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THE IMPLICATIONS OF A FLOATING EXCHANGE RATE REGIME: A SURVEY OF FEDERAL RESERVE SYSTEM PAPERS

by

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*This survey provides an overview of the work done in the Federal Reserve System on the System's Special International Research Objective for 1979. This objective calls for the study of the effects of the current floating exchange rate regime on important ecnomic variables. Jeffrey R. Shafer was the coordinator of the objective for the Board of Governors . The authors wish to express their appreciation to Michael Keran of the Rederal Reserve Bank of San Francisco, who was coordinator of the objective for the Federal Reserve Banks and to the other authors of papers for their contributions and suggestions. The views expressed in this survey are the authors' alone. They do not represent official views of the Federal Reserve System, its Board of Governors, or its staff.

Table of Contents

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Jo Anna Gray and Jeffrey R. Shafer

I. Introduction

Among the most significant international developments of the last decade has been the emergence of an exchange rate system characterized by the widespread floating of major currencies. At times during the 1970's, the dollar and other currencies have fluctuated widely in value with respect to one another. The desire to understand better the implications of these exchange rate movements for trade flows, international capital movements, inflation rates, and other important economic variables has generated a substantial research effort. This paper provides a survey of recent contributions to this effort by Federal Reserve System economists, mainly work done in 1979.

The effects of exchange rate changes on other economic variables must be assessed in the context of the processes that generate these changes. Exchange rates are "endogenous" variables -- they are determined within the economic and financial system, not given to it. Exchange rates and other endogenous variables such as outputs, price levels, and trade flows are simultaneously and jointly determined. Changes in these endogenous variables are caused by changes in the exogenous components of variables such as the supplies of financial assets and the supplies of natural resources and by random fluctuations in economic relationships. Thus, in order to understand the relationship between exchange rates and,

for example, trade flows, it is necessary to understand the general equilibrium environment in which both are determined. For this reason, our survey begins with a review of the research done by System economists on the process of exchange rate determination. This constitutes section II. More than half the papers covered by this survey are concerned with theoretical and empirical aspects of exchange rate determination and are discussed there.

Research on the direct influence of exchange rate flexibility on other key economic variables and relationships is reported in Section III. The empirical work discussed in this section includes studies of the impact of exchange rate changes on economic variables such as prices and trade flows, as well as studies of the effect of exchange rate flexibility on economic relationships such as the interdependence of monetary policy and intervention policy. Both theoretical and empirical work on the question of vicious circles is reviewed. The section also includes a discussion of the impact of the move toward floating exchange rates among industrial countries on the exchange rate policies of developing countries.

Some brief comments on the state of current understanding of the floating exchange rate system, as reflected by the papers reviewed in this summary, are contained in section IV.

II. How Exchange Rates are Determined in a Floating Exchange Rate Environment

This section reviews the extensive and varied research into the process of exchange rate determination that System economists have undertaken. A common thread running through this work is that foreign exchange markets are viewed as asset markets. Thus they are seen as analogous to equity markets or bond markets. Expectations concerning the future play a dominant role in determining demand in such markets, in contrast to, say, the market for a perishable commodity, which is dominated by the current flow of supply and demand for immediate consumption. The distribution of wealth across different countries, where asset needs or preferences may vary, also effects demand. Finally, any flow of current benefits such as an interest return or usefulness in undertaking transactions affects demand.

The supplies that are considered crucial in the asset market view of exchange rate determination are the supplies of nominal assets controlled by the government. All other assets net out to zero within the private economy since one person's asset is another's liability. Some of the research reviewed below considers only the role of money supplies in determining exchange rates. Other work considers the role of supplies of government debt denominated in different currencies, as well.

The asset view of exchange markets suggests that exchange rates will be directly affected by changes in the way market participants desire to allocate their financial portfolios across assets denominated in different currencies. Such shifts may be caused by changes in the relative rates of return or risk associated with assets denominated in different

currencies. Changes in flow variables, like the current account or government deficit, are expected to have little direct effect on the exchange rate over a short period of, say, a year or less since they have only a gradual cumulative effect on either the stock demand or the stock supply of assets. However, insofar as such developments affect expectations concerning the future values of variables such as money supplies, price levels, or terms of trade, they may have large and immediate indirect effects. And, of course, over a longer period the cumulative direct effects of such changes may become important.

The remainder of this section contains a more detailed discussion of the topics raised above, and is divided into three parts:

-- In the first, issues and papers bearing on various aspects of the demands for assets are summarized.

-- In the second, the supplies of assets are discussed.

-- In the third, two broad classes of models of exchange rate determination are described. For each class, the particular assumptions made about the demand for, and the supply of, nominal assets are central to the conclusions drawn from the models belonging to that class.

II.1. Aspects of the Demand for Assets

Among the factors influencing asset demands are absolute and relative rates of return, the degree of substitutibility among assets, wealth, and the transactions role of certain assets. Research on each of these factors was undertaken within the System during 1979.

Expected exchange rate changes are an important determinant of relative rates of return on assets denominated in different currencies.

The first group of papers discussed are those relating to the role of expectations in determining asset demands and exchange rates. We then turn to two empirical papers which report tests for the existence of systematic differences in realized rates of return on assets denominated in different currencies. This evidence is of particular interest since such differences (frequently referred to as risk premia) would be evidence of imperfect substitutibility among these assets. A discussion of several other closely related papers concludes this section. The last group of papers reviewed highlight the implications of substitutibility and wealth effects for the simultaneous determination of exchange rates and other endogenous variables.

A. The role of expectations

One of the important ways in which expectations enter asset demands is in the calculation of rates of return. In general, asset holders would be expected to demand more of an asset as a result of an increase in its expected rate of return relative to expected rates of return on other assets. Thus, it is differences in rates of return, rather than absolute levels, that are most often assumed to affect asset demands. Differences in rates of return, or relative rates of return, on assets denominated in different currencies are affected by the expected rate of change of the exchange rate, but not directly by rates of inflation. Consider, for example, the relative rate of return on two assets -- one denominated in domestic currency and the other in foreign currency -- held by a domestic resident. The difference in the rates of return on these two assets, as perceived by the domestic resident, is simply the difference in

the foreign and domestic nominal rates of interest plus the expected rate of appreciation of the foreign currency against the domestic currency.

As the preceding discussion illustrates, expectations, particularly expectations of exchange rate changes, can be expected to play an important role in determining demands for assets denominated in different currencies and, hence, in exchange rate determination. Rogoff's paper [36] on anticipated shocks illustrates the nature of this role. His framework is adopted from earlier work by Dornbusch.[1/] In Dornbusch's model, an unanticipated decrease in one country's money supply may cause its exchange rate to appreciate and overshoot its long run equilibrium value initially. If so, the exchange rate subsequently depreciates and the price level falls, each moving monotonically to its new long run value. If the exchange rate undershoots initially, it subsequently appreciates as the price level falls. Rogoff analyzes the impact of an anticipated money supply change. He finds that at the time a future money supply decrease becomes known, the exchange rate for the home currency will jump and may overshoot its new long run equilibrium value. Regardless of whether the exchange rate initially overshoots or undershoots, prices fall and the exchange rate appreciates between the time the money supply decrease is announced and the time when it actually occurs. At the time the money supply decrease occurs, there is not a second jump in the exchange rate. Thereafter, the exchange rate depreciates until its new long run equilibrium value is reached. Thus Rogoff's paper provides an example of a situation in which the expectation of an event can cause a large movement in the exchange rate long before the event itself occurs.

An implication of Rogoff's analysis is that if an event (e.g., a change in monetary policy) is anticipated, the event itself will not cause a large movement in the exchange rate. Both Brown [6] and Mudd [32] present empirical evidence that is consistent with this implication. Both authors, using different methodologies, test the hypothesis that discount rate changes generate announcement effects in the foreign exchange market. Such effects would be seen if discount rate movements signalled previously unanticipated changes in interest rates or future rates of growth of the money supply. If, however, the discount rate change -- or the associated change in future money growth -- was anticipated by market participants, it would have no announcement effect because it would contain no new information. Neither author finds evidence, except for November 1, 1978, that U.S. discount rate changes during the floating rate period of the 1970's affected the foreign exchange value of the dollar.

While the importance of expectations in determining economic variables like the exchange rate is generally recognized, there has been considerable controversy concerning the proper representation of expectations in macroeconomic models. At the center of this controversy is a view of expectations formation known as "rational expectations". According to this view economic agents use efficiently all available information, including information on the structure of the economy and the systematic component of government policy, in forming their expectations. An implication of rational expectations models is that agents do not make systematic prediction errors -- forecasts are unbiased.

Among the important characteristics of rational expectations models is their "saddle-point" stability: One stable path for the exchange

rate and price level can be found, but other unstable paths exist. Along the unstable paths, which are often referred to as speculative bubbles, exchange rates and prices "fly off the handle", their value tending toward infinity or zero over time. Most research into rational expectations rules out unstable paths by assumption. Canzoneri [9], however, explores the relevance of such paths in his paper on rational destabilizing speculation. He shows that if agents expect an extraneous variable (such as the price of gold) to affect the exchange rate, such an expectation may become self-fulfilling even if there is no fundamental economic connection between the variable and the exchange rate. Furthermore, the resulting path of the exchange rate will take the form of a speculative bubble that is fully consistent with rational expectations. Thus the paper provides theoretical support for the proposition that exchange rates may fluctuate widely for psychological or "non-fundamental" reasons. However, it does not deal with the question of how the market comes to focus on irrelevant information or ultimately disregards it. Canzoneri explores intervention policies that stabilize the exchange rate in the face of behavior of the sort he hypothesizes. The appropriate policy turns out to be an accomodating policy of "leaning with the wind" -- a policy that runs counter to conventional wisdom.

In constructing theoretical and empirical models of exchange rate determination, it is commonly assumed that the expected rate of change of the exchange rate is proportional to the difference between the actual exchange rate and its long run equilibrium value. Such an assumption is simple and intuitively appealing. Moreover, this partial adjustment specification of expectations formation has been shown to be consistent

with rational expectations in simple models, like Dornbusch's, which can be reduced to a single dynamic equation. For the partial adjustment specification of expectations to be rational, both the actual and the expected exchange rate must move monotonically to their new long-run equilibrium values following the initial instantaneous adjustment to a shock. That is, the exchange rate must always move in the "right" direction, as it does in Dornbusch's and related models. Canzoneri and Aoki [3] and Shafer [37] demonstrate that this simple characterization of exchange rate behavior does not generalize to richer models.

Canzoneri and Aoki generalize Dornbusch's small country model, in which the markets for goods adjust slowly while financial markets clear instantaneously, to a two country model in which the speeds of adjustment of the markets for goods differ between the two countries. Shafer chooses to expand the financial structure to include two imperfectly substitutable assets -- domestic and foreign bonds. Both models postulate rational expectations with regard to the exchange rate. The solution of these models requires the solution of three or more differential equations. Because of the more varied behavior that can occur in larger dynamic systems, neither model necessarily exhibits the simple exchange rate behavior described earlier. In both models, the exchange rate may move away from its new long-run value for some time following a shock. However, in such cases, the exchange rate will eventually reverse its direction of movement and converge to its new long-run value.

