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Keywords: Asian international input-output table, triangular trade, production network

JEL classification: C67, D57, F14, F15

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Shock Transmission Mechanism of the Economic Crisis in East Asia: An Application of International Input-Output Analysis[§]

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Abstract

This paper investigates the impacts of the 2008 economic crisis on industries in East Asia. By using the updated Asian international input-output table for 2008, the paper attempts to identify the transmission mechanism and the magnitude of impact of the crisis on industries in East Asia. The analyses reveal that the crisis significantly affected industrial output of the nine East Asian countries. In particular, the countries which are deeply involved in production networks were affected most seriously. Moreover, the analyses show that the impact was transmitted to East Asian industries considerably through the “triangular trade”, in which China imports parts and components from neighboring East Asian countries and then exports final products to the U.S. and EU markets.

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1. Introduction

East Asian economies were hit hard by the financial crisis which originated in the U.S. in September 2008 (the “Lehman Shock”) and have experienced severe recessions. Although financial institutions in East Asia are in healthier condition than those in the U.S. and Europe which are weighted down by bad loans such as subprime mortgages (ADB 2009a), the real GDP growth rates of many East Asian economies are expected to become negative and even lower than that of the U.S., the seismic center of the crisis (IMF 2009).¹

This paper aims to identify the mechanism by which the crisis was transmitted to and amplified in East Asia. Specifically, we will address the following questions. First, how large is the impact of the collapse of the U.S. economy on East Asian industries? Second, what mechanism or structure amplified the impact in East Asia? To explore these questions, empirical analyses are conducted using the Asian international input-output tables (hereafter “Asian tables”) compiled by the Institute of Developing Economies (IDE-JETRO).² Since the most recent version of the table is for the year 2000 and not suitable for analyzing the current crisis, the updated 2008 table was constructed by IDE-JETRO.³

The analyses identify the magnitude of the impact of the sharp decline in U.S. imports on East Asian industries. The analyses also reveal numerically that the major transmission mechanism of the crisis is the regional production networks that have formed in East Asia since the late 1990s, i.e. the “triangular trade” through China.

The structure of this paper is as follows. Section 2 discusses the structures that amplified the shock transmission of the crisis. In section 3, the analytical methodology is presented, followed by the results of the empirical analysis. The paper discusses how the production networks in East Asia, which have become widespread in recent years, are related to the shock transmission of the economic crisis. Section 4 provides a summary and conclusions.

¹ According to IMF forecast (as of October 2009), the real GDP growth rates in 2009 are projected to be lower than that of the U.S. (–2.7%) in many Asian economies (–5.4% in Japan, –2.0% in Korea, –4.9% in Taiwan, –4.5% in Hong Kong, –3.1% in Malaysia, –5.0% in Singapore, –3.2% in Thailand).

² For details of the Asian tables, refer to IDE (2006), *Asian International Input-Output Table 2000*, Statistical Data Series, No. 89 & 90, Chiba, Japan.

³ See Inomata and Uchida (eds.) (2009) for details of the updating methodology of the table.

2. The structure of Asian trade: The triangular trade

2.1 Economic growth in East Asia

After the recession in the late 1990s caused by the Asian financial crisis, East Asian countries returned to sound economic growth (Table 1). From 2000 to 2007, Northeast Asian countries (China, Japan, Korea, and Taiwan) posted an annual real GDP growth of 4.4%, but excluding Japan the growth rate of the other three countries was as high as 8.3%. Especially, China enjoyed annual growth of over 10% and its economy, in real GDP terms, more than doubled during the observed period. Although not as dramatic as China, Korea and Taiwan also recorded steady growth of 5.1% and 4.0%, respectively. Southeast Asian economies (Indonesia, Malaysia, the Philippines, Singapore and Thailand) also achieved annual growth rates in excess of 5%.

However, since the financial crisis struck in the U.S. in the fall of 2008, the growth of East Asian economies has decelerated dramatically: although both Northeast Asia and Southeast Asia maintained positive growth in 2008 as a whole (2.9% and 4.1%, respectively), the growth rates turned negative in many countries after the crisis (see Table 1). Especially, Korea and Taiwan recorded growth rates of -18.8% and -13.7% respectively in the fourth quarter of 2008. China maintained a high growth rate of 9.0% in 2008, but the rate slowed to around 6-7% in early 2009. The Japanese economy was already sluggish even before the crisis, and thus it became the only country to record negative growth in 2008. In Southeast Asia, Singapore was affected most strongly by the crisis, followed by Malaysia and Thailand. On the other hand, the Philippines and Indonesia, which are less dependent on exports than other Southeast Asian countries, recorded relatively small declines in growth rate. Another important feature is that although the growth rate of the United States fell sharply, it was less severe than in the hardest hit East Asian economies: for example, the U.S. economy contracted by 1.9% in the fourth quarter of 2008, a much smaller figure than in East Asian countries which recorded negative growth rates.

(Table 1)

Weak domestic demand and high dependency on exports were major sources of the steady

growth before the crisis but then became a major cause of the severe contraction after the crisis in East Asia (ADB 2009b). Table 2 indicates that the export-GDP ratios of East Asian countries are much higher than those of the U.S., and they continued to increase until recently. Note that even in Japan where the export dependence used to be as low as in the U.S., the ratio has increased very sharply, doubling during the observed period.⁴ This implies that East Asian economies are increasingly vulnerable to external shocks, and indeed, the countries with high export-GDP ratios in Southeast Asia, such as Singapore, Malaysia, and Thailand, have been hit hardest by the crisis, whereas Korea, Taiwan, and Japan have been affected strongly via the triangular trade through China, as shown below.

(Table 2)

2.2 Mechanics of the triangular trade

Since the 1990s, the intra-East Asian trade of parts and components has grown greatly. The share of parts and components in East Asian exports and imports respectively increased from 18% and 16% in 1993 to 24% and 25% in 2003, with China accounting for a significant part of the increase (Gaulier et al. 2007). According to Gaulier et al. (2007), China became a new location for firms in advanced East Asian economies (Japan, Korea, Taiwan, Singapore and Hong Kong) seeking to relocate labor-intensive stages of production. On the other hand, East Asia became more dependent on the rest of the world, especially the U.S. and the EU, for its exports of final goods (Gaulier et al. 2007). Haddard (2007) called such a trade structure in which a country/region imports parts and components, assembles them, then exports the final products to other regions the “triangular trade” and found that it is especially prevalent in electrical appliances. China has played a central role in the formation of a triangular trade structure as an assembly base (Lemoine et al. 2004, Haddard 2007).

This triangular trade structure is a form of international fragmentation of production. The fragmentation is “the splitting of a production process into two or more steps that can be undertaken in different locations but that leads to the same final product” (Deardorff 1998). The

⁴ In this period, Japan’s dependence on exports increased due to weak domestic demand and the weak yen against the US dollar, which was often supported by the low interest rate policy of the Bank of Japan.

international fragmentation of production is being driven by several forces, including the differences in wages and skills across countries and the reduction of trade costs (e.g. tariffs, transport costs, information) (Haddard 2007). The triangular trade in East Asia is a fragmentation process organized by multinational firms especially in Northeast Asia. Multinational firms in Northeast Asia—as well as in the U.S. and the EU—have segmented the process of producing a product into several stages, which are then allocated to each production site depending on factor intensities and technological levels. In particular, labor-intensive stages of production, such as final products assembling, are relocated to labor-abundant countries (Gaulier et al. 2007), and China has played a central role in this trend. Since the 1990s, foreign firms have increased their presence in China’s trade and by 2007 accounted for about 60% of China’s trade (Table 3). Together with the high shares of the processing trade in China’s total trade, these indicate that foreign firms have established assembly bases in China. China’s policies favoring foreign firms (e.g. tax breaks for processing trade, membership of the WTO and FTAs), as well as rapid infrastructure development in coastal areas, have contributed to the significant increase in the processing trade.

