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Trade and Investment Performance Under Floating Exchange Rates: The U.S. Experience 1/

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Abstract

Contrary to the arguments of several scholars, we have failed to find either a conclusive theoretical case or clear empirical evidence of an effect, harmful or otherwise, of exchange rate variability (as measured by either short-term volatility or long-run misalignment) on overall levels of international trade. In this paper, after reviewing the theories and evidence on this issue, we go on to consider the impact of exchange rate variability on direct foreign investment. We summarize and amplify upon the scant theoretical literature of this issue, and proceed to test U.S. data for the presence of such an impact. We find none.

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1. Introduction

Since the move to a managed floating exchange rate system in 1973, world financial markets have been characterized by large movements in nominal exchange rates. These movements have been accompanied by large swings in real exchange rates, reflecting the fact that nominal exchange rate variations have not closely followed changes in relative prices of traded goods. The short-run variability of exchange rates--whether measured in real or nominal terms, bilateral or effective terms--has been substantially higher in the post-1973 period than it was under the Bretton Woods system (Frenkel and Goldstein, 1986). Further, exchange rate variations have been much greater than the early advocates of floating had expected. For example, in an influential article, Harry Johnson (1969, pp. 19-20) argued that the allegation that a flexible rate system would result in unstable rates ignored "the crucial point that a rate that is free to move under influences of changes in demand and supply is not forced to move erratically, but instead will move only in response to such changes in demand and supply...and normally will move only slowly and predictably." 1/

This paper assesses the causes of exchange rate variability and examines its consequences for trade and investment. Following Williamson (1985), we distinguish between two concepts of variability--(i) short-term volatility and (ii) longer-term misalignment. Volatility involves short-term (monthly, weekly, or even hourly) fluctuations in exchange rates as measured, say, by their absolute percentage changes during a particular period. In contrast, misalignment is a subjective concept and as such difficult to quantify. Misalignment has been defined as a departure over a substantial period of time of the exchange rate from its "fundamental equilibrium value" (i.e., the exchange rate that yields a cyclically adjusted current account balance equal to normal private capital flows--those capital flows which exist in the absence of undue restrictions on trade and special incentives to incoming or outgoing capital) (Williamson, 1985; Crockett and Goldstein, 1987). For example, the value of the U.S. dollar in 1984 and early 1985 was considered by many commentators to be considerably higher than justified by the fundamentals; hence, the value of the dollar was perceived by these commentators as bound to come down. The problem with getting a grip on misalignment is, as Crockett and Goldstein (1987) have observed, the difficulty entailed in measuring such concepts as a "substantial" period of time, the "cyclically adjusted" current accont balance, "normal" private capital flows, "undue" restrictions on trade, and "special incentives" on capital flows.

The remainder of this paper is divided into four sections. In the next section we discuss the main explanations of exchange rate behavior

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1/ Perceptively, Johnson also recognized that exchange rates would be stable only as long as "underlying economic conditions (including government policies)" remained stable (1969, p. 17, italics supplied).

provided in the recent literature, for if exchange rate variability has been in some sense "excessive," it must have been unpredicted by theories of exchange rate determination, or at least inconsistent with the stylized explanations posited by those theories. Section 3 provides a conceptual discussion of the possible costs of exchange rate variability and misalignment. These main costs are usually associated with allocation effects on trade and investment. We argue that, theoretically, the costs of exchange rate variability on trade and investment are ambiguous. Section 4 presents empirical results of the effects of exchange rate variability on trade and direct investment in the U.S. economy. Our results do not support the hypothesis that exchange rate variations (defined in terms of either short-term volatility and longer-term misalignment) have hampered trade and investment in the context of the U.S. economy. Concluding comments are contained in Section 5.

2. Explanations of exchange rate behavior

Why have exchange rates moved so much and for prolonged periods of time? In what follows, we review six explanations of exchange rate behavior. Before doing so, however, several observations are in order.

The first pertains to the characterization of the present international exchange rate regime. At the outset, we described the current system as one of managed floating--not one of freely floating currencies. This is because most countries (almost all of them developing countries) adhere to pegged exchange rate arrangements while a number of countries (including the eight members of the European Monetary System) follow limited flexibility vis-à-vis a single currency or group of currencies. 1/ Further, even among the floating currency countries, exchange rates have not been permitted to float cleanly, as evidenced by recent efforts to talk the U.S. dollar up or down (sometimes within the same day), informal agreements among the Big Five (the Plaza Agreement, the Louvre Accord), and large interventions by central banks. Indeed, intervention strategies have differed among countries and over time, ranging from free floating, to short-term smoothing, to heavy intervention aimed at achieving a targeted rate.

The second observation is that the world operating environment since 1973 has differed substantially from the period characterizing the Bretton Woods period. As Shafer and Loopeska (1983) argue, floating rates should not be blamed for the slowdown in world growth and trade which accompanied the move to managed floating. Specifically, they note that the rapid growth of the economies of Europe and Japan in the 1950s and 1960s was, in part, a catching up after World War II and was unlikely to be sustained; that the floating rate period inherited international disequilibrium and inflation; and that the world economy

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1/ See Tavlas (1987). However, as Goldstein (1984, pp. 3-4) reports, most of world trade is conducted at unpegged currencies.

suffered two oil price shocks during the floating rate period. Also, the post-1973 period has been characterized by developments that contributed to exchange rate variability, including technological advances in communications which have forged closer linkages among world financial markets enabling events in any one market to have an almost instantaneous impact on other markets. This rapid advance in communications technology has not surprisingly been accompanied by a relaxation of controls on capital movements.

