Ties Binding Asia, Europe and the United States*

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Abstract

We investigate changes in Asia's regional and global trade linkages and their influence on macroeconomic relationships among Asia, Europe, and the United States (US). We first document changes in tripartite trade patterns and discuss stylized facts about East Asia's trade structure, with particular focus on the role of China. China plays a critical role in rapidly expanding intra-Asian trade as an assembly and production center that supplies final goods for the advanced economies. However, China's trade shares in final goods with East Asia and in parts and components with Europe and US are rising, suggesting that the region's production chains are increasingly integrated into the global business network. Empirical results from a panel vector auto-regression model generally confirm increasingly mutual macroeconomic interdependence among East Asia, Europe, and US. The findings suggest a future role for Asia as an important trade partner and balancing power in the world economy.

Key words: trade integration, economic interdependence, East Asia, China, panel VAR
JEL codes: E32, F15, O19, O53

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I. Introduction

The 2008/2009 global financial crisis proved to be a turning point for the debates on Asia's macroeconomic independence from the world economy. In the run-up to the crisis, many argued that Asia would decouple from the United States (US) or Europe. However, precipitous drops in industrial production and exports across East Asia in the wake of the global crisis was a solemn reminder that the region's rapidly integrating economy remains strongly tied to the fate of the global economy.

As a group, East Asia[1] accounts for 18% (on a purchasing power parity basis) of total world gross domestic product (GDP) in 2008, compared to 9% in 1990. The fast-growing regional economy and its potentially large spending power was a ground for the decoupling debate.

Persistent increases in intra-Asian trade and investment flows have contributed to East Asia's economic and trade integration. The idea that emerging market economies in Asia could maintain an independent growth momentum was also largely grounded in the rapid expansion of intraregional trade. Another critical factor has been the rise of China. China's economic ascent has been spectacular. It is now the third largest economy (at purchasing power parity) and the largest trader in the world.

However, China has thus far played a role in the region's vertical production integration as an assembly center of the production sharing networks. With China importing intermediate goods from the rest of East Asia and exporting the final assembly to destinations outside the region, the rise of intra-Asian trade has been structurally dependent on extraregional demand.

The 2008/2009 global financial crisis highlighted vulnerability of East Asia's export-dependent growth. However, as the region's economic prowess grows, it is conceivable that its spending power will also increase. The issue of global rebalancing is also essentially about whether or not East Asia can provide additional source of

global demand. Particularly during the recent crisis, the region's large economies, namely China, continue to grow positively on relatively resilient domestic demand, offering hope that East Asia's positive growth may help facilitate the global recovery.

To shed light on these issues, we document the evolution of trade linkages and macroeconomic interdependence among Asia, Europe, and US in the following structure. Section II briefly summarizes changes in trade patterns and some stylized facts about East Asia's trade. Section III investigates the role of China in connecting East Asia's intraregional and extraregional trade by paying particular attention to its role as a hub in the region's production sharing networks. Section IV employs a panel Vector A uto-Regression (VAR) model to evaluate the impact of East Asia's business cycle fluctuations on the US and Europe and vice versa. Concluding remarks follow in Section V.

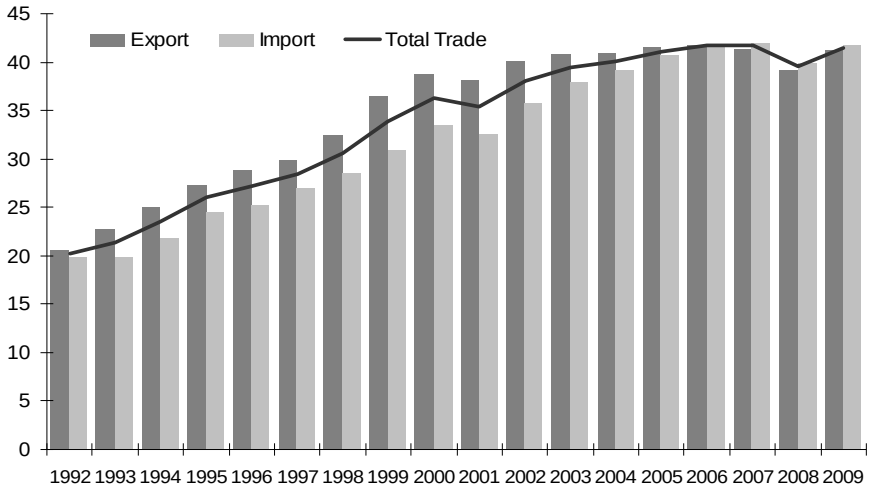
II. East Asia's Trade Patterns and Global Linkages

It has now become a stylized fact that a significant portion of trade among economies of East Asia is trade of intermediate goods. Many studies have pointed that rapid growth in intra-Asian trade is driven largely by trade of intermediate goods (Athukorala, 2008; Brooks and Hua, 2009).

Sharing of production networks across East Asia has given strong momentum to regional economic and trade integration since 1990s. Figure 1 highlights the rising share of parts and components in East Asia's total manufacturing trade, along with increasing intra-regional trade since the 1990s. ADB (2006) reports that strong growth in intra-firm and intra-industry trade through vertical supply networks of multinational companies has boosted Asian trade both intra-regionally and inter-regionally. It suggests that regional production sharing networks by multinational companies to take advantage of local specific conditions and low-cost labor might have been an

underlying force behind the intra-regional trade of intermediate goods that are destined for final consumption outside the region.

Figure 1. East Asia's Intraregional Parts and Components Trade
(percent of total manufacturing trade)



Note: East Asia includes China, Hong Kong SAR, Indonesia; South Korea, Malaysia, Philippines, Singapore, and Thailand. Data for Taipei,China is unavailable. Data for China, Malaysia, Philippines and Singapore in 2009 are also preliminary.

The list of commodity codes used to identify parts and components is based on Athukorala (2005). Relevant SITC rev. 3 codes were converted to SITC rev. 4 using the UN Correspondence Table to account for economies which switched their reported data to SITC rev. 4 from 2007-2009. While approximately 3.6% of the codes prescribed by Athukorala cannot be directly converted and overlapped with other SITC rev. 3 codes, these additional codes only amount to 0.94% of the total parts and components trade value for 2006.

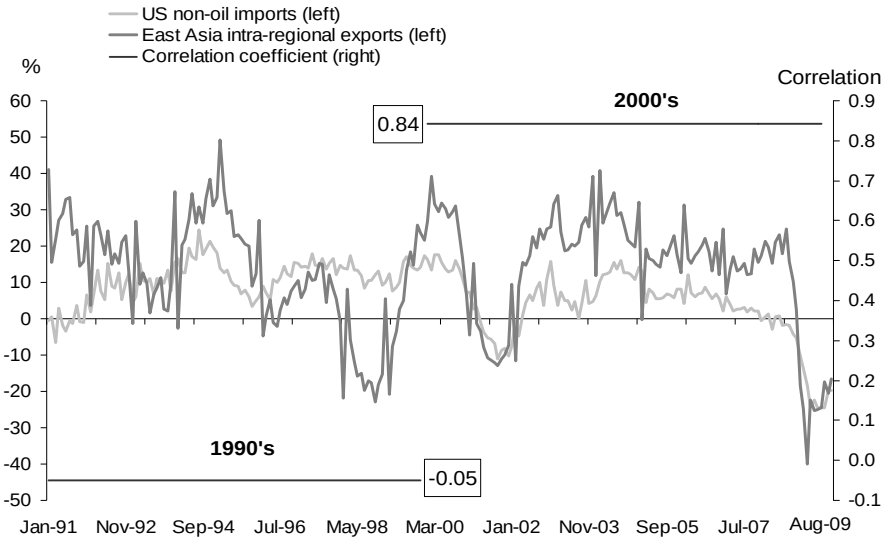
Source: UN Comtrade Database, downloaded 29 July 2010.