2.2 Deepening of triangular trade in East Asia

The triangular trade structure in East Asia has accelerated since China joined the WTO in 2001. Figures 1(a) through 2(b) indicate the trade flows of major commodities between the three regions, East Asia, the U.S., and the EU.

(Figure 1(a))

(Figure 1(b))

The total trade flow of parts and accessories expanded about 1.8 times, from US\$ 832 billion in 2000 to US\$ 1,515 billion in 2007 (Figures 1(a) and 1(b)). The transactions within East Asia increased most rapidly from US\$ 186 billion to US\$ 423 billion (2.26 times) compared with other transactions between/within the three regions. In particular, transactions between China and the other two regions in East Asia increased quite rapidly. In 2000, although China was already a net importer of intermediate inputs from the other two regions, the major

trade link was between Northeast Asia and Southeast Asia. This occurred because Southeast Asia at that time was still serving as an assembly base, using intermediate inputs provided by Northeast Asian countries, especially Japan.⁵ In 2007, the picture changed dramatically. China became by far the largest net importer of intermediate inputs, US\$ 66 billion from Northeast Asia and US\$ 22 billion from Southeast Asia. These reflect the increasing role of China as an assembly base in East Asia.

(Figure 2(a))

(Figure 2(b))

The trade in consumer goods is in sharp contrast to that of parts and accessories. The most remarkable feature in the trade of consumer goods is exports from East Asia to the U.S. and the EU, and they respectively increased by factors of 1.9 and 2.7 (Figures 2(a) and 2(b)). The figures in parentheses are the trade values of China with the U.S. and the EU. China's exports increased at a much faster pace than East Asia's total exports. In 2007, exports from China accounted for about 74% of exports from East Asia to the U.S. and the EU. On the other hand, the only remarkable trade of consumer goods in East Asia is the flow from China to Northeast Asia, especially to Japan.⁶ The other trade flows are very small compared with the trade of intermediate goods within the same region or export of consumption goods to the outer regions.

The changes in trade flows described above reflect the deepening of the triangular trade structure, in which China imports intermediate inputs from neighboring East Asian countries, assembles them, then exports final consumer products to the U.S. and the EU.⁷ Such a trade structure is likely to have increased the vulnerability of East Asian economies to external shock, and the triangular trade became a major mechanism for transmission of the economic crisis in East Asia.

⁵ Since the mid-1980s, a large number of firms in Japan, Korea, and Taiwan have invested in Southeast Asia, which had become an assembly base in East Asia until being taken over by China.

⁶ Japan's imports of consumer goods from China in 2007 stood at US\$ 43,770 million, accounting for 81% of Northeast Asia's total imports from China. Like other East Asian countries, Japan used to have a very low share of consumer goods in total imports. However, in just a decade from the mid-1980s, the share increased from less than 10% to around 30%.

⁷ In 2007, the processing trade accounted for 45% of China's total trade (National Bureau of Statistics 2008).

Section 3 measures the impact of the economic crisis on East Asian industries by using the Asian international input-output tables, and identifies how the impact of the crisis was transmitted in East Asia.

3. Impact of the crisis on East Asian industries

3.1 The model: Multiplier decomposition method

East Asian industries were significantly affected by the economic crisis, with gross output falling sharply due to the slump in U.S. import demand. In this paper, using a simple input-output technique⁸, the impact of the financial crisis on East Asian industries is decomposed into four elements, namely, the decrease in gross output caused by: (1) intra-country multiplier effects; (2) feedback effects; (3) trilateral spillover effects; and (4) multilateral spillover effects. The method for calculating these effects is presented below.

For a nine-country model, which excludes the U.S. from the original endogenous countries of the Asian tables, the equilibrium established in the system is expressed as

$$\begin{bmatrix} X^C \\ \vdots \\ X^T \end{bmatrix} = \begin{bmatrix} A^{CC} & \dots & A^{CT} \\ \vdots & \ddots & \vdots \\ A^{TC} & \dots & A^{TT} \end{bmatrix} \begin{bmatrix} X^C \\ \vdots \\ X^T \end{bmatrix} + \begin{bmatrix} F^C \\ \vdots \\ F^T \end{bmatrix} \quad (1)$$

where,

X^r : an output vector for Country r

A^{rs} : an input coefficient matrix of Country s from Country r

F^s : a final demand vector for Country s ($r, s = C, I, J, K, M, N, P, S, T$)⁹

Solving for X , we obtain

⁸ For the relevant input-output techniques, especially the analysis of the feedback effects, see Miller and Blair (2009).

⁹ C, J, K, M, N, P, S, T respectively stand for China, Indonesia, Japan, Korea, Malaysia, Taiwan, the Philippines, Singapore, and Thailand. These countries are endogenous countries of the Asian tables, excluding the U.S. In matrices (and vectors) appearing in equations, we assume that countries are arranged in the above (alphabetical) order.

$$\begin{aligned}
\begin{bmatrix} X^C \\ \vdots \\ X^T \end{bmatrix} &= \left\{ \begin{bmatrix} I & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & I \end{bmatrix} - \begin{bmatrix} A^{CC} & \cdots & A^{CT} \\ \vdots & \ddots & \vdots \\ A^{TC} & \cdots & A^{TT} \end{bmatrix} \right\}^{-1} \begin{bmatrix} F^C \\ \vdots \\ F^T \end{bmatrix} \\
&= \begin{bmatrix} \tilde{B}^{CC} & \cdots & \tilde{B}^{CT} \\ \vdots & \ddots & \vdots \\ \tilde{B}^{TC} & \cdots & \tilde{B}^{TT} \end{bmatrix} \begin{bmatrix} F^C \\ \vdots \\ F^T \end{bmatrix}
\end{aligned} \tag{2}$$

where,

I : an identity matrix ($n \times n$: n is the number of industrial sectors)

\tilde{B}^{rs} : Leontief inverse matrix (partitioned)

Replacing the final demand vector ($F^C \cdots F^T$) with the U.S. import vector for respective East Asian countries ($U^C \cdots U^T$), the gross output induced by the U.S. import demand is given by

$$\begin{bmatrix} X_U^C \\ \vdots \\ X_U^T \end{bmatrix} = \begin{bmatrix} \tilde{B}^{CC} & \cdots & \tilde{B}^{CT} \\ \vdots & \ddots & \vdots \\ \tilde{B}^{TC} & \cdots & \tilde{B}^{TT} \end{bmatrix} \begin{bmatrix} U^C \\ \vdots \\ U^T \end{bmatrix} \tag{3}$$

