiscal policy. In general the effectiveness of any policy instrument will crucially depend on what happens to the demand for money and therefore, under flexible exchange rates, the currency substitution hypothesis argues that the demand for the money of a single country may be sensitive to international portfolio substitution. This, in turn, may have serious implications for the effectiveness of a given monetary and fiscal policy.

Finally if we decompose the nature of foreign capital flows resulting from changes in exchange rate expectations we may uncover an interesting tradeoff between the expansionary impact occurring in the domestic export and import competing sectors relative to the interest rate sensitive sectors of the domestic country. Here money financed domestic deficits lead to expectations of a fall in the value of the domestic currency. If international portfolio behavior is such that bond trading exceeds currency trading, the relatively less would be the leftward shift in the BB schedule given the shift in the MM schedule. The market outcome in this case may be a relatively smaller decline in the domestic rate of interest at the expense of a larger depreciation in the domestic currency. Hence the expansionary impact, arising out of the asset markets, of domestic money financed deficits may be skewed in favor of the domestic export and import competing sectors relative to the domestic interest rate sensitive sectors. Note that this result is tentative in that it arises in a partial equilibrium model with an exogenous current account. Nevertheless, one of the important implications of this model concerns the relationship between the elasticity of international asset substitutability and the distribution

of the transmission mechanism of a policy instrument between the exchange rate and the domestic interest rate. Indeed here, if expectations effects swamp wealth effects, the possibility arises of a market outcome with no change in the domestic rate of interest with a large depreciation in the value of the domestic currency in which case the transmission mechanism of the monetary policy instrument will occur solely through the exchange rate.

2) Domestic Bond Financed Deficits

Once again our focus shall be on the domestic country and hence we shall assume that the foreign country budget deficit and supplies of outside financial assets remain constant. Starting from an initial position of equilibrium we seek to explore the impact on the domestic money and bond market of an increase in the domestic budget deficit which is financed by the issue of domestic government debt. As before we shall first discuss the market outcome algebraically and then graphically.

To find the domestic interest rate effects associated with an increase in the domestic budget deficit which is bond financed we require the determinant of the following matrix;

$$52) \quad A'_r = \begin{vmatrix} y_1 & a_{12} & a_{13} \\ y_2 & a_{22} & a_{23} \\ y_3 & a_{32} & a_{33} \end{vmatrix}$$

where;

$$53) \quad \begin{aligned} y_1 &= [hQ/B^t - m(\,)] \\ y_2 &= [1 - b(\,) + hK/B^t] \\ y_3 &= [hJ/B^t - f(\,)] \end{aligned}$$

Hence;

54) $dr/dDEF_{Bond} = [\text{Det } A'_r / \text{Det } A] > 0$

Sufficient conditions for dr/dDEF > 0 are;

55) $\text{Det } A > 0$
$y_3 a_{22} a_{13}$ is small

To find the foreign interest rate effects associated with a domestic bond financed increase in the deficit we require the determinant of the following matrix;

56) $$A'^{*}_r = \begin{vmatrix} a_{11} & y_1 & a_{13} \\ a_{21} & y_2 & a_{23} \\ a_{31} & y_3 & a_{33} \end{vmatrix}$$

Hence;

57) $dr^{*}/dDEF_{Bond} = [\text{Det } A'^{*}_r/\text{Det } A] \gtrless 0$

To find the exchange rate effects associated with an increase in the domestic deficit which is bond financed we need the determinant of the following matrix;

58) $$A'_e = \begin{vmatrix} a_{11} & a_{12} & y_1 \\ a_{21} & a_{22} & y_2 \\ a_{31} & a_{32} & y_3 \end{vmatrix}$$

Hence;

59) $de/dDEF_{Bond} = [Det\ A'_e/Det\ A] \gtrless 0$

Graphically the shift in the MM schedule under debt financing is given by;

$$60) \quad dr/dDEF^{MM}_{Bond} = \frac{[h(Wm^{*}_{r+z} - W^{*}em^{*}_{r-z} + W^{*}em^{*}_{z})/M^{t} - m(\ )]}{[Wm_{r} + W^{*}em^{*}_{r-z}]} > 0$$

Here the increase in the deficit when bond financed will unambiguously shift the MM schedule back to the left. In this case the income and substitution effects work together to deliver a situation of excess demand in the domestic money market. Under limited information rational expectations, bond financing of the deficit leads to expectation of an appreciation of the domestic currency. This leads to an increase in the foreign demand for domestic currency, currency substitution, which along with the wealth induced increase in the domestic demand for domestic money leads to a situation of excess demand in the domestic money market. Ceteris paribus, the stronger are the wealth and currency substitution effects the more pronounced will be the leftward shift in the MM schedule.

In the domestic bond market the effect of bond financing is ambiguous. The shift in the BB schedule under domestic bond financing is given by;

$$61) \quad dr/dDEF \,\Big|_{\text{Bond}}^{BB} = \frac{[1 - b(\,) + h(Wb^{*}_{r+z} - W^{*}eb^{*}_{r-z})/B^{t}]}{[Wb_{r} + W^{*}eb^{*}_{r-z}]} \gtrless 0$$

The nature of the ambiguity is found in the numerator and depends on the strength of asset supply effects relative to income and substitution effects, which together lead to an increase in the demand for domestic debt. Here under limited information rational expectations the substitution effect stems from the domestic deficit being bond financed which leads to expectation of an appreciation in the value of the domestic currency and thus inducing an increase in both domestic and foreign demand for domestic debt. The income effect refers to the increase in the domestic demand for domestic debt due to the increase in the wealth of the private sector in the domestic country. In keeping with our assumptions in part A we assume that the asset supply effects dominate any induced substitution and income effects leading to an upward and to the right shift in the BB schedule under domestic debt financed deficits. The market outcome under these assumptions is given in Figure 4 below.

Here the market outcome depends on the magnitude of excess demand in the domestic money market relative to excess supply in the domestic bond market. Since the income and substitution effects work in the same direction in the domestic money market but work counter to the asset supply effect in the domestic bond market, Figure 4 is drawn with a greater shift in the MM schedule relative to the BB schedule. The market outcome under these assumptions will be a rise in the domestic

rate of interest and an appreciation in the value of the domestic currency.

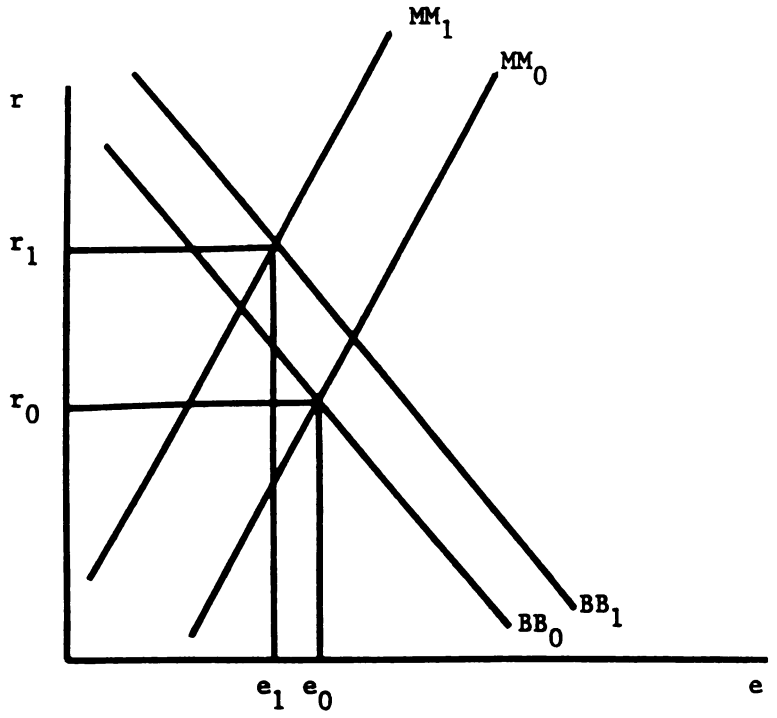

FIGURE 4: Impact of Domestic Bond Financed Deficits on the Domestic Country

The role of currency substitution relative to its absence can be seen in the numerator of equation 60) with the term $W^{*}em_{z}^{*}$. Graphically, under rational expectations, bond financed deficits generate expectations of an appreciation of the domestic currency which induces an increase in the foreign demand for domestic money. The more powerful and pronounced this effect the greater will be the backward and to the left shift in the MM schedule thus producing a relatively larger rise in the domestic interest rate and a relatively greater appreciation in the value of the domestic currency. In this case currency substitution acts

to destabilize the demand for domestic money leading to a greater excess demand in the domestic money market relative to its absence. The implication of currency substitution therefore may be to theoretically weaken the expansionary impact of any debt financed fiscal policy arising out of the financial markets in the short-run.