Finally, as Frenkel and Goldstein (1986) note, exchange rates are financial asset prices and, therefore are flexile and forward looking--unlike many goods prices which are sticky and backward looking (reflecting previous contractural agreements). 1/ Volatility is to be expected in an auction market such as the exchange market under floating rates simply because of continuous surprises. Nordhaus (1978, p. 250) made this point explicitly: "In those pure auction markets where prices are the main shock absorber, considerable price volatility is the result. These conditions generally prevail in raw foods and commodities markets, in markets for many financial instruments such as common stocks, or when a regime of pure floating exchange rates exists. Such volatility is an intrinsic feature of real world auction markets--markets in which there are incessant surprises due to weather, changes in taste, inventions, political upheaval, inflation, recession, and boom, etc." Indeed, Harberler (1986, p. v) argues that it is the ability of flexible exchange rates to absorb shocks which has eased quantity and price adjustments in goods and labor markets. Further, Obstfeld (1985) argues that it is doubtful whether the fixed exchange rate system would have survived the changed world environment since 1973 without the imposition of controls on capital movements and restrictions on trade.

The auction market characteristic is important, but it certainly does not account fully for the magnitude of exchange rate movements. In order to understand why instability may be an inherent characteristic of flexible rates, we turn to a brief overview of theories of exchange rate behavior.

1/ Frenkel and Goldstein (1986, p. 647) also point out that exchange rate changes have been smaller than changes in other asset prices such as national stock markets and short-term interest rates.

A useful starting point for considering theories of exchange rate determination is the portfolio balance model. 1/ The model is built around the determinants of net outside supplies of stocks of assets denominated in different currencies and the demands for them. Individuals are assumed to allocate their wealth, which has a given total value at each moment, among alternative assets, including, most generally, domestic and foreign money and domestic and foreign securities. Assets denominated in different currencies are viewed by investors as perfect substitutes--i.e., uncovered interest rate parity holds. Thus, if one country has a higher expected monetary growth rate and consequently a higher expected inflation rate, assets denominated in its currency will carry an interest-rate differential that is equal to the expected depreciation in its exchange rate. Expectations play a key role in the determination of equilibrium. Another component of the portfolio model is that goods of different countries are essentially perfect substitutes and there are virtually no barriers to instantaneous (price) adjustment in goods markets. The assumptions with respect to both asset prices and goods prices will be relaxed below.

a. Rational speculative bubbles

By treating exchange rates as financial asset prices, the portfolio approach draws attention to the substantial influence of expectations. A number of writers, including Mussa (1976), Frenkel and Mussa (1980) and Dornbusch (1980) have argued that the exchange rate market, as any asset market, is efficient; a market is considered to be efficient when prices reflect all available information, including expectations about economic policies. Consequently, the behavior of exchange rates is affected in an important way by new information that is continuously being processed by economic agents. Short-term fluctuations in exchange rates, according to the efficient markets view, are to be expected if the forces which lie behind exchange market equilibrium are themselves subject to substantial short-term fluctuation. As Mussa (1976, p. 203) has stated, "under a floating exchange rate regime, private agents must continuously revise their expectations of the future behavior of money supplies and other relevant variables in forming their expectations about the appropriate level of the nominal exchange rate." Continuous revisions in expectations make for continually changing exchange rates. Indeed, if exchange rate variations were exclusively determined

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1/ The portfolio balance model is an extension of the vintage 1970s' monetary model. As Krueger (1983, p. 50) observes, "at the present time it is difficult to distinguish an adherent of the monetary approach from the author of a portfolio balance model." An important bridge between the two approaches was provided in the article by Frenkel and Rodriguez (1975), which incorporated the treatment of asset accumulation and current account determination within the monetary approach. For an interesting appraisal of the monetary approach, see Boughton (1988).

by new and unanticipated information, the exchange rate would follow a random walk--today's exchange rate would be the best predictor of expected future exchange rates.

Note that if expectations are continuously revised in the same direction for a substantial period of time--for example if expectations of interest rates are modified repeatedly in the direction of higher and higher rates, reflecting an expected progressive tightening of monetary policy--the efficient markets view gives rise to what is referred to as rational speculative bubbles. Consequently, the efficient markets framework can account for both short-term volatility in exchange rates and longer-term movements, although the latter do not imply deviation from any fundamental equilibrium value.

b. Irrational speculative bubbles

The efficient markets view assumes that private agents process all information in a rational manner. Therefore, the market equilibrium exchange rate reflects the underlying economic fundamentals. By contrast, the irrational speculative bubbles story views economic agents as myopic. McKinnon (1976) had argued that exchange rate instability might be caused by an inadequate supply of private capital available for taking net positions in either the forward or spot markets on the basis of long-term exchange rate expectations. Thus, as Artus and Young (1979, p. 678) observed, the McKinnon hypothesis indicates that "cyclical variations in the demand for foreign exchange originating from trade or financial activities that may be sustained for a number of years may lead to large exchange rate movements because of a lack of investors with both the funds and the willingness to take a longer-run open position."

