III International Trade and Real Exchange Rates

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The real exchange rate is one of the key relative prices in an economy, defining the rate of exchange between domestic goods and their foreign counterparts. As a result, changes in the exchange rate have economy-wide implications that are communicated largely through international trade. The effects of exchange rate changes on the economy are particularly important for the APEC region because the exchange rates of its two largest members, the United States and Japan, have experienced large deviations from trend over the past twenty years. The appreciation and subsequent depreciation of the U.S. dollar over the mid-1980s had a significant impact on regional trade linkages, as has the appreciation of the yen since 1993.

In looking at the relationship between real exchange rates (defined as the relative price of goods in different countries) and trade, it is useful to distinguish between the effects of day-to-day exchange rate volatility and more persistent movements in the exchange rate. The breakup of the Bretton Woods fixed exchange rate system in the early 1970s led to the general adoption of floating exchange rates. One consequence of this shift was a marked increase in the level of exchange rate volatility, with day-to-day and month-to-month movements in the exchange rate becoming much larger. For example, the standard deviation of monthly changes in the exchange rate between the yen and the dollar after 1973 has been over triple the value between 1962 and 1972 (Mussa and others, 1994, Table 2). In addition to this short-term volatility, there have also been more persistent deviations of real exchange rates from long-term trends. The most obvious cases are those mentioned earlier: the appreciation and depreciation of the dollar in the mid-1980s and the more recent appreciation of the yen.

This section assesses the impact of both types of exchange rate behavior on trade within the APEC region. The focus will be largely on the impact of medium-term changes in the exchange rate. There is strong evidence that such movements have significant effects on trade; empirical trade equations consistently have found that the real exchange rate is one of the key determinants of both exports and imports. In addition to reviewing the relevant literature, some new estimates of the impact of such exchange rate changes on trade volumes will be presented.

Evidence on the ramifications of short-term exchange rate volatility will also be discussed. Unlike the case for more persistent movements in real exchange rates, studies looking at the effects of exchange rate volatility on trade have come to rather mixed conclusions, with the weight of the evidence pointing to a relatively small impact. This conclusion appears to be fairly robust across different time periods, countries, and statistical techniques. It does, however, contrast with anecdotal evidence that the increase in exchange rate volatility has been a significant concern to people in business.

Patterns of Trade in the APEC Region

The APEC region covers a wide geographic area, including economies from East Asia, Oceania, North America, and, with the recent accession of Chile, South America. Particularly notable from the point of view of analysis is that the region includes much of East Asia, the most economically dynamic region of the world over the past twenty years. The contrast between the rapid economic expansion of this part of the world with the more measured growth of the rest of the APEC region—in particular the more developed economies—provides APEC with a rich set of dynamics that underlie many of the trends in trade.

Table 3-1 shows the rate of growth of real trade in goods and services for the relevant economies during 1973–93, as well as growth in domestic real GDP and a trade-weighted average of real GDP in the economies of trading partners. Both real exports and imports of the economies in the region have grown at over 6 percent a year, over half as much again as trade in the world as a whole. There are significant variations in experience across economies, with the growth in trade being particularly rapid in many of the East Asian countries, in particular the "tigers" (Hong Kong, Korea, Singapore, and Taiwan Province of China), as well as China, Malaysia, Thailand, and Chile. By contrast, the slowest rates of

Table 3-1. Real Growth in Trade of Goods and Services and Output, 1973–93
(Percent a year)

	Exports	Imports	GDP	Trading-Partner GDP[1]
Australia	5.2	4.7	2.8	3.7
Canada	4.5	5.4	2.8	2.5
Chile	9.1	8.1	3.9	2.7
China[2]	11.8	11.8	9.5	—
Hong Kong	16.1	12.9	7.2	3.2
Indonesia	6.1	7.3	6.0	3.8
Japan	6.8	3.4	3.6	3.8
Korea	12.5	11.7	8.2	3.3
Mexico	7.4	5.5	3.6	2.4
Malaysia	10.3	10.2	6.8	4.5
New Zealand	3.9	2.4	1.3	3.1
Papua New Guinea	5.5	2.2	2.8	—
Philippines	5.4	5.5	3.1	3.5
Singapore	9.2	7.9	7.4	4.7
Thailand	12.8	6.6	7.7	3.9
Taiwan Province of China	9.4	10.9	7.8	3.4
United States	5.4	5.3	2.3	3.3
APEC	6.2	6.2	3.8	—
World	4.1[3]	4.1[3]	3.0	—

Source: IMF, World Economic Outlook database and *International Financial Statistics* (various issues). Further details are given in the appendix to Section III.

[1]An export-weighted average of partner-country real GDP in APEC and much of Europe.

[2]1979–93.

[3]Average of exports and imports.

growth have been experienced in the industrial countries within the region (Australia, Canada, Japan, New Zealand, and the United States) as well as the Philippines.

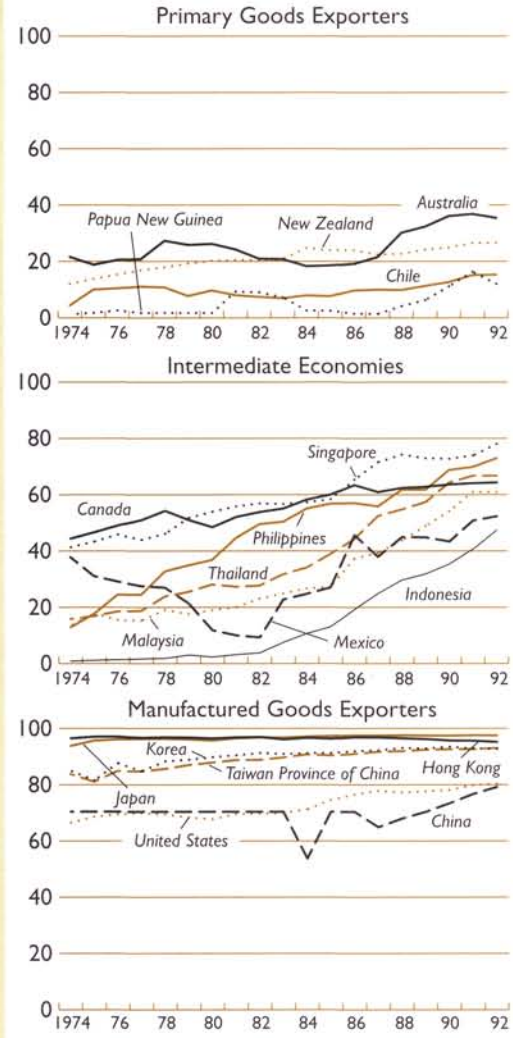
This pattern of rapid expansion in much of East Asia and slower expansion elsewhere, particularly in the industrial countries of the region, also holds for the growth of real GDP. The correspondence between the growth in output and trade should not come as any great surprise, since one of the principal empirical determinants of bilateral trade between countries is the level of output in both countries.[1] It follows that countries whose output is growing rapidly will also experience a speedy expansion of trade. It also follows that bilateral trade will tend to expand fastest with trading partners whose output is also growing rapidly. Because trade tends to be relatively localized (distance is another important determinant of the level of bilateral trade), trade will tend to expand particularly rapidly in regions where all countries are growing rapidly. Some countries in East Asia have benefited from this effect, as can be seen from the data on the growth of output in trading-partner markets, reported in Table 3-1. While the variation in the growth of trading-partner real GDP across economies is much less pronounced than the variation in growth of domestic real GDP, reflecting the diversified nature of external trade, it is clear that in many cases economies with the faster rate of growth of trade also experienced more rapid output growth in destination markets.[2]

The type of goods traded also varies significantly across the APEC region. Figure 3-1 shows the pro-

[1]This is one of the predictions of the gravity model of trade; see Anderson (1979) and Bergstrand (1985). Frankel, Stein, and Wei (1995) provide a discussion of the theoretical underpinnings of the model.

