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Table of Contents

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International Dimensions of U.S. Economic Policy in the 1980s

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In recent years, greater attention has been given to the international coordination of monetary and fiscal policies largely because of movements in the foreign exchange value of the dollar and the increase in the U.S. trade deficit. The emphasis on monetary and fiscal policies reflects the view that both types of policies contributed to these developments. Policy coordination implies a greater international dimension to the economic policies of the U.S. and other major countries. However, the impact of international considerations probably will be limited since the goals of policy coordination can be expected to be consistent with individual countries' domestic goals. In the case of U.S. monetary policy, although added attention has been given to international developments, policy appears to have remained consistent with traditional domestic goals.

In late 1982, the U.S. economy began what has become its longest peacetime expansion. Since then, real GNP growth has been moderate to robust, unemployment in the U.S has fallen sharply, and inflation has been moderate. However, with the economy at or beyond full employment in early 1989, the threat of an acceleration in inflation became a concern.

Despite generally favorable domestic statistics, other developments over the course of the current expansion raised concerns in the U.S. and among many of its major trading partners. In particular, international attention has focused both on the foreign-exchange value of the dollar, which soared and then plummeted during the 1980s, and the high and persistent U.S. trade deficit.

While differences of opinion abound concerning the implications of exchange rate movements and trade imbalances, it is clear that these developments have sparked interest in greater international coordination of monetary and fiscal policies. The international emphasis on monetary and fiscal policies reflects the view that both types of policies have contributed to movements in exchange rates and trade imbalances.

This paper examines U.S. economic policy in the 1980s in relation to the foreign exchange-value of the dollar, the U.S. trade deficit, and the international coordination of monetary and fiscal policies. The first section examines the theoretical arguments and some of the empirical evidence on the effects of U.S. monetary and fiscal policies on the value of the dollar and the U.S. trade balance. The second section takes a critical look at prospects for relying on international coordination of policies. The third section examines the extent to which the goals of international policy coordination have been consistent with U.S. domestic policy goals. A summary and conclusions are presented in the last section.

I. The Effects of Monetary and Fiscal Policies

The swing in the foreign-exchange value of the dollar in the 1980s has been dramatic. Chart 1 traces the index for the nominal multilateral trade-weighted U.S. dollar exchange rate from the Board of Governors of the Federal Reserve and its real exchange rate counterpart. Both measures show a prolonged run-up through February 1985, then a sharp drop through the end of 1987, and a subsequent mild rebound in 1988.

As the dollar appreciated in the early 1980s, the U.S. trade position deteriorated. As seen in Chart 2, the U.S. moved from a trade surplus in real goods and services of close to $80 billion (annual rate) at the end of 1980 to a deficit of about $150 billion in late 1986. Since then, the trade deficit in 1982 dollars has improved some, but as of the end of 1988, the deficit still was substantial, even though the real exchange value of the dollar moved back close to its level in 1980.

The sharp changes in the value of the dollar and the deterioration in the U.S. trade position have sparked debate over their causes. Part of the debate is over the roles of monetary policy versus fiscal policy. This section considers theoretical arguments and empirical evidence concerning the relationship between movements in exchange rates and the U.S. trade deficit, on the one hand, and on the other, first, monetary policy and, then, fiscal policy.

Chart 1
Trade Weighted U.S. Dollar Exchange Rates

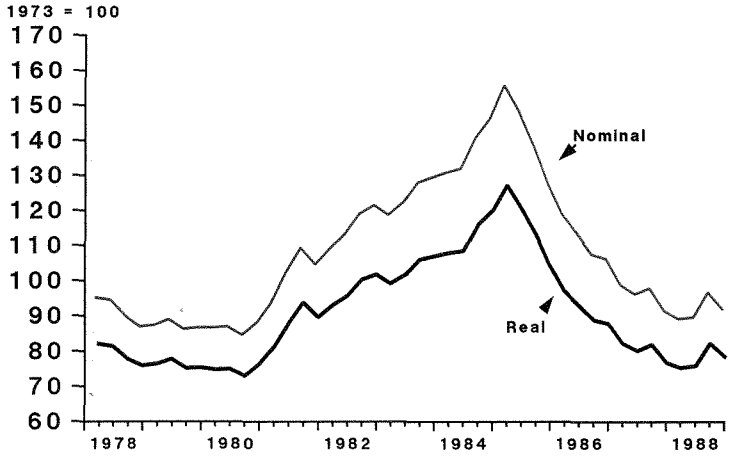
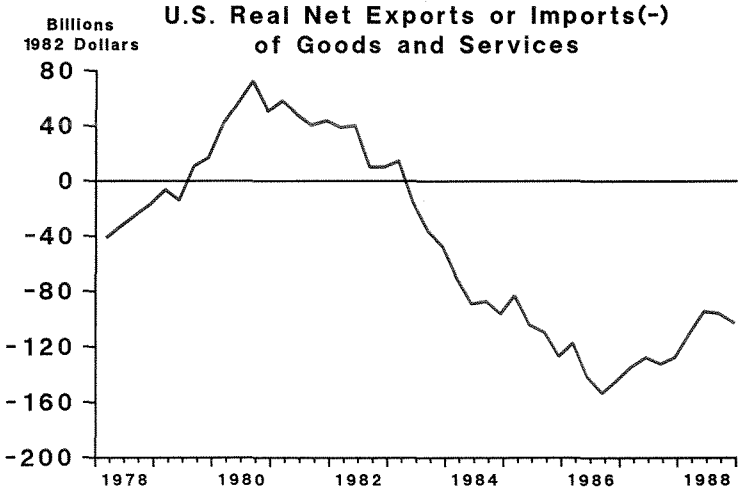


Chart 2
U.S. Real Net Exports or Imports(-) of Goods and Services



Real Exchange Rates and Monetary Policy

Monetary policy and real exchange rates are connected through the effects of monetary policy on real interest rates. Generally it is recognized that monetary policy can affect real interest rates in the short run. Given its effects on real interest rates, the link between monetary policy and the real exchange rate can be derived from the uncovered interest parity condition.[1]

In its simple form, the uncovered interest parity condition posits that, with free mobility of financial capital and perfect substitutability between foreign and domestic assets, the difference between the log of the current nominal exchange rate and the log of the future expected nominal exchange rate is a function of the difference between domestic and foreign nominal interest rates.[2] However, by introducing current and expected prices (foreign and domestic), the parity condition can be transformed into an expression in which the *real* value of the dollar in the current spot market is a function of two factors: 1) the difference between U.S. real interest rates and foreign real interest rates; and 2) the expected future exchange rate. That is,

$$\log q_t = n(r_t^d - r_t^f) + E_t(\log q_{t+n}),$$

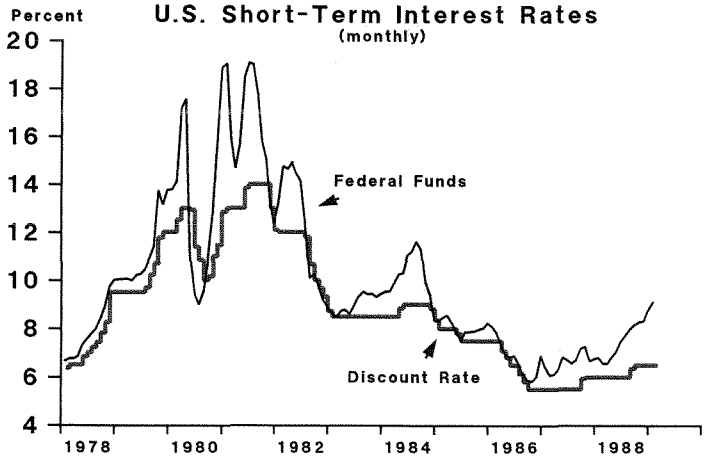
where q_t is the real exchange rate (units of foreign currency per unit of domestic currency deflated by the ratio of foreign prices to domestic prices), r_t^d is the real domestic (U.S.) interest rate on securities with maturity n, r_t^f is the real foreign interest rate on securities of comparable risk and maturity, and $E_t(\log q_{t+n})$ is the current expected value of the log of the real exchange rate n periods in the future.[3]

Tight monetary policy in the U.S. relative to that in other economies could contribute to an appreciation of the dollar by raising U.S. interest rates relative to those in other countries. With the free flow of financial capital, the higher U.S.-foreign real interest rate differential would induce gross capital flows that would cause the real value of the dollar to appreciate.

To the extent that U.S. monetary policy affects the real exchange rate through changes in the real interest rate differential, the impact should not be permanent. That is, in the above expression for the real exchange rate, for a large enough n, the expected real exchange rate should not be affected.[4] Allowing for shorter-run effects, however, the tightening of U.S. monetary policy that commenced in the Fall of 1979 had the potential to have a major impact on the value of the dollar.[5]

Depicting the extent of this and other changes in monetary policy in the 1980s *via* the monetary aggregates is complicated by the distortions from financial innovations and deregulation.[6] It is better, therefore, to use movements in nominal and real short-term interest rates to characterize changes in monetary policy, though these are not ideal indicators, either. As shown in Chart 3, the nominal interest rate on federal funds increased sharply in late 1979, apparently in response to the tightening of monetary policy that occurred then. In the second and third quarters of 1980, the federal funds rate and other interest rates were distorted by the Credit Controls of the Carter Administration. Interest rates were temporarily reduced by the artificial constraints on bank credit expansion, but they bounced back in late 1980 as monetary policy remained taut.

Chart 3
U.S. Short-Term Interest Rates
(monthly)



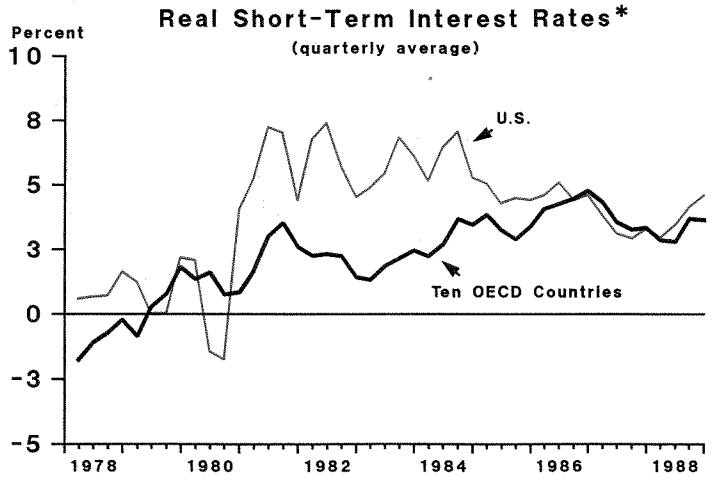
The behavior of real interest rates also is consistent with a tightening of monetary policy in late 1979. Although the measurement of *ex ante* real interest rates is complicated by the need for reliable measures of expected inflation, there is little doubt that U.S. real interest rates had increased by 1981. Assuming that the expected inflation rate for a current quarter is based on the inflation rate prevailing over the previous year, Chart 4 reveals that short-term real interest rates jumped up in the 1980s from levels prevailing in the late 1970s.

At the same time, real interest rates in other major countries also rose, but by less than real interest rates in the U.S. Consequently, as shown in Chart 5, the differential between real interest rates on short-term, private, dollar-denominated instruments and rates on comparable instruments denominated in other key currencies rose in the early 1980s. Throop (1988) finds a similar pattern for estimates of differentials on long-term real interest rates.

From the expression for the real exchange rate presented earlier, a rise in U.S. real interest rates relative to those of other economies would appreciate the U.S. dollar. Indeed, simulation results using the Federal Reserve Bank of San Francisco's structural macroeconomic model show that much of the appreciation of the dollar in the early 1980s is attributable to the differential between U.S. and foreign long-term interest rates. Helkie and Hooper (1988) report similar results regarding the effects of interest rate differentials.

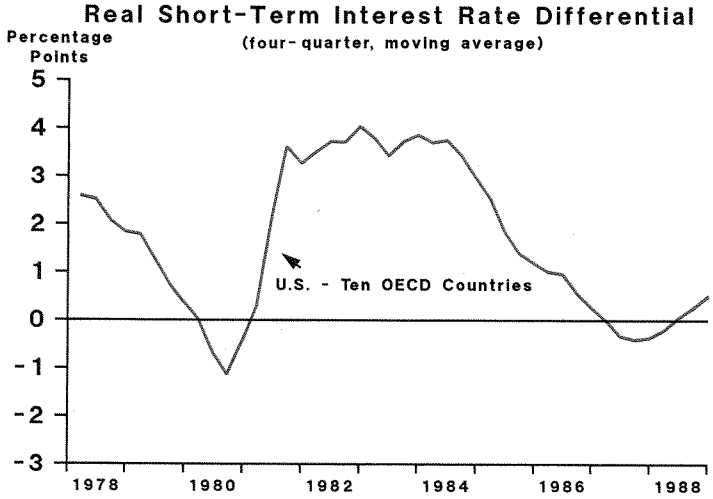
Tying the continued climb in the real exchange value of the dollar beyond 1982 to tight U.S. monetary policy, how-

Chart 4
Real Short-Term Interest Rates*
(quarterly average)



*Real rates are the nominal rate less the percent change in CPI over the previous four quarters. The U.S. rate is based on the three-month commercial paper rate. The rate for the OECD countries is based on a trade-weighted average of private market rates.

Chart 5
Real Short-Term Interest Rate Differential
(four-quarter, moving average)



ever, is somewhat more tenuous. It generally is thought that the episode of tight monetary policy persisted only through mid-1982. The evidence usually cited to support this view is the sharp drop in the federal funds rate at that time. The conventional view, however, has to be seen in light of the rebound in *real* interest rates during 1983, shown in Chart 4. The behavior of real interest rates suggests that, through mid-1984, the effective easing in monetary policy may have been less than that indicated by the movement in nominal interest rates. As discussed below, this may have been due to other factors, such as fiscal policy, that were affecting real interest rates.

Whatever the sources of influence on real interest rates, the important point for exchange rate determination is that the spread between U.S. real interest rates and foreign interest rates was fairly constant from 1981 through mid-1984 (Chart 5). This suggests that the real interest rate differential was not contributing to the *further* appreciation of the dollar that occurred through early 1985.

From early 1985 through early 1987, however, the movements in nominal and real short-term interest rates suggest a period of monetary accommodation in the U.S., as most observers have acknowledged. During that period, the U.S.-foreign real interest rate differential fell and the dollar depreciated sharply, as would be expected from the expression for the real exchange rate that was derived from the uncovered interest parity condition. Likewise, the behavior of the real interest rate differential and the dollar in 1987 and 1988 are in keeping with the movement toward tighter U.S. monetary policy, which also is reflected in the rises in nominal and real interest rates during the period.

Real Exchange Rates and Fiscal Policy

The theoretical effects of fiscal policy (that is, the nexus of government taxation and spending decisions) on real exchange rates depend on a number of factors. From Mundell (1963) and Fleming (1962), an increase in domestic government spending will appreciate a domestic currency if financial capital is highly mobile, but the currency will depreciate if capital is not very mobile. Sachs and Wypolosz (1984) also show that, in theory, the effect of fiscal policy on the real exchange rate depends on other factors such as wealth effects.

Nevertheless, the widely held view is that an expansionary U.S. fiscal policy will lead to an appreciation of the real value of the dollar. Evidence from Bryant *et. al.* (1988) supports this view. In the Brookings Institution project, which involves simulation experiments with 12 of the better-known multicountry econometric models, fiscal policy is defined in terms of government spending. The simulation results from the models indicate that an expansionary U.S. fiscal policy causes the real exchange value of the dollar to increase.[7]

Typically, the effect of fiscal policy on the real exchange rate is seen as stemming from changes in the differential on domestic and foreign interest rates. The argument is that an expansionary U.S. fiscal policy stimulates the U.S. economy more than it stimulates other economies, and, thus, causes the domestic real interest rate to increase relative to foreign real interest rates.

Real exchange rates also can be affected by fiscal policy through a second channel. Hutchison and Pigott (1984) and Hutchison and Throop (1985) emphasize that, even without an effect on the real interest rate differential, an expansionary U.S. fiscal policy can raise the level of the real exchange rate that is expected to persist over the longer run.

This can happen if goods markets are slow to adjust and U.S. and foreign goods and services are not perfect substitutes. Under these conditions, an expansionary fiscal policy in the U.S. (relative to that of the rest of the world) can increase the relative demand for U.S.-produced goods. Even when world real interest rates are equal, capacity constraints on the production of goods and services in the U.S. would mean an appreciation of the real value of the dollar in order to eliminate the excess real demand for U.S. goods and services.[8] Then, as long as the expansion in fiscal policy were expected to persist, the real exchange rate expected in the future would rise. From the expression for the real exchange rate presented earlier, the higher expected real exchange rate would mean a higher real exchange rate today.

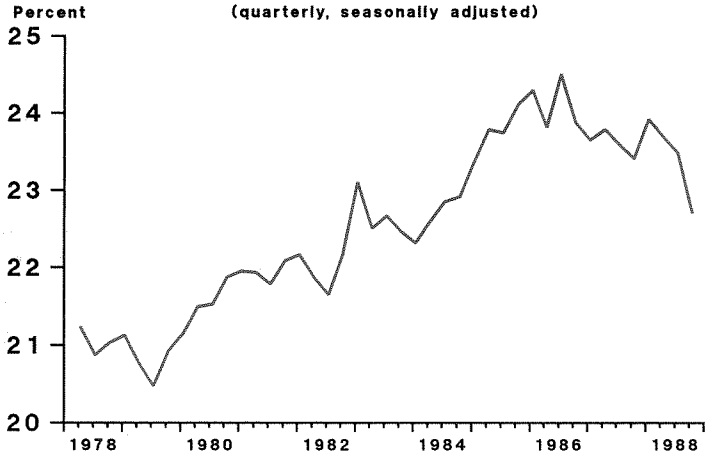
These arguments suggest that the shift to a more expansionary fiscal policy in the 1980s could have contributed to a higher real value of the dollar. With the 1981 Tax Act, the Reagan Administration embarked on a program of tax reform that was intended to spur economic growth. The program cut tax rates, which reduced revenues, and introduced a less progressive tax rate schedule. However, the tax program had little in the way of offsetting spending cuts. In fact, high-employment federal spending as a percent of high-employment GNP rose through 1986 (Chart 6). The Tax Act also led to a jump in the federal high-employment deficit after 1981. As seen in Chart 7, the budget deficit rocketed from $30-$40 billion in the late 1970s to over $200 billion in 1986. As a percent of high-employment GNP, the high-employment budget deficit reached a peak of over five percent.

Some have questioned whether the rise in the fiscal budget deficit *per se* was expansionary.[9] Nonetheless,

Hutchison and Throop (1985) and Throop (1988) present persuasive empirical evidence that the federal fiscal deficits have affected the real exchange rate. Both studies emphasize the effects of fiscal deficits working through changes in the long-run expected real exchange value of the dollar, rather than through changes in the real interest rate differential.[10] Their findings indicate that, relative to fiscal tightening in other countries, the prolonged fiscal expansion associated with the rise in the U.S. budget deficit after 1982 caused the expected exchange value of the dollar to rise and led to the continued rise of the dollar between 1982 and early 1985. Throop (1988) maintains that the imbalances between foreign and domestic fiscal policies also worked to buoy the value of the dollar through 1986, although after February 1985, the real value of the dollar fell in response to the decline in the real interest rate differential.

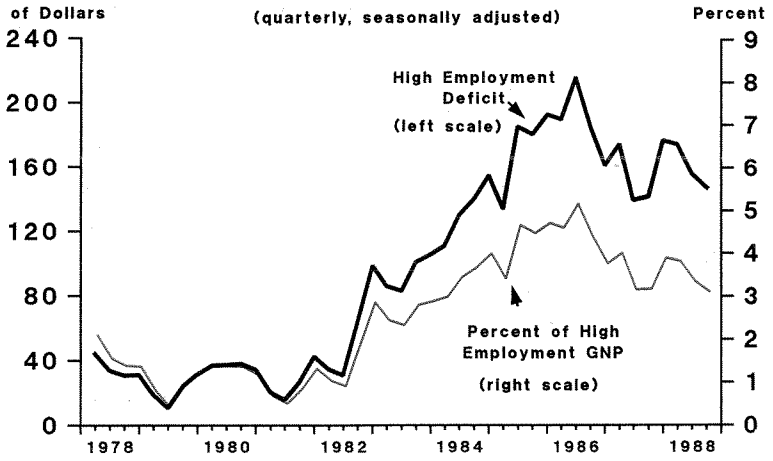
Since 1986, fiscal policies internationally have been somewhat more balanced. In late 1985, the Congress and the Administration "committed" to reduce the budget deficit through a resolution and subsequently the Gramm-Rudman-Hollings bill in December 1985. In part due to the Gramm-Rudman-Hollings constraints, U.S. fiscal policy has become less expansionary as measured by the high-

Chart 6
High Employment Federal Spending* to High Employment GNP
(quarterly, seasonally adjusted)



*High employment deficit and GNP are based on a six percent unemployment rate.

