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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

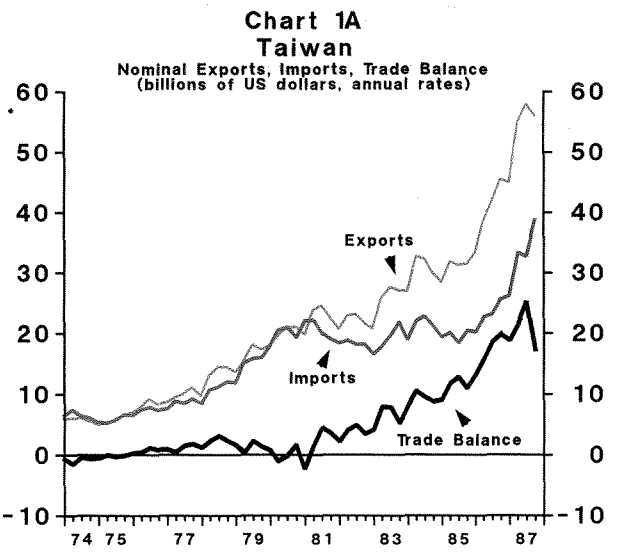
Trends in Trade

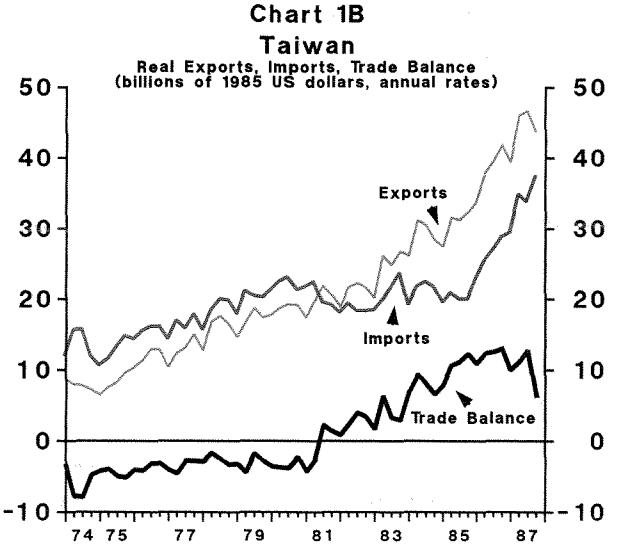
Chart 1a shows the trend in nominal exports, imports, and the trade balance of Taiwan. Chart 1b shows these same trends, but in real, or price-level adjusted, terms. The corresponding nominal and real trade flows for Korea are illustrated in Charts 2a and 2b. Taiwan's and Korea's trade surpluses have 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.

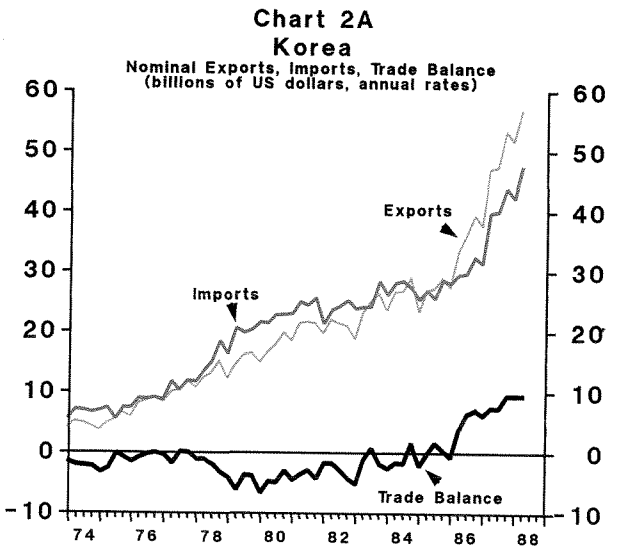
The charts reveal some differences between the nominal and real measures of trade flows, particularly in the short-run. Taiwan's real trade surplus appears to have stabilized in late 1985, whereas in nominal U.S. dollars, it continued to rise until the second half of 1987 (both measures show a sharp 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.