[2]What is less clear is the degree to which the causation may have gone the other way, with the growth in trade stimulating the expansion in output. This issue is beyond the scope of this paper.

Figure 3-1. Proportion of Exports That Are Manufactures
(In percent)



portion of merchandise exports (by value), which consist of manufactured goods for each of the economies.[3] There are a number of economies whose trade was heavily concentrated in nonmanufactured goods, which essentially correspond to primary goods. Examples of such primary good exporters include Australia, Chile, New Zealand, and Papua New Guinea, although in the case of Australia there has been some recent expansion in exports of manufactures. At the other end of the scale, the exports of China, Hong Kong, Japan, Korea, Taiwan Province of China, and the United States were heavily concentrated in manufactured goods throughout the period. A number of economies fall into an intermediate category, in which exports were predominantly primary goods at the start of the period but have become more heavily concentrated in manufactured goods over time. This pattern holds for much of East Asia, including Indonesia, Malaysia, the Philippines, Singapore, and Thailand, as well as for Canada and Mexico in North America. This transformation has progressed furthest in Singapore and is most recent in Indonesia, Mexico, and Malaysia.

The composition of imports (Figure 3-2) often shows characteristics opposite to those of exports. For example, Japan is a heavy importer of primary goods, whereas Australia's imports are largely manufactures. In many other economies, however, manufactures make up a high proportion of both exports and imports. In addition, the recent rise in the proportion of exports that are manufactured goods in the intermediate economies has not led to a decrease in the proportion of such imports. Indeed, there appears to have been a slight rise in the proportion of manufactured imports for these countries, as there has for the region as a whole.[4] In short, manufactured goods appear to have been taking up an increased proportion of trade over time, and differences in the composition of imports and exports have been reduced.

The pattern of trade in the 1970s was largely consistent with models that emphasize the importance of differences in resources as a motivation for trade—with natural-resource-rich economies such as Australia and Indonesia specializing in exporting primary goods, and resource-poor economies such as Japan specializing in exporting manufactures. The more recent trend toward high proportions of manufactures in both exports and imports, particularly in the transitional economies, is less consistent with this type of analysis.[5] These recent trends are more compatible with "new" theories of trade, which emphasize that important determinants of the composition of trade include increasing returns to scale and the desire of consumers for product variety. These new theories are able to explain high levels of intra-

[3]Ratios calculated using volumes of exports show very similar trends to those using values, indicating that the results reflect changes in real behavior rather than movements in relative prices between manufactured and primary goods.

[4]Unlike the case for exports, data on the relevant import volumes are not readily available, so it is not possible to ascertain the degree to which these trends reflect movements in the relative price between primary and manufactured goods.

[5]Note, however, that countries can import and export very different types of goods within the manufacturing sector. For example, China predominantly exports labor-intensive, low-skill products while importing higher-value-added products.

Figure 3-2. Proportion of Imports That Are Manufactures
(In percent)

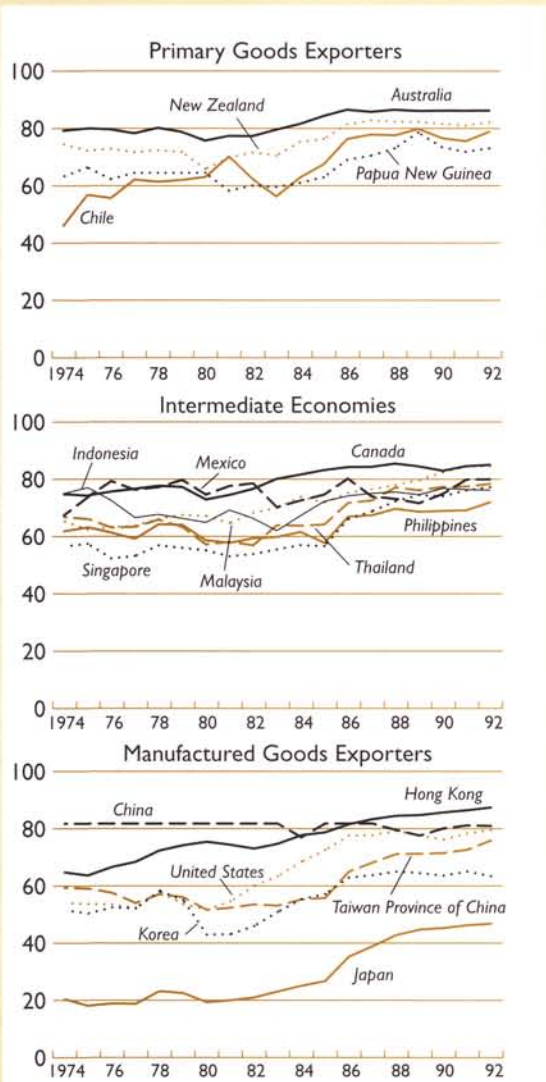
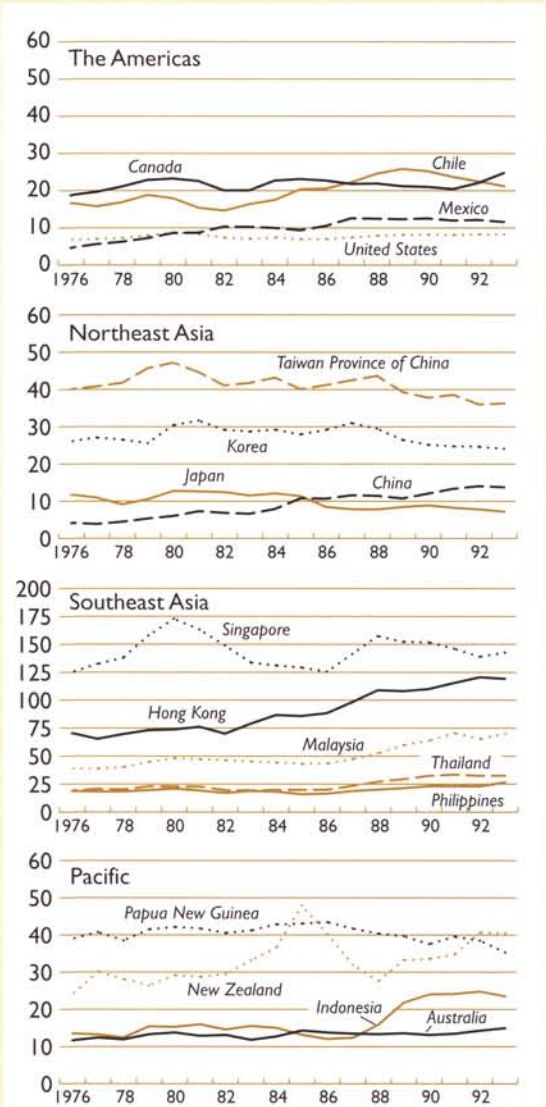


Figure 3-3. Openness to Trade
(In percent)



sectoral trade in manufactures, as discussed further below.

The degree of openness of the economies in the APEC region to trade, measured as the average of nominal exports and imports of merchandise as a ratio of domestic output, is shown in Figure 3-3.[6] The two most open economies are Hong Kong and Singapore, which are centers of entrepôt trade, as is clearly indicated by the fact that average levels of trade often exceed domestic output (note that the panel including Hong Kong and Singapore has a different scale from the others). The recent rapid expansion of both exports and imports as a ratio to output in Malaysia indicates that this country may also be developing this characteristic. At the opposite end of the scale, Japan and the United States, the two largest economies in the region, are also the least open to trade. This reflects a general characteristic that large economies are less open to international

[6]Merchandise trade is used because most of the analysis in this section focuses on such trade. The same underlying trends are evident when trade in services is included, although the ratios are somewhat larger.