Chart 7
High Employment Federal Government Deficit*
(quarterly, seasonally adjusted)



*High employment deficit and GNP are based on a six percent unemployment rate.

employment deficit as well as by high-employment spending. Moreno (1988) also points out that there has been some expansion of fiscal policy in other countries. He discusses the 6 trillion yen (1.8 percent of GNP) package of spending increases and tax cuts approved by the Japanese Cabinet in June 1987. Hutchison (1987) also identifies changes in Japanese policy. In addition, according to publications of the Organization for Economic Cooperation and Development (OECD), West Germany is projected to move toward increasing its budget deficit to 2¼ percent of GNP by 1992 from 1¾ percent in 1987.

Nevertheless, it is uncertain how fiscal imbalances will be resolved in the future. For example, the U.S. Congressional Budget Office projects the budget deficit to improve only slightly over the next five years (see Chart 8). If these projections are consistent with market expectations, fiscal policy likely still is holding up the expected, and, thereby, the current real exchange value of the dollar.

U.S. Trade Balance

The discussion so far has focused on the theoretical arguments and empirical evidence relating to the effects of monetary and fiscal policies on the real exchange rate. The impact of monetary and fiscal policies on the real trade balance also depends on how these policies affect overall spending. This is because real net exports for the U.S. are related to both the real exchange rate and real spending in the U.S. relative to that in other countries.

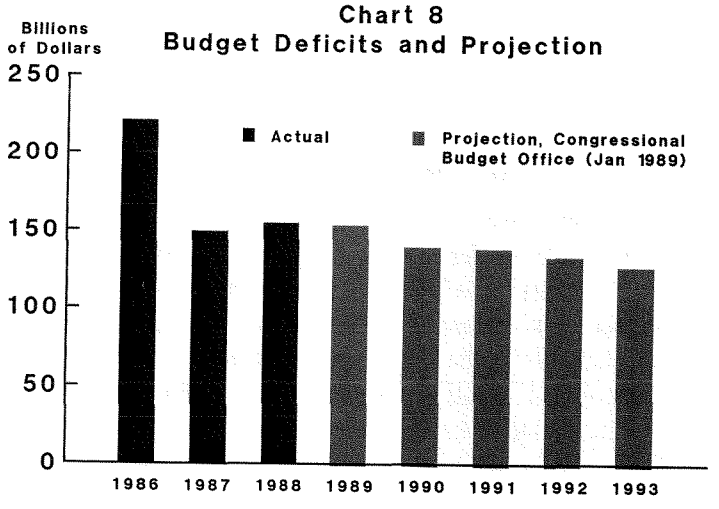
From the discussion above, tight U.S. monetary policy can lead to an appreciation of the dollar because of a higher U.S. real interest rate. But the higher real interest rate also tends to dampen U.S. real spending relative to that in other countries. While the first effect would mean higher imports relative to exports, the second would have the opposite effect.

The ambiguous effect of monetary policy on the U.S. trade balance carries over to the empirical evidence from the Brookings Institution project. In Bryant *et. al.* (1988), some of the model simulations suggest that tight monetary policy would increase the U.S. trade deficit, while others show the opposite result. On average, the results of the simulation show that monetary policy has close to a neutral effect on the U.S. trade balance. Therefore, even if monetary policy affected the real foreign exchange value of the dollar in the 1980s, it may not have contributed much to the higher real trade deficit. This also means that explicit attempts to influence the trade deficit by changing exchange rates through monetary policy might meet with only limited success.

In contrast, theory says that expansionary fiscal policy can appreciate the dollar and raise U.S. spending relative to that in other countries. Given that it appreciates the real dollar exchange rate, expansionary U.S. fiscal policy relative to that in other countries should have unambiguous effects: such a policy should reduce U.S. net exports.[11]

The results in Bryant *et. al.* (1988) support this view of the effects of fiscal policy. Most of the models indicate that the U.S. trade balance is negatively related to U.S. fiscal policy. Moreover, other empirical studies have found that much of the rise in the U.S. trade deficit in the 1980s can be traced to expansionary U.S. fiscal policy. Throop (1988), for example, finds that about half of the increase in the U.S. trade deficit in the 1980s can be traced to the fiscal policy imbalance between the U.S. and other countries.[12] That study also finds that a reduction in the U.S. budget deficit from $230 billion in 1986 to about $150 billion by 1987 contributed significantly to the improvement in the U.S. trade deficit since 1986.

Chart 8
Budget Deficits and Projection



II. Implications for Policy Coordination

Recognition that monetary and fiscal policies can affect exchange rates and trade balances is one reason more attention is being given to the international repercussions of these policies. The recent attempts at international economic policy coordination involving the U.S. grew out of the G-5 (U.S., Germany, Japan, Britain, and France) Agreement in September 1985.[13] That meeting specifically was motivated by a desire on the part of the participants to depreciate the dollar further. By September 1985, the dollar had depreciated considerably from its peak in February 1985, but still was considered too high to resolve world trade imbalances. In addition, the decline in U.S. real net exports, which eventually hit a low in late 1986, was thought to have created imbalances among sectors of the U.S. economy, raising prospects for protectionist measures by the U.S. against its trading partners.[14] Finally, there was concern over the long-run implications of U.S. reliance on foreign financing.[15]

The September 1985 Agreement called for the coordination of both fiscal and monetary policies to affect exchange rates and the trade imbalance. The discussion in the previous section suggests that these efforts to reduce fiscal imbalances are reflected in the lower real U.S. trade deficit. However, most of the efforts at coordination have involved monetary policy, including domestic open market operations and unsterilized currency intervention,[16] as well as sterilized currency intervention.[17] The discussion in the previous section suggests that the coordination of monetary policies (and sterilized currency interventions), in contrast, probably has had a limited effect on trade imbalances.

But is there another interpretation of the role of monetary policy in international policy coordination? One interpretation is that its role is one of "stabilizing" exchange rates. When the dollar was depreciating sharply from early 1985 through 1986, exchange rate stabilization might be characterized as aiming to smooth the downward adjustment in the value of the dollar—that is, preventing it from falling too rapidly. More recently, stabilization appears to be aimed at dampening short-run swings in the exchange value of the dollar.

There is some debate regarding whether it is appropriate to damp movements in exchange rates. In general, stabilization in this sense is appropriate when fluctuations in exchange rates mainly are due to temporary shifts in the demand for money (or financial assets more generally) among different countries.[18] Such temporary shifts could be due to unstable investor demands for individual currencies. In this case, a shift in preferences toward holding dollar assets would tend to appreciate the dollar and call for a relative easing in U.S. policy. On the other hand, a shift in preferences away from dollar assets would call for U.S. policy to tighten in order to stabilize the dollar.

However, in the real world, we know that exchange rates also react to real shocks, both temporary and permanent, as well as to longer-run shifts in the demand for money and/or financial assets. Under these circumstances, the appropriate monetary response to movements in exchange rates requires policymakers to be able to quantify the relative importance of financial shocks and real shocks.[19] It also requires policymakers to be able to distinguish *ex ante* whether exchange rate movements are due to temporary or permanent shocks.[20]

To the extent that the impact of real shocks and shifts in long-run money demand are more important than the effects of temporary money (asset) demand shocks on exchange rates, gearing monetary policies to restrain the value of the dollar too narrowly will tend to destabilize economic growth and inflation. This is a serious problem since more appropriate goals of monetary policy, such as stabilizing nominal income growth or prices, would be subverted.

III. U.S. Monetary Policy and International Coordination

This last point is not meant to rule out the usefulness of international policy coordination in a broader context for the U.S. The U.S. has an open economy and, as Bryant *et. al.* (1988) point out, monetary policy in other major countries can have real effects on the U.S. economy. Since the international transmission of the effects of policy depends in part on the stance of U.S. monetary policy relative to that of other countries, U.S. policymakers can be more effective if policies are coordinated in some broad sense.

However, it is not clear that exchange rates *per se* are the appropriate basis for such coordination. Indeed, the goals of the Federal Reserve, like those of most other central banks of countries with large open economies, are stated in terms of domestic variables, such as sustainable growth in the domestic economy and stable prices. International policy coordination clearly should not undermine or sacrifice these domestic goals. On the contrary, international agreements are possible only if the participants believe

such agreements make it more feasible to achieve domestic goals.

In this view, exchange rate considerations should influence policy if they are consistent with a country's domestic goals. To determine how this applies to the U.S., this section examines whether U.S. monetary policy since late 1985 was influenced by exchange rate considerations that were in conflict with domestic policy goals.

September 1985 Agreement

In the September 1985 Agreement among the G-5 countries, the concern was over the high value of the dollar and the U.S. trade deficit. To the extent that the September Agreement made it more likely that the imbalances among the fiscal policies of the U.S. and its trading partners would improve, the appropriate response of monetary policy was to allow both real and nominal interest rates to fall. Consistent with these policy coordination goals, we did see a series of reductions in the U.S. discount rate and a more or less steady decline in the federal funds rate in 1986. However, this stance of U.S. monetary policy also was consistent with the goal of stimulating the domestic economy. In 1986, the unemployment rate was above seven percent, inflation was below three percent, and GNP growth was slow.

EXHIBIT

Order in which Policy Variables Appeared in the FOMC Directive

MEETING	FIRST	SECOND	THIRD	FOURTH	FIFTH
3/85 to 7/85	MONETARY AGGREGATE	STRENGTH OF EXPANSION	INFLATION	CREDIT MARKET CONDITIONS	EXCHANGE RATES
8/85 to 4/86	MONETARY AGGREGATE	STRENGTH OF EXPANSION	EXCHANGE RATES	INFLATION	CREDIT MARKET CONDITIONS
5/86	MONETARY AGGREGATE	STRENGTH OF EXPANSION	FINANCIAL MARKET CONDITIONS	EXCHANGE RATES	—
7/86 to 2/87	MONETARY AGGREGATE	STRENGTH OF EXPANSION	EXCHANGE RATES	INFLATION	CREDIT MARKET CONDITIONS
3/87	EXCHANGE RATES	MONETARY AGGREGATE	STRENGTH OF EXPANSION	INFLATION	CREDIT MARKET CONDITIONS
5/87	INFLATION	EXCHANGE RATES	MONETARY AGGREGATE	STRENGTH OF EXPANSION	—
7/87	INFLATION	MONETARY AGGREGATE	STRENGTH OF EXPANSION	—	—
8/87 to 9/87	INFLATION	STRENGTH OF EXPANSION	EXCHANGE RATES	MONETARY AGGREGATE	—
11/87	FINANCIAL MARKET CONDITIONS	STRENGTH OF EXPANSION	INFLATION	EXCHANGE RATES	MONETARY AGGREGATE
12/87 to 5/88	FINANCIAL MARKET CONDITIONS	STRENGTH OF EXPANSION	INFLATION	EXCHANGE RATES	MONETARY AGGREGATE
7/88	MONETARY AGGREGATE	STRENGTH OF EXPANSION	INFLATION	FINANCIAL MARKETS	EXCHANGE RATES
8/88 to 11/88	INFLATION	STRENGTH OF EXPANSION	MONETARY AGGREGATE	EXCHANGE RATES	FINANCIAL MARKETS

Another source of relevant evidence is the Federal Open Market Committee's monetary policy directives. Heller (1988) argues that the order in which the various economic variables are mentioned in the directive generally is consistent with the relative importance placed on these variables in monetary policy considerations. As shown in the Exhibit, which is updated from one in Heller (1988), the order in which exchange rates were mentioned in the directives was raised from fifth in the meetings of March 1985 through July 1985 to third in the meetings of August 1985 through April 1986. This evidence suggests that U.S. monetary policy placed greater emphasis on the exchange value of the dollar, in line with the objectives spelled out in the September 1985 Agreement.[21]

Louvre Agreement

The Louvre Agreement of February 1987 marked the explicit move to the objective of stabilizing exchange rates around their existing levels, rather that seeking to depreciate the dollar further. Since then, exchange rate policy has focused almost exclusively on monetary policy coordination.

As Cheng (1988) points out, the first nine months of 1987 do not provide us with a clear indication of the extent to which exchange rate considerations augmented purely domestic considerations. In 1987, the pressure on the dollar generally was downward. At the same time, real GNP growth was quite robust, inflation appeared to be on the rise, and the unemployment rate had fallen to about six percent by mid-year. Thus, the goal of exchange rate stabilization was consistent with domestic developments. Some tightening of policy was warranted, and the Federal Reserve did so throughout the Spring and again in September 1987.

One indication that exchange rates played a role in the FOMC's decision to tighten in 1987 is that, in the March and May 1987 meetings of the Committee, exchange rates were either the first or second item mentioned in the policy directive.

Stock Market Breaks

One instance in which U.S. policymakers paid little or no attention to exchange rate developments was after the price breaks in world stock markets in October 1987. The breaks reshaped the outlook for the U.S. economy. The substantial loss of wealth was expected to cut into consumption and housing demand, and business investment was expected to slow. Perhaps even more importantly, there was concern over a more general disruption to financial markets stemming from the stock break. A heightened emphasis on the state of financial markets is consistent with the ordering of the policy variables in the FOMC's directives for the meetings just following the problems in the world stock markets. The response of the Federal Reserve was to inject liquidity into the market and to drive down interest rates, despite the downward pressure on the dollar. In this case, stabilizing the exchange value of the dollar was inconsistent with domestic developments, and the Federal Reserve acted solely on the basis of domestic concerns.

G-7 Agreement of December 22, 1987

The post-break employment developments in the U.S. provided the early signals that the sharp drop in equity values was not sending the U.S. economy into a tailspin. For example, from October to December 1987, the U.S. unemployment rate fell 0.2 percentage point to 5.8 percent. A softening of concern over the effects of the stock market break opened the door for resumption of international policy coordination. Efforts to support the dollar through currency intervention on the part of the G-7 (G-5 plus Canada and Italy) countries were resumed in late December 1987 and the first part of 1988.

However, clear signs of a tightening in U.S. monetary policy were not seen until somewhat later in 1988. Chart 3 shows that the federal funds rate remained in the 6½ to 6¾ percent range through March of 1988. The stability of short-term U.S. interest rates in the first part of 1988 is consistent with a continued concern over the condition of the U.S. economy, but not with a goal of boosting the value of the dollar.

Further into 1988, concerns over the dire effects of the stock market break faded considerably. For the first half of 1988, real GNP growth in the U.S. was over three percent (annual rate) and the unemployment rate, at 5.4 percent by July 1988, was at or below what most analysts view as the natural rate of unemployment. Consistent with the performance of the domestic economy, between March 1988 and the beginning of 1989, U.S. short-term interest rates rose by 250 to 300 basis points, reflecting in part tighter U.S. monetary policy.

The shift in policy in 1988, then, came only when it was fairly clear that the economy was strengthening and capacity constraints were signalling concern over inflation. Thus, although U.S. monetary policy may have affected the exchange value of the dollar in line with the objectives of policy coordination, the shift in U.S. policy apparently did not occur until domestic developments clearly warranted it.

IV. Summary and Conclusions

Movements in the foreign exchange value of the dollar and the increase in the U.S. trade deficit have fostered international agreements for policy coordination. The agreements call for the coordination of monetary and fiscal policies among the large open economies. While some progress has been made toward reducing fiscal imbalances between the U.S. and other major economies, most of the efforts at international coordination have involved monetary policy.

In the absence of further progress in reducing the U.S. fiscal deficit, it is questionable whether policy coordination can reduce world current account imbalances. While monetary policy can affect real exchange rates, it may not have much effect on real trade balances. This raises doubts about the appropriateness of centering the international coordination of monetary policy on the exchange value of the dollar, particularly in light of the difficulties involved in discerning among various types of shocks to exchange rates. Rather, policymakers internationally should focus on the more appropriate roles of monetary policy, such as stabilizing nominal income growth or the price level. This would have implications for exchange rates, but under this approach, exchange rates would play only an indirect role in policy.

Since 1985, international coordination of monetary policies directed at affecting the exchange value of the dollar may have influenced the timing and perhaps the degree of specific moves to ease or tighten U.S. monetary policy. But, whatever attention has been paid to policy coordination, the U.S. experience suggests that monetary policy has been first and foremost consistent with domestic developments. This should not be surprising since, in the end, countries participate in policy coordination to further their own domestic interests.

NOTES

1. See Dornbush (1976), Frankel (1979), Hooper and Morton (1972), and Hutchison and Throop (1985).

2. With perfect capital mobility and asset substitutability, the uncovered interest parity condition is

$$\log s_t - E_t(\log s_{t+n}) = n(i_t^d - i_t^f),$$

where

s_t = the current nominal exchange rate (units of foreign currency per unit of domestic currency).

i_t = the nominal interest rate on a security with maturity n (d denotes domestic and f denotes foreign).

$E_t(s_{t+n})$ = the expected value at time t of the nominal exchange rate n periods ahead.

If domestic and foreign assets are not perfect substitutes, the expression above also would include a risk-premium term.

3. See Hutchison and Throop (1985) for a discussion of the uncovered interest parity condition and the determination of the real exchange rate.

4. If n is small, changes in monetary policy could affect the expected inflation term. See Bryant *et. al.* (1988) for estimates of the effects of a change in monetary policy on exchange rates and foreign and domestic prices.

5. The change in monetary policy was accompanied by the adoption of nonborrowed reserves targeting operating procedures by the Federal Reserve from October 1979 through mid-1982.

6. See Judd and Trehan (1987) for an analysis of the behavior of the aggregates in the 1980s.

7. Reporting on the effects of a contraction in fiscal policy in Bryant *et. al.* (1988), it is stated: "All models simulated sustained declines in U.S. interest rates adjusted for inflation relative to ROECD (other OECD countries); that change in the real interest rate differential works to depreciate the inflation-adjusted value of the dollar."

8. In the case of increased government spending, for example, the higher value of the dollar would work to offset higher U.S. government demand for goods and services by reducing private demand (both domestically and in other countries) for U.S.-produced goods. The change in private demand would result in a deterioration in U.S. net exports. In this way, the appreciation of the dollar allows goods markets to clear.

As Hutchison and Pigott (1984) point out, this effect also could be associated with an expansionary fiscal policy resulting from a revision in tax laws that increased the after-tax return on investment, even if the fiscal budget balance were not affected. In this case, the increase in relative demand for domestic goods would come from private investment.

9. The neo-Ricardian theory, popularized by Barro (1974), holds that the method used to finance government spending (taxing or borrowing) does not affect aggregate demand. The argument is that if the government relies on debt, rational taxpayers will anticipate higher future taxes and adjust their saving accordingly. The increase in saving will exactly meet the increase in government borrowing. This should leave the real interest rate and real exchange rates unaffected.

One hypothesis that is consistent with the neo-Ricardian framework is that U.S. fiscal policy in the 1980s was expansionary because the changes in marginal tax rates made investment in U.S. assets relatively more attractive. This, in turn induced capital flows, the appreciation of the dollar and the increase in the trade deficit. It is not clear, however, that investment relative to GNP in the U.S. has been extraordinary during the current expansion. One possible explanation is that the effects of the lower tax rates on investment demand were offset by much higher real interest rates in the 1980s.

10. There is considerable debate, both at the theoretical and empirical levels, concerning the effects of fiscal policy on interest rates. Hutchison and Pyle (1984), for example, find that short-term real interest rates are systematically and positively related to central government fiscal budget deficits. Evans (1985), on the other hand, argues that the empirical evidence for the U.S. does not support the view that higher nominal interest rates are associated with large fiscal deficits.

11. The different implications of monetary and fiscal policy for the trade balance also may provide a partial explanation for the slow adjustment of the U.S. trade deficit and for its persistence through 1988, despite the sizable drop in the value of the dollar. The decline in real net exports was not reversed until the last quarter of 1986 (Chart 2). That is somewhat longer than the average lag in the response of net exports to a change in the real exchange rate. This longer lag is consistent with the argument that the drop in the exchange rate in 1985 was related mainly to real interest rate changes reflecting a relative easing of U.S. monetary policy, rather than a correction in the international imbalances in fiscal policies.

This cannot be the whole story, however. Even when the effects of monetary policy on income and exchange rates are taken into account, macroeconomic models tend to overestimate the improvement in the U.S. trade balance. Other factors contributing to the slow adjustment in the U.S. trade deficit are slower passthroughs of import prices and the increased importance of the Newly Industrialized Economies for which the dollar has depreciated less compared to, say, the G-10 countries. These factors are discussed in Glick (1988) and Moreno (1986).