Krugman (1985) has recently applied the McKinnon hypothesis to the context of the "high" value of the U.S. dollar of late 1984 and early 1985. According to Krugman, "the case for a [speculative bubble]...is in fact the argument that there is insufficient speculation" (1985, p. 106; original italics). Krugman's argument runs as follows. The large U.S. trade deficits of the mid-1980s had produced a situation where the dollar was unsustainably high. The dollar was bound to fall in value, but investors' expectations were irrational. Had these expectations been rational, recognizing that the fact that the dollar needed (on the basis of long-run fundamentals) to come down, the expected future depreciation of the dollar would have inhibited the holding of dollar-denominated assets, thereby putting downward pressure on the value of the dollar. Instead, market participants paid "more attention to the higher [relative] yield on dollar securities than to the forces which [would] eventually weaken the dollar. Thus, the dollar [was] high because investors [paid] too little attention to the prospect of future exchange rate changes, not too much" (Krugman, 1985, p. 106). The market had reached a consensus that the dollar would come down slowly. If the long-term fundamentals pointed to the need for a rapidly falling dollar, then the market had overreacted to the then-

existing interest differential due to a lack of forward-looking speculation, producing an irrational speculative bubble. Krugman used this argument to predict correctly that "the dollar must at some point plunge" (1985, p. 107). 1/ Assuredly Krugman's expectations proved to be more accurate than the representative market expectation; we are not sure, however, that this fact establishes that speculation was either irrational or insufficient.

c. Overshooting: the case of sticky prices

Overshooting, can occur in any portfolio model in which some markets do not adjust instantaneously. For example, Branson (1976), Dornbusch (1976) and Kouri (1976) have focused on the slow speed of price adjustment in the goods market to explain exchange rate instability; this reflects the view that goods prices are backward looking in the short to medium term while exchange rates are flexible and forward looking. The sticky price argument runs as follows: An unanticipated change in the nominal money supply produces an increase in the real quantity of money because prices do not adjust promptly. As a result, real interest rates fall, leading to an incipient capital outflow and a depreciation in the real exchange rate which is proportionately more than the change in money (Dornbusch, 1986, p. 213). With lower real interest rates lower, the demand for goods picks up. In parallel, real exchange depreciation causes a substitution from foreign goods in favor of home country goods in both the domestic and export markets. Over time, as goods prices increase, the real money supply will contract and the real exchange rate will appreciate until real equilibrium is regained.

As Frankel (1986) has argued, if the market is foresighted, it anticipates that the expansion in demand will set prices in motion above their previously expected path. Assuming rational expectations, the anticipation of further exchange rate appreciation must be sufficient to offset the interest rate differential between domestic and foreign rates, so that opportunities for profits do not exist by holding either domestic or foreign assets. The fact that following the monetary innovation the exchange rate fell below the level that was expected in the long run, accounts for the exchange rate overshooting.

d. Overshooting: the case of asset accumulation

Now assume flexible goods prices but relax the assumption of perfect substitutability between domestic and foreign assets. Consequently, the variable that is not free to adjust instantaneously is the level of domestic claims on foreign assets. Next assume, for purposes of illustration, an expansionary domestic fiscal policy leading to cumulative current account imbalances. In the context of the Mundell-Fleming framework, the fiscal expansion results in a rise in

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1/ A hard landing was also predicted by Marris (1985).

domestic interest rates, an excess supply of foreign assets and an appreciation of the currency. Frankel (1986) and Dornbusch (1987) have shown that the accumulated net external indebtedness that accompanies the current account deficits will decrease the level of domestic claims on foreign assets eventually undoing their initial excess supply and with it the appreciation of the domestic currency, but the currency will not just fall back to its original value since the current account deficits result in reduced income from net foreign assets. As Dornbusch (1987, p. 7) has argued: "The reduction in net external assets means that following a period of deficits, the current account cannot be balanced simply by returning to the initial real exchange rate. Now there will be a deficit from the increased debt service. Therefore, to restore current account balance, an overdepreciation is required."

Both of the overshooting hypotheses are able to account for exchange rate variability and long-term movements in rates. Short-term variability arises because both hypotheses emphasize the role of news. For example, as Artus and Young (1979, p. 679) observe with respect to the current account story: "Market participants--continually reassess their views of the needed exchange rate change on the basis of actual current balance developments without always being able to discount properly the effects of temporary divergences in economic cylces, J-curve effects of exchange rate changes, and so forth." Moreover, the fact that the overshooting hypotheses are able to explain short-term and long-term movements in the exchange rate should not be taken to imply that the exchange rate deviates in any way from its equilibrium value (a la Williamson (1985)). Levich (1985, p. 1018) makes this point explicitly: "[The] definition of overshooting draws a distinction between short-run and long-run equilibria while retaining the notion that the exchange rate is priced fairly at all times, a perfect reflection of all information."

e. The safe-haven hypothesis

Dooley and Isard (1987) extend the portfolio balance model, focusing on international portfolio shifts. In particular, the safe haven approach "departs from other portfolio balance models of exchange rates by shifting attention away from the financial characteristics of assets....Instead, the approach emphasizes that variations over time in the prospective income streams on physical capital in different countries can generate changes in observed holdings of claims to those income streams, giving rise to desired and international capital flows and associated changes in relative prices and exchange rates" (Dooley and Isard, 1987, p. 71). 1/ Consequently, the exchange rate is determined in such a manner as to give rise to a current account deficit equal to the rate at which foreigners wish to acquire claims on the

