CESSA WP 2015-10

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November 2015

Center for Economic and Social Studies in Asia (CESSA) Working Paper
Downloadable from:
http://www.econ.ynu.ac.jp/cessa/publication/workingpaper.html

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Abstract

By constructing the Global Input-Output (GIO) Table and using a demand-driven model of shock transmission, we evaluate the impact of the global financial crisis (GFC) on Asian countries through the induced transactions of intermediate and value-added inputs. We demonstrate that the supply-driven model, which is typically used in analyzing the issue of trade in value-added and global value chains, tends to overestimate the negative world demand shock on non-machinery industries. This approach masks magnifying effects of induced intermediate inputs and value-added transactions in response to the negative demand shock, which results in the overestimation of the GFC impact on China. In contrast, our demand-driven model better captures the magnifying effects of the negative world demand shock, showing that Japanese Motor Vehicle and General Machinery industries were most severely affected by the GFC, because foreign demand shock tends to be absorbed in the domestic production sector of these industries.

JEL Classification: F15, F33, F42, F44
Keywords: Global Input-Output Table, shock transmission, Asia, global value chain, intermediate goods trade, trade in value-added, supply shock, demand shock

[*] This study is financially supported by Yokohama National University and the JSPS (Japan Society for the Promotion of Science) Grant-in-Aid for Scientific Research (A) 24243041, (B) 24330101 and Grant-in-Aid for Challenging Exploratory Research 26590032.
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1. Introduction

In September 2008, the world plunged into the unprecedented global financial crisis (GFC), accompanied by a deep decline in world trade. The United States experienced the most severe downturn in trade in terms of the magnitude and speed since the late 1960s (Crowley and Luo, 2011). This unprecedented collapse of world trade in 2008-09 is referred to as the "Great Trade Collapse". Such large negative demand shock caused a sharp decline in Asian trade. According to Figure 1, China's manufacturing exports declined by US$207.1 billion from 2008 to 2009, which was larger than the corresponding decline in exports of Japan (US$176.0 billion) and other Asian countries. In terms of the real GDP growth rate, however, Table 1 illustrates a contradictory evidence that Japan was hit much harder than China by the GFC: the Japanese real GDP growth rate fell sharply from -1.0 percent in 2008 to -5.5 percent in 2009, which contrasts markedly with a slight decline in China's real GDP growth rate from 9.6 percent to 9.2 percent during the same period. Moreover, Japan is the only country that recorded a negative growth in 2011 among the eleven Asian countries in Table 1. Why was Japan hit much harder by the GFC than China and other Asian countries?

Insert Figure 1 around here

Insert Table 1 around here

The main objective of this paper is to investigate why Japan was far more heavily affected by the GFC than other Asian countries. A large number of studies have analyzed a negative impact of the GFC on Asian trade. Kawai and Takagi (2009), for instance, attempted to explain why Japan was hit so hard by the GFC using the vector autoregressive (VAR) technique. Ando and Kimura (2012) examined the GFC impact on Japanese and Asian exports at the most disaggregated level, and decomposed export changes into extensive and intensive margins to examine which factor most affected Japanese and Asian exports. However, this line of research cannot empirically investigate how negative demand shock from foreign countries affects domestic production and how its induced effect causes a subsequent decline in intermediate input procurements from domestic and foreign producers.

Fukao and Yuan (2009) employed the Asian International Input-Output Table (Asian IIO Table) published by Institute of Developing Economies (IDE) to investigate the effect of a decline in U.S. final demand on Asian exports to the United

States, the subsequent decline in Asian domestic production, and further reduction of intermediate goods trade through the induced change in domestic production. This approach is particularly useful in considering the "triangular trade" that has developed in Asia. Specifically, given growing regional production network in Asia,[1] U.S. demand induces Asian exports to the United States, which in turn tends to induce intra-Asian trade along the production chain. Such global and regional value chains could not be investigated without employing the international input-output (IIO) table.