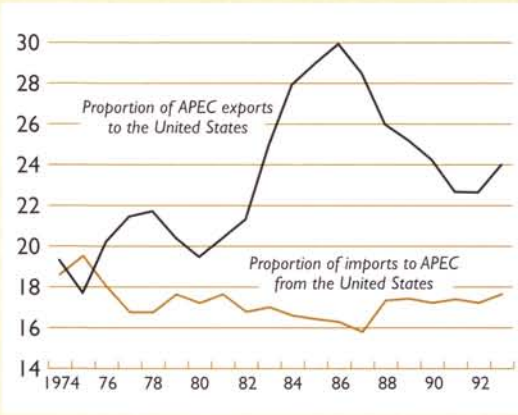
trade than small ones, presumably reflecting the greater potential within larger economies for intranational trade, which is not included in the international trade data. In some other economies the ratios have increased rapidly over a limited period, possibly reflecting the impact of trade liberalization. A striking example of this phenomenon is the expansion of trade in China in the 1980s.[7]

There are also important trends within the region as regards intraregional trade. In 1993 approximately two-thirds of all merchandise trade from the APEC region (excluding China, Papua New Guinea, and Brunei Darussalam) went to other economies in this area, up from just over half in 1974.[8] Chile, Hong Kong, and the United States had ratios somewhat below this average (although in the case of Hong Kong this is heavily influenced by the exclusion of China), while Taiwan Province of China and Canada were somewhat above it. The increase in intra-APEC trade largely reflects the rapid economic expansion of many of the Asian members. The proportion of merchandise exports to APEC coming from East Asia[9] increased from around 20 percent in 1974 to over 30 percent in 1993, while that from other economies in the region has remained relatively constant over the same time period.

With the important exception of Japan, the East Asian countries have also generally increased the proportion of APEC exports they receive. The most striking feature of these data, however, is the increase in the proportion of APEC exports going to the United States during the mid-1980s, as the dollar appreciated, and during the subsequent reversal of the appreciation (Figure 3-4). While some of this trend may reflect the path of aggregate demand, the appreciation of the dollar clearly had a significant, if temporary, impact on regional trade patterns. By contrast, the recent appreciation of the yen has not led to the same change, presumably because it has been accompanied by weak domestic demand in Japan.[10]

Bilateral trade patterns show some interesting features, largely revolving around the United States and Japan. Figure 3-5 shows the direction of trade of total exports and imports for seven regions, six within APEC (the United States, Japan, the newly

Figure 3-4. Trade Between the United States and the Rest of the APEC Region
(In percent)



industrializing economies or NIEs,[11] other Asian,[12] Pacific,[13] other Americas[14]) along with non-APEC economies, and Table 3-2 shows the weight of the United States and Japan in 1993 merchandise trade for each economy in the region. Japan's export share is significantly larger than its import share for both the United States and the NIEs, a pattern that is repeated between the NIEs and the United States.[15] Hence, the NIEs generally have a triangular trading relationship, being net importers from Japan and net exporters to the United States. A similar, although less strong, pattern is true of the other Asian economies. By contrast, the Pacific economies have the opposite trilateral arrangement, being net importers from the United States and net exporters to Japan (Table 3-2 indicates this is also true of Chile). Finally, the other American economies have trade that is dominated by bilateral ties with the United States.

The triangular trading relationships of the NIEs, other Asian, and Pacific economies make their economies particularly susceptible to changes in the yen-dollar rate. For example, an appreciation of the yen against the U.S. dollar (compared with trend) generates a rise in the prices of imports compared with prices of exports for those countries that are net

[7]Price controls were lifted on many goods around this period, which may also have affected the ratio.

[8]All data come from IMF, *Direction of Trade Statistics* (Washington, various issues). China, Papua New Guinea, and Brunei Darussalam were excluded because their historical data were not reliable. If China, by far the largest of the excluded countries, were included, the proportion of intra-APEC trade in 1993 would rise to just over 70 percent.

[9]Japan, Taiwan Province of China, Korea, Hong Kong, the Philippines, Thailand, Malaysia, Singapore, and Indonesia.

[10]The explanation may also involve J-curves and lags.

[11]Hong Kong, Korea, Singapore, and Taiwan Province of China.

[12]Indonesia, Malaysia, the Philippines, and Thailand.

[13]Australia and New Zealand.

[14]Canada, Chile, and Mexico.

[15]Another interesting feature of the data is the rise in the proportion of U.S. imports coming from Japan and the NIEs in the mid-1980s. Apparently, these economies were particularly benefited by the movement in the exchange rate.

Figure 3-5. Import and Export Weights
(In percent)