The effects of an increase in the domestic money supply in the Canzoneri-Aoki framework illustrate this behavior. In the long-run, the home currency must depreciate. Initally, however, the exchange rate may

overshoot or undershoot its new long-run value. If the exchange rate overshoots initially, it will subsequently appreciate until it reaches its new long-run value. This adjustment path is similar to the one generated by Dornbusch's model in the case of overshooting. But it is possible for the exchange rate to undershoot initially. If it does so, it will subsequently appreciate for a period of time, moving away from its new equilibrium value. Eventually, it will reverse its direction of movement and depreciate until it reaches its long-run value. Thus, these models show that, even in a rational world, the exchange rate may not always move in the direction of its equilibrium value.

As the preceding discussion demonstrates, fluctuations of exchange rates about their equilibrium values are not necessarily inconsistent with rational market behavior. It has been observed, however, that exchange rates during the floating rate period of the 1970's have been much more volatile than money stocks or price levels, raising the question of just how much exchange rate volatility is consistent with rational behavior. Meese and Singleton [30] address this question, providing both a critique of the existing literature and an analysis of their own. More specifically, they explore the possibility of a "magnification effect" in the determination of exchange rates. Since there does not exist a consensus definition of a magnification effect, they consider several alternative measures of such an effect, including comparisons of the variance of the exchange rate with the variances of exogenous variables such as the money supply and real output, as well as the elasticity of the exchange rate with respect to changes in the same exogenous variables.

Meese and Singleton find that in the simplest, flexible-price, monetary models, a magnification effect is only possible if the money supply follows a special kind of non-stationary random process, in which case its variance is not a well-defined concept. In more general frameworks, whether or not a magnification effect is present depends on the parameters of the model. Thus, they conclude that the observed volatility of exchange rates is not necessarily inconsistent with the implications of macroeconomic models of exchange rate determination that assume agents are rational. Whether or not the observed phenomena are inconsistent with rational behavior is an empirical question, the answer to which depends on the empirical values of the model parameters.

B. Tests of risk averse behavior and rational expectations in exchange markets

A large body of research has developed involving empirical tests of the rationality of expectations in various asset markets, including the market for foreign exchange. A major problem with such empirical work is that the hypothesis tested is inevitably a joint hypothesis. For instance, it is sometimes asserted that if the foreign exchange market reflects rational expectations, forward exchange rates will be unbiased predictors of future spot exchange rates.[2/] This will only be true, however, if there is no risk factor associated with exchange rate uncertainty. A risk premium or discount would give rise to a systematic error in predicting future spot exchange rates using current forward rates. For a risk factor to be absent, in general, either market participants must be indifferent toward uncertainty (risk neutral) or exchange risk must be fully diversifiable. The latter condition means that although there may be

risk associated with holding only one currency, an optimally diversified portfolio of currencies is riskless. Hence, tests of the ability of the forward rate to provide unbiased forecasts of the future spot rate are really tests of the joint hypothesis of (i) exchange market efficiency (which is usually defined to mean rational expectations and minimal transactions costs), and (ii) the absence of a risk factor on foreign exchange.

The empirical evidence on the existence of a foreign exchange risk premium is central to the theory of exchange rate determination. A number of issues turn on the question of whether or not domestic and foreign assets are perfect substitutes, and exchange risk is one characteristic that may distinguish these assets. If asset holders are risk averse, and if exchange risk cannot be completely diversified, then assets denominated in domestic currency and assets denominated in foreign currencies will be imperfect substitutes. Other potential differences between domestic and foreign assets, such as political risk and default risk, are also recognized, but are less frequently appealed to in rationalizing the assumption of imperfect substitutibility. For the study of relationships among major currencies these latter differences may not be important since the liabilities of a country or its residents need not be denominated in that country's currency.

Both Frankel [12] and Meese and Singleton [31] conduct tests of the joint hypothesis of exchange market efficiency and the existence of a time varying risk factor. Frankel begins his paper with a discussion of possible sources of imperfect substitutibility among assets, one source being the exchange risk associated with the currency in which an asset is

denominated. He then develops a testable hypothesis by specifying asset demands as a function of the exchange risk premium, which is defined to be the excess of the expected appreciation of the exchange rate over the forward premium. Assuming rational expectations, he then expresses the observed discrepancy between the forward rate for a given date and the spot rate that is realized on that date as a function of the share of domestic private wealth allocated to domestic assets, plus a random error term. Of the many tests reported in the paper, none provide grounds for rejecting the null hypothesis that the coefficient on the portfolio share is zero. Hence, Frankel's evidence is consistent with the absence of an exchange risk premium that is systematically related to the portfolio shares of domestic and foreign assets.

Meese and Singleton begin their paper by rejecting the joint hypothesis of exchange market efficiency and risk neutrality using newly developed variance bounds tests, as well as conventional regression analysis. They relate the variance bounds tests to the conventional regression tests of efficiency and risk neutrality, and then propose the hypothesis that the failure of the forward rate to be an unbiased predictor of the future spot rate is a consequence of a time varying risk premium. A lower bound for the variance of this risk premium is derived and estimated. The estimated lower bound is found to be significantly different from zero. This finding supports their hypothesis of a time varying risk premium.

In contrast to Frankel, then, Meese and Singleton do find evidence for a time varying risk premium in the foreign exchange market. The conclusions of the two papers are not, however, necessarily inconsistent. Together, they could imply expectations that are not

rational or the existence of a risk premium, the size of which is largely determined by time varying factors other than the relative shares of domestic and foreign assets in domestic portfolios. Alternatively, the tests employed by Frankel may not have been powerful enough to find the sort of risk premium he was looking for even though it existed.

Papers by Fieleke [11] and Throop [39] also contain results that may be interpreted as evidence of the imperfect substitutability of net asset positions denominated in different currencies for particular groups of market participants. These results may also be read as evidence of the existence of a risk factor in the relative rates of return on assets denominated in different currencies.

Fieleke studies data collected by the U.S. Treasury on the net positions in several foreign currencies of U.S. banks and of U.S. nonbanks during the period 1975-78. These data show that the net positions of U.S. banks were very small, absolutely and relative to their total foreign currency activity. U.S. nonbanks held larger positions over time by either criterion. Fieleke presents regressions of the foreign currency positions of both groups, measured several different ways, against the deviations between the actual spot exchange rate 3 months later and the 3 month forward rate at the time the positions were recorded. He finds no systematic relationship between the relatively small positions taken by banks and deviations between the future spot rate and the forward rate. However, he finds that nonbanks did tend to have positions that were systematically related to these deviations. The results for nonbanks suggest that a variable risk premium existed to which these market participants responded. Taking both sets of results together, U.S.

nonbanks were more willing to take positions to obtain a higher rate of return than were U.S. banks -- that is, U.S. nonbanks appeared to consider spot asset positions denominated in different currencies as somewhat better substitutes than did U.S, banks, but they did not consider them to be perfect substitutes.

Throop's study examines the short-run impact on foreign money market rates of variations in interest rates in the U.S. money market during both the Bretton Woods years and the period of managed floating. For the Bretton Woods years it is found that official intervention in the foreign exchange market was closely associated with pressures on exchange rates generated by interest sensitive capital flows. Since the effect of intervention on foreign money supplies was not completely sterilized, the shift of private capital produced sympathetic changes in foreign interest rates. But a 100 basis point change in the U.S. interest rate is estimated to have produced, on average, only a 55 basis point change in the foreign interest rate, consistent with imperfect substitutability between domestic and foreign assets. Throop identifies a relatively inelastic supply of forward cover to investors as an important reason for the incomplete response of foreign interest rates in the fixed exchange rate period, indicating the existence of significant (and variable) premiums in the forward market for bearing exchange risk. These results also show considerably smaller, but still measurable, roles for political risk and default risk in creating imperfect substitutability between domestic and foreign financial assets.

The theory of behavior toward risk has implications for the allocation of portfolios among currencies that go beyond imperfect

substitutibility. In particular, the capital asset pricing model allows one to predict the optimal allocation of portfolio shares among assets, given knowledge of the distribution of the returns on assets -- the means, variances, and covariances of the returns. In an application of this theory, Laney [24] calculates the currency positions that are consistent with optimal portfolio choice using observed average rates of return on currencies, the variances of those rates of return, and the correlations among them during 1975-76. He notes that, given the pattern of correlations, it may be efficient to hold a long position in a currency that is expected, on average, to depreciate. Indeed, this appears to have been the case for the Italian lira. More generally, however, the correspondence between his calculated portfolio shares and actual portfolio shares (specifically, those reported by U.S. banks) was loose. Differences between the unobservable expectations of means and covariances held by position managers and those that were observed after the fact are undoubtedly an important reason why the correspondence was not better.

In a separate paper, Laney [27] presents an historical review of reserve currency use. The paper notes that more than one currency has been in use as a reserve throughout history, and that a shift towards floating exchanges rates would be expected to lead countries to seek greater diversification of foreign exchange reserves. However, Laney finds no clear trend of diversification out of dollars in IMF data through 1977. Nevertheless, the dollar share of reserves has tended to decline when the dollar has been weak and to rise when it has been strong. It is noted that valuation effects are present in the data and could partly account for this pattern, but no attempt is made to quantify them.

Akhtar and Putnam [2] test for the effects of exchange rate variability on the demand for narrowly defined money in Germany. They hypothesize that increased exchange rate variability will reduce the demand for narrowly defined money and find that this hypothesis is supported by money demand equations for Germany estimated over the 1972-1976 period. They include the standard deviation of the daily spot dollar/mark exchange rate in these equations as an explanatory variable, and find that this variable is statistically significant.

C. The implications of substitutibility and wealth effects for exchange rate determination

Expected, exchange-rate-adjusted, relative yields will be equal if domestic and foreign assets are perfect substitutes. The domestic nominal rate of interest will equal the foreign interest rate plus the expected rate of depreciation of the domestic currency (that is, uncovered interest parity will hold), and the forward rate will equal the expected future spot rate (that is, both covered and uncovered interest parity will hold). If, on the other hand, these assets are imperfect substitutes, their exchange-rate-adjusted relative yields will be altered by changes in their supplies. Whether or not relative yields are sensitive to changes in the outstanding supplies of assets determines, in turn, whether or not intervention policy and monetary policy can be treated as distinct policies. If domestic and foreign assets are perfect substitutes -- and, therefore, relative yields are fixed -- it is not possible to distinguish the effects of intervention policy from the effects of monetary policy. If these assets are imperfect substitutes, however, intervention may affect exchange rates even if money supplies are held constant (that is, the

intervention is sterilized). Intervention policy and monetary policy may then be treated as distinct policies. This issue is explored further in the last part of section II.3.

Imperfect substitutibility is also a necessary assumption if one is interested in studying the effects on the exchange rate of changes in preferences for assets denominated in domestic and foreign currencies. The shifts in currency preferences most often thought to be sources of exchange rate volatility involve shifts among interest bearing assets denominated in different currencies rather than shifts in demand among narrowly defined monies. Models in which domestic and foreign currency non-money assets are assumed to be perfect substitutes cannot be used to analyze such shifts. Since an asset holder is, by definition, indifferent to the composition of his portfolio when the assets he holds are perfect substitutes, changes in desired portfolio shares among non-monetary assets are conceptually meaningless. If, however, assets are assumed to be imperfect substitutes, a shift in asset preferences is a well defined concept.