A policy implication of the model is to explore the nature of crowding-out arising from large bond financed deficits in the domestic country. The emphasis of this model is to view the issue of crowding-out in an open economy framework stressing expectations and international asset substitution. Under limited information rational expectations a bond financed domestic deficit will lead to expectations of an appreciation in the domestic currency. If foreign residents react to this by purchasing domestic country assets, assuming that they prefer domestic debt relative to domestic currency, the outcome of these substitution effects may be less of a rightward shift in the BB schedule given the shift in the MM schedule. The market outcome in this case may be a relatively smaller increase in the domestic rate of interest at the expense of a greater appreciation in the value of the domestic currency. Hence, if foreign and domestic portfolio behavior is sensitive to expectations surrounding the value of the domestic currency and bond substitution behavior is more important than currency substitution behavior, the asset market crowding-out related to bond financed deficits may be skewed to the domestic export and import competing industries through exchange rate appreciation rather than to domestic interest rate sensitive industries through the domestic interest rate. This is a possible explanation for the Reagan years in the United States in which federal government budget deficits and trade

deficits reached historical highs while nominal interest rates have behaved rather cyclically. Indeed the experience has contradicted the forecasts of many economists like Martin Feldstein and Henry Kaufman who argued that large bond financed deficits would lead to higher interest rates. Our model says that if the cyclical nature of interest rates in the United States has been partly due to inflows of foreign capital the United States deficit should have been accompanied by an appreciation of the dollar. Consistent with the predictions of the theory, the dollar over this period has been particularly strong against all major currencies. Hence the popular view that the dollar is overvalued is questioned by this theory. Particularly the notion that the dollar is overvalued neglects that the dollar is determined as a market outcome and emphasizes interest rate effects relative to exchange rate expectations effects. Here, as long as the deficits in the United States remain large, the dollar is likely to remain strong. This outcome is not inconsistent with falling nominal interest rates in the United States.

3) Cross Country Effects of Domestic Budget Deficits

Here we seek to investigate the cross-country effects of changes in the domestic country budget deficit on the foreign country's asset markets. These cross-country effects will arise from international asset substitution reacting to exchange rate expectations. Consider the foreign country effects of a bond financed increase in the budget deficit of the domestic country. Under the rational expectations specification a bond financed increase in the domestic deficit will lead to expectations of an appreciation in the value of the domestic currency. This will induce economic agents to buy domestic assets and sell foreign assets. Therefore domestic country bond financing of an increase in its deficit may lead to an increase in foreign nominal interest rates with a depreciation in the value of the foreign currency. We can show this two country outcome graphically by reference to Figure 5. The purpose of Figure 5 is to show how international asset markets will simultaneously adjust in response to a bond financed increase in the domestic country budget deficit. We can model the foreign money and bond market equilibrium loci in $e\text{-}r^*$ space in the same fashion as we have done for the domestic country. Specifically, the slopes of the foreign country bond market equilibrium locus (FF) and the foreign money market equilibrium locus (NN) are derived using the same assumptions used to derive the slopes of the schedules for the domestic country, namely, that wealth effects associated with changes in the exchange rate dominate any induced expectations effects. Hence as the domestic currency depreciates, e rises, foreign wealth falls inducing a reduction in the foreign demand for foreign money. Thus the NN schedule has a negative slope in $e\text{-}r^*$ space. Similarly as e rises the induced

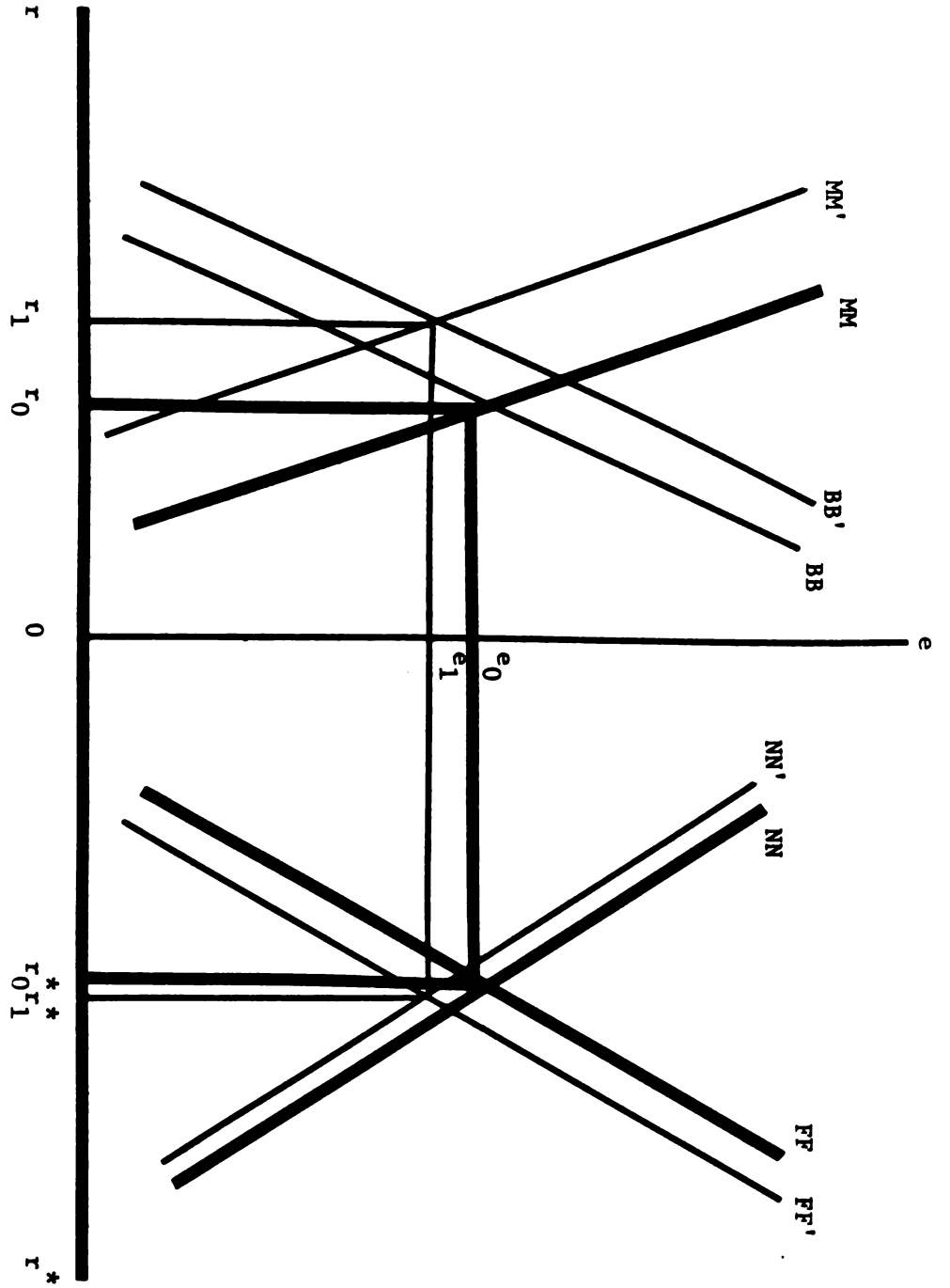

FIGURE 5: Cross Country Effects of Domestic Bond Financed Deficits

fall in foreign wealth will lead to a decrease in foreign demand for foreign debt thus leading to higher interest rates. Hence the FF schedule has a positive slope in e-r^* space. The domestic country asset market schedules are identical to those found in Figure 4.

As shown in Figure 4, the shifts of the domestic country asset market loci, MM and BB, resulting from a bond financed deficit, reflect an excess supply of domestic debt and an excess demand for domestic money. In the foreign country, reflecting attempts by international economic agents to sell foreign country assets, there will be excess supply in both money and bond markets. Hence the foreign country market outcome, induced by an increase in domestic country deficit, may be a depreciation of its currency along with a rise in short-term nominal interest rates. Ceteris paribus, the more substitutable are foreign and domestic assets the potentially larger will be these cross-country impact effects. This may explain the experience of France and the United States during the 1980's. French officials have argued that the large debt financed deficits in the United States have caused higher French interest rates while also leading to a sharp fall in the Franc. Note an interesting twist to the French argument is that if high levels of real economic growth in the United States can be sustained with the continued rise in the value of the dollar into the late 80's then Europe, in turn, may also achieve rapid levels of economic growth led by booms in their export sectors with, however, higher rates of inflation than in the United States. Nevertheless the model presented here

theoretically supports the possibility of significant cross-country effects of recent large United States budget deficits.[18]

18. Note that McKinnon would argue that the problem here is swings in exchange rate expectations and the behavior induced by these swings. The policy prescription he would recommend is that any appreciation in the value of the domestic currency should be met by an increase in the domestic money supply and similarly the foreign country should counter its depreciation by a cut in its money supply. It is interesting to note that this is an effective strategy in this model since these policy changes, if publicly announced, will counter the domestic deficit through the equation which generates exchange rate expectations in the model. The net effect would be no change in expectations surrounding the value of the domestic currency and hence little destabilizing international asset substitution.

Chapter VI: EMPIRICAL TESTS OF THE MODEL

The goal of this chapter is to test the open portfolio model developed in chapter IV. Specifically we shall test the reduced form solution of the model and its ability to track the endogenous variables using quarterly time series data for the United States, France, and the Federal Republic of Germany.