Trade of intermediate goods through regional production sharing may provide a missing link between trade and business cycle fluctuations. It is relatively well-documented that intra-industry trade as a result of vertical specialization and production sharing tends to lead to business cycle synchronization (Shin and Wang, 2004). Using industry level data, Ramanarayanan (2009) also shows that cross-country industry pairs with more trade intensity tend to be more synchronized than the pairs with less trade intensity.

Evidence suggests that buoyant demand from the world's major economies represent still a dominant factor behind East Asian export growth. Figure 2 demonstrates a tight relationship between US non-oil import growth and that of East

Asian exports.[2] The decadal correlations between growth rates of US non-oil imports and Asian exports show that this linkage has strengthened rather than weakened despite strong growth in intra-Asian trade.

Figure 2. Correlation between Growth in East Asia's Intraregional Exports and US Non-oil Imports



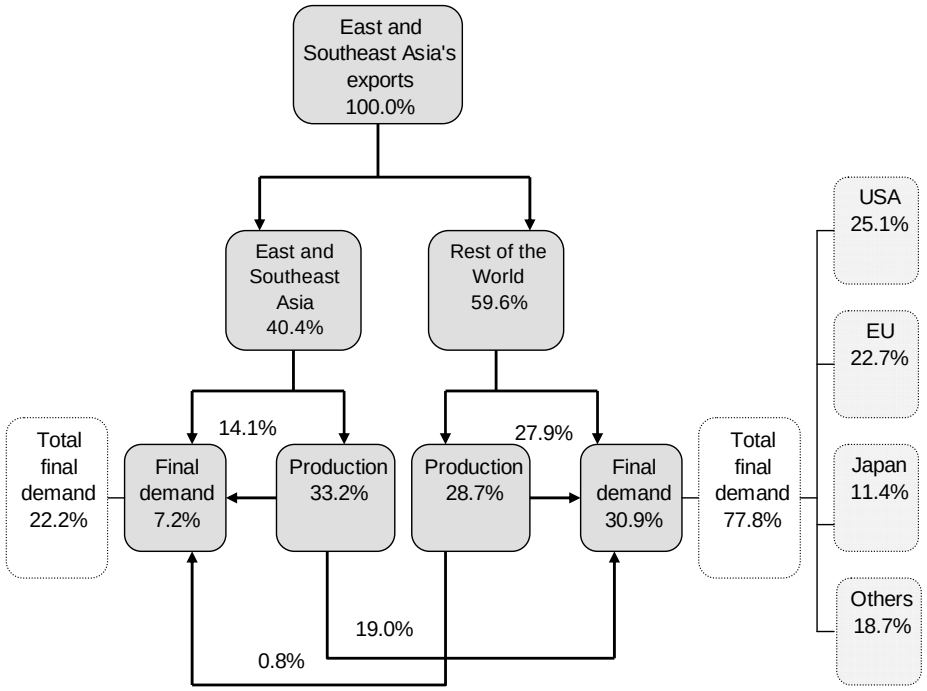
Note: East Asia comprises China; Hong Kong SAR; Indonesia; South Korea; Malaysia; Philippines; Singapore; Taipei,China; and Thailand.

Sources: IMF Direction of Trade Statistics, CEIC Database and Datastream, downloaded 27 January 2010.

Figure 3 shows a breakdown of Asian exports to those destined for other countries within the region and those that leave the region based on the Global Trade Analysis Project (GTAP) database.[3] Intraregional trade within Asia is then factored into the region's final demand and what is used in the production process. A similar decomposition is made in the trade among the rest of the world. On both ends are reported total final demands by different regions/economies, which take into account the trade of intermediate goods in the production process for final demands. Based on this analysis, about 59% of total Asian exports (instead of about 35.4% of total exports as shown in Table 1) are eventually consumed by G3 economies. On the other hand,

only 22.2% of total Asian exports are eventually absorbed by the region's domestic demand (instead of 40.6% of total exports).

Figure 3. Breakdown of East Asia's Exports



Note: East Asia comprises China; Hong Kong SAR; Indonesia; South Korea; Malaysia; Philippines; Singapore; Taipei,China; and Thailand.
Source: Data sourced from Global Trade Analysis Project (GTAP) version 7, downloaded 5 October 2009.

Table 1. East Asia Export Profile in 2009 (percent)

Exports to	
East Asia	40.6
United States	13.0
Japan	7.6
European Union 27	14.8
Rest of the World	24.0
Total	**100.0**

Note: East Asia comprises China; Hong Kong SAR; Indonesia; South Korea; Malaysia; Philippines; Singapore; Taipei,China; and Thailand.

Source: IMF Direction of Trade Statistics and CEIC Database.

The results suggest that the world's major industrial countries remain as main export destinations for final goods departing from East Asian ports, when taking into account the share of intermediate goods trade that is for assembly and production

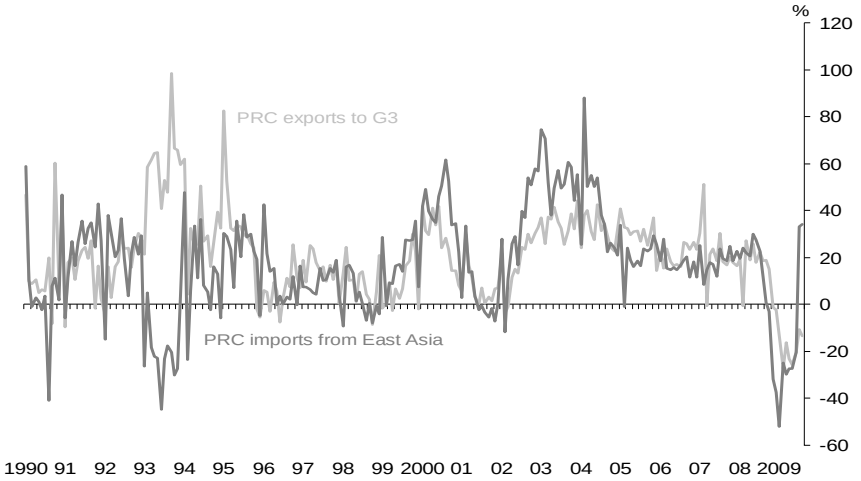
within the region but eventually shipped out of the region.[4] Interestingly, Europe is nearly as big as the US in terms of the final demand for East Asia's products.

To the extent that intra-Asian trade is driven by demand outside the region, growth of East Asian economies would be highly sensitive to a shock emanating from major demand destinations.

III. China's Role in Future Regional and Global Trade Patterns

The role of China as the region's main assembly and production center seems to shape intraregional trade flows and the region's trade dynamics with the rest of the world. Figure 4 shows that the growth rates of Chinese exports to G3 are highly correlated with those of Chinese imports from the rest of East Asia since the early 1990s. As China imports a large share of the intermediate goods from the rest of East Asia to serve final demand from G3, a slowdown in the G3 economy could have negative impact on Chinese exports, thus adversely affecting Chinese imports from the rest of East Asia. This suggests that the Asian economy remain exposed to the G3 economic fluctuations via its exposure to the Chinese economy.

Figure 4. Relationship between China's Exports to G3 and Imports from East Asia (percent)



Note: East Asia comprises Hong Kong SAR; Indonesia; South Korea; Malaysia; Philippines; Singapore; Taipei,China; and Thailand.
Source: IMF Direction of Trade Statistics, downloaded 28 January 2010.

Using disaggregated trade data, the rest of this section examines the structure of China's trade in more details to determine whether it continues to be driven largely by trade in parts and components.[5] It will also assess whether there is a change in the role of China. The hypothesis is that China is slowly becoming a larger consumer of regional exports of final goods, while at the same time keeping its role as an assembler of final goods for export outside the region—particularly to the US and Europe.

