Part 2

Export dynamics in East Asia

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Introduction

Economic growth in East Asia over the past two decades has been underpinned by rapid expansion in manufacturing exports. This surge has been accompanied by a shift in these exports' commodity composition toward machinery categories, which are among the fastest growing sectors in world merchandise trade (ADB 2007). Although the speed of adjustment has varied, countries in the region tended to start with a focus on technologically simple labor-intensive goods such as apparel and footwear, and then moved to a range of more capital-intensive, technologically sophisticated items, especially electrical and nonelectrical machinery.

This process was initially led by Japan, followed by the newly industrialized economies (NIEs) of Hong Kong, China; Republic of Korea (hereafter Korea); Singapore; and Taipei,China; and more recently by Indonesia, Malaysia, Philippines, and Thailand. Over time, real currency appreciation caused these economies to develop more capital-intensive industries and to actively participate in direct investment not only as hosts, but also as investors.

Rapid advances in production technology and technological innovations in transportation and communications have allowed companies to "unbundle" the stages of production so that different tasks can be performed in different places. Also, trade liberalization and investment policy reforms in developing countries have greatly reduced barriers to trade and investment, thereby further encouraging expansion and dispersion of outward direct investment of multinational enterprises (MNEs). These dynamics have resulted in the increasing importance of international product fragmentation—the cross-border dispersion of component production/assembly within vertically integrated production processes[1]—and a shift in the composition of exports toward intermediate goods (parts and components).

These emerging patterns may have implications for the factors that influence export performance. For example, Jones and Kierzkowski (2001) and Arndt and Huemer (2004) have argued that a surge in intermediate goods trade could dilute real exchange rate impacts as there may be high fixed costs in establishing the "service links" that fuse the fragments of the production process together.

This chapter of *Asian Development Outlook 2007 Update* examines the influence of real exchange rate changes on export performance in 1990–2006, a period in which intermediate goods trade burgeoned. To see whether trade in intermediate goods is "special" and to allow comparisons, the analysis is conducted for different categories of exports

and separately for nine economies in East Asia.[2] The analysis is conducted separately for total merchandise exports, manufacturing exports, and exports of Standard International Trade Classification (SITC) 7, which largely consists of machinery and transport equipment parts and components. Though exports are now growing quickly in some countries of South Asia, it has not yet latched onto international production networks to the same degree as East Asia. Besides, comparable data do not exist for South Asian countries.

In the next section, *Changes in export and trade composition*, shifts in the commodity composition of exports and changes in the direction of trade are reviewed. Over the past three decades, manufacturing exports in East Asia have expanded rapidly and gained in relative importance in total exports. Exports of machinery and transport equipment (SITC 7) have increased substantially since the late 1980s, dwarfing traditional manufacturing exports such as textiles, clothing, and footwear. Parts and component exports, most of which are in SITC 7, have also expanded rapidly, highlighting the importance of international product fragmentation. Imports of parts and components in these economies have also risen, illustrating the higher level of import content used in producing manufactures. This form of international specialization has also been accompanied by an increase in the share of intraregional exports. The People's Republic of China (PRC) has become a significant export destination for other economies, particularly for SITC 7 components, as the country's importance as an assembly and shipment hub for final goods has grown.

In *Determinants of export performance,* the analytical approach is explained and the main empirical results are presented. Supply and demand influences on export volumes are considered and their short- and long-run impacts are isolated. Of particular interest is the responsiveness of export volumes to the real exchange rate, the sensitivity of this relationship to different export categories, and how the former changes through time. The data presented in this chapter suggest that, at least through traditional demand and supply channels, export volumes have become less responsive in both the short and long run to real exchange rate changes. It is possible that with changes in market structure and industrial organization, real exchange rate adjustments now occur through other more complex channels.

In the last section, *Conclusions and policy challenges,* possible interpretations for the main results are considered and broad policy questions are posed. The results presented in this chapter add to a wide body of evidence on the determinants of export performance, and confirm the importance of supply-side factors. At-the-border and behind-the-border barriers to trade are also likely to be a key influence on a country's ability to integrate itself in emerging production networks.

Though real exchange rate influences on export performance appear to have been receding in 1990–2006, the particular model employed in this chapter may not have been able to detect influences operating through deeper channels. Indeed, it is highly unlikely that the profound shifts in economic structure that have been observed in East Asia could have occurred without changes in real exchange rates.

Likewise, the increasing complexity that is observed in the export basket of fast-growing countries has been closely associated with secular appreciation of their real exchange rates (ADB 2007). These deeper influences, which may operate at frequencies measured in decades rather than quarters, are likely to work through domestic and cross-border investment decisions, and are a topic for future study.

Changes in export and trade composition

Export-oriented industrialization has been a marked feature of growth and development in East Asia for the past three decades or more. The share of exports in GDP in this region has grown continuously in this period and this rise has been even more pronounced since 2000 (Figure 2.1). Export shares relative to GDP began to diverge from developing-country and world averages in the late 1980s, and by 2005 these shares were some 1.5–2 times as high.

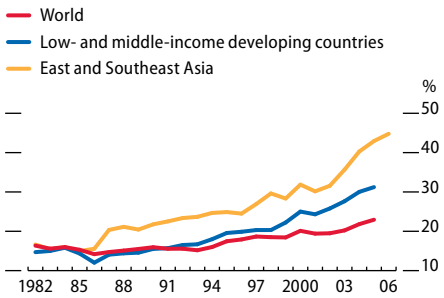
The rise of exports in Asia has followed a distinctive pattern. After Japan's export success in the 1950s and 1960s, the NIEs began to enter export markets as Japan's industrial structure shifted away from labor-intensive to more sophisticated products. Policies supporting exporters then allowed the NIEs to expand their exports in labor-intensive activities in which Japan was losing advantage. However, by the late 1980s, these economies were losing their edge in labor-intensive activities as a result of rising wage costs and attendant real currency appreciation. In addition, the imposition and gradual tightening of quantitative restrictions by industrial countries blunted penetration in textiles, garments, and footwear markets (Wells 1986). These factors encouraged a shift toward more capital-intensive industries and outward direct investment in countries where costs were lower, trends given added impetus by the 1985 Plaza Accord, which saw a sharp revaluation of the yen and a steady appreciation of NIE currencies.

As profitability fell at home, producers from Japan and the NIEs began to move their production platforms to Southeast Asia. Countries there were attractive to investors because of their relatively favorable macroeconomic conditions, and trade and investment policies. On the heels of direct inward investment, an export boom followed in labor-intensive manufacturing.

At the same time, rapid advances in production technology created the opportunity for investors to redesign production processes in ways that accentuated task specialization, i.e., splitting up fabrication and assembly processes. By relocating some segments of the value chain rather than entire industries to lower-cost locations, industries reaped greater profits (Krugman 1995). This process occurred extensively in the electronics industry so that by the mid-1980s, Southeast Asian countries started exporting electronic and other more technologically sophisticated products.

Later, in the early 1990s, the PRC emerged as a fast-growing exporter of labor-intensive manufactures. Product lines "migrated" to the PRC from other countries in East Asia, attracted by its large pool of cheap labor, its rapidly improving infrastructure, and policies favoring exporters.

2.1 Share of exports in GDP



Source: World Bank, *World Development Indicators* online database, downloaded 11 June 2007.

Click here for figure data

Evolution of merchandise trade

The evolution of export and trade patterns in the region can be traced using detailed trade data, specifically the United Nations Commodity Trade Statistics Database (UNCOMTRADE), based on SITC Revision 3 (SITC, Rev. 3), and Statistics Canada World Trade Analyzer for Taipei,China. Figure 2.2 shows how the profile of manufacturing exports has changed over time.[3] In the past three decades, manufacturing exports from East Asian economies have expanded rapidly and gained in relative importance in total merchandise exports. In Hong Kong, China; Korea; and Taipei,China, the proportion of manufacturing to total exports has been persistently high, at around 90% over the past three decades. Other than for Indonesia and Thailand, the share of manufacturing exports has exceeded 75% in the postcrisis period. The share has significantly increased in the Philippines, from 50% in 1991–1995 to more than 90% in 1996–2005, while it has climbed gradually in the other economies.

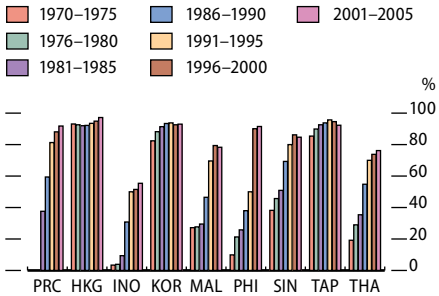
Indonesia has had the slowest rise in manufacturing export shares, despite trade liberalization and export promotion policies from the late 1980s. Nevertheless, by the mid-1990s, manufactured goods contributed around 50% of the country's total merchandise exports, compared with less than 10% at the beginning of the 1980s. But this share has barely moved since the early 1990s. This slow progress would seem to reflect "Dutch Disease," where the hydrocarbon and other natural resource-based export sectors tend to dominate other non-oil manufacturing exports.

Figure 2.3 provides a breakdown for the nine economies of the anatomy of exports within manufacturing.[4] It shows that exports of machinery and transport equipment (SITC 7) have expanded rapidly, dwarfing the traditional manufacturing duo of clothing and footwear (SITC 8). (Indonesia is the only exception to this general pattern.) For the PRC and Hong Kong, China, exports in SITC 7 began to really take off in the early 1990s, reflecting the dominant role of outsourcing activity in manufacturing. In the PRC, the share of SITC 7 in total merchandise exports more than tripled from less than 15% in 1992 to almost 45% in 2006, while in Hong Kong, China, it doubled from 25% to 50% in the same period. SITC 8 in Hong Kong, China declined continuously from 60% in 1970 to 30% in 2006, while in the PRC it rose in 1984–1993 but has since declined constantly. By 2006, the share of SITC 8 was less than 30% of total merchandise exports. The share of other manufacturing exports (chemicals—SITC 5, and basic (resource-based) manufacturing—SITC 6) has shown broad stability.

The trends of SITC 7 exports for Korea and Taipei,China are similar. Both take off in the mid-1980s, becoming the most significant contributor to manufacturing and total exports by the early 1990s. Until then, textiles, clothing, and footwear in SITC 8 played an important role. By 2006, SITC 7 exports accounted for almost 60% of total exports in Korea and about 50% in Taipei,China. SITC 7 exports have also grown in Malaysia and Singapore. By 2006, the share in total exports had surpassed 50% in these two countries.