The Leontief inverse matrix in Equation (3) can be decomposed as

$$\begin{bmatrix} X_U^C \\ \vdots \\ X_U^T \end{bmatrix} = \left\{ \begin{bmatrix} B^{CC} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & B^{TT} \end{bmatrix} + \begin{bmatrix} \tilde{B}^{CC} - B^{CC} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \tilde{B}^{TT} - B^{TT} \end{bmatrix} + \begin{bmatrix} 0 & \cdots & \tilde{B}^{CT} \\ \vdots & \ddots & \vdots \\ \tilde{B}^{TC} & \cdots & 0 \end{bmatrix} \right\} \begin{bmatrix} U^C \\ \vdots \\ U^T \end{bmatrix} \tag{4}$$

where,

$$B^{rr} = (I - A^{rr})^{-1}$$

In Equation (4), since B^{rr} is an intra-country multiplier matrix of Country r , the first term post-multiplied by the U.S. import vector, $B^{rr} U^r$, represents the intra-country multiplier effects caused by the U.S. import demand (Effect (1) in Figure 3 (a)). Other terms are relevant to the industrial linkages across borders or spatial linkages. The second term, the diagonal matrix post-multiplied by the corresponding import vector, $(\tilde{B}^{rr} - B^{rr}) U^r$, indicates the magnitude of

the feedback effects in Country r (Effect (2) in Figure 3(a)). Note that the feedback effects are caused by its own final demand, but its gross output is induced through the spatial linkages: for example, when the production of the Korean electronics industry is stimulated by the U.S. import demand, it will induce intermediate imports from neighboring East Asian countries such as Japan and China (reflecting their close production network), which then will generate intermediate demand for Korea, thus stimulating Korea's production again. On the other hand, the third term, $\sum_{s \neq r} \tilde{B}^{rs} U^s$, indicates the magnitude of the inter-country spillover effects of East Asian countries on Country r . $\tilde{B}^{rs} U^s$, for example, indicates the gross output which is induced by the U.S. import demand for Country s but accrues to industrial output in Country r . Note that such linkage effects are transmitted via very complex channels. For example, when the production of the Chinese electronics industry is stimulated by the U.S. import demand, it will induce intermediate demand for Korea, thus boosting the production of Korean industries (here, the transmission channel of repercussion effects is straightforwardly expressed as the U.S. \rightarrow China \rightarrow Korea). It should be noted that such a one-way trilateral channel is the primary transmission mechanism of repercussion effects in the triangular trade where r and s represent Korea and China, respectively. The magnitude of the spillover effects can be calculated as¹⁰

$$T^{rs} = B^{rr} A^{rs} B^{ss} U^s = L^{rs} U^s \quad (5)$$

where T^{rs} indicates the magnitude of the trilateral spillover effects on Country r through Country s (Effect (3) in Figure 3(b)): L^{rs} represents the multipliers of the trilateral spillover effects. Although the above transmission mechanism is overwhelmingly important, it is not the whole story. In addition to the more visible trilateral channel, the repercussion effects are transmitted from Country s to Country r through various channels which may involve more than three countries. For example, when the production of the Chinese electronics industry is

¹⁰ In the input-output equation, the direction of transmission of repercussion effects should be read from the right to left terms. In Equation (4), for example, $B^{ss} U^s$ represents the gross output in Country s induced by the U.S. import demand through the intra-country multiplier effects. $A^{rs} B^{ss} U^s$ indicates the intermediate import demand for Country r induced by $B^{ss} U^s$. Finally, $B^{rr} A^{rs} B^{ss} U^s$ represents the gross output in Country r induced by $A^{rs} B^{ss} U^s$.

stimulated by the U.S. import demand, it will cause China to import intermediates not only from Korea but also from other neighboring countries, such as Japan and Taiwan. Then, through its extensive networks, it will further boost industrial output of other East Asian countries as well. Finally, if the final country uses inputs from Korea, it will stimulate Korea's industrial production (thus the transmission channel will be the U.S.→China→East Asian country 1→East Asian country 2→East Asian Country 3 ... →Korea). Note that, as shown in Figure 3(b), such multilateral spillover effects include the feedback effects between Korea and China as well as between Korea and other East Asian countries. Since $\tilde{B}^{rs}U^s$ captures all the repercussion effects generated through both the trilateral and multilateral channels and T^{rs} is only relevant to the trilateral channel, then $\tilde{B}^{rs}U^s - T^{rs} (= (\tilde{B}^{rs} - L^{rs})U^s)$ represents the whole repercussion effects generated through the multilateral channels (Effect (4) in Figure 3(b)).

Finally, from Equations (4) and (5), the impact of the economic crisis is calculated as

$$\begin{aligned} \begin{bmatrix} \Delta X_U^C \\ \vdots \\ \Delta X_U^T \end{bmatrix} &= \left\{ \begin{bmatrix} B^{CC} & \dots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \dots & B^{TT} \end{bmatrix} + \begin{bmatrix} \tilde{B}^{CC} - B^{CC} & \dots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \dots & \tilde{B}^{TT} - B^{TT} \end{bmatrix} \right. \\ &\quad \left. + \begin{bmatrix} 0 & \dots & L^{CT} \\ \vdots & \ddots & \vdots \\ L^{TC} & \dots & 0 \end{bmatrix} + \begin{bmatrix} 0 & \dots & \tilde{B}^{CT} - L^{CT} \\ \vdots & \ddots & \vdots \\ \tilde{B}^{CT} - L^{TC} & \dots & 0 \end{bmatrix} \right\} \begin{bmatrix} \Delta U^C \\ \vdots \\ \Delta U^T \end{bmatrix} \end{aligned} \quad (6)$$

where,

- ΔX_U^r : The impact of the Lehman Shock on industrial output in Country r
- ΔU^r : Changes in the U.S. import demand for Country r caused by the Lehman Shock (i.e. in the period of the third quarter of 2008 to the first quarter of 2009)

3.2 Impact of the Lehman Shock

(Table 4)

Table 4 shows the trend of U.S. imports since 2005. U.S. imports from the world continued to increase until the third quarter of 2008, with seasonal fluctuations, but then plunged after the Lehman Shock in September 2008, and the strong influence of the economic crisis can be

observed from the fourth quarter of 2008. The downward trend continued until the first quarter of 2009, but reversed in some countries in the second quarter of 2009.¹¹ Imports from China grew much faster than those from other countries, and accordingly the impact of the crisis was the greatest on China: imports from China dropped from US\$ 96,150 million in the third quarter of 2008 to US\$ 64,810 million in the first quarter of 2009. It should be noted that imports from Indonesia performed relatively well, while imports from other East Asian countries fell below the trend of U.S. total imports from the world. In particular, imports from Japan and Malaysia were stagnant and started to decline significantly earlier than the Lehman Shock.

(Table 5)

Next, Equation (3) is used to estimate the total gross output of East Asian industries induced by the U.S. import demand in each quarter.¹² Table 5 shows that in the third quarter of 2008, Chinese output reached its peak and was induced most strongly by the U.S. import demand (US\$ 211,893 million), followed by Japan (US\$ 79,979 million) and Korea (US\$ 29,512 million). Induced outputs closely reflect the magnitude of the U.S. import demand, and are approximately two to three times as large as the U.S. import demand for respective countries, except for the Philippines where the said multiplier is more than four. The Lehman Shock clearly had a great effect on induced output, especially in China. Similarly, as in the trend of the U.S. import demand, induced output declined most sharply in Japan and Malaysia.

¹¹ It is known that U.S. imports were tending to dip in the first quarter even before the crisis. However, it is obvious that the decline in the first quarter of 2009 was significantly larger than would be expected from seasonal fluctuations.

¹² The Asian table covers nine East Asian economies and the U.S. as its endogenous countries or regions. However, in this exercise, the U.S. was exogenized from the intermediate transactions, and the entire U.S. import demand (both intermediate and final demand) is treated as an exogenous variable. Then, to investigate the impact of the financial crisis, the U.S. import demand for the nine East Asian economies was given as an exogenous variable from the first quarter of 2008 to the second quarter of 2009. The number of industrial sectors in the Asian table is 25. For sector descriptions, see the Appendix.