1. Data Description

Merchandise trade data released on a monthly basis by China's customs agencies are used for the analysis. Merchandise export and import data are decomposed into three categories: basic goods, parts and components, and final goods. The focus in the analysis here is on the last two categories, i.e., parts and components and final goods. Parts and components are considered intermediate goods that need to be further processed to produce final goods. In general, parts and components have no use until they are blended with other inputs to generate goods for final consumption. Final goods, in contrast, do not require any further transformation and can be used or consumed immediately.

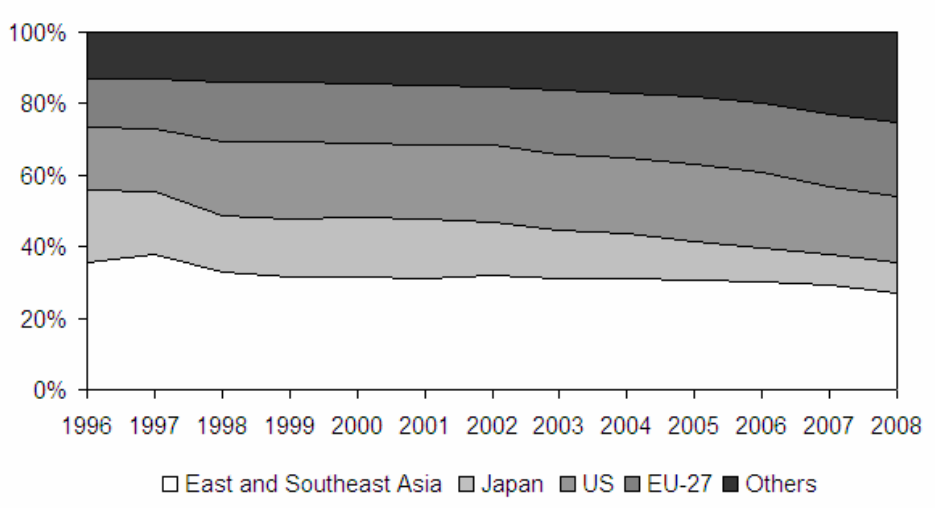
Basic goods consist of food and beverages, natural resources, and raw materials. Construction materials, which consist basically of cement, are also categorized as basic goods. Classifying parts and components and final goods involves some degree of subjectivity and discretion particularly since the actual use of the good is no longer monitored as soon as it is imported. Data in this analysis is based on the International Harmonized Customs Classification.

2. Key Findings

A. China's Overall Trade Structure

Figure 5 provides a snapshot of China's major export partners. Between 1996 and 2008, the importance of East and Southeast Asia as a destination for China's exports has steadily declined. From 35.5% in 1996, East and Southeast Asia's share of Chinese exports has fallen to 27.2% in 2008. The share of exports to Japan has been also falling—at a faster rate than that for East and Southeast Asia (20.4% down to 8.2%). The share of China's exports to the US has remained relatively stable during the same period, averaging 20.2%. But, the EU's share has grown from 13.3% to 20.6%, and that for the rest of the world has increased from 13.1% to 25.4% during 1996-2008. This implies that China has increased its integration into the world economy, allowing its exports to gain more ground in the EU and in the rest of the world.

Figure 5. Share of Chinese Exports by Economy/Region

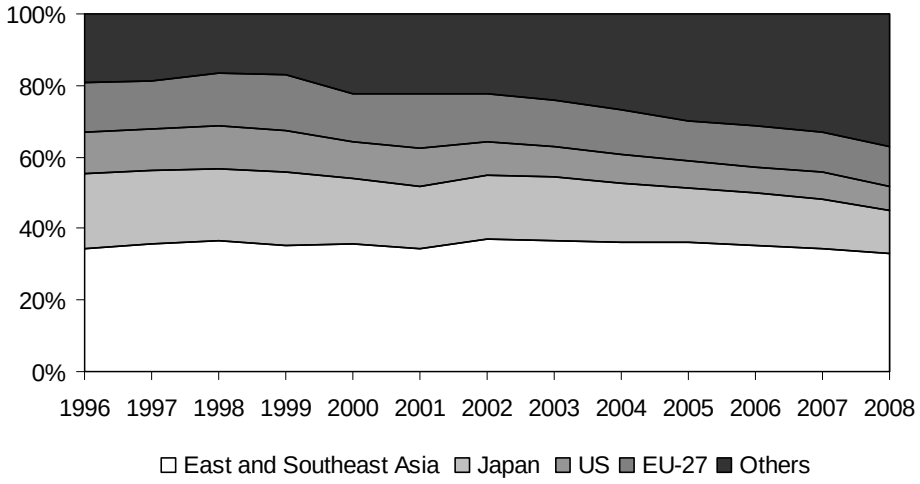


Note: East and Southeast Asia includes Brunei Darussalam; Cambodia; Hong Kong SAR; Indonesia; South Korea; Lao PDR; Malaysia; Mongolia; Myanmar; Philippines; Singapore; Taipei,China; Thailand; and Viet Nam.
Source: CEIC Data Company Ltd., downloaded 4 August 2009.

In contrast, Figure 6 shows that while the share of China's imports from the EU as well as East and Southeast Asia have stayed quite steady, those from Japan and the US have gradually fallen. China's imports are thus increasingly being sourced from the rest of the world, with the share growing from 19.4% to 37.2% between 1996 and 2008. The growing share of the rest of the world in China's imports is perhaps due to

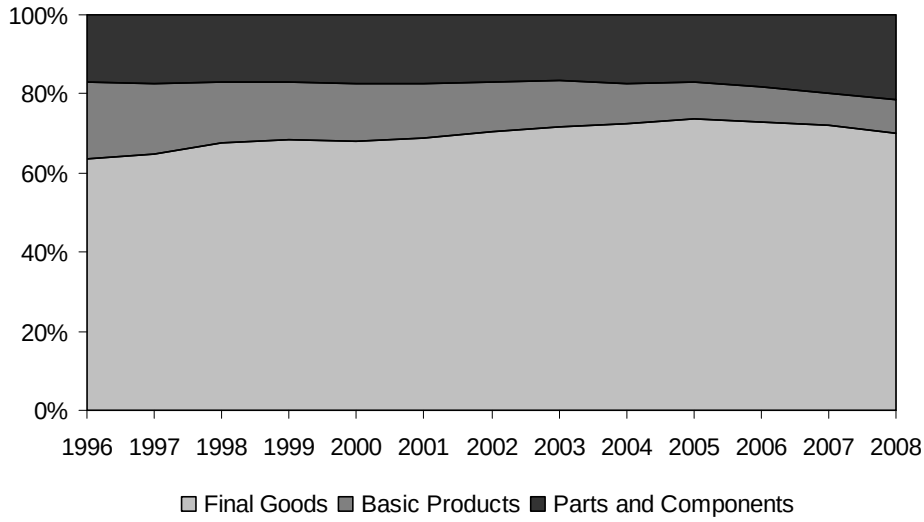
the country's rising demand for resources. Overall, China has maintained a positive gap between its export and import shares with the US and the EU, and negative gaps with the East and Southeast Asia, Japan, and the rest of the world.

Figure 6. Share of Chinese Imports by Economy/Region



Note: East and Southeast Asia includes Brunei Darussalam; Cambodia; Hong Kong SAR; Indonesia; South Korea; Lao PDR; Malaysia; Mongolia; Myanmar; Philippines; Singapore; Taipei,China; Thailand; and Viet Nam.
Source: CEIC Data Company Ltd., downloaded 4 August 2009.