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1/ In a recent extension of their approach, Dooley and Isard (1988) emphasize overshooting dynamics based on fiscal shocks in association with slow adjustment of real variables.

domestic country. As such, the approach stresses the "safe-haven phenomenon" whereby the strength of the U.S. dollar in the first half of the 1980s is ascribed to the perceived relative strengthening of the U.S. economic and political situation. The transmission of such perceptions included a shift of bank lending from less developed countries to the U.S. capital market and increased direct investment in the United States. One important implication of the safe-haven hypothesis 1/ is that the choice between a fixed or flexible exchange rate regime may not have a very significant influence, ceteris paribus, on the variability of the real terms of international competition, as characterized by the relative prices of tradable goods and the real balance of trade" (Dooley and Isard, 1987, p. 79).

f. Demand shifts and other influences

Stockman (1987a, 1987b) provides a thorough, textbook-like review of explanations of exchange rate movements, summarizing most of the foregoing approaches and adding other detailed cases. His analysis includes shifts of demand in each country for internationally traded goods, and other real shifts, but does not include irrational bubbles. He concentrates solely on shifts of fundamentals like those in the previous three cases just considered. The result adds to the richness and complexity of the issues we are considering, and calls into question any approach that considers only one or two influences on exchange rates.

Stockman develops an equilibrium model of the determination of exchange rates and prices of goods. 2/ Changes in relative prices of goods, due to supply or demand shifts, induce changes in exchange rates and deviations from purchasing power parity. According to Stockman (1987a, p. 12), "repeated disturbances to supplies or demands...thereby create a correlation between changes in real and nominal exchange rates. This correlation is consistent with equilibrium in the economy, in the sense that markets clear through price adjustments."

A number of important policy inferences be drawn from the equilibrium model of exchange rates. For purposes of this paper, the relevant inferences are that changes in exchange rates do not cause changes in relative prices but are themselves dependent variables driven by fundamentals, i.e., by exogenous variables. Further, the issue of whether exchange rate variability has detrimental effects on the economy--either through its effects on trade or investment--is not the relevant question "because the exchange rate is an endogenous variable. The right question is whether the underlying disturbances to

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1/ See the notes to Table 1 for additional details.

2/ Disequilibrium theories of the exchange rate are based on sluggish adjustment of nominal prices and imply that the correlation between real and nominal exchange rate changes is exploitable by government interventions in the foreign exchange market (Stockman, 1987a, p. 13).

the economy are 'good' or 'bad,' so (of course) the answer lies with the disturbance" (Stockman, 1987a, p. 17, original italics). We would add that if "fundamentals" refer to consumer preferences, comparative advantage, other supply conditions, and comparative rates of inflation among different trading partners, then the associated changes in exchange rates are efficient, i.e., they increase world output. Whether these changes affect trade and investment (as they sometimes would) is less interesting than whether other changes in exchange rates affect trade and investment.

3. Effects of exchange rate variability

In the light of the discussion in the preceding section of the causes of exchange rate volatility, we would prefer, so far as possible, to divide changes of exchange rates into the part due to fundamentals and the part due to other factors, i.e. to misguided speculation. Ideally we would like to represent each such influence accurately by a right-hand-side variable in a regression; these variables would be exogenous, while exchange rates, trade, and investment would be a subset of the jointly determined (enodgenous) variables of a comprehensive model. The regression, in that case, would be one of the reduced form equations, with, say, direct investment as the dependent variable. Besides the difficulty in trying to specify and measure the relevant exogenous variables, however, we are faced with the impossible task of finding a measure of the speculative influence. Consequently we need a proxy for it, and the only proxy available is exchange rate variation not explained by the exogenous variables that represent fundamentals. Although this residual variability is not the fundamental cause of whatever effects we might observe in trade and investment, it can be viewed as the proximate cause, in its role as a proxy for misguided speculation. We can then address the question of what happens if governments adopt policies that stabilize exchange rates around the equilibrium rates determined by fundamentals. Would trade increase, and would international investment be larger or better allocated as a result? This approach has two clear advantages. First is the practical consideration just mentioned--that we can measure exchange-rate variability whereas we cannot measure the amount of misguided speculation. Second, if all of the variability not explained by specified exogneous variables is due to irrational speculative bubbles or to other such causes, it is not clear that this variability should be considered exogenous; there would be no prima facie reason to suppose that treating it as exogenous would bias the analysis. Of course, not all the fundamentals can be measured, so that some bias may result from our approach; but we see no alternative.

In a recent paper with Ulan (Bailey, Tavlas, and Ulan, 1987), we reviewed many of the arguments for and against the proposition that short-term exchange rate volatility reduces trade because of the risks and costs it involves. 1/ The argument that it does hamper trade is simple and almost self-evident: because contracts to sell goods, movement of the goods themselves, and payments for them rarely all

coincide, there will be an element of exchange risk in foreign trade. This risk is equivalent to a cost to a risk-averse trader; and the trader will sometimes bear an actual cost to avoid it. Although this cost may be small for short-term transactions (because transactions costs are low for foreign exchange), the bid-ask spread widens with volatility; also, forward exchange markets exist for only about a year or so into the future. Being like transportation cost, in that it affects trade in both directions, it will tend to reduce a country's exports and its imports.