12. Though difficult to quantify, the trade imbalance also may be related in part to factors such as trade barriers and international debt problems. Trade barriers reduce the

total amount of international trade, and bilateral effects depend on the relative strengths of the barriers. To the extent that the net effect of trade barriers is to reduce the U.S. share of exports, the U.S. net export position would shrink. International debt problems could reduce U.S. net exports by lowering the demand for U.S. goods, if the reduction in lending to LDCs with debt problems limits their ability to finance trade deficits and forces them to cut back imports. In addition, the trade deficit may have been affected by more attractive U.S. investment opportunities.

13. Glick (1986) discusses the motivations behind these policy actions and alternative ways of conceptualizing policy coordination.

14. This view is expressed in Johnson (1986). However, Glick and Hutchison (1988, 1989a) present evidence that suggests that the appreciation of the dollar did not deindustrialize the U.S. economy. During the 1980s, manufacturing output relative to GNP has been stable.

15. The implications of the high U.S. trade deficit and the corresponding U.S. reliance on foreign financing depend on how domestic spending has been affected. To the extent that the trade deficit has come about because of higher U.S. investment, our reliance on foreign financing does not represent a fundamental problem. Higher investment today creates the productive means for repaying our foreign debt without detracting from the standard of living in the U.S. in the future. On the other hand, those that express concern over the trade deficit argue that the foreign funds are being used to finance higher private and government consumption. This would mean that foreign borrowing is creating a burden which can be met only by a reduction in the standard of living in the U.S. in the future.

16. See Hoskins (1989).

17. When a central bank increases or decreases its holding of foreign-denominated assets using unsterilized intervention, it changes its reserve liabilities. The effects on the supply of money are similar to those of open market operations in which the central bank changes its holdings of assets denominated in the domestic currency. Under sterilized intervention, in contrast, the money supply is not affected. In this case, the balance sheet of the central bank would show a swapping of assets denominated in domestic and foreign currencies, without a change in reserve liabilities.

18. See McKinnon 1982, 1985.

19. See Glick and Hutchison, this issue of the *Economic Review*.

20. One important situation in which policymakers would have information regarding the reason for a movement in exchange rates is if further progress is made in reducing the fiscal imbalances. In that case, monetary policy would have a role as an adjunct to the adjustments in fiscal policy. As argued above, to the extent that policy coordination is aimed at significantly reducing the trade imbalance, its root cause, the international fiscal imbalance, must be addressed. Assuming that most of the adjustment comes from a tightening of U.S. fiscal policy, the trade deficit would be reduced by the combination of a lower real interest rate, a lower real exchange value of the dollar, and lower U.S. spending. In this context, U.S. monetary policy should facilitate the drop in nominal interest rates as real interest rates decline. Obviously, the international coordination of monetary policy should not attempt to stabilize the real exchange value of the dollar, but it should allow the depreciation of the dollar stemming from fiscal policy changes to proceed.

21. More recently, in testimony before the Congress, Federal Reserve Chairman Alan Greenspan also indicated the importance of the exchange value of the dollar in U.S. monetary policy.

REFERENCES

Barro, Robert J. "Are Government Bonds Net Wealth?," *Journal of Political Economy,* November-December, 1974.

Bryant, Ralph, Dale W. Henderson, Gerald Holthan, Peter Hooper, and Steven Symansky. eds., *Empirical Macroeconomics for Interdependent Economies,* Brookings Institution, 1988.

Cheng, Hang-Sheng. "Monetary Policy, 1987," *Weekly Letter,* Federal Reserve Bank of San Francisco, February 12, 1988.

Dornbusch, Rudiger. "Expectations and Exchange Rate Dynamics," *Journal of Political Economy,* December 1976.

Evans, Paul. "Do Large Deficits Produce High Interest Rates?," *American Economic Review,* March 1985.

Fleming, J. Marcus. "Domestic Financial Policies Under Fixed and Flexible Exchange Rates," *International Monetary Fund Staff Papers,* Vol. 9 No. 3, 1962.

Frankel, Jeffrey A. "On the Mark: A Theory of Floating Exchange Rates Based on Real Interest Differentials," *American Economic Review,* September 1979.

Furlong, Frederick T. and Jack H. Beebe. "Domestic and International U.S. Economic Policy in the 1980s," Processed. Paper delivered at the Eighth Pacific Basin Central Bank Conference on Economic Modeling in Kuala Lumpur, Malaysia, November 14–18, 1988.

Glick, Reuven. "International Policy Coordination," *Weekly Letter,* Federal Reserve Bank of San Francisco, June 13, 1986.

_____. "The Persistent Trade Deficit," *Weekly Letter,* Federal Reserve Bank of San Francisco, March 11, 1988.

Glick, Reuven and Michael Hutchison. "The Dollar and Manufacturing Output," *Weekly Letter,* Federal Reserve Bank of San Francisco, August 26, 1988.

_____. "Does Exchange Rate Appreciation Deindustrialize the Open Economy: A Critique of U.S. Evidence," *Economic Inquiry,* forthcoming 1989a.

_____. "Exchange Rates and Monetary Policy," *Economic Review,* Federal Reserve of San Francisco, Spring, 1989b.

Helkie, William L. and Peter Hooper. "An Empirical Analysis of the External Deficit, 1980–86," in Ralph Bryant, Gerald Holtham, and Peter Hooper, eds., *External Deficits and the Dollar: the Pit and the Pendulum,* Washington: Brookings Institution, 1988.

Heller, H. Robert. "The Making of U.S. Monetary Policy," Processed. Paper delivered at Seminar for Economic Policy, The University of Cologne, West Germany, April 27, 1988.

Hooper, Peter and John Morton. "Fluctuation in the Dollar: A Model of Nominal and Real Exchange Rate Determination," *Journal of International Money and Finance,* April, 1982.

Hoskins, W. Lee. "International Policy Coordination: Can We Afford It?," *Economic Commentary,* Federal Reserve Bank of Cleveland, January 1, 1989.

Hutchison, Michael. "Coordinating Policies with Japan," *Weekly Letter,* Federal Reserve Bank of San Francisco, August 28, 1987.

Hutchison, Michael and Charles Pigott. "Budget Deficits, Exchange Rates and the Current Account Theory and U.S. Evidence," *Economic Review,* Federal Reserve Bank of San Francisco, Fall, 1984.

Hutchison, Michael and David Pyle. "The Real Interest Rate/Budget Deficit Link: International Evidence, 1973–82," *Economic Review,* Federal Reserve Bank of San Francisco, Fall, 1984.

Hutchison, Michael and Adrian W. Throop. "U.S. Budget Deficits and the Real Value of the Dollar," *Economic Review,* Federal Reserve Bank of San Francisco, Fall, 1985.

Johnson, Robert A. "Anticipated Fiscal Contraction: The Economic Consequences of the Announcement of Gramm-Rudman-Hollings," *International Finance Discussion Papers,* Number 291, Washington: Board of Governors of the Federal Reserve System, July 1986.

McKinnon, Ronald. "Currency Substitution and Instability in the World Dollar Standard," *American Economic Review,* June, 1982.

_____. "The Dollar Exchange Rate as a Leading Indicator for American Monetary Policy," Processed. Paper delivered at the *Academic Conference,* Federal Reserve Bank of San Francisco, Fall, 1985.

Moreno, Ramon. "The NICs, the Dollar and U.S. Imports," *Weekly Letter,* Federal Reserve Bank of San Francisco, August 15, 1986.

_____. "A Stable Dollar?," *Weekly Letter,* Federal Reserve Bank of San Francisco, February 19, 1988.

Mundell, Robert. "Capital Mobility and Stabilization Policy Under Fixed and Flexible Exchange Rates," *Canadian Journal of Economics and Political Science,* November 1963.

Sachs, Jeffrey and Charles Wypolosz. "Real Exchange Rate Effects of Fiscal Policy," *National Bureau of Economic Research* Working Paper No. 1255, January 1984.

Throop, Adrian W. "International Trade and Fiscal Policy in the FRBSF Macroeconometric Model," Processed. Paper delivered at the Eighth Pacific Basin Central Banking Conference on Economic Modeling, Kuala Lumpur, Malaysia, November 14–18, 1988.

_____. "Current Fiscal Policy: Is it Stimulating Investment or Consumption?," *Economic Review,* Federal Reserve Bank of San Francisco, Winter, 1985.

Exchange Rates and Monetary Policy

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Exchange rates have been given increasing consideration in the conduct of monetary policy. This article develops a model of the determination of the exchange rate, interest rate, price level, and level of output to derive the optimal response of monetary authorities to exchange rate movements. The relative magnitudes and persistence of disturbances, as well as the structure of the economy, are shown to play roles. Advocates of using monetary policy to maintain greater fixity of exchange rates view monetary shocks as the predominant source of disturbances to the economy.

In recent years, a number of policy makers, academics, and practitioners have suggested that the Federal Reserve pay more attention to the dollar exchange rate in its formulation of monetary policy. These calls have ranged from using monetary policy to maintain the value of the dollar exchange rate at some benchmark or parity level, to targeting the dollar within "zones," or simply using the dollar as an important "signal," or indicator, for the appropriate direction of monetary policy.

The Federal Reserve, in fact, has paid more attention to the exchange rate in the formulation of policy during the past three years. In testimony to Congress outlining monetary policy objectives, Federal Reserve Chairman Greenspan has underscored the importance of the dollar as a factor in monetary policy deliberations.[1] The growing importance of the exchange rate in the implementation of U.S. policy also is indicated in the monetary policy directives of the Federal Open Market Committee.[2]

Moreover, since the Group of Five (U.S., Germany, Japan, Britain, and France) Agreement in September 1985, the United States has expressed its willingness to cooperate internationally with foreign central banks in using exchange rates as an indicator of appropriate monetary policy. On several occasions, policy makers have gone a step further, suggesting that the exchange rate be used as the primary "target" of policy rather than simply an indicator. For example, the exchange rate dominated other concerns when finance ministers and central bankers met at the Louvre meeting of the G-7 (G-5 plus Canada and Italy) in February 1987 and issued a communiqué calling for greater policy coordination to stabilize the dollar.

Although policymakers recently have been more willing to consider exchange rates in the formulation of monetary policy, the advisability of doing so remains an unresolved issue among economists. In a series of recent papers supporting an increased focus on exchange rates, McKinnon (1982, 1985) argues that the U.S., Japan, and Germany should use purchasing power parity exchange rates as the basis for a coordinated monetary policy. In McKinnon's judgment, speculative capital flows arising from shifts in international portfolio preferences are the dominant factor affecting exchange rates. In such an environment, targeting the exchange rate would work to offset the disturbances to financial markets.

In contrast, other economists (for example, Obstfeld [1985] and Willett [1985]) have argued that this approach to monetary policy is inappropriate. Willett argues that ". . . international considerations certainly should not be ignored in monetary analysis, but exchange-rate targeting offers neither a fail safe guide to monetary policy formulation nor a painless way to control inflation."[3] In Willett's view, "real" factors, such as fiscal policy, productivity shifts, and technological change, have played a major role in moving exchange rates in recent years.

In this debate, one of the most important theoretical and empirical issues focuses on the distinction between the "monetary" and "real" causes of exchange rate movements. This formulation of the problem marks an important departure from the traditional monetary policy debate. Traditionally, the policy debate has contrasted the desirability of money aggregate targeting with interest rate targeting (Poole, 1970). The new emphasis contrasts the desirability of money aggregate targeting with exchange rate targeting.

This article reviews the issues surrounding the appropriate role of exchange rates in the formulation and control of monetary policy in the United States. Our objectives are two-fold. First, we attempt to clarify the meaning of an exchange rate policy *per se* and how it relates to domestic monetary policy. Second, in the context of the recent debate and its focus on "monetary" versus "real" disturbances to the economy, we illustrate some of the factors that are important in determining an "optimal" exchange rate policy.

The rest of the paper is organized as follows. In Section I, we discuss the instruments available to the central bank in its attempt to implement an effective exchange rate policy. The important distinction between "sterilized" and "unsterilized" foreign exchange intervention is drawn and it is argued that exchange rate policy is effective only if it involves the latter. In Section II, we formulate an open economy macroeconomic model of the determination of the exchange rate, interest rate, price level, and level of output. To focus clearly on the issues associated with the present policy debate, the model is kept simple by allowing only transitory money and real aggregate demand shocks.

We derive the optimal response of the monetary authorities to exchange rate changes in their attempts to minimize output and price fluctuations in the economy. We show that the relative magnitudes of the disturbances facing the economy, as well as the structure of the economy, play an important role in determining the appropriate response of the monetary authorities to exchange rate changes.

In Section III, we discuss how the analysis is influenced by other types of shocks to the economy and by the introduction of permanent shocks. Specifically, we investigate the role played by supply shocks (for example, oil shocks, labor force shocks, and productivity or technology shocks) and by permanent disturbances to the exchange rate and other variables affecting the economy's long-run equilibrium. The value of an "exchange-rate focused" monetary policy is evaluated under these circumstances, and the contrast between interest-rate targeting and exchange-rate targeting is drawn. Section IV summarizes and draws conclusions.

I. What is an Exchange Rate Policy?

An exchange rate policy implies a systematic effort on the part of the monetary authorities to influence the level or rate of change of the exchange rate. A variety of policy instruments are potentially available to influence the exchange rate, including foreign exchange market intervention, domestic monetary policy, various forms of controls on international trade and capital flows, and official announcements of future policies.

Most attention has focused on either foreign exchange market intervention or domestic monetary policy as the primary instruments available to the central bank in its pursuit of a systematic exchange rate policy. Although there may be some potential value in "expectations" or "announcement" effects associated with a central bank's announcement concerning the appropriate level for the exchange rate, normally, the central bank must also change some current market fundamentals to credibly implement an exchange rate policy.

In many respects, it is possible to accomplish the same objectives with either domestic monetary policy or foreign exchange intervention policy. Domestic monetary policy typically involves a change in the domestic monetary base (that is, reserves held by the banking sector plus currency held by the public) brought about by the central bank through the open market puchase or sale of domestic government securities. Foreign exchange intervention involves the exchange of domestic assets for foreign assets by the central bank. Foreign exchange market intervention activity may take two forms: (1) "unsterilized," or "monetary," intervention operations—purchases or sales of the

foreign currency in the foreign exchange market that have a direct effect on the domestic monetary base; and (2) "sterilized," or "non-monetary," intervention—purchases or sales of foreign currency in the foreign exchange market that are simultaneously offset by domestic open market operations.

In the case of unsterilized intervention, the central bank changes its net foreign asset holdings through purchases and sales of foreign exchange and allows a corresponding change in its monetary liabilities, that is, the monetary base. For example, the central bank may decide to purchase foreign currency from the private sector. To pay for its purchase, the central bank credits banks' reserve accounts, causing the domestic base to increase. The central bank then may choose to purchase a foreign government bond or an interest-bearing foreign commercial bank account with its foreign exchange receipts.[4] However, whether the central bank continues to hold the foreign currency or interest-bearing foreign assets, the domestic monetary base has increased in the same way that it would with domestic open market operations.

Unsterilized intervention thus amounts to using the foreign exchange market to conduct monetary policy in lieu of the domestic financial market. In fact, in many nations with relatively undeveloped domestic money markets, the foreign exchange market is the primary vehicle through which the central bank adjusts commercial bank reserves and the domestic money base.[5]

With sterilized intervention, in contrast, the central bank offsets the change in its net foreign asset holdings with a change in its net domestic assets. In the case of an increase in its foreign asset holdings discussed above, the central bank would sell a domestic bond in order to leave domestic base money unchanged. The net effect is that the central bank holds more foreign bonds and fewer domestic bonds, leaving base money unchanged. With the monetary liabilities of the central bank unchanged in this case, the effect of the foreign exchange market intervention operations on the monetary base is "sterilized."

Changes in the portfolio holdings of the private sector mirror those of the central bank. In the examples above, both sterilized and unsterilized intervention decrease the foreign assets held by the public. Unsterilized intervention increases the public's holdings of base money, and sterilized intervention increases the public's holdings of domestic bonds.

Few disagree that unsterilized intervention has a significant influence on the market exchange rate. By changing base money, monetary intervention influences the broader monetary aggregates, prices, interest rates, exchange rates, and usually real variables as well. Extensive empirical evidence suggests that monetary policy has a pervasive influence over the nominal and real exchange rate in the short-run, and is the primary determinant of the nominal exchange rate in the longer run, as the nominal exchange rate adjusts to reflect differences in trend inflation between nations.[6]

On the other hand, because it amounts to an exchange of domestic bonds for foreign bonds held in private portfolios, sterilized intervention will be effective only if investors view the bonds as less-than-perfect substitutes (and the investors are risk averse). In this instance, relative yields and the exchange rate will adjust in response to the change in the relative supplies of assets in portfolios.

However, most studies have failed to find systematic effects on exchange rates arising from sterilized official intervention operations over periods longer than a month.[7] Moreover, attempts to find significant and systematic portfolio ("risk premia") effects in the foreign exchange market generally also have been unsuccessful.[8] In light of this evidence, the Report of the Working Group on Exchange Market Intervention (the Jurgensen Report) commissioned at the 1982 Versailles economic summit concluded that a credible exchange rate policy must be supported by fundamental policy shifts, particularly in monetary policy.[9]

Thus in practice, as well as in theory, it is much more effective for central banks to implement an exchange rate policy by changing the monetary base through unsterilized intervention than through other potential instruments. We will therefore concentrate on this aspect of exchange rate policy in the analysis below.

II. Analytics of Monetary Policy and Exchange Rate Determination

We now formulate a rational expectations model of a small open economy that illustrates the process by which the equilibrium exchange rate is determined. Since our focus is on the implications of short-term macroeconomic disturbances, in this model we posit the existence of transitory money and real demand shocks of domestic and foreign origin. The implications of considering aggregate real supply shocks and permanent shocks within the model are discussed in Section III.

The Model

The model comprises four equations: aggregate demand and supply equations for the domestic good, an international interest rate relation linking domestic and foreign interest rates, and an equation describing money market equilibrium:

$$y_t = c_0 + c_1(p_t - E_{t-1}p_t) \tag{1}$$

$$y_t = a_0 + a_1(s_t + p_t^* - p_t) - a_2[i_t - (E_t p_{t+1} - p_t)] + u_t^d \tag{2}$$

$$i_t = i_t^* + E_t s_{t+1} - s_t \tag{3}$$

$$m_t = p_t - b_1 i_t + b_2 y_t + u_t^m \tag{4}$$

where all variables (except interest rates) are expressed in logarithms, foreign variables are denoted by an asterisk (*), and E_t represents the expectations operator conditional on information available at time t.

Equation (1) describes domestic output supply behavior, with output y_t depending on unanticipated changes in the domestic price level, $p_t - E_{t-1}p_t$. This specification implicitly presumes that the wages at which workers supply their labor to firms are based on price expectations formed from information available in the previous period. Because of this one period "contract lag," firms expand output when current prices rise above the price expected by workers. In the absence of unanticipated price changes, output equals its "natural" level, c_0.[10]

Equation (2) describes domestic aggregate output demand behavior. Aggregate real demand for the domestic good depends on a constant term a_0; positively on the real exchange rate, $s_t + p_t^* - p_t$; negatively on the domestic real interest rate, $i_t - (E_t p_{t+1} - p_t)$; and on a (white-noise) random demand disturbance term u_t^d, with mean zero and variance σ_d.[11] Here s_t denotes the nominal exchange rate defined as the domestic currency price of foreign currency; i_t denotes the domestic nominal interest rate; and p_t^* denotes the foreign price level. A rise in s represents an increase in the amount of domestic currency necessary to buy a unit of foreign currency and hence a nominal depreciation in domestic currency value.

A rise in the real exchange rate $s_t + p_t^* - p_t$, that is, a real depreciation of the domestic currency, induces greater demand for domestic output while a higher real interest rate induces lower current consumption (and investment) and thereby reduces current demand. The demand disturbance term may be interpreted as representing the effects of transitory exogenous shifts in the demand for domestic output arising, for example, from changes in autonomous private and foreign (export) spending, or in domestic fiscal expenditures. (Permanent shifts in demand are reflected by changes in the parameter a_0.) Note that in the case of perfect international substitution of goods, a_1 becomes infinite in size, and this aggregate demand equation reduces to the familiar purchasing power parity relationship.