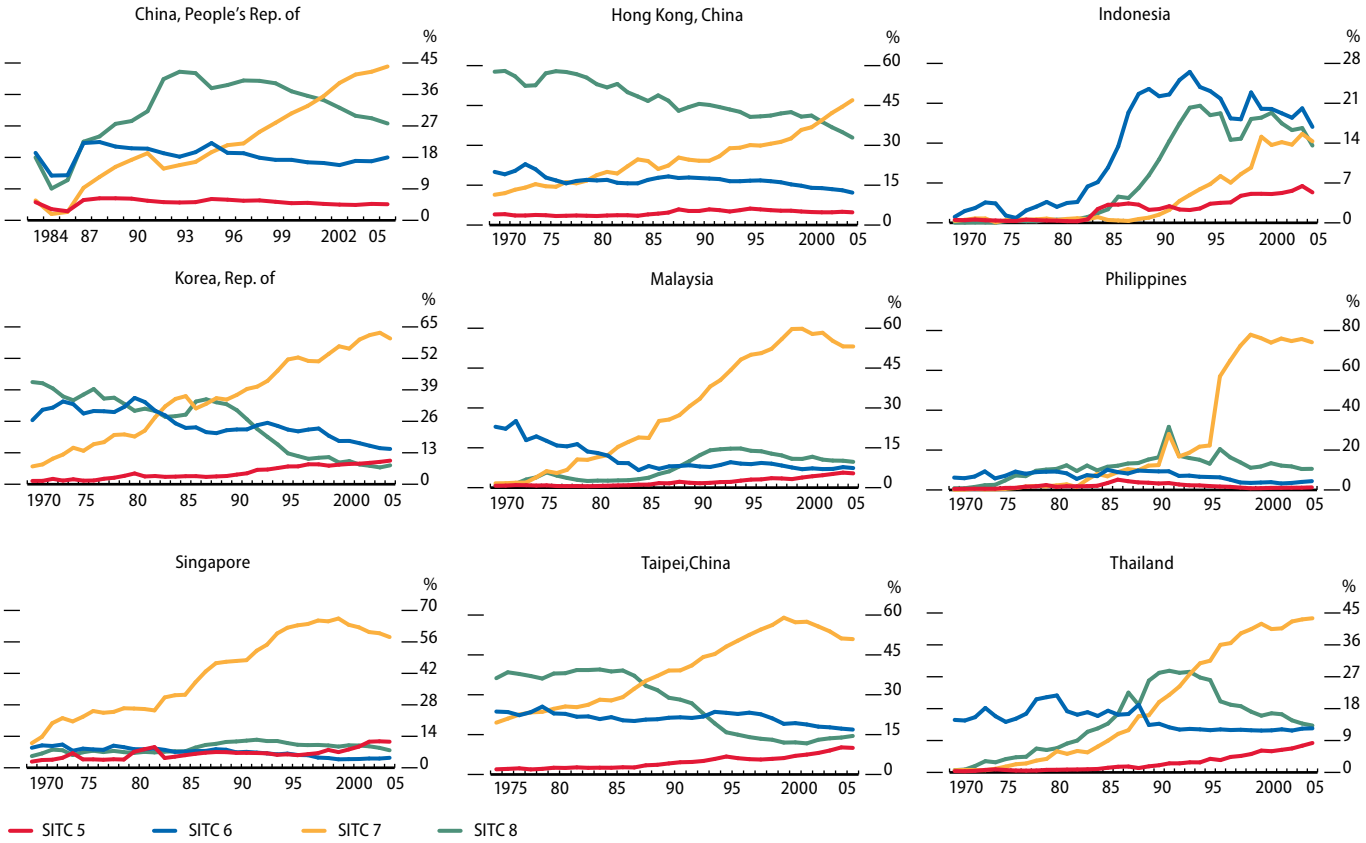
SITC 7 exports show expansion in both the Philippines and Thailand, with a more pronounced surge in the former. By 2000, SITC 7's share had climbed to almost 75% in the Philippines but was around 45% in

2.2 Share of manufacturing exports in total exports



PRC = China, People's Rep. of; HKG = Hong Kong, China; INO = Indonesia; KOR = Korea, Rep. of; MAL = Malaysia; PHI = Philippines; SIN = Singapore; TAP = Taipei,China; THA = Thailand.
Sources: ADB Statistical database system; CEIC Data Company, Ltd.; United Nations Comtrade database, *DESA/UNSD*, all downloaded 16 July 2007.

2.3 Percentage shares of four subcategories in manufacturing exports



Sources: ADB Statistical database system; CEIC Data Company, Ltd.; United Nations Comtrade database, *DESA/UNSD*, all downloaded 16 July 2007.

Thailand, reflecting Thailand's broader export base and deeper industrial structure.

The evolution of Indonesia's export structure is different from the broad drift toward SITC 7 that has occurred in other countries. Resource-base manufacturing, mostly mineral products (SITC 6) and miscellaneous manufacturing (SITC 8), predominantly wearing apparel and footwear, have accounted for almost two thirds of the country's manufactured exports. By 2006, SITC 6 exports contributed almost 20% of total merchandise exports, while SITC 8 contributed about 12%. SITC 7 contributed a similar share as SITC 8 in 2006. In Indonesia, SITC 7's share was far below that in other East Asian economies.

Trade in parts and components

An important feature of international product fragmentation is the increasing significance of trade in parts and components. Box 2.1 discusses the characteristics of such fragmentation. To gain better knowledge of the relative importance of such trade in these nine economies, the SITC 7 five-digit industries from UNCOMTRADE are examined. The items within these classifications are separated into parts and components, and final products, according to the lists of parts and components in Athukorala (2006). The list contains 168 categories at the five-digit level. Note that data on the SITC 7 five-digit industries of Taipei,China are based on Athukorala (2006); also that imports are investigated along with exports to roughly demonstrate the degree of

2.1 International product fragmentation

International product fragmentation is the cross-border dispersion of component production/assembly within vertically integrated production processes. Its expansion has been largely underpinned by three mutually reinforcing developments over the past few decades. First, rapid advancements in production technology have enabled industries to slice up the value chain into finer, portable components. Second, technological innovations in transportation and communications have collapsed the distance once separating the world's nations, and improved the speed, efficiency, and economy of coordinating geographically dispersed production processes. This has facilitated establishment of "service links" to combine various fragments of the production process in a timely and cost-efficient manner (Jones and Kierzkowski 2001). Third, liberalization policy reforms in both home and host countries have removed many barriers to trade and investment (Athukorala 2006).

Recent years have witnessed two other important developments in the process, setting the stage for rapid expansion in the share of fragmentation-based trade in world trade.

First, some fragments of the production process in certain industries have become "standard fragments," which can be effectively used in multiple products. Examples include long-lasting batteries originally developed by computer producers and now widely used in cellular phones and electronic organizers; transmitters, which are used not only in radios but also in personal computers; and electronic chips, which have spread beyond the computer industry into consumer electronics and motor vehicle production (Jones and Kierzkowski 2001, Brown et al. 2003, Athukorala 2006).

Second, the coverage of global assembly operations has seen noteworthy expansion from production and assembly of components to assembly of final products, such as computers, cameras, television sets, and motor cars. Given the heavy initial fixed costs, multinational enterprises (MNEs) are hesitant to establish overseas plants in final assembly without considerable first-hand commercial experience in the host country.

Because of these two developments, overseas production units of MNEs involved in such final stage assembly are located in other industrialized countries or in more advanced NIEs. However, in recent years, the PRC has emerged as an important location for final assembly in many product lines, largely because of the vast domestic market for these products, which naturally reduces the risks of covering the initial establishment costs (Borrus 1999, Athukorala 2006).

Production outsourcing practices were first employed from the late 1970s by Japanese, US, and western European MNEs, but the procedure has been more pronounced since the late 1980s. More recently, MNEs from more advanced developing countries, notably in East Asia, have also joined this process. In response to rapid domestic wage increases, to the growing reluctance of domestic labor to engage in low-paid employment, and to stringent restrictions on the importation of labor, firms in the electronics industry and other durable consumer goods industries in East Asia have begun to produce components and conduct subassembly activities in neighboring countries, where labor costs are still low.

In recent years, outsourcing practices have begun to spread beyond the domain of MNEs. Many companies that are not part of MNEs' networks now procure components globally through "arm's-length" trade. Technological innovations in communications have reduced costs of outsourcing, particularly through lower research costs. The process has also been facilitated by the standardization of some components. However, MNEs are still responsible for the bulk of fragmentation trade (Rangan and Lawrence 1999, Urata 2001, Athukorala 2006).

Over time, the fragmentation process has also expanded to involve many countries in the assembly process at different stages, resulting in product fragments crossing borders repeatedly before they are incorporated into the final product.

import content in these economies and to help understand the role of the real exchange rate in export performance.

Table 2.1 shows the proportion of parts and components in total manufacturing exports and imports in 1990–1996 and 2000–2006.[5]

Exports

Malaysia, Philippines, Singapore, and Thailand stand out in East Asia for their heavy dependence on parts and components for export dynamism. The share of parts and components in total manufacturing exports has increased rapidly in these four countries, reaching over 40% in the first

2.1 Share of parts and components in total manufacturing (%)

Economy	Exports		Imports	
	1990–1996	2000–2006	1990–1996	2000–2006
China, People's Rep. of	5.7	13.9	14.5	31.4
Hong Kong, China	13.4	27.4	15.3	29.7
Indonesia	4.0	12.5	17.7	16.1
Korea, Rep. of	21.8	27.5	26.3	33.2
Malaysia	38.2	42.5	35.0	50.4
Philippines	30.4	60.3	26.2	57.8
Singapore	31.0	46.5	32.7	47.6
Taipei,China	24.5	39.9	32.3	38.7
Thailand	18.9	26.3	22.9	30.8

Sources: United Nations Comtrade database, *DESA/UNSD*; Athukorala (2006) for Taipei,China.

three and about 30% in Thailand, in 2000–2006. Between 1990–1996 and 2000–2006, the share of components in total manufacturing exports more than doubled in the PRC, from 5.7% to 13.9%. In Korea and Taipei,China, the relative importance of components in total manufacturing exports has increased over the years, contradicting the popular belief that these economies had shifted palpably from assembly activities to final goods production.

Even though the share of parts and components in Indonesia rose considerably in the same period, it was because of their initial low export base. In fact, their dollar value remained low relative to those of other economies in the region: in 2005, for example, the dollar value of parts and components exports from Indonesia was about one fourth that of Thailand. The small weight of parts and components and SITC 7 in Indonesian manufacturing exports indicates that the country has been slower than others to integrate in cross-border production networks.

Imports

The share of parts and components in total manufacturing imports also exhibits an upward trend in the region, again with the exception of Indonesia. Manufacturing production relies heavily on imported inputs. The import share of parts and components has more than doubled in the PRC and the Philippines. In the PRC, the share of parts and components imports has expanded more quickly than its share in exports, suggesting an important role for assembly activities.

As argued in Athukorala (2006), while growth in fragmentation-based trade is now a global phenomenon, it is far more important and is growing more rapidly in East Asia than elsewhere in the world. Significant differences in wages and other complementarities among the countries of the region have provided the basis for rapid expansion of an intraregional product-sharing system, giving rise to increased cross-border trade in parts and components. First movers also enjoy considerable benefits in the form of agglomeration economies, not just at an enterprise level, but also at the level of industries, cities, and regions (Barry and Bradley 1997, Ruane and Gorg 2001).