However, the arguments are not all on one side. For example, exporters may gain knowledge through trade that would help them anticipate future exchange rate movements better than can the average participant in the foreign exchange market. If so, the profitability of this knowledge could offset the risk of exchange rate volatility. If they wish to hedge longer-term investment or other transactions, rather than use the forward exchange market, they can borrow and lend in local currency to offset their other commitments. For example, a plant in a foreign country can be financed mainly with local capital, so that the investor limits his exchange risk in the basic investment. An additional counter-argument, of especially great weight, is that we have to specify the alternative to volatility. If the volatility is due to fundamental factors influencing the exchange rate, intervention by the authorities to reduce it would be unsustainable and eventually disruptive. To achieve a reduction of apparent, observed volatility, they would have to intervene with exchange controls or other restrictions on trade and payments. That could be more harmful to trade, and reduce it more, than would unrestrained movement of the exchange rate.

Furthermore, volatility of a single exchange rate is a poor measure of the risk of trade with the country involved, due to portfolio considerations. In general, a firm will be involved in trade with several countries, and so will have a mixed portfolio of foreign claims and obligations. What additional exposure in one country adds to the risk of the portfolio depends both on the variability of the direct bilateral exchange rate and on its correlation with other exchange rates. Hence, the effect of exchange rate volatility on trade cannot be determined a priori, but is an empirical question.

If the effect of exchange rate volatility on trade is uncertain, the effect on investment flows is even more so. (In fact, we have found very little systematic published or unpublished discussion of this effect.) Besides not being sure whether exchange rate volatility reduces trade, if it does we cannot be sure whether this effect would tend to increase or reduce international direct investment. A reduction in trade might mean more concentration on the home market by exporting firms, or it might mean that multinationals dispersed their production

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1/ See also Yeager (1976) for a discussion of the issue.

more completely into overseas markets and exported less from their major production plants in the home country. The first of these two cases would mean less international investment, presumably, whereas the second would mean more. This uncertainty augments the uncertainty due to the ambiguous effect of exchange rate volatility on trade.

This point came out clearly in a recent paper by Cushman (1985), the one empirical article dealing with direct investment as a function of exchange rate volatility that we were able to find. Cushman notes that actual trade is more complex than simple models would suggest. Although a firm may export a good whose inputs consist exclusively of domestic goods and services, its trade may also involve intermediate goods in various ways. The effect of exchange rate volatility, or other factors, on the location of economic activity (i.e., on the location of value added) can therefore be complicated, and that complicates the analysis of investment flows. This consideration gives further scope for the effect to run in either direction.

Cushman's analysis emphasized, as did ours (1987, op. cit.), that a businessman or portfolio investor will balance risk against expected profit when he plans a transaction. Suppose, as Williamson (1985) suggests, that floating exchange rates result in significant "misalignments"--real exchange rates pushed out of line by temporary capital movements. Potential direct investors across national boundaries may share this view. Those who feel able to anticipate future changes of misaligned exchange rates will take this expectation into account in calculating expected and risk-adjusted rates of return (see Frankel, 1986). If the profit expectation were uncorrelated with the risk, the effect of risk itself would be predictable for each transaction, taken separately. However, the Williamson argument is that misalignments are more frequent and more serious when exchange rates, freely floating, are volatile than when they are not. If so, risk will be postively correlated with expected profits for many transactions, so that the net effect is indeterminate until one has the specific numbers and the degree of risk aversion.

These points help highlight the central importance of the notion of misalignment to the analysis. If all variability of exchange rates were due to variation in the fundamentals, such as independent, unpredictable changes in monetary and fiscal policy in different countries, exchange rates would approximate a random walk. Without misalignment, there would be few opportunities for profitable anticipation, by traders or direct investors, of future exchange rate changes. Although some firms or households may believe that they can foresee shifts in such fundamentals, only in a few exceptional cases would the ability to do so be related to a firm's volume of foreign trade or investment. (Also, it would be harder to argue, as a rule, that the effects on trade and resource allocation, if any, of this type of exchange rate variability was harmful and distortive.)

Because it appears that "variability" has implicitly been almost synonymous with misalignment in much of the previous conceptual work on this issue, we have based our discussion on misalignment and on short-term volatility. With that approach, exchange rate variability can affect trade in either direction. Its effect on direct investment is still more uncertain, inasmuch as it could go in either direction even if the effect of variability were to reduce trade. With the consequences of both short-term volatility and misalignment on trade and investment conceptually uncertain, we turn to some empirical results concerning the effects of these two measures of exchange rate movements on trade and investment in the case of the U.S.

4. Exchange rate movements and U.S. export and investment performance

In recent years, a number of empirical studies dealing with the post-1973 period have been produced which examine the issue of whether short-term exchange rate volatility hampers trade. Only one study has investigated the relationship between volatility and investment. To our knowledge, not a single empirical study has examined the effects of misalignment, per se, on either trade or investment.