Due to the limitation of data availability, however, Fukao and Yuan (2009) could use only the year-2000 data of the Asian IIO Table.[2] To overcome such data constraint, recent studies have tried to construct new IIO tables. The seminal work of Hummels *et al*. (2001) first analyzed the vertical specialization and value chains using the input-output (IO) table. The subsequent studies such as Daudin *et al*. (2011) and Johnson and Noguera (2012) developed the research on trade in value added (TiVA), constructing multi-country IO tables. The most notable development is the recent release of the World Input-Output Database (WIOD) and the OECD Inter-Country Input-Output (ICIO) Table,[3] which has made significant contribution to the literature on TiVA and other related studies such as global value chain (GVC) and production fragmentation.[4,5]

To analyze the GFC impact on Asian countries, especially the degree of transmission of negative U.S. demand shock to Asian countries, it is necessary to use the IIO table so that we can empirically investigate the shock transmission mechanism along GVCs. To our knowledge, however, there have been only a few studies that apply the IIO approach to the question of shock transmission, even though the research on GVC has been growing.[6] As will be shown in the subsequent sections, the recent

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[1] Ferrarini (2013) maps global and regional linkages in production network and vertical trade, and shows a rapid increase in the degree of regional linkage in East Asia.

[2] The Asian IIO table is published every five years and the latest IIO table becomes available usually after more than five-year delay. In the end of March 2014, the year 2005 Asian IIO table was published after nine years of delay. See the website of IDE-JETRO. (http://www.ide.go.jp/English/Publish/Books/Sds/material.html).

[3] See respective websites of the WIOD (http://www.wiod.org/index.htm) and OECD-ICIO (http://www.oecd.org/sti/ind/input-outputtables.htm) for the details of IIO tables. For research based on the WIOD data, see, for instance, Foster and Stehrer (2013) and Timmer, Erumban, Los, Stehrer and de Vries (2014). Moreover, details on measuring Trade in Value Added is available on http://www.oecd.org/industry/ind/measuringtradeinvalue-addedanoecd-wtojointinitiative.htm.

[4] For the recent development of internationally-linked IO tables, see also two special issues of *Economic Systems Research*: one is "Global Multiregional Input-Output Frameworks" in 2013, Volume 25(1), and the other is "A Comparative Evaluation of Multi-Regional Input-Output Databases" in 2014, Volume 26(3).

[5] For a good survey of the literature on production fragmentation, see Kimura and Obashi (2011).

[6] For the recent research on GVCs, see Koopman *et al*. (2008, 2012, 2014), Johnson and Noguera (2012), Nagengast and Stehrer (2014), Stehrer *et al*. (2012), Timmer *et al*. (2014), Wang *et al*. (2013),

research on TiVA and GVCs that employs IIO tables relies on a supply-driven model in nature. Since our objective is to analyze the effect of negative demand shock on Asia, it is necessary to employ not a supply-driven model but a demand-driven model.

A novelty of the present study is to develop a demand-driven model of shock transmission (henceforth, shock transmission (*ST*) model) to measure the impact of external demand shock on domestic and foreign economies through the induced transactions of intermediate inputs and value-added inputs. We demonstrate that not the supply-driven model but the demand-driven *ST* model can capture the magnifying effect of negative world demand shock, driving individual economies into serious economic downturn. This demand-driven *ST* approach enables us to demonstrate why Japan was the most severely affected by the GFC.

Another novelty of this study is to construct a new IIO table, which is named "Global Input-Output (GIO) Table", to examine the shock transmission to Asia. It is well known that intra-Asian trade along production chains has been driven by the Electrical Machinery industry. Although the WIOD and ICIO Table have a broader country coverage than the GIO Table, the former IIO tables do not fully provide the disaggregated data of the Electrical Machinery industry. In contrast, the GIO Table allows us to use the data on four sub-sectors of the Electrical Machinery industry, which better reflects the negative and, possibly, positive impact of the GFC on regional trade in Asia.