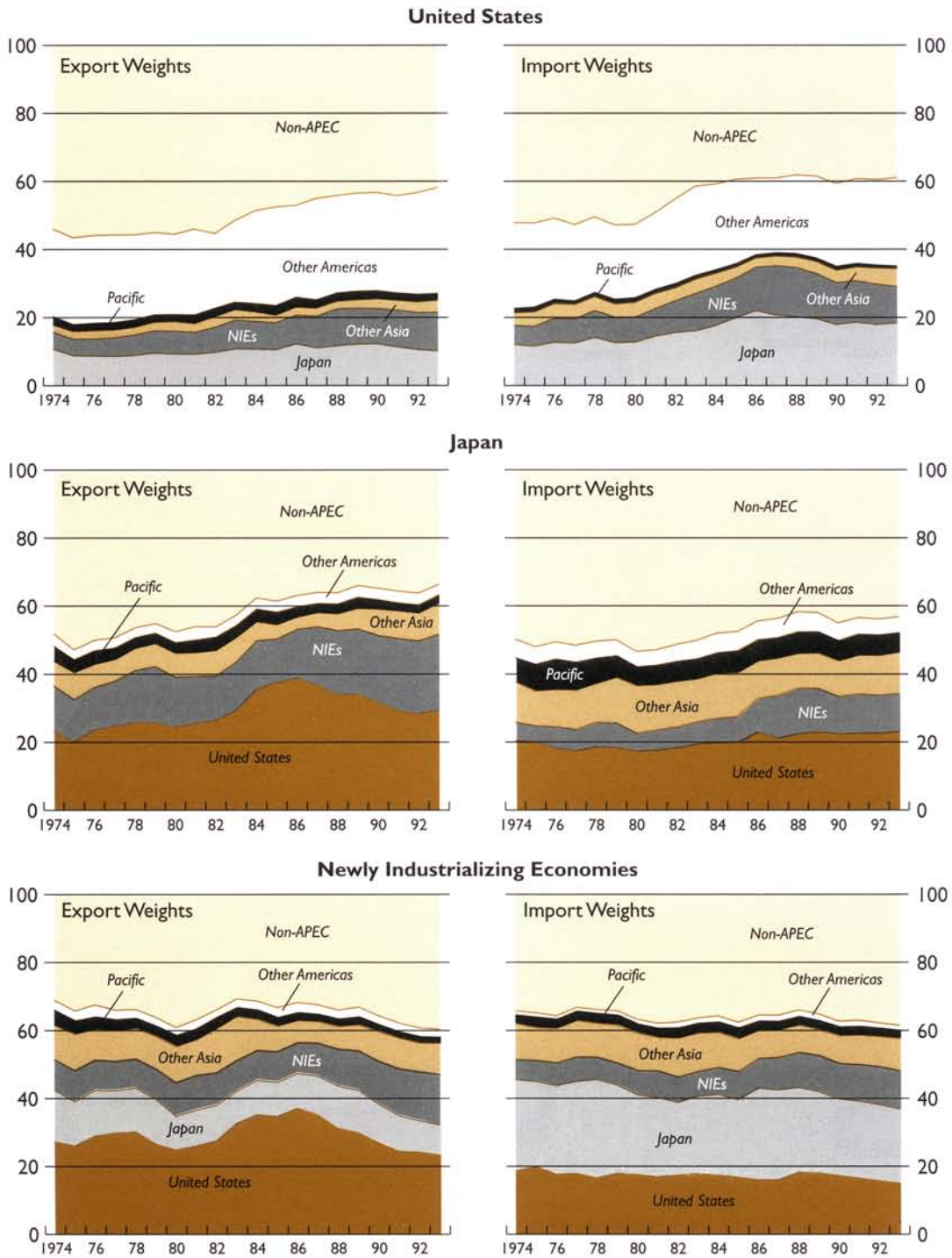
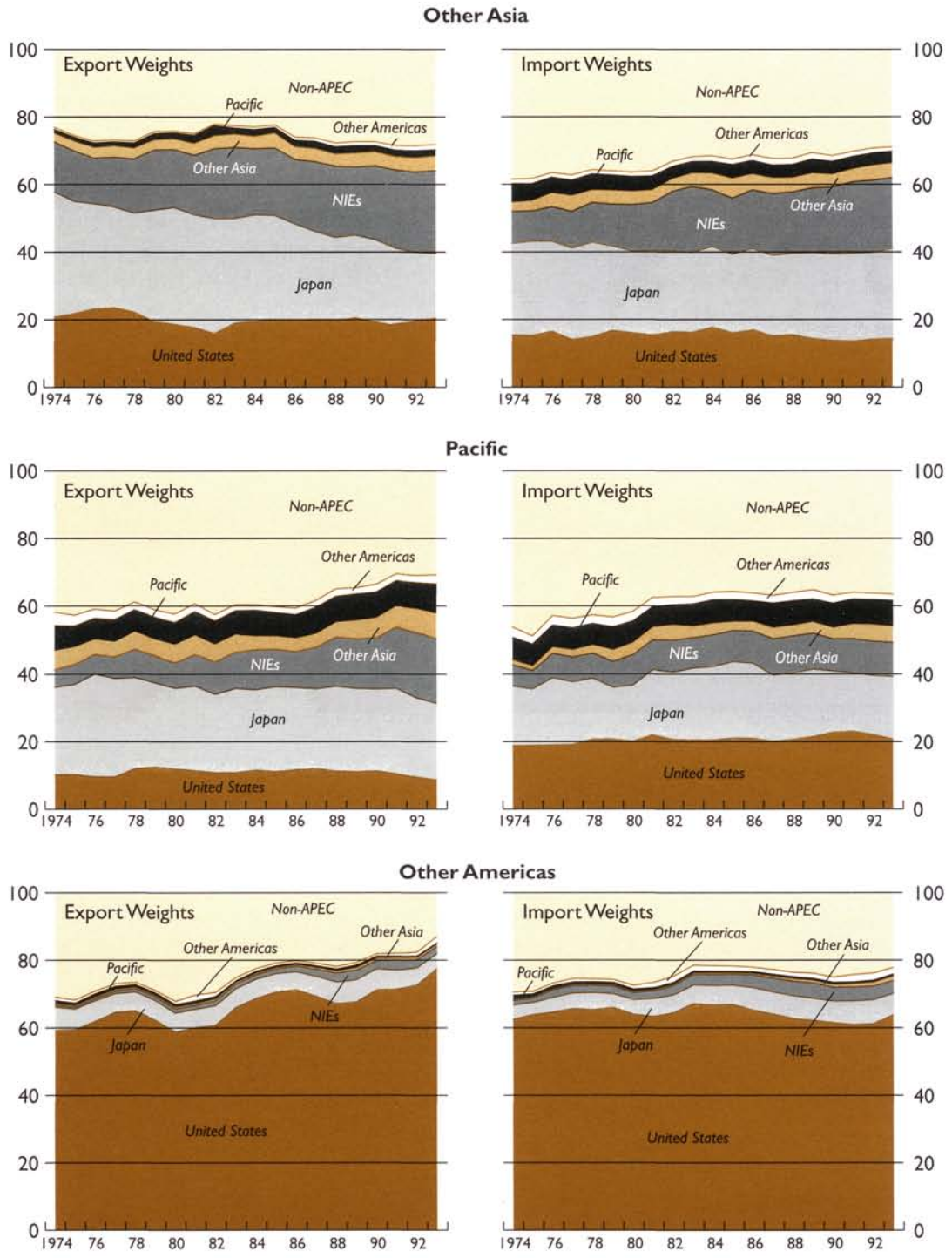


Figure 3-5 *(concluded)*



Note: NIEs comprise Taiwan Province of China, Korea, Hong Kong, and Singapore. "Other Asia" comprises Thailand, Malaysia, Indonesia, and the Philippines. "Pacific" comprises Australia and New Zealand. "Other Americas" comprises Canada, Mexico, and Chile.

Table 3-2. Weights of United States and Japan in Merchandise Trade in 1993
(In percent of total trade)

	United States		Japan	
	Exports	Imports	Exports	Imports
Australia	8.0	21.5	24.6	19.0
Canada	81.3	65.0	4.6	6.1
Chile	17.3	15.7	22.6	8.0
China	18.5	10.2	17.2	22.5
Hong Kong	23.1	7.3	5.2	16.6
Indonesia	14.2	11.5	30.3	22.1
Japan	29.4	23.2	...	...
Korea	22.7	20.6	14.5	23.0
Mexico	78.5	68.3	2.1	6.5
Malaysia	20.3	16.9	13.0	27.5
New Zealand	11.7	18.0	14.6	16.2
Philippines	38.5	20.0	16.1	22.8
Singapore	20.4	16.3	7.5	21.9
Thailand	21.5	11.7	17.0	30.3
Taiwan Province of China	27.7	21.7	10.6	30.1
United States	...	...	10.3	18.4

Source: Calculated from IMF, *Direction of Trade Statistics* (various issues).

importers from Japan and net exporters to the United States (a depreciation in the yen against the U.S. dollar has the opposite effect).[16] This deterioration in the terms of trade will tend to lower economic welfare in the affected economies, although these effects might be mitigated by an increase in the competitiveness of the countries' exports vis-à-vis Japanese goods in the United States and other markets. In any case, changes in the yen-dollar exchange rate can have important economic implications for other countries in the region.

Trade and the Exchange Rate

Relative Prices

Much of trade theory focuses on underlying reasons for international trade, with relatively limited discussion of the role of the exchange rate either in determining or being determined by these flows. The factor-proportions theory associated with the names of Heckscher and Ohlin focuses on how differences in factor endowments produce incentives to trade (see Dixit and Norman, 1980, and Jones and Neary, 1985). Countries with, say, large amounts of land and minerals (such as Australia) can be expected to export agricultural goods and commodities, while countries with abundant numbers of people might be expected to trade labor-intensive manufactured goods. Within this approach, the role of the exchange rate is largely limited to the relatively general issue of ensuring that all countries have a comparative advantage in exporting some types of goods.

Although the factor-proportions theory can explain many aspects of trade, it does not explain why much of the trade between industrial countries involves two-way flows of finished manufactured goods (such as cars), which, as discussed earlier, also appear to be becoming more prevalent in the APEC region. This led to the development of the "new" theories of international trade based on increasing returns to scale in production and the desire of consumers for variety in consumption (Krugman, 1980, and Helpman and Krugman, 1985). Increasing returns to scale imply that countries will specialize in the production of different brands of goods within an industry, while the desire of consumers for variety generates demand for foreign brands. The result is international trade in which similar goods are being exchanged in both directions. As in the factor-proportions theory, however, there is relatively little emphasis on the exchange rate or its role in determining trade patterns.[17]

More recently, trade theory has also focused on the behavior of the external balance over time, with the development of the intertemporal approach to the current account.[18] This work emphasizes the role of the external balance in facilitating desirable paths of consumption, saving, and investment across countries. Because these models focus on the appropriate path for net trade over time, and because the real exchange rate is an important determinant of such trade flows, this line of research has implications for the path of the real exchange rate. To date, however, this aspect of the issue appears not to have been studied in any detail, in part because such considerations significantly complicate the analysis.

In contrast to the relative lack of importance of the exchange rate in much of the theoretical work on

[16]Bayoumi, Hewitt, and Symansky (1995) includes some welfare calculations for the NIEs from changes in defense spending that illustrate the potential importance of this trilateral trade relationship.