3.3 Decomposition of the impact

(Table 6)

Table 6 shows the list of the top eight industries (out of 25 industries) in East Asia which were affected most strongly by the Lehman Shock. These industries suffered a serious decrease in gross output due to the collapse of the U.S. import demand, especially during the third quarter of 2008 and the first quarter of 2009: the industrial output in the nine East Asian countries declined by US\$ 128 billion in this period caused by the collapse of the U.S. import demand.¹³ Such decline in output is then decomposed into four elements by applying Equation (6). Furthermore, the elasticity of induced output, i.e. the percentage change in the induced output of each sector divided by the percentage change in the total induced output, is calculated to compare the relative magnitude of the impact of the crisis on respective sectors.

Table 6 indicates that China's gross output was affected most strongly by the crisis (US\$ 68,987 million), followed by Japan (US\$ 28,175 million) and Korea (US\$ 7,176 million). In particular, "Textile and leather" declined most sharply. However, it should be noted that "Computers and electronic equipment" and "Other electrical equipment" were also affected significantly.

The share of the spillover effects is relatively low in China: since China is a large net importer of parts and components from other East Asian countries (see Figure 1(a)), China affects them strongly through the triangular trade, but is not affected so much itself by the triangular trade. Moreover, the share of the feedback effects is even lower (less than 1 or 2 %), and the feedback effects are generally weak in all East Asian countries (less than 1%). Thus, a significant part of the impact of the crisis on China is transmitted through the intra-country multiplier effects.

In Japan, "Transport equipment" was affected most significantly, followed by "Services" and "Computers and electronic equipment". The rapid decline of "Transport equipment" reflects the trade structure of Japan which is heavily dependent on automobile exports to the U.S.

¹³ This is approximately three-fourths of the gross domestic product of the Philippines in 2008 (US\$ 167 billion, at current prices).

market. Moreover, since automobiles are a kind of luxury goods, their induced output was highly elastic (the elasticity is 1.3).¹⁴ Among the manufacturing industries, “Computers and electronic equipment” are affected strongly through spillover effects. Similarly, “Metal products” and “Chemical products” indicate high shares of spillover effects. In particular, the trilateral spillover effects through China are dominant. Note that these industries show a strong contrast with “Transport equipment” in which the share of the spillover effects is very low.

There is a close similarity between Korea and Taiwan. In both countries “Computers and electronic equipment” declined most sharply, followed by “Metal products”, “Services”, and “Other electrical equipment”. It is astonishing that the share of the spillover effects, especially the trilateral channel through China, is extremely high in “Computers and electronic equipment”, “Chemical products”, and “Trade and transport”. It is also notable that the share of the multilateral spillover effects is relatively high for “Computers and electronic equipment”. These results suggest that extensive production networks have been formed close to China, where Korea and Taiwan supply a large amount of electronic parts and components, as well as relevant industrial materials and services, to China and then final products are exported to the U.S. Thus, the impact of the economic crisis was magnified via the spillover effects, especially the trilateral channel through China. Conversely, the share of the spillover effects in Korea’s “Transport equipment” is very low, as in Japan.

Southeast Asian countries also indicate a similar tendency regarding the electronic and electrical industry. Except for Indonesia, “Computers and electronic equipment” presents the most significant decline in Southeast Asia; in Malaysia where the total decline in gross output was the largest in Southeast Asia (US\$ 6,130 million), this sector alone accounts for 54.1% of the total decline in gross output caused by the crisis. As in Northeast Asia, “Other electrical equipment” also indicates a large decline in Southeast Asia.

Looking at the shares of the inter-country spillover effects, it is remarkable that they are extremely high in Singapore. In particular, sectors such as “Trade and transport” (trilateral 60.5%, multilateral 11.7%) and “Metal products” (44.6%, 8.1%) are affected strongly by the spillover effects. In Malaysia, the said shares are high in “Services” and “Metal products”, while

¹⁴ Note that other industries in the table which were strongly affected by the crisis have relatively high elasticity.

in Thailand and the Philippines, they are high in “Computers and electronic equipment” and “Trade and transport”. However, it is notable that, compared with Korea and Taiwan, the spillover effects through China are relatively weak in these countries: only “Trade and transport” in Singapore and “Computers and electronic equipment” in Thailand exceed 20% in the trilateral channel. These results imply that although Southeast Asian countries are deeply involved in regional production networks, they are less strongly involved in the triangular trade through China, especially compared with Korea and Taiwan. This seems to be due to the difference in geographical distance from China: the closer to China, the more deeply involved in the triangular trade through China. In this context, it should be noted that the Philippines is strongly affected by the spillover effects through China (much more so than Singapore in terms of the relative share of “through China” in the spillover effects).

Indonesia shows quite a different picture from other Southeast Asian countries. In Indonesia, “Crude petroleum and natural gas” declined most sharply, followed by “Forestry” and “Trade and transport”, while “Computers and electronic equipment” does not appear in Table 6, and only “Other electrical equipment” is listed as the seventh most affected sector. These facts suggest that, unlike other East Asian countries, Indonesia is not strongly involved in regional production networks centered on electronic and electrical products. Rather, it is involved in the networks as an important supplier of mining products. For example, Indonesia’s share of spillover effects is very high in “Other mining” (63.6%, 15.4%). This sector also indicates a high share in spillover effects through China (26.1%, 8.7%).

As shown above, China has become an increasingly important player in production networks in East Asia. The analysis indicates that the following networks of intermediate goods and services have been formed in association with the triangular trade, and thus the impact of the economic crisis was transmitted via these channels:

- (1) Network of parts and components, particularly those for the computers and other electronics industry
- (2) Network of industrial materials, particularly chemical and metal products
- (3) Network of primary commodities, particularly mining commodities
- (4) Network of services, particularly trade and transport services

Among them, Korea and Taiwan—as well as Japan and Southeast Asian countries to a lesser extent—are deeply involved in the triangular trade through China via Networks (1) and (2). In addition, resource-rich Southeast Asian countries like Indonesia are involved in the triangular trade via Network (3). On the other hand, Network (4) accompanies all industrial transactions, thus its output is affected significantly via the triangular trade in all countries.

As described above, there are four layers of networks through which intermediate inputs are provided to the export platform in East Asia, notably China. Among them, as shown in Section 2, production networks in the manufacturing sector have attracted keen attention from many researchers, because they have strengthened the competitiveness of East Asian industries by efficiently using the location advantages of various countries or regions. In the following, we again examine the production networks in East Asia and discuss their relevance to the shock transmission of the economic crisis.

3.4 Production networks and shock transmission

The results obtained from the input-output analysis above can be interpreted in terms of the progress of international fragmentation as discussed in Section 2. According to Lall et al. (2004), the intensity of production fragmentation differs across industries, depending on four factors: (1) the technical ‘divisibility’ of production processes; (2) the factor intensity of the process (only labor-intensive processes can be efficiently relocated to lower-wage sites); (3) the technological complexity of each process (only simple and stable processes can be efficiently relocated); and (4) the value-to-weight ratio of the product (only lightweight and high value-added products can be shipped long distances to exploit cost differences).

Considering the above criteria, Lall (2003) concludes that in high-technology industries, fragmentation is strong in electronics; in medium-technology industries, fragmentation is strong in automobiles, but the weight of the product and its high basic capability requirements mean that it only extends to a few proximate, relatively industrialized locations; and in low-technology industries, fragmentation is strong in clothing, footwear, sports goods and toys. Below we focus on these sectors and examine how the characteristics of respective industries affect production fragmentation which then influences the shock transmission of the economic crisis.