Export destinations

The growing importance of international product fragmentation in these nine economies has been associated with the diversification of export

2.2 Destination of Asian exports (% of total)

Economy/Destination	Total exports		Manufacturing		SITC 7	
	1990–1995	2000–2005	1990–1995	2000–2005	1990–1995	2000–2005
China, People's Rep. of						
United States	15.8	20.8	18.0	22.1	18.5	22.1
Japan	17.1	13.1	14.0	11.9	10.9	10.3
European Union (15 countries)	11.4	16.2	12.0	16.8	11.5	18.7
Other East Asia	33.5	23.3	35.0	22.9	35.4	25.4
Southeast Asia	6.1	7.0	5.1	6.5	8.0	8.0
Other Asia	1.8	2.3	1.6	2.2	2.6	1.6
Rest of the world	14.4	17.3	14.3	17.5	13.1	13.9
Hong Kong, China						
United States	22.1	17.9	23.6	18.7	17.2	11.7
Japan	5.4	5.2	5.4	5.4	3.6	4.8
European Union (15 countries)	14.6	13.6	15.6	13.9	13.1	11.0
China, People's Rep. of	31.3	40.6	29.7	40.0	36.4	49.0
Other East Asia	4.4	4.5	3.9	4.3	5.9	6.1
Southeast Asia	6.4	5.9	6.1	5.8	9.6	7.3
Other Asia	1.0	1.3	1.0	1.3	0.6	0.6
Rest of the world	14.9	11.0	14.8	10.8	13.6	9.5
Indonesia						
United States	13.1	12.4	17.4	18.2	24.7	13.7
Japan	30.5	20.3	14.5	12.6	6.8	14.2
European Union (15 countries)	12.3	12.7	17.6	16.7	13.5	12.8
China, People's Rep. of	3.5	5.7	3.5	3.9	1.3	1.9
Other Southeast Asia	12.5	12.5	11.2	7.6	5.4	6.0
East Asia	12.7	17.3	16.3	21.3	34.9	39.6
Other Asia	1.2	3.9	1.2	2.4	0.8	0.9
Rest of the world	14.2	15.2	18.3	17.1	12.7	10.9
Korea, Rep. of						
United States	22.5	16.5	23.9	17.3	27.1	19.4
Japan	14.8	8.9	12.8	7.2	8.0	5.6
European Union (15 countries)	11.7	12.7	12.5	13.7	15.0	16.5
China, People's Rep. of	4.8	17.3	4.5	16.9	2.5	12.9
Other East Asia	10.2	9.6	9.7	9.3	7.1	9.4
Southeast Asia	11.7	9.9	11.3	9.6	12.5	9.0
Other Asia	2.4	2.6	2.4	2.6	1.6	2.5
Rest of the world	22.0	22.4	22.9	23.3	26.2	24.6
Malaysia						
United States	19.0	19.2	25.5	23.1	29.1	26.2
Japan	13.0	10.7	8.5	8.8	8.2	8.2
European Union (15 countries)	12.8	11.9	14.1	12.8	14.0	13.4
China, People's Rep. of	2.4	5.4	1.4	4.6	0.5	4.3
Other Southeast Asia	10.4	12.0	9.1	11.8	8.4	12.6
East Asia	27.3	24.4	27.0	23.8	28.7	24.2
Other Asia	2.4	3.3	0.7	1.6	0.5	1.0
Rest of the world	12.7	13.1	13.7	13.6	10.5	10.0
Philippines						
United States	36.3	21.4	38.9	22.4	36.7	16.9
Japan	16.1	15.5	12.2	15.4	16.3	15.9
European Union (15 countries)	16.8	16.2	18.2	16.8	15.4	17.4
China, People's Rep. of	1.3	4.9	0.6	4.6	0.1	5.1
Other Southeast Asia	9.8	16.1	9.5	14.8	12.3	17.4
East Asia	9.2	15.6	8.9	15.9	11.4	17.4
Other Asia	0.6	0.3	0.6	0.3	0.2	0.2
Rest of the world	9.9	10.0	11.1	9.8	7.6	9.8

2.2 Destination of Asian exports (% of total) *(continued)*

Economy/Destination	Total exports		Manufacturing		SITC 7	
	1990–1995	2000–2005	1990–1995	2000–2005	1990–1995	2000–2005
Singapore						
United States	18.8	12.7	22.8	14.7	25.8	16.0
Japan	7.4	6.1	5.9	6.2	5.9	5.7
European Union (15 countries)	12.7	11.8	14.8	13.2	16.4	12.5
China, People's Rep. of	2.0	6.2	1.4	6.4	1.0	5.9
Other Southeast Asia	14.6	16.6	13.1	16.4	12.9	17.8
East Asia	24.5	28.3	23.7	27.5	21.5	27.2
Other Asia	3.2	3.6	2.4	3.1	1.6	2.5
Rest of the world	16.9	14.7	15.8	12.7	14.9	12.5
Taipei,China						
United States	27.5	20.1	25.3	18.3	25.0	18.1
Japan	10.8	8.6	6.7	7.0	5.5	7.7
European Union (15 countries)	15.4	13.2	14.4	12.4	17.2	14.3
China, People's Rep. of	9.3	23.0	8.3	20.6	6.9	16.0
Other East Asia	14.1	12.0	12.5	10.9	9.7	11.4
Southeast Asia	11.6	10.1	9.6	8.9	10.2	9.2
Other Asia	0.8	0.8	0.6	0.7	0.3	0.4
Rest of the world	10.5	12.1	22.5	21.2	25.2	22.9
Thailand						
United States	20.3	17.6	22.7	18.9	24.3	16.3
Japan	16.8	14.0	13.3	13.3	14.4	13.9
European Union (15 countries)	15.7	14.4	15.7	15.8	13.1	16.2
China, People's Rep. of	1.8	6.3	0.6	5.3	0.4	5.5
Other Southeast Asia	8.4	8.9	8.1	9.3	7.4	9.5
East Asia	16.9	20.3	19.3	19.6	30.0	21.9
Other Asia	1.4	2.0	1.4	2.1	0.6	1.4
Rest of the world	18.7	16.5	19.0	15.6	9.8	15.3

Note: For this table only, East Asia comprises: People's Republic of China; Hong Kong, China; Republic of Korea; Mongolia; Taipei,China. Southeast Asia comprises: Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam.

Sources: United Nations Comtrade database, *DESA/UNSD* downloaded 16 July 2007; Statistics Canada, World Trade Analyzer.

destinations. Table 2.2 compares the composition of total, manufacturing, and SITC 7 exports between 1990–1995 and 2000–2005 in these economies by destination. The colored data points indicate where export shares increased over the comparison period.

It is clear that international product fragmentation taking place in this region has induced more intraregional trade over the past 15 years. In particular, the PRC has become one of the major export destinations for all economies in the region, particularly for SITC 7 exports. In Korea, Malaysia, Philippines, Singapore, and Thailand, export value to the PRC as a share of total exports increased almost five times in this period, at the expense of the US and the European Union (EU). It was only for the PRC that the US and EU have been increasingly important over the past 15 years. The US and EU markets accounted for 21% and 16%, respectively, of the PRC's total export market in 2000–2005, increasing from 16% and 11% in 1990–1995.

In significant measure, the expansion of intraregional trade reflects the PRC's role as an assembly point and its greater reliance on demand from outside the region, the US and EU in particular. Through its

forward linkages to the PRC, the rest of the region also remains dependent on external sources of final demand (see also ADB 2007).

Determinants of export performance

This section examines the determinants of export performance in the East Asian economies, with particular attention to the role of real exchange rates. As detailed above, intra-industry trade in parts and components has become a prominent feature of the region's export trade. As yet, there is no consensus about how this may affect the channels through which real exchange rate changes operate. Some authors (e.g., Jones and Kierzkowski 2001, Arndt and Huemer 2004) have argued that surging intermediate goods trade may dilute the immediate impact of real exchange rates on export performance as intermediate exports, by definition, involve a high proportion of imported parts and components. The depreciation (or appreciation) of a currency lowers (raises) the foreign-currency price of exports but also increases (reduces) the home-currency price of component imports. To the extent that import content costs rise (decline), this will offset any expansion in demand induced by a depreciation (appreciation).

In addition, such studies have pointed out that international product fragmentation requires the establishment of "service links" in order to connect the various fragments of a production process in a seamless, rapid, and cost-efficient manner. Thus, the locational decisions of MNEs conducting assembly activities within an international production network are strongly influenced by the presence of other key variables such as infrastructure, logistic capabilities, the availability of skilled operators, and modern technical and managerial skills (Barry and Bradley 1997, Ruane and Gorg 2001). There is a general tendency for MNE affiliates to become increasingly embedded in host countries the longer they are present, and the more conducive the overall investment climate of the host country becomes over time. In these circumstances, real exchange rate changes are but one part of a far wider set of considerations about where to locate production facilities.

However, some commentators (e.g., Obstfeld 2002, Rauch and Trindade 2002, Hahn 2007) have argued that the increasing importance of product fragmentation and of trade in parts and components induces stronger substitution responses as the presence of production facilities in different countries allows firms to respond more nimbly to international price changes by shifting activities across borders. Hahn (2007) observes that the relatively high output response to relative prices of the intermediate goods sectors is likely to be particularly related to the relatively low degree of product differentiation and subsequently high degree of substitutability and competition between domestic and foreign production.

Ultimately, the influence of the real exchange rate on export performance is an empirical rather than a theoretical issue. Many studies have looked at this question (including those of Goldstein and Khan 1985, Bushe et al. 1986, Arndt and Huemer 2004, Athukorala 2004, and Chinn 2003, 2005). Employing the "imperfect substitution" model used by these authors, new evidence about the role of the real exchange rate on

2.2 Specification of export demand and supply functions

The "imperfect substitution" model is based on conventional equations of demand for and supply of exports. Suppose demand and supply equations have the following log-linear equilibrium relationships:

Export demand:

$$X = \beta_0 - \beta_1 \left(P^X / P^W\right) + \beta_2 Y \quad (1)$$

Export supply:

$$X = \alpha_0 + \alpha_1 \left(P^X / \bar{P}^d\right) + \alpha_2 Z \quad (2)$$

where X = volume of exports, P^X = export price expressed in foreign currency, P^W = price of competing goods in the import markets expressed in foreign currency, $\bar{P}^d = P^d / e$, P^d = price of exportables in the domestic market expressed in local currency, e = nominal exchange rate (local currency per unit of foreign currency), Z = production capacity in the tradable sector, and Y = real income in importing countries, $\alpha_i, \beta_i > 0$.

Equation 1 asserts that demand for exports is negatively related to the relative price of exports and of the competing goods in the import markets. All other things being equal, an increase in the price of exports lowers the demand for exports while a rise in the price of the competing goods increases demand for exports.

Equation 2 presents the supply side of exports. Decisions of firms to export depend on their relative returns between domestic sales and exports given production capacity. The return in domestic sales is measured by the price of close substitute products in the domestic market, i.e. "exportables." An increase in the price of exportables lowers the supply of exports, other things being equal, as there would be larger profits in the local market. Conversely, a rise in export prices and production capacity would increase the supply of exports.

Ideally, equations (1) and (2) should be solved simultaneously. However, such an approach tends to be constrained by data availability, which would be even more severe when conducting a disaggregated multicountry study. Therefore, a number of empirical studies in this research area (e.g., Goldstein and Khan 1985, Bushe et al. 1986, Arndt and Huemer 2004, Athukorala 2004, and Chinn 2003, 2005) examine export behavior using a single-equation approach where both demand and supply equations are solved together to yield an expression for the equilibrium volume of exports as illustrated in equation (3):

$$X = \delta_0 + \delta_1 \left(P^W / \bar{P}^d\right) + \delta_2 Y + \delta_3 Z \quad (3)$$

where $\delta_0 = \dfrac{\alpha_0\beta_1 + \alpha_1\beta_0}{\alpha_1 + \beta_1}$, $\delta_1 = \dfrac{\alpha_1\beta_1}{\alpha_1 + \beta_1}$, $\delta_2 = \dfrac{\alpha_1\beta_2}{\alpha_1 + \beta_1}$,

$\delta_3 = \dfrac{\alpha_2\beta_1}{\alpha_1 + \beta_1}$, and $\delta_1, \delta_2, \delta_3 > 0$.

In other words, the equilibrium volume of exports under the single-equation approach can be rewritten as follows:

$$X = f\left(RER,\ Y,\ Z\right) \quad (4)$$

where *RER* is the real exchange rate, the relative prices of foreign to domestic goods expressed in a common currency.