Figure 7. Chinese Exports by Commodity Classification

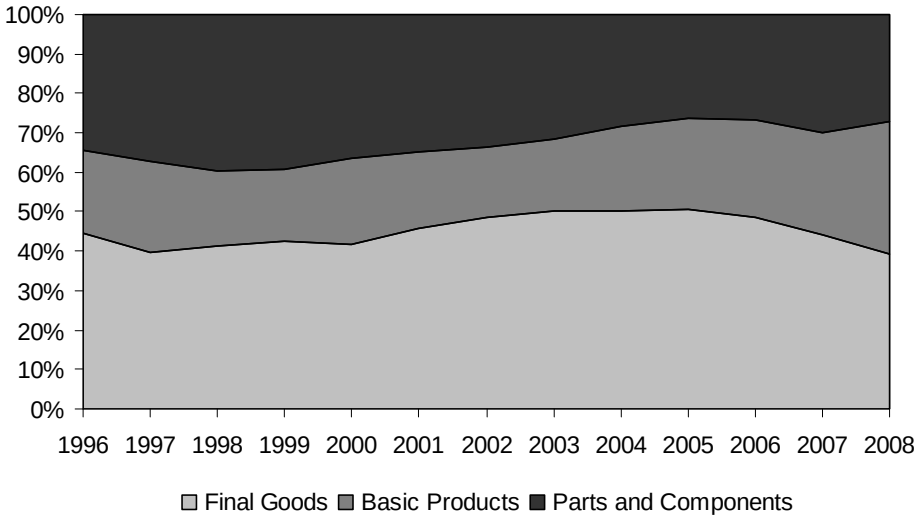


Source: TradeData International Pty. Ltd.

In terms of commodity classification, China's exports have been mostly final goods (Figure 7). From less than two thirds of total in 1996, the share of final goods exports

has risen above 70% since 2002. The share of parts and components exports has also grown, but at a much slower pace, rising from about 17% in 1996 to 21.6% in 2008.

Figure 8. Chinese Imports by Commodity Classification



Source: TradeData International Pty. Ltd.

China's imports of basic products have grown the fastest, with its share rising from 21.3% to 33.5% between 1996 and 2008 (Figure 8). The share of China's final goods imports increased to about 50% in 2003-2005, but has since fallen to 39.5% as of 2008. Similarly, the share of parts and components has steadily diminished to 27.1% in 2008.

Between 1996 and 2008, the share of final goods in China's total exports (averaging 69.6%) has consistently been higher than in its total imports (averaging 45.2%). In contrast, the share of parts and components in China's total imports has consistently been larger than in its total exports (32.8% vs. 17.9% on average). This validates the view that China acts as the world's factory, assembling imported intermediate goods for re-export to the rest of the world. Nevertheless, the gap between the export and import shares of China's parts and components trade has steadily turned less negative during the period (i.e., the gap is narrowing, meaning export shares are slowly catching up to import shares), and the gap in final goods

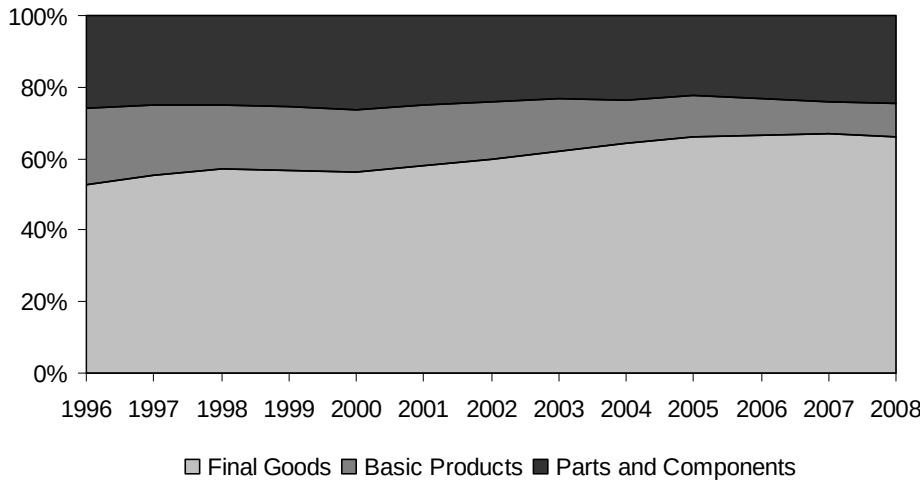
trade has steadily risen (i.e., the gap is widening, meaning export shares are rising much faster than import shares).

B. Trade between China and East Asia

The general pattern of China's trade in parts and components with East and Southeast Asia is similar to China's total trade (Figures 9 and 10). During 1996-2008, China's import shares of parts and components from East and Southeast Asia have generally been larger than its export shares to the rest of the region (38.1% versus 24.4% on average). While these support China as the world's factory thesis, it is worth noting that the gap in parts and components trade has also narrowed between 1996 and 2008.

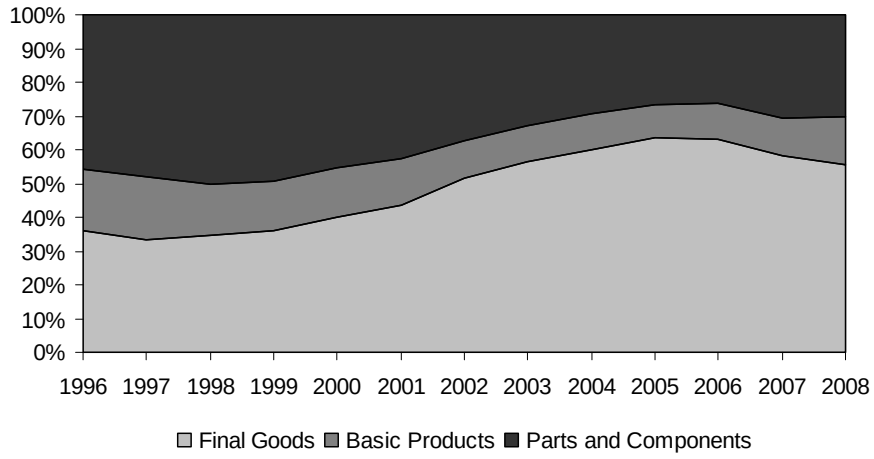
China's trade in final goods with East and Southeast Asia is likewise similar to China's trade with the world, i.e., export shares are generally larger than import shares. The gap in China's final goods trade shares with East and Southeast Asia has been narrowing through 2005, but it began to turn up in 2006 and has continued to widen through 2008.

Figure 9. Chinese Exports to East and Southeast Asia by Commodity Classification



Note: East and Southeast Asia includes Brunei Darussalam; Cambodia; Hong Kong SAR; Indonesia; South Korea; Lao PDR; Malaysia; Mongolia; Myanmar; Philippines; Singapore; Taipei,China; Thailand; and Viet Nam.
Source: TradeData International Pty. Ltd.

Figure 10. Chinese Imports from East and Southeast Asia by Commodity Classification



Note: East and Southeast Asia includes Brunei Darussalam; Cambodia; Hong Kong SAR; Indonesia; South Korea; Lao PDR; Malaysia; Mongolia; Myanmar; Philippines; Singapore; Taipei,China; Thailand; and Viet Nam.
Source: TradeData International Pty. Ltd.

In particular, the share of final goods in China's trade with East and Southeast Asia has been rising rapidly. In terms of exports, the share has increased from 52.8% in 1996 to 66.1% in 2008, while the share has grown from 36.1% to 55.4% in terms of imports during the same period. In fact, China has steadily been exporting more final goods to East and Southeast Asia, while parts and components exports have been relatively stable. Meanwhile, China has been importing more final goods from East and Southeast Asia and less parts and components.

Trade in parts and components within the East and Southeast Asian region has been gradually slowing, but has remained quite substantial, accounting for at least a quarter of total trade.