To anticipate the results, we show a strong advantage of the demand-driven model over the supply-driven model in considering the negative impact of the GFC on Japan, China, and other Asian countries. In measuring the GFC impact by the supply-driven model,[7] China is found to be more severely affected than Japan.[8] In addition, the negative GFC impact on major machinery industries (including the Electrical Machinery industry, Motor Vehicle industry, and General Machinery industry) tends to be underestimated, whereas the negative impact on the Other Industries is substantially overestimated. In contrast, our demand-driven *ST* approach demonstrates that Japanese domestic production was worst hit by the GFC, mainly due to the large negative impact on the Motor Vehicle industry and the General Machinery

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Kwon and Ryou (2015), etc. The GVC related literature attempts to decompose gross exports into their bilateral value-added transactions.

[7] To our knowledge, there have been only a few studies that measure the impact of the GFC on the domestic economy from the demand-driven aspect. In general, the supply-driven model tends to be used in the literature on TiVA and GVC to reveal foreign contents embodied in gross exports from the supply-driven point of view.

[8] By its nature, column sum of the TiVA (third equation in section 2) matrix results a row vector or respective country's gross export, as illustrated in equation (9) with respect to gross production.

industry. The result of the *ST* approach shows that China was the second worst hit by the GFC, which was accounted for mainly by machinery industries including the Electrical Machinery. Moreover, the overestimation of the impact on the Other Industries are reasonably corrected by the *ST* approach. Japanese Motor Vehicle companies have formed and developed industrial clusters in Japan, and have less tendency to import intermediate inputs from other countries. This production process is different from the Electrical Machinery industry where production fragmentation has been actively operated especially in Asia. This difference can explain why Japan was most severely affected by the GFC and, hence, more vulnerable to negative foreign demand shock than other countries.

The remainder of this paper is organized as follows. Section 2 presents the research method of this paper by presenting the shock transmission model for induced intermediate inputs and value-added inputs. Section 3 describes the data construction of the GIO Table and comparison with the WIOD and ICIO Table. Sections 4 presents the results of the shock transmission analysis. Finally, Section 5 concludes this study.

2. Research Method

2.1 Shock Transmission Model

To evaluate the degree of global and regional economic linkages and value chains, we develop the shock transmission (*ST*) method based the IIO framework.[9] Under a three-country IIO model, we assume that all endogenous countries encounter a fall of finished goods exports to the world, namely finished goods exports of country 1, 2, and 3 decline by ΔE_1^F, ΔE_2^F, and ΔE_3^F, respectively. This simultaneous decline in finished goods exports induces a fall in production in the three countries and can be estimated by using the global Leontief inverse matrix $\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$ as:

$$\mathbf{ST} = \mathbf{L}\Delta\hat{\mathbf{E}}^F = \begin{bmatrix} L^{11} & L^{12} & L^{13} \\ L^{21} & L^{22} & L^{23} \\ L^{31} & L^{32} & L^{33} \end{bmatrix} \begin{bmatrix} \Delta E_1^F & 0 & 0 \\ 0 & \Delta E_2^F & 0 \\ 0 & 0 & \Delta E_3^F \end{bmatrix} = \begin{bmatrix} L^{11}\Delta E_1^F & L^{12}\Delta E_2^F & L^{13}\Delta E_3^F \\ L^{21}\Delta E_1^F & L^{22}\Delta E_2^F & L^{23}\Delta E_3^F \\ L^{31}\Delta E_1^F & L^{32}\Delta E_2^F & L^{33}\Delta E_3^F \end{bmatrix}$$

[9] See Appendix 1 for conventional IIO model based on three countries.