Note that in a small open economy in which firms are price takers in export markets, equations (1) and (2) cannot be solved simultaneously. If a country is a true price taker, P^X and P^W would be perfectly, or at least very highly, collinear. In this case, the relative price variable would exhibit minimal variability. Therefore, for a true small open economy, the coefficient on the relative price variable cannot be precisely estimated and it may turn out relatively low (statistically insignificant) even when its true value is very large (Browne 1981, Riedel 1988, Athukorala and Riedel 1991). Thus, for a small open economy, equation (1) should be inverted and expressed in terms of P^X (referred to as the inverse demand function), as follows:

$$P^X = \gamma_0 + \gamma_1 X + \gamma_2 P^W + \gamma_3 Y \quad (5)$$

exports is presented in this section. A novel feature of this analysis is that it differentiates between real exchange rate effects on different categories of exports; it also isolates how real exchange rate influences vary across time. Box 2.2 explains export demand and supply relationships and how they are reflected in the empirical model.

2.3 Real exchange rate coefficients

Economy	Total exports			Manufacturing			SITC 7		
	Long-run	Short-run		Long-run	Short-run		Long-run	Short-run	
		No lag	1st lag		No lag	1st lag		No lag	1st lag
China, People's Rep. of	0.60	0.62		0.58	0.58		0.47	0.41	
Hong Kong, China	0.35	0.54	0.39	0.32	0.54	0.30	0.27	0.26	
Indonesia	1.86	1.73	0.35	1.78	1.63	0.39	1.50	1.28	0.41
Korea, Rep. of	0.46	0.28		0.44	0.14		0.28	0.10	
Malaysia	0.78	0.47		0.58	0.31		0.40	0.39	
Philippines	0.11	0.22		0.08	0.35		0.07	0.36	
Singapore	0.41	0.50		0.31	0.41		0.29	0.32	
Taipei,China	0.48	0.27		0.43	0.47			0.35	
Thailand	0.97	0.44		0.69	0.34		0.60	0.33	

Notes: 1. Data on reexports are excluded in this chapter. 2. See Box 2.3 for measurement of the real exchange rate. 3. World demand is measured as the weighted average of the real incomes of key export partners, which together account for 80% of shipments of East Asia to all trading partners. 4. See Appendix 1 for measurement of production capacity. The results are based on the long-run restriction of production capacity to be unity.

Source: Staff estimates.

Before discussing the results, some clarification on what they mean is required. Estimated real exchange rate impacts reflect the confluence of both demand and supply effects on export volumes. Unfortunately, more and better data would be required to disentangle demand–supply effects. In addition, the model is unable to capture the impacts that differences in market structure and/or pricing behavior of firms might make. However, given the dominant role of MNEs in the manufacturing trade of East Asian economies over the period, it is unlikely that individual firms within developing countries are able to influence market structures or to change pricing behavior within an industry (Hobday 1995, 2000).[6] In addition, competition among MNEs in global markets could also limit changes in pricing behavior of firms.

Export relationships are estimated for each of the nine economies using quarterly data for 1990–2006. The empirical analysis links export volumes to the real exchange rate, world demand, and domestic production capacity. (Appendix 1 provides a detailed discussion of the data sources, variable measurement, and period of coverage for each economy. The econometric analysis is also explained more fully there.) The estimation is conducted using procedures pioneered by Hendry et al. 1984, Hendry 1995, and Pesaran et al. 2001. These procedures seek to discover the most parsimonious representation of the true but unknown process generating the volume of exports that is both consistent with the observed data and the theory embedded in the "imperfect substitution" model. Short-run, transitory effects can be recovered, as can long-run ("equilibrium") relationships in which variables move together over protracted periods.

Real exchange rates

The empirical results are shown in Table 2.3 for both the estimated long- and short-run real exchange rate coefficients. (The full regression results are reported in Appendix 2.) First, from the estimates of the long-run real exchange rate, differences are present in the responsiveness of exports to real exchange rates across the three export categories in all economies. The long-run real exchange rate coefficients of machinery and transport equipment (SITC 7) exports are the lowest in all economies while the

2.3 Measuring the real exchange rate

The real exchange rate (RER) is a broad summary measure of the prices of one country relative to the prices of another or to a group of countries, both expressed in a common currency. It can generally be expressed as:

$$RER = \frac{eP^*}{P} = \prod_{i=1}^{I} \frac{\left(eP_i^*\right)^{w_i}}{P_i} \quad (1)$$

where e is the nominal exchange rate defined as units of home currency to a unit of foreign currency, P^* denotes the foreign (world market) price level, P is the domestic price level, and w_i is the weight ($\Sigma w_i=1$). An increase in the value of the RER indicates that foreign goods become more expensive relative to domestic goods, so that international competitiveness improves. An increase (decrease) in the RER is referred to as depreciation (appreciation).

The RER is sometimes used to measure the internal relative price incentive in a particular economy for producing or consuming tradable as opposed to nontradable goods. In this case, the RER is defined as the relative prices of tradable to nontradable goods and is referred to as the internal RER (Hinkle and Nsengiyumva 1999). A rise in the internal RER (a real depreciation) means that the tradable sector has become more competitive in relation to the nontradable sector. Therefore, the incentive structure favors switching of resources from nontradable to tradable production, and demand moves from tradable to nontradable goods.

Even though, in fact, a movement of the internal RER can be used to reflect the country's international competitiveness, it is based on the restrictive assumption that the "law of one price" holds for tradable goods. When it holds, the domestic tradable price is set by international markets adjusted by a nominal exchange rate so that the ability to improve a country's international competitiveness position depends on incentives and profitability in domestic production of the nontradable goods sector. However, when the law of one price does not hold, the internal RER may not accurately reflect the country's international competitiveness (Little et al. 1993, Hinkle and Nsengiyumva 1999).

Concepts of the RER are relatively straightforward, but two key issues are involved in constructing the RER—the choice of prices and country weights.

Choice of prices

The most commonly used price series in constructing the RER for measuring international price competitiveness is the consumer price index (CPI). The CPI has the advantage of being timely, similarly constructed across countries, and available for a wide range of countries over a long time span. CPI-based RER measures, however, tend to provide a good reflection of the purchasing power of the domestic currency instead of a country's international price competitiveness because of the fact that CPI baskets contain a high proportion of nontradables. This makes a CPI-based RER less than ideal for assessing competitiveness (Little et al. 1993 p. 262, Dornbush and Vogelsang 1991 p.4).

Therefore, a measure based on costs of production would be more appropriate in assessing international price competitiveness. In this regard, the producer price index (PPI), which contains a high proportion of tradable goods and is tightly linked with the costs of production, would conceptually be superior to a CPI-based RER.

The internal RER, measured using the PPI-CPI relative price measure, is sometimes used to proxy international price competitiveness. Keeping in mind the basket of goods used in composing price indexes, the PPI adjusted by the nominal exchange rate is used to represent prices of tradable goods, while the CPI is used to reflect nontradable prices. However, as already noted, the internal RER reflects international price competitiveness only when the law of one price holds. This law is unlikely to hold in reality (Kasa 1992, Faruqee 1995, Corsetti and Dedola 2002).

The divergence in the prices of tradable goods (in terms of a common currency) among countries can emanate from several sources. For example, the increasing importance of differentiated characteristics, especially in manufactured goods, causes finite elasticities of demand under an environment of imperfect competition. Transportation costs, trade restrictions, and taxes may cause the prices of tradable goods to vary across countries. The presence of medium-term labor contracts could be another source of distortion in this RER measure, because such contracts keep wages and unit production costs sticky so that producers are often inclined not to adjust prices in response to exchange rate changes.

Although there are at least three price alternatives—CPI-CPI, PPI-PPI, and PPI-CPI—to measure the RER, the box figure shows that these three alternatives tend to move closely with each other so that the pattern of RER of the nine East Asian economies does not seem to be very sensitive to different price measures. The correlation coefficients among these three alternatives in the period 1990–2006 were also very high, i.e., more than 0.8 (box table). As a consequence, alternative price-based RER measures yield virtually identical results in econometric

2.3 Measuring the real exchange rate *(continued)*

analysis. The exception is Singapore, where the correlation coefficients tend to be high only between the PPI-CPI and CPI-CPI based RER measures while they were lower than 0.4 between the PPI-PPI based RER measure and the other two measures.

Country weights

The choice of a weighting scheme depends crucially on the purpose for which the RER is being constructed. For countries where most trade is covered by official data, actual trade (exports plus imports) weights can be used for assessing changes in competitiveness. However, when the intercountry pattern of trade is significantly different for imports and exports, it may be preferable for some analytical purposes to use either export or import weights rather than averaging these together.

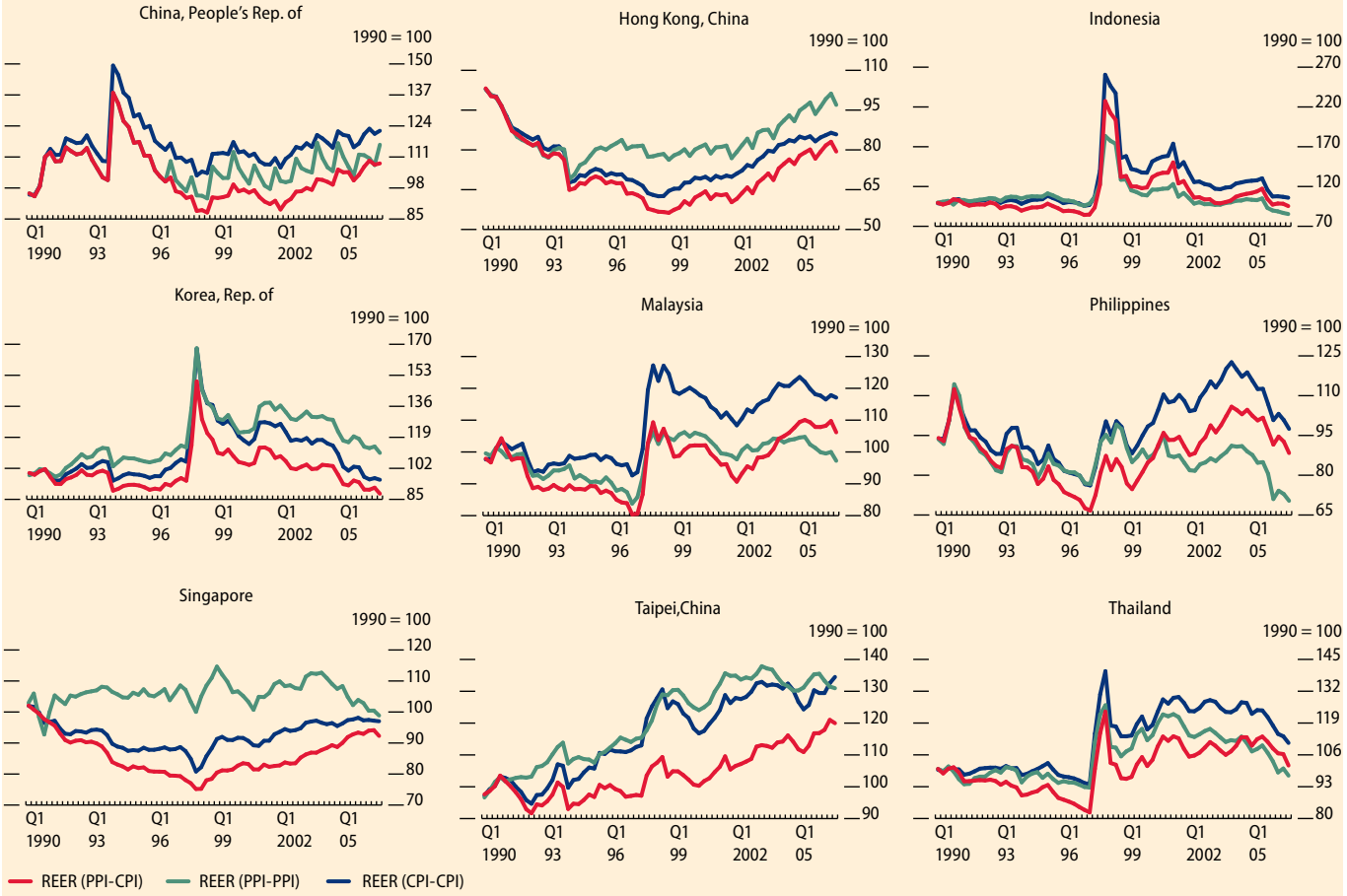
When assessing a country's ability to penetrate world markets, the export weight should be used. As weights should reflect reasonably well the structure of exports in the period being analyzed, the use of current weights is generally preferred (Hinkle and Nsengiyumva 1999).