[17]This may change. In particular, with increasing international capital mobility and its implications for the medium-term variability of exchange rates, more attention is beginning to be paid to the impact of exchange rate movements on patterns of trade.

[18]See Sachs (1981) for an early contribution. Obstfeld and Rogoff (forthcoming) contains a survey.

trade, it has played a central role in estimated equations for trade volumes.[19] Trade volumes are usually related to changes in relative prices and to changes in real activity either at home (for imports) or abroad (for exports).[20] For example, in a typical import equation the volume of imports would be related to current and lagged values of the real exchange rate (or the relative price of imports) and of domestic output (or expenditures). Such equations have proven to be highly successful empirically, and they have been consistently used in policy work and macroeconomic models as a way of looking at the impact of the exchange rate on the tradable goods sector.[21] The basic results from this line of work, as summarized by Goldstein and Khan (1985), are that changes in both relative prices and real activity have a significant impact on trade volumes and the nominal trade balance. Their consensus estimates on the negative price elasticity are between ½ and 1 for imports, and somewhat higher (1¼ to 2½) for exports. (These elasticities refer to the prices actually faced by traders, and the elasticities with respect to real exchange rates could well be smaller because of pricing-to-market behavior.) Trade in manufactures appears to have slightly higher elasticities than trade in primary goods, but the differences are not large.

There is, however, a significant difference in the timing of the responses of trade volumes to activity and to relative prices. Although the real activity effect occurs almost immediately, the response of trade volumes to changes in real exchange rates builds more gradually over time. Because a devaluation in the real exchange rate produces an unfavorable terms of trade response, with import prices rising relative to export prices, the initial impact of a fall in the exchange rate on the nominal trade balance can be small or even perverse. The expected effects of the exchange rate on the nominal trade balance may only become clear in the medium term.

Despite their empirical success, these types of equations are not without their critics. The most important concern centers on whether supply terms should also be included in the equations for export volumes, and focuses on the "45-degree rule," which states that there is a one-to-one relationship between estimated elasticities of export demand and growth in home output. Standard export volume equations only take account of demand factors such as the growth of the overseas markets and relative prices. If all economies had the same underlying elasticities with respect to activity, then, with stable real exchange rates, high-growth economies should show a tendency for imports to grow faster than exports, while slow-growing economies should exhibit the opposite characteristic. This differential in the growth of exports and imports would need to be offset by a decline in the real exchange rate of faster-growing economies as consumers are compensated for accepting more goods from these economies.[22] In practice, however, economies with high output growth also have high growth of exports and no decline in their real exchange rates. Instead, estimates of the elasticity on foreign activity are high for high-growth economies and low for low-growth economies—the 45-degree rule (Houthakker and Magee, 1969, and Krugman, 1989). These differences in elasticities mean that export volumes grow at rates similar to those of import volumes in most economies without significant trends in exchange rates.

The close correspondence between estimated activity elasticities for exports and real domestic growth suggests some form of misspecification—a particularly important potential problem for the APEC region, given the wide range of growth experiences within the region. Several authors have suggested that this comes from not including a term measuring domestic supply in the export equation.[23] Such a term can be justified in several ways. For example, in the context of the "new" trade theories it can be argued that, as output expands, so does the number of brands produced by a country. Because consumers desire diversity, this increase in brands generates an increase in demand for exports.[24] Alter-

[19]Goldstein and Khan (1985) provided a survey. Two issues that will not be discussed are the pass-through of exchange rates into traded goods prices, in particular pricing-to-market behavior (Krugman, 1987), and so-called "beachhead" effects in which changes in the exchange rate have permanent effects on the trade balance through the fixed costs of entering or leaving a market (Dixit, 1989, and Baldwin and Krugman, 1989).

[20]Some results using this type of specification for APEC economies are reported in the discussion of trade elasticities, below.

[21]Of particular interest from the point of view of the APEC region has been work on the trade deficit in the United States such as Bryant, Holtham, and Hooper (1988) and Krugman (1991), both of whom concluded that real exchange rates are important for trade adjustment.

[22]This discussion ignores the impact of differential productivity growth between traded and nontraded goods on the real exchange rate, generally termed the Balassa-Samuelson effect, discussed in Section II.

[23]An alternative explanation particular to the NIEs, offered by Riedel (1988), is that these economies produce goods that are highly substitutable. Accordingly, the market will accept any amount of goods produced at the going international price, and any deviations from the law of one price reflect statistical discrepancies. This approach, however, fails to explain why trade volumes are found to be connected with deviations from the law of one price in the form of real exchange rate changes.

[24]Krugman (1989). Analogously, the expansion of supply may be correlated with the development of higher-quality products at prices that lead to an increase in the demand for exports.

natively, in a more traditional demand and supply framework, the addition of a supply term involves relaxing the assumption that supply is perfectly elastic that is used to identify the export equation.

There are by now a number of estimates of export equations that include supply terms in them, including several for APEC economies.[25] The results from this estimation have been relatively successful, to the extent that such terms are often significant. More important from the point of view of this discussion, estimates of price elasticities using this specification are generally similar to those produced by traditional export equations. Hence, the issue of the 45-degree rule does not appear to be of central importance in estimating price elasticities of trade.

Exchange Rate Volatility

The connection between exchange rate volatility and trade has also been examined in some detail, particularly in the early part of the period of floating exchange rates.[26] These analyses can be conveniently divided into those that use time-series evidence to look at the relationship between volatility and trade and those that use cross-sectional comparisons across countries.

Much of the time-series evidence has started from the types of empirical models of trade volumes discussed above. The impact of exchange rate volatility is then measured by adding a term representing this volatility into the equation. The results from these studies have varied quite widely. A few have found significant effects from the volatility term, but most have found little or no impact (see the surveys in IMF, 1984, and more recently in Commission of the European Communities, 1990). The theoretical issues involved are discussed in Gagnon (1993), who used a model of international trade to estimate the likely impact of increased exchange rate volatility. He found that higher volatility has a small negative impact on trade volumes, with the rise in volatility after the Bretton Woods period lowering trade by only 1–3 percent, which may help to explain the ambiguity of the empirical results.

An alternative approach is to compare behavior across countries, rather than over time. Again, a model of expected trade flows between countries is used to calculate expected trade volumes between these countries, with a term representing exchange rate volatility added. Frankel and Wei (1993) carried out such a test using a large set of data on bilateral trade between 63 industrial and developing economies (implying almost 2,000 bilateral flows), including many members of APEC. The large number of observations enabled them to estimate a highly significant coefficient on exchange rate volatility. However, as in the case of Gagnon's theoretical work, the implied impact was relatively small. For example, a doubling of the level of the real exchange rate variability in Europe in 1990 (which would have returned such variability to its 1980 level, before attempts to control such volatility through the exchange rate mechanism of the European Monetary System) would have lowered intraregional trade volumes by only 0.7 percent.

Overall, the evidence appears to point to a small direct effect of exchange rate volatility on trade volumes. At the same time, this observation appears at odds with concerns often expressed by business people about floating exchange rates. One explanation for this may be that higher short-term volatility has been associated with larger, and more persistent, exchange rate misalignments, and that these misalignments clearly involve substantial costs and can increase protectionist pressures. Another is that in many cases floating exchange rates may have been associated with more unstable macroeconomic policies. Such indirect influences, which are unlikely to be captured in econometric studies that relate exchange rate volatility to trade volumes, may also help to explain the dichotomy between the empirical evidence and the widespread concerns about exchange rate volatility among policymakers.

Estimated APEC Trade Elasticities

This part of the section reports some new estimates of trade equations for the APEC economies to supplement the work on exchange rate elasticities discussed above. Standard empirical specifications are used because attempts to include domestic supply in the export equations were not successful. Equations are estimated for 15 APEC economies (China, Papua New Guinea, and Brunei Darussalam were excluded because of lack of data).

Annual data on real merchandise exports and imports from 1974 through 1993 were regressed on the real effective exchange rate for the economy in question (defined using consumer prices across countries) plus the growth in real GDP of partner countries (for exports) or of real domestic GDP (for imports).[27] The

[25]For example, Helkie and Hooper (1988) for the United States and Muscatelli and Stevenson (1995) for NIEs.