It is understandable that the electronics industry is very active in production fragmentation, because its parts and components, especially high-tech products, are small and light but high value added. Moreover, since they are highly export-oriented, they receive preferential treatment, such as unlimited access to imported inputs and exemption from import duties, and thus there is little incentive to raise the share of local procurement. Such characteristics in the electronics industry have helped “Computers and electronic equipment” (and “Other electrical equipment” to a lesser extent) to expand their production networks, and thus they are affected strongly via the spillover effects especially through China (see Table 6). The other key reason for strong spillover effects on the electronics industry is that these products are one of the most important export items to the U.S. market for many East Asian countries, and so they are affected significantly through spillover effects by each other’s export performance.

On the other hand, the automobile sector has quite different characteristics. First, parts and components in the automobile industry are in general bulky and heavy. Therefore, automobile assemblers have strong incentives to save on transport costs by procuring parts and components locally. Moreover, geographical proximity would facilitate “just-in-time” delivery as in the case of Toyota. In other words, strong agglomeration economies in the automobile sector give the firms strong incentive to procure parts and components locally, a trend that is often accelerated by the industrial policy of the host country which encourages the localization of parts and components production: actually, it has been shown that the local content in the automobile sector continues to increase in many East Asian countries, while the opposite trend is observed in the electronics sector (Kuroiwa 2008, 2009). Therefore, although the automobile sector has strong potential for production fragmentation, the geographical spread of production networks is limited. Therefore, as in Japan and Korea, “Transport equipment” is only marginally affected by the spillover effects, and the impact of the economic crisis is transmitted mostly through the internal industrial linkages.¹⁵ It should also be noted that only Japan and Korea are major

¹⁵ Note that “Transport equipment” also includes other sub-sectors, such as motorcycles, aircraft, shipbuilding, and other transport equipment. The shares of automobiles, however, are overwhelmingly high in exports of “Transport equipment” to the U.S. market, standing at 92% and 96%, respectively in Korea and Japan in 2008. Therefore the characteristics of automotive are strongly reflected in those of the “Transport equipment” sector.

exporters of automobiles to the U.S. market, so that the transport sector in these countries are not significantly affected by other East Asian countries' export performance.

Clothing and other related industries also have strong potential for fragmentation. In the case of clothing, for example, the downstream production process (e.g. sewing and assembling) is significantly more labor-intensive than the upstream (e.g. spinning and weaving). It is shown, however, that the share of the spillover effects in "Textile and leather" is not very high in China, Taiwan, Malaysia, Thailand, and the Philippines. This is because the localization of production in the upstream sector has already proceeded to a considerable extent, so large amounts of intermediate inputs do not need to be imported from other East Asian countries.

4. Conclusion

The triangular trade, which involves China as an assembler, neighboring East Asian countries as suppliers of intermediate inputs, and the U.S. as a final market, has been formed in recent years. Analyses using the multiplier decomposition method revealed that a significant portion of the impact of the economic crisis was transmitted via the triangular trade, especially through China. Moreover, the analyses identified four layers of intermediate goods and services networks in association with the triangular trade: (1) network of parts and components, particularly those for the computers and other electronics industry; (2) network of industrial materials, particularly chemical and metal products; (3) network of primary commodities, particularly mining commodities; and (4) network of services, particularly trade and transport services. The magnitude of impact varies across countries depending on the mix as well as the strength of these networks.

It is also shown that China's neighboring countries, such as Korea and Taiwan—as well as Japan and Southeast Asian countries to a lesser extent—are deeply involved in the triangular trade through China and are affected by the crisis through the spillover effects. It should be noted that geographical distance is associated with the strength of trilateral and multilateral spillover effects.

Finally, production networks have been formed reflecting the characteristics of respective industries. Consequently, the electronics industry, notably “Computers and electronic equipment”, has formed extensive production networks throughout East Asia, and thus this industry is affected strongly by the spillover effects. On the other hand, parts and components production in “Transport equipment” and “Textile and leather” has been localized, so these are less significantly affected by the spillover effects.

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Table 1 Real GDP growth

(%)

	Yearly			Quarterly					
	1995-99	2000-07	2008	2008 Q1	2008 Q2	2008 Q3	2008 Q4	2009 Q1	2009 Q2
Northeast Asia	2.5	4.4	2.9						
(excluding Japan)	(6.9)	(8.3)	(6.8)						
China	8.7	10.1	9.0	10.6	10.4	9.9	9.0	6.1	7.1
Japan	0.5	1.7	-0.7	0.9	-0.7	-1.3	-3.4	-3.3	0.6
Korea	3.4	5.1	2.2	4.4	1.7	1.0	-18.8	0.5	11.0
Taiwan	5.8	4.0	0.1	5.1	-1.3	-13.7	-13.7	-11.3	18.8
Southeast Asia	1.3	5.3	4.1						
Indonesia	-0.3	5.1	6.1	2.4	2.8	3.7	-3.7	1.3	3.1
Malaysia	3.8	5.5	4.6	7.4	6.6	4.8	0.1	-6.2	-3.9
Philippines	3.4	5.1	4.7	4.4	4.4	5.0	4.5	4.4	4.4
Singapore	5.4	6.0	1.1	8.3	3.7	0.8	-3.7	-9.6	-3.2
Thailand	-0.6	5.1	2.6	0.5	-5.3	-0.1	0.8	-2.6	-3.0
U.S.A.	4.3	2.6	0.4	2.0	1.6	0.0	-1.9	-3.3	-3.8

Sources: Yearly data is calculated from the International Monetary Fund, World Economic Outlook Database, October 2009. Quarterly data is taken from the statistical bureau of each country. Some figures are preliminary.

Table 2 Export-GDP ratio (Exports/GDP)

(%)

	1995	2000	2005	2007
Northeast Asia				
China	20	21	34	36
Japan	8	10	13	16
Korea	23	32	34	35
Taiwan	41	47	56	61
Southeast Asia				
Indonesia	20	38	30	26
Malaysia	82	105	103	94
Philippines	23	50	42	35
Singapore	140	149	190	179
Thailand	34	56	62	62
U.S.A.	8	8	7	8

Sources: UN comtrade database. IMF, World Economic Outlook Database and International Financial Statistics. ADB, Key Indicators.

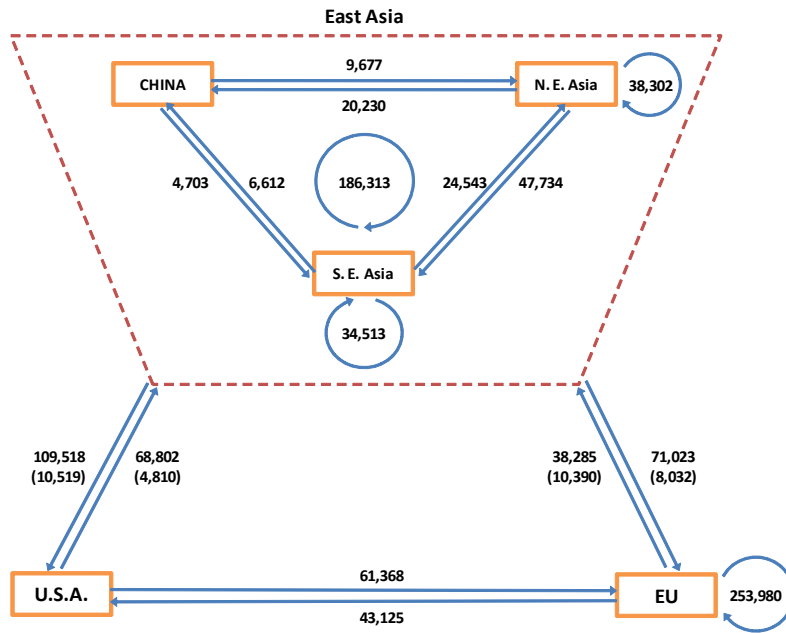
Table 3 Characteristics of China's trade