There exists a subset of the open portfolio literature which has estimated open portfolio models under various specifications. For example Branson, Halttunen and Masson [1977] test a two-country version of their small country model. They estimate the Dollar-Mark exchange rate using M1 money stocks and net foreign asset positions for both the United States and Germany as exogenous variables. Their results, except for relative money stocks, are largely insignificant and are plagued by autocorrelation. Similarly Bisignano and Hoover [1982] estimate the Dollar-Mark exchange rate using base money, privately held domestic government debt, and domestically held foreign currency assets for each country as exogenous variables. They find all variables insignificant except for U.S. base money and the stock of privately held U.S. government debt by United States residents. From these results they conclude; "Our evidence suggests that, in the short-run at least, a combination of large Federal deficits and slow monetary base growth will result in a major appreciation of the U.S. Dollar." One of our objectives here shall be to test this conclusion using a different specification reflecting the model developed in this dissertation.

The equations estimated here are derived from the reduced form solution to the model and extend previous empirical studies in several

ways. First we are estimating an open model which formally includes a government financing constraint for each country. This allows estimation of a specification which formally includes the Federal budget deficits for each country as a regressor. This, in turn, enables a discussion of the empirical evidence on crowding-out associated with large United States budget deficits and whether this crowding-out has occurred through rising interest rates or through an appreciation in the value of the Dollar. In testing these deficit effects we shall examine two different measures of the deficit. First we shall fit the model using a flow measure of deficits. This flow measure is simply the excess of the flow of Federal spending over the flow of Federal revenue. On the other hand, the stock measure of the deficit looks at incremental changes in the stock of outstanding government debt associated with bond financing the deficit. We use two different measures of the budget deficit because intuitively, in the open portfolio model, the endogenous variables adjust each period to allow the markets for stocks of assets to clear each period. Thus interest rates and exchange rates adjust to absorb the stocks of outside financial assets rather than the flow of deficit spending.[19] In addition testing a large two-country specification allows us to test how

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19. This is pointed out by Blanchard [1983] who developed a model in which short-term interest rates depend on the current level of debt and not on the current level of deficits. He argues; "This analysis suggests that the current focus on deficits rather than on debt is possibly misdirected. It is true that the anticipated sequence of U.S. deficits is exceptional in peacetime and implies a large increase in the level of debt. The current level of debt as well as the anticipated levels of debt for the medium run are still much lower than at many times in the past."

well the open portfolio model tracks the short-run domestic and foreign nominal interest rate.

The reduced form solution to the collapsed model is given as;

$$62) \quad x = A^{-1}Cv$$

Accordingly the reduced form solves for the change in the endogenous variables needed to maintain equilibrium under a change in the exogenous variables. If estimated as is, equation 62) gives an interpretation of the reduced form coefficients as being similar to a second derivative, and therefore difficult to interpret. Therefore, we shall estimate the reduced form in levels of the variables. Hence our test of the model consists of regressing the endogenous variables on the exogenous variables; both countries monetary bases, budget deficits, and the domestic country current account.

Since this is a short-run model prices are assumed constant and all variables are measured in nominal terms. The model also assumes that asset markets clear each period thus the regression specification contains no lagged exogenous variables. Because of time series stock data the estimating equations will be log linear in the exogenous stock variables. The data set consists of quarterly observations for the United States, France and the Federal Republic of Germany for the period 1972IV to 1983IV, constituting the mass of experience under flexible exchange rates.

Since we are estimating the reduced form of the model ordinary least squares will be appropriate. We ignore all problems of simultaneity because of the very short-run nature of the model.

However, time series tests of open portfolio models usually exhibit first order serial correlation and thus we shall investigate some alternative methods for estimation with autocorrelation. One technique is a maximum likelihood technique due to Beach and McKinnon [1978] which is used along with the standard Cochrane-Orcutt and Hildreth-Lu procedures.

Estimation results for the exchange rate using the flow measure of the deficit for each set of countries are found in Tables 1 and 2. The actual regression equation can be found at the top of each table and t-statistics are reported in parenthesis under each coefficient estimate. The regression results for the French Franc/Dollar exchange are found in Table 1. The Ordinary Least Squares results are largely significant for both individual coefficients as well as the complete model. Particularly note that the United States budget deficit correlates with a rising Dollar as does a rising French monetary base correlate with a falling Franc. However the Durbin-Watson statistic detects the presence of first-order serial correlation. Use of the techniques for estimation with autocorrelation produce largely insignificant results although the coefficient for the French monetary base has the correct sign and is significant, using a one-tailed test, at the 90% level of confidence for the Maximum Likelihood regression. Nevertheless, the Durbin-Watson statistic for the corrected regressions all lie within the inconclusive region of the Durbin-Watson test. Therefore the results of the model, using the flow measure of the budget deficit, are somewhat poor for the case of France-United States.

The regression results for the Deutschemark/Dollar exchange rate, using the flow measure of the budget deficit, are found in Table 2. The

TABLE 1: Regression of (FF/$) Exchange Rate on Relative Monetary Bases and Budget Deficits

$$* (FF/\$) = a_0 + a_1 \ln(USBASE) + a_2 \ln(FRBASE) + a_3 USDEF + a_4 FRDEF + a_5 USCURR + error *$$

Method	a_0	a_1	a_2	a_3	a_4	a_5	R^2	F	D.W.	rho
OLS	-5.711	-1.664	3.658	.014	.006	-.000	.7881	29.01	1.134	
	(-2.42)	(-2.21)	(5.09)	(2.91)	(2.35)	(-3.80)				
AR-ML	-3.875	.570	1.359	-.001	.001	-.000	.3705	4.12	1.571	.96
	(-.50)	(.36)	(1.80)	(-.80)	(1.31)	(-1.72)				(28.89)
CORC	9.469	-1.150	1.119	-.001	.001	-.000	.1808	1.54	1.501	.98
	(.68)	(-.52)	(1.47)	(-.65)	(.87)	(-1.75)				(37.60)
HILU	.1+14	-1.910	.972	-.001	.000	-.000	.1832	1.57	1.550	1.00
	(1.46)	(-.89)	(1.29)	(-.61)	(.73)	(-1.74)				(.4+08)

All data are from selected International Financial Statistics

Ordinary Least Squares results are largely insignificant except for the coefficient a_3 which has the correct sign and is significant at the 95% level of confidence. Thus the flow of deficit spending in the United States is shown to correlate with an appreciation in the value of the dollar. Note also that coefficient a_5 has the correct sign and is also significant. The complete model is significant by reference to the F-statistic, however the Durbin-Watson statistic detects first-order serial correlation. Use of the Maximum Likelihood and other standard correction techniques produce insignificant results although the complete model fairs better under the Maximum Likelihood technique. Indeed the coefficients are not robust under alternative estimation techniques. The results show that the model, under the flow measure of the budget deficit, fits the data rather poorly for the case of the United States and Germany. Hence the flow measure of the deficit produces poor results in both cases although the French-United States case performs best.

In Tables 3 and 4 we report the exchange rate results using the stock measure of the budget deficit. Thus the regression equations here are the same as in Tables 1 and 2 except for the deficit being replaced by the total stock of outstanding government debt. The exchange rate results for the French-United States case are found in Table 3. The Ordinary Least Squares results show a significant improvement over the results found in Table 1. However the Durbin-Watson statistic detects the presence of first-order serial correlation. Nevertheless, unlike Table 1, when techniques are used for estimation under autocorrelation the model remains highly significant and the serial correlation is purged from the regressions. Also coefficients a_1, a_2, a_3, and a_5 have

TABLE 2: Regression of (DM/$) Exchange Rate on Relative Monetary Bases and Budget Deficits

$$* \ (DM/\$) = a_0 + a_1 \ln(USBASE) + a_2 \ln(GERBASE) + a_3 USDEF + a_4 GERDEF + a_5 USCURR + error \ *$$

Method	a_0	a_1	a_2	a_3	a_4	a_5	R^2	F	D.W.	rho
OLS	8.049 (5.62)	-.412 (-.57)	-.783 (-.92)	.005 (1.94)	-.004 (-.34)	-.000 (-1.77)	.3841	4.86	.6464	
AR-ML	6.510 (2.10)	-.313 (-.50)	-.510 (-1.22)	-.001 (-1.17)	.001 (.84)	-.000 (-1.29)	.5753	9.48	1.7452	.91 (15.81)
CORC	1.101 (.39)	.630 (1.06)	-.410 (-1.02)	-.001 (-1.38)	.003 (.80)	-.000 (-1.35)	.1307	1.05	1.6312	.83 (9.87)
HILU	1.732 (.69)	.526 (.95)	-.430 (-1.06)	-.001 (-1.28)	.003 (.76)	-.000 (-1.40)	.1258	1.00	1.5726	.80 (8.84)

the correct sign and are significant for alternative techniques. Notably the log of the United States debt stock is shown to cause a rise in the value of the U.S. Dollar. Hence the stock measure of the budget deficit for the France-United States case produces robust results confirming the significance of relative country monetary bases and debt stocks on the value of the Franc/Dollar.