Among the papers which assume that domestic and foreign non-money assets are perfect substitutes are those by Keran [22,23], Rogoff [36], and Wallich and Gray [41]. Examples of frameworks which exploit the assumption of imperfect substitutibility are those of Goodfriend [13], Henderson [15], and Shafer [37]. These two groups of papers also illustrate the potential importance of the distribution of wealth across countries in determining exchange rates. If asset preferences are well defined and differ across countries, then a redistribution of wealth between countries will cause a shift in relative asset demands. These wealth induced changes in asset

demands will, in turn, affect exchange rates. Since wealth transfers between countries can be measured by the current account (which is equal, but opposite in sign, to private plus official capital flows), it can be argued that the current account is a determinant of the exchange rate. The papers by Goodfriend, Henderson, and Shafer incorporate wealth effects and, consequently, provide a role for the current account in the determination of the exchange rate. The papers by Keran, Rogoff, and Wallich and Gray do not. The conclusions of these papers are discussed in greater detail in section II.3.

In discussing asset preferences, narrowly defined money is often distinguished from other assets because its nominal rate of return is fixed, usually at zero. The demand for money arises, not because it pays an explicit yield like interest bearing bonds, but because it pays a non-pecuniary return in the form of transactions services. It is generally assumed that different monies (e.g. dollars and deutsche marks) are not perfect substitutes in fulfilling the transactions demand for money -- that the citizens of a country prefer to hold their transactions balances in domestic money. The importance of this assumption is underscored by Wallace [40] in his paper on foreign exchange markets. Wallace argues that if currencies are regarded by asset holders as perfect substitutes, rather than as imperfect substitutes, then price levels and exchange rates will be indeterminate in the absence of government intervention.[3/] His analysis highlights the fact that the usual assumption of imperfect substitutibility of monies is essential in obtaining a unique equilibrium in most general equilibrium models of exchange rate determination.

II.2 The Supply of Assets

Asset supplies, in contrast to demands, are generally treated as exogenous or as governed by ad hoc policy reaction functions. The menu of assets incorporated into the bulk of the existing literature on exchange rate determination is limited in number to four: domestic currency, domestic bonds, foreign currency, and foreign bonds. All of these assets are assumed to be liabilities of either the domestic government or a foreign government; private debt is generally excluded from consideration on the grounds that it nets out within the private sector. The supplies of currencies are treated as exogenous in some models and as endogenous in others. Cheng [10], Goodfriend [13], and Henderson [15], for example, assume that money supplies and their rates of growth are exogenously set by the relevant monetary authorities. Canzoneri [9] and Wallich and Gray [41], on the other hand, specify reaction functions for the monetary authorities that determine the supply of domestic currency. These reaction functions require the money supply to respond to deviations of economic variables such as output and prices from their target levels. Thus, in these models, the money supply is linked to other variables and is, in this sense, endogenous.

In those models that explicitly treat them, bond supplies are automatically determined by the decisions of central banks regarding monetary policy and intervention. The changes in a country's outstanding supply of bonds mirrors the changes in its money supply brought about through open market operations, and the changes in its holdings of foreign

assets brought about through sterilized intervention. Fluctuations in government deficits are generally ignored.

An analytical framework that included markets for all four assets -- domestic currency, foreign currency, domestic bonds, and foreign bonds -- as well as a goods market or markets, would be an extremely cumbersome framework, particularly if the dynamic behavior of the system is to be studied. For this reason, most theoretical economists resort to simplifying assumptions that allow them to drop one or more of these asset markets. In the following section we discuss various examples of simplifying assumptions about asset demands and supplies, the kinds of models these assumptions produce, and the conclusions they generate.

II.3. Models of Exchange Rate Determination

The models of exchange rate determination discussed in this section are divided into two groups. The first includes what are frequently referred to as "monetary" models and the second is composed of "portfolio balance" models. The monetary models focus on money market equilibrium in one or more countries in determining the current exchange rate. Where bond markets are explicitly considered, domestic and foreign bonds are assumed to be perfect substitutes. In the monetary models studied by System economists, it is also true that wealth effects--on both the demand for money and the demand for goods--are ignored. These models are analytically convenient and offer good mileage at a low cost on a number issues. But, as indicated in earlier sections, the assumption of perfect substitutibility of interest bearing assets, and the absence of

wealth effects, rules out the use of these models in examining some questions.

In contrast, portfolio balance models assume that domestic and foreign assets are imperfect substitutes. They also allow for wealth effects in the money and/or goods markets. These models can be used to address issues that the monetary models cannot. It is, in principle, possible to distinguish the effects of intervention policy and monetary policy in such models. The response of relative yields to exogenous shocks can be studied. And the role of the current account in exchange rate determination can be explicitly modeled. The cost of this additional analytical scope is, as always, greater analytical inconvenience. Rather than build excessively cumbersome machinary to examine particular issues, most authors choose to simplify their analysis by considering only one foreign and one domestic asset. Henderson [15] and Goodfriend [13], for example, assume that the only assets available to economic agents are domestic and foreign money. No interest bearing assets appear in their models. Shafer [37], on the other hand, includes both domestic and foreign bonds in his model, but no monies. The paper by Hernandez-Cata et al [16], an exception to this rule, reports on simulations with the Federal Reserve Board's multi-country model, which contains markets for both money and bonds in five different countries.

The major distinguishing features of the two classes of models we discuss are, then, the substitutibility of domestic and foreign assets,[4/] and the presence of wealth effects. Thus, Henderson's model, for example, is classified as a portfolio balance model rather than a monetary model even though the only assets that actually appear in his

framework are monies. With this discussion as background, we turn now to a more detailed examination of individual models of exchange rate determination.

A. Monetary models

The monetary models reviewed below are representative of the more traditional monetary models in which expectations do not play an explicit role. System economists have also contributed to the rapidly growing body of research on rational expectations monetary models. The papers by Canzoneri [9], Rogoff [36], and Wallich and Gray [41] fall into this category. The discussions of these papers are contained in sections II.1 and III.2., and are not repeated in the present section.

In his paper, Cheng [10] uses a simple monetary model to explore the impact of various exogenous shocks on the domestic price level of a small country under the extreme assumptions of a strictly fixed and a fully flexible exchange rate. Cheng's analysis shows that if the monetary authority's objective is solely the minimization of domestic inflation, an asymmetric exchange rate rule is indicated: float when the national currency tends to appreciate, and peg when it tends to depreciate, provided that pegging is accompanied by appropriate adjustment policies. The intuitive rationale for this rule lies in the relationship between exchange market (or, equivalently, money market) pressure and changes in the domestic price level. As in all monetary models, money market equilibrium is the focal point of the analysis. An excess demand for domestic currency must resolve itself in an exchange rate appreciation when the exchange rate is floating, or reserve accumulation (resulting in an increased domestic money supply) when the exchange rate is fixed. Since the domestic price

level is positively related to the domestic money supply, appreciation is clearly the least inflationary alternative. Similary, a fixed exchange rate and reserve decumulation (resulting in a money supply decrease), is less inflationary than an exchange rate depreciation in the face of an excess supply of domestic currency. In the empirical sections of the paper Cheng examines the exchange rate and inflation experiences of four Pacific Basin countries (Japan, the Philippines, Korea, and Taiwan) and finds that they are generally consistent with the implications of his theoretical analysis.

Keran [22,23] focuses directly on the implications of monetary models for exchange rate determination. His theoretical building blocks are purchasing power parity and the quantity equation relating money supply to output and prices. The resulting framework indicates that relative rates of growth of money supplies play an important role in determining rates of exchange among currencies. In his two papers, Keran conducts closely related tests of the hypothesis that the bilateral exchange rates of the dollar against the currencies of various major countries are determined by the relative rates of change of money supplies in the two countries, adjusted for real growth. The effect of relative money supply growth rates on the exchange rate is found to be statistically significant. However, only a relatively small proportion (varying from 14 to 35 per cent) of the total variability of the exchange rate is explained in these tests.

Humphrey and Lawler [21] have provided still another monetary model of exchange rate determination. They build a model that incorporates demand functions for money and the assumption that interest bearing assets

denominated in different currencies are perfect substitutes. Hence nominal interest rate differentials are identified with differences in expected exchange rate changes. Purchasing power parity (that is, the assumption that the relative purchasing power of different currencies remains unchanged) is employed to tie relative demands for money to the exchange rate and to equate expected exchange rate changes and expected inflation differentials. From these elements they derive a reduced form equation that relates the exchange rate to relative money supplies, relative real incomes, and relative nominal interest rates. They show estimated equations for the dollar/U.K. pound exchange rate and the dollar/Italien lira exchange rate for the period 1973I to 1976II. The equations fit reasonably well -- R-squared is .87 in both cases -- and coeficients have the predicted signs -- the value of a currency is negatively related to a country's money supply and nominal interest rate, and positively related to its real income. They note that the equation did not provide goods results for the Canadian dollar, Japanese yen, or German mark.

The monetary approach to exchange rate determination is also reflected in the papers by Resler [35] and Mudd [33]. Resler's paper is concerned with the Federal Reserve's late 1978 efforts to increase the demand for dollars in the foreign exchange market by increasing Eurodollar borrowings by U.S. banks. He maintains that the increased reserve requirements on large CDs which were implemented at that time, in conjunction with the elimination of reserve requirements on Eurodollar borrowing, did, indeed, lead to a significant increase in Eurodollar borrowing by U.S. banks in late 1978 and 1979. He goes on to point out, however, that increases in Eurodollar borrowing need not, and in this

case probably did not, represent increases in demand for U.S. dollars and hence did not generate a consequent rise in the foreign exchange value of the dollar. In fact, the opposite may have occured. The private banking sector may have simply substituted Eurodollar borrowings for issuing large domestic CDs, while nonbanks switched from domestic bank liabilities to Eurodollar liabilities. To the extent that this round trip flow of dollars occurred, there would have been no net effect on the demand for U.S. dollars and therefore no direct demand-induced effect on the exchange value of the dollar. Furthermore, the switch from large CDs, which carried an eight per cent reserve requirement, to Eurodollars, which carried no reserve requirement, would have freed reserves. Resler argues, then, that the switch from large CDs to Eurodollars may have led to an increase in the U.S. money supply and thereby depressed the dollar's foreign exchange value relative to what it otherwise would have been. Thus, the measures that were undertaken to stimulate increased Eurodollar borrowing in 1978 may have led to a weaker, rather than stronger, U.S. dollar.

In his paper on interest rates and the exchange value of the dollar, Mudd argues that rising U.S. interest rates need not imply an appreciating, or stronger, dollar. He points out that interest rates and the exchange rate are both affected by monetary policy. In the short run, a decrease in the rate of growth of money will produce a rise in the domestic nominal rate of interest and an appreciation of the exchange rate. In the long run, however, as the expected rate of inflation adjusts downward, the nominal interest rate will fall and the exchange rate will continue to appreciate. Thus, rising U.S. interest rates are not necessarily associated with a stronger dollar. Mudd goes on to observe

that the hypothesis of a positive correlation between U.S. interest rates and the foreign exchange value of the dollar is not supported by actual experience in the period immediately prior to the writing of his paper.