(%)

	1995	2000	2005	2007
Share of processing trade in total trade				
Exports	50	55	55	51
Imports	44	41	42	39
Total	47	49	49	45
Share of foreign-funded enterprises in total trade				
Exports	32	48	58	57
Imports	48	52	59	59
Total	39	50	58	58

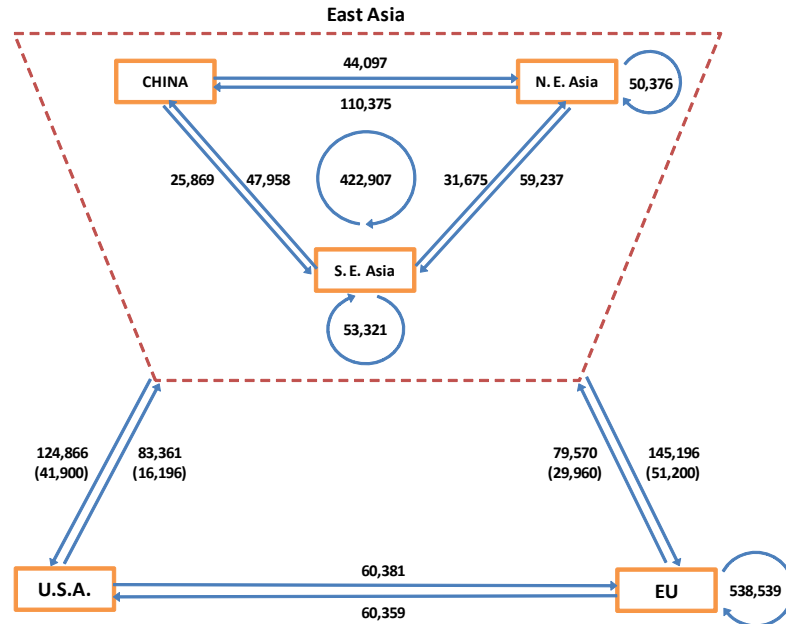
Source: National Bureau of Statistics, *China Statistical Yearbook*, various years.

Figure 1(a) Trade flows of parts and accessories (2000, Million US\$)



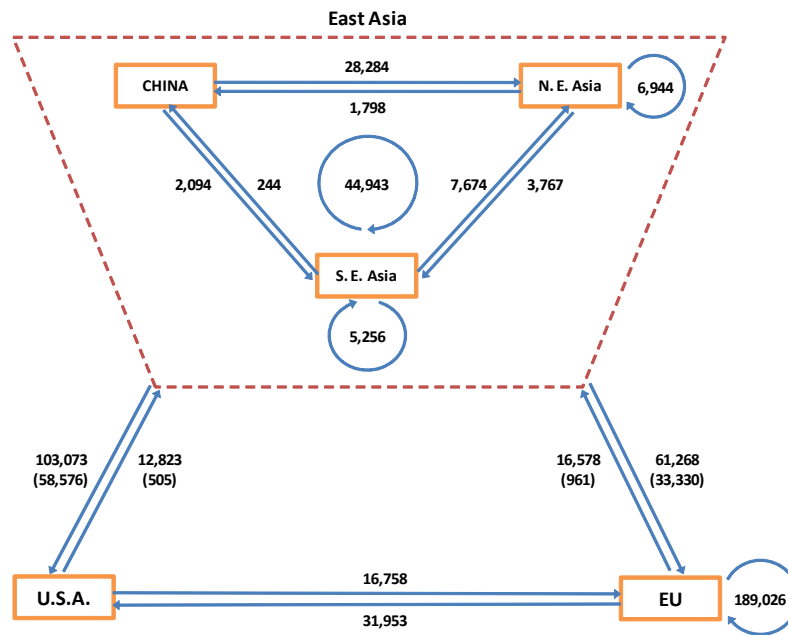
Sources: UN comtrade database. Taiwan Directorate General of Customs.
 Note: "S.E. Asia" and "EU" indicate ASEAN10 and EU27, respectively.

Figure 1(b) Trade flows of parts and accessories (2007, Million US\$)



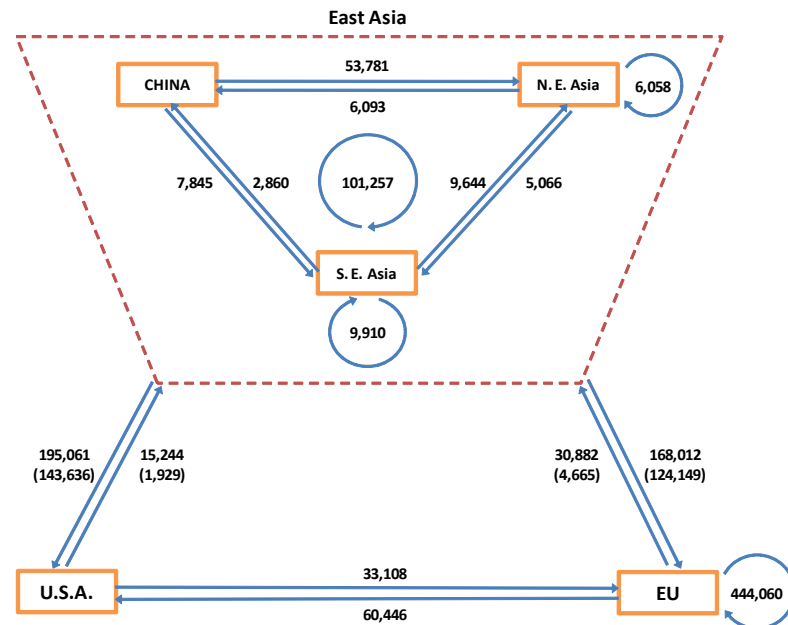
Sources: UN comtrade database. Taiwan Directorate General of Customs.
 Note: "S.E. Asia" and "EU" indicate ASEAN10 and EU27, respectively.

Figure 2(a) Trade flows of consumer goods (2000, Million US\$)



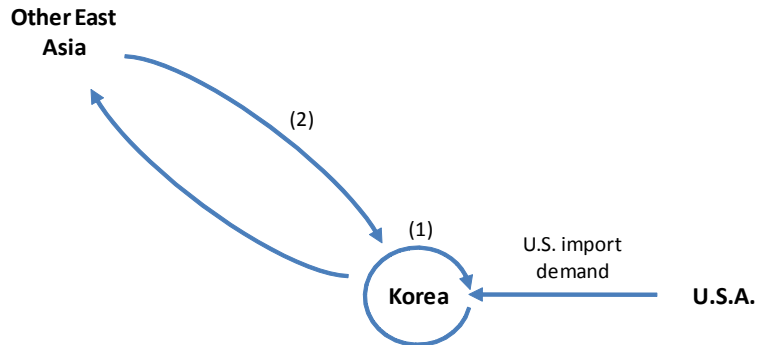
Sources: UN comtrade database. Taiwan Directorate General of Customs.
 Note: "S.E. Asia" and "EU" indicate ASEAN10 and EU27, respectively.