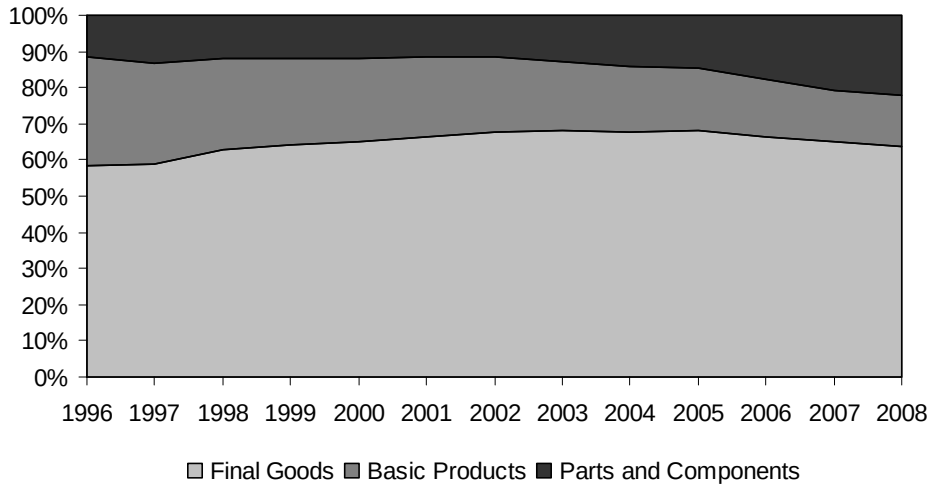
C. Trade between China and G3

Japan

The share of China's final goods exports to Japan steadily gained until 2005, although its pace has slowed through 2008 (Figure 11). The share of China's parts and components exports to Japan, meanwhile, has increased from 11.6% in 1996 to 22.3%

in 2008. This suggests that China is now gaining presence as supplier of intermediate inputs in Japan.

Figure 11. Chinese Exports to Japan by Commodity Classification

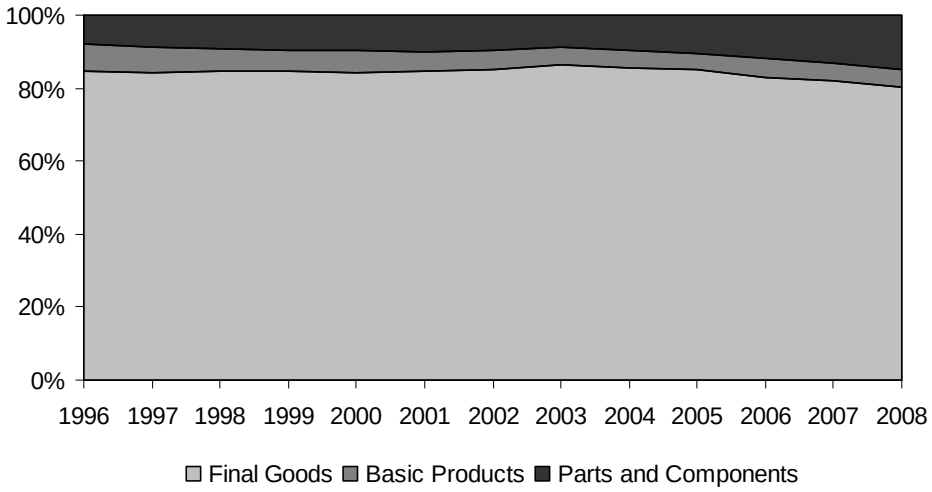


Source: TradeData International Pty. Ltd.

The United States

China's exports to the US have largely been in final goods, with such goods accounting for more than four fifths of total (Figure 12). There has, however, been a steady rise in the share of parts and components exports, from just 8.0% in 1996 to 14.8% in 2008. With rising export shares (and steady import shares[6]), China's parts and components trade is slowly making its way to US manufacturing operations as intermediate goods. This could be seen as China is increasingly becoming the choice of US manufacturers as their supplier of intermediate inputs.

Figure 12. Chinese Exports to US by Commodity Classification

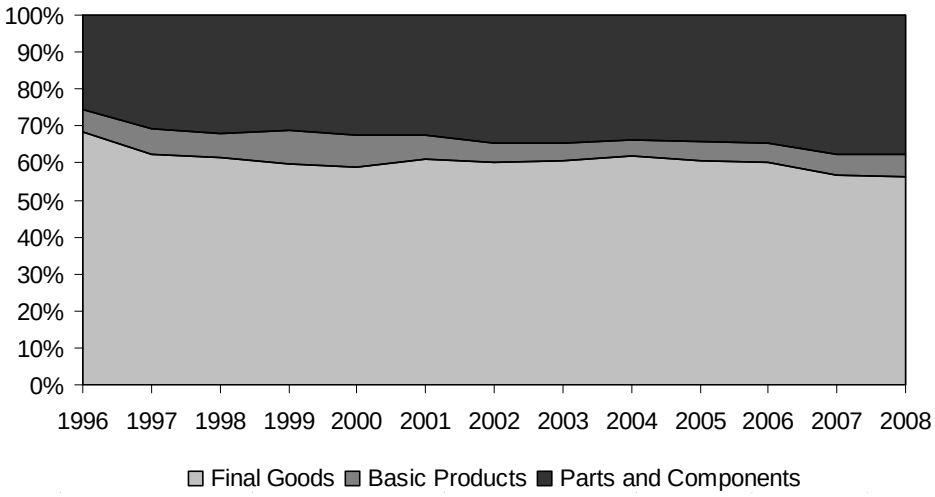


Source: TradeData International Pty. Ltd.

EU

China's trade with the EU has steadily risen between 1996 and 2008. Final goods dominate China's exports to the EU, accounted for 78.0% of total exports on average during the period; parts and components averaged 13.7%. Interestingly, China imports from the EU are increasingly shifting toward parts and components and away from final goods (Figure 13). From just 25.6% in 1996, the share of parts and components imports has risen to 37.7% in 2008. The share of final goods imports, meanwhile, declined from 68.6% to 56.3% during the same period. In contrast to the case of the US, it appears that the EU is progressively becoming a source of China's intermediate inputs.

Figure 13. Chinese Imports from EU by Commodity Classification



Source: TradeData International Pty. Ltd.

IV. The Effect of Trade Linkages on Output Co-Movements

1. Theory and Literature

Changes in trade patterns between trade partners influence business cycle co-movements. On theoretical grounds, the effect of international trade linkages on business cycle co-movements is ambiguous.

Trade integration is often emphasized as an important channel of output co-movement in the literature of international business cycles. Greater trade integration stimulates the spillovers of aggregate demand shocks, thereby increasing output co-movement (Frankel and Rose, 1998). The spread of technology shocks through trade can also make business cycles more correlated across countries (Canova and Dellas, 1993). Spillovers can also occur through the change in relative prices of factors and products. A positive shock in one country raises the relative price of labor-intensive goods and thus, as much as they trade freely, leads to higher wage and employment throughout the world (Kraay and Ventra, 2002).

However, as Krugman (1993) and Kose and Yi (2002) argue, more trade may also encourage greater specialization of production, resulting in less synchronization of

business cycles.[7] In this context, not just the size of trade but also the similarity of trade structure is considered to be important in explaining output co-fluctuations. Some studies found that when bilateral trade concentrates more on intra-industry trade than inter-industry trade, the tendency of synchronizing output fluctuations strengthens (Imbs, 2004; Shin and Wang, 2004). Ramanarayanan (2009) also argues that increasingly globalized production chains due to advances in transportation and communication technologies, as well liberalization of trade policies may be responsible for the magnified impact of trade links on business cycle synchronization.

There is yet to be any conclusive evidence for how changing patterns of Asia's intra- and inter-regional trade affect the macroeconomic interdependence among regional economies and between the regional economies and the world's major industrial economies.