B. Portfolio balance models

This section is divided into two parts. In the first, we review three papers -- Henderson [15], Goodfriend [13], and Shafer [37] -- which develop and analyze theoretical models of exchange rate determination. As mentioned earlier, these models assume that non-money interest bearing assets denominated in different currencies are imperfect substitutes. They also allow wealth to affect the demand for assets or goods or both. As a consequence, the current account plays a role in exchange rate determination. The second part of the section contains a discussion of the econometric model results reported by Haas and Alexander [14], Hernandez-Cata et al [16], Hooper and Morton [20], and Bazdarich [4].

Theoretical models

Henderson and Goodfriend both choose to analyze models in which the menu of assets available to domestic residents is limited to domestic and foreign money. As Henderson points out, such a framework is equivalent to one in which there are also domestic and foreign interest bearing assets, but monetary policy is committed to pegging nominal interest rates at home and abroad. Both papers concentrate on the process of international adjustment under flexible exchange rates, with emphasis on the role of the trade account in determining exchange rates. Goodfriend employs an informal analysis to highlight a number of aspects of exchange rate determination. The analysis is based on a more technical treatment of the subject contained in his dissertation.[5/] In his paper, Henderson

develops a comprehensive structural model with which he illustrates and then synthesizes two currently competing views of exchange rate determination.

Goodfriend begins by describing the interaction of the goods and money markets that determines the equilibrium exchange rate when domestic residents hold assets in the form of both domestic and foreign currency. The exchange rate is assumed to affect the excess demand for domestic goods -- and, therefore, the trade account -- through its impact on the terms of trade. Holding other variables constant, a rise in the exchange rate (a depreciation of the home currency) raises the relative price of foreign goods, creating an increase in the excess demand for home goods and a rise in the trade surplus. The impact of the exchange rate on the money market is limited to its "valuation" effect, since Goodfriend does not take into account the effect of expected exchange rate changes on the demand for money.[6/] The valuation effect of a rise in the exchange rate results from the consequent rise in the domestic currency value of foreign money relative to the domestic money. Such a rise generates an increase in the excess demand for domestic currency. The short run equilibrium exchange rate is the rate which eliminates the excess demand for money. In the short run, this rate may not equate the domestic demand for goods with domestic supply. If it does not the resulting trade account deficit or surplus will generate wealth transfers that drive the system to its full, long-run equilibrium. Suppose, for instance, that the current exchange rate equilibrates the money market but is associated with a trade account deficit. The trade account deficit would generate a transfer of wealth (money) from domestic residents to foreign residents. This transfer would

reduce spending at home, since spending is assumed to be positively related to wealth, and raise it abroad, and would thereby reduce the deficit. The transfer would also lower the demand for domestic currency relative to foreign currency since the residents of each country are assumed to have a preference for their own currency. This, in turn, leads to a depreciation of the home currency. This process continues until long-run equilibrium -- a zero trade account balance and money market equilibrium -- is reached. This example serves to illustrate the nature of the direct role the current account plays in exchange rate determination. This direct role of the current account depends on the existence of wealth effects in goods markets or money markets or both, and is almost always a feature of portfolio balance models of the sort reviewed in this section.[7/]

Henderson develops three models of exchange rate determination that are designed to illustrate the two most commonly cited impediments to achieving long-run equilibrium instantaneously -- wealth effects and slow price adjustment. In each of these models he explores the effects of exchange market intervention, defined to be the exchange of domestic money for foreign money by the monetary authorities. His first model is intended to be representative of the class of portfolio balance models. Wages and prices are assumed to be fully flexible, so that output is always equal to its full-employment level. But wealth enters both the demand for money and the demand for goods functions. Unlike Goodfriend, Henderson explicitly incorporates endogenous exchange rate expectations into his analysis; the expected change in the exchange rate is assumed to be proportional to the deviation of the actual exchange rate from its long-run equilibrium value. As discussed earlier, however, this specification of expectations is not

necessarily rational. Henderson's first model, then, is closely related to the model implicit in Goodfriend's paper, and assigns a similar role to the current account.

His second model is intended to be representative of the class of monetary models. Wealth effects in the goods and money markets are eliminated, but wages and prices are assumed to adjust slowly to the excess of aggregate demand (which determines actual output) over full employment output. In the short run, then, output may not equal its full employment level. This framework is essentially identical to the one constructed by Dornbusch (referenced earlier).

Henderson's third framework is a synthesis of the first two; it includes both wealth effects and slow price adjustment.

The three models are used to demonstrate that robust conclusions can be drawn about the effects of intervention policy. Suppose, for example, that the monetary authorities undertake a purchase of foreign currency with domestic currency (the domestic money supply increases). In all three models, the home currency depreciates and nominal income rises in the home country. The price of the home good rises if it is flexible. Output rises in the home country if the price of the home good adjusts slowly when the demand for the home good exceeds full-employment supply. However, the adjustment of the exchange rate, prices, and output may not be monotonic following a shock in the last model, as they are in the first two models. In the synthesis framework the exchange rate may move away from its new long-run value for a period of time following a shock to asset supplies. This kind of result is also characteristic of higher order rational expectations models of exchange rate determination,

as discussed above in section II.1. An example of such a model is provided by Shafer [37], to which we turn next.

Shafer employs a model that is specifically designed to explore the behavior of an international financial system in which the correction of current account imbalances is left exclusively to exchange rate changes. In particular, the current account is assumed to adjust gradually in response to deviations of the real exchange rate from its equilibrium level. The analysis focuses on real magnitudes by pushing nominal magnitudes such as money supplies, price levels, and nominal rates of interest into the background. Real interest rates and real incomes are assumed to follow predetermined paths. (It may be assumed that monetary and fiscal policy are assigned exclusively to the control of these two real variables.) The analysis concentrates on the endogenous determination of, and interaction among, the current account, expected real exchange rate changes, and the demands for interest-bearing assets denominated in different currencies. Perfect foresight with regard to the exchange rate is assumed, except at the instant a disburbance occurs.

Disturbances in the model generate initial changes in the exchange rate that parallel results from other models. The subsequent adjustments have distinctive characteristics, however. Although the model has a stable saddle point solution for reasonable parameter values, the movement back to equilibrium is a protracted one involving cycles in the exchange rate and the current account. Following some disturbances the exchange rate may continue to move away from its long-run equilibrium level after its initial jump. Thus the model suggests conditions under which exclusive reliance on the exchange rate for external adjustment in the

belief that such a policy will result in a fairly rapid restoration of equilibrium may be unwarrented, even when exchange rate expectations are rational. The structure of the model allows, in principle, for an examination of the impact of sterilized intervention (changes in official net-foreign-asset positions) on adjustment dynamics. The implications of the model for such an analysis are, however, not explored. Another issue concerning reliance on exchange rates for adjustment -- the vicious and virtuous circles debate -- cannot be addressed using Shafer's framework, since only real variables enter his analysis.

Econometric model results

The three models of exchange rate determination discussed above illustrate the kind of simplifying assumptions that are necessary if one is to conduct an analytical study of the process of exchange rate determination. An alternative approach to the study of exchange rate determination -- econometric modelling -- is provided by Hernandez-Cata et al, Haas and Alexander, and Hooper and Morton.

The paper by Hernandez-Cata et al reports on several sets of simulation experiments carried out with the Federal Reserve Board's multi-country model (MCM); two of these sets of simulations are described below. The MCM is a system of linked national macro-economic models, at the center of which is a medium sized model of the U.S. economy. Linked to it, and to each other, are models for Canada, West Germany, Japan, the United Kingdom, and an abbreviated model representing the rest of the world. Each national model includes equilibrium conditions for the goods market, the money market and the balance of payments. Although national bond markets are not treated explicitly (by application of Walras' Law),

capital flow equations are estimated as components of the balance of payments for each country. Net capital flows in each period are assumed equal to net stock excess demands for assets during the period; that is, complete adjustment to stock disequilibrium is assumed to occur within a period. The specification of stock demands is consistent with that of the portfolio balance models discussed earlier. Assets denominated in different currencies are imperfect substitutes and, accordingly, private sector portfolio preferences depend on exchange-rate-adjusted relative yields. Finally, exchange rates are endogenously determined.

One set of simulation experiments described in the paper involves contractionary monetary policies in the United States, Japan, and Germany. The results of these simulations are generally consistent with the implications of the theoretical models reviewed in earlier sections. A country that undertakes a contractionary monetary policy experiences a temporary fall in output and a permanent decrease in its price level. It's exchange rate appreciates rather dramatically. Interest rates rise initially, but peak quickly and then begin to fall. The trade balance improves over the short run, presumably because income effects dominate terms of trade effects in these models.

Another set of exercises compares the effects on domestic variables of a contractionary open market operation in the United States in linked and unlinked versions of the U.S. model. The unlinked version of the U.S. model holds bilateral exchange rates and foreign variables such as incomes and interest rates fixed. The linked version is the full MCM with exchange rates determined within the model. A contractionary monetary policy has a larger negative impact on output and the price level in the

linked version of the U.S. model than in the unlinked version. The positive impact on the trade balance and the initial jump in the exchange rate associated with a contractionary monetary policy are smaller in the linked model than in the unlinked model. These differences between linked and unlinked simulations are attributable both to exchange rate changes, which are endogenous in the MCM, and to feedback effects from the linked foreign economies. It is not possible to isolate the effects of exchange rate flexibility in these simulations.

Hooper and Morton develop a single equation to explain and predict a weighted-average foreign currency value of the U.S. dollar, in contrast to the large model used by Hernandez-Cata, et al. They develop a theoretical basis for the equation they estimate that includes elements of both monetary models and portfolio balance models. Money demand functions imply an equilibrium or long-run relationship between relative price levels in the United States and abroad, on the one hand, and money supplies, inflation rates (measured by long-term interest rates) and potential real outputs, on the other hand. The equilibrium relative price level derived in this way is one of two factors defining an equilibrium exchange rate. The other factor is the equilibrium terms of trade. Taking the equilibrium terms of trade as given for the moment, Hooper and Morton determine the current exchange rate by assuming uncovered interest parity (equality between the short-term interest rate differential and the expected rate of change in the exchange rate) and by assuming that the actual exchange rate is expected to converge to its equilibrium value at a constant rate. To this point the model is monetary.

However, unlike monetary models, the equilibrium terms of trade in the Hooper and Morton model are assumed to be determined by the long-run willingness of residents of the United States to accumulate non-monetary claims on other countries or vice versa. Thus, an aspect of portfolio balance models appears. Permanent shifts in exogenous variables influencing the current account require offsetting changes in the equilibrium terms of trade and hence in both the equilibrium and the current exchange rate. Hooper and Morton assume that market participants gauge permanent shifts of exogenous influences on the current account by cumulative deviations of either the actual U.S. current account or the actual U.S. trade balance from their historical average values. Thus the principal mechanism through which the authors see the current account affecting the exchange rate is through expectations rather than through contemporaneous changes in portfolio balance.

The authors recognize, however, that if market participants care, or expect others to care, about the size of their claims on foreigners in the long run, they should also care, or expect others to care, in the short run. Thus a risk premium ought to be observed that is sensitive to changes in net asset positions. Deviations from uncovered interest parity ought to occur that are correlated with changes in the net foreign asset position of the private residents of a country (the negative of the sum of the current account balance and official exchange market purchases of the currency). Hooper and Morton find no evidence of such a risk premium, however.