[26]The earlier literature was surveyed in International Monetary Fund (1984).

[27]Annual data were used because quarterly data were not available for many of these economies. No attempt was made to look at different types of goods, such as manufactures and primary goods, separately.

Table 3-3. Estimated Activity Elasticities

	Exports		Imports	
	Short-run	Long-run	Short-run	Long-run
Panel of all countries	1.88**	1.96**	1.95**	1.46**
Australia	0.04	1.33**	1.77**	1.85**
Canada	2.22**	2.06**	1.99**	2.01**
Chile	2.04*	2.87**	1.53**	1.70**
Hong Kong	2.98*	4.11**	1.76**	1.92**
Indonesia	1.03	1.27	–0.27	1.66**
Japan	1.73**	2.10**	2.11	0.79**
Korea	4.90**	3.12**	1.61	1.36**
Mexico	–0.05	1.55	1.16	1.60**
Malaysia	2.14	1.86**	3.06**	1.47**
New Zealand	1.51	0.98**	0.78	1.70**
Philippines	2.15	1.34**	2.09**	1.65**
Singapore	3.52**	1.77**	2.89**	1.05**
Thailand	3.28*	2.73**	3.93**	1.03**
Taiwan Province of China	2.70**	3.28**	0.94	1.23**
United States	0.65	1.47**	3.29**	2.46**

Note: See the appendix to Section III for details of the regressions. One and two asterisks indicate that the coefficient is significant at the 5 and 1 percent levels, respectively.

real exchange rate was used, rather than a more direct estimate of relative prices of traded goods, because it provides a more direct link between exchange rate changes and trade. A standard error-correction estimation procedure was adopted in which the long-run elasticities were first estimated using an equation that included only levels of exports (imports), the real exchange rate, and partner-country (domestic) real GDP. Next, the short-run elasticities were estimated from a dynamic equation using the rate of change of the variables plus the residuals from the levels equation (the "error-correction term").

Details of the data, specification, estimation technique, and parameter estimates are given in the appendix to this section. To gain more of an idea of "average" behavior across all countries, a panel regression was run, in which the data across all countries were combined and used to estimate a single regression. Such a regression is a useful way of summarizing the characteristics of the data, given the relatively limited number of data points (20) per economy and the consequent lack of precision of many of the estimated coefficients associated with individual regressions. Note, however, that tests showed that the assumption that the estimated coefficients are equal across all countries is rejected, implying significant variation in behavior across individual economies.

Table 3-3 reports the estimated short- and long-run elasticities with respect to output and the real exchange rate.[28] Panel estimates indicated similar activity elasticities for both exports and imports, with the short-run elasticity being around 2 and the long-run value being similar for exports and about 1½ for imports. The size and importance of activity effects in determining real trade are confirmed by the estimates for individual economies. The vast majority of both short- and long-run elasticities are estimated at over 1. The long-run export elasticities show clear evidence of the 45-degree rule, with fast-growing economies such as Hong Kong, Korea, and Taiwan Province of China having estimated activity elasticities of over 3, while slower-growing and more mature economies such as Australia, New Zealand, and the United States have relatively low values.

The results for short- and long-run real exchange rate elasticities (Table 3-4) were more mixed than those for activity, as is typical in the literature. In the case of exports the panel estimation yielded a short-run elasticity of –0.18, which rose to –0.80 in the long run, indicating a significant increase in the elas-

[28]The long-run elasticities are best thought of as representing the likely impact of sustained medium-term deviations from trend, not as reflecting the impact of long-term trends in the real exchange rate.

Table 3-4. Estimated Real Exchange Rate Elasticities

	Exports		Imports	
	Short-run	Long-run	Short-run	Long-run
Panel of all countries	–0.18**	–0.80**	0.26**	0.28
Australia	–0.31	–0.19	0.21	0.45**
Canada	0.15	0.00	0.23	0.49
Chile	–0.45	0.10	0.44	0.23*
Hong Kong	0.02	–0.07	0.32	1.01**
Indonesia	–0.16	–0.32	0.63**	0.68**
Japan	–0.23*	–0.69**	–0.03	0.55
Korea	–0.41	–0.52	0.27	0.61
Mexico	–0.16	–0.77	1.23**	1.43**
Malaysia	–0.06	–0.53	0.24	0.01
New Zealand	–0.05	–0.51	–0.20	0.68
Philippines	0.06	0.10	–0.01	–0.75
Singapore	0.52	–0.21	0.07	0.00
Thailand	–0.09	–0.99	2.14**	0.75
Taiwan Province of China	–0.04	–0.70*	0.32	0.66
United States	–0.28*	–0.86**	0.05	0.26**

Note: See the appendix to Section III for details of the regressions. One and two asterisks indicate that the coefficient is significant at the 5 and 1 percent levels, respectively.

ticity over time. The results for individual countries were generally correctly signed and rose over time but, except in the case of the United States and Japan, were rarely significant at conventional levels. The price elasticities on imports were again generally correctly signed, rose over time, but were rarely significant at conventional levels. Unlike the export regressions, however, the individual estimates tended to be larger than the panel results. This was particularly true of the long-run estimates, where the median value of the individual economy estimates (0.55) was almost double the (insignificant) panel estimate of 0.28.

One reason for the lack of precision of the real exchange rate elasticities may be the impact of factors such as changes in trade policy or shifts in the type of goods being traded, which may be of particular importance for many of the economies in the APEC region. Such shifts may obscure the true relationship between real exchange rates and trade. It is notable that the estimates for economies such as the United States and Japan, which are least likely to experience such shifts because of the relative stability of their trade regimes, are generally better determined than those for many of the faster-growing developing nations. Another potential source of problems is the use of consumer price indices in the calculation of the real exchange rate. These indices, which were adopted because of their wide availability, include nontraded goods; thus, although they correspond to movements in overall relative prices across economies, they do not necessarily correspond closely to relative prices of goods that are traded. Finally, the use of aggregate data on trade may obscure differences in behavior across different types of goods, such as manufactures and primary commodities.

Overall, the standard empirical model of trade appears to work fairly well for the APEC region, a conclusion that is supported by similar work on the region by others.[29] At the same time, the small estimated elasticities on the real exchange rate indicate a degree of elasticity pessimism, which is again not an unusual result from this type of estimation for developing countries.[30] In summary, sustained exchange rate changes appear to have significant, if somewhat muted, effects on trade within the APEC region.

[29]Estimates for the industrial countries in the region abound. For example, Masson, Symansky, and Meredith (1990) provided estimates for the United States, Japan, and Canada. Results using various specifications for exports of several NIEs can be found in Arize (1990).

[30]Reinhart (1995) came to a very similar conclusion. As noted earlier, the Goldstein and Khan (1985) elasticities reflect transaction prices, which will tend to be larger than those from real exchange rates, owing to pricing-to-market behavior.

Table 3-5. Effect of Major Regional Currencies on Trade in the APEC Region
(Percent change)

	10 Percent Real Appreciation Against the U.S. Dollar			10 Percent Real Appreciation Against the Japanese Yen		
	Exports	Imports	Real net trade/GDP[1]	Exports	Imports	Real net trade/GDP[1]
Australia	–0.14	0.56	–0.11	–0.44	0.49	–0.14
Canada	–1.46	1.69	–0.78	–0.08	0.16	–0.06
Chile	–0.31	0.41	–0.15	–0.41	0.21	–0.13
Hong Kong	–0.42	0.19	–0.72	–0.09	0.43	–0.63
Indonesia	–0.26	0.30	–0.13	–0.55	0.57	–0.26
Korea	–0.41	0.54	–0.23	–0.26	0.60	–0.21
Mexico	–1.41	1.78	–0.38	–0.04	0.17	–0.03
Malaysia	–0.37	0.44	–0.56	–0.23	0.72	–0.65
New Zealand	–0.21	0.47	–0.27	–0.26	0.42	–0.27
Philippines	–0.69	0.52	–0.31	–0.29	0.59	–0.25
Singapore	–0.37	0.42	–1.13	–0.14	0.57	–1.03
Thailand	–0.39	0.30	–0.22	–0.31	0.79	–0.37
Taiwan Province of China	–0.50	0.56	–0.38	–0.19	0.78	–0.34

Note: See the text for an explanation of the calculations.
[1]As a percentage of real GDP.