Equation (3) represents the international interest rate parity condition. Assuming risk neutrality on the part of agents and perfect capital mobility, equilibrium in the international bond market requires that the domestic nominal interest rate, i_t, equal the foreign nominal interest rate, i_t^*, plus the expected depreciation of the domestic currency. This condition implies that the return to holding domestic and foreign assets is equal. An exogenous risk-premium term could be introduced without affecting the analysis.

Finally, equation (4) represents the money market equilibrium condition. This requires the domestic real money supply to equal domestic real money demand, where the latter depends positively on domestic output, and negatively on the domestic nominal interest rate. In addition, money demand is affected by a (white-noise) random shock term, u_t^m, with mean zero and variance σ_m. The shock term represents transitory shifts in the demand for money. For example, a transitory shift by foreign residents away from foreign currency and toward domestic currency (currency substitution) or a transitory downward velocity shift of domestic origin would be represented by positive realizations of u_t^m.

To allow the possibility of exchange market intervention by monetary authorities, it is assumed that the nominal money supply is determined by the following intervention rule:

$$m_t = \bar{m} - k(s_t - \bar{s}), \tag{5}$$

where the money supply is given by the sum of a constant

trend component $\bar{m}$ and a component that varies in response to deviations in the current level of the nominal exchange rate from its long-run equilibrium level $\bar{s}$.

A zero value of k corresponds to a policy that targets money supply growth. A non-zero value of k corresponds to a monetary policy that responds to the current level of the exchange rate as a signal of economic conditions.[12] The polar cases of fixed and flexible rates correspond to infinite and zero values, respectively, of the intervention parameter, k. Intermediate values of k correspond to managed floating. With more general specifications of the intervention rule, monetary authorities might respond to other signals as well, such as the domestic interest rate or price level. (See Turnovsky [1981].)[13]

A positive value of k implies that policy is directed at "leaning against the wind," that is, a depreciation in domestic currency value (rise in s) induces a contraction of the money supply. This is a widely employed policy for moderating exchange rate movements. A negative value of k implies the opposite policy of "leaning with the wind."

For simplicity, the analysis retains the small-country assumption, and treats the foreign country variables $p_t^*$and i_t^*as exogenous, constant, and for convenience, equal to zero.

Equilibrium Adjustment

The set of equations (1)–(5) can be solved for the current values of y_t, p_t, s_t, and i_t as functions of money and demand disturbances:[14]

$$y_t - \bar{y} = -\frac{c_1(a_1 + a_2)}{A_0} u_t^m + \frac{c_1(b_1 + k)}{A_0} u_t^d \qquad (6)$$

$$p_t - \bar{p} = -\frac{a_1 + a_2}{A_0} u_t^m + \frac{b_1 + k}{A_0} u_t^d \qquad (7)$$

$$s_t - \bar{s} = -\frac{a_1 + a_2 + c_1}{A_0} u_t^m - \frac{1 + b_2 c_1}{A_0} u_t^d \qquad (8)$$

$$i - \bar{i} = \frac{a_1 + a_2 + c_1}{A_0} u_t^m + \frac{1 + b_2 c_1}{A_0} u_t^d \qquad (9)$$

where

$$A_0 = (b_1 + k)(a_1 + a_2 + c_1) + (a_1 + a_2)(1 + b_2 c_1),$$

and $\bar{y}$, $\bar{p}$, $\bar{s}$, and $\bar{i}$ are the long-run equilibrium levels of the system, which may be shown to equal:

$$\bar{y} = c_0$$

$$\bar{p} = \bar{m} + + b_1 \bar{i}^* - b_2 c_0$$

$$\bar{s} = \frac{c_0 - a_0 + a_1(\bar{p} - \bar{p}^*) + a_2 \bar{i}^*}{a_1}$$

$$\bar{i} = \bar{i}^*$$

Observe that the long-run nominal exchange $\bar{s}$ depends on long-run real and nominal factors. The long-run equilibrium value of the domestic currency depreciates ($\bar{s}$ rises) as the long-run domestic price level ($\bar{p}$) rises, as the long-run output level (c_0) rises, and as aggregate demand (a_0) shifts permanently downward.

Output, the domestic price level, the exchange rate, and the domestic interest rate may diverge from their long-run equilibrium values because of transitory disturbances. We now discuss the effects of transitory increases in nominal money demand and in real aggregate demand on the equilibrium for the economy.

A transitory rise in money demand (u_t^m) induces a nominal appreciation of the domestic currency, a rise in the domestic interest rate, and a decline in the domestic price level. In addition, because the nominal currency appreciation is larger than the fall in domestic prices, the rise in money demand causes a decline in $s_t - p_t$, that is, a real appreciation as well.[15] Consequently, the demand for the domestic good decreases. With wages fixed during the contract period, the fall in the domestic price level raises the producer's real wage, implying a fall in aggregate supply and output. Thus during the contract period, the upward shift in money demand has a contractionary effect on the economy.

On the other hand, a transitory positive real demand shock (u_t^d) induces a nominal appreciation of the domestic currency and a rise in the domestic price level, as well as a real appreciation, that is, a fall in $s_t - p_t$. Intuitively, the demand shock creates an excess demand for domestic output. Excess demand then induces an increase in the real value of the domestic currency to shift demand away from the domestic market.

The sign and magnitude of the intervention parameter k plays an important role in the equilibrium adjustment of the economy.[16] Observe that if k is positive, the larger is k, the larger is the denominator A_0. Consequently, from expressions (6)–(9), the responses of output, the price level, the exchange rate, and the interest rate to monetary shocks are less (in absolute value) than in the absence of any intervention. Intuitively, the more policymakers lean against the wind ($k > 0$), the more the effects of any money demand shocks are dampened by offsetting changes in the

money supply in response to changes in the exchange rate. Analogously, if the authorities lean with the wind ($k < 0$), then exchange rate movements exaggerate equilibrium responses to money shocks.

In contrast, it can be shown that the price and output responses to aggregate demand disturbances are magnified in the case of leaning against the wind and are dampened in the case of leaning with the wind. For example, a positive demand disturbance directly creates higher output and prices, but because the monetary authority responds to the associated appreciation in the domestic currency by increasing (decreasing) the money supply, the monetary authority induces a stronger (weaker) output response when a strategy of leaning against (with) the wind is pursued.

Optimal Intervention

The optimal degree of intervention can be determined by finding that value of k that minimizes the expected value of a particular policy loss function (L). For simplicity, we assume that policymakers are concerned with minimizing a weighted average of squared deviations of domestic output and the price level from their equilibrium levels:

$$L = w_1(y - \bar{y})^2 + w_2(p - \bar{p})^2$$

$$0 \leq w_1 \leq 1, \quad 0 \leq w_2 \leq 1, \quad w_1 + w_2 = 1$$

It is assumed that in determining the optimal exchange rate response function, policy makers know the structural parameters of the economy; the only source of uncertainty concerns the relative magnitudes of the stochastic disturbances.

It can then be shown that the formula for the optimal intervention strategy ($\hat{k}$) has the following form:

$$\hat{k} = -b_1 + \frac{(a_1 + a_2)(a_1 + a_2 + c_1)\sigma_m}{(1 + b_2 c_1)\sigma_d} \qquad (10)$$

where σ_m and σ_d signify the variances of the transitory money and aggregate demand shocks, respectively.

According to equation (10), the optimal intervention strategy depends on the relative variances of money and aggregate demand shocks, as well as on the structural parameters of the economy. In the presence of both domestic monetary and aggregate demand disturbances, a limited form of foreign exchange intervention is called for, with the degree of intervention determined by the relative importance of the two disturbances.[17]

Equation (10) implies that the greater is the relative magnitude of money shocks, the more the authorities should lean against the wind and intervene to resist exchange rate movements (that is, the higher should be the value of $\hat{k}$) since this policy stance will lead to smaller output effects arising from the initial money shocks. Quite simply, a positive money demand shift tends to appreciate the exchange rate. If the central bank increases the money supply in response, money market equilibrium may be restored with little or no effects on real output.[18] Conversely, the greater is the relative magnitude of aggregate demand shocks, the lower should be the value of $\hat{k}$, and the less should the authorities lean against the wind. If the variance of aggregate demand disturbances is large enough, in fact, leaning with the wind (that is, $\hat{k} < 0$) is desirable. In this instance, the authorities will again intervene, but in a manner that leads to a *decrease* in the money supply in response to the exchange rate appreciation so as to lessen the stimulatory effect on output.

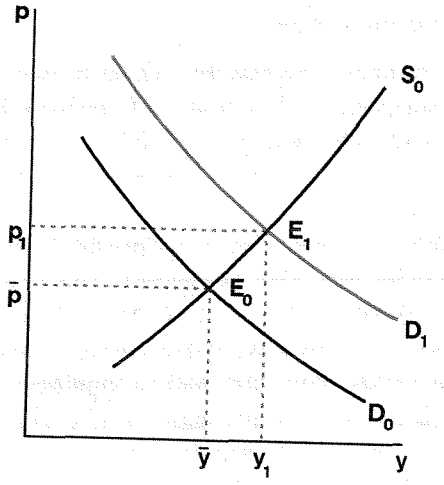
In the extreme case that money disturbances alone affect the economy ($\sigma_d = 0$), (10) implies that $\hat{k}$ takes on an infinite positive value, and perfectly fixed exchange rates are desirable. This corresponds with the rule proposed by McKinnon (1982, 1985). One interpretation of McKinnon's views is that the preferences of international investors between foreign and domestic currency are unstable (so-called "speculative" capital flows), and in turn lead to a predominance of money demand shocks in the U.S. economy. Ample evidence of U.S. money demand shocks exists, and some research indicates foreign sources of shocks, as well. The main rationale for McKinnon's policy recommendation of greater fixity in exchange rates (larger $\hat{k}$) is based on his perception of the greater relative importance of money shocks facing the economy.[19]

Perfectly flexible rates, in contrast, are desirable only in the special case that aggregate demand disturbances alone affect the economy ($\sigma_m = 0$) *and* the interest sensitivity of money demand is zero ($b_1 = 0$). A major economic rationale for Willett's (1985) policy recommendation of greater exchange rate flexibility (low $\hat{k}$ value) is his perception that real disturbances have been a relatively large source of uncertainty in the economy over the past decade.

Optimal exchange rate policy depends on the structural parameters of the economy in addition to the relative magnitudes of disturbances.[20] For example, in this framework the authorities should lean harder against the wind, the greater are the sensitivities of aggregate demand to the real exchange rate (a_1) and of aggregate supply to price surprises (c_1).

Note that the relative preferences of policymakers for output or inflation (w_1, w_2) do not appear in expression (10). The reason is that in this simple model, the economy is affected only by aggregate money and real demand

Chart 1



disturbances. Policies that minimize output fluctuations also minimize variations in inflation. Hence, the output-inflation tradeoff reflected in the weights w_1 and w_2 assigned by policymakers in their loss function drops out of the optimal intervention function.

This can be illustrated with Chart 1. The chart shows the effects on the economy of a monetary shock (downward shift in money demand) or goods market shock (rise in the demand for domestic output). Both shift the aggregate demand curve upward from D_0 to D_1, and put temporary upward pressure on prices and output. The supply schedule is unaffected. To offset the positive shock to aggregate demand, the central bank contracts money and shifts aggregate demand back to D_0. Since the contraction of aggregate demand stabilizes both output and the price level around the equilibrium values $\bar{y}$ and $\bar{p}$, there is no policy conflict in this case between the output and price objectives of the central bank.[21] In Section III we discuss how this result is affected by the introduction of real supply shocks.

III. Qualifications and Extensions

The simple analytical model described above demonstrates some of the complexities involved in attempting to formulate the appropriate role of exchange rates as an indicator or signal in the conduct of monetary policy. We have focused on two important types of shocks—money disturbances and real aggregate demand disturbances—to help us distinguish between the most divergent points of view among economists concerning the appropriate role of exchange rates in monetary policy decisions. The real world is more complicated than any simple model can hope to depict, however, and to some extent, the gains in clarity associated with our model partly have been made by abstracting from several other important policy issues. In this section we extend the analysis to address some of these complications. Specifically, we investigate the complications arising when the economy faces shocks to aggregate supply, and when the shocks are permanent rather than transitory. We also consider the relative merits of an exchange rate rule as opposed to an interest rate rule in the conduct of monetary policy under these circumstances.

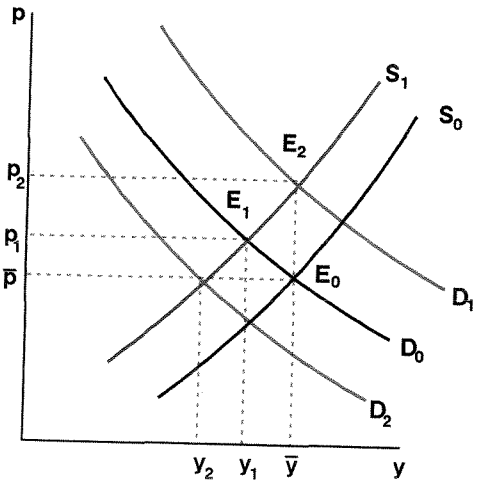
Supply Shocks

The introduction of a stochastic term in the real supply equation (1) captures the effects of transitory supply shifts arising from changes in technology and productivity, labor force growth, or natural resource availability in the economy. The oil shocks of the early and late 1970s, for example, are typically viewed as having significant unanticipated effects on the output supply function. Introducing supply shocks complicates the analysis in two important ways.

First, the optimal degree of monetary response k becomes a function of the variance of supply disturbances as well as of money demand and real aggregate demand. However, the appropriate response to exchange rate movements generated by supply disturbances no longer is clear-cut because the effect of a supply shock on the exchange rate is ambiguous. If goods demand is highly responsive to the real exchange rate (that is, foreign and domestic goods are close substitutes) and to real interest rates (a_1 and a_2 are large), then the domestic currency will appreciate in response to a positive supply disturbance. If demand is not responsive (a_1 and a_2 are small), however, the currency will depreciate in order to induce the purchase of the additional domestic output associated with the positive supply shock.[22] Thus, assuming policymakers are able to distinguish between supply and demand shocks, they still must know not only the *signs* of the relevant structural parameters (a_1 and a_2), but also their magnitudes to develop the optimal response of monetary policy to movements in exchange rates.

A second complication associated with the introduction of supply shocks in the model concerns the output-inflation tradeoff. With supply shocks, output and the price level move in different directions. In this case, the relative

Chart 2



weights policymakers place on inflation and output stability in their loss function (w_1, w_2) become important for the optimal monetary response to exchange rates.

Chart 2 illustrates the basic conflict for the case of an adverse (negative) supply shock that shifts the aggregate supply schedule from S_0 to S_1. Downward pressure is placed on output (to y_1) and upward pressure is placed on the price level (to p_1). With only one instrument (money), policymakers must choose which target, or linear combination of the two targets, they wish to stabilize. For example, if policymakers are concerned solely with output stability ($w_1 = 1$, $w_2 = 0$ in the loss function), the central bank should expand aggregate demand to D_1. This would stabilize output at its long-run equilibrium, but would exaggerate the price rise to p_2. The appropriate exchange rate policy in this case is to lean with (against) the wind if the supply shock induces a currency depreciation (appreciation).

At the other extreme, if policymakers are solely concerned with price stability ($w_1 = 0$, $w_2 = 1$), then the appropriate response would be to follow a contractionary monetary policy and reduce aggregate demand from D_0 to D_2. This would keep prices around the longer-term equilibrium ($\bar{p}$), but also would exaggerate the contractionary effect on output and move y to y_2. In this case, the policymaker should lean against (with) the wind if the supply shock induces a currency depreciation (appreciation).

Thus, in general, when the economy is facing a supply shock, greater output stability is gained at the expense of larger fluctuations in price and *vice versa*. Hence, policymakers' views of the relative costs involved in the output-inflation tradeoff become an important element in the determination of the optimal exchange rate policy.[23]

Permanent Disturbances

The focus of our analysis thus far has been on short-term stabilization policy. Our analytical framework for the optimal monetary response to exchange rate changes was therefore couched in terms of transitory disturbances to various markets.

In reality, of course, the economy faces not only temporary shocks but also permanent shocks. Moreover, temporary shocks may persist for more than one period. For example, the rise of the dollar during the early to mid-1980s was associated first with a significant monetary contraction and then with a large fiscal expansion. These were not simple one-period transitory disturbances, but lasted over a period of several years.

The effects of these policy shifts on the exchange rate and the price level have been the subject of a large body of research. Unquestionably, the long-term equilibrium value of the exchange rate $\bar{s}$ was affected by these developments. The bulk of the empirical research supports our model's prediction that a permanent monetary contraction (decline in $\bar{m}$) or fiscal expansion (rise in a_0) works to appreciate the long-term equilibrium value of the dollar exchange rate. This is seen by inspection of the expression for $\bar{s}$ given in Section II.

Our central bank loss function assumes that policymakers attempt to stabilize output and prices around their long-run equilibrium values. It is implicitly assumed that there is no attempt to offset longer-term movements in these values, and as such no reaction by the central bank to changes in $\bar{s}$. The justification for this approach is that monetary policy has no effects on the long-term (equilibrium) value of output, regardless of the form of the policy rule and response to exchange rate movements.

This formulation of the problem is appropriate for a short run focus over the course of the business cycle, but raises an important question: what if the central bank cannot distinguish transitory ($s - \bar{s}$) movements from long-term equilibrium movements ($\bar{s}$) in the exchange rate? We have assumed that the central bank knows the equilibrium values of all variables, including the exchange rate, and therefore can distinguish transitory movements, as distinct from movements in the long-run values. However, if there is a confusion between transitory and permanent movements, in addition to uncertainty concerning the nature of the underlying disturbances (real or monetary shocks), the noise in the information provided by the exchange rate is increased.

In practice, of course, policy makers *do* have difficulty distinguishing between permanent and transitory disturbances. If the Federal Reserve had attempted to offset the appreciating dollar associated with the persistent fiscal stimulus between 1982 and 1984, for example, monetary policy would have been significantly more expansionary than it was. The monetary stimulus to aggregate demand would have pushed nominal output growth and inflation significantly higher, making U.S.-produced goods more expensive even with an unchanged dollar exchange rate. The equilibrium real value of the dollar ($s + p^* - p$) still would have appreciated. Hence, it is apparent in this example that an attempt by the Fed to offset the sustained pressures on the dollar would have primarily shifted the effects away from the nominal exchange rate towards the domestic price level. Thus, to the extent that permanent or very persistent shocks are important, monetary policy needs to allow the exchange rate to adjust to the new long-run equilibrium level.

Exchange-Rate versus Interest-Rate Targets

Exchange rates and interest rates are both asset prices which, if allowed to adjust freely to market conditions, might serve as indicators of the direction of monetary policy. This raises an interesting question: in what ways does an exchange-rate target differ from an interest-rate target?

In our model, as long as the economy only faces shocks to real goods demand and/or money demand, there is no substantive difference between an exchange-rate policy target and an interest-rate policy target. This is seen in the reduced-form equations (8) and (9) for s and i, respectively. The exchange rate and interest rate response to money demand and real demand shocks are equal in magnitude and opposite in sign.

Thus, for example, a transitory increase in U.S. money demand would raise interest rates and cause the dollar to appreciate. Similarly, a transitory increase in the demand for U.S. goods also would raise interest rates and cause the dollar to appreciate. In both cases, exchange rates and interest rates give the same signal and do not help to distinguish between the two types of shocks. The Federal Reserve therefore gains no additional information by looking at interest rates (exchange rates) when following an exchange-rate (interest-rate) rule in its attempts to stabilize output and prices.

When supply shocks are present, however, this is not necessarily the case since the interest rate may reveal information about economic conditions that is not reflected in exchange rates alone. For example, under circumstances discussed above (low aggregate demand responsiveness to changes in exchange rates and interest rates), a positive supply shock, such as a transitory fall in oil prices, will cause the domestic currency to depreciate and *raise* interest rates. In this case, looking at both exchange rates and interest rates would enable policymakers to distinguish the supply disturbances from other shocks that would depreciate the dollar and lower interest rates, such as a fall in money demand or in goods demand. Thus, under the more general circumstances where supply shocks are taken into account, an optimal monetary policy rule would incorporate both exchange rates and interest rates.[24]

VI. Conclusions

This paper has investigated the issues surrounding a central bank policy of targeting exchange rate levels. We first distinguish between the various policy instruments that are potentially available to the central bank in its attempts to "manage" exchange rates. We argue that a credible exchange rate policy must be supported by monetary policy in order to be effective. However, we also demonstrate that a monetary policy designed to minimize exchange rate fluctuations will not generally be an optimal policy. In particular, the appropriate monetary response to an exchange rate movement should be dictated by the extent to which the exchange rate provides a reliable "signal" to future changes in variables of ultimate policy interest, that is, output and/or prices.