The expectations mechanisms assumed by Hooper and Morton for the equilibrium terms of trade and for the adjustment of the current exchange rate to the equilibrium rate could be consistent with rational

expectations. However, the authors do not test the constraints on parameter values that are implied by rational expectations.

The authors present the results of fitting several variants of their equation to monthly and quarterly data covering the period from July, 1973, to December, 1978. The ordinary least squares estimator is used. The equations generally explain 80 to 90 percent of the variance of the logarithm of the weighted-average dollar over this period. However, serial correlation of residuals is high for the monthly equations, suggesting that the goodness of fit of these equations may be overstated.

The empirical results can be used to attribute the exchange rate changes that occurred during the sample period to various sources. Hooper and Morton note that over this period the average absolute quarterly change in the weighted average dollar was 2.7 percent. Of this, only 0.3 percent was attributable to anticipated changes. Unanticipated monetary disturbances generated average exchange rate changes of 1.9 percent, deviations of the current account from its expected level generated average exchange rate changes of 1.6 percent, and unanticipated short-term interest rate changes generated average exchange rate changes of 1.3 percent. (Some of these changes were offsetting.) Thus each of the unanticipated factors was a much more important influence on the exchange rate than anticipated changes.

Haas and Alexander develop and estimate a quarterly model in which short-term international capital flows for Canada and the spot and forward exchange value of the Canadian dollar are jointly determined. The model is in the spirit of the theoretical portfolio balance models discussed earlier. Short-term capital flows are assumed to reflect

adjustment of actual to desired holdings of net short-term foreign assets. Other variables in the system are domestic and foreign interest rates, domestic and foreign wealth, and official Canadian intervention. The equations are estimated using the two-stage-least-squares estimator with a set of exogenous variables drawn from the exogenous variables of the RDX2 model of the Canadian economy. The sample period covers all of the first and the early part of the second period since World War II during which the Canadian dollar was permitted to float: 1953 to 1969 and 1971 to 1975.

The estimation results, using a continuous time estimation technique, suggest that most of the adjustment of the actual share of foreign liabilities in Canadian portfolios to the desired share occurs within one quarter. This result supports the appropriateness of the asset market view of exchange rate determination that underlies the theoretical work reviewed above.

The estimated equations indicate that the direct effect of an exogenous increase of U.S. $100 million in the desired net short-term foreign liability position would induce an initial appreciation of the Canadian dollar against the U.S. dollar of .11 U.S. cents. A one percent change in the interest rate differential, allowing for the induced effect on the forward exchange rate, would lead to a one-time capital flow of slightly more than U.S. $400 million. When the equations are imbedded in the RDX2 model to allow for feedbacks through other variables, these effects are cut roughly in half.

The Haas and Alexander paper serves to illustrate two difficulties that arise in attempts to implement empirically the theoretical models discussed earlier. The first difficulty arises from the

intrinsic unobservability of expected future exchange rates. The authors deal with this problem by generating a forecast of the future exchange rate using an equation that relates next period's exchange rate to current and past values of the exchange rate and other variables. Such an approach is related to the rational expectations view of exchange market expectations, but Haas and Alexander do not impose all of the constraints that this view implies.

The second problem arises because of the scarcity of data on the domestic and foreign currency positions of the private sector. The portfolio balance theories discussed above all assume that what is crucial for exchange rate determination is the demand and supply of assets denominated in different currencies. The usual balance of payments data sources do not consistently provide such information. What they do provide is information on changes in foreigners' holdings of domestic assets and liabilities and domestic residents' holdings of foreign assets and liabilities, with little or no information on the currencies of denomination involved. Empirical work typically makes use of balance of payments data by assuming either that a net foreign asset position can be assumed to be denominated entirely in either the domestic currency, in one foreign currency (as in Haas and Alexander), or in a fixed basket of foreign currencies.

None of the models reviewed thus far have explicitly explored the possibility that a permanent change in a variable such as output may have a different effect on asset demands -- and, therefore, the exchange rate -- than a cyclical change in the same variable. Bazdarich [4] focuses on this issue in his analysis of U.S. experience during the 1975-78 expansion.

During this period, strong output growth in the United States was accompanied, on average, by a depreciating dollar. Bazdarich questions the implied proposition, popular at the time, that strong economic growth would unconditionally lead to a weak currency. He presents a theory of exchange rate determination in which money demand depends on permanent income rather than actual income, and the current account is affected by demand-induced cyclical changes in output but not by permanent changes in output (that is, growth in potential output). Under these assumptions, a demand-induced cyclical expansion of output such as occurred in 1975-78 will lead to a depreciation of the dollar. However, growth in potential output, holding money supply growth constant, will lead to an appreciating currency. Thus, growth, per se need not be associated with a weak currency.

Bazdarich presents some regressions to support the hypothesis that changes in potential output and cyclical fluctuations in output have different effects on GNP and net exports and its components. The direct effects of these variables on the exchange value of the dollar are also measured. On the basis of the evidence presented, it is concluded that the distinction between fluctuations in potential output and demand-induced cyclical fluctuations in output is important in the determination of exchange rates.

III. The Implications of Floating Exchange Rates

This section reviews work done by System economists on the direct influence of exchange rate flexibility on important economic variables and relationships. The papers are divided into two groups: those which address partial equilibrium issues and those which address general equilibrium issues. This classification should be regarded more as one of convenience than strict description since, for some papers, assignment to either category would be plausible. We will comment on these two groups of papers in turn, providing, where possible, a discussion of the relationship between particular results and the general equilibrium view of exchange rate determination provided in section II.

III.1. Partial Equilibrium Issues

As the papers and discussion of section II make abundantly clear, exchange rates are endogenous. They, and other endogenous variables such as outputs, price levels, interest rates, and trade flows, are simulataneously determined. Changes in these endogenous variables are caused by changes in the exogenous components of variables such as the supplies of financial assets and the supplies of natural resources. In view of the general equilibrium nature of exchange rate determination, exchange rate changes cannot be regarded as independent causes of changes in prices, interest rates, or trade and capital flows, or vice versa. Nonetheless, a number of partial equilibrium studies of the effects of exchange rate changes on a variety of economic variables and relationships have been conducted as part of the effort to evaluate the implications of exchange rate flexibility. Such work contributes to our understanding of

the (more or less) direct effects of exchange rate changes on other economic variables, as well as providing important building blocks for the general equilibrium view of exchange rates emphasized in section II. Research on this topic by System economists includes work on the effects of exchange rate flexibility on prices, trade and current account flows, and the independence of national monetary policies.

A. The effects on prices

The research reviewed in this section is concerned with estimating the impact of exchange rate changes on both export prices and the general price level. The papers dealing with export price determination are those by Brusca [7,8] and Bernauer [5]. As Brusca points out, the responsiveness of export prices to exchange rate changes has implications for the process of adjustment following an appreciation or depreciation. In particular, the effectiveness of exchange rate changes in correcting trade imbalances depends, in part, on the tendency of domestic producers not to fully offset the effect of exchange rate changes on their prices measured in foreign currency by altering their prices in terms of domestic currency.

In his two papers, Brusca estimates several equations to explain U.S. export prices for the period 1973-78. Each model includes as explanatory variables a measure of the price of domestic output and a measure of the exchange rate. His results may be summarized by the following observations: First, the choice of a measure of domestic output prices makes a significant difference for the estimated response of export prices to the exchange rate. Second, an exchange rate change has an immediate impact effect on export prices, followed by a second distinct

effect approximately four quarters later. Each of these points is discussed in greater detail below.[8/]

Brusca experiments with two different measures of domestic output prices: manufactures wholesale prices and the non-farm GNP deflator. The first contains a higher proportion of traded goods prices than the second and, accordingly, is more heavily influenced by exchange rate changes. Because of this, regressions of export prices on the wholesale price index and the exchange rate give a lower estimated response of export prices to the exchange rate than regressions of export prices on the GNP deflator and the exchange rate. The wholesale price index picks up some of the effects attributable to the exchange rate. The GNP deflator, which contains a higher proportion of non-traded goods prices, is less susceptible to this problem. The estimated elasticity of export prices with respect to the exchange rate lies between .14 and .32 for all sample periods when the wholesale price index is used to measure domestic output prices. The elasticity lies between .33 and .57 when the GNP deflator is used. The higher elasticity may, on the basis of the preceeding discussion, be regarded as a more appropriate measure of the impact of exchange rate changes on export prices.

In estimating the impact of real exchange rate changes on export prices, Brusca employs a third degree polynominal lag structure. This leads to a pattern of weights, or adjustment elasticities, that shows an initial impact on export prices that subsides and is then followed by a second effect that peaks approximately four quarters later. Brusca offers two explanations for this pattern of weights, which he claims to be very robust to changes in the specification of his regression equation. First,

the pattern may reflect the fact that pass-through occurs at different speeds for goods exported with different production lags. Second, there may be an impact mark-up effect followed by a series of input-output cost effects transmitted from other sectors of the economy with a lag.

The results reported by Bernauer on the effects of exchange rate changes on Canada's export prices differ from those reported by Brusca for for the United States. Bernauer estimates a value of .86 for the elasticity over the period 1970-77, which is much higher than Brusca's estimates. A higher value is consistent with Canada's smaller size and the composition of her exports, which are largely primary products that must compete in world markets with virtually identical products from other countries. On the other hand, Bernauer's estimated elasticity is not significantly different from zero, so that the hypothesis that exchange rate changes have no effect on export prices cannot be rejected for Canada. Bernauer's paper, which also includes estimates of the impact of exchange rate changes on export volume and import volume and prices, is discussed further in the next section.

The second group of papers reviewed in this section are concerned with the implications of exchange rate changes for the general level of prices in the United States. The paper by Hooper and Lowrey [19], which contains a survey of recent literature on this topic, provides the organizational structure for our discussion. The other papers included in this section are those by Hooper [17] and Prakken [34].

Hooper and Lowrey begin by categorizing the various models that have been used in the estimation of the impact of exchange rate changes on domestic prices. The models are divided into two groups, partial

equilibrium and general equilibrium. The partial equilibrium models are, in turn, of three types:

--Single price equations in which the domestic price level is expressed as a function of labor costs, domestic materials costs, demand pressure, and import prices or foreign prices adjusted for exchange rates.

--Input-output models that involve an analysis of accounting, rather than behavioral, relationships.

--Structural models that attempt to take account of the endogenous behavior of the determinents of domestic prices other than exchange rates. These models sometimes take explicit account of the reaction functions of the fiscal and monetary authorities.

A characteristic of all the partial equilibrium models is that the exchange rate is assumed to be exogenous. This shortcoming is not present in the general equilibrium models Hooper and Lowrey discuss. In these models the exchange rate is viewed as responding to various exogenous shocks which may have independent effects on domestic prices. These models also capture some of the feedback from domestic prices and other variables to the exchange rate itself.