Impact of Changes in Bilateral Exchange Rates on Trade

Given the large differences in openness and the importance of trilateral trading relationships in the APEC region, it is of interest to consider the likely impact on trade of changes in the dollar and the yen, the two key currencies in the region. This section provides some highly stylized estimates of the impact of bilateral changes between the dollar and the yen on the one hand and other regional currencies on the other. The calculation uses 1993 values for openness and direction of trade and assumes a real exchange rate elasticity for export volumes of –0.18, the short-run value estimated using the panel data set. The real exchange rate elasticity for real imports is likewise set to 0.26, the estimated value using the panel data. As discussed earlier, long-run effects are likely to be significantly larger.

The effects of a 10 percent appreciation against the dollar and the yen on real exports, real imports, and real net trade as a percentage of GDP (which provides an estimate of the overall impact on activity) are reported in Table 3-5. Note that the impact on the nominal trade balance will be smaller than that on real net trade because changes in prices will partially offset the change in volumes. In addition, it should be recalled that the results refer to a real exchange rate appreciation. To the extent that nominal exchange rate movements cause offsetting movements in domestic prices, the effects of nominal exchange rate changes will be smaller.

The economies of the region can be divided into three categories.[31] Canada and Mexico are relatively sensitive to changes in the real value of the U.S. dollar while being fairly insulated from movements in the yen. The extremely open economies of Hong Kong, Singapore, and Malaysia are also highly sensitive to changes in the dollar and are almost equally influenced by changes in the real value of the yen. Finally, the vast majority of economies in the region are dependent on both exchange rates, but to a rather lesser extent than Hong Kong, Malaysia, and Singapore.

These results are intended only to be illustrative. Different assumptions about trade elasticities would give different results. To take just one example, it is very possible that Japan's exports to East Asian economies, which are often heavily skewed toward investment goods, may be relatively insensitive to changes in exchange rates. The calculations also take no account of third-country effects. As the exchange rate against, say, the dollar appreciates, economies

[31]Results for the United States and Japan are not reported because they would depend on whether the appreciation was general across all countries or specific to a few.

may seek out new markets to replace the lower demand for exports coming from the United States.

At the same time, Table 3-5 does illustrate two general features of the APEC region. The first is the universal importance of the United States in the trade of other countries. The second is the similar importance of Japan in the trade of those economies in Asia and the Pacific.

Concluding Perspectives

There has been a steady increase over time in the importance of the intra-APEC component of overall international trade in the region, and in the proportion of manufactured goods within merchandise trade. Both of these trends largely reflect robust growth in East Asia. Another feature of some parts of the region is triangular trading relationships with the two largest economies in the region, the United States and Japan. This is particularly true of the East Asian economies, which tend to be net importers from Japan and net exporters to the United States.

The available evidence indicates that higher exchange rate volatility has little direct influence on regional trade flows. By contrast, sustained deviations in the exchange rate from trend (which may be more likely to occur in a situation of higher volatility) do have a significant impact on trade volumes, although the elasticities estimated in this study were on the lower end of existing estimates. Illustrative simulations indicate that all of the economies in the region are significantly affected by changes in the value of the U.S. dollar, while the Japanese exchange rate plays a similar role for those APEC economies not in the Americas.

In short, with the exception of the immediate neighbors of the United States, movements in both of the major regional currencies can have a significant impact on trade and activity for other countries in the region. The trilateral trading pattern of many of these economies further complicates this situation, because movements in the bilateral rate of the dollar against the yen also create changes in their external terms of trade. Such a situation creates significant complications for policymakers when the bilateral exchange rate between the dollar and the yen shows a significant divergence from its long-term trend, as occurred in the mid-1980s with the appreciation and subsequent depreciation of the dollar.

Appendix: Estimation of the Trade Equations

Annual data from 1974–93 on real merchandise exports, real merchandise imports, real GDP, real GDP of partner countries, and real effective exchange rates were collected for APEC economies (except China, Papua New Guinea, and Brunei Darussalam, which were excluded for data reasons). Exports, imports, and real GDP were generally collected from the IMF's World Economic Outlook database, although in some cases data from the IMF's *International Financial Statistics* were used. The real effective exchange rates were based on IMF estimates calculated using consumer price indices for a wide range of developing and industrial countries, reported in *International Financial Statistics*. Owing to limitations in availability of historical consumer prices for some developing countries, only a subset of the countries used in the official IMF calculations was included, with only those countries with weights of 1 percent or greater in the original IMF calculations being used.[32] Finally, the real GDP of partner countries was calculated using an export-weighted combination of the real GDP of other countries in the region and most European economies.

Dickey-Fuller tests of the data indicated that in the vast majority of cases the logarithms of real exports, real imports, real GDP, real GDP in partner countries, and real effective exchange rates were nonstationary, whereas their first differences were stationary.[33] Accordingly, a three-step estimation procedure suggested by Engle and Yoo, as described in Cuthbertson, Hall, and Taylor (1992), was adopted. It is a simple adaption of the standard two-step procedure suggested by Engle and Granger (1987) in which the initial parameter estimates of the long-run relationship (the cointegrating vector) were used to add an error-correction term to the second-stage dynamic equation. The third stage involved a further level of regression whose results were used to improve the efficiency of the first-stage parameter estimates and to provide standard errors for these coefficients. This is useful because the coefficients from the first-stage regression have nonstandard distributions, so that statistical significance cannot be calculated using the estimated standard errors.

In the first step the logarithm of exports (imports) was regressed on the real exchange rate and partner-

[32]Experiments with real effective exchange rates based on separate export and import weights produced very similar results. Despite the importance of trilateral trading patterns in many countries, the different weights on exports and imports made relatively little difference to the empirical results.

[33]Details of these tests are available from the author. In the case of Mexico, exports and real GDP were not found to be stationary even in first differences. Similarly, in the Philippines first differences of imports and real GDP did not appear to be stationary. More marginal failures occurred in the cases of the first differences of real exchange rates for Malaysia, Singapore, and the United States; real GDP in New Zealand and Thailand; and real exports for the United States.

country (domestic) GDP. Specifically, the following regressions were run using ordinary least squares:

$$\begin{aligned} \ln(X_t) &= \alpha_X + \beta_X \ln(E_t) + \Psi_X \ln(YF_t) + \varepsilon_{Xt} \\ \ln(M_t) &= \alpha_M + \beta_M \ln(E_t) + \Psi_M \ln(Y_t) + \varepsilon_{Mt}, \end{aligned} \tag{3-1}$$

where X, M, E, YF, and Y represent real exports, real imports, the real effective exchange rate, partner-country GDP, and domestic GDP, respectively.

The coefficients β and Ψ represent initial estimates of the long-run elasticities with respect to the real exchange rate and output. The next step in the estimation was to estimate a dynamic equation involving the first differences of the explanatory variables plus the lagged residuals from the first-stage estimation, the "error-correction term."[34] Specifically, the following regressions were estimated:

$$\begin{aligned} \Delta\ln(X_t) &= \delta_X + \phi_X \Delta\ln(E_t) + \eta_X \Delta\ln(YF_t) \\ &\quad + \kappa_X \varepsilon_{Xt-1} + \varepsilon'_{Xt} \\ \Delta\ln(M_t) &= \delta_M + \phi_M \Delta\ln(E_t) + \eta_M \Delta\ln(Y_t) \\ &\quad + \kappa_M \varepsilon_{Mt-1} + \varepsilon'_{Mt}. \end{aligned} \tag{3-2}$$

The coefficients ϕ and η represent the short-run elasticities with respect to the real effective exchange rate and activity, respectively, and κ, the coefficient on the error-correction term, specifies the speed with which the system tends to the long-run equilibrium. Specifically, the mean lag of the adjustment process is equal to $-1/\kappa$, so that the larger is the value of κ in absolute terms, the faster is the rate of adjustment to long-run equilibrium.