In Table 4 we report the exchange rate results, using the stock measure of the deficit, for the Germany-United States case. The Ordinary Least Squares results show a great improvement over the results found in Table 2. The debt stocks for each country, coefficients a_3 and a_4, have the correct sign and are highly significant. Coefficient a_1, the U.S. base, is also significant and the correct sign whereas coefficients a_2 and a_5 are significant but coefficient a_2 has an incorrect sign. The F test easily passed but once again the Durbin-Watson statistic detects first order serial correlation. Of all of the correction techniques used the Maximum Likelihood technique produces the best results. Under this technique both countries debt stocks remain significant and of the correct sign. The complete model explains the movement in the exchange rate well and the first-order serial correlation is purged from the regression. Hence the stock measure of the budget deficit for each country, once again, produces robust results confirming the effects of relative country debt stocks on the exchange rate. Therefore we have shown, for both cases of France-United States and Germany-United States, the stock measure of the deficit fits the data much better than the flow measure of the deficit when used to test the model's ability to track the exchange rate.

TABLE 3: Regression of (FF/$) Exchange Rate on Relative Monetary Bases and Debt Stocks

$$* (FF/\$) = a_0 + a_1 \ln(USBASE) + a_2 \ln(FRBASE) + a_3 \ln(USDEBT) + a_4 \ln(FRDEBT) + a_5 USCURR + error *$$

Method	a_0	a_1	a_2	a_3	a_4	a_5	R^2	F	D.W.	rho
OLS	19.368	-11.630	2.812	1.912	3.113	-.000	.9168	85.99	1.2080	
	(4.19)	(-8.83)	(5.55)	(1.37)	(4.02)	(-2.85)				
AR-ML	-.606	-4.187	1.340	2.30	.966	-.000	.5989	10.45	2.0063	.90
	(-.09)	(-2.41)	(1.89)	(1.93)	(1.46)	(-1.82)				(14.58)
CORC	-8.812	-3.381	1.319	2.928	.940	-.000	.4659	6.10	1.8625	.88
	(-1.13)	(-1.88)	(1.90)	(2.41)	(1.44)	(-1.71)				(12.77)
HILU	-9.681	-3.284	1.300	3.002	.934	-.000	.4446	5.60	1.8821	.90
	(-1.17)	(-1.82)	(1.87)	(2.42)	(1.44)	(-1.68)				(13.69)

TABLE 4: Regression of (DM/$) Exchange Rate on Relative Monetary Bases and Debt Stocks

$$* (DM/\$) = a_0 + a_1 \ln USBASE + a_2 \ln(GERBASE) + a_3 \ln(USDEBT) + a_4 \ln(GERDEBT) + a_5 USCURR + error *$$

Method	a_0	a_1	a_2	a_3	a_4	a_5	R^2	F	D.W.	rho
OLS	1.071	-1.464	-1.860	4.173	-1.810	.000	.7267	20.74	1.1795	
	(.40)	(-1.71)	(-3.40)	(7.59)	(-4.81)	(2.08)				
AR-ML	.461	-.881	-.444	2.37	-1.35	-.000	.7402	19.95	1.7879	.74
	(.12)	(-1.01)	(-1.00)	(2.89)	(-2.47)	(-.81)				(7.04)
CORC	1.861	-.544	-.451	1.108	-.362	-.000	.1329	1.07	1.7586	.78
	(.51)	(-.65)	(-1.07)	(1.14)	(-.52)	(-.98)				(8.39)
HILU	1.815	-.505	-.439	1.018	-.291	-.000	.1290	1.03	1.7740	.80
	(.50)	(-.60)	(-1.05)	(1.03)	(-.41)	(-.99)				(8.84)

What are the implications of these empirical results? Do they confirm the predictions of the model? To help us answer these questions we shall formulate a few testable hypotheses that characterize the model and submit them to the data for each country. The first testable hypothesis concerns not the nature of the model but the relevance of any discussion concerning the currency substitution hypothesis. Specifically we seek to verify whether currency substitution is an empirically significant phenomenon. Here to argue that currency substitution is empirically significant in this framework we must, at least, show that the coefficients for the monetary base of each country are significant and have the correct sign. Focusing on the AR-1 regressions using the flow measure of the deficit we find the base coefficients are largely insignificant, with the exception of coefficient a_2, the log of the French monetary base, which has the correct sign in the Maximum Likelihood regression in Table 1. Using the stock measure of the deficit, Table 3 shows coefficients a_1 and a_2 are highly significant and have the correct signs for the France-United States case. However, as shown in Table 4, the German-United States case, both countries monetary bases are insignificant and the German base has the wrong sign. Hence the evidence presented here is, at best, mixed. Our results indicate that currency substitution appears to be a significant phenomenon between the Franc and the Dollar. However there is little evidence to support this hypothesis for the case of the Mark and the Dollar. This may be due to the Franc and the Dollar being more sensitive to exchange rate expectations induced portfolio substitution than the Mark.

Our model argued that if foreign and domestic outside financial assets are effective substitutes, then bond financed increases in the domestic country budget deficit should lead to an appreciation in the value of the domestic currency. Hence the relationship we seek to explore here is between the budget deficit and the exchange rate. Specifically, the model argues that portfolio adjustment reacting to exchange rate expectations surrounding a bond financed increase in the domestic country budget deficit will cause an appreciation in the domestic currency. Hence we seek to test the proposition that bond financed deficits appreciate the value of the originating country's currency. As before, the results using the flow measure of the budget deficit are significant only for the Ordinary Least Squares regressions. Using the stock measure of the deficit, for the United States-France case found in Table 3, we find the U.S. debt stock is consistently significant and has the correct sign across different estimating techniques. Hence, for the France-United States bilateral case, the specification used here produces rather robust results arguing that large U.S. deficits may have induced crowding-out in export and import competing industries through an appreciation in the value of the Dollar. For the Germany-United States case found in Table 4 the Maximum Likelihood AR1 regression is of particular interest. Here coefficients a_3 and a_4 are significant and have the correct signs. Thus each country's deficit is seen to correlate with an appreciation of its currency. Hence, for both country pairings, increases in debt stocks are shown to induce an increase in the value of the originating country's currency.

As we have argued in chapter V, international asset substitution, based on exchange rate expectations, may have ramifications concerning the distribution of the transmission mechanism of crowding out between the domestic interest rate and the exchange rate. The results here are consistent with the notion that a large share of any crowding-out occurring in the United States is arising in the export and import competing sectors of the economy. The theoretical results of the model also argued that international asset substitution may enhance the effectiveness of monetary policy at the expense of fiscal policy. Hence the evidence concerning the impact of increases in the debt stock on the exchange rate may support the hypothesis of a weakening of the effectiveness of debt financed fiscal policies from a spillover of spending into imports.

Finally the issue of whether or not the dollar is overvalued. Recently both business and academic economists have argued that the Dollar is overvalued and that a sharp fall in the Dollar is just around the corner. These views were confounded when short-term real interest rates fell during the last part of 1984 in the United States and the Dollar continued strong against all major currencies. What can explain the continued strength of the Dollar? The model developed within argues that the movement in the Dollar commencing at the beginning of the Reagan administration and continuing throughout is the outcome of strong debt financed fiscal measures such as the Kemp-Roth Tax Cut as well as continued high levels of government spending. Hence I argue that the value of the Dollar is a market outcome which is unlikely to drastically change given no sudden move by Congress to cut the deficit or the Fed to reinflate the money supply. Therefore forecasts calling for a sharp

fall in the Dollar neglect the impact of continued large budget deficits in the United States on international asset markets especially when domestic and foreign currency denominated assets are effective substitutes.

Now we turn to investigate the model's ability to track changes in short-term nominal interest rates for each country. In Tables 5, 6, 7, and 8 we report results from regressing the United States Treasury Bill rate on the model under alternative countries and measures of the budget deficit. In Tables 5 and 6 the flow measure of the budget deficit is used whereas in Tables 7 and 8 the stock measure is used. Note also that the level of U.S. nominal gross national product is added to the estimating equations to isolate asset stock effects from income and price effects arising from the business cycle.