Correlation coefficients

Economy	PPI-PPI PPI-CPI	PPI-PPI CPI-CPI	PPI-CPI CPI-CPI
China, People's Rep. of	0.90	0.92	0.84
Hong Kong, China	0.93	0.95	0.99
Indonesia	0.92	0.90	0.99
Korea, Rep. of	0.84	0.94	0.96
Malaysia	0.87	0.88	0.86
Philippines	0.87	0.83	0.90
Singapore	0.35	0.23	0.89
Taipei,China	0.82	0.96	0.89
Thailand	0.85	0.94	0.93

Source: Staff calculations.

Alternative price-based RER measures



Source: Staff calculations.

Click here for figure data

coefficients of total merchandise exports are the highest, with those of manufacturing exports coming in between.

These results would seem to suggest that exports of manufactured final products, especially labor-intensive products, are more responsive to changes in the real exchange rate than are exports of SITC 7 products, which have to rely to a greater extent on imported parts and components. In the case of total exports, primary products have a significant weight, and primary products by nature rely heavily on local raw materials compared with manufacturing products. Hence, it is expected that the impact of real exchange rate changes are most prominent in export categories that have a heavier primary weight, and this appears to be confirmed by the data.

Taken together, these results are consistent with the hypothesis that expanding product fragmentation and intermediate goods trade weakens the influence of the real exchange rate on export performance operating through conventional demand and supply channels.

The real exchange rate coefficients also vary considerably across the nine economies. In general, the real exchange rate has the least impact on the Philippines' exports while the impact is the greatest in Indonesia. The long-run coefficients of the real exchange rate in the Philippines in all three categories are less than 0.2, while they all are greater than 1 in the case of Indonesia. This is consistent with the fact that exports and imports in the Philippines have been dominated by parts and components over the past decade. The Philippines' exports are heavily concentrated in electrical machinery with a high reliance on imported components.

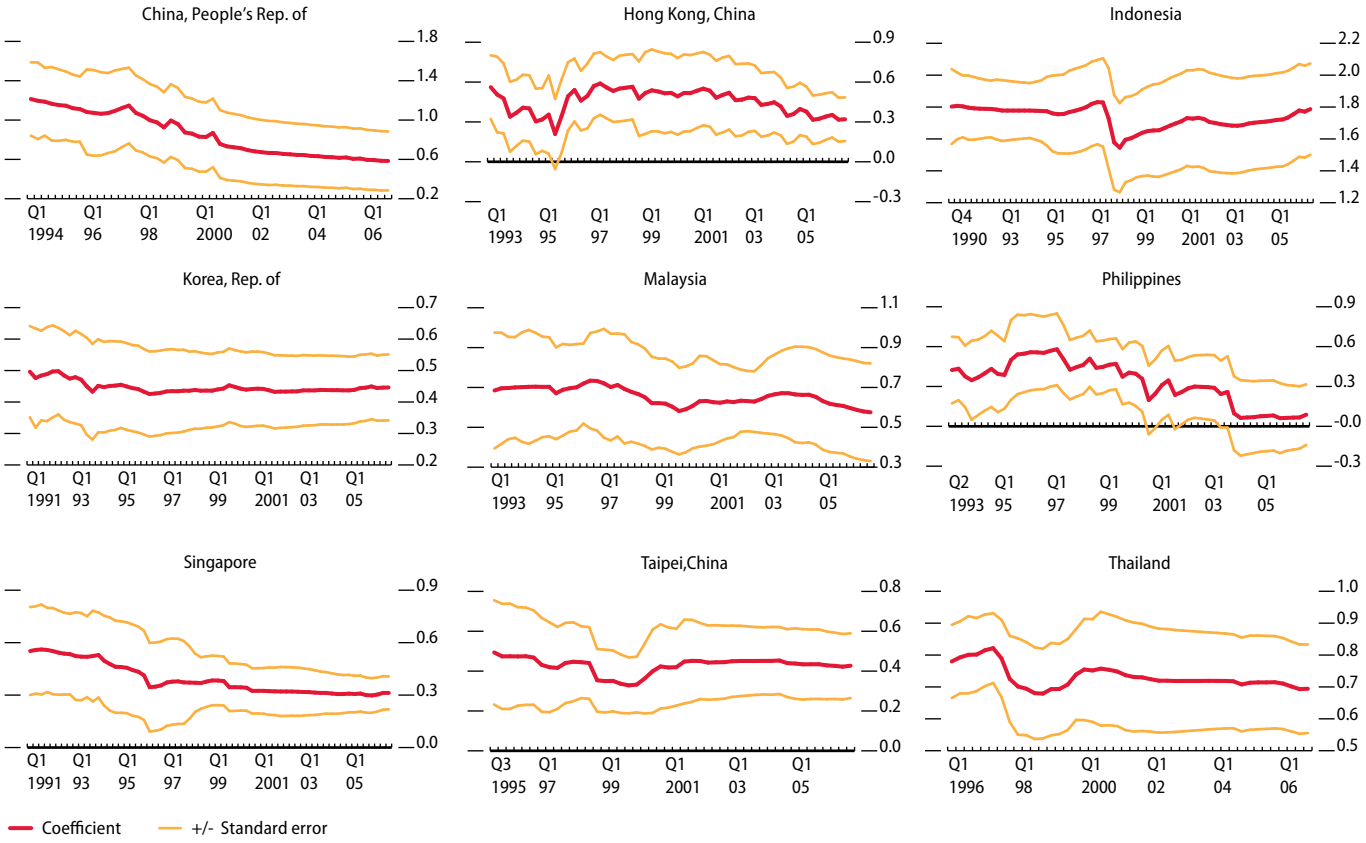
In contrast, Indonesia has much greater product diversification in its export basket. In addition, Indonesia to date has been slow in joining international production networks of MNEs in the SITC 7 category. The reliance on primary and traditional manufactured exports possibly makes Indonesian exports more sensitive to the real exchange rate.

The long-run coefficient on export volume with respect to changes in the real exchange rate in Hong Kong, China; Korea; Singapore; and Taipei,China are all relatively low. For SITC 7 exports, the real exchange rate coefficient in these economies is around 0.3 and is insignificantly different from zero in Taipei,China. In addition to the degree to which parts and components are represented in the export basket, real exchange rate responses will also be influenced by the technological sophistication and complexity of exports. More advanced products may offer fewer opportunities for substitution.

There is only a minor difference in the responsiveness of manufacturing exports and total exports to the real exchange rate in Hong Kong, China; Korea; and Taipei,China, reflecting the relative importance of their manufacturing exports in overall exports. As shown in Figure 2.2 earlier, the contribution of manufacturing exports to total exports has exceeded 85% over the past three decades. In Singapore, the relatively lower share of manufacturing exports in total exports results in a wider gap in long-run coefficients between these two categories.

In Malaysia and Thailand, the long-run real exchange rate coefficients of total exports are comparatively high. This may reflect a more diversified export structure. Despite exhibiting a declining trend, the share of nonmanufacturing products in both economies in 2000–2005

2.4 Recursive estimates of long-run elasticities of manufacturing exports



Note: In recursive estimates, the equation is solved repeatedly, using ever larger subsets of the sample data. The first observations are used to form the first estimated coefficients and then the next observations are added to the dataset and are used to compute the second estimated coefficients. This process is repeated until all the sample points have been used.
Source: Staff calculations.

Click here for figure data

still amounts to more than 20% of total exports, compared to less than 10% in the other economies, except Indonesia.

In the short run, the pattern of the coefficients in all product categories provides a striking resemblance to their long-run estimates, but with lower magnitudes. The real exchange rate still has the highest impact in Indonesia and the lowest in the Philippines, with other economies coming in between. In Taipei,China, the short-run real exchange rate coefficient corresponding to SITC 7 exports becomes statistically significant and is broadly comparable with those in the other NIEs. In Hong Kong, China and Indonesia, the statistical significance of the first lag of the real exchange rate implies that the impact on exports of a current change in the real exchange rate persists over the next quarter.

The influence of trade in parts and components can also be seen in the evolution of the relationship between exports and the real exchange rate. Figure 2.4 shows how the estimated coefficients of the real exchange rate have moved through time. As successive data points are added to the sample, the estimated coefficients of the real exchange rate term drift down. This is a general feature across all nine economies. The decline has been the most pronounced in the Philippines and the PRC. By comparison, the estimated coefficient has barely budged in Indonesia, where trade in parts and components has been small.

Recent economic literature reports similarly low coefficients of real

2.4 Production capacity coefficients

	Total exports			Manufacturing			SITC 7		
	Long-run	Short-run		Long-run	Short-run		Long-run	Short-run	
		1st lag	2nd lag		1st lag	2nd lag		1st lag	2nd lag
China, People's Rep. of	1.24	0.18		1.16	0.21		1.01	0.30	
Hong Kong, China	1.07	0.38		1.04	0.36		1.02		
Indonesia	1.09		0.88	1.07			1.04		
Korea, Rep. of	1.22	0.14		1.01			1.10		
Malaysia	1.08		0.61	1.04		0.35	1.02		0.36
Philippines	1.10			1.08			1.06		
Singapore	1.09		0.15	1.03		0.23	1.01		0.20
Taipei,China	1.07	0.20		1.04	0.11		0.96	0.10	
Thailand	1.07	0.27		0.99	0.33		1.03	0.18	

Source: Staff estimates.

exchange rate responses for parts and components exports. For example, Arndt and Huemer (2004) examine the effect of cross-border production sharing between the US and Mexico on the sensitivity of trade to the real exchange rate in 1989–2002. They, too, employ a single-equation approach. Exports are disaggregated into exports of manufactures, of nonmanufactures, and of motor vehicle parts and components. For the last category, largely seen in MNE production networks, export volumes were found to be unresponsive to changes in the real exchange rate.

Athukorala (2004) investigates the role of the real exchange rate in Thailand's export performance over 1995–2003. Export volume is specified as a function of the real exchange rate, world demand, and capacity utilization, for total manufactured exports and the four subcategories: chemicals (SITC 5), basic (resource-based) manufacturing (SITC 6), machinery and transport equipment (SITC 7), and miscellaneous manufacturing (SITC 8). Athukorala's results point to significant differences in the degree of responsiveness across the four categories, with responsiveness being least for machinery and transport equipment.