In addition to providing a summary of recent efforts to measure the impact of changes in exchange rates on U.S. domestic prices, Hooper and Lowrey illustrate how measures of the responsiveness of domestic prices to exchange rate changes depend on (i) the measure of the dollar's average foreign exchange value employed, (ii) the assumed impact of exchange rate changes on oil prices, and (iii) the macroeconomic policy reaction to the depreciation. They provide a consensus estimate of this responsiveness, as well as standardize and report the results of a number of individual

studies. The estimated elasticity of consumer prices with respect to the exchange rate ranges from a low of .11 to a high of .27 in the individual studies. The consensus estimate given by Hooper and Lowrey is .18 under the assumption that oil import prices change in the same proportion as non-oil prices in response to an exchange rate change, and .15 under the assumption that they do not respond at all. About half the total impact may be expected to take place within a year and the remainder within two to three years.

In concluding their paper, the authors make two important points: The results of the partial equilibrium models provide a measure of the domestic price effects of real exchange rate changes only. Further, this effect is measured under the assumption that the exchange rate could have been held constant without changing other variables that would have affected domestic prices -- probably an unrealistic assumption.

In a separate paper, Hooper [17] presents estimates of the impact of exchange rate changes on the U.S. price level using both the MPS model and the Board's Multi-Country Model. These estimates differ noticeably from those reported by Hooper and Lowrey for the MPS and MCM. The reasons for the differences are instructive since they illustrate the kinds of choices that must be made in carrying out an estimation exercise of this sort. The results attributed to the MPS model in the two papers highlight these choices. The two MPS estimates of the elasticity of the U.S. price level with respect to the exchange rate are .1 (Hooper) and from .12 to .17 (Hooper and Lowrey) under the assumption that oil prices do not respond to exchange rate changes. The source of the discrepancy is the difference in assumptions made regarding the response of the monetary authorities to the

effects of an exchange rate change. The larger elasticity is a result of assuming a more accommodating monetary policy. The greater the commitment of monetary policy to moderating interest rate fluctuations by validating the price changes initiated by exchange rate changes, the larger will be the response of the price level to exchange rate changes.

A comparison of the results reported for the MCM is also useful. Hooper finds an elasticity of the U.S. price level with respect to the exchange rate of .22 using the U.S. sector of the MCM. Hooper and Lowrey report an elasticity of between .08 and .15 for the full MCM. The difference may be attributed to two factors. First, using the U.S. sector of the MCM alone eliminates the foreign feedback effects that are captured in the full MCM. These feedback effects tend to reduce the price effects of an exchange rate change in the MCM. Accordingly, a lower elasticity may be expected for the full MCM than for the U.S. sector alone. Second, when the U.S. sector alone is used to estimate the impact of an exchange rate change, the exchange rate is treated as an exogenous variable. Consequently, it is possible to consider the effects of an exogenous change in the exchange rate in that model. Such an exercise is meaningless in the full MCM, where exchange rates are endogenous. The analysis of exchange rate changes in the MCM must be made using model simulations in which a change in an exogenous variable results in changes in both the exchange rate and the price level. The measured elasticity of the price level with respect to the exchange rate has, of course, no causal implications under these circumstances. It measures a contemporaneous correlation. Hooper and Lowrey report the estimated elasticities associated with three different exogenous shocks: a tightening of Japanese monetary policy, a

tightening of German fiscal policy, and a shift from dollar to mark denominated assets. The range of the resulting elasticities -- from .08 to .15 -- indicates the importance of taking into account the source of an exchange rate change in assessing its likely impact.

Yet another important aspect of empirical tests of the effect of exchange rate changes is the choice of a measure of "the" exchange rate index. The importance of this choice may be illustrated by comparing Prakken's paper on the inflationary impact of an exchange rate depreciation with Hooper and Lowrey's discussion of Prakken's paper. In his paper, Prakken reports an estimated elasticity of the U.S. price level with respect to the exchange rate of .2. In their discussion of Prakken's paper, Hooper and Lowrey report an elasticity of .15. The difference arises because Hooper and Lowrey attempt to standardize the results of all the papers included in their survey in order to facilitate comparison of the results, and the exchange rate index they use for standardization differs from Prakken's. Using their method of standardization, Prakken's results imply an elasticity of .15.

In conducting his tests, Prakken uses an exchange rate index in which the weight applied to each bilateral exchange rate is the share of the associated country in total U.S. trade. That is, the weights are bilateral trade shares. Hooper and Lowrey, by contrast, choose as their standard exchange rate index one in which the weights are multilateral trade shares -- the share of a country in total world trade. For the United States, the bilaterally weighted index gives substantially greater weight to Canada, whose exchange rate has fluctuated less against the dollar than other countries on average. The larger the exchange rate

change that is associated with a given change in the price level, the smaller will be the calculated elasticity of the price level with respect to the exchange rate. Thus, in standardizing Prakken's results, Hooper and Lowrey significantly reduced his measure of this elasticity.

B. The effects on trade and current account flows

Two sets of issues involving the implications of exchange rate flexibility for trade flows have been addressed by research in the System. The first concerns the effects of exchange rate changes, by themselves, on the volumes of various trade components. A knowledge of the size and timing of such effects is essential to an assessment of the role exchange rate changes can and do play in the balance of payments adjustment process. The second concerns the impact of the observed increase in exchange rate volatility since the abandonment of the Bretton Woods system on the aggregate volume of trade. A significant decrease in trade volume could imply a serious social cost associated with exchange rate volatility.

The first set of questions includes the fundamental one of whether a depreciation of the currency will improve the merchandise trade balance and current account balance. Under special conditions the answer to this question can be shown to depend on whether or not the sums of the elasticities of export volume and import volume with respect to an exchange rate change are greater or less than one (the Marshall-Lerner condition). In the very short run these elasticities tend to be low, with their sum less than one, and so the trade balance often worsens immediately following a currency depreciation, reflecting an increased import bill due to higher import prices. Hence the adjustment of the current account balance following a depreciation is often described as following a "J curve".

Studies of the response of the current account balance, or its trade component, to a currency depreciation are often conducted in a partial equilibrium framework where only exchange rates, export and import prices, and trade volumes adjust. In a general equilibrium framework, other variables, such as domestic prices and aggregate demand at home and abroad would be expected to respond to an exogenous exchange rate change and to influence the path of the current account.

Many emirical studies examining the response of the trade balance to exchange rate changes have been undertaken in recent years, both within the System and by economists elsewhere. The preponderance of evidence from these studies suggests that exchange rate changes do have important effects on the current account balance of the United States and other large countries. Here we summarize results from a few of the most recent papers prepared within the System.

Hooper [17] examines the effects of a permanent one percent appreciation of the dollar simulated by models in use at the Board. Partial equilibrium simulations, in which only the exchange rate, trade volumes, and traded goods prices are permitted to change, are presented for trade equations developed by the U.S. International Transactions Section (USIT) and for the trade equations embedded in the Multi-Country Model (MCM).

The USIT equations show a J-curve response with a positive change in the trade balance of $0.3 billion in the quarter in which the appreciation occurs. After four quarters the net effect on the trade balance is negative by $0.8 billion. The full effect after 10 quarters is a $1.7 billion negative effect.

The MCM equations do not give a J-curve as trade volumes are immediately and strongly affected by an exchange rate change. The full effect, reached within 8 quarters, is a negative $1.3 billion. This is smaller than the effect given by the USIT equations. MCM simulations for the full current account show an additional reduction of the balance by $0.3 billion from non-merchandise trade transactions.

Hooper also presents simulations that incorporate indirect effects through U.S. domestic prices and U.S. aggregate demand. The paths of foreign prices and demand are still held fixed, however. For these simulations the USIT equations are imbedded in the MPS model. The USIT-MPS simulations show a slightly larger ($1.9 billion) effect on the trade balance after 10 quarters when U.S. domestic responses are taken into account. The current account in this simulation declines by less than the trade balance, however. The MCM trade balance adjusts more slowly than when domestic U.S. variables are not permitted to change, but the net change after 10 quarters is virtually the same ($1.2 billion). The adjustment of non-trade current account items in the simulation makes a positive rather than negative contribution to the current account in the short run (apparently owing to the influence of interest rates). However, the net contribution of non-trade transactions is zero ten quarters out.

Partial equilibrium equations for Canadian trade volume and prices are presented in Bernauer [5]. These equations show long-run price elasticities of 2.25 for import volume (with a total lag of over 3 years) and 0.6 for export volume (with a total lag of 2 years). Thus, the Marshall-Lerner condition is satisfied in the long run. As noted above, the elasticity of export prices with respect to a change in the Canadian

exchange rate is 0.86, but this estimate is not statistically significantly different from zero after 3 quarters. The elasticity of import prices is near 1.0 after 4 quarters.

These equations, taken together, imply a J-curve of 4-5 quarters following a depreciation of the Canadian dollar, holding constant other variables affecting trade volumes and prices. Thereafter, the effect on the Canadian trade balance is positive. The full positive response occurs with a lag of 4 years.

While there has been a great deal of work on the effects of exchange rate changes on U.S. merchandise trade, less attention has been given to the effects on other current account transactions. Little [27] studies one component of these other transactions for the United States -- international travel. Her estimated equations for bilateral travel flows in the U.S. balance of payments show significant and important relative price effects on travel payments and receipts. This result suggests that exchange rate changes should have a substantial effect on these flows.

The question of the effects of exchange rate variability on trade are addressed by two papers, which come to opposite conclusions. Both papers stress that exchange rate variability is not uniquely related to the choice between a "fixed" exchange rate regime or a "floating" rate regime. Underlying developments at times forced large parity changes in the Bretton Woods exchange rate regime, while exchange rate fluctuations during some parts of the floating exchange rate period have been quite small.

Hooper and Kohlhagen [18] develop a model of exporter and importer behavior in which the effect of increased exchange risk on the price of traded goods depends on whether traded goods prices are set in the

currency of the exporter or the currency of the importer. If prices are set in the currency of the country of import, the associated exchange risk is assumed by the exporter, which reduces the supply of traded goods at any given price and therefore leads to a rise in their equilibrium price. Similarly, if prices are set in the currency of the country of export, the exchange risk is assumed by the importer, which reduces the demand for imports and leads to a fall in their equilibrium price. In either case the volume of trade should be reduced.

The authors test the ability of the model to explain trade prices and volumes for the trade of Germany and the United States with major industrial countries individually and in the aggregate for the period 1965 to 1975. The equations consistently showed significant effects of exchange rate variability on trade prices. The most most successful measure of exchange rate variability employed was the average, over a quarter, of the absolute deviations of weekly observations of the spot rate from the three month forward rate observed three months earlier. In general, an increase in exchange rate variability is associated with a decline in trade prices. An exception is U.S. imports, for which trade prices rise with an increase in exchange rate variability. The authors believe this pattern to be consistent with the findings of several studies that have analyzed the currency denomination of trade contracts; namely, that trade among industrial countries is most often denominated in the exporter's currency, with U.S. imports, which are largely denominated in dollars, being an exception.

The regressions did not support the hypotheses that trade volume would be reduced by exchange rate variability. Only 1 of 16 cases gave a

result that was significant at the 90 percent level, and half of the coefficients on the exchange rate variability measure were positive.

The authors conjecture that the lack of significant trade volume effects reflect low short-run price elasticities of the supply of exports and the demand for imports. They note, however, that longer-run effects, which may be significant with respect to quantity, in particular, cannot be captured using their framework.