Empirical findings in this area remain limited, although recent literature tends to refute the decoupling argument. For example, ADB (2008) and Takagi and Kozuru (2008) provide evidence that Asia’s output is responding significantly to both regional and global output shocks in the post-crisis period. Kim, Lee, and Park (2010) also show that real economic interdependence between East Asia and the G7 economies increased significantly in the post-crisis period, suggesting “recoupling”, rather than decoupling.

Given the theoretical ambiguity, whether and to what extent trade integration leads to business cycle synchronization is ultimately an empirical question. Interestingly, many empirical studies find that business cycles are more synchronized as trade integration deepens (Frankel and Rose, 1998; Baxter and Kouparitsas, 2005).

Empirical findings tend to differ on the extent and nature of business cycle co-movement, depending on the choice of methodology and sample period. Recent studies, however, suggest that the degree of business cycles synchronization among

Asian economies has been increasing, partly due to deepened integration in trade. Using a quantitative survey of the previous literature that analyzes the links between trade and business cycle synchronization, Rose (2009) concludes that Asian business cycle synchronization is likely to grow in conjunction with the rise in intra-Asian trade. Asian trade seems likely to continue to rise relative to GDP as transportation costs shrink and supply chains become ever more complex and integrated. There are many other factors such as monetary and financial integration and macroeconomic policy cooperation, which also seem to exert positive influence on business cycle co-movements.

Moneta and Ruffer (2006) also estimate various specifications of a dynamic factor model for output of 10 East Asian economies and find a significant common factor in their business cycles. The evidence of synchronization draws primarily on the result of co-movement in export and common disturbances, such as oil price and the yen-US dollar exchange rate. However, it remains unclear how rapid growth in intra-Asian trade affects the macroeconomic interdependence between East Asia and the world's major industrial countries.

2. Panel VAR Model

To examine the issue, we use a panel vector auto-regression (VAR) model. VAR models can identify the relevant structural shocks, such as US, European, and East Asian regional shocks, and analyze the effects of each shock on an individual variable in a systematic way. We use a panel structure to increase the degree of freedom because sample periods under consideration are relatively short.

Let's assume that an East Asian economy, i (i=1,2,…,10), is described by the following structural form equation:

$$G(L)y_t^i = d^i + e_t^i \qquad (1)$$

where $G(L)$ is a matrix polynomial in the lag operator L, y_t^i is an $m\times1$ data vector, d^i is an $m\times1$ constant matrix, m is the number of variables in the model, and e_t^i denotes a vector of structural disturbances.

By assuming that structural disturbances are mutually uncorrelated, $\mathrm{var}(e_t^i)$ can be denoted by Λ, which is a diagonal matrix where diagonal elements are the variances of structural disturbances. The individual fixed effect, d^i, is introduced to control for the country specific factors that are not included in the model. We are interested in examining the time-series relationship. Therefore, by including the individual fixed effect, we exclude the cross-sectional information in the estimation.

We pooled the data and estimated the following reduced form panel VAR with the individual fixed effects:

$$y_t^i = c^i + B(L)y_{t-1}^i + u_t^i, \qquad (2)$$

where c^i is an $m\times1$ constant matrix, $B(L)$ is a matrix polynomial in the lag operator L, and $\mathrm{var}(u_t^i) = \sum$.

There are several ways of recovering the parameters in the structural form equation from the estimated parameters in the reduced form equation. The identification schemes under consideration impose recursive zero restrictions on contemporaneous structural parameters by applying Cholesky decomposition to the reduced form residuals, Λ, as in Sims (1980).

A. Empirical Method

To examine the relationship between US, European, and Asian regional output, and their effects on the output of individual East Asian economies, we constructed a four variable VAR model [log US, log E, log A, log A_i] where the contemporaneously exogenous variables are ordered first: US is the US output, E is the European output, A is East Asian aggregate output, and A_i is an individual output of an East Asian

economy. The first three variables are included to examine the relationship among US, European, and East Asian regional output. The last variable is included to examine the effects of US, European, and East Asian regional output shocks on the output of individual East Asian economies.

Some orderings of the variables can be regarded as a natural one. US, European, and East Asian regional output are treated as contemporaneously exogenous to individual East Asian country's output as individual East Asian country's output is far smaller than US, European, and East Asian regional output. Then, US and European output are assumed to be contemporaneously exogenous to East Asian regional output as US and European output are larger than East Asian regional output.[8]

The East Asian aggregate is constructed as the aggregate of nine East Asian economies (China; Hong Kong SAR; Indonesia; South Korea; Malaysia; Philippines; Singapore; Taipei,China; and Thailand), while excluding each country's own economy.[9] We also consider a model in which Chinese output instead of East Asian aggregate, and consider only eight individual countries, excluding China in order to focus on interactions of Chinese economy with emerging East Asian countries, the U.S., and Europe.

We use quarterly data and estimate the model for the period of Q1 2000 to Q2 2007 to eliminate the influences from the 1997/1998 Asian crisis and the 2008/2009 global crisis). A constant term and four lags are assumed. As the measure of output, real GDP is used. Since we are interested in business cycle phenomenon, we exclude the trend from data by applying an H-P filter for each sub-period.

B. Empirical Results

Figure 14 reports the impulse responses for the post-crisis period—in the case of the basic model ([log US, log E, log A, log A_i]). There are 16 graphs in this figure. Each graph shows the impulse response of each variable to shocks to each variable. The

responding variables are denoted at the far left of each row of graphs, while the names of shocks are denoted at the top of each column of graphs. For example, the graph in the fourth row and the second column shows the impulse responses of log E to shocks to log A_i. The solid line in each graph shows the point estimate while the dotted lines show 90% probability bands. The numbers show percentage changes.

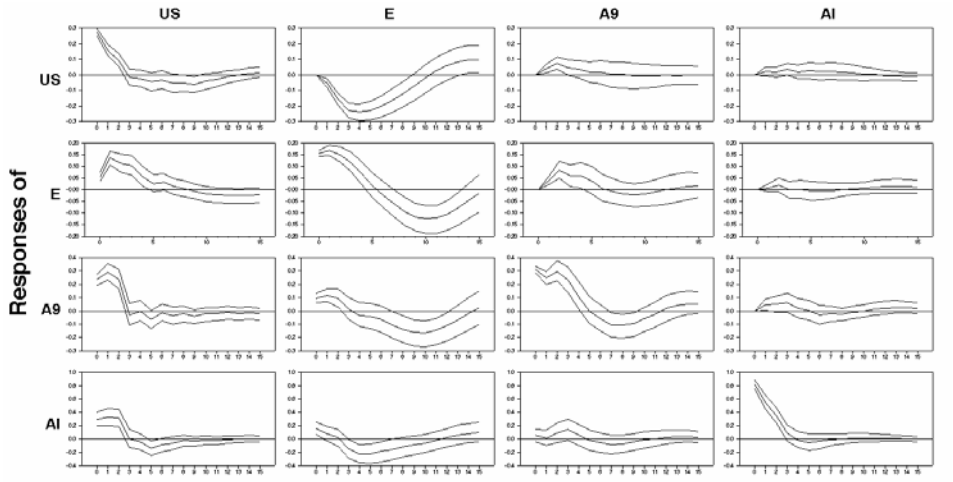
The results also show that the effects of US and European shocks on the East Asian aggregate and individual economies are quite substantial. In response to US shocks, US output increases about 0.25% on impact, decreases over time, and returns to the initial level in about one year. In response to US output shocks, the East Asian aggregate output and individual output increase 0.2%–0.3% on impact, decreases over time, and returns to the initial level in about one year. The impulse responses of European aggregate, and Asian aggregate and individual outputs to European output shocks are more complicated, but positive European output shocks have positive effect on Asian economies for a few quarters.