To analyze these issues, we present an open economy macroeconomic model that explicitly allows for different degrees of monetary response to exchange rate changes. The model takes into account short-term (transitory) disturbances to the goods market and money market. In this stochastic setting, we show that the optimal monetary response to exchange rate changes depends on the nature of the shocks the economy faces.

In the introduction we pointed out that two polar views on the appropriate use of exchange rates have dominated the policy debate; one view argues for strong monetary responses to incipient exchange rate movements (fixed exchange rates) and the other view argues for relatively little monetary response (floating exchange rates).

Our analysis suggests that there are reasonable arguments supporting both points of view, depending on how one reads the historical record on the types of disturbances that have predominated. Namely, the main conclusion

arising from our theoretical analysis is that an economy facing primarily money market disturbances will benefit from a strong monetary response to exchange rate fluctuations. An active exchange rate policy in this sense will reduce domestic output fluctuations. However, if goods market disturbances are the primary source of economic fluctuations, then less active exchange rate management would be appropriate.

Those who argue for an "activist" monetary response and relative fixity in exchange rates usually view monetary shocks—either of domestic or foreign origin—as having been the predominant source of shocks to the U.S. economy over the past decade. Moreover, the presumption is that the relative frequency and magnitude of the monetary shocks will continue to predominate in the near future. In contrast, those who argue for a limited monetary response usually view real demand disturbances—either of domestic or foreign origin—as the predominant source of shocks to the U.S. economy. These different readings of the historical record lead observers to different views on optimal exchange rate policy.

There is ample evidence of numerous real and monetary shocks influencing the U.S. economy over the past decade. Examples of recent real aggregate demand shocks are the large shifts in government spending and tax policies under the Reagan Administration, the introduction of new competitors from East Asia in world trade, and the boom in business investment spending in the early 1980s. Examples of recent monetary shocks are the shift in foreign investment preferences toward U.S. assets in the early 1980s, financial innovation in the U.S. economy and related velocity shifts, and Federal Reserve monetary control regime shifts.

Which type of shocks has been more important, how persistent have they been, and which will likely predominate in the future? The relative importance of shocks in the historical record is an empirical issue that remains to be resolved, despite voluminous research in this area. In the face of this uncertainty, to say nothing of the problems introduced by such supply shocks as the movements in the price of oil over the last 15 years, it would appear that some pragmatism in policymaking would be appropriate. One can interpret U.S. policy actions in this light. The Fed's recent move to a greater focus on the exchange rate is largely a pragmatic response to recent events and the concern that at times the degree of exchange rate volatility has been excessive. A gradual move away from perfectly flexible exchange rates and toward greater exchange rate fixity supported by monetary policy has been the result.

NOTES

1. See Greenspan (1988).

2. Furlong (1989) uses the order in which various economic factors were mentioned in the FOMC monetary policy directives from 1985 through August 1988 to evaluate the importance of each factor in policy decisions. This ranking criterion shows that increasing attention has been paid to exchange rates.

3. Willett (1985), p. 212.

4. The central bank need not convert its foreign exchange receipts into foreign currency securities, but in practice, central banks rarely hold the monies of other countries.

5. Switzerland is an example of an industrial nation that undertakes all of its open market operations through the foreign exchange market.

6. Empirical evidence showing a strong link between changes in the money aggregates and exchange rates has been found by Frankel (1979) and Mussa (1979), among others.

7. See Obstfeld (1982), Hutchison (1984), and Loopesko (1984).

8. See Frankel (1982).

9. The sale of government bonds to finance government budget deficits generally plays a larger role in determining the bond mix in private portfolios than does intervention. This poses another difficulty for central banks in using sterilized intervention as a tool for exchange rate management.

10. In an open economy, aggregate supply may depend also on anticipated changes in the price of domestic goods relative to changes in the general price level, and hence on changes in the expected real exchange rate. However, we implicitly assume that the *ex ante* labor supply function is inelastic with respect to the real wage prior to signing labor contracts. Once labor contracts are signed, the (*ex post*) amount of labor supplied is determined by the demand for labor which depends only on the price of domestic goods. This implies that aggregate supply would be independent of the real exchange rate.

Equation (1) could be modified to incorporate wage indexation. With full wage indexation, an unanticipated change in the general price level can lead to proportional adjustment of the domestic price. In this case, unless there were aggregate supply shocks, output would always be constant. For a concise discussion of these issues, see Marston (1985).

11. For simplicity, the real domestic interest rate is defined in terms of p, the price of the domestic good alone, rather than the general price level, which includes the price of imported goods. An analogous assumption is employed below when the nominal money supply is deflated by p. The general results are unaffected by this simplification.

12. The difference between using the exchange rate as a "signal," or "indicator," as opposed to a "target," of policy is fairly subtle. This is because any systematic monetary response to exchange rate movements will, in turn, influence the value of the exchange rate. In the case where the signal is an exogenous variable to the system (an observable signal that reflects, for example, a composite of underlying exogenous disturbances), this complication does not arise. It is noteworthy that a monetary policy that simply fixes the value of the exchange rate dissipates the "signalling" value of the exchange rate unless equivalent information concerning the changes in international reserves associated with government intervention activities is revealed to agents. See Bhandari (1982), Kimbrough (1983, 1984), Flood and Hodrick (1985), and Glick and Wihlborg (1986).

13. It should be noted that in the model as specified, lagged variables would be irrelevant to policymakers, since disturbances are not serially correlated and the current period's equilibrium is always independent of the previous period's equilibrium.

14. For details, see Glick and Hutchison (1989). It should be noted that the particular assumptions of one-period contract lags, transitory disturbances, and no inventory or real investment channels through which the effects of current shocks would persist into the future imply that current shocks have no effect on the economy beyond the current period. Thus, the rational expectation at time t of any future value of a variable is the long-run stationary value of that variable.

15. This may be seen by subtracting the coefficient for a money demand shock in (7) from the corresponding coefficient in (8). Recall that the foreign price level is assumed constant, implying $p^* = 0$.

16. Note that in this model, foreign exchange intervention is based on the authorities' knowledge of the current exchange rate, while agents base wages on information available in period $t - 1$. It is this asymmetry that allows intervention to influence output. This asymmetry may be justified by relatively greater costs associated with renegotiating nominal wages compared with adopting policy responses. See Henderson (1984).

17. The role of the relative variances of disturbances in determining exchange rate policy previously has been noted by Boyer (1978), Frankel and Aizenman (1982), Henderson (1984), and Devereux (1988). The results are analogous to those of Poole (1970) for optimal monetary policy in a closed economy. More complex policies involving two policy instruments are necessary if agents have more than one objective or if the coefficients of the model are not known with certainty.

18. It should be pointed out that Frenkel and Aizenman (1982) draw the opposite conclusion and conclude that greater exchange rate flexibility should be permitted if money shocks dominate. The reason is that they employ a model that assumes purchasing power parity and no wage contract lags so that income and the exchange rate essentially are determined by money market conditions.

In the presence of money shocks, their model implies that it is better to restore money market equilibrium by allowing price changes to occur through exchange rate changes than through output changes.

19. This rationale for monetary policy in the form of unsterilized intervention presumes that the predominant disturbances to the economy are portfolio shifts between domestic and foreign monies. If, however, the predominant disturbances are shifts between domestic and foreign-currency denominated securities and if these assets are imperfect substitutes, the appropriate monetary policy would be sterilized intervention. In this case, the central bank will offset the shift in asset demand without affecting the money supply.

20. It should be emphasized that the Lucas critique (1972) implies that the behavioral parameters of the model depend on agents' expectations concerning future government policies. Therefore, changes in government policies may affect the structure of the economy and the effectiveness of the policies themselves.

21. An alternative way to draw this conclusion is to note from the reduced-form equilibrium expressions (6) and (7) that output and price fluctuations are multiplicatively related by the parameter c_1.

22. The relevant condition for an appreciation in response to a positive supply disturbance is $(a_1 + a_2)b_2 > 1$. See Glick and Hutchison (1989).

23. The introduction of wage indexation generally reduces the impact of supply shocks. See Devereux (1988).

24. Imperfect substitutability between domestic and foreign assets also would affect the relative information content of the exchange rate and interest rate.

REFERENCES

Bhandari, J. "Informational Efficiency and the Open Economy," *Journal of Money, Credit and Banking,* November 1982.

Boyer, Russell. "Optimal Foreign Exchange Intervention," *Journal of Political Economy,* 1978.

Devereux, Michael. "The Optimal Mix of Wage Indexation and Foreign Exchange Market Intervention," *Journal of Money, Credit and Banking,* August 1988, Part 1.

Flood, R. and R. Hodrick. "Central Bank Intervention in a Rational Open Economy: A Model with Asymmetric Information," in J. Bhandari, ed., *Exchange Rate Management and Uncertainty,* Boston: MIT Press, 1985.

Frankel, Jeffrey. "On the Mark: A Theory of Floating Exchange Rates Based on Real Interest Differentials, *American Economic Review,* September 1979.

_____. "In Search of the Exchange Risk Premium: A Six-Currency Test Assuming Mean-Variance Optimization," *Journal of International Money and Finance,* December 1982.

Frenkel, Jacob and J. Aizenman. "Aspects of the Optimal Management of Exchange Rates," *Journal of International Economics,* 1982.

Frisch, H. "Real and Nominal Shocks in an Open Economic Model with Wage Contracts," *Giornale Degli Economisti e Annali di Economia,* 1985.

Furlong, Frederick. "International Dimensions of U.S. Economic Policy in the 1980s," *Economic Review,* Federal Reserve Bank of San Francisco, this issue.

Glick, Reuven and Michael Hutchison. "Stochastic Disturbances and Optimal intervention Policy," Mimeo, 1989.

Glick, Reuven and Clas Wihlborg. "The Role of Information Acquisition and Financial Markets in International Macroeconomic Adjustment," *Journal of International Money and Finance,* September 1986.

Greenspan, Alan. "1988 Monetary Policy Objectives," Statement before the Committee on Banking, Housing and Urban Affairs of the U.S. Senate, July 13, 1988.

Henderson, Dale. "Exchange Market Intervention Operations: Their Effects and their Role in Financial Policy," in J. Bilson and R. Marston, eds., *Exchange Rate Theory and Policy,* NBER, Chicago: University of Chicago Press, 1984.

Hutchison, Michael. "Intervention, Deficit Finance and Real Exchange Rates: The Case of Japan," *Economic Review,* Federal Reserve Bank of San Francisco, Winter 1984.

Kimbrough, Kent. "The Information Content of the Exchange Rate and the Stability of Real Output under Alternative Exchange Rate Regimes," *Journal of International Money and Finance,* April 1983.

_____. "Aggregate Information and the Role of Monetary Policy in an Open Economy," *Journal of Political Economy,* April 1984.

Loopesko, Bonnie. "Relationships Among Exchange Rates, Intervention and Interest Rates: An Empirical Investigation," *Journal of International Money and Finance,* 1984.

Lucas, Robert E. "Expectations and the Neutrality of Money," *Journal of Economic Theory,* April 1972.

Marston, R. "Stabilization Policies in Open Economies," in Ron Jones and Peter Kenen, eds., *Handbook of International Economics,* Vol II, Amsterdam: Elsevier, 1985.

McKinnon, Ronald. "Currency Substitution and Instability in the World Dollar Standard," *American Economic Review,* June 1982.

_____. "The Dollar Exchange Rate as a Leading Indicator for American Foreign Policy," Federal Reserve Bank of San Francisco, *Proceedings of the Academic Conference,* Fall 1985.

Mussa, Michael. "Empirical Regularities in the Behavior of Exchange Rates and Theories of the Foreign Market," *Carnegie-Rochester Conference Series on Public Policy,* 1979.

Obstfeld, Maurice. "Can We Sterilize? Theory and Evidence," *American Economic Review,* May 1982.

_____. "Floating Exchange Rates: Experience and Prospects," *Brookings Papers on Economic Activity,* No. 2, 1985.

Poole, William. "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model," *Quarterly Journal of Economics,* May 1970.

Turnovsky, Stephen. "Monetary Policy and Foreign Price Disturbances under Flexible Exchange Rates," *Journal of Money, Credit and Banking,* May 1981.

Willett, Thomas. "The Dollar Exchange Rate as a Leading Indicator for American Monetary Policy: Comments," *Proceedings of the Academic Conference,* Federal Reserve Bank of San Francisco, Fall 1985.

Working Group on Exchange Market Intervention Established at the Versailles Summit of the Heads of State and Government, June 4–6, 1982. Report of the Working Group on Exchange Market Intervention," March 1983.

Exchange Rates and Trade Adjustment in Taiwan and Korea

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This paper identifies the extent to which exchange rate movements directly explain improvements in competitiveness and rising trade surpluses in Taiwan and Korea in the 1980s. The hypothesis that exchange rate movements improved competitiveness and thus contributed directly to trade imbalances in the 1980s holds for Korea, but not for Taiwan. On the basis of the paper's results, the options available to both economies in attempting to correct their external imbalances are briefly examined.

The large trade surpluses of the newly-industrializing economies (NIEs) of East Asia have been the subject of much discussion in recent years. Following their meetings at the Louvre in Paris in February 1987, the Finance Ministers of the G-6 major industrial countries issued a communiqué noting that the Asian NIEs[1] were contributing importantly to the present pattern of global imbalances. They called on the NIEs to assume greater responsibility for preserving an open world trade system by reducing trade barriers and pursuing policies that allow their currencies to reflect more fully underlying economic fundamentals.

Among the NIEs, Taiwan and Korea, in particular, have accumulated large trade surpluses in recent years,[2] leading to allegations of unfair trading practices. For example, in October 1988, the U.S. Treasury reported to the Congress that Taiwan and Korea have used trade restrictions to gain competitive advantage, and that it considers Taiwan and Korea to have "manipulate(d) the rate of exchange between their currency and the U.S. dollar for purposes of preventing effective balance of payments adjustments or gaining unfair competitive advantage in international trade."[3] As a result, the United States is negotiating with both Taiwan and Korea on their exchange rate policies.

These negotiations apparently assume that Taiwan and Korea would have been far less competitive, and their trade surpluses would have been much smaller, if currency manipulation had not prevented the appreciation of their currencies. This assumption cannot be easily tested, as it is impossible to determine what the exchange rates of Taiwan and Korea would have been in the absence of government intervention in exchange markets. However, it is possible to determine the direct contribution of exchange rate movements to the competitiveness, and hence trade surpluses, of Taiwan and Korea. A finding that exchange rate movements account for significant competitive gains and have therefore been a major source of trade imbalances would support the concern with the exchange rate policies of these two economies.

The paper is organized as follows. Section I reviews trends in trade flows, and discusses how trade and exchange rate policies may have influenced competitiveness. Section II describes a standard partial equilibrium model

of export and import prices and volumes to determine the relationships between exchange rates, competitiveness, and real trade flows in these two economies. Section III discusses the results of estimating this model and identifies the contribution of exchange rates, relative prices, and relative income growth to the trade surpluses of Taiwan and Korea between 1974 and 1987. Rough calculations also illustrate the extent of exchange rate appreciation that would be required to eliminate recent trade surpluses and subsequently maintain trade balance. Section IV presents conclusions.

I. Trade Flows and Competitiveness

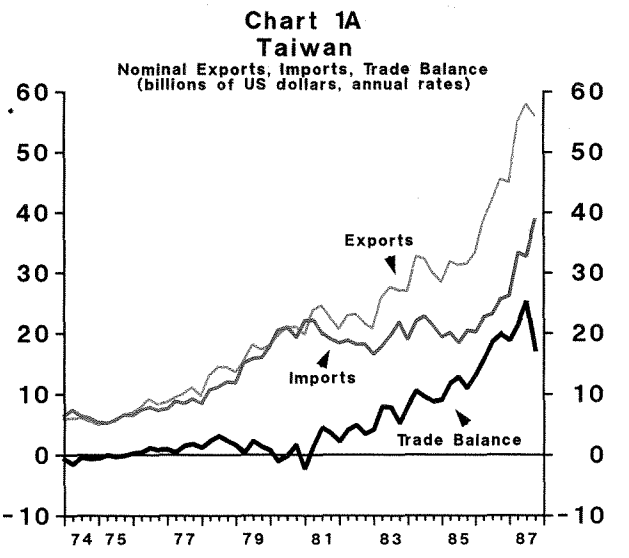
Trends in Trade

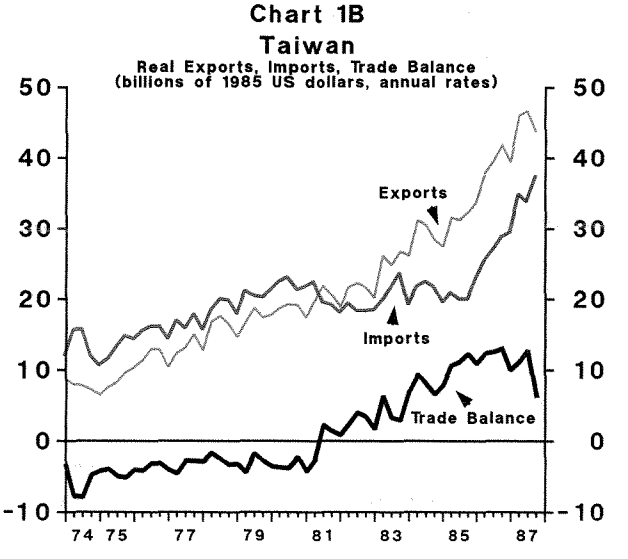
Chart 1a shows the trend in nominal exports, imports, and the trade balance of Taiwan. Chart 1b shows these same trends, but in real, or price-level adjusted, terms. The corresponding nominal and real trade flows for Korea are illustrated in Charts 2a and 2b. Taiwan's and Korea's trade surpluses have grown to unprecedented magnitudes, particularly in nominal terms. The 1987 nominal trade surplus was $21 billion for Taiwan and $8 billion for Korea and, respectively, 19.5 percent and 7.1 percent of GNP, compared to 3.5 percent for Japan.

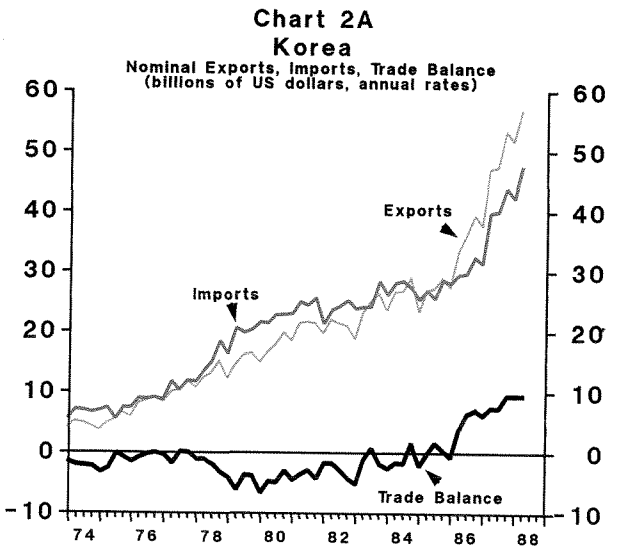
The charts reveal some differences between the nominal and real measures of trade flows, particularly in the short-run. Taiwan's real trade surplus appears to have stabilized in late 1985, whereas in nominal U.S. dollars, it continued to rise until the second half of 1987 (both measures show a sharp drop in Taiwan's trade surplus in the second half of 1987). It is also apparent that the increase in Korea's trade surplus since 1985 is much larger in nominal terms than it is in constant 1985 U.S. dollars.