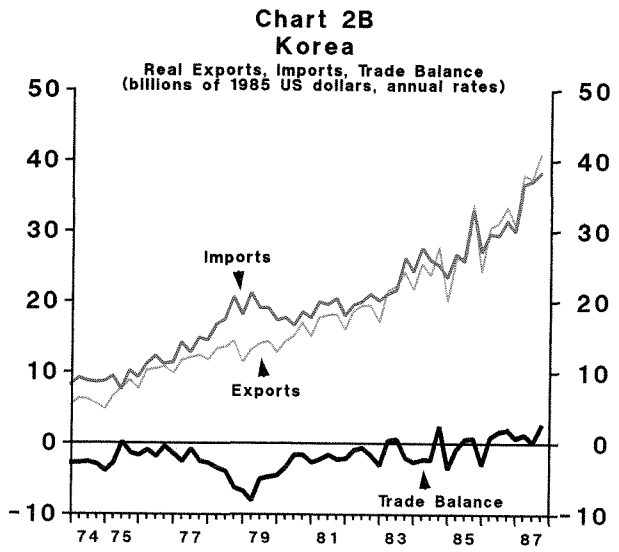
However, the overall trends in real and nominal trade balances are about the same for both Taiwan and Korea. One striking feature is the rapid growth of exports in both economies, at a pace exceeding export growth in most of the rest of the world. Real exports grew at a compound annual growth rate of 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.

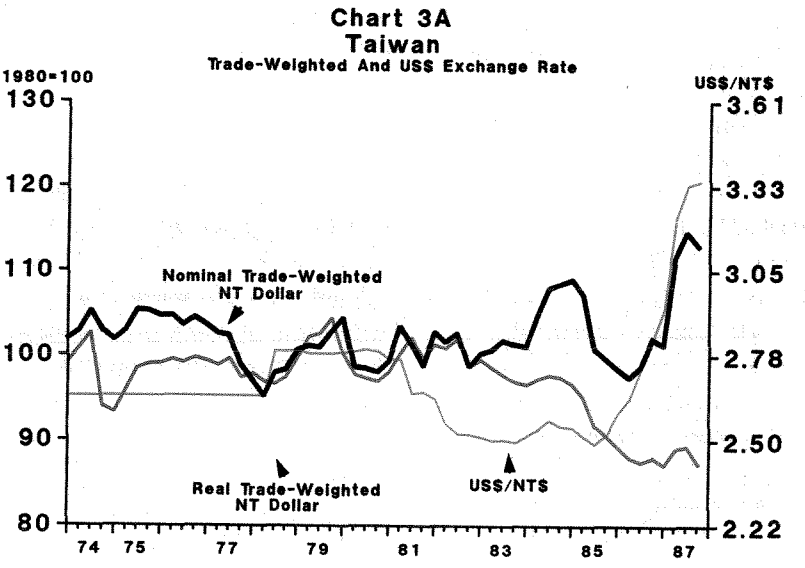
Chart 3a also shows that even as the nominal NT dollar reached its highest values over the sample period, the real trade-weighted exchange rate was on a downward trend from 1980 to 1986, and remained below its 1980 peak in 1987. Thus, relatively low domestic inflation, rather than nominal exchange rate 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.

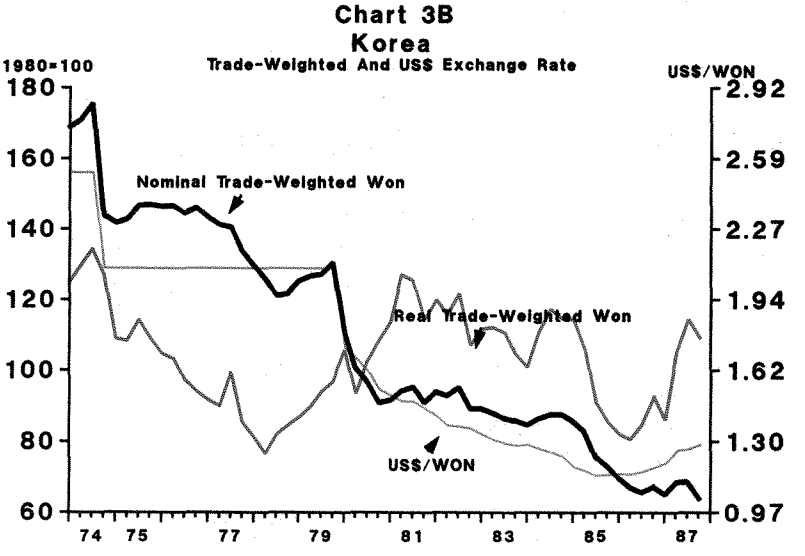
Turning now to Korea, Chart 3b reveals that since 1974 there has been a downward trend in the nominal value of the won on a dollar- and a trade-weighted basis. In line with the policy intentions discussed previously, the nominal trade-weighted won declined sharply in 1980 and since 1985, notwithstanding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

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