Table 5 reports the results using the flow measure of the deficit for the France-United States case. The Ordinary Least Squares results are largely insignificant, except for the French monetary base and U.S. deficit coefficients, both of which have intuitively incorrect signs. Once again, the Durbin-Watson statistic detects the presence of first-order serial correlation. Of attempts at estimation under autocorrelation the Hildreth-Lu technique is of particular interest here. Since the selected value of rho is one, the estimating equation is equivalent to first differencing the data. The result is that five of the seven estimated coefficients are significant. Both country's monetary bases, coefficients a_1 and a_2 are significant but have incorrect signs. Hence the evidence on currency substitution is again, at best, mixed. The complete model is significant by reference to the F statistic and the estimating equation is purged of autocorrelation. Concerning the evidence on the relationship between actual budget

TABLE 5: Regression of U.S. Treasury Bill Rate on French-U.S. Monetary Bases and Budget Deficits

$$* \text{USTBR} = a_0 + a_1 \ln(\text{USBASE}) + a_2 \ln(\text{FRBASE}) + a_3 \text{USDEF} + a_4 \text{FRDEF} + a_5 \ln(\text{USGNP}) + a_6 \text{USCURR} + \text{error} *$$

Method	a_0	a_1	a_2	a_3	a_4	a_5	a_6	R^2	F	D.W.	rho
OLS	-61.7	-2.98	8.58	-.04	-.006	5.53	.000	.7085	15.39	1.3821	
	(-7.99)	(-.22)	(3.58)	(-2.67)	(-.63)	(.60)	(3.98)				
AR-ML	-43.6	1.78	5.77	-.004	.005	1.79	.000	.1782	1.30	1.5836	.82
	(-2.1)	(.20)	(1.76)	(-.49)	(.99)	(.27)	(.28)				(9.56)
CORC	-42.4	1.63	5.91	-.004	.005	1.64	.000	.1551	1.10	1.5953	.84
	(-1.27)	(.18)	(1.74)	(-.44)	(.97)	(.22)	(.18)				(10.5)
HILU	-.2E+15	16.7	7.19	-.007	.006	57.1	.000	.4348	4.6	2.0585	1.0
	(-4.06)	(2.11)	(2.59)	(-.87)	(1.67)	(4.10)	(.27)				(.4E+8)

TABLE 6: Regression of the U.S. Treasury Bill Rate on German-U.S. Monetary Bases and Budget Deficits

$$* \text{USTBR} = a_0 + a_1 \ln(\text{USBASE}) + a_2 \ln(\text{GERBASE}) + a_3 \text{USDEF} + a_4 \text{GERDEF} + a_5 \ln(\text{USGNP}) + a_6 \text{USCURR} + \text{error} *$$

Method	a_0	a_1	a_2	a_3	a_4	a_5	a_6	R^2	F	D.W.	rho
OLS	-58.6	-5.4	1.68	-.02	-.08	11.3	.000	.6129	10.02	.8250	
	(-5.60)	(-.38)	(.25)	(-1.13)	(-.85)	(1.17)	(3.03)				
AR-ML	-41.7	-.90	.01	-.005	.001	7.11	.000	.1046	.70	1.6952	.81
	(-2.02)	(-.10)	(.003)	(-.46)	(.02)	(1.12)	(.20)				(9.28)
CORC	-46.4	-.67	.03	-.005	.001	7.55	.000	.0763	.49	1.7237	.83
	(-1.41)	(-.07)	(.007)	(-.45)	(.03)	(1.09)	(.15)				(10.2)
HILU	-.2E+15	13.1	2.6	-.008	.02	62.3	-.000	.3251	2.89	2.1696	1.0
	(-3.63)	(1.70)	(.78)	(-.86)	(.59)	(4.04)	(-.17)				(.4E+8)

deficits and short-term nominal interest rates we find, by reference to coefficient a_3, there is no evidence for the period 1972IV to 1983IV that large deficits in the United States have indeed led to higher short-term U.S. nominal rates of interest.

In Table 6 we report results using the flow measure of the deficit for the German-United States case. The Ordinary Least Squares results are largely insignificant and are shown to have first-order serial correlation. In this case, all attempts at estimation under first-order serial correlation are unsatisfactory. Hence, once again, the model fits the data rather poorly when the flow measure of the budget deficit is used. Therefore the data, for both country cases, does not confirm the hypothesis that large U.S. budget deficits will cause higher short-term nominal rates of interest and hence we argue that while budget deficits may have some effect on the market outcome of interest rates, there is no empirical evidence that the outcome is necessarily higher short-term rates of interest.

Tables 7 and 8 report the results of regressing the United States Treasury Bill rate on the model using the debt stocks of each country as the stock measure of the budget deficit. The first thing to note is that the model fits the data much better when the stock measure of the deficit is used. The Ordinary Least Squares results in Table 7 produce five out of seven coefficients which are significant, including the U.S. monetary base, debt stock, and level of nominal gross national product. However, coefficient a_3, the level of the outstanding stock of U.S. Government debt, is shown to have led to lower short-term Treasury Bill rates. This is an unsettling find in that it is counter-intuitive as well as going against conventional wisdom concerning budget deficits and

TABLE 7: Regression of U.S. Treasury Bill Rate on French-U.S. Monetary Bases and Debt Stocks

$$* \text{USTBR} = a_0 + a_1 \ln(\text{USBASE}) + a_2 \ln(\text{FRBASE}) + a_3 \ln(\text{USDEBT}) + a_4 \ln(\text{FRDEBT}) + a_5 \ln(\text{USGNP}) + a_6 \text{USCURR} + \text{error} *$$

Method	a_0	a_1	a_2	a_3	a_4	a_5	a_6	R^2	F	D.W.	rho
OLS	-94.2	-15.4	4.41	-30.5	2.84	43.8	.000	.8750	44.3	1.2644	
	(-5.8)	(-2.02)	(2.53)	(-6.13)	(1.11)	(6.45)	(.58)				
AR-ML	-81.8	-5.15	4.49	-29.4	3.62	34.1	.000	.7035	14.2	1.7282	.47
	(-4.29)	(-.73)	(2.11)	(-5.82)	(1.43)	(5.16)	(.39)				(3.3)
CORC	-92.0	-4.65	4.05	-30.8	3.28	36.8	.000	.7327	16.4	1.778	.45
	(-4.6)	(-.66)	(1.93)	(-6.11)	(1.31)	(5.46)	(.37)				(3.38)
HILU	-91.7	-3.89	4.03	-30.6	3.27	36.1	.000	.7020	14.1	1.8283	.5
	(-4.3)	(-.55)	(1.85)	(-5.9)	(1.29)	(5.2)	(.34)				(3.8)

interest rates. Also, attempts at estimation under autocorrelation produce robust results for coefficients a_2; the French monetary base, coefficient a_3; the U.S. debt stock, and coefficient a_5; the level of U.S. nominal Gross National Product. The significance of coefficient a_2, as also found in Table 5, confirms the role of currency substitution in the market outcome concerning the U.S. interest rate. However, our model suggests that an increase in the French monetary base will induce a reallocation of international asset portfolios in favor of U.S. currency denominated assets and, therefore, contribute to lower interest rates in the United States, confirming the incorrect sign of coefficient a_2. Hence, once again, the evidence concerning the significance of currency substitution is rather mixed.

On the issue of interest rate induced crowding-out arising from large budget deficits in the United States the evidence presented in Table 7 is rather unsettling. Specifically, coefficient a_3, the log of the level of outstanding U.S. debt is consistently highly significant but of the wrong sign. Hence the evidence, using the stock measure of the deficit, appears to support the notion of crowding-in rather than crowding-out as a consequence of large U.S. deficits. To test further this apparently robust result we ran a Chow Test by splitting the sample into 1972IV-1978IV and 1979I-1983IV. The sample split was based on the effective tenure of Paul Volcker who was appointed in 1978, although the split roughly mirrors the beginning of large deficits in the United States. The result of the Chow test is fairly ambiguous. At the 90% level of confidence, the sample cannot be aggregated. However, the null hypothesis of aggregation cannot be rejected at the 95% level of confidence. We also find that coefficient a_3 retains its significance and the incorrect sign for each subsample regression. Hence, the

TABLE 8: Regression of U.S. Treasury Bill Rate on German-U.S. Monetary Bases and Debt Stocks

$$* \text{USTBR} = a_0 + a_1 \ln(\text{USBASE}) + a_2 \ln(\text{GERBASE}) + a_3 \ln(\text{USDEBT}) + a_4 \ln(\text{GERDEBT}) + a_5(\text{USGNP}) + a_6 \text{USCURR} + \text{error} *$$

Method	a_0	a_1	a_2	a_3	a_4	a_5	a_6	R^2	F	D.W.	rho
OLS	-178.1	-9.66	-.94	-18.4	-10.3	53.3	.000	.8963	54.7	1.6448	
	(-11.2)	(-1.34)	(-.28)	(-5.2)	(-4.8)	(8.5)	(1.83)				
AR-ML	-176.3	-4.45	-.32	-18.7	-10.2	49.5	.000	.8318	29.6	1.8715	.25
	(-8.8)	(-.62)	(-.09)	(-4.7)	(-3.9)	(7.5)	(1.32)				(1.63)
CORC	-174.2	-4.26	-.44	-19.9	-9.52	49.7	.000	.8284	28.9	1.8940	.26
	(-8.5)	(-.59)	(-.13)	(-4.6)	(-3.4)	(7.4)	(1.18)				(1.81)
HILU	-173.5	-3.51	-.32	-20.0	-9.41	49.1	.000	.8142	26.3	1.9225	.30
	(-8.17)	(-.49)	(-.09)	(-4.5)	(-3.2)	(7.2)	(1.09)				(2.0)

evidence here confirming lower interest rates as the outcome of increases in the U.S. debt stock appears rather robust.