The positive effects of US and European shocks on East Asian economies are consistent with the trade pattern of East Asia. As illustrated in the previous sections, rapid growth in intra-Asian trade can be traced to the expansion of the region's production sharing network and thus remains structurally driven by global demand. This may explain significant and positive spillovers from the global output shocks onto the East Asian economies.

Interestingly, the reverse effect is also prominent. East Asia's aggregate shocks have positive effects on both the US economy and the European aggregate. In response to East Asian aggregate shocks, the peak responses of East Asian output, European output, and US output are about 0.3%, 0.1%, and 0.06%, respectively. The positive effects are estimated differently from zero with more than 95% probability. East Asia plays an increasingly important role as a supplier of intermediate goods for

the advanced economies, while importing more of final goods from these economies. Such an increasingly globalized production network between East Asia and advanced countries such as Europe and the US may have contributed to the positive influence of East Asian economies on Europe and the US.

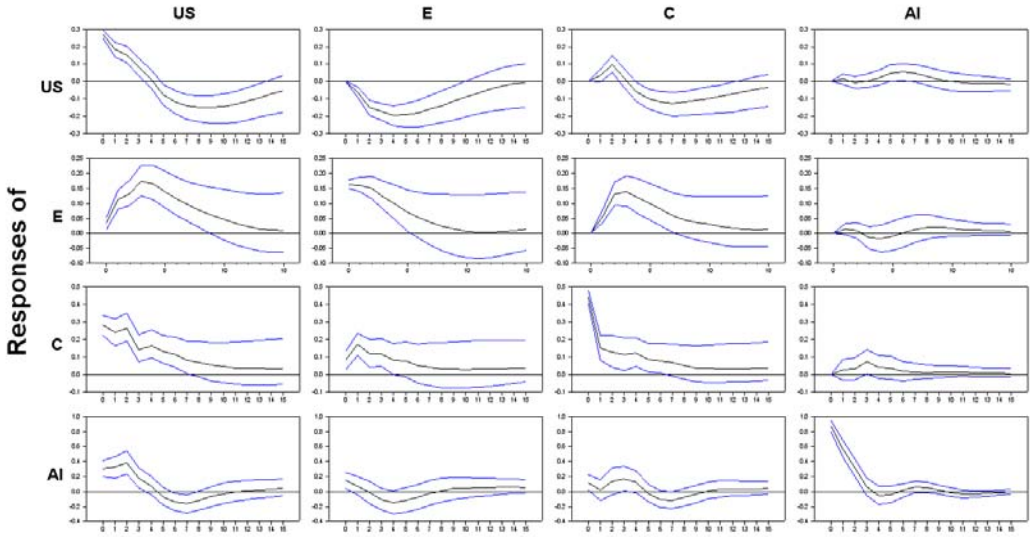
Figure 14. Impulse Responses (2000–2007:2)



On the other hand, it is interesting that the East Asian aggregate shocks have a larger (positive) effect on European output than the US output. It's also notable that a positive US output shock has a positive effect on European output, but a positive European output shock has a negative effect on US output.[10]

We also find that aggregate and individual Asian output mostly move in the same direction to each shock. These patterns of impulse responses are consistent with the idea that growing intra-Asian trade with production sharing network has contributed to increased output co-movements in East Asia.

Figure 15. Impulse Responses (2000–2007:2), Model with Chinese Output



Finally, Figure 15 reports the impulse responses for the model with Chinese output. "C" indicates Chinese output. The results are qualitatively similar to those of the basic model. Both U.S. and European output shocks have positive effects on Chinese output. Chinese output shocks have a strong and persistent positive effect on European output. Chinese output shocks also have a positive effect on the U.S. output and individual East Asian output in the short-run. These results suggest increasingly mutual macroeconomic interdependence among China, emerging East Asian countries, Europe, and U.S, to be consistent with the hypothesis that East Asian region's production chains are increasingly integrated into the global business network.

V. Concluding Remarks

This paper has explored the evolution of trade linkages and its influence on macroeconomic interdependence among East Asia, the US, and Europe. First, as suggested in previous literature, trade plays an important role in linking economies and transmitting shocks, positively influencing business cycle co-movements. Evidence points to increasing business cycle synchronization and regional integration in East

Asia as intra-Asian trade expands. The VAR results generally confirm this, as East Asia's aggregate and individual outputs move mostly in the same direction in response to foreign and East Asian aggregate shocks. Rapid growth in intra-Asian trade, particularly through production sharing arrangement across the region, appears to provide a strong impetus to regional integration.

Second, rapid growth in intra-Asian trade has been deeply rooted in the region's production sharing network and hence remains heavily influenced by global demand. Empirical findings show that both US and European shocks have exerted significant and positive effects on the East Asian aggregate and individual economies in the 2000s. Moreover, the East Asian aggregate output shock has positive and significant effects on the US and European economies as well. Also interestingly, the East Asian aggregate output shocks have a larger (positive) effect on European output than US output.

Third, changes in the trade structures among East Asia, Europe and the US point to the increasingly globalized production network. East Asia plays an increasingly important role as a supplier of intermediate goods for the advanced economies, while importing more of final goods from these economies. This change may explain why shocks from emerging Asian economies exert a significant and positive influence on global economies. As East Asia becomes more integrated into the global production network, output co-movements between East Asia and the US/European economies would likely increase. This is also consistent with our earlier findings of "recoupling" (see Kim, Lee, and Park, 2010).

One of the key factors driving these changes is the rise of China. It may be too early to predict how China's economic ascent will shape Asia's trade linkages and macroeconomic relationships both within and outside the region. However, recent evidence suggests the role of China—connecting East Asia's intraregional and

extraregional trade—is making fundamental changes in the nature of macroeconomic interdependence and growth spillovers among East Asia, Europe, and the US.

The changes in China's trade patterns offer interesting insights for the future. Firstly, on future directions of East Asia's relationship with the US and Europe, China's exports are gaining ground in the EU. The EU's share has grown from 13.3% to 20.6%, while that of the US remains stable, averaging at 20.2%. Greater trade linkages between Asia and Europe may help reduce excessive reliance of global trade on US consumers.

Secondly, the share of parts and components in China's trade has been declining, and the share of final goods trade rising, although China's trade in parts and components remains substantial, implying that it is flourishing alongside vigorously expanding trade in final goods. Especially, China's trade with East Asia increasingly centers on final goods and becomes less reliant on parts and components. China is progressively integrating with East Asia, becoming a source for and destination of final goods in the sub-regions.

Thirdly, China's trade with EU is dominated by final goods, but imports of parts and components are rising, indicating that the EU is progressively becoming a source of China's intermediate inputs. Meanwhile, China's trade with the US and Japan is dominated by final goods, but parts and components exports are rising. China is becoming an important supplier of US and Japanese parts and components. Time will tell if and how these changes in China's trade patterns will help rebalance global trade flows and contribute to an orderly resolution of global imbalances.

Some future studies are worthwhile. First, although this paper focuses on trade linkages only, future studies on financial linkages among these regions, including FDI linkages, are worth investigating. Second, exploring an explicit role of trade structure or trade variables in the international transmission of shocks is an important future

research agenda. Finally, asymmetry in international transmission of shocks, for example, the asymmetric role of exports and imports, is also an interesting issue to examine in a future research.

References

Asian Development Bank, 2006, Uncoupling Asia: Myth and Reality, in *Asian Development Outlook 2006 Update*, Hong Kong, China: Oxford University Press for the Asian Development Bank.

_____, 2008, *Emerging Asian Regionalism: A Partnership for Shared Prosperity*, Manila: Asian Development Bank.

_____, 2009, *Asian Development Outlook 2009 Update*, Manila: Asian Development Bank.

_____, 2008, *Recent Trends in Asian Trade and Implications for Infrastructure Development*, Background paper prepared for the ADB/ADBI Flagship Study, Infrastructure and Regional Cooperation, Asian Development Bank, Manila.