Recently, the International Monetary Fund (IMF) (2007) estimated the responsiveness of 16 US goods and services export categories[7] to changes in the real exchange rate in 1973–2002. The standard empirical trade model relating export volumes to relative export prices and foreign income under the assumption of perfectly elastic supply of domestic goods is applied. IMF found that the responsiveness of exports to real exchange rate changes tends to be low in automotive, consumer durable goods, and capital goods sectors in which international product fragmentation tends to be more pronounced, compared with other goods and service export categories.

Production capacity

Within the estimation framework used in this chapter, the declining responsiveness of exports to real exchange rate changes in East Asia seems to imply that other variables influencing export supply and demand may have increased in importance. In particular, production capacity generally plays an important role in determining export performance (Table 2.4). Long-run estimates are not only statistically significant but large in absolute value and are close to 1. This tends to imply that other supply-side factors, such as infrastructure, logistics capabilities, skills, and

2.5 Coefficients of world demand

	Total exports			Manufacturing			SITC 7			
	Long-run	Short-run		Long-run	Short-run		Long-run	Short-run		
		No lag	1st lag		No lag	1st lag		No lag	1st lag	2nd lag
China, People's Rep. of	1.34	2.81		1.27	2.88		1.05	3.31		
Hong Kong, China	0.49	0.54		0.56	0.59		0.60	0.57		
Korea, Rep. of	0.66	0.86	0.32	0.70	0.97	0.43	0.71	1.30	0.17	0.69
Malaysia	0.48	0.62		0.59	0.64		0.68	0.57		
Philippines	0.15	0.25		0.54	0.24		0.57	0.26		
Singapore	0.69	0.49		0.73	0.59		0.75	0.66		
Taipei,China	0.88	0.90		1.00	1.04		1.04	1.10		
Thailand	0.46	0.46		0.56	0.68		0.57	0.82		

Notes: 1. The results are based on the long-run restriction of production capacity to be unity. 2. For Indonesia, there is no statistical significance of external demand influence for all three export categories.

Source: Staff estimates.

the general business climate, are likely to be important in determining export performance. However, in this chapter, no specific assumptions are made about the source of this supply shift effect (Chinn 2003, 2005).[8] The production capacity variable may itself be endogenous and subject to real exchange rate influences. Movements of the real exchange rate could influence revenues and profits of parents and affiliates, although this effect would depend on whether most sales are in the domestic market or are exports. In addition, profits after tax will influence reinvested earnings, and this could affect capacity with some lag (IMF 2003).

Aside from an unusual event—a massive and permanent real appreciation as under the Plaza Accord (above)—movements of the real exchange rate in flexible currencies with managed floats are not predicted to have significant impacts on industrial production capacity in the short run. Hence, theoretically, the real exchange rate is unlikely to be the key factor in influencing production capacity in these economies, because involvement of MNEs plays a pivotal role in determining export capacity and success.

There is a consensus among economists that this involvement is influenced mainly by the general investment climate, which covers a wide range of economic and social factors, such as macroeconomic stability, the general business environment, and institutional context, rather than real exchange rate movements (Wells 1986, Hobday 1995, Yusuf et al. 2003, Fukao et al. 2003, Brooks and Hill 2004, Dollar et al. 2004, Hill 2004). Therefore, the possible indirect effect of the real exchange rate on production capacity is unlikely to dominate investment decisions enough to alter the results of a declining impact of the real exchange rate on export performance explained above.

World demand

Long-run coefficients of world demand vary systematically across export categories (Table 2.5) and are generally inversely correlated with real exchange rate influences. For the PRC, the responsiveness of SITC 7 exports to changes in world demand is low relative to that for manufacturing and total exports but it is still high compared to most other countries. This is possibly because the PRC's own exports are largely in final assembled goods, especially labor-intensive manufactured

products such as clothing and footwear, but also assembled electrical and nonelectrical durable goods.

As shown in Table 2.1 earlier, the proportion of parts and components exports in total manufacturing exports in the PRC in 2000–2006 was still less than 15%. In addition, the PRC's labor-intensive manufactured products figure prominently in the world market. Clothing and footwear from the PRC accounted for more than 20% and 25% of global exports, in 2000–2005, compared with less than 5% for the other economies in the region. Thus, changes in trading partners' demand tend to affect the PRC's final assembly exports more than its parts and components exports. Note that in contrast to other Asian economies, the PRC's exports have tended to rely more on demand from outside the region, particularly from the US and EU markets, over the past decade (Table 2.2 above).

This confirms that even though fragmentation trade has played a pivotal role in deepening intraregional economic interdependence, this has been sustained by continuing strong external reliance on final goods demand (ADB 2007).

In all economies, other than the PRC and Indonesia, the responsiveness of exports to external demand is the highest for SITC 7 while it is the lowest for total exports, with manufacturing exports coming in between. These findings add weight to the observation that emerging patterns of intraregional trade do not necessarily indicate a weakening of integration with external markets outside developing Asia (ADB 2007).

Indonesia again is an outlier. In all export categories, no statistically significant external demand influence can be detected. Primary exports where prices are set in world markets or by global price-setting mechanisms have a high weight in the country's export basket. The insignificance of external demand for SITC 7 could be because Indonesia has not yet actively participated in international product fragmentation, with the result that SITC 7 exports are not sensitive to changes in trading partners' demand.

Conclusions and policy challenges

The main results of this chapter require careful interpretation. The estimation procedures used allow the examination and isolation of the responsiveness of three categories of exports to changes in the real exchange rate. The results are consistent with a growing literature on international trade fragmentation in finding that the direct influence of real exchange rate changes on export performance may be trending downward as intrafirm and intra-industry trade in SITC 7 categories plays an increasingly important role in East Asian trade.

Further research on the interaction of exchange rates, prices, and market structure with trade and investment outcomes may allow these results to be further refined in future work. However, the methodology used here has distinct merit in that it carefully treats each of the three major independent variables and the data on which these independent variables were based. The results point to supply-side variables (production capacity measures) as becoming more important influences on the region's export performance than movements in the real exchange rate, as production networks of MNEs expand.

The results also indicate that the integration of the region through expanding trade in parts and components within the production networks of MNEs is complementary to the deeper process of globalization. The region's exports of final goods are inextricably linked to demand in the broader world economy.

The results of this chapter are broadly supportive of the majority of views expressed in the growing literature on the important role of supply-side factors in regional export performance, especially for manufactured products and in some of the fastest-growing industries in global trade, namely electrical and nonelectrical machinery and transport equipment. Among the potentially most important supply-side factors are those that accommodate the activities of MNEs, which play a leading role in the expansion of trade in the region—and particularly trade in parts and components, both within production networks and through intrafirm trade. This has potentially significant policy implications.

These policy implications include the importance of improvements in business investment climates through increased legal certainty and strengthened governance to enforce contracts, to protect intellectual property, and to ensure that product standards are met. In turn this will require institutional advances that reduce trade costs, such as customs reform and improved infrastructure and logistic services, in order to offset costs incurred in improving legal certainty and enforcement of laws and regulations. Labor productivity and unit labor costs are also quite important in this context, given emerging shortfalls in the availability of skilled workers in countries with aging populations in industrial economies.

MNEs are also averse to ownership restrictions and seek out locations where decisions can be managed effectively between parents and affiliates. Multinationals with large foreign ownership shares tend to have larger export propensities than local firms or affiliates with restricted foreign ownership shares. Multinationals normally accept some exchange rate risk in their multicountry operations and seek to mitigate these through being present in numerous countries. However, MNEs have a tendency to concentrate investment in industrial economies and will come to developing countries only when conditions are conducive. Among the most important of these are macroeconomic stability and potential for growth. East Asia has been successful in attracting foreign direct investment for precisely these reasons.

The protection of intellectual property rights may also be important in influencing the ability and willingness of MNEs to transfer technology and may influence their decisions on where to conduct assembly operations. Beneficial technology and management spillovers are likely to be seen when the supply-side factors are attended to by governments. Macroeconomic conditions are also clearly important in this context as firms look to the potential for domestic markets to expand under stable prices, prudent fiscal policies, and deepening financial markets (largely for equities and bonds). Clearly, more research is needed to determine the relative importance of these diverse variables in export performance. Nor should such analysis ignore the possibility that demand-side factors may take on greater importance in the future, particularly in light of the proliferation of discriminatory trade agreements.

Despite the apparent weakening of the direct influence of changes in the real exchange rate on export performance in the region, there are other indirect channels through which the real exchange rate may influence outcomes—especially, as we have seen, in their possible impact on investment behavior and decisions of firms, especially MNEs. Future research addressing the possible indirect channels through which changes in the real exchange rate may interact with the decision of firms to invest abroad, where to invest, and in what activities, may be useful in this context. The apparent secular appreciation of the real exchange rate in fast-growing East Asian economies, notably those that are major source countries of outward foreign direct investment, might be related to increased sophistication and complexity of export baskets in the region. Included in this future research agenda are further explorations of possible linkages between foreign direct investment, multinational activities and pricing behavior, and alternative exchange rate specifications.

Endnotes

1 This phenomenon has gone under alternative names, such as "vertical specialization" (Hummels et al. 2001, Irwin 2002), "slicing the value chain" (Krugman 1995), "international production sharing" (Ng and Yeats 2001), "outsourcing" (Rangan and Lawrence 1999, Hanson et al. 2001), and "product fragmentation" (Jones 2000, Jones and Kierzkowski 2001, Baldwin 2001, Athukorala 2006).

2 The nine economies in East Asia are the People's Republic of China (PRC); Hong Kong, China; Indonesia; Republic of Korea; Malaysia; Philippines; Singapore; Taipei,China; and Thailand.

3 Export data on manufactured goods for the PRC were not available prior to 1981.

4 Disaggregated data on manufactures for the PRC were unavailable prior to 1984 and the data series for Taipei,China begins in 1975.

5 See ADB (2007) for a more detailed discussion of trends and patterns of East Asian trade in parts and components.

6 Most internationally traded manufactured goods are tailor-made, so that their manufacturing process tends to be complex and includes, in addition to assembly, research and development, product design, and marketing activities. Consequently, the role of MNEs in developing countries has become more important for export success. For many SITC 7 items, production technology per se is a proprietary asset, and world production and trade are conducted mainly by a handful of leading MNEs. For consumer manufactured goods, such as apparel and footwear, in which the production technology is likely to involve standard technology, the MNE network is still important in helping domestic firms establish international marketing skills, quality control, and product design.

7 The 16 goods and services export categories are: foods, feeds, and beverages; durable industrial supplies; nondurable industrial supplies; transportation capital goods; IT capital goods; other capital goods; automotive; consumer durables; consumer nondurables; other goods; travel; passenger fares; other transportation; royalties and license fees; other private services; and other services. The simple average of the real exchange rate coefficient is 0.49; incorrect signs of coefficients associated with royalties and license fees and durable industrial supplies are found. The results of the IMF study appear to be consistent with the results reported here.

8 In terms of statistics, the Wu-Hausmann test is conducted to ensure that there is no evidence of simultaneity for any of these variables.

Appendix 1

Econometric procedure, variable measurement, and data sources

Econometric procedure

The econometric analysis in this chapter is based on the general-to-specific modeling (GSM) procedure (Hendry et al. 1984, Wickens and Breusch 1988, Hendry 1995, Pesaran et al. 2001). The GSM procedure is applicable when a set of variables includes series that are nonstationary, or a mixture of nonstationary and stationary. In the case of a finite sample and nonstationary data series, this procedure generally provides more precise estimates than the other two well-known approaches, namely the Phillips Hansen and Johansen procedures. The Johansen procedure in particular, which is based on full vector autoregression, tends to deteriorate significantly in small samples, generating estimates with "fat tails" (frequent outliers) and sometimes substantial mean bias (Hargreaves 1994). Therefore, the GSM procedure is chosen for estimating the behavioral equations in this chapter.