In Table 8 the results of regressing the United States Treasury Bill rate on the model using the stock measure of the budget deficit for the Germany-United States case are reported. As before, the performance of the model using the debt stock for each country are clearly superior to those in Table 6. The Ordinary Least Squares results show significant coefficients for each country's debt stocks and the log of the level of nominal gross national product for the United States. The complete model is highly significant in explaining the movement in the short-term U.S. Treasury Bill rate. Also all attempts at estimation under first-order serial correlation produce rather similar and hence robust results for coefficients a_3, a_4 and a_5. Specifically, the effect of U.S. nominal income has the correct sign and is highly significant for all regressions. Similarly, coefficients a_3 and a_4, each country's debt stocks, have a significant negative impact on short-term U.S. nominal interest rates in each regression. Once again, the robust nature of these results present us with the unsettling find that increases in the stock of debt in the United States and in Germany are correlated with lower short-term nominal interest rates in the United States. To test this result further we run a Chow test on the split sample: 1972IV-1978IV and 1979I-1983IV. The result of the Chow test, at the 95% level of confidence, is that the sample cannot be aggregated. However, we fail to reject the null hypothesis of aggregation at the 99% level of confidence. Nevertheless, the regression results for each subsample produce a highly significant coefficient a_3 but with the incorrect sign. In other words, according to the data using the stock

measure of budget deficits, large budget deficits in the United States have led to lower, not higher, short-term interest rates and hence may have crowded-in, rather than crowded-out, domestic economic activity. The robust nature of this result for both data sets must force us to overcome any attempt to dismiss these results but rather should prompt us to seek a possible theoretical explanation for such a market outcome.

The possibility of budget deficits resulting in crowding-in rather than crowding-out has received some attention in the literature. Recently, Evans [AER 1985] found empirical results similar to ours and argued that because of perceived future tax liabilities budget deficits will be financed by a reduction in consumption expenditure and therefore may be correlated with lower interest rates.[20] Similarly, Ben Friedman [BPEA 1978] showed that; "The question of whether the portfolio effect of bond financed deficit spending crowds out or crowds in private investment reduces to the long-debated issue of whether bonds are closer portfolio substitutes for money or for capital." In addition the model presented within stresses the role of expectations surrounding the deficit and the behavior of both domestic and foreign portfolio holders with regard to holding domestic debt. Here if bond financed deficits produce expectations of an appreciation of the domestic currency both domestic and foreign residents will shift funds into domestic debt raising the possibility of a market outcome of lower domestic interest rates, or a cap on the increase in interest rates, resulting from an

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20. Evans quotes R. Kormendi; "Government Debt, Government Spending and Private Sector Behavior," AER Dec. 1983, who suggested that changes in the deficit in the postwar period have been offset by equal changes in private saving, thereby removing the need for interest rates to change.

increase in the domestic budget deficit. This action, however, is likely to be accompanied by an appreciation of the domestic currency thus shifting the crowding-out related to the deficit to the export and import competing sectors of the economy.

Finally we turn to the issue of cross-country effects of large budget deficits in the United States. In Tables 9, 10, and 11, we report the results from regressing the short-term German Call Money rate on the model. In Table 9 we find the results using the flow measure of deficit spending in each country. As we found in earlier regressions which used the flow measure of the deficit, the model fits the data rather poorly. The French-United States case is similar and hence not reported. Therefore, the results using Ordinary Least Squares and the several methods used to correct for first-order serial correlation are largely insignificant and tests of the complete model do rather poorly.

In Table 10 we find the regression results which use the stock measure of the deficit for each country. As before the model performs much better when the stock measure of the deficit is used. In the Ordinary Least Squares regression five of the coefficients have significant t-statistics. Concerning evidence on currency substitution effects, coefficient a_1, the United States monetary base, is significant and has the correct sign. The coefficient on the U.S. debt stock, a_3, is barely significant but has the correct sign, confirming that increases in the U.S. debt stock is correlated with rising short-term interest rates in Germany. However the German debt stock, coefficient a_4, has a significant negative impact on the short-term nominal rate of interest in Germany. This result is similar to what we found concerning

TABLE 9: Regression of German Call Money Rate on Relative Monetary Bases and Budget Deficits

* GERCMR = $a_0 + a_1 \ln(USBASE) + a_2 \ln(GERBASE) + a_3 USDEF + a_4 GERDEF + a_5 \ln(GERGNP) + a_6 USCURR + error$ *

Method	a_0	a_1	a_2	a_3	a_4	a_5	a_6	R^2	F	D.W.	rho
OLS	-3.59	6.64	9.41	-.006	-.18	-9.25	.000	.1722	1.31	.5092	
	(-.05)	(.25)	(1.01)	(-.22)	(-1.35)	(-.32)	(1.90)				
AR-ML	-22.5	-2.82	-3.96	-.012	.021	8.72	-.000	.1181	.80	1.3414	.89
	(-.51)	(-.33)	(-.99)	(-1.16)	(.50)	(.80)	(-.06)				(14.64)
CORC	-187.7	-1.1	-5.08	-.013	.023	30.31	.000	.1039	.69	1.4673	.95
	(-1.31)	(-.13)	(-1.28)	(-1.28)	(.57)	(1.46)	(.06)				(21.11)
HILU	-.8E+14	1.00	-4.83	-.012	.024	40.17	-.000	.1316	.90	1.559	1.0
	(-1.49)	(.12)	(-1.26)	(-1.25)	(.60)	(1.83)	(-.17)				(.4E+8)

TABLE 10: Regression of German Call Money Rate on Relative Monetary Bases and Debt Stocks

$$* \text{GERCMR} = a_0 + a_1 \ln(\text{USBASE}) + a_2 \ln(\text{GERBASE}) + a_3 \ln(\text{USDEBT}) + a_4 \ln(\text{GERDEBT}) + a_5 \ln(\text{GERGNP}) + a_6 \text{USCURR} + \text{error} *$$

Method	a_0	a_1	a_2	a_3	a_4	a_5	a_6	R^2	F	D.W.	rho
OLS	-507.5	-27.9	-1.61	9.68	-30.96	105.4	.000	.6259	10.5	.9418	
	(-6.18)	(-1.70)	(-.25)	(1.67)	(-6.52)	(4.46)	(2.69)				
AR-ML	-172.1	-2.24	-4.12	-11.70	-6.24	44.21	-.000	.2610	2.11	1.6402	.87
	(-2.02)	(-.29)	(-1.12)	(-1.51)	(-.93)	(2.62)	(-.14)				(13.28)
CORC	-200.6	-1.82	-4.65	-15.36	-3.35	49.35	-.000	.2274	1.76	1.6963	.88
	(-2.15)	(-.24)	(-1.25)	(-1.74)	(-.45)	(2.73)	(-.069)				(12.59)
HILU	-198.1	-1.71	-4.63	-15.49	-2.92	48.68	-.000	.2250	1.74	1.7163	.9
	(-2.05)	(-.22)	(-1.25)	(-1.75)	(-.38)	(2.66)	(-.08)				(13.69)

the short-term United States Treasury Bill rate. Finally the log of the level of nominal Gross National Product in Germany, coefficient a_5, has the correct sign and is highly significant. The complete model is also significant by reference to the F-statistic however evidence of first-order serial correlation is detected by the Durbin-Watson statistic.

All attempts at estimation under correction for first-order serial correlation produce results which differ from the Ordinary Least Squares results. Here the U.S. debt stock, coefficient a_3, changes sign and remains significant in two of the three regressions at the 90% confidence level. Hence the cross-country effects of U.S. budget deficits are seen to correlate with lower, not higher, German short-term nominal interest rates. In either case, the cross-country empirical effects of the U.S. debt stock on German interest rates are non-robust. In addition to these changes, the German debt stock, coefficient a_4, retains its negative sign although becoming insignificant in regressions correcting for autocorrelation. The log of the level of German nominal gross national product, coefficient a_5, has the correct sign and is significant for all estimation techniques. Note also that the Durbin-Watson statistic for the corrected regressions lie within the inconclusive region of the test therefore signifying the possible remaining existence of first-order serial correlation. In sum, as we have found in earlier regressions, the stock measure of the deficit performs much better, however the model tends to track the U.S. Treasury Bill rate more effectively than the short-term German rate of interest.

Finally, in Table 11 we report the split sample Ordinary Least Squares results for the German Call Money rate. Here the null

TABLE 11: Split Sample Regression of German Call Money Rate on Relative Monetary Bases and Debt Stocks

$$* \text{GERCMR} = a_0 + a_1 \ln(\text{USBASE}) + a_2 \ln(\text{GERBASE}) + a_3 \ln(\text{USDEBT}) + a_4 \ln(\text{GERDEBT}) + a_5 \ln(\text{GERGNP}) + a_6 \text{USCURR} + \text{error} *$$

Method	Sample	a_0	a_1	a_2	a_3	a_4	a_5	a_6	R^2	F	D.W.
OLS	1972IV-1978IV	-268.3	-16.7	1.29	5.63	-20.9	58.5	-.000	.8094	12.7	1.1981
		(-1.64)	(-.99)	(.13)	(.29)	(-1.63)	(1.87)	(-.40)			
OLS	1979I-1983IV	-354.0	-2.96	-12.8	-44.0	21.3	84.2	.000	.9019	19.94	1.8409
		(-2.5)	(-.20)	(-1.65)	(-5.21)	(1.90)	(2.85)	(.43)			

hypothesis of aggregation is rejected at the 99% level of confidence using a Chow test. The regression during the period of large U.S. deficits, 1979I-1983IV, is of particular interest. Here, coefficient a_1, the coefficient of the log of the U.S. monetary base, is insignificant. Hence we find no evidence of currency substitution effects with respect to the determination of the short-term German interest rate. Coefficient a_3, the coefficient of the log of the U.S. debt stock, has a negative sign and is highly significant. Thus, our evidence here suggests that the cross-country effects of large U.S. deficits may be to promote lower, not higher, short-term German nominal interest rates. Note also that coefficient a_4, the coefficient of the log of the German debt stock, changes sign over the two subsample periods. In the period of large U.S. deficits, 1979I-1983IV, coefficient a_4 has the correct sign and is significant. Finally coefficient a_5, the coefficient of the log of German nominal gross national product is fairly robust and of the correct sign.