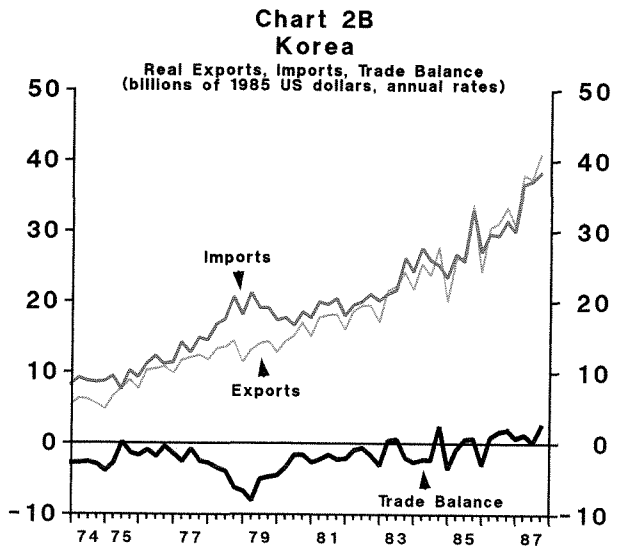
However, the overall trends in real and nominal trade balances are about the same for both Taiwan and Korea. One striking feature is the rapid growth of exports in both economies, at a pace exceeding export growth in most of the rest of the world. Real exports grew at a compound annual growth rate of 14 to 15 percent in Taiwan and Korea between 1974 and 1987. It is also remarkable that until the 1980s, rapid growth in imports matched or even exceeded the growth in exports over long periods.[4] In Taiwan, trade surpluses ballooned only after 1981, when import growth tapered off, while exports continued to grow at roughly their previous trend. In contrast, Korea had trade *deficits* until 1985. Trade surpluses grew after 1985 because export growth outpaced very rapid import growth. Imports have not levelled off in Korea.[5]

A major shift in the composition of traded goods contributed to the strong export performance of Taiwan and Korea. In Taiwan, the share of manufacturing exports increased from 41 percent in 1965 to 91 percent in 1986, while in Korea, it increased from 51 percent to 90 percent









over the same period.[6] Light manufactures are dominant, but the share of capital-intensive manufactures has risen in recent years, particularly in Korea.[7] In both economies export growth has been most rapid in those sectors where world demand has been growing most rapidly.

Rapid growth in imports of capital goods destined for the export-producing sector[8] has accompanied the growth of manufactured exports in the two NIEs. Partly as a result, manufactured imports' share in total imports rose from 58 to 65 percent between 1965 and 1986 in Taiwan and from 51 to 64 percent in Korea. In both economies, the share of fuels in total imports at least doubled, while the shares of other primary commodities and foods in total imports fell. Trade was also characterized by a triangular trade pattern, with NIEs importing capital goods mainly from Japan, and exporting light manufactures to the U.S.[9]

Although this triangular trade pattern has weakened in recent years, it may have contributed to the large bilateral surpluses of Taiwan and Korea with the U.S. In 1987, $17.2 billion of Taiwan's $21 billion nominal trade surplus was with the U.S. Korea's trade surplus with the U.S. was $8.9 billion, exceeding its overall trade surplus of about $8 billion. (At the same time, both Taiwan and Korea had bilateral deficits in the neighborhood of $5 billion with Japan.) These sizable bilateral surpluses are the reason that U.S. authorities, in particular, have been concerned about both the trade and exchange rate policies of Taiwan and Korea.

Trade Policies

Critics have accused Taiwan and Korea of maintaining restrictive trade policies (tariffs, non-tariff barriers, subsidies, and tax incentives) that have contributed to their trade surpluses in the 1980s. If this belief is correct, the trade liberalization implemented in recent years in Taiwan and Korea will significantly reduce existing trade surpluses. If it is incorrect, those who expect trade liberalization to correct the external imbalances of Taiwan and Korea will be disappointed, although the further liberalization of trade in both economies is probably desirable on its own merits. Unfortunately, the contribution of trade restrictions to the trade surpluses of the two NIEs in the 1980s is unclear.[10]

On the one hand, most of the growth of trade surpluses in each economy appears to have occurred during periods when trade barriers were falling, or at the very least not rising.[11] In the case of Taiwan, average tariff rates remained around 31 percent from 1980 to 1984 (down from 44 percent in 1978) and fell to around 20 percent in 1987. Non-tariff barriers do not appear to have increased in the first half of the 1980s, either. As a result of a trade liberalization program initiated in 1986, the share of permissible imports has been rising. In 1988, the OECD reported that permissible imports (for which import licenses are automatically approved) accounted for about 70 percent of total imports, while controlled imports accounted for 20 percent (10 percent are not subject to licensing).[12]

In the case of Korea, average tariff rates fell from 33 percent in 1984 to about 20 percent in 1987 (a period of rising trade surpluses), while the share of importable commodities enjoying automatic licensing approval rose

from 85 percent in 1984 to 94 percent in 1987 (compared to about 50 percent in 1977).

On the other hand, selective trade barriers, which prevented imports of certain goods (notably luxuries),[13] may have slowed the growth of total imports, and thus contributed to rising trade surpluses. Specifically, barriers to imports of consumer goods may have prevented a shift in the composition of imports that would have offset a tendency toward trade surpluses in both economies. Over time, productivity increases in rapidly developing economies such as Taiwan and Korea will lower the imports of capital and intermediate goods that are required for any unit of exports, leading to a tendency toward rising trade surpluses. At the same time, however, rising incomes associated with productivity gains should lead to increased imports of highly income-elastic consumer goods. This in turn, should offset the lagging growth in imports of capital and intermediate goods.[14]

In this situation, selective trade barriers may have prevented the rise in the imports of consumer goods, and contributed to rising trade surpluses in the two economies because these barriers, in effect, lowered the overall income elasticity of imports. For example, in Taiwan, a sharp drop in investment in the early 1980s reduced imports of raw materials and capital goods, the largest components of total imports, while trade barriers probably prevented an offsetting rise in the imports of consumer goods.[15] This may have contributed to the stagnation in imports in Taiwan in the first half of the 1980s (Charts 1a and 2a).

Exchange Rate Policies

In addition to concerns about trade barriers, the trading partners of Taiwan and Korea have accused these countries of manipulating their currencies to gain competitive advantage, which, in turn, has contributed to very large trade surpluses. While currency manipulation and its effectiveness are often difficult to establish, some insights into a government's exchange rate objectives can be obtained by examining policy statements, capital controls, and indicators of intervention in exchange markets.

Up to the late 1970s, the New Taiwan (NT) dollar, like the Korean won, were officially pegged to the U.S. dollar. Taiwan has not declared its exchange rate targets since it shifted from fixed exchange rates to a managed float in February 1979, although it uses an undisclosed basket of currencies as a guide for exchange rate management. Nevertheless, the shift in capital controls away from preventing capital outflows toward discouraging capital inflows, and indirect indicators of intervention in exchange markets suggest a desire to limit the appreciation of the NT dollar.

Traditionally, capital controls in Taiwan focused on preventing outflows of foreign currency, for example, by requiring that all foreign exchange be sold to the central bank for local currency. (Authorized foreign currency deposits in local banks were exempt.) Such controls on capital outflows became irrelevant in the 1980s because of a strong surge in gross capital inflows, which many observers believe was associated with speculation that the NT dollar was undervalued. As a result of these developments, controls on trade-related transactions were completely lifted after July 1987, and capital export limits were eased substantially. (Capital exports of $1 million or less per transaction, with an annual limit of $5 million, require no government authority.)

At the same time, significant restrictions were placed on capital inflows. Financial inflows were limited to $50,000 per year per account and after October 1987, restrictions on dollar borrowing by Taiwan banks (to prevent speculation) and a $3 million limit on dollar short positions were imposed. Inward direct foreign investment is still subject to approval. While earlier measures to limit capital outflows eased downward pressure on the value of the NT dollar, the more recent restrictions on capital inflows tend to dampen the appreciation of the NT dollar by limiting conversions of foreign assets into domestic currency.

In addition to changes in the focus of capital controls, there is indirect evidence of massive intervention to limit currency appreciation. The purchase of foreign currency by Taiwan's central bank tends to increase central bank foreign exchange reserves, and if it is unsterilized, tends to increase the domestic money supply, as well. Taiwan's foreign exchange reserves more than doubled in 1986 and rose a further 66 percent in 1987 to US $76.7 billion, over 50 times its level ten years earlier. At the same time, M1 money growth rose from 12.2% in 1985 to 51% in 1986 and 38% in 1987. Emery (1988) found that much of the growth in the money supply in recent years was the result of foreign assets acquired by the central bank.

Korea abandoned its peg to the U.S. dollar in January 1980 and subsequently has targeted a basket of currencies, which is adjusted to reflect changes in Korea's external position. While the composition of the basket of currencies has not been disclosed, Korean authorities have been somewhat more explicit than Taiwan about their exchange rate objectives in this decade. In 1980, the Korean government devalued the currency to dampen growth in external deficits.[16] After 1985, Korean authorities apparently adjusted their exchange rate target to maintain an annual

trade surplus of about $5 billion in order "to reduce Korea's large outstanding external debt to a more manageable level."[17] In fact, Korea's surpluses have exceeded this amount, permitting a reduction of Korea's external debt through prepayments from US $46.7 billion at the end of 1985 to US $35.6 billion at the end of 1987.[18] Korea's present goal is to become a net creditor by 1991, but recent reports indicate that this target will be met in 1989, two years ahead of schedule.

Efforts at exchange rate management appear to have had a smaller impact on domestic monetary control in Korea, as there has been no sudden explosion in foreign exchange reserves nor such a rapid acceleration in the rate of growth of the money supply as in Taiwan. Foreign exchange reserves in Korea rose from US $2.8 billion in 1985 to US $3.6 billion in 1987, while M1 growth averaged a little over 15 percent in 1986 and 1987, compared to 11 percent in 1985. Unlike Taiwan, until 1987, there was less evidence of strong incipient capital inflows that might have produced a stronger won than was actually observed perhaps because of the large repayments of external debt.

Exchange Rates and Competitiveness

The outcome of government efforts to influence the currency in Taiwan and Korea and the impact of exchange rate movements on competitiveness is partly indicated by the behavior of nominal and real (adjusted for relative inflation rates) exchange rates. Nominal exchange rate movements are a useful indicator of government intentions in exchange markets because they can be controlled directly by policy makers; in particular, countries wishing to achieve competitive gains typically devalue the nominal value of their currencies. However, nominal rates are not the only factor affecting competitiveness. Many countries with depreciating exchange rates experience no competitive gains because of high domestic inflation.[19] An often-used measure of how movements in nominal exchange rates may affect competitiveness is the real exchange rate. While more precise measures are developed in the next section, movements in the real exchange rate serve to illustrate basic trends in competitiveness.

Charts 3a and 3b illustrate the path of the U.S. dollar and trade-weighted nominal and real exchange rates for Taiwan and Korea, respectively, from 1974 to 1987.[20] Chart 3a indicates that the nominal NT dollar fell against the U.S. dollar as the latter appreciated against most major currencies in the early 1980s. The NT dollar then appreciated strongly against the U.S. dollar after 1985, as the latter weakened. As a result, the nominal trade-weighted NT dollar fluctuated around its value in 1980 from the second half of 1979 to the first half of 1983. Although there was a sharp dip in the nominal trade-weighted index in 1985, fluctuations since 1984 have on the whole followed a strong upward trend. In particular, the sharp appreciation that occurred after 1985 raised the trade-weighted value of the nominal Taiwan dollar rose to its highest levels over the period in the chart.

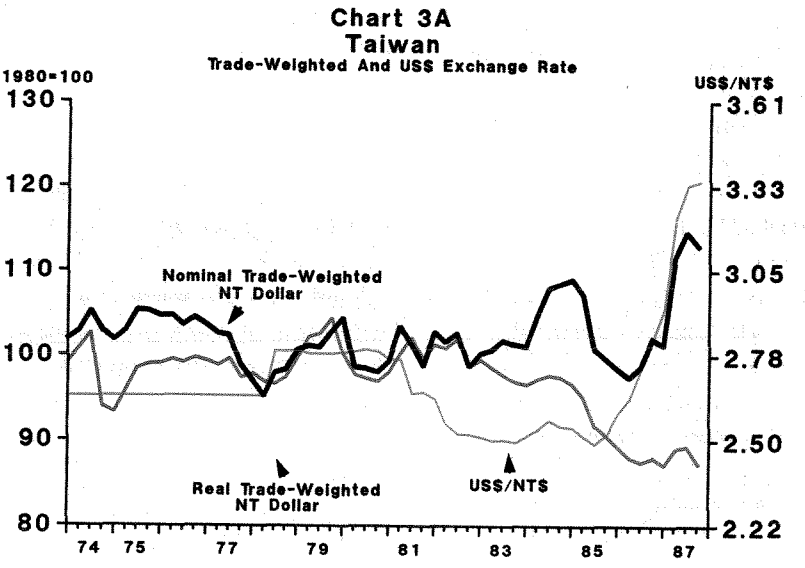
Chart 3a also shows that even as the nominal NT dollar reached its highest values over the sample period, the real trade-weighted exchange rate was on a downward trend from 1980 to 1986, and remained below its 1980 peak in 1987. Thus, relatively low domestic inflation, rather than nominal exchange rate movements, appears to explain gains in competitiveness in Taiwan. Nonetheless, critics of Taiwan's exchange rate policy argue that the nominal NT dollar would have appreciated much more in the absence of government manipulation of the currency, perhaps rising by enough to offset the gains in competitiveness caused by Taiwan's low inflation.

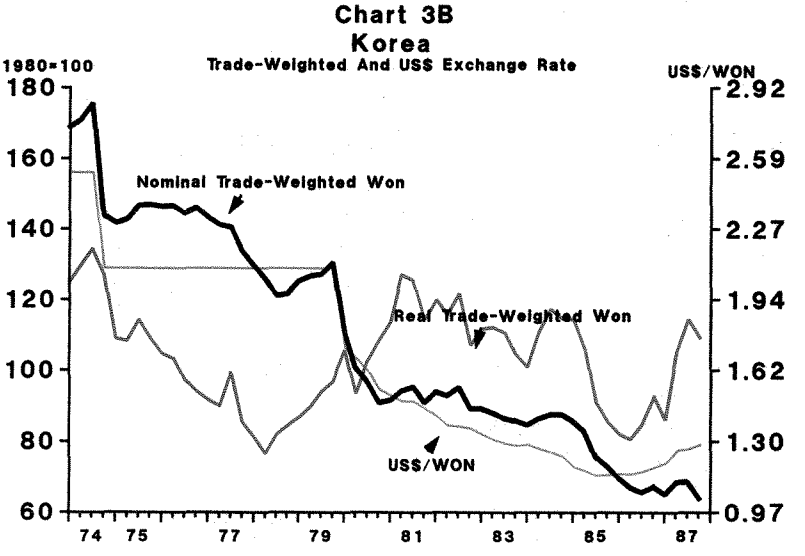
Turning now to Korea, Chart 3b reveals that since 1974 there has been a downward trend in the nominal value of the won on a dollar- and a trade-weighted basis. In line with the policy intentions discussed previously, the nominal trade-weighted won declined sharply in 1980 and since 1985, notwithstanding an 18 percent appreciation against the U.S. dollar between 1985 and 1987.

Despite the strong nominal depreciation of the won, the real value of the won suggests that at least until 1985, there were no gains in competitiveness, since inflation in Korea far exceeded inflation among its trading partners. After 1985, however, the decline in the won appears to have been reflected in real gains in competitiveness.

Notwithstanding the evidence of government action to influence the value of the NT dollar and the won, it is not easy to determine the extent to which currency manipulation may have affected the values of the currencies of the two NIEs. The reason is that we cannot measure the extent to which Taiwan or Korea's currencies would have appreciated in the absence of government intervention and capital controls.

However, it is possible to measure more precisely the extent to which exchange rate changes directly contributed to changes in competitiveness, as well as the relative contribution of changes in competitiveness to the trade surpluses of Taiwan and Korea. These questions are addressed in the remainder of the paper.





II. Modelling Trade Prices and Trade Flows

In this section, a standard[21] model of export and import prices and trade flows is developed to assess the contribution of exchange rates to competitiveness and the trade surpluses of Taiwan and Korea. In the model, the influence of exchange rates on competitiveness is analyzed by developing equations that relate exchange rates (and other price variables) to export and import prices. Then, equations that relate changes in prices and income to trade flows are developed.

This model enables us to assess whether changes in exchange rates and in competitiveness are the major explanation for trade surpluses, or whether other factors are more important. Also from the model, we can derive rough estimates of the extent of exchange rate appreciation that would be required to eliminate the trade surpluses that now exist, assuming that no other changes in policy are made.

Trade Prices

In Section I, the real exchange rate was used to analyze how nominal exchange rate movements are reflected in changes in competitiveness. While the real exchange rate is a useful proxy for changes in competitiveness for most purposes, it has certain disadvantages. For example, the

real exchange rate measure implies that a 10% currency appreciation immediately results in a 10% loss in competitiveness. However, this is not always the case. Exporters may not raise their export prices by 10%, but instead choose to absorb some of the impact of exchange rate changes by reducing their profit margins. Thus, a model of how exporters and importers set their prices, such as the one developed below, provides a better indicator of how exchange rate changes are reflected in changes in competitiveness.

It is assumed that in setting the prices of traded goods, suppliers add a markup over their costs of production, represented by domestic prices in the case of exports, and by foreign prices in the case of imports. The markup is in turn a function of competing goods prices, which are influenced by exchange rates, domestic prices (in the case of imports) and foreign prices (in the case of exports).[22]

The price of exports (PX) in domestic currency is thus expressed as a reduced-form function of the exchange rate (XR, defined as units of foreign currency over domestic currency), domestic prices (CPI), and foreign prices (FCPI).

$$PX_t = a_0 + a_1 XR_t + a_2 CPI_t + a_3 FCPI_t \qquad (1)$$

where all variables are expressed in logarithms (so that the coefficients may be interpreted as elasticities), $a_1 < 0$, and $a_2, a_3 > 0$.

The coefficient a_1 warrants some discussion. A currency appreciation increases the export price expressed in foreign currency, thereby reducing the competitiveness of domestic producers in world markets. If $a_1 = 0$, exporters fully "pass through" this export price change. If $a_1 < 0$, exporters are attempting to offset the loss in competitiveness by lowering the export price in domestic currency. Thus, the pass through from exchange rates to export prices is measured by $1 + a_1$. In a perfectly competitive environment, a pass through coefficient of unity ($a_1 = 0$) might be expected. A pass through coefficient of less than one is typically interpreted to reflect imperfectly competitive markets,[23] as discussed below.

Import prices (PM) in domestic currency may be expressed as a reduced form function of the exchange rate, foreign prices, and domestic prices, where foreign prices reflect the costs of production and the other variables influence the extent of the mark-up over foreign prices.

$$PM_t = b_0 + b_1 XR_t + b_2 FCPI_t + b_3 CPI_t \qquad (2)$$

It is expected that $b_1 < 0$ and $b_2, b_3 > 0$. In this case, the pass through of exchange rates to import prices is measured by b_1. If there is a full pass through of exchange rates to import prices, the coefficient $b_1 = -1$; if the pass through is not complete, $0 > b_1 > -1$.

Trade Flows

The real demand for exports (X^d) is a function of the relative price of exports (PEX) and foreign income (FGDP). The relative price of exports is defined as PEX = (PX)(XR)/FCPI, where PX is the export price, XR is units of foreign currency over domestic currency, and FCPI is the foreign consumer price index. These relationships may be represented by the following equation:

$$X_t^d = c_0 + c_1 PEX_t + c_2 FGDP_t \qquad (3)$$

If relative export prices rise, the demand for exports will fall, so $c_1 < 0$. On the other hand, if foreign income rises, the demand for exports will rise, so $c_2 > 0$. As suggested previously, two offsetting factors determine the impact of a currency appreciation on the relative export price expressed in foreign currency (PEX). From the definition of PEX, a currency appreciation raises PEX by raising XR. However, exporters may offset this effect by lowering the export price in domestic currency (PX) (see discussion of equation 1).

Similarly, the real demand for imports (M^d) depends on the relative price of imports (PIM) and domestic income (GDP):

$$M_t^d = d_0 + d_1 PIM_t + d_2 GDP_t \qquad (4)$$

Where $d_1 < 0$ and $d_2 > 0$. The relative price of imports is the ratio of import prices to the domestic price level, that is, PIM = PM/CPI.

The price and income elasticities of exports and imports reflect preferences, the composition of exports and imports, and the impact of trade barriers. For example, the demand for primary commodities is generally less price elastic than the demand for manufactured goods.[24] As a result, the price elasticity of exports will tend to be smaller than the price elasticity of imports in countries that export primary commodities and import manufactured goods.

Trade barriers also may affect the observed elasticities. For example, if a country's imports are limited by quotas, while those of its trading partners are not, the price elasticities of imports will tend to be low compared with the price elasticities of exports. The income elasticity of imports also may be lower than the income elasticity of exports if quotas affect a sufficiently broad range of imports, or if, as suggested earlier, quotas or other quan-

titative restrictions prevent an increase in the imports of consumer goods.