Abrams [1] presents the results of two tests that indicate large bilateral trade volume effects from exchange rate variability for OECD countries for the years 1973 - 1976. The first test used pooled cross section and time series observations to predict the sum of bilateral export and import flows. Negative coefficients, significant at the 99 percent level, on two measures of exchange rate variability (variance of percent monthly exchange rate changes during the previous year and variance of these changes about a trend) are found when put in the equation one at a time. The magnitudes suggest substantial reductions in trade volume compared with the predictions of his equations for stable periods under the Bretton Woods system -- 15-20 percent reductions in trade volume for 1973-1976 compared with what would be predicted by the equations if exchange rate variability had been the same as in 1970, when the floating of the Canadian dollar was the only change in the parity structure. On the other hand, relative to the more unstable year 1971, there was virtually no change in predicted trade volume. He does not examine how well his equations match the actual experience of 1970 and 1971, however.

The second test measures the effects of exchange rate variability

on the shortfall of trade volumes from optimal levels of trade. The effects of exchange rate variability emerge as even larger in this test.

The widely differing conclusions of the two papers leave the issue of the effect of exchange rate uncertainty on the volume of trade unresolved. The papers employ very different methologies and use very different sets of data. It would be useful if the Hooper-Kohlhagen work could be extended to trade among more countries and if the fit of the Abrams equations could be tested over a longer time period, especially over the later years of the Bretton Woods system. However the close association between increased exchange rate volatility and other developments, such as oil price increases, more volatile inflation rates, and larger fluctuations in real economic activity may make it impossible to resolve the uncertainties surrounding this important issue. Finally, it should be noted that neither paper addresses the longer-term impact of exchange rate variability on trade volumes, which might be expected to be larger than the effects over a few quarters or a year.

C. The effects on the independence of national monetary policies

Two empirical approaches to the question of the impact of floating exchange rates on the independence of national monetary policies have been pursued by System economists. One approach, adopted by Laney [26], is to attempt to measure the effects of the move from fixed to floating rates on the independence of monetary policy and intervention policy for individual countries. An alternative, pursued by Throop [39], is to examine the degree of dependence of U.S. and foreign interest rates during both fixed rate and floating rate periods. Before turning to the

particulars of these papers, it will prove useful to review briefly the theory relevant to this exercise.

The question of whether monetary policy and intervention policy can be and are pursued independently by central banks has been the focus of a great many of the theoretical and empirical studies of the par value exchange rate period of the 1960's. The empirical work on this question has centered on measuring two relationships between the domestic assets and the net international reserve position of a central bank: an offset coefficient, which measures the degree of potential independence of monetary policy, and a sterilization coefficient, which measures the extent to which a central bank has sought to exercise this independence.

An offset coeficient captures the extent to which changes in the monetary base brought about through open market operations -- including any open market operations undertaken to sterilize the effects of intervention on the monetary base -- are offset by private sector portfolio adjustments when the central bank follows a policy of fixing the exchange rate. Thus it reflects the portfolio behavior of the private sector, especially the degree of substitutability in private portfolios of assets denominated in different currencies.

An offset coeficient of zero would be observed if assets denominated in domestic and foreign currency were not substitutable at all. In this case an expansionary domestic open market operation would lower the domestic interest rate, but this reduction would not induce investors to attempt to switch from assets denominated in domestic currency to assets denominated in foreign currency. There would be no pressure on the

exchange rate, the central bank would not need to intervene, and, hence, there would be no reduction in its net international reserves.

An offset coeficient of minus one would be observed if domestic and foreign currency denominated assets were perfect substitutes. In this case, any tendency for the domestic interest rate to decline would induce investors to sell assets denominated in domestic currency and buy assets denominated in foreign currency. Intervention would have to occur until the change in official reserves matched the increase in domestic assets of the central bank, the monetary base had been reduced to its original level, and the interest rate had returned to its initial level. The central bank would find it impossible to alter the money supply under these circumstances.

To summarize, as domestic and foreign securities become better substitutes, the degree of independence of monetary policy and exchange rate policy diminishes, and the value of the offset coefficient approaches minus one.

A sterilization coefficient captures the extent to which a central bank seeks to pursue an independent monetary policy while maintaining an unchanged exchange rate. It measures central bank efforts to undo the effects of intervention on the monetary base through offsetting open market operations. A sterilization coefficient of zero indicates that the central bank normally takes no domestic action to prevent changes in its net international reserve position from influencing the monetary base. A sterilization coefficient of one indicates that the central bank sterilizes fully and intervention is not permitted to affect the monetary base.

As the preceding discussion indicates, offset coefficients and sterilization coefficients are constructs useful in quantifying the degree of monetary independence available, and actually exercised, under a fixed exchange rate regime. In a situation where exchange rates are neither fixed nor fully flexible, but rather "managed", the interpretation of these coefficients is more complicated. For example, under a managed float, an offset coefficient reflects the degree of substitutibility of assets denominated in different currencies (as it does under fixed rates), but it also reflects the degree to which central banks intervene to stabilize exchange rates and the effects on asset demands of the changes in the exchange rate that do occur.

Laney [26] provides empirical estimates of offset and sterilization coefficients for a number of countries for both the fixed exchange rate period of the late 60's (1964 to 1972) and the managed float period of the 70's (1972 to 1977). He finds that sterilization coefficients were higher in absolute value during the floating rate period than during the fixed rate period for most countries. Offset coefficients were generally less than one in absolute value in both periods. For many countries that floated independently, and for Germany, which remained in the European Snake, the absolute value of the offset coefficient fell after floating began. Other members of the European Snake, however, show an increase in their offset coefficients in the post-float period.

As already indicated, the interpretation of these results is complicated by the shift from fixed rates to a managed float between the two sample periods. Under a managed float, the offset coefficient estimated by Laney is an increasing function of the degree of

substitutibility of bonds denominated in domestic and foreign currencies, a decreasing function of the extent to which the float is "free" rather than "managed", and also a function of exchange rate changes themselves. Hence, the drop in offset coefficients experienced by most independently floating countries in the 70's may reflect an increase in the independence of monetary policy for these countries -- as a result, presumably, of a decrease in the substitutibility of assets denominated in different currencies. But the decline may also simply reflect the move to more flexible exchange rates.

Since the sterilization coefficient is just a parameter of the central bank's reaction function, it is not necessarily dependent on the choice of exchange rate regime. Accordingly, the increase in the estimated sterilization coefficients between the fixed and floating rate periods presumably indicate that central banks chose to exercise more fully the degree of monetary independence available to them.

An alternative approach to the question of the independence of monetary policies under alternative exchange rate regimes is taken in Throop's paper [39]. This study focuses on the extent to which the independence of monetary policies abroad may have been undermined by interest-sensitive capital flows. For the Bretton Woods period, it finds evidence of significant official intervention in the exchange market in response to interest-sensitive capital flows, which was not accompanied by complete sterilization. The result was a partial short-run dependence of foreign money market rates and money supplies on U.S. monetary conditions. This dependence was limited primarily by the existence of exchange rate risk, and secondarily by political risk and default risk. In contrast, for

the period of managed floating the study shows virtually no response of foreign interest rates to U.S. interest rates for most countries in the sample. Instead, a change in the U.S. interest rate generally produced a fully offsetting change in the forward premium on foreign exchange. This result points to greater independence of monetary policy in the managed floating rate period than in the fixed rate period.

III.2. General Equilibrium Issues

In this section we review a group of papers that focus on two sets of general equilibrium issues. They address, in turn, the recent debate over vicious and virtuous circles, and the choice of exchange rate regime for small countries.

A. Vicious circles

The move to floating exchange rates has been accompanied by high inflation and a depreciating currency in some countries, and by low inflation and an appreciating currency in others. These patterns, dubbed vicious and virtuous circles, respectively, have raised the question of the extent to which exchange rate changes contribute to, or cause, inflation. The two papers discussed below examine some of the theoretical and empirical aspects of this question.

Wallich and Gray [41] employ a rational expectations monetary model to explore some selected aspects of the recent debate over vicious and virtuous circles. In contrast to the monetary models discussed in section II.3., however, Wallich and Gray choose to allow for the possibility of an endogenous money supply, a modification that is essential to their view of the vicious circle phenomenon. They define a vicious

circle to be the price level increase and exchange rate depreciation experienced by a country following an exogenous disturbance or a series of disturbances. These changes are measured relative to the benchmark case of a country whose monetary authority does not pursue external or internal stabilization policies of any kind. They then examine the relationship between vicious circles and (i) the extent to which a country is exposed to exogenous shifts in the demands for its currency and its output, (ii) the amount of feedthrough from the exchange rate to nominal wages (through the price index) due to formal or informal indexing arrangements, and (iii) the relative importance assigned by the monetary authority to the competing domestic objectives of price stability and full employment. The authors conclude: first, monetary disturbances (e.g., speculative shifts in currency holdings) are not the most likely initiating causes of vicious or virtuous circles. The circumstances most conducive to a vicious circle, for example, are an exogenous decline in aggregate demand combined with indexed wage contracts and a domestic objective on the part of the monetary authority of stabilizing output. Second, if a government's domestic objective function is asymmetric, it can be legitimately claimed that its choice of domestic objective determines whether it will find itself caught in a vicious or virtuous circle. By an asymmetric objective is meant a greater concern for deviations of a variable from its target value in one direction than in the other. It is reflected in a policy rule that may, for example, neutralize decreases in output below its full employment value, but dictate no response to increases in output. Or it may provide for an offset to increases in the price level (or inflation), but not decreases. Finally, when vicious or virtuous circles result from the

pursuit of asymmetric domestic objective functions in highly indexed economies, vicious circles will tend to be less stable, or more explosive, than virtuous circles.

In a related paper, Laney [25] examines the precipitous 1976 depreciation of the Italian Lira, which is often cited as an example of a vicious circle. The rate of growth of Italian money supply relative to its trading partners increased sharply in mid-1976. With only a one month lag Italy's weighted average exchange rate depreciated dramatically and its import prices accelerated. With only slightly longer lags, wholesale prices, consumer prices, and nominal wages also accelerated. Laney interprets these observations as evidence that domestic monetary policy caused both the exchange rate depreciation and the rise in prices experienced by Italy during this episode. Whether or not this evidence indicates a vicious circle depends on what is meant by a vicious circle. The evidence is clearly inconsistent with the hypothesis that an exogenous change in the lira exchange rate precipitated Italy's 1976 bout of inflation--a hypothesis that reflects one popular view of vicious circles. On the other hand, the evidence is consistent with the behavior of a highly indexed economy in the face of a monetary shock, as analyzed by Wallich and Gray. They argue, however, as does Laney, that such behavior is only tenuously related, if at all, to popular notions of vicious circles.

B. The choice of exchange rate regime for small countries

The shift to floating exchange rates among industrial countries has posed choices for smaller countries concerning the exchange rate policy they should follow. Two System papers consider aspects of these questions.

Siegman [38] considers a broad range of trends and issues concerning developing countries and the international financial system. The third section of the Siegman paper reviews the exchange rate choices and practices of developing countries since the major industrial countries allowed their currencies to float in 1973. Siegman notes that developing countries have been subject to greater variability of their exchange rates since 1973, but this variability is attributable more to underlying factors than to the exchange rate system. Many developing countries have continued to peg to a single currency despite this variability, but an increasing number have shifted to pegging to the SDR or some other basket. Many developing countries have continued to resist using exchange rate changes as an adjustment policy, but the IMF, through its stabilization programs has encouraged greater exchange rate adjustment to good effect.