Most recent empirical studies have supported the proposition that short-term volatility does indeed impede trade (Cushman (1983); Akhtar and Hilton (1984); Kenen and Rodrik (1986); Maskus (1986); Thursby and Thursby (1987); and De Grauwe and de Bellefroid (1987)). The coverage of these studies has been impressive. They have encompassed both total and bilateral trade flows, differences in sampling data (i.e., time series and pooled time series cross-sectional), bilateral and trade-weighted measures of exchange rates, real and nominal exchange rates, and a range of industrial countries. Studies which have rejected the hypothesis that volatility has adversely impacted on trade include the IMF (1984), Gotur (1985), and several papers with which we have been associated--Bailey, Tavlas, and Ulan (1986); Aschheim, Bailey, and Tavlas (1987); and Bailey, Tavlas, and Ulan (1987).

In the most comprehensive of our studies--Bailey, Tavlas, and Ulan (1987)--we tested for the impact of exchange rate volatility on real exports of 11 OECD countries, using for most countries two measures of volatility for both real and nominal exchange rates. 1/ In all, over the managed floating period we presented 33 regression equations. In addition to exchange rate volatility, the factors which were posited to affect exports of these countries were real GDP in partner industrial countries, real export earnings of oil producing countries, and relative prices (defined as the ratio of the dollar-denominated export unit values of each country relative to the dollar-denominated export unit

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1/ The countries examined were Australia, Canada, France, Germany, Italy, Japan, New Zealand, the Netherlands, Switzerland, the United Kingdom, and the United States.

values for the IMF's "industrial country" aggregate). Of the 33 regressions estimated, only 3 showed a significant and negative impact of volatility on exports. These 3 regressions each involved real volatility. So perhaps real volatility is the culprit. Considering only those equations with real exchange rate volatility variables, that still left only 3 instances out of 16 in which exchange rate volatility negatively and significantly affected real exports.

Despite the diversity of empirical results, some generalizations can be drawn from the current status of empirical work. First, most studies (including our work) that find a significant effect for volatility on trade find it only for real exchange rate volatility. But as our aforementioned results indicate, even in the case of real volatility the evidence is anything but overwhelming. Second, of the studies that do find a negative effect of exchange rate volatility on trade, most do so using bilateral trade data (e.g., Cushman (1983); Akhtar and Hilton (1984); Maskus (1986); and Thursby and Thursby (1987)). Thus it may be that volatility affects the pattern of trade, but not its overall level. Regarding the aggregate trade studies that find a negative impact of volatility on trade, Kenen and Rodrik (1986) examine the effects of exchange rate volatility on imports--not exports. Still, in only 4 of the 11 countries examined did the results show a negative and significant impact. On the other hand, De Grauwe and de Bellefroid (1987) find less ambiguous effects of volatility on exports. However, their study does not include a relative price term. In their words: "The reader may wonder why no relative price (or competitiveness) variables appear in the equation. The reason is that we concentrate here on the determinants of the long-run growth rates of trade....Over very long periods...these relative price effects are likely to have disappeared" (De Grauwe and de Bellefroid, 1987, p. 195). The theoretical motivation behind this argument escapes us. At the very least, the effect of relative prices should have been empirically tested. By failing to do so, it is likely that the results obtained by De Grauwe and de Bellefroid comingled the effects of relative prices with exchange rate volatility, obtaining an exaggerated or spurious impact for the latter.

The final generalization to be drawn from empirical work is that the primary determinants of trade are real output in trading partner countries and the terms of trade. In this context, equations (1a), (1b), and (1c) in Appendix Table 1 provide estimates on the determinants

of U.S. export volumes over the managed floating rate period. 1/ Equation (1a) shows that some 93 percent of the variance of real exports from the United States is explained by real output in other industrial countries, real export earnings of oil exporting nations (a proxy for their ability to buy other nations' exports), and relative export prices between the United States and its industrial couantry trading partners adjusted for exchange rate changes. (Thus, relative prices reflect real exchange rates in terms of traded goods.) 2/ Equation (1b) adds the volatility of the real effective exchange rate to the previous specification. While the coefficient is negative, it is insignificant and does not change the coefficients of the other variables. Because the relative price term is adjusted for exchange rate changes, it may be that the relative price term is biasing the volatility coefficient toward zero. Accordingly, in equation (1c) we drop the relative price term while retaining the volatility term. The coefficient on the latter variable remains insignificant; meanwhile, the significance of the coefficients on the other remaining variables declines while serial correlation increases, suggesting misspecification problem.

If short-term volatility of the exchange rate has not adversely affected U.S. exports over the managed floating period, what about exchange rate misalignment, defined as the difference between the real effective exchange rate (REER) and the real "fundamental equilibrium" exchange rate (FEER)? As Frenkel and Goldstein (1985) have noted, there is an assortment of problems associated with measuring an equilibrium exchange rate; any such measure is bound to be only an approximate one. Undaunted by the difficulties, Williamson (1986) provides estimates of the FEER and the REER over the period 1976:1 through 1984:4. We have updated Williamson's estimates of these two series based on data contained in Williamson (1986). The effects of deviations from the equilibrium exchange rate (i.e., REER minus FEER) are provided in equations (1d) through (1f). Equation (1d) is merely the specification in (1a), but estimated over the now shorter estimation period. Equation (1e) adds the misalignment series; the misalignment variable is insignificant and has a positive coefficient. Finally, equation (1f) drops the relative price term while retaining the misalignment variable. The latter remains insignificant; meanwhile the properties of the equation (coefficients on other variables, serial correlation) deteriorate, again suggesting that misspecification results from dropping relative prices.