Using the results in Tables 9, 10 and 11, what is the empirical evidence on cross-country interest rate effects of recent large budget deficits in the United States? As we saw in Table 9 there may be a significant effect through the value of the Mark relative to the Dollar but the case for significant cross-country interest rate effects has little support. Also the role of currency substitution with respect to the German interest rate is shown to be insignificant. Viewing the CORC and HILU regressions the U.S. debt stock is shown to be significantly correlated with lower German rates of interest. This cross-country effect runs counter to the expected outcome of the theory and thus remains to be explained. Hence empirical verification of significant

cross-country effects of large United States deficits, outside of exchange rates, remain to be established.

In sum, the empirical results of the open portfolio model derived within allow us to discuss two areas of policy interest. First, if there has been significant crowding-out in the United States arising from large bond financed deficits, where has this crowding-out occurred? The empirical results here support the hypothesis of the theory that this crowding-out has occurred through an appreciation in the value of the Dollar while interest rates have behaved rather cyclically. Hence this crowding-out would have occurred through the export and import competing sectors rather than through interest rate sensitive industries. Theoretically this would occur if foreign capital flows are effectively sensitive to exchange rate expectations.

Second, have the large budget deficits in the United States led to significant cross-country effects on other countries asset markets? With respect to the Deutschemark/Dollar exchange rate the evidence is sufficient to argue there are significant effects occurring through the exchange rate. With respect to foreign interest rates there is little empirical evidence that large United States deficits have caused higher interest rates in Europe.

Chapter VII: CONCLUSION

This dissertation has presented an open portfolio model that formally includes currency substitution and explores the impact effects of large United States budget deficits on international financial markets. Using this model we discuss the policy implications of budget deficits and currency substitution and submit the model to a test using data for Germany, France, and the United States.

The main implication of the model is that currency substitution may serve as a transmission mechanism of international financial shocks. Here, under currency substitution, changes in the foreign demand for domestic money, reacting to changes in exchange rate expectations surrounding domestic policy actions, may destabilize the domestic money market. Hence flexible exchange rates may cause swings in the foreign demand for domestic money which in turn may produce swings in the demand for domestic money and velocity. This international portfolio substitution, with emphasis on currency substitution, it is argued, will augment the effectiveness of monetary policy while weakening the effectiveness of fiscal policy.

Finally we have shown theoretically significant cross-country effects of large budget deficits arising from international portfolio substitution. The importance of these cross-country effects depends on the degree of substitutability between domestic and foreign financial assets. We also decompose foreign capital flows between debt and currency flows and show that the distribution of these flows between debt and currency has important ramifications on the transmission mechanism of crowding-out in the open economy. Here the more sensitive

are foreign capital flows to expectations concerning the value of domestic debt, relative to currency, the more the crowding-out related to large bond financed deficits is likely to be skewed to the export sector through the exchange rate rather than the domestic sector through higher interest rates. Using this analysis of linking changes in the deficit to exchange rate expectations and therefore to international portfolio behavior, we have argued that there is a link between large United States budget deficits and the rise in the value of the Dollar. Empirically we have shown the existence of significant cross-country effects relating to U.S. budget deficits on the value of the Dollar, however the evidence on significant cross-country interest rate effects is insufficient.

APPENDICES

APPENDIX IV-A

Steady State Properties of the Model

The collapsed representation of the model, as given in equation 36), is;

$$63) \quad Ax = Cv$$

where the notation is defined therein.

The reduced form solution is therefore;

$$64) \quad x = A^{-1}Cv$$

Since we are attempting to argue that expectations are realized in the steady state, our focus shall be on the behavior of the exchange rate in the steady state. From 64) the reduced form for the exchange rate is given as;

$$\begin{aligned} 65) \quad dlne &= q_0 dlnM^t + q_1 dlnM^t_{t-1} + q_2 dlnB^t_{t-1} + q_3 dlnN^t \\ &+ q_4 dlnN^t_{t-1} + q_5 dlnF^t_{t-1} + q_6 dlnDEF + q_7 dlnDEF^* \\ &+ q_8 dlnW_{t-1} + q_9 dlnCURR + q_{10} dlne_{t-1} \end{aligned}$$

Note that, since we are attempting to examine the steady state rate of exchange rate depreciation, equation 65) is specified in logs.

The following restrictions, when imposed, define the steady state of the model;

i) $dlnM^t = dlnM^t_{t-1}$

ii) $dlnB^t = dlnB^t_{t-1}$

iii) $dlnN^t = dlnN^t_{t-1}$

iv) $dlnF^t = dlnF^t_{t-1}$

v) $dlnW_{t-1} = dlnW$

vi) $dlnCURR = dlnCURR_{t-1}$

vii) $dlne_{t-1} = dlne_t$

viii) $dlnDEF = dlnM^t + dlnB^t$

ix) $dlnDEF^* = dlnN^t + dlnF^t$

Imposing these restrictions on equation 65) gives us;

$$66) \quad (1 - q_{10})dlne = (q_0 + q_1)dlnM^t + q_2 dlnB^t + (q_3 + q_4)dlnN^t + q_5 dlnF^t + q_6 dlnDEF + q_7 dlnDEF^* + q_8 dlnW + q_9 dlnCURR$$

Collecting terms and assuming that $a_{10} \neq 1$ we have the following;

$$67) \quad dlne = [(q_0 + q_1)/(1 - q_{10})]dlnM^t + [(q_2)/(1 - q_{10})]dlnB^t + [(q_3 + q_4)/(1 - q_{10})]dlnN^t + [(q_5)/(1 - q_{10})]dlnF^t + [(q_6)/(1 - q_{10})]dlnDEF + [(q_7)/(1 - q_{10})]dlnDEF^* + [(q_8)/(1 - q_{10})]dlnW + [(q_9)/(1 - q_{10})]dlnCURR$$

We shall now use equation 67) to identify the steady state properties of the model. Consistent with our emphasis on the budget

deficit, we inquire into two cases in the steady state; that with a balanced budget and that with constant growth in the deficit.

CASE 1: Steady State with a Balanced Budget

In this case we define the model to be in long-run equilibrium when each country has a balanced budget and a constant trade balance. Formally:

$$68) \quad dlnDEF = dlnDEF^{*} = dlnCURR = 0$$

Hence the long-run equilibrium is characterized by no change in relative outside asset stocks. By application to equation 67) the result will be a constant level of the exchange rate over time. Note, in this case, with no explicit restrictions on parameters g and h, equation 27) will always generate exchange rate expectations which are realized in the steady state.

CASE 2: Steady State with an Unbalanced Budget

In this case the long-run equilibrium is characterized by a constant rate of growth of relative outside asset supplies arising from the financing of constantly increasing deficits. Here the rate of change of the deficit is assumed to be constant in each country and also that the trade balance will change at a constant rate. Under these assumptions the exchange rate will change at a constant rate of depreciation over time. Formally this result is obtained from equation 67) when constant rates of growth of outside asset supplies and constant coefficients are imposed.

APPENDIX IV-B

Steady State Properties of the Limited Information Rational Expectations Hypothesis

We have argued that, in the steady state, under certain restrictions, the expectations specification found in equation 27) will produce expectations consistent with perfect foresight rational expectations. Our goal here, therefore, is to uncover the set of restrictions needed for the expectations specification to generate exchange rate expectations consistent with the steady state properties of the model under a variety of characterizations of long-run equilibrium.