On the other hand, if tariff barriers are significant, the relatively higher price of imports compared to domestic goods will lower the share of imports in total income. Under certain conditions, tariff barriers also may lower the income elasticity of imports in comparison to the income elasticity of exports.[25]

III. Estimation and Results

These equations were estimated using quarterly data for the period 1974:1–1987:4 for both Taiwan and Korea.[26] Descriptions of the variables used in estimation and the data sources are provided in Appendix A. All equations were estimated by OLS. The underlying assumption is that once trade prices are set by the mark-up equations, the quantities supplied will adjust (possibly with a lag, as described in Appendix B) to satisfy the resulting demand for imports and exports. This assumption underlies a large number of empirical studies of international trade flows.[27]

The equations were estimated in first-difference form, with the (one quarter) lagged levels of the explanatory variables and of the respective dependent variables on the right-hand side of each equation. This "error-correction" specification (which can be obtained as a transformation of the traditional stock adjustment model) has three desirable features: (1) it avoids the possibility of spurious correlation among strongly trended variables; (2) long-run relationships which may be lost by expressing the data in differences are captured by including the lagged levels of the variables on the right hand side; and (3) the specification in equations (1) to (4) is now expanded so as to distinguish between short-run and long-run elasticities. Further details on the equations are provided in Appendix B.

The standard Durbin-Watson (d-statistic) test for serial correlation cannot be used for these regressions because of the inclusion of the lagged dependent variable on the right hand side. An alternative test for serial correlation was performed by regressing the residuals of each regression on the right-hand side variables and the lagged residual. A significant coefficient on the lagged residual indicates the presence of serial correlation. Serial correlation could not be rejected in one case at the 10 percent level.

Trade Prices

In estimating equations (1) and (2), unit values[28] were used to represent export and import prices. Furthermore, an index of commodity prices, which may be seen as an additional proxy for the effects of international price movements on import and export prices, was included as an explanatory variable in both price equations.

Table 1 reports the parameter estimates for the trade price (unit value) equations in Taiwan and Korea. The export unit value equations, shown in the first and fourth columns of Table 1, suggest that in the long run, exporters in Taiwan and Korea, respectively, pass through 36% and 58% of any changes in the exchange rate. These pass-through coefficients are derived from the long-run elasticities on the exchange rate shown in the lower half of Table 1.

One explanation for these relatively small pass through coefficients may be that exporters in both Taiwan and Korea can price strategically to maintain market share because they have high profit margins. High profit margins may result from a number of characteristics of the export sectors of the two economies. First, a relatively high proportion of the exports of Taiwan and Korea are in light industry sectors that are subject to quotas (textiles, for example). This may produce quota rents for exporters. Second, the governments of Taiwan and Korea have provided concessionary financing and other fiscal incentives for export promotion. Third, there are trading and marketing facilities in these countries that may have some degree of monopoly power, even when the individual scale of production is small. Finally, producers in both economies have demonstrated the ability to improve production efficiency, rather than raise prices, in response to changes in exchange rates. (On the other hand, the relatively small scale of production and fairly competitive environment in Taiwan, and the relatively small size and recent entry of Taiwanese and Korean exporters in world markets may weaken their ability to price strategically.)

Another possible reason why the pass through is relatively low in both economies is that most of the exports of these two countries are denominated in foreign currency, which exposes exporters to currency risk. Currency risk will affect the pass through because exporters will only alter their prices in response to those changes in the exchange rate that they consider to be permanent on the basis of past experience. Moreover, risk-averse exporters will reduce the pass through to the extent that they are uncertain about this estimate. Uncertainty is likely to be higher if exchange rates are volatile.

Such exchange rate uncertainty is more likely to limit the extent of the pass through in Taiwan, where exchange rates have apparently been more volatile. Moreover, the comparatively small scale of production may lead to greater risk aversion among exporters, particularly since small exporters may lack the sophistication or resources to hedge in forward exchange markets.

Turning to import unit values, two versions of these price equations were run: the first uses the log difference and the log lagged level of the commodity price index as

Table 1

Parameter Estimates for Trade Price Equations

(all variables in logs, standard errors in parentheses)

	Taiwan			Korea		
	Exports	**Imports 1**	**Imports 2**	**Exports**	**Imports 1**	**Imports 2**
Intercept	1.62***	−0.18	−6.71***	0.65	−0.08	−2.19**
	(.58)	(.74)	(1.26)	(.62)	(.74)	(.93)
First Differences:						
Exchange Rate	−0.14	−0.47**	−0.26	−0.21***	−0.33	−0.47***
	(.17)	(.24)	(.26)	(.08)	(.09)	(.10)
Commodity Prices	0.07	0.13	0.07	0.23**	0.38	0.35***
	(.15)	(.21)	(.16)	(.12)	(.16)	(.10)
Foreign price	1.30*	−0.52	1.85**	2.24***	3.56***	3.69***
	(.77)	(1.00)	(.84)	(.51)	(.58)	(.58)
Domestic price	0.35**	0.71***	0.92***	0.01	−.01	0.39*
	(.17)	(.24)	(.21)	(.51)	(.25)	(.21)
Lagged Levels:						
Exchange Rate	−0.43***	−0.31*	−0.85***	−0.19***	−0.09	−0.26***
	(.12)	(.16)	(.17)	(.07)	(.06)	(.08)
Commodity Price	0.39***	0.47***	0.62***	0.19***	0.24***	.23***
	(.08)	(.10)	(.09)	(.07)	(.07)	(.07)
Foreign price	−0.07	−0.33**	0.41***	0.03	−0.13	−0.05
	(.08)	(.12)	(.13)	(.14)	(.19)	(.17)
Domestic Price	0.43***	0.66***	1.00***	0.27***	0.15	0.29***
	(.12)	(.20)	(.19)	(.10)	(.12)	(.11)
Lagged Dependent Variable	−0.68***	−0.42***	−0.82***	−0.44***	−0.15***	−0.30***
	(.13)	(.11)	(.12)	(.10)	(.06)	(.06)
RBARSQ	0.40	0.44	0.60	0.61	0.78	0.81
D.F.	43	43	43	43	43	43
Test for serial correlation:						
Coefficient on lagged residual	0.38	−0.10	−0.02	0.28	−0.13	−0.20
	(.26)	(.23)	(.24)	(.19)	(.17)	(.16)
Long-run Elasticities:						
Exchange rate	−0.64	−0.74	−1.04	−0.42	−0.58	−0.87
Commodity Prices	0.58	1.10	0.76	0.43	1.58	0.77
Foreign Prices	−0.10	−0.78	0.50	0.07	−0.89	−0.16
Domestic Price	0.64	1.55	1.22	0.60	0.99	0.95

Notes: The export and first import price equations use commodity price levels as the explanatory variable. The second import equation uses the ratio of commodity prices to foreign prices. The trade price equations include seasonal dummy variables (not reported).

*** *Significant at 1%*
** *Significant at 5%*
* *Significant at 10%*

the explanatory variable. These regressions are shown in columns 2 and 5 of Table 1. In these regressions, the coefficient on foreign prices has the wrong sign, and it is not significant in the equation for Korea. One possible reason for this result is that the commodity price index captures most of the variation in foreign costs.

In an attempt to deal with this difficulty, a second regression was run using the *ratio* of commodity prices to foreign prices as an explanatory variable. The results are reported in columns 3 and 6 of Table 1. As can be seen, the coefficient on trade-weighted foreign prices now has the right sign in the equation for Taiwan (column 3), and the fit improves considerably. It still is not significant in the equation for Korea (column 6), but the fit also seems to improve. The import unit value equations, shown in the third and sixth columns of Table 1, suggest a long-run pass through of exchange rate changes to import prices of 87 percent in Korea to a little over 100 percent in Taiwan.

Trade Flows

Table 2 reports regression results for the trade volume equations for Taiwan (columns 1 and 2) and Korea (columns 3 and 4). The elasticities have the expected sign and

Table 2

Parameter Estimates for Trade Volume Equations

(all variables in logs, standard errors in parentheses)

	Taiwan		Korea	
	Exports	**Imports**	**Exports**	**Imports**
Intercept	−3.00*	1.38**	−2.22	−1.11
	(1.56)	(0.60)	(1.39)	(0.88)
First Differences:				
Relative Prices	0.01	−0.19	0.21	0.14
	(0.21)	(0.24)	(0.19)	(0.22)
Income	2.36**	0.34	4.40***	0.23*
	(1.06)	(0.49)	(1.15)	(0.12)
Lagged Levels:				
Relative Prices	−0.45***	−0.41***	−0.28**	−0.39***
	(0.13)	(0.14)	(0.11)	(0.12)
Income	1.65***	0.23***	1.12***	0.56***
	(0.43)	(0.08)	(0.35)	(0.12)
Dependent Variable	−0.58***	−0.28***	−0.39***	−0.52***
	(0.13)	(0.10)	(0.10)	(0.10)
RBARSQ	0.65	0.45	0.84	0.65
D.F.	47	47	47	47
Test for serial correlation:				
Coefficient on lagged residual	−0.33	−0.01	−0.30	−0.35*
	(0.24)	(0.20)	(0.19)	(0.21)
Long-run Elasticities:				
Relative Prices	−0.79	−1.44	−0.72	−0.74
Income	2.87	0.82	2.84	1.08

Note: The trade volume equations include seasonal dummy variables (not reported).

*** Significant at 1%
** Significant at 5%
* Significant at 10%

the fit is satisfactory, considering that the dependent variable is in first difference form.

The coefficients on the first differences of relative prices are significant neither for Taiwan nor for Korea. On the other hand, the coefficients on the lagged price levels (which underlie the long-run elasticities) are highly significant. In Taiwan, the long-run price elasticity of imports is 80 percent larger than the long-run price elasticity of exports; while in Korea, the corresponding elasticities are about the same.[29]

The estimates of the long-run income elasticity of exports in Taiwan and Korea (about 2.8) are within the range of estimates of the income elasticity of imports for the U.S.,[30] which is consistent with the role of the U.S. as the major export market for both economies. However, the long-run income elasticities of imports in Taiwan and Korea are much smaller (respectively, .82 and 1.08).

The price and income elasticities do not provide a consistent picture of the possible role of trade policies in explaining the trade flows of Taiwan and Korea. On the one hand, the *price* elasticities of imports are at least as high as the price elasticities for exports in both NIEs,[31] which suggests that the effect of trade barriers on trade flows has been no greater in the two NIEs than among their trading partners. On the other hand, the smaller *income* elasticities of imports than of exports in both economies is consistent with the hypothesis formulated in Section I that selective trade barriers biased imports toward commodity groups with low income elasticities and for which demand was growing relatively more slowly.

The differences in income elasticities for export and import volumes imply that Taiwan has to grow at about 3.5 times the rate of its trading partners to *maintain* trade balance in the absence of changes in relative prices. The corresponding figure for relative growth in Korea is 2.6 times faster. However, because trade surpluses exist, Taiwan and Korea must grow at even faster rates in order to restore trade balance.[32] Over the period from 1974 to 1987, both Taiwan and Korea grew at approximately 2.5 times the rate of their trading partners.

Proximate Sources of Real Trade Balance

The preceding regressions permit us to weigh the relative contributions of the explanatory variables to changes in the trade balances of Taiwan and Korea over the sample period. The results of these calculations are reported in Table 3.

Since the relative magnitudes of these contributions have changed over time, the sample period is divided into

Table 3

Sources of the Real Trade Deficit/Surplus: Average Annual Change*

(billions of 1985 dollars)

	Taiwan			Korea		
	1975–1980	1981–1984	1985–1987	1975–1980	1981–1984	1985–1987
Actual change in trade balance	0.49	2.76	0.93	0.03	0.46	0.86
relative price effects	0.59	0.54	−1.77	0.24	−0.16	0.71
of which exchange rate effects	0.14	−0.56	−1.06	1.02	0.60	2.16
income effects	0.10	1.06	1.84	−0.15	0.18	−0.03
unexplained	−0.20	1.16	0.86	−0.06	0.44	0.18
Of which contribution of change in						
Exports	1.80	2.58	4.97	1.48	2.45	4.04
— due to relative export prices	0.15	0.30	0.55	0.12	0.16	1.33
of which exchange rate effects	0.02	−0.10	−0.24	0.34	0.22	0.85
— due to foreign GNP	1.26	2.25	3.49	1.04	1.87	2.72
— unexplained	0.40	0.03	0.93	0.32	0.42	−0.02
Imports	1.32	−0.18	4.04	1.45	1.99	3.18
— due to changes in relative import prices	−0.44	−0.24	2.32	−0.12	0.32	0.62
of which exchange rate effects	−0.12	0.46	0.82	−0.68	−0.38	−1.31
— due to domestic GNP	1.16	1.19	1.65	1.19	1.69	2.75
— unexplained	0.60	−1.13	0.07	0.38	−0.02	−0.20

*Quarter over previous year's quarter.

three sub-periods: the period of U.S. dollar depreciation, 1975–80; the period of dollar appreciation, 1981–84; and the most recent episode of dollar depreciation, 1985–87. The contribution of each explanatory variable to the average four quarter change in real exports and imports, expressed in 1985 dollars, was computed for each of the three sub-periods using the following expressions:

$$X_t - X_{t-4} = (p_x)(PEX_t')(X_{t-4}) + (x)(Y_t^{*\prime})(X_{t-4}) + e_x \quad (5)$$

$$M_t - M_{t-4} = (p_m)(PIM_t')(M_{t-4}) + (m)(Y_t')(M_{t-4}) + e_m \quad (6)$$

where "′" represents percent changes, p_x and p_m are, respectively, the long-run price elasticities of exports and imports, x and m are the long-run income elasticities of exports and imports, and the levels of exports and imports, X and M, are expressed in constant 1985 dollars.

The contribution of price effects to the total change in exports is given by the first multiplicative right-hand-side term in equation (5), the contribution of income effects is given by the second multiplicative right-hand-side term, and the unexplained portion is e_x. The contribution of the exchange rate to the change in exports was calculated by taking the product of the change in the exchange rate, the long run pass through (one plus the long-run elasticity for the exchange rate in the export price equation), the long-run elasticity of relative prices p_x and the previous period's level of exports. The contributions to import changes are calculated in a similar fashion.

The net contributions of relative prices, exchange rates, and income to changes in the real trade balance were then obtained by subtracting the contributions of these variables in the import equation from the corresponding contributions in the export equation. These net contributions are reported in the first five lines of Table 3.

The first three columns of Table 3 report the results for Taiwan. Nominal exchange rates on the average have tended to appreciate, and therefore to *limit the growth* in trade surpluses in the 1980s, and particularly after 1985. However, these exchange rate changes did not consistently result in losses in competitiveness. Taiwan experienced competitive gains through 1984 apparently due to other factors, such as low inflation, that outweighed the effects of currency appreciation. As a result, price effects tended to *increase* trade surpluses until 1984. In the 1985–87 period, however, Taiwan has experienced significant losses in competitiveness beyond those caused by the appreciation of the NT dollar. Relative price changes have significantly reduced the growth in trade surpluses. A major reason is a strong decline in relative import prices.[33]

Income effects were the major contributor to the trade surpluses in Taiwan in the 1980s, but not in the second half of the 1970s. One reason the contribution of income effects increased in the 1980s is that Taiwan's average growth slowed to twice that of its trading partners in the 1981–84 period, compared to 2.6 times in the 1975–80 period. (Taiwan's relative growth rose again to about 2.6 times that of its trading partners in the 1985–87 period.)

Another reason is that after 1980, the level of exports exceeded the level of imports. As can be seen in equations (5) and (6), if the previous period's exports (X_{t-4}), are higher than the previous period's imports (M_{t-4}), a percentage point increase in foreign GNP growth applied to these higher exports would tend to produce a larger change in exports than would a percentage point increase in domestic GNP growth on imports. This effect is quite important. For example, the growth of Taiwan relative to that of its trading partners accelerated between the period from 1981 to 1984 and the period from 1985 to 1987. This should have reduced the positive contribution of income effects to trade surpluses. Instead, Table 3 shows that the contribution of income effects *grew* over the two periods because exports were so much higher than imports in the 1985–87 period. Once exports exceed imports, domestic income must grow at an even faster rate to offset the impact of foreign GDP growth on exports if trade balance is to be restored.

In the case of Korea (columns 4 to 6), exchange rates have consistently tended to depreciate, contributing to positive changes in the trade balance. However, the effects of a weakening currency have been offset by relatively high domestic inflation, and the positive contribution of relative prices to trade surpluses has been much smaller.

In contrast to Taiwan, income effects tended to reduce Korea's trade balance in the 1970s and after 1987, because Korea's growth significantly outpaced that of its trading partners. On the other hand, income effects contributed to increases in the trade balance in the 1981–84 period, when the ratio of Korea's growth relative to that of its trading partners dropped from 2.6 to 2.2. The contribution of income effects in Korea in this period was nevertheless smaller than it was in Taiwan, because the gap between the income elasticities of exports and imports is smaller, and because the level of exports did not exceed the level of imports in Korea.

To sum up, the proximate causes of trade surpluses are quite different in Taiwan and Korea. In Taiwan, income effects are the dominant cause of rising trade surpluses, while exchange rate movements have tended to *limit* gains in competitiveness and the growth in trade surpluses. Gains in competitiveness were nevertheless achieved be-

cause of low domestic inflation. On the other hand, for Korea, exchange rates have generally contributed to increasing competitiveness, but the effects were to a large extent offset by relatively high domestic inflation. In contrast to Taiwan, the contribution of income effects to trade surpluses has been small or negative.

Exchange Rates and Balanced Trade

The preceding regressions can be used to illustrate the degree of currency appreciation that may be consistent with eliminating trade surpluses and maintaining approximate trade balance in Taiwan and in Korea. Rough estimates[34] suggest that to eliminate Taiwan's trade surpluses after 1985, a one-time trade-weighted appreciation of approximately 30 percent is required. Assuming the average domestic and foreign growth rates (8.8 percent and 2.4 percent, respectively) observed over the entire sample period (1974–1987), an additional annual appreciation starting at about five percent is required to offset income effects.[35] Once trade balance is achieved, the exchange rate would have to appreciate by about two percent a year to maintain real trade balance. These figures may be compared to an actual trade-weighted appreciation of the NT dollar of 15 percent between late 1986 and early 1987.

To eliminate Korea's 1987 trade surplus in real terms, a currency appreciation of about 17 percent would be necessary. An additional annual appreciation of over two percent is required, which will fall to 1/2 percent a year when trade is balanced. These estimates assume domestic and foreign income growth at their average levels for the 1974 to 1987 period (nine percent and 3.6 percent, respectively).

In assessing the implications of the preceding calculations, the following points are worth bearing in mind. First, the above exercises are only illustrative, as they ignore a number of factors that affect the actual path of the trade balance.[36] Second, if capital flows were liberalized and a free float were adopted in both economies, the exchange rate would not necessarily adjust to balance merchandise trade in the manner described above. Theory says that in an open economy with capital mobility, exchange rates would adjust to assure balance of payments equilibrium, so that trade surpluses or deficits are matched by corresponding capital flows. However, the resulting exchange rate may be consistent with either merchandise trade surpluses or deficits in the short-run. Finally, exchange rate appreciation is not the only way of eliminating trade surpluses, and in some cases, it may be appropriate to use other measures, as well.

IV. Conclusions

This paper has identified the extent to which exchange rate movements directly explain improvements in competitiveness and rising trade surpluses in Taiwan and Korea in the 1980s. The hypothesis that exchange rate movements improved competitiveness and thus contributed directly to trade imbalances in the 1980s holds for Korea, but not for Taiwan.

In the case of Taiwan, nominal exchange rates on the average appreciated in the 1980s, tending to *limit* competitive gains as well as rising trade surpluses, particularly after 1985. While Taiwan experienced gains in competitiveness due to other factors, such as relatively low domestic inflation, such gains in competitiveness are not the major reason for the growth in Taiwan's trade surpluses in the 1980s. A more important reason for rising trade surpluses is that Taiwan has not grown fast enough to guarantee trade balance, given an income elasticity of exports that is 3.5 times larger than the income elasticity of imports.

In the case of Korea, nominal exchange rate movements appear to have offset losses in competitiveness associated with Korea's relatively high inflation. Through 1984, then, exchange rate movements contributed to a reduction in Korea's trade deficits, and after 1984, to an increase in the trade surplus. In contrast to Taiwan, the income effects have tended to reduce the trade balance, because the gap between export and import income elasticities is much smaller.

In recent years, both Taiwan and Korea have allowed their currencies to appreciate in an effort to correct their external imbalances and defuse protectionist responses among their trading partners. The results of this paper may be used to examine the options available to both economies in pursuing this effort.

The simulations presented in this paper indicate that, given plausible assumptions regarding relative income growth, a large one-time appreciation and subsequent permanent annual appreciation of the NT dollar and the Korean won would be required to restore and then maintain trade balance (in order to offset the gap between export and import income elasticities) in both economies. Since permanent currency appreciation may adversely affect economic activity, it may be desirable to supplement exchange rate appreciation with other measures to reduce external

imbalances. This is particularly true for Taiwan, where the required currency appreciation is higher largely because factors other than changes in exchange rates have been more important contributors to the trade surpluses.