Athukorala, Prema-chandra, 2005, 'Product Fragmentation and Trade Patterns in East Asia,' Asian Economic Papers, Vol. 4, No. 3, pp. 1-27.

Baxter, Marianne and Michael A. Kouparitsas, 2005, 'Determinants of Business Cycle Comovement: A Robust Analysis,' Journal of Monetary Economics, Vol. 52, No. 1, pp. 113-157.

Brooks, Douglas and Changchun Hua, 2009, 'Asian Trade and Global Linkages,' Asian Development Review, Vol. 26, No. 1, pp. 103-128.

Canova, Fabio and Harris Dellas, 1993, 'Trade Interdependence and the International Business Cycle,' Journal of International Economics, Vol. 34, No. 1-2, pp. 23-47.

CEIC Data Company Ltd, *CEIC Database,* Available at http://www.ceicdata.com.

Clark, Todd E. and Eric van Wincoop, 2001, 'Borders and Business Cycles,' Journal of International Economics, Vol. 55, No. 1, pp. 59-85.

Citigroup, 2006, *Asia Macro Views*, 4 September, Available at: yamp.reqa.com/edisi/data/AMV_

Spore_Economy_The_New_The_Dual_060104.pdf.

Frankel, Jeffrey and Andrew Rose, 1998, “The Endogeneity of the Optimum Currency Area Criteria,’ Economic Journal, Vol. 108, No. 449, pp. 1009-1025.

Global Trade Analysis Project Version 7. Available at: http://www.gtap.agecon.purdue.edu/

Herkel, Thomas, 1998, Introduction to the GTAP Data Base, in *Global Trade Assistance and Protection: The GTAP 4 Data Base* , eds., Robert A. McDougall, Aziz Elbehri, and Truong P. Truong, Indiana: Purdue University.

Imbs, Jean, 2004, ‘Trade, Finance, Specialization, and Synchronization,’ The Review of Economics and Statistics, Vol. 86, No. 3, pp. 723-734.

International Monetary Fund. *Direction of Trade Statistics*. Available at: http://www2.imfstatistics.org/DOT/.

Kim, Soyoung, Jong-Wha Lee, and Cyn-Young Park, 2010, Emerging Asia: Decoupling or Recoupling, The World Economy. Forthcoming.

Kose, M. Ayhan and Kei-Mu Yi, 2002, The Trade Comovement Problem in International Macroeconomics, *Federal Reserve Bank of New York Staff Reports* No. 155, Federal Reserve Bank of New York, NY.

Krugman, Paul, 1993, Lessons of Massachusetts for EMU, in *Adjustment and Growth in the European Monetary Union*, eds., Francesco Giavazzi and Francisco Torres, New York: Cambridge University Press, pp. 241-261.

Meng, Bo, Hajime Sato, Jun Nakamura, Nobuhiro Okamoto, Hiroshi Kuwamori, and Satashi Inomata, 2006, Inter-industrial Structure in the Asia-Pacific Region: Growth and Integration, by Using 2000 AIO Table, *IDE Discussion Paper* No. 50, Institute of Developing Economies-Japan External Trade Organization, Tokyo, Available at: http://www.ide.go.jp/English/Publish/Download/Dp/050.html.

Moneta, Fabio and Rasmus Ruffer, 2006, Business Cycle Synchronisation in East Asia, *European Central Bank Working Paper* No. 671, European Central Bank, Frankfurt.

Pula, Gabor and Tuomas Peltonen, 2009, Has Emerging Asia Decoupled? An Analysis of Production and Trade Linkages Using the Asian International Input-Output Table, *European Central Bank Working Paper* No. 993, European Central Bank, Frankfurt.

Ramanarayanan, Ananth, 2009, Ties that Bind: Bilateral Trade's Role in Synchronizing Business Cycles, Economic Letter—Insights from the Federal Reserve Bank of Dallas, Vol. 4, No. 1, pp. 1-8. Available at: www.dallasfed.org/research/eclett/2009/el0901.html.

Rose, Andrew, 2009, Understanding Business Cycle Synchronization: Is Inflation Targeting Paving the Way to Asian Monetary Union?, Paper presented at the ADB/HKIMR and subsequently a seminar at the ADB, Asian Development Bank, Manila.

Shin, Kwanho and Yunjong Wang, 2004, Trade Integration and Business Cycle Synchronization in East Asia, Asian Economic Papers, Vol. 2, No. 3, pp. 1-20.

Takagi, Shinji and Issei Kozuru. 2008. "Output and Price Linkages in Asia's Post-Crisis Macroeconomic Interdependence." Paper presented at the High-Level Symposium on Asian Economic Integration, 4-5 September, Nanyang Technological University, Singapore.

Thomson Reuters. *Datastream*. Available at: http://thomsonreuters.com/products_services/financial/financial_products/investment_management_research/portfolio_management/datastream

TradeData International Pty. Ltd. Available at: http://www.tradedata.net/

United Nations. *UN Comtrade Database*. Available at:

http://comtrade.un.org/db/default.aspx.

Notes

[1] Throughout this paper, East Asia refers to nine emerging economies in East and South East Asia. They include China; Hong Kong SAR; Indonesia; South Korea; Malaysia; the Philippines; Singapore; Taipei,China; and Thailand.

[2] The US non-oil imports account for nearly 50% of total G3 non-oil imports, while highly synchronized with movements of G3 non-oil imports.

[3] The GTAP database (version 7) corresponds to the world economy in 2004. The database provides "detailed bilateral trade characterizing economic linkages among regions, together with individual country input–output databases, which account for inter-sectoral linkages within regions" (Hertel, 1998: 2). This version disaggregates the world economy into 113 countries and regions (including all nine economies in East and Southeast Asia under this study) and 57 sectors.

[4] Other sources also confirm the similar results. Citibank (2006) claimed that based on the 2000 Asian Input-Output table (AIO table) only 11% of Asian exports are destined for the regional demand. Meng et. al. (2006) showed that the dependence of Asian production on overseas markets has strengthened rather than weakened between 1995 and 2000 based on the comparison of the 2000 AIO table with the 1995 AIO table. Pula and Peltonen (2008) also concluded that intraregional trade (including China markets) is responsible for only 7% of the region's overall GDP, using the country-level update of the AIO table for 2006, while G3 countries account for 16%.

[5] ADB (2009) also addresses the issues related to the structure of China's trade with developing Asia using the same disaggregate trade data set. We use different regional as well as product classifications to focus on China's trade with East Asia, Japan, Europe and the US.

[6] Import patterns are not reported due to the space constraint, but available upon request.

[7] Several studies emphasize the similarity in production structure as an important determinant of co-movements of output. Industry-specific shocks can cause more business cycle synchronization among countries with similar production structures. Clark and van Wincoop (1999) and Imbs (2004) provide evidence that more similarity in industry structure is associated

with higher co-movement of output and employment. Imbs emphasizes that the effect of trade on business cycle synchronization is largely driven by intra-industry trade reflecting similar production structure.

[8] The ordering between US and European output is unclear, so we also construct the model that changes the ordering between US and European output as follows: [log E, log US, log A, log Ai]. We do not report the empirical results of this alternative ordering due to the space constraint, but they are broadly similar to those from the basic structure.

[9] To check whether the results are similar, we also experiment with the following two models. First, we use China's output instead of East Asian aggregate, and consider only eight individual countries, excluding China. Second, we add Japan as an East Asian country; we include Japan in East Asian aggregate, and consider 10 individual countries, including Japan. Again, the space constraint doesn't permit us to report the results, but the findings are broadly similar.

[10] There are various possible explanations such as asymmetric trade structure, asymmetric policy response, different nature of output shocks, and so on.