The third stage involved regressing the residuals of the second-stage regressions on the level of the real exchange rate and activity, this time multiplied by the negative of the coefficient on the error-correction term, κ. The coefficients from this third stage were added to the initial parameter estimates from the first stage to provide the final estimates of the long-run coefficients, with the standard errors from this third-stage regression representing the standard errors of these adjusted coefficients. In a few cases this adjustment equation caused the coefficient on the real effective exchange rate to become perverse. This was generally associated with small and insignificant estimates of the error-correction parameter, κ, used to calculate data for the third-stage regression. In these cases the parameter estimates from the original first-stage levels regression were reported.

[34]These errors need to be stationary for the procedure to be valid. Formal Dickey-Fuller tests rarely indicated that nonstationarity could be rejected for these terms. However, the coefficients on the lagged level of the residual were often large, indicating that there was significant mean-reverting behavior. Given the known lack of power of Dickey-Fuller tests in small samples, the estimation was continued.

To gain more of an idea of "average" behavior across all countries, a panel regression was also calculated, in which the data across all countries were combined and used to estimate a single regression. Tests showed that the assumption that the estimated coefficients are equal across all countries is rejected, implying significant variation in behavior across individual economies. Because the stacking of the data meant that a much larger number of observations were involved in the regression (300, as opposed to 20 in the individual regressions), the two-step estimation procedure was dispensed with and equations (3-1) and (3-2) were combined into a single regression:

$$\begin{aligned} \Delta X_t &= \xi + \phi_X \Delta E_t + \beta'_X E_{t-1} + \eta_X \Delta YF_t \\ &\quad + \Psi'_X YF_{t-1} + \kappa_X X_{t-1} \\ \Delta M_t &= \xi + \phi_M \Delta E_t + \beta'_M E_{t-1} + \eta_M \Delta Y_t \\ &\quad + \Psi'_M Y_{t-1} + \kappa_M M_{t-1}, \end{aligned} \tag{3-3}$$

where $\beta' = \beta * \kappa$ and $\Psi' = \Psi * \kappa$.

Regression results for exports are reported in Table 3-6; Table 3-7 reports the same information for imports. The long-run elasticities on activity for exports are large and generally highly significant. The estimate from the panel regression is 1.96, while the estimates for the individual countries vary from just under 1 in the case of New Zealand to slightly over 4 for Hong Kong. Almost all are significant at the 1 percent level. The impact of the 45-degree rule can be clearly seen in the data, with fast-growing economies such as Hong Kong, Korea, and Taiwan Province of China having estimated activity elasticities of over 3, while slower-growing and more mature economies such as Australia, New Zealand, and the United States have relatively low values. The short-run activity elasticities from the panel regression are well determined and very similar to their long-run counterparts. The estimated short-run activity elasticities for individual economies are for the most part similar in magnitude to their long-run counterparts but are generally less well-determined.

The estimated short- and long-run elasticities on the real effective exchange rate from the panel regression for exports are both highly significant, with the estimated elasticity rising from –0.18 to –0.80 over time. The most successful individual country regressions are for the United States and Japan, the two largest economies in the region, which show a pattern similar to the panel results. By contrast, although the price elasticities on the other individual regressions are generally correctly signed, they are rarely significant at conventional levels in either the short run or the long run. They also tend to be smaller in absolute value than the panel results. Finally, the terms on the error-correction terms indi-

Table 3-6. Export Regression Results

	Long-Run Elasticities		Short-Run Elasticities		
	Output	Real exchange rate	Output	Real exchange rate	Error-Correction Term
Panel of all countries	1.96**	–0.80**	1.88**	–0.18**	–0.09**
Australia	1.33**	–0.19	0.04	–0.31	–0.50*
Canada	2.06**	0.00	2.22**	0.15	–0.33
Chile	2.87**	0.10	2.04*	–0.45	–0.45
Hong Kong	4.11**	–0.07	2.98*	0.02	–0.72**
Indonesia	1.27	–0.32	1.03	–0.16	–0.24
Japan	2.10**	–0.69**	1.73**	–0.23*	–0.55**
Korea	3.12**	–0.52	4.90**	–0.41	–0.58**
Mexico	1.55	–0.77	–0.05	–0.16	–0.10
Malaysia	1.86**	–0.53	2.14	–0.06	–0.53*
New Zealand	0.98**	–0.51	1.51*	–0.05	–0.74**
Philippines	1.34**	0.10	2.15	0.06	–0.42
Singapore	1.77**	–0.21	3.52**	0.52	–0.48
Thailand	2.73**	–0.99	3.28*	–0.09	–0.36
Taiwan Province of China	3.28**	–0.70*	2.70**	–0.04	–0.83**
United States	1.47**	–0.85**	0.65	–0.28*	–0.59**

Note: The text describes how the elasticities were calculated. One and two asterisks indicate that the coefficient is significant at the 5 and 1 percent levels of significance, respectively.

Table 3-7. Import Regression Results

	Long-Run Elasticities		Short-Run Elasticities		
	Output	Real exchange rate	Output	Real exchange rate	Error-Correction Term
Panel of all countries	1.46**	0.28**	1.95**	0.26**	–0.20
Australia	1.85**	0.45**	1.77**	0.21	–1.11**
Canada[1]	2.01**	0.49	1.99**	0.23	–0.15
Chile	1.70**	0.23*	1.53**	0.44	–0.86**
Hong Kong[1]	1.92**	1.01**	1.76**	0.32	–0.12
Indonesia	1.66**	0.68**	–0.27	0.63**	–1.00**
Japan	0.79**	0.55	2.11	–0.03	–0.31
Korea	1.36**	0.61	1.61	0.27	–0.22
Mexico	1.60**	1.43**	1.16	1.23**	–0.13
Malaysia[1]	1.47**	0.01	3.06**	0.24	–0.36
New Zealand	1.70**	0.68	0.78	–0.20	–0.43*
Philippines	1.65**	–0.75	2.09**	–0.01	–0.25
Singapore	1.05**	0.00	2.89**	0.07	–0.43*
Thailand	1.03**	0.75	3.93**	2.14**	–0.45*
Taiwan Province of China[1]	1.23**	0.66	0.94	0.32	–0.34
United States	2.46**	0.26**	3.29**	0.05	–0.82**

Note: The text describes how the elasticities were calculated. One and two asterisks indicate that the coefficient is significant at the 5 and 1 percent levels of significance, respectively.

[1]The Engle-Yoo procedure was not used in these cases.

cate that the mean lag in these regressions generally appears reasonable, of the order of two years or so.

The results for the import equations are in many respects similar to those for the export equations. The activity elasticities tend to be large and well determined, particularly in the long run, where all of the estimates are significant at the 1 percent significance level. The range of estimated long-run elasticities is also somewhat smaller than in the case of the export elasticities, as might be expected given the absence of the problem posed by the 45-degree rule.

The price elasticities are again generally correctly signed but rarely significant at conventional levels. Unlike the export regressions, however, the individual estimates tend to be larger than the panel results. This is particularly true of the long-run estimates, where at 0.55 the median value of the individual economy estimates is almost double the (insignificant) panel estimate of 0.28. Finally, although many of the individual economy error-correction terms show reasonable adjustment speeds, some of them indicate surprisingly fast or slow responses.

To summarize, the output elasticities are generally large and well determined. By contrast, the price elasticities are less well-determined and generally quite low. Hence, although there is considerable evidence that real exchange rates do effect trade volumes in the expected directions, the results are quite pessimistic as regards the size of the underlying elasticities.

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