However, finding other measures to reduce external imbalances will be more difficult for Taiwan than for Korea. The results of this paper indicate that Korea can also reduce trade surpluses by maintaining a sufficiently high rate of domestic growth in comparison to that of its trading partners; however, this is not a feasible long-run strategy for Taiwan, because the gap between the income elasticities of exports and imports is so large.

Alternatively, both economies (and particularly Taiwan) can seek to identify measures that will reduce the gap between the income elasticities of exports and imports. Unfortunately, there is little guidance in the literature on how this might be accomplished. It is possible that further import liberalization may reduce the elasticities gap by significantly increasing imports, but this issue needs to be researched further. In the case of Taiwan, an analysis of the reasons why imports have lagged in relation to exports in the 1980s, and the possible role of stagnant domestic investment spending, also may provide insights.

APPENDIX A
Variable Definitions and Data Sources

Variable Definitions

(all variables are expressed in logarithms)

CPI	=	domestic price level
FCPI	=	trade-weighted foreign CPI
FGDP	=	trade-weighted foreign GDP.
GDP	=	real domestic GDP
M	=	import volume
PEX	=	(PX)(XR)/FCPI = relative price of exports
PIM	=	PM/CPI = relative price of imports
PM	=	import unit values, in domestic currency
PX	=	export unit values, in domestic currency
X	=	export volume
XR	=	trade-weighted index of units of foreign currency to domestic currency (an increase is an appreciation), 1980 trade weights.

Data Sources

Exchange rate, CPI, nominal and real exports and imports, unit values for exports and imports, annual real GDP, investment, and quarterly industrial production (the latter are used as instruments to generate quarterly GDP series): *Financial Statistics, Taiwan District, Republic of China* (compiled in accordance with IFS format) for Taiwan and IMF *International Financial Statistics* for Korea.

The exchange rate, CPI, and real GDP series for the trading partners of Taiwan and South Korea are obtained from IMF, *International Financial Statistics,* with the exception of Hong Kong, where the source is Hong Kong's *Monthly Digest of Statistics.*

Direction of trade data, on the basis of which trade weights are constructed and bilateral trade balances are discussed, are from the OECD, the IMF *Direction of Trade Statistics,* or *Monthly Statistics of the Republic of China.*

Commodity prices are represented by the Journal of Commerce commodity price index.

APPENDIX B
The Error-Correction Model

To illustrate the derivation of the equations in the form they were estimated, consider the export volume equation (equation 1 in the text), rewritten to assume that prices and income affect export demand with one lag:

$$X_t^d = a_0 + a_1 PEX_t + a_2 PEX_{t-1} + a_3 FGDP_t + a_4 FGDP_{t-1} \quad (A.1)$$

A disequilibrium framework is also assumed, so that export volumes adjust to the difference between desired (X_t^d) and actual export volume in the previous period:

$$\Delta X_t = z\,(X_t^d - X_{t-1}) \quad (A.2)$$

where Δ represents a first difference. Substituting (A.2) into (A.1) yields an equation that is frequently estimated:

$$X_t = e_0 + e_1 PEX_t + e_2 PEX_{t-1} + e_3 FGDP_t + e_4 FGDP_{t-1} + e_5 X_{t-1}. \quad (A.3)$$

This is the geometric lag specification, where $e_i = z.a_i$, $i = 1,2,3,4$ and $e_5 = 1-z$. Thus, $1-e_5$ is the coefficient of adjustment. The actual demand elasticities are obtained by dividing the coefficients in equation (A.3) by $(1-e_5)$.

A potential difficulty with (A.3) is that the variables in levels may contain strong trend components, producing spurious correlation between the variables. This is often addressed by running the regression in equation (A.3) using first differences rather than the levels of the variables. However, this creates other problems, as such a regression may fail to capture the long-run relationships among the variables. Hendry (1979), therefore, suggests an alternative "error-correction" specification, that includes first differences and the lagged levels of the variables:

$$\Delta X_t = f_0 + f_1 \Delta PEX_t + f_2 \Delta FGDP_t + f_3 PEX_{t-1} + f_4 FGDP_{t-1} + f_5 X_{t-1} \quad (A.3')$$

In equation (A.3′) short run relationships are captured by the coefficients on the changes in the variables, while long-run relationships are captured by the coefficients on the lagged levels of the variables on the right hand side. The reader can verify that equation (A.3′) is a simple linear transformation of equation (A.3) where $f_5 = e_5 - 1 < 0$. The long-run price elasticity of exports is then $f_3/(-f_5) = (e_1+e_2)/(-f_5) < 0$ and the long-run income elasticity of exports is $f_4/(-f_5) = (e_3+e_4)/(-f_5) > 0$.

The "error-correction" specification for import volumes and export and import prices is derived in an analogous manner. The adjustment mechanism described by equation (A.2) can be said to apply to trade prices because contracts may prevent producers from immediately adjusting their prices to desired levels.

NOTES

1. The G-6 industrial countries that met to discuss economic policies at the time of the Louvre meeting were the U.S., Japan, Germany, France, the United Kingdom, and Canada. Italy joined the later meetings of the (G-7) industrial countries. The Asian NIEs are Taiwan, (South) Korea, Singapore, and Hong Kong. The text refers to Taiwan, rather than Taiwan, Province of China, for the sake of brevity.

2. In contrast, in 1987, Hong Kong had a current account surplus, but balance in its merchandise trade; Singapore has a small current account surplus and a very large deficit in merchandise trade. Both economies have among the most liberal trading regimes in the world.

3. U.S. Department of the Treasury (1988), p. 37. See also pp. 16–19. The report was submitted in compliance with the Omnibus Trade and Competitiveness Act of 1988 (P.L. 100–418).

4. Rapid import growth is one characteristic of economies adopting an export-led growth strategy, rather than import-substitution policies. See Note 11.

5. The levelling off in Taiwan's imports coincided with a sharp decline in investment spending after 1980, which widened the gap between saving and investment. Domestic investment in Taiwan was 20 percent of GNP in 1987, down from 35 percent in 1980. Over the same period, gross national saving rose from 33 percent of GNP to 41 percent of GNP. The counterpart to Taiwan's trade surpluses, the gap between national saving and national investment, thus rose dramatically between 1980 and 1987. On the other hand, the ratio of investment spending to GNP in South Korea fell from 33 percent of GNP in 1980 (which possibly was unsustainable) to 29 percent of GNP in 1987. The ratio of national saving to GNP has remained somewhat above 30 percent.

6. In contrast, the share of manufactured exports of highly indebted developing countries rose from 11 percent to 32 percent over the same period. The rapid growth of manufactured exports in the two NIEs has occurred notwithstanding rising protectionist barriers in industrial countries, such as the imposition of more stringent quotas on textiles, and U.S. non-tariff barriers on capital-intensive manufactures such as steel, in which South Korea, in particular, is becoming increasingly competitive.

7. The share of capital-intensive manufactures in South Korea's exports in 1982 was 26 percent, about 10 percentage points larger than the corresponding figure for Taiwan. This share has probably increased more rapidly in South Korea than in Taiwan in recent years as a result of the entry of South Korea into the automobile markets of North America and Europe and the growth in demand for South Korean steel.

8. For example, Kuo and Fei (1985) report that in the case of Taiwan, the proportion of total imports that is used in the export sector grew from 23 percent in 1961 to 63 percent in 1976.

9. The falling share of agricultural commodities in the imports of Taiwan and South Korea, in which the U.S. is particularly competitive, also limited the growth of imports from the U.S.

10. See De Rosa (1986), OECD (1988), and Wu (1988) for a discussion of recent trade policies and trade restrictions.

11. Due to trade liberalization which began in the late 1950s and early 1960s, the trade regimes of both Taiwan and South Korea are in many respects more liberal than those of other developing countries. The reason is that the export-led growth strategies of Taiwan and South Korea require a *reduction* in the levels of protection for domestic manufacturing, in order to motivate domestic producers to produce for world markets rather than for the smaller domestic market. Protection rates have been reduced by bringing domestic prices more closely in line with world prices, first by lowering import barriers over time, and second by providing subsidies and other benefits to encourage production for exports (in order to reduce further the incentives for production in protected domestic markets created by the remaining barriers to trade). Benefits to exporters included preferential access to foreign exchange, concessionary financing and tax breaks, and exemptions from customs duties for raw material and capital goods imports for the export sector. The importance of these incentives fell over time as trade was liberalized.

The impact of these measures is reflected in lower effective rates of protection in Taiwan and South Korea in comparison to other developing economies. For example, by 1969, the nominal protection rate in Taiwan had fallen to nine percent, and to 13 percent in South Korea, compared to 36 percent for Argentina. The effective protection rates were, respectively, five, 10, and 47 percent.

12. OECD (1988). Taiwan sources suggest that a much greater degree of trade liberalization was already in place by 1975. Drawing on official Taiwan sources and earlier research by S.C. Tsiang and others, Wu (1988) indicates that the share of permissible importables has remained at around 97 percent of total importables since 1975, while the share of controlled or prohibited imports has been around three percent. The large discrepancy between OECD and Taiwan source estimates apparently results from different definitions. For example, the list of permissible importables cited by Wu includes goods that are not automatically approved for import.

13. Trade barriers in both economies target consumer and agricultural goods, particularly those with high value added (fresh and canned fruits, for example). Restrictions are also imposed on imports in certain sectors where the development of domestic manufacturing capacity apparently is desired. For example, Korea protects certain sectors where its manufacturers are recent or potential entrants in world markets, such as computers and

peripherals, telecommunications equipment, and motor vehicles.

14. For discussions and empirical estimates of the income elasticities of various commodity groups see, Theil (1975) and Johnson, *et al* (1984).

15. A rise in imports of consumer goods might have resulted from a rise in the share of consumption in total spending.

16. This was part of an IMF-style adjustment program which included efforts to dampen domestic demand growth. An interesting account of this unusually successful adjustment episode is provided by Aghevli (1985).

17. See presentation of Director-General of the International Policy Coordination Office of Korea's Economic Planning Board. Koo (1987), p. 11.

18. Debt prepayments and the appreciation of the won against the U.S. dollar contributed to a decline in the debt-to-GNP ratio (both expressed in U.S. dollars) from approximately 58 percent in 1985 to 36 percent in 1987.

19. Conversely, a country whose nominal currency is appreciating may experience competitive gains if domestic inflation is sufficiently low. As discussed later, Taiwan is a rare example of this latter case.

20. Trade-weighted exchange rate indices were constructed by taking the geometric average of the nominal exchange rates of each economy with the 10 most important trading partners (excluding non-NIE developing countries) in the case of Taiwan and the nine most important trading partners in the case of South Korea. The weights (in each case based on 1980 bilateral exports and imports) were: *Taiwan;* US 45.2, UK 3.0, FRG 7.1, Italy 2.2, France 1.5, Canada 2.8, Japan 25.0, Australia 4.2, Hong Kong 7.1, and Korea 1.9. *South Korea;* US 40.1, UK 3.7, FRG 6.5, Italy 1.5, France 2.0, Canada 3.0, Japan 37.5, Australia 3.8, and Netherlands 1.8. The most important industrial country or East Asian NIE trading partners were included in the basket.

21. Very similar models are described in Hooper (1976) and Helkie and Hooper (1987). See also Goldstein and Khan (1985).

22. Actually, the price setting specification that follows may be interpreted either in terms of a mark-up or in terms of the law of one price. As noted by Dornbusch (1987), the former is appropriate in the case of trade in distinct manufactured goods, the latter is appropriate in the case of more homogeneous commodities. The trade flows analyzed in this paper involve total trade of both commodities and manufactured goods. Since these are not homogeneous, the mark-up interpretation appears to be more appropriate.

23. A long-run pass-through coefficient greater than one is also possible, although the intuition is less transparent. Feenstra (1988) notes that if the elasticity of demand is constant or decreasing in price, and if marginal costs are declining, profit maximizing price-setters may pass through more than 100 percent of exchange rate changes.

24. See Goldstein and Khan (1985) for a discussion of the results found in the literature.

25. A shift in relative prices caused by tariffs can affect the income elasticity of imports, and not just income shares, if preferences are not homothetic. The implications of tariffs for income elasticities are not addressed in the literature, possibly because homothetic preferences are usually assumed in empirical studies of demand (see Johnson *et al* [1984]).

26. Quarterly data were not available for GDP for the entire sample period. In the case of Taiwan, a quarterly series was created from annual data using quarterly industrial production as an instrument. In the case of South Korea, a quarterly series was created for 1986 and 1987, as the IFS does not report quarterly data over the period. The technique is described in Chow and Lin (1971).

27. See Goldstein and Khan (1985) for a fuller discussion of estimation methods in empirical studies of international trade.

28. A unit value index is an implicit price index, obtained by dividing total nominal expenditures on a product by the quantity of the product.

29. The long-run price elasticity of non-oil exports of the U.S. (-0.83) according to Helkie and Hooper (1987), is close to the price elasticity of imports of South Korea ($-.74$), but well below the corresponding price elasticity for Taiwan (-1.44).

On the other hand, the long-run price elasticity of exports of Taiwan and South Korea ($-.79$ and $-.72$, respectively) appear to be smaller than the price elasticity of U.S. imports reported by Helkie and Hooper (-1.15). One possible explanation is that a relatively large share of the exports of Taiwan and South Korea still is concentrated in light industry exports which are less substitutable for a wide range of U.S. manufactured goods or which may be subject to quotas (e.g. textiles).

30. Helkie and Hooper (1987) estimate an income elasticity of two, Throop (1988) gives an estimate of three. Helkie and Hooper obtain a lower estimate of the income elasticity of U.S. imports because they introduce additional explanatory variables to reflect developments in the productive capacity and market penetration of U.S. trading partners. This approach was not followed in the present paper because an appropriate proxy for such developments is very hard to define.

31. This is particularly surprising, since the share of (relatively price inelastic) primary commodities in imports is higher than the share of primary commodities in exports in both economies.

32. See discussion of equations (5) and (6) below in text.

33. The fall in relative import prices is not fully explained by the appreciation of exchange rates. This suggests that other factors, such as the decline in oil prices, may have played a role as well.

34. If trade is balanced, the annual percent change in the exchange rate required to offset income effects so as to

maintain trade balance is:

$$XR' = -(xy'^* - my') / [(1+h_1)\,p_x - p_m h_2]$$

where XR′ is the percent change in the exchange rate, y′* and y′ are the foreign and domestic growth rates, x is the long-run income elasticity of exports, m is the long-run income elasticity of imports, $(1+h_1)$ is the long-run pass through from exchange rates to export prices, p_x is the long-run price elasticity of exports, h_2 is the long-run pass through from exchange rates to import prices, and p_m is the long-run price elasticity of imports.

If trade is not balanced, the annual percent change in the exchange rate required to eliminate the trade imbalance (ignoring income effects) is:

$$XR' = -T / [(1+h_1)\,(p_x X_0 - h_2 p_m M_0)]$$

Where T is the trade surplus or deficit, X_0 is the initial level of exports and M_0 is the initial level of imports. In addition, an annual appreciation is required to offset the impact of income effects. In the first year, the appreciation is:

$$XR' = -(xy'^* X_0 - my'M_0) / [(1+h_1)(p_x X_0 - h_2 p_m M_0)].$$

35. The one-time appreciation may be distributed over several periods, but then the subsequent annual appreciation rates will be larger.

36. For example, the calculations assume that both economies will grow at their 1974–87 average rate in comparison to their trading partners, whereas more rapid appreciation might slow economic growth below this average (and lead to a larger trade surplus through income effects). The calculations also exclude the effect of other factors, such as low domestic inflation in Taiwan, on competitiveness.

REFERENCES

Aghevli, Bijan B. "A Case of Successful Adjustment: Korea's Experience During 1980-84." *Occasional Papers* No. 39. Washington: International Monetary Fund, 1985.

Balassa, Bela and Associates. *Development Strategies in Semi-Industrial Economies.* Washington: The World Bank, 1982.

Balassa, Bela A. and John Williamson. *Adjusting to Success: Balance of Payments Policies in the East Asian NICs.* Washington: Institute for International Economics, 1987.

Branson, William. "Trade and Structural Independence Between the U.S. and NICs" in Colin I. Bradford and William H. Branson, eds., *Trade and Structural Change in Pacific Asia.* NBER Conference Report Chicago: University of Chicago Press, 1987.

Chow, Gregory C. and An-loh Lin. "Best Linear Unbiased Interpolation, Distribution, and Extrapolation of Time Series by Related Series," *The Review of Economics and Statistics,* 1971.

DeRosa, Dean A. "Trade and Protection in the Asian Developing Region," *Asian Development Review.* Asian Development Bank, 1986, Vol 4, No. 1.

Dornbusch, R. "Exchange Rates and Prices," *American Economic Review, 77.*

Feenstra, Robert C. "Symmetric Pass-Through of Tariffs and Exchange Rates under Imperfect Competition: An Empirical Test." *Working Paper* No. 2453. NBER, December 1987.

Giovannini, A. Exchange Rates and Traded Goods Prices, *Journal of International Economics,* 1988.

Goldstein, Morris and Mohsin S. Khan. "Income and Price Effects in Foreign Trade," in Ronald Jones and Peter Kenen, eds., *Handbook of International Economics,* Volume II. New York: North Holland, 1985.

Harvey, A.C. *The Econometric Analysis of Time Series.* New York: John Wiley & Sons, 1981.

Helkie, William and Peter Hooper. "The U.S. External Deficit in the 1980s: An Empirical Analysis." *International Finance Discussion Papers* No. 304. Washington: Board of Governors of the Federal Reserve System, February 1987.

Hendry, David F. "Predictive Failure and Econometric Modelling in Macroeconomics: The Transactions Demand for Money," in P. Omerod, ed., *Modelling the Economy.* London: Heinemann Educational Books, 1979.

Hooper, Peter. "Forecasting U.S. Export and Import Prices and Volumes in a Changing World Economy." *International Finance Discussion Papers* No. 99. Washington: Board of Governors of the Federal Reserve System, December 1976.

Johnson, Stanley, Zuhair Hassan and Richard Green. *Demand Systems Estimation: Methods and Applications.* Ames, Iowa: Iowa State University Press, 1984.

Koo, Bohn-Young. "Korea's Strategy for Balanced Growth and Improved Trade Relations." Processed. Presented to The Asia Society, New York, May 11, 1987.

Liang, Kuo-shu and Ching-ing Hou Liang. "Taiwan's New International Role in Light of Changes in Comparative Advantage, Trade Patterns and Balance of Payments." Processed. Presented at the Conference on Economic Development Experiences of Taiwan, sponsored by the Institute of Economics, Academia Sinica, Resource Systems Institute, East-West Center, Chung-Hua Institution for Economic Research. Taipei, Taiwan, June 8–10, 1988.

Lin, Ching-yuan. "Policy Reforms, International Competitiveness and Export Performance: Chile and Argentina versus The Republic of Korea and Taiwan, Province of China." *Working Paper* WP/87/49. Washington: IMF July 23, 1987.

Moreno, Ramon. "The NICs, the Dollar and the U.S. Deficit," *FRBSF Weekly Letter,* Federal Reserve Bank of San Francisco, August 15, 1986.

Organization for Economic Co-operation and Development. *The Newly-Industrializing Countries, Challenge and Opportunity for OECD Industries.* Paris, 1988.

Rana, P.B. "Changes in the Export Patterns of Asian and Pacific Developing Countries: An Empirical Overview." *Asian Development Bank Economic Staff Paper* No. 34. Manila: The Asian Development Bank, 1987.

Shinohara, Miyohei. "Real Exchange Rates and Patterns of Industrialization in East and Southeast Asia." *The Developing Economies.* Vol XXI, No. 4. Tokyo: Institute of Developing Economies, December 1983.

Theil, Henri. *Theory and Measurement of Consumer Demand.* Amsterdam: North Holland, 1975.

Throop, Adrian, "A Macroeconometric Model of the U.S. Economy." *Working Paper* 88-06. Federal Reserve Bank of San Francisco, September 1988.

U.S. Office of the United States Trade Representative. *1987 National Trade Estimate Report on Foreign Trade Barriers.* Washington, 1988.

U.S. Congress. Joint Economic Committee. *Restoring International Balance: The Taiwan Economy and International Trade.* 1987.

World Bank. *World Development Report 1987.* New York: Oxford University Press, 1987.

World Bank. *World Development Report 1988.* New York: Oxford University Press, 1988.

Wu, Chung-lih. "Some Measures to Promote a More Balanced Bilateral Trade Relationship Between the ROC and the U.S.A.—Economic and Political Implications," *Economic Review,* International Commercial Bank of China, Taiwan, China, January-February 1988.