1/ Equations (1a) through (1c) are estimated over the quarterly period, 1975:1 through 1986:1. We began the estimation period in 1975:1 because exchange rate volatility is entered with an eight-period (i.e., two-year) lag, taking us back to 1973:1, the beginning of managed floating. We ended the estimation period in 1986:1, because, as of this writing (end-1987), export earnings of oil exporting nations (a term in the equations) is available only through 1985:4. Because that term is entered with a one-quarter lag, we were able to estimate through 1986:1.

2/ See the notes to Table 1 for additional details.

As noted, with the exception of Cushman (1985), empirical work dealing with the determinants of direct investment in the U.S. economy in recent years is nonexistent. 1/ Indeed, Cushman's paper dealt with bilateral direct investment outflows from the United States to five countries over the period 1963 through 1978; thus his data were drawn largely from the managed rate period. In what follows, we present results on the determinants of aggregate direct investment inflows into the United States over the quarterly interval, 1976:1 through 1986:1 (see the notes to Table 2 for the reason why we began with 1976:1), testing for the effects of short-term exchange rate volatility and long-term misalignment on real direct investment inflows.

We use a stock adjustment model to estimate the determinants of real direct investment--manipulation of the stock adjustment model results in a lagged dependent variable as one determinant of direct investment. In addition, we posit that direct investment is determined by the expected performance of the U.S. economy--proxied by "anticipated" real GDP in the United States--by real relative export prices (the same variable which was used in the equations for export volumes), by the real interest rate differential between long-term rates in the United States and those in the main trading partners of the United States, and by an oil shock term, aimed at capturing the effects of the oil price hike of the late 1970s. More detailed explanations of the variables used and the empirical results are reported in Table 2. These variables also happen to be variables that help determine real exchange rates, through their effects on trade and investment. With such variables in the equations, the regression coefficients for exchange rate variability and misalignment capture the effects of speculative errors for given fundamentals.

A general observation concerning the empirical results is that the explained variances of the regressions are considerably below those obtained for the export equations. Equation (2a) presents our basic specification. Anticipated real GDP, the real interest rate spread series, and the lagged dependent variable all have positive (as expected) and significant coefficients. The oil price shock series also has a positive coefficient, but it is only marginally significant; the implication is that the oil price shock of the late 1970s increased direct investment into the United States either in accord with the safe-haven hypothesis or as part of the financing of the enlarged trade deficit. The relative price (real terms of trade) series has a negative coefficient (as expected) and is significant.

Equation (2b) tests for the impact of short-term exchange rate volatility on direct investment; the coefficient on the volatility variable is marginally significant, and positive. In equation (2c) we

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1/ Cushman observed that, "Empirical work concerning exchange rate uncertainty on direct investment is rare" (1985, p. 298). The few studies that Cushman was able to find were published during the 1970s.

drop the relative price term in order to test whether its inclusion in equation (2b) was biasing the impact of the volatility term. (This is the same procedure that we undertook for the export equations.) The volatility term has a negative coefficient in equation (2c), but is insignificant. Finally, equations (2d) and (2c), with and without relative prices, respectively, test for the impact of the misalignment series. In equation (2d) the misalignment series is marginally significant, but with a positive coefficient. In equation (2e) it is negative and insignificant. In sum, we were unable to find any adverse impact of either exchange rate volatility or misalignment on real direct investment into the United States during the managed floating rate period.

5. Conclusions

We have argued that exchange rates vary both because of long-term fundamental influences and because of speculative and other transitory influences. These influences, especially the latter, are unpredictable, and they vary more sharply at some times than others. Consequently the volatility of exchange rates is itself variable, and one can easily understand the rationale for an international policy regime that aims to reduce it.

To the extent that the size and variance of movements in exchange rates have been unpredictable, have they also been harmful? Advocates of fixed exchange rates posit that exchange rate variations are harmful because they entail resource allocation effects on trade and investment. For the U.S. economy, our results indicate that exchange rate variations have not had significant effects on trade and direct investment. Of course, we doubt whether a fixed exchange regime would have been able to survive during a period which has included huge disturbances, such as the two oil price shocks to the world economy. Our results on investment are exploratory, and may be revised if progress should be made on the difficult specification problems involved. The issue is empirical, and must eventually be resolved by testing the various claims against the data.

Table 1. Effects of Exchange Rate Variability on U.S. Export Volumes

Equation	Constant	Real OECD GDP	Relative Export Prices	Real Oil Revenues	Exchange Rate Variability: Short-term volatility	Exchange Rate Variability: Long-term misalignment	Rho	$\bar{R}^2$	D.W.	Estimation Period
(1a)	-2.46	1.05	-0.77	0.11			0.62	0.926	1.70	1975:1-1986:1
	(3.0)	(7.9)	(5.9)	(2.5)			(4.6)			
(1b)	-2.23	1.02	-0.72	0.12	-0.84		0.62	0.923	1.75	1975:1-1986:1
	(2.6)	(7.0)	(4.8)	(2.5)	(0.7)		(4.1)			
(1c)	0.70	10.55		0.08	-1.64		0.89	0.900	1.73	1975:1-1986:1
	(0.4)	(1.9)		(1.4)	(0.9)		(12.5)			
(1d)	-2.18	1.01	-0.73	0.09			0.69	0.908	1.65	1976:1-1986:1
	(1.9)	(5.5)	(4.8)	(1.8)			(5.1)			
(1e)	-2.24	1.02	-0.78	0.09		0.0005	0.67	0.906	1.67	1976:1-1986:1
	(2.0)	(5.7)	(4.3)	(1.8)		(0.4)	(4.8)			
(1d)	0.54	0.59		0.04		-0.0003	0.93	0.889	1.44	1976:1-1986:1
	(0.2)	(1.6)		(0.7)		(0.2)	(16.1)			

Sources: IMF, International Financial Statistics; Morgan Guaranty Bank; Williamson (1985; 1986); and authors' calculations.