The GSM approach embodies the relationship being investigated within a sufficiently complex dynamic specification, including lagged dependent and independent variables, so that a parsimonious specification of the model can be uncovered. Under this procedure, estimation begins with an autoregressive distribution lag specification of an appropriate lag order:

$$Y_t = \alpha + \sum_{i=1}^{m} A_i Y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{m} B_{ij} X_{j,t-i} + \mu_t \qquad (1)$$

where α is a constant, Y_t is the endogenous variable, $X_{j,t}$ is the j^{th} explanatory variable, and A_i and B_{ij} are the parameters.

Equation (1) can be rearranged by subtracting Y_{t-1} on both sides and turns the set of explanatory variables into terms of differences representing the short-run dynamics. The lagged levels of both dependent and explanatory variables are still left in the rearranged functional form on the right-hand-side in order to capture the long-run (cointegrating) relationship in the system (equation 2):

$$\Delta Y_t = \alpha + \sum_{i=1}^{m-1} A_i^* \Delta Y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{m-1} B_{ij}^* \Delta X_{j,t-i} + C_0 Y_{t-m} + \sum_{j=1}^{k} C_1 X_{j,t-m} + \mu_t \qquad (2)$$

where $A_i^* = -\left[I - \sum_{i=1}^{m-1} A_i \right]$, $B_{ij}^* = \left[\sum_{i=0}^{m-1} B_{ij} \right]$, $C_0 = -\left[I - \sum_{i=1}^{m} A_i \right]$, $C_1 = \left[\sum_{i=0}^{m} B_{ij} \right]$,

the long-run multiplier of the system is given by $C_0^{-1} C_1$.

Equation (2) can also be rewritten in terms of the general form of the error correction mechanism (ECM) as follows:

$$\Delta Y_t = \alpha + \sum_{i=1}^{m-1} A_i^* \Delta Y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{m-1} B_{ij}^* \Delta X_{j,t-i} + C_0 \left[Y_{t-m} + \left(\sum_{j=1}^{k} C_1 \Big/ C_0 \right) X_{j,t-m} \right] + \mu_t \qquad (3)$$

Equation (2) is a particular formulation generally used as the "maintained hypothesis" of the specification search. The dynamics of the general model could be written in many different ways, all of which would yield the same estimates of the unknown parameters. The ECM is generally preferred over other formulations. In particular, an ECM involves a parameterization that clearly distinguishes between short- and long-run effects. This separation makes it an excellent vehicle for either assessing the validity of the long-run implications of theory or for incorporating theoretical insights into the estimation process.

The estimation procedure involves first estimating the unrestricted equation (1), and then progressively simplifying it by restricting statistically insignificant coefficients to zero and reformulating the lag patterns where appropriate in terms of levels and differences to achieve orthogonality. As part of the specification search, it is necessary to check rigorously at every stage for possible misspecification of even the more general types of models. Such checks will involve both a visual examination of the residuals from the fitted version of the model and the use of tests for serial correlation, heteroskedasticity, and normality in the residual, and the appropriateness of the particular functional form used. In particular, any suggestion of autocorrelation in the residuals should lead to a rethink about the form of the general model. The cointegration relationship can be tested through the bound test proposed by Pesaran et al. (2001). Above all, theoretical consistency must be borne in mind throughout the testing procedure.

Variable measurement and data sources

The models in this chapter were estimated using quarterly data. For the producer price equation, the model was estimated for 1987–2006 while the period of coverage for the export equation varies from country to country according to the availability of export data. Table A1 provides the period of coverage for estimating the export equation. The variable measurement and data sources used for the econometric analysis are provided in Table A2.

A1 Period of coverage for econometric analysis of the export function, nine economies

Economy	Coverage
China, People's Rep. of	1993–2006
Hong Kong, China	1991–2006
Indonesia	1990–2006
Korea, Rep. of	1990–2006
Malaysia	1992–2006
Philippines	1991–2006
Singapore	1990–2006
Taipei,China	1994–2006
Thailand	1995–2006

A2 Variable measurement and data sources for econometric analysis, nine economies

	Variable measurement	Data sources
Consumer price index	Index (1990 = 100)	CEIC Data Company Ltd.
Producer price index	Index (1990 = 100)	CEIC Data Company Ltd.
Real effective exchange rate	The ratio of export-weighted producer price indexes of trading partner countries expressed in domestic currency relative to domestic producer prices.	Staff calculations
Nominal exchange rate	The bilateral exchange rate against the US dollar	CEIC Data Company Ltd. and International Monetary Fund, *International Financial Statistics*
Nominal effective exchange rate	The export-weighted bilateral exchange rate (domestic against foreign currencies)	Staff calculations
World demand	The weighted average of real incomes of key export partners. The weight covers 80% of total export partners.	CEIC Data Company Ltd. and staff calculations
Production capacity (total and subcategories)	The Hodrick-Prescott filter of real output (total and subcategories)	CEIC Data Company Ltd. and staff calculations
Export value (total and subcategories)	The export value refers only to domestic exports (i.e., excluding reexports)	CEIC Data Company Ltd.
Export prices (total and subcategories)	Index (1995 = 100)	CEIC Data Company Ltd.
World producer price index	The export-weighted producer price indexes of trading partner countries	CEIC Data Company Ltd. and staff calculations

Note: The nine economies are People's Republic of China; Hong Kong, China; Indonesia; Republic of Korea; Malaysia; Philippines; Singapore; Taipei,China; and Thailand.

Appendix 2

Determinants of exports: Regression results

A1 People's Republic of China

	Total exports (TE)	Manufacturing exports (ME)	SITC 7 exports (SITC7)
Short-run coefficient	*(ΔTE)*	*(ΔME)*	*(ΔSITC7)*
Constant	0.01	0.02	0.04
	(1.02)	*(1.51)***	*(2.47)**
Δ(REER)	0.62	0.58	0.41
	*(3.28)**	*(2.93)**	*(2.31)**
Δ(world demand)	2.81	2.88	3.31
	*(7.82)**	*(7.76)**	*(6.56)**
Δ(production capacity, PC_i)$_{-1}$	0.18	0.21	0.30
	*(3.75)**	*(2.24)**	*(2.33)**
Error correction	-0.56	-0.67	-0.52
	*(-6.20)**	*(-8.09)**	*(-4.67)**
Long-run coefficient	*(TE/PC_i)*	*(ME/PC_i)*	*(SITC7/PC_i)*
(REER)	0.60	0.58	0.47
	*(1.92)**	*(1.96)**	*(1.52)***
(World demand)	1.34	1.26	1.04
	*(2.91)**	*(2.77)**	*(2.49)**
Trend	0.008	0.009	0.03
	*(2.43)**	*(2.84)**	*(3.32)**
Adjusted R-square	0.84	0.81	0.76
S.E. of regression	0.07	0.07	0.10
LM test for serial correlation	1.75	1.78	0.62
F-test	(p-value = 0.11)	(p-value = 0.11)	(p-value = 0.54)
RESET test for functional form	0.57	3.16	1.04
F-test	(p-value = 0.45)	(p-value = 0.08)	(p-value = 0.31)
J-B test for normality	0.76	1.74	3.03
χ^2	(p-value = 0.68)	(p-value = 0.42)	(p-value = 0.22)
ARCH test for heteroskedasticity	0.01	0.003	2.04
F-test	(p-value = 0.92)	(p-value = 0.95)	(p-value = 0.14)

A2 Hong Kong, China

	Total exports (TE)	Manufacturing exports (ME)	SITC 7 exports (SITC7)
Short-run coefficient	*(ΔTE)*	*(ΔME)*	*(ΔSITC7)*
Constant	0.04	0.02	0.03
	*(2.64)**	*(2.11)**	*(4.94)**
Δ(REER)	0.54	0.55	0.26
	*(2.38)**	*(2.19)**	*(1.40)****
$\Delta(REER)_{-1}$	0.39	0.30	
	*(1.62)***	*(1.14)****	
Δ(world demand)	0.54	0.59	0.57
	*(9.43)**	*(8.94)**	*(10.92)**
Δ(production capacity, $PC)_{-1}$	0.38	0.36	
	*(2.12)**	*(1.80)**	
Error correction	-0.42	-0.47	-0.26
	*(-3.43)**	*(-3.26)**	*(-3.18)**
Long-run coefficient	*(TE/PC_i)*	*(ME/PC_i)*	*$(SITC7/PC_i)$*
(REER)	0.35	0.32	0.27
	*(1.61)***	*(1.52)***	*(1.51)***
(World demand)	0.49	0.56	0.60
	*(5.07)**	*(5.67)**	*(5.92)**
Trend	0.003	0.004	0.02
	*(2.13)**	*(3.06)**	*(3.55)**
Adjusted R-square	0.73	0.70	0.67
S.E. of regression	0.05	0.06	0.06
LM test for serial correlation	1.71	1.69	0.24
F-test	(p-value = 0.19)	(p-value = 0.19)	(p-value = 0.79)
RESET test for functional form	0.38	0.11	0.85
F-test	(p-value = 0.54)	(p-value = 0.75)	(p-value = 0.36)
J-B test for normality	1.55	2.22	0.67
χ^2	(p-value = 0.46)	(p-value = 0.33)	(p-value = 0.71)
ARCH test for heteroskedasticity	0.06	0.20	0.00
F-test	(p-value = 0.81)	(p-value = 0.65)	(p-value = 0.99)

A3 Indonesia

	Total exports (TE)	Manufacturing exports (ME)	SITC 7 exports (SITC7)
Short-run coefficient	*(ΔTE)*	*(ΔME)*	*(ΔSITC7)*
Constant	0.04	0.06	0.15
	*(3.72)**	*(3.57)**	*(3.04)**
Δ(REER)	1.73	1.63	1.28
	*(10.50)**	*(9.24)**	*(5.75)**
$\Delta(REER)_{-1}$	0.35	0.39	0.41
	*(2.17)**	*(1.74)***	*(1.81)**
Δ(production capacity, $PC)_{-1}$	0.88		
	*(2.27)**		
Error correction	-0.09	-0.12	-0.13
	*(-1.91)**	*(-2.19)**	*(-2.20)**
Long-run coefficient	*(TE/PC_i)*	*(ME/PC_i)*	*$(SITC7/PC_i)$*
(REER)	1.86	1.78	1.50
	*(9.46)**	*(7.98)**	*(7.12)**
Trend	0.04	0.04	0.06
	*(2.94)**	*(8.43)**	*(2.59)**
Adjusted R-square	0.70	0.66	0.60
S.E. of regression	0.09	0.12	0.19
LM test for serial correlation	0.19	1.68	1.79
F-test	(p-value = 0.82)	(p-value = 0.19)	(p-value = 0.10)
RESET test for functional form	2.99	1.97	1.11
F-test	(p-value = 0.10)	(p-value = 0.07)	(p-value = 0.30)
J-B test for normality	0.39	0.40	2.32
χ^2	(p-value = 0.82)	(p-value = 0.80)	(p-value = 0.31)
ARCH test for heteroskedasticity	0.44	0.19	0.19
F-test	(p-value = 0.51)	(p-value = 0.66)	(p-value = 0.66)