Maroni [29] focuses on recent Latin American experience with managed exchange rates, especially the experiences of Chile and Argentina. These countries have both experimented with preannounced rates of depreciation for their currencies vis-a-vis the U.S. dollar for up to a year ahead. The preannounced paths have typically been one component of macroeconomic policy packages designed to help achieve certain inflation and real exchange rate goals. The announcement of a particular exchange rate path is intended to moderate inflationary expectations. Subsequent developments, both internal and external, have tended, in some periods, to undercut the desirability of pursuing the announced schedule. For example, the Chilean authorities twice undertook discrete appreciation with respect to the path. The technique of preannouncement establishes an exchange rate regime that corresponds closely to a fixed exchange rate system when

countries have widely divergent inflation rates and fixed nominal exchange rates are not feasible.

IV. Concluding Reflections

This survey has been restricted to research undertaken within the Federal Reserve System, for the most part during 1979. Hence it does not represent the full range of work on topics related to floating exchange rates, either within the System over a longer time period or within the economics profession. Nevertheless, it presents a broad range of theoretical and empirical work that can provide a basis for some general comments on the present state of understanding of a floating exchange rate regime.

We have chosen not to draw conclusions for the conduct of domestic and international monetary policy or for economic policy more generally from the work we have reviewed. Individual authors explicitly or implicitly consider the policy implications of their work in many of the individual papers. However, the papers as a group leave some important economic questions unresolved, either because of gaps in their coverage or because of unresolved differences in their conclusions. We will content ourselves with identifying some of the questions whose resolution seems most important for the evaluation of monetary policy alternatives.

The papers reviewed in this survey reflect the ascendancy of the asset market view in theoretical models of exchange rate determination in recent years and the considerable success of this general class of models in empirical tests. Two general conclusions follow from this body of work. First, exchange rates are endogenous variables in a floating exchange rate regime. It is not appropriate, in general, to consider the effects of exchange rate changes independently of the events that generate them and the effects of these events, working through other channels, on other

economic magnitudes. Second, the behavior of exchange rates is crucially related to domestic monetary policies and the dynamic response of domestic prices and output to monetary policy actions. Over longer periods of time, rather simple relationships may be found between relative levels of money supplies and exchange rates, but in the short run the relationship is more complex and other factors may play a larger role.

The papers suggest two major issues concerning monetary policy in a "managed" floating exchange rate regime:

-- To what extent should domestic monetary policy respond to external variables such as exchange rates or trade balances?

-- To what extent can and should the monetary authorities undertake sterilized intervention to moderate exchange rate movements?

Two types of arguments provide a rationale for a monetary policy that responds to external variables, particularly the exchange rate. The first may be usefully regarded as one concerning the selection of intermediate targets. Given domestic objectives (with respect to levels of output, employment, or inflation), more easily or more immediately observable intermediate targets such as monetary aggregates, interest rates, exchange rates, or trade balances may be used as a guide to monetary policy in the short run. The inclusion of external variables in the menu of intermediate targets may be appropriate if these variables convey information unavailable elsewhere or have an independent effect on the monetary authority's ultimate objectives. For example, a depreciation of the exchange rate in excess of what is expected by policy makers may provide an early signal that policy is more expansionary in its

effects than policy makers had anticipated. Thus it could suggest the need for a more restrictive policy. Alternatively, the depreciation may be viewed as "unjustified" or exogenous. But because of the inflationary impact of a depreciation on domestic prices, policy makers might choose to use monetary policy to attenuate or altogether prevent such a depreciation.

Distinguising exchange rate changes that convey important information about market fundamentals from those that may be viewed as exogenous is not a simple task. Nor are the policy implications of such changes always obvious even when the nature of the change can be identified. These difficulties would be considerably reduced if exchange rate changes could be assessed in the context of a comprehensive general equilibrium framework. In view of the short run nature of many policy issues, the structural aspects of such a model are important. Presently, a sufficiently comprehensive framework does not exist. The work reported in this survey does, however, indicate that we now have some of the individual pieces necessary for the construction of such a framework, as well as some initial success at modelling exchange rate determination in a general equilibrium setting.

The work we have reviewed on the effects of exchange rate changes on domestic prices provides a measure of the inflationary impact of exogenous exchange rate changes. The results reported on the effects of exchange rate changes on the trade balance provide evidence relevant to another structural issue: Are exogenous exchange rate changes self correcting, or will the economic system, in the absence of policy, fail to generate pressures that drive the exchange rate toward its equilibrium value? Finally, the Board's Multi-Country Model represents a successful

first step in the direction of modelling exchange rate determination in a general equilibrium environment characterized by a substantial amount of structural detail.

A second rationale for using monetary policy to prevent or smooth exchange rate changes concerns the costs of exchange rate volatility, per se. Some aspects of this issue have been examined by system economists, as indicated in our survey. However, presently available evidence is limited and appears to generate conflicting conclusions. Further work on the effects of exchange rate volatility on the allocation of resources is needed.

While a case for conditioning monetary policy on the exchange rate or trade balance may be drawn from the preceding discussion, other considerations temper such a conclusion. The relationship between exchange rate or trade balance movements, on the one hand, and movements in inflation rates and output, on the other, depends on the types of disturbances impinging on the economic system, Thus, while a policy of smoothing the exchange rate may prevent shifts in the demand for domestic assets from effecting domestic output and prices, such a policy may actually exacerbate the output effects of certain kinds of real shocks. Calculating the optimal response of monetary policy to exchange rate movements requires, then, knowledge of the relative importance of the different disturbances to which an economic system is exposed, and the joint effect of those disturbances on the exchange rate and other economic variables of interest. Although considerable progress on these questions has been made recently in the context of asset market models of exchange rate determination, a great deal more work is needed.

Finally, the answer to the first of the two major policy questions posed above depends, in part, on the answer to the second. If monetary policy can be conducted independently of intervention policy, then exchange rates can be managed without the use of monetary policy. Intervention of this type is referred to as sterilized intervention. Where sterilized intervention is a viable option, the case for using monetary policy to control exchange rate volatility may be considerably weakened. However, the signaling argument for adjusting monetary policy in response to exchange market pressures would still apply. We turn now to the question of the extent to which the monetary authority can and should undertake sterilized intervention.

Two empirical issues are central to the question of the possibility and desirability of influencing exchange rates through sterilized intervention -- that is, independently of domestic monetary policy. One is the degree of substitutability between non-money assets denominated in different currencies. The other is the formation of expectations of future exchange rates, which play a crucial role in asset market models of exchange rate behavior. A number of the papers included in this survey examine one or the other of these issues, but they do not contain conclusive or even uniform results.

If non-monetary assets are perfect or nearly perfect substitutes, sterilized intervention will not, as a consequence of altering the relative supplies of assets denominated in different currencies, succeed in modifying exchange rates. However, one conjectured source of exchange rate instability -- shifts in demands for non-money assets denominated in different currencies -- will also not exist. We discussed the evidence on

substitutability in the context of research on the presence of risk-premia for different currencies. The evidence to date seems inconclusive.

Issues concerning expectations formation also have potentially important implications for the usefulness of sterilized intervention policy. If expectations are not rational -- that is, if they do not reflect "market fundamentals" or are subject to excessive volatility -- there may exist an additional case for using intervention to moderate fluctuations in exchange rates. Further, in the absence of rational expectations, the answer to question of whether the monetary authority can undertake intervention policies that are independent of monetary policy no longer rests solely on the issue of substitutibility.

The evidence on the rationality of exchange rate expectations is inconclusive, particularly when shorter time periods are considered. Perhaps more importantly, that evidence on exchange rate behavior which suggests a failure of rational expectations in the context of certain models has not been followed by useful alternative models. Among the requirements for such models are satisfying mechamisims for expectations formation, a specification of the interaction between expectations and official intervention behavior, and empirical validity. Until such work is done or stronger empirical evidence for rational expectations is advanced, the effects of alternative intervention strategies, including a strategy of no intervention, cannot be appraised with confidence.

The case for using sterilized intervention, where it is feasible, to moderate exchange rate changes includes some, but not all, of the arguments for using monetary policy for that purpose. To the extent that exchange rate changes provide an early signal of an inappropriate monetary

policy, monetary policy rather than sterilized intervention should respond to the exchange rate changes. On the other had, if "unjustified" exchange rate pressures could be identified with confidence, offsetting them with a policy of sterilized intervention would minimize the effects on domestic variables. More generally, knowledge of the cause of an exchange rate change is necessary to determine not only whether it should be offset, but also how it should be offset. The existence of exchange rate variability per se, then, has no obvious implications for the choice of an instrument if policy makers choose to smooth exchange rate fluctuations. As indicated earlier, however, the existence of exchange rate variability may strengthen the case for a policy of resisting exchange rate changes, regardless of the instrument used, if the variability is associated with economic costs.

Footnotes

1/Dornbusch, Rudiger, "Expectations and Exchange Rate Dynamics," Journal of Political Economy, Vol. 84, No. 6 (December 1976).

2/The covered interest parity condition states that as long as the characteristics of two assets denominated in different currencies are identical except for exchange risk, then the difference in covered rates of return on the two assets must be equal. That is, the interest rates on the two assets must equal the forward discount on one of the currencies relative to the other. The proposition discussed here concerning the equivalence of forward rates and expected future spot rates implies that the expected rate of exchange rate change is equal to the forward discount, which, in turn, is equal to the interest rate differential if covered interest arbitrage holds. Thus, the proposition is equivalent to the proposition that the difference in expected rates of return on uncovered assets denominated in different currencies is zero.

3/These results are developed formally by John Kareken and Neil Wallace in a paper entitled "Samuelson's Consumption-Loan Model with Country-Specific Fiat Monies" (Federal Reserve Bank of Minneapolis, Staff Report 24, July 1978). The interested reader is also referred to their article on "International Monetary Reform: The Feasible Alternatives" (Federal Reserve Bank of Minneapolis, Quarterly Review, Summer 1978).

4/Here we are referring to the substitutibility of assets that are both denominated in different currencies, and held jointly by the citizens of at least one country.

5/Money, the Terms of Trade, and Balance of Payments Adjustment with a Flexible Exchange Rate: A Theoretical and Emprical Study of the Dynamics of International Adjustment, (Ph.D. Dissertation, Brown University, 1980).

6/Goodfriend does not, in this paper, take account of endogenous expected exchange rate changes in constructing his goods and money market equilibrium conditions. He does, however, analyze the impact of an exogenous change in exchange rate expectations in the latter part of the paper. Goodfriend deals with the incorporation of endogenous (rational) expectations into his theoretical framework in Chapter IV of his dissertation. (See footnote 4 for citation.)

7/The current account balance may also play an indirect role in exchange rate determination by providing information to the market that influences expectations and thereby affects the current spot exchange rate.

8/Brusca also finds that the choice of a measure of the exchange rate makes a significant difference for the estimated response of export prices to domestic output prices.

Implications of Floating Exchange Rate Regimes

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*The papers included in this review were received at various stages of revision. Many that were working papers at the time have since been revised and, in some cases, published. Accordingly, we have supplied only the title and author of each paper, as well as the Federal Reserve System affiliation of the author at the time the paper was written. Individual authors may be contacted for copies of, or information on, their respective papers.

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