Notes: Numbers in parentheses are t-ratios. Real OECD is real GDP (current period) in national currency units for 11 industrial country trading partners converted to U.S. dollars at 1985:1 exchange rates. Relative prices is the dollar-denominated export unit value index divided by the IMF's "industrial couantry" export unit value series. It is entered with a two-quarter lag. Real oil revenues is the dollar value of oil exporters' export earnings (as provided by the IMF) deflated by the dollar-denominated export unit value index of the "industrial nations" taken as a whole to represent the real purchasing power of the oil exporters as it relates to industrial country exports. It is entered with a one-quarter lag. Short-term exchange rate variability is the absolute value of the quarterly percentage change in the real effective exchange rate (as constructed by Morgan Guaranty Bank). It is calculated by using an eight-period (t-1 through t-9) second-degree Almon lag. Long-term exchange rate misalignment is the deviation of the real effective exchange rate (REER) from the fundamental equilibrium exchange rate (FEER) as constructed by Williamson (1985). Williamson (1985) provides data on REER and FEER for the period 1976:1-1984:4. For 1985:1-1986:1, figures for REER and FEER have been updated by the authors, extrapolating data on the basis of figures contained in Williamson (1986). The export volume series (IMF) was seasonally adjusted using the X-11 ARIMA technique. Rho was estimated using a maximum likelihood procedure.

Table 2. Effects of Exchange Rate Variability on Real Direct Investment Into the United States (1976:1-1986:1)

Equation	Constant	Anticipated Real GDP	Relative Export Prices	Real Interest Rate Spread	Lagged Dependent Variable	Oil Shock Dummy	Short-Term Volatility	Long-Term Misalignment	Rho 1	Rho 2	$\bar{R}^2$	DW
(2a)	-3.00	0.87	-2.95	0.08	0.54	0.21			-0.44	-0.40	0.522	2.03
	(1.4)	(2.2)	(3.1)	(2.0)	(3.2)	(1.4)			(2.1)	(2.1)		
(2b)	-1.15	0.68	-4.00	0.14	0.49	0.35	9.45		-0.55	-0.47	0.555	2.08
	(0.5)	(1.9)	(3.3)	(2.4)	(3.0)	(2.1)	(1.4)		(2.7)	(2.6)		
(2c)	-3.39	0.81		-0.04	0.63	0.17	-6.96		-0.36	-0.28	0.411	1.89
	(1.1)	(1.6)		(0.9)	(3.0)	(0.8)	(1.1)		(1.5)	(1.3)		
(2d)	-2.74	0.93	-4.35	0.06	0.45	0.27		0.02	-0.41	-0.42	0.566	2.16
	(1.4)	(2.4)	(3.5)	(1.3)	(2.5)	(1.8)		(1.8)	(1.8)	(2.3)		
(2e)	-2.00	0.72		-0.03	0.53	0.28		-0.001	-0.22	-0.20	0.384	1.85
	(0.7)	(1.3)		(0.4)	(1.9)	(1.3)		(0.1)	(0.7)	(0.8)		

Sources: Data Resources, Inc.; Federal Reserve Board; IMF, International Financial Statistics; Morgan Guaranty Bank; Williamson (1985; 1986); and authors' calculations.

Notes: Numbers in parentheses are t-ratios. Dependent variable is nominal direct investment inflow into the United States (Federal Reserve Board's flow of funds series, seasonally adjusted) divided by the GDP deflator. Anticipated real GDP was constructed by regressing the logarithm of real U.S. GDP on its past values in periods t-1 through t-13, using a second-degree Almon polynomial distributed lag with no end-point restrictions. The predicted series made by that regression was used as the anticipated series. Relative export prices is the same series used in Table 1; as with the regressions contained in Table 1, it is entered with a two-quarter lag in the regressions reported above. Real interest rate spread is the differential between the real average market yield on U.S. Government ten-year bonds (constant maturity) and the real average yield on long-term government bonds of major U.S. trading partners. The spread series is from Data Resources, Inc., U.S. model databank. Because it is available beginning only in 1976:1, all the above regressions were estimated beginning in 1976:1. The oil shock dummy variable is a shift dummy representing the second oil price shock. It equals unity from 1979:2 through 1980:2, and it equals zero for all other observations. The volatility and misalignment series are the same as used in the equations in Table 1. Rho 1 and Rho 2 were estimated using a maximum likelihood procedure since the widely used Cochrane-Orcutt procedure results in inconsistent parameter estimates in the presence of lagged dependent variables—see Aschheim and Tavlas (1988). We are grateful to John Wilson of the Federal Reserve Board for providing us with the nominal direct investment series.

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