Figure 1(b) Trade flows of consumer goods (2007, Million US\$)



Sources: UN comtrade database. Taiwan Directorate General of Customs.
 Note: "S.E. Asia" and "EU" indicate ASEAN10 and EU27, respectively.

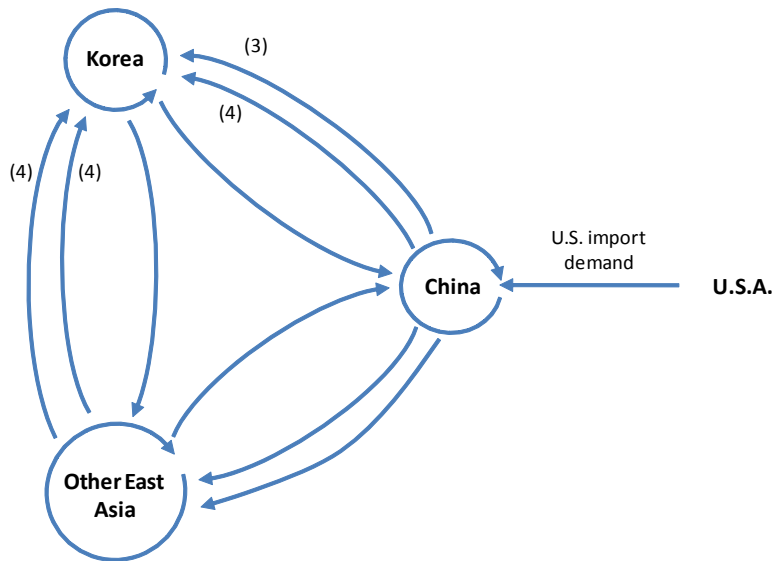
Figure 3(a) Transmission channels of the repercussion effects on Korea induced by the U.S. import demand ($r = \text{Korea}$)



- (1) Intra-country multiplier effects on Korea: $B^{KK} U^K$
- (2) Feedback effects on Korea: $(\hat{B}^{KK} - B^{KK}) U^K$

Source: Drawn by the authors.

Figure 3(b) Transmission channels of the Spillover effects through China on Korea induced by the U.S. import demand ($r = \text{Korea}$; $s = \text{China}$)



- (3) Trilateral spillover effects through China on Korea*: $L^{KC} U^C$
- (4) Multilateral spillover effects through China on Korea: $(\hat{B}^{KC} - L^{KC}) U^C$

Source: Drawn by the authors.

*Korean industries are also induced by the inter-country multiplier effects through other East Asian countries. Thus China shall be replaced by Japan, Taiwan and other East Asian countries accordingly.

Table 4 Trend of U.S. imports from East Asian countries

(Million US\$)

	2005	2006	2007	2008 Q1	2008 Q2	2008 Q3	2008 Q4	2009 Q1	2009 Q2
China	243,470	287,774	321,443	72,729	81,517	96,150	87,377	64,810	68,629
Japan	138,004	148,181	145,463	37,267	36,434	34,174	31,388	21,768	20,943
Korea	43,781	45,804	47,562	11,725	12,626	12,490	11,228	9,665	9,554
Taiwan	34,826	38,212	38,278	9,002	9,065	9,676	8,583	6,669	6,646
Singapore	15,110	17,768	18,394	4,493	3,963	3,915	3,514	3,356	3,675
Malaysia	33,685	36,533	32,629	7,966	8,247	7,978	6,545	5,016	5,229
Thailand	19,890	22,466	22,755	5,722	5,881	6,281	5,655	4,358	4,140
Philippines	9,250	9,694	9,408	2,208	2,153	2,294	2,058	1,630	1,486
Indonesia	12,014	13,425	14,301	3,662	3,826	4,402	3,909	3,253	3,059
East Asia	550,031	619,857	650,232	154,774	163,712	177,359	160,257	120,526	123,361
World	1,673,455	1,853,938	1,956,962	504,614	555,188	572,678	471,160	352,435	362,796

Sources: UN comtrade database. Taiwan Directorate General of Customs.

Table 5 Quarterly gross output induced by the U.S. import demand

(Million US\$)

	2008 Q1	2008 Q2	2008 Q3	2008 Q4	2009 Q1	2009 Q2
China	162,293	180,696	211,893	192,304	142,906	151,173
Japan	84,406	83,312	79,979	73,197	51,804	51,033
Korea	27,068	29,153	29,512	26,623	22,335	22,615
Taiwan	19,615	20,176	21,599	19,276	14,861	15,169
Singapore	11,873	10,912	10,992	9,819	8,985	9,791
Malaysia	16,709	17,368	17,026	14,175	10,897	11,478
Thailand	11,231	11,673	12,347	11,165	8,700	8,404
Philippines	9,603	9,614	10,086	9,063	7,106	6,829
Indonesia	9,128	9,458	10,568	9,414	7,966	7,524
East Asia	351,927	372,361	404,002	365,035	275,561	284,017

Source: Authors' calculation from the Asian international input-output table.

**Table 6 Decrease in gross output caused by the slump in the U.S. import demand
(2008Q3 – 2009Q1)**

	Total impact (Decline in total output) (Million US\$)	Impact of own country's export*		Trilateral spillover effects		Multilateral spillover effects		Elasticity	
		Intra-country	Feedback	Thru. East Asia	Thru. China	Thru. East Asia	Thru. China		
		(%)	(%)	(%)	(%)	(%)	(%)		
China									
1	Textile, leather, and the products thereof	9,953	98.8	0.1	1.0	-	0.1	-	1.0
2	Computers and electronic equipment	9,498	90.7	1.6	6.7	-	1.0	-	0.9
3	Other electrical equipment	8,772	96.9	0.3	2.5	-	0.3	-	1.1
4	Other manufacturing products	7,149	98.2	0.2	1.4	-	0.2	-	1.1
5	Metal products	6,424	93.3	0.9	5.1	-	0.7	-	1.0
6	Chemical products	5,721	95.3	0.8	3.5	-	0.5	-	1.0
7	Trade and transport	3,272	91.1	1.3	6.7	-	0.9	-	1.0
8	Services	2,388	95.6	0.6	3.3	-	0.4	-	1.0
All (25) sectors		68,987	95.4	0.7	3.5	-	0.5	-	1.0
Japan									
1	Transport equipment	5,859	99.0	0.0	0.9	0.4	0.1	0.1	1.3
2	Services	5,645	93.6	0.1	5.3	2.9	1.0	0.6	1.2
3	Computers and electronic equipment	3,732	67.8	0.4	26.2	14.9	5.6	3.2	1.0
4	Other electrical equipment	2,404	88.6	0.2	9.7	4.7	1.5	0.9	1.1
5	General machinery	2,131	92.0	0.2	6.7	2.9	1.1	0.6	0.8
6	Metal products	2,102	71.3	0.5	24.2	11.2	4.0	2.3	0.9
7	Trade and transport	1,917	75.5	0.4	20.5	11.0	3.7	2.2	1.0
8	Chemical products	1,082	66.2	0.5	27.9	16.6	5.4	3.8	0.6
All (25) sectors		28,175	85.6	0.2	12.0	6.4	2.2	1.3	1.0
Korea									
1	Computers and electronic equipment	1,717	49.4	0.3	43.3	30.4	7.0	3.3	1.2
2	Metal products	917	66.0	0.3	30.3	19.5	3.5	1.5	1.1
3	Services	801	77.1	0.1	20.2	14.3	2.6	1.2	0.9
4	Other electrical equipment	618	72.9	0.2	24.2	15.6	2.7	1.1	0.6
5	Petroleum and petro products	578	82.5	0.1	15.1	12.3	2.2	1.0	1.8
6	Chemical products	563	47.5	0.3	47.8	38.8	4.5	2.3	1.1
7	Transport equipment	378	96.4	0.0	3.2	1.3	0.4	0.1	0.9
8	Trade and transport	355	54.5	0.3	40.1	28.3	5.2	2.4	1.0
All (25) sectors		7,176	66.7	0.2	29.3	20.7	3.8	1.8	1.0
Taiwan									
1	Computers and electronic equipment	1,747	56.0	0.5	38.0	27.6	5.5	2.4	1.0
2	Metal products	874	77.9	0.2	20.1	15.9	1.8	0.7	1.1
3	Services	837	81.7	0.2	16.3	12.3	1.8	0.8	1.1
4	Other electrical equipment	454	84.8	0.1	13.6	9.2	1.5	0.6	0.6
5	Trade and transport	442	55.8	0.4	39.4	29.8	4.4	1.9	1.0
6	Other manufacturing products	374	85.4	0.1	13.2	10.2	1.3	0.5	1.0
7	Textile, leather, and the products thereof	370	87.8	0.0	11.7	10.4	0.4	0.2	1.2
8	General machinery	353	93.9	0.1	5.4	2.9	0.7	0.3	1.1
All (25) sectors		6,738	72.8	0.3	24.1	18.3	2.8	1.2	1.0