A4 Republic of Korea

	Total exports (TE)	Manufacturing exports (ME)	SITC 7 exports (SITC7)
Short-run coefficient	*(ΔTE)*	*(ΔME)*	*(ΔSITC7)*
Constant	0.02	0.02	0.02
	*(3.39)**	*(2.76)**	*(2.08)**
Δ(REER)	0.28	0.14	0.10
	*(2.50)**	*(1.30)****	*(1.32)****
Δ(world demand)	0.84	0.96	1.30
	*(9.10)**	*(12.53)**	*(8.34)**
$\Delta(\text{world demand})_{-1}$	0.32	0.43	0.17
	*(3.46)**	*(5.39)**	*(1.23)****
$\Delta(\text{world demand})_{-2}$			0.69
			*(4.67)**
$\Delta(\text{production capacity, } PC)_{-1}$	0.14		
	*(1.57)***		
Error correction	-0.40	-0.40	-0.40
	*(-3.47)**	*(-3.54)**	*(-3.64)**
Long-run coefficient	*(TE/PC_i)*	*(ME/PC_i)*	*$(SITC7/PC_i)$*
(REER)	0.46	0.44	0.28
	*(4.76)**	*(4.25)**	*(1.62)***
(World demand)	0.66	0.70	0.71
	*(5.79)**	*(4.95)**	*(3.32)**
Trend	0.01		
	*(2.94)**		
Adjusted R-square	0.83	0.81	0.75
S.E. of regression	0.04	0.05	0.08
LM test for serial correlation	1.50	1.49	1.69
F-test	(p-value = 0.17)	(p-value = 0.18)	(p-value = 0.12)
RESET test for functional form	0.13	1.10	0.46
F-test	(p-value = 0.72)	(p-value = 0.29)	(p-value = 0.50)
J-B test for normality	2.00	3.10	1.86
χ^2	(p-value = 0.36)	(p-value = 0.21)	(p-value = 0.39)
ARCH test for heteroskedasticity	0.25	1.05	0.12
F-test	(p-value = 0.61)	(p-value = 0.31)	(p-value = 0.72)

A5 Malaysia

	Total exports (TE)	Manufacturing exports (ME)	SITC 7 exports (SITC7)
Short-run coefficient	*(ΔTE)*	*(ΔME)*	*(ΔSITC7)*
Constant	0.01	0.02	0.02
	*(2.58)**	*(2.75)**	*(2.49)**
Δ(REER)	0.47	0.31	0.39
	*(3.96)**	*(3.48)**	*(2.97)**
Δ(world demand)	0.62	0.64	0.57
	*(5.11)**	*(3.92)**	*(3.01)**
$\Delta(\text{production capacity, } PC)_{-2}$	0.61	0.35	0.36
	*(4.30)**	*(2.28)**	*(2.02)**
Error correction	-0.11	-0.16	-0.11
	*(-2.04)**	*(-1.92)**	*(-1.53)***
Long-run coefficient	*(TE/PC_i)*	*(ME/PC_i)*	*$(SITC7/PC_i)$*
(REER)	0.78	0.57	0.40
	*(5.56)**	*(2.35)**	*(1.59)***
(World demand)	0.48	0.59	0.68
	*(3.86)**	*(1.52)***	*(1.32)****
Trend		0.01	0.01
		*(4.97)**	*(4.84)**
Adjusted R-square	0.60	0.59	0.57
S.E. of regression	0.04	0.05	0.06
LM test for serial correlation	0.31	0.68	0.31
F-test	(p-value = 0.73)	(p-value = 0.50)	(p-value = 0.73)
RESET test for functional form	0.33	0.06	0.03
F-test	(p-value = 0.57)	(p-value = 0.81)	(p-value = 0.87)
J-B test for normality	2.34	1.38	1.57
χ^2	(p-value = 0.31)	(p-value = 0.50)	(p-value = 0.46)
ARCH test for heteroskedasticity	0.61	0.003	0.33
F-test	(p-value = 0.44)	(p-value = 0.95)	(p-value = 0.56)

A6 Philippines

	Total exports (TE)	Manufacturing exports (ME)	SITC 7 exports (SITC7)
Short-run coefficient	*(ΔTE)*	*(ΔME)*	*(ΔSITC7)*
Constant	0.004	-0.01	-0.01
	(0.81)	*(-1.14)*	*(2.07)**
Δ(REER)	0.22	0.35	0.36
	*(2.12)**	*(2.01)**	*(2.07)**
Δ(world demand)	0.25	0.25	0.26
	*(2.21)**	*(1.35)****	*(1.36)****
Error correction	-0.49	-0.24	-0.28
	*(-5.72)**	*(-2.97)**	*(-3.15)**
Long-run coefficient	*(TE/PC_i)*	*(ME/PC_i)*	*$(SITC7/PC_i)$*
(REER)	0.11	0.08	0.07
	*(1.76)**	*(1.57)***	*(1.52)***
(World demand)	0.15	0.54	0.57
	*(1.32)****	*(2.59)**	*(2.51)**
Trend	0.008	0.02	0.02
	*(10.35)**	*(11.83)**	*(12.73)**
Adjusted R-square	0.68	0.65	0.68
S.E. of regression	0.06	0.05	0.05
LM test for serial correlation	1.51	1.54	1.26
F-test	(p-value = 0.20)	(p-value = 0.22)	(p-value = 0.29)
RESET test for functional form	0.07	0.06	0.06
F-test	(p-value = 0.78)	(p-value = 0.80)	(p-value = 0.80)
J-B test for normality	2.88	0.15	0.19
χ^2	(p-value = 0.24)	(p-value = 0.93)	(p-value = 0.91)
ARCH test for heteroskedasticity	1.22	1.25	1.54
F-test	(p-value = 0.31)	(p-value = 0.29)	(p-value = 0.18)

A7 Singapore

	Total exports (TE)	Manufacturing exports (ME)	SITC 7 exports (SITC7)
Short-run coefficient	*(ΔTE)*	*(ΔME)*	*(ΔSITC7)*
Constant	0.01	0.01	0.01
	*(2.04)**	*(2.25)**	*(2.06)**
Δ(REER)	0.50	0.41	0.32
	*(1.52)***	*(1.65)***	*(1.57)***
Δ(world demand)	0.49	0.59	0.66
	*(4.43)**	*(5.35)**	*(5.22)**
Δ(production capacity, $PC)_{-2}$	0.15	0.23	0.20
	*(1.24)****	*(2.07)**	*(1.67)***
Error correction	-0.29	-0.30	-0.18
	*(-3.28)**	*(-3.49)**	*(-2.51)**
Long-run coefficient	*(TE/PC_i)*	*(ME/PC_i)*	*$(SITC7/PC_i)$*
(REER)	0.41	0.31	0.29
	*(6.72)**	*(2.31)**	*(1.52)***
(World demand)	0.69	0.73	0.75
	*(3.05)**	*(3.17)***	*(2.57)**
Trend	0.006	0.006	0.006
	*(10.13)**	*(10.02)**	*(7.93)**
Adjusted R-square	0.69	0.63	0.68
S.E. of regression	0.05	0.05	0.05
LM test for serial correlation	0.86	0.39	0.61
F-test	(p-value = 0.43)	(p-value = 0.68)	(p-value = 0.54)
RESET test for functional form	0.29	0.001	0.07
F-test	(p-value = 0.59)	(p-value = 0.97)	(p-value = 0.80)
J-B test for normality	0.36	0.90	0.75
χ^2	(p-value = 0.83)	(p-value = 0.64)	(p-value = 0.68)
ARCH test for heteroskedasticity	1.14	0.62	0.08
F-test	(p-value = 0.29)	(p-value = 0.43)	(p-value = 0.78)

A8 Taipei,China

	Total exports (TE)	Manufacturing exports (ME)	SITC 7 exports (SITC7)
Short-run coefficient	*(ΔTE)*	*(ΔME)*	*(ΔSITC7)*
Constant	0.01	0.01	0.02
	*(2.44)**	*(2.45)**	*(2.32)**
Δ(REER)	0.27	0.47	0.35
	*(1.42)***	*(2.17)**	*(1.32)****
Δ(world demand)	0.90	1.04	1.10
	*(11.88)**	*(11.95)**	*(10.18)**
Δ(production capacity, $PC)_{-1}$	0.20	0.11	0.10
	*(1.23)****	*(1.56)***	*(1.54)***
Error correction	-0.50	-0.49	-0.37
	*(-4.59)**	*(-4.52)**	*(-3.30)**
Long-run coefficient	*(TE/PC_i)*	*(ME/PC_i)*	*($SITC7/PC_i$)*
(REER)	0.48	0.43	
	*(3.84)**	*(2.63)**	
(World demand)	0.88	1.00	1.04
	*(6.64)**	*(8.42)**	*(6.23)**
Adjusted R-square	0.80	0.80	0.77
S.E. of regression	0.03	0.04	0.05
LM test for serial correlation	0.12	1.73	1.76
F-test	(p-value = 0.88)	(p-value = 0.12)	(p-value = 0.18)
RESET test for functional form	0.03	0.003	0.08
F-test	(p-value = 0.86)	(p-value = 0.95)	(p-value = 0.78)
J-B test for normality	0.14	2.68	1.84
χ^2	(p-value = 0.93)	(p-value = 0.26)	(p-value = 0.39)
ARCH test for heteroskedasticity	0.86	3.20	2.09
F-test	(p-value = 0.35)	(p-value = 0.10)	(p-value = 0.14)

A9 Thailand

	Total exports (TE)	Manufacturing exports (ME)	SITC 7 exports (SITC7)
Short-run coefficient	*(ΔTE)*	*(ΔME)*	*(ΔSITC7)*
Constant	0.01	0.01	0.01
	*(1.92)**	*(0.96)*	*(1.14)*
Δ(REER)	0.44	0.34	0.33
	*(2.99)**	*(2.54)**	*(2.56)**
Δ(world demand)	0.46	0.68	0.82
	*(2.60)**	*(4.39)**	*(4.66)**
Δ(production capacity, $PC)_{-1}$	0.27	0.33	0.18
	*(1.47)***	*(2.06)**	*(1.84)**
Error correction	-0.16	-0.47	-0.43
	*(-1.66)***	*(-4.52)**	*(-3.99)**
Long-run coefficient	*(TE/PC_i)*	*(ME/PC_i)*	*($SITC7/PC_i$)*
(REER)	0.97	0.69	0.60
	*(6.23)**	*(5.00)**	*(3.28)**
(World demand)	0.46	0.56	0.57
	*(1.60)***	*(2.68)**	*(1.83)**
Adjusted R-square	0.80	0.80	0.75
S.E. of regression	0.03	0.04	0.05
LM test for serial correlation	0.49	1.75	2.60
F-test	(p-value = 0.62)	(p-value = 0.19)	(p-value = 0.10)
RESET test for functional form	1.64	0.10	0.33
F-test	(p-value = 0.21)	(p-value = 0.75)	(p-value = 0.56)
J-B test for normality	2.65	0.75	1.45
χ^2	(p-value = 0.27)	(p-value = 0.68)	(p-value = 0.48)
ARCH test for heteroskedasticity	1.87	0.19	0.22
F-test	(p-value = 0.14)	(p-value = 0.67)	(p-value = 0.64)

Notes: T-ratios are given in parentheses: * Significant at the 1% level; ** Significant at the 5% level; and *** Significant at the 10% level. The long-run coefficients corresponding to production capacity in all economies are not significantly different from 1 so that results reported here are based on the imposition of long-run production capacity coefficient to be equal to 1. This is also done to ensure the stability of model in the long run. All variables are measured in natural logarithms so that the regression coefficients can be interpreted as elasticities.

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