Here, in addition to the steady state assumptions found in part A, we define long-run equilibrium, in the steady state, as one where the deficits in each country grow at a constant rate. To facilitate our discussion we seek to find the restrictions on the parameter h in the most general version of the model and then impose a series of special cases of long-run equilibrium to discuss the consistency of the restrictions across cases. We, therefore, find it useful to introduce the following variables which, in combination, will give us a variety of characterizations of long-run equilibrium;

$$69) \quad \alpha = dB^t/DEF$$

$$(1 - \alpha) = dM^t/DEF$$

$$\gamma = d\ln F^t/d\ln B^t$$

$$\beta = d\ln N^t/d\ln M^t$$

Imposing these assumptions on equation 67) in addition to assuming that g = 0, which implies that $q_{10} = 0$, we have;

$$70) \quad dlne = [((1 - \alpha)/M^t)(q_0 + q_1 + \beta q_3 + \beta q_4 + q_6 + \beta q_7) + (\alpha/B^t)(q_2 + \gamma q_5 + q_6 + \gamma q_7) + (q_8/W)]DEF$$

To isolate behavior of the expectations specification in the long-run, steady state, equilibrium we make the following behavioral assumptions;

$$g = 0$$

$$dlnM^t = \ln(M^t/M^t_{t-1})$$

$$dlnB^t = \ln(B^t/B^t_{t-1})$$

$$dlnN^t = \ln(N^t/N^t_{t-1})$$

$$dlnF^t = \ln(F^t/F^t_{t-1})$$

Imposing these restrictions, in addition to those of the steady state, on equation 27) gives us;

$$71) \quad z = h[(1 - \beta)((1 - \alpha)/M^t) + (\gamma - 1)(\alpha/B^t)]DEF$$

Expectations will be realized if and only if;

$$72) \quad z = dlne$$

Using equations 70) and 71), the following restrictions involving the parameter h must hold;

$$73) \quad h[(1 - \beta)((1 - \alpha/M^t) + (\gamma - 1)(\alpha/B^t)]$$
$$= [((1 - \alpha/M^t)(q_0 + q_1 + \beta q_3 + \beta q_4 + q_6 + \beta q_7)$$
$$+ (\alpha/B^t)(q_2 + \gamma q_5 + q_6 + \gamma q_7) + (q_8/W)]$$

We have just found restrictions on the parameter h necessary for equation 72) to hold in terms of the reduced form parameters of the model. To find these restrictions in terms of the structural coefficients we must rewrite the reduced form coefficients in terms of the structural coefficients of the model. Formally;

$$q_0 = [(x_1 f_1 + x_2 m_1 + x_3 b_1)/(e(\det A))]$$

where;

$$x_1 = (a_{11}a_{22} - a_{21}a_{12})$$

$$x_2 = (a_{21}a_{32} - a_{31}a_{22})$$

$$x_3 = (a_{31}a_{12} - a_{32}a_{11})$$

$$m_1 = [1 - hQ/M^t - hQ/B^t]$$

$$b_1 = -[1 + hK/M^t + hK/B^t]$$

$$f_1 = -[hJ/M^t + hJ/B^t]$$

$$q_1 = [(x_1 f_2 + x_2 m_2 + x_3 b_2)/(e(\det A))]$$

where;

$$m_2 = [hQ/B^t - m^*(\ ) + hQ/M^t_{t-1}]$$

$$b_2 = [1 - b^*(\ ) + hK/M^t_{t-1} + hK/B^t]$$

$$f_2 = [hJ/M^t_{t-1} - f^*(\ ) + hJ/B^t]$$

$$q_2 = [(x_1 f_3 + x_2 m_3 + x_3 b_3)/(e(detA))]$$

where;

$$m_3 = [hQ/B^t - hQ/B^t_{t-1} - m^*(\ )]$$

$$b_3 = [1 - b^*(\ ) - hK/B^t - hK/B^t_{t-1}]$$

$$f_3 = -[f^*(\ ) - hJ/B^t + hJ/B^t_{t-1}]$$

$$q_3 = [(x_1 f_4 + x_2 m_4 + x_3 b_4)/(e(detA))]$$

where;

$$m_4 = [hQ/N^t + hQ/F^t]$$

$$b_4 = [hK/N^t + hK/F^t]$$

$$f_4 = [hJ/F^t + hJ/N^t - e]$$

$$q_4 = [(x_1 f_5 + x_2 m_5 + x_3 b_5)/(e(detA))]$$

where;

$$m_5 = -[em^*(\ ) + hQ/N^t_{t-1} + hQ/F^t]$$

$$b_5 = -[eb^*(\ ) + hK/N^t_{t-1} + hK/F^t]$$

$$f_5 = [e - ef^*(\ ) - hJ/N^t_{t-1} - hJ/F^t]$$

$$q_5 = [(x_1 f_6 + x_2 m_6 + x_3 b_6)/(e(detA))]$$

where;

$$m_6 = [hQ/F^t_{t-1} - hQ/F^t - em^*( )]$$

$$b_6 = -[eb^*( ) + hK/F^t - hK/F^t_{t-1}]$$

$$f_6 = [hJ/F^t_{t-1} - hJ/F^t - ef^*( ) + e]$$

$$q_6 = [(x_1 f_7 + x_2 m_7 + x_3 b_7)/(e(detA))]$$

where;

$$m_7 = [hQ/B^t - m( )]$$

$$b_7 = [1 - b( ) + hK/B^t]$$

$$f_7 = [hJ/B^t - f( )]$$

$$q_7 = [(x_1 f_8 + x_2 m_8 + x_3 b_8)/(e(detA))]$$

where;

$$m_8 = -[hQ/F^t + em^*( )]$$

$$b_8 = -[eb^*( ) + hK/F^t]$$

$$f_8 = [e - ef^*( ) - hJ/F^t]$$

$$q_8 = [(x_1 f_9 + x_2 m_9 + x_3 b_9)/(e(detA))]$$

where;

$$m_9 = -[m(\ ) - m^*(\ )]$$

$$b_9 = -[b(\ ) - b^*(\ )]$$

$$f_9 = -[f(\ ) - f^*(\ )]$$

After substituting these definitions into equation 73) and reducing we can explicitly solve for the parameter h in terms of the structural coefficients for the general model. Formally;

$$\begin{aligned}
h = [&[((1-\alpha)/M^t)[x_1(\beta e - f^*(\ ) - f(\ ) - 2\beta e f^*(\ )) + x_2(1 - m^*(\ ) \\
&- 2\beta e m^*(\ ) - m(\ )) + x_3(1 - b^*(\ ) - 2\beta e b^*(\ ) - b(\ ))] \\
&+ (\alpha/B^t)[x_1(2\gamma e - f(\ ) - f^*(\ ) - 2\gamma e f^*(\ )) + x_2(-m^*(\ ) \\
&- m(\ ) - 2\gamma e m^*(\ )) + x_3(2 - b^*(\ ) - b(\ ) - 2\gamma e b^*(\ ))] \\
&+ (1/W)(x_1 f_9 + x_2 m_9 + x_3 b_9)]/[[(1-\beta)((1-\alpha)/M^t) \\
&+ (\gamma - 1)(\alpha/B^t)][(e(\det A)) - [((x_1(1-\alpha))/M^t)(J/M^t_{t-1} - J/M^t \\
&+ \beta J/N^t - \beta J/N^t_{t-1} + J/B^t - \beta J/F^t) + ((x_2(1-\alpha))/M^t)(Q/B^t - Q/M^t \\
&+ Q/M^t_{t-1} + \beta Q/N^t - \beta Q/N^t_{t-1} - \beta Q/F^t) + ((x_3(1-\alpha))/M^t)(K/M^t_{t-1} \\
&- K/M^t + \beta K/N^t - \beta K/N^t_{t-1} + K/B^t - \beta K/F^t) + ((x_1\alpha)/B^t)(2J/B^t \\
&- J/B^t_{t-1} + \gamma J/F^t_{t-1} - 2\gamma J/F^t) + ((x_2\alpha)/B^t)(2Q/B^t - Q/B^t_{t-1} \\
&+ \gamma Q/F^t_{t-1} - 2\gamma Q/F^t) + ((x_3\alpha)/B^t)(\gamma K/F^t_{t-1} - K/B^t_{t-1} - 2\gamma K/F^t)]]]]
\end{aligned}$$

Equation 74) gives us the restrictions on the parameter h, needed for the expectations specification to be realized in the steady state equilibrium, in terms of the structural coefficients for any values in the range of α, γ and β. The following chart gives the variety of characterizations of long-run equilibrium which can be obtained in the model for alternative values of α, γ and β.

Foreign Country Budget Deficit

Domestic Country Budget Deficit	Balanced Budget	Money Financed	Bond Financed
Money Financed	$\alpha = 0$ $\gamma = 0$ $\beta = 0$	$\alpha = 0$ $\gamma = 0$ $\beta > 0, \beta \neq 1$	$\alpha = 0$ $\gamma > 0, \gamma \neq 1$ $\beta = 0$
Bond Financed	$\alpha = 1$ $\gamma = 0$ $\beta = 0$	$\alpha = 1$ $\gamma = 0$ $\beta > 0, \beta \neq 1$	$\alpha = 1$ $\gamma > 0, \gamma \neq 1$ $\beta = 0$

Here, given assumptions on the values of α, γ and β, all one has to do is to impose these values on equation 74) to find the explicit structural restrictions on the parameter h for the expectations mechanism to be realized in steady state equilibrium for that particular case. Now, what can be said about the consistency of these restrictions across the different cases found in the previous chart? We argue, since all cases are found by imposing certain values of α, γ and β on equation

74), that the restrictions on h are consistent across cases. For example, the restrictions on h for the case of a money financed domestic deficit and a foreign balanced budget are the same for those of a money financed domestic and foreign deficit with $\beta = 0$. Hence, we conclude, under certain restrictions, the Limited Information expectations specification will generate expectations concerning the exchange rate which are realized in long-run, steady state, equilibrium.

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