Source: Authors' calculation from the Asian international input-output table.

*It holds that Intra-country multiplier effects + Feedback effects + Trilateral spillover effects through East Asia + Multilateral spillover effects through East Asia = 100%. The spillover effects through China is a part of those through East Asia.

Table 6 (Continued)

	Total impact (Decline in total output) (Million US\$)	Impact of own country's export*		Trilateral spillover effects		Multilateral spillover effects		Elasticity	
		Intra-country (%)	Feedback (%)	Thru. East Asia (%)	Thru. China (%)	Thru. East Asia (%)	Thru. China (%)		
Singapore									
1	Computers and electronic equipment	901	61.3	0.5	31.1	10.0	7.1	4.5	1.8
2	Other electrical equipment	592	80.8	0.2	16.0	4.4	2.9	1.7	1.8
3	Services	301	68.8	0.4	25.7	8.9	5.1	3.1	1.1
4	General machinery	162	70.4	0.4	24.5	7.7	4.7	2.6	1.2
5	Trade and transport	156	27.0	0.8	60.5	21.1	11.7	6.9	0.9
6	Petroleum and petro products*	133							1.0
7	Metal products	96	46.7	0.6	44.6	12.5	8.1	4.3	1.3
8	Transport equipment	36	68.1	0.3	26.6	6.9	5.0	2.6	0.8
All (25) sectors		2,007	46.1	0.6	44.4	14.9	8.9	5.2	1.0
Malaysia									
1	Computers and electronic equipment	3,317	84.3	0.7	12.7	8.2	2.3	1.3	1.1
2	Other electrical equipment	959	90.0	0.4	8.3	3.2	1.3	0.7	1.1
3	Trade and transport	493	79.6	0.9	16.4	9.0	3.1	1.8	1.0
4	Services	187	74.7	0.9	19.9	6.6	4.6	2.9	0.8
5	Metal products	181	78.9	0.9	16.8	6.1	3.4	1.9	1.0
6	Timber and wooden products	140	89.4	0.4	8.9	2.8	1.3	0.8	1.0
7	Food, beverage and tobacco	134	95.6	0.1	3.7	2.1	0.6	0.3	0.6
8	Textile, leather, and the products thereof	116	95.0	0.2	4.2	1.5	0.6	0.4	0.9
All (25) sectors		6,130	83.2	0.7	13.5	7.1	2.6	1.5	1.0
Thailand									
1	Computers and electronic equipment	811	60.8	0.4	33.9	24.8	4.9	2.1	1.0
2	Other electrical equipment	614	91.0	0.1	7.8	3.6	1.1	0.5	1.3
3	Trade and transport	278	70.3	0.3	25.6	14.6	3.8	1.8	1.0
4	Other manufacturing products	238	96.5	0.0	3.0	1.3	0.4	0.2	1.3
5	Services	197	86.5	0.1	11.8	6.3	1.5	0.7	1.1
6	Textile, leather, and the products thereof	195	94.3	0.0	5.2	3.2	0.4	0.2	0.7
7	General machinery	171	75.6	0.3	21.0	5.5	3.1	1.4	0.8
8	Metal products	160	88.9	0.2	9.2	1.6	1.7	0.9	1.5
All (25) sectors		3,647	80.5	0.2	16.9	9.8	2.4	1.1	1.0
Philippines									
1	Computers and electronic equipment	1,265	69.2	0.1	26.5	19.1	4.2	1.8	1.0
2	Trade and transport	316	67.2	0.1	28.3	17.0	4.4	2.0	1.0
3	Services	238	72.0	0.1	24.0	14.2	3.9	1.8	0.9
4	Other electrical equipment	203	94.2	0.0	5.1	2.8	0.7	0.3	0.9
5	Food, beverage and tobacco	184	94.6	0.0	4.6	2.4	0.8	0.4	1.3
6	Textile, leather, and the products thereof	161	97.9	0.0	1.8	1.0	0.2	0.1	0.7
7	Transport equipment	98	92.7	0.0	7.0	0.4	0.3	0.1	1.9
8	Metal products	74	75.8	0.1	19.9	5.1	4.2	2.3	1.3
All (25) sectors		2,979	77.1	0.1	19.7	12.6	3.2	1.4	1.0
Indonesia									
1	Crude petroleum and natural gas	431	73.1	0.1	20.8	3.3	6.0	3.9	1.7
2	Forestry	275	98.1	0.0	1.7	1.2	0.1	0.1	2.0
3	Trade and transport	223	69.1	0.1	25.3	8.3	5.6	2.7	1.0
4	Chemical products	192	85.3	0.1	11.7	4.4	3.0	1.7	1.3
5	Services	170	79.8	0.1	16.5	5.7	3.6	1.8	1.1
6	Metal products	144	65.8	0.1	27.5	3.1	6.5	3.3	1.6
7	Other electrical equipment	134	87.5	0.0	10.1	2.2	2.4	1.1	1.0
8	Other mining	116	20.8	0.2	63.6	26.1	15.4	8.7	1.2
All (25) sectors		2,602	78.8	0.1	17.1	5.1	4.0	2.2	1.0

Source: Authors' calculation from the Asian international input-output Table.

*In this sector, industrial output caused by the intra-country multiplier effects increased in this period. So the data is not comparable with other sectors.

Appendix: Sector description of the Asian international input-output table

Code	Description
1	Paddy
2	Other agricultural products
3	Livestock and poultry
4	Forestry
5	Fishery
6	Crude petroleum and natural gas
7	Other mining
8	Food, beverage and tobacco
9	Textile, leather, and the products thereof
10	Wooden furniture and other wooden products
11	Pulp, paper and printing
12	Chemical products
13	Petroleum and petro products
14	Rubber products
15	Non-metallic mineral products
16	Metals and metal products
17	Industrial machinery
18	Computers and electronic equipment
19	Other electrical equipment
20	Transport equipment
21	Other manufacturing products
22	Electricity, gas, and water supply
23	Construction
24	Trade and transport
25	Services