The right hand side of the above equation estimates the amount of decrease in the gross production induced by the finished goods export decline in all three countries, which measures the degree of shock transmission among three countries along vertical direction.[10] Since gross production consists of intermediate and value-added inputs, we divide the induced gross production in two contents: one is intermediate goods contents and the other is value-added contents. By making this division, we can analyze the magnifying effect of finished goods export shock through the intermediate input channel and the value-added channel denoted by **ST**(*Int*) and **ST**(*VA*), respectively, using the following division rule:

$$\mathbf{ST}(Int) = \mathbf{A}\left(\mathbf{L}\Delta\hat{\mathbf{E}}^{F}\right) \tag{1}$$

and

$$\mathbf{ST}(VA) = \hat{\mathbf{A}}^{v}\left(\mathbf{L}\Delta\hat{\mathbf{E}}^{F}\right) \tag{2}$$

where $\mathbf{A} = \mathbf{Z}\hat{\mathbf{Y}}^{-1}$ is the intermediate input coefficient matrix calculated from intermediate input transaction matrix **Z** and the gross production vector **Y**; $\hat{\mathbf{A}}^{v}$ is the diagonal matrix of value-added coefficient vector (row) defined by $\mathbf{A}^{v\prime} = \mathbf{V}'\hat{\mathbf{Y}}^{-1}$; **L** is the global Leontief inverse matrix; $\Delta\hat{\mathbf{E}}^{F}$ is a diagonal matrix of the country *i*'s export decline of finished goods ΔE_i^F.

In Section 4, we present summary results based on the shock transmission model for both intermediate inputs and value-added contents for selected industries in Japan, China, and Korea.

2.2 TiVA Approach as the Supply-driven IO Model

The basic model of trade in value-added (henceforth denoted by **TiVA**) of the gross exports[11] $\mathbf{E} = \begin{pmatrix} E_1 & E_2 & E_3 \end{pmatrix}'$, can be estimated by the following equation based on the three country IIO table presented in Figure A1 of Appendix 1.

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[10] Here, it is important to mention that diagonal elements in matrix $\mathbf{L}\Delta\hat{\mathbf{E}}^{F}$ includes a decline of final goods exports.

[11] The gross exports consist of both intermediate goods and final goods exports.

$$\mathbf{TiVA} = \hat{\mathbf{A}}^{v}\mathbf{L}\hat{\mathbf{E}} = \begin{bmatrix} a_1^v & 0 & 0 \\ 0 & a_2^v & 0 \\ 0 & 0 & a_3^v \end{bmatrix}\mathbf{L}\hat{\mathbf{E}} = \begin{bmatrix} a_1^v L^{11}E_1 & a_1^v L^{12}E_2 & a_1^v L^{12}E_3 \\ a_2^v L^{21}E_1 & a_2^v L^{22}E_2 & a_2^v L^{23}E_3 \\ a_3^v L^{31}E_1 & a_3^v L^{32}E_2 & a_3^v L^{33}E_3 \end{bmatrix} \tag{3}$$

In the right hand side of the TiVA equation, the second column, for instance, represents the value-added embodied in three different countries due to country 2's gross exports. Elements in any rows are the amount of value-added in respective countries associated with exports of all three countries. Here, it is important to note that the column sum of matrix multiplication of $\hat{\mathbf{A}}^{v}\mathbf{L} = \begin{pmatrix} 1 & 1 & 1 \end{pmatrix}\hat{\mathbf{A}}^{v}\mathbf{L} = \mathbf{A}^{v\prime}\mathbf{L}$ in right hand side of equation (3) results in a row vector of ones, as derived in Appendix 1 equation (a5). It means that the magnifying inducement effects of gross export, supposed to measure by the Leontief inverse **L**, become analytically ineffective in equation (3). Instead, the TiVA model reallocates the gross exports into embodied domestic and foreign contents with respect to value-added coefficient and the Leontief inverse.

We further show that the TiVA model is explicitly equivalent to the supply-driven IO model. Without loss of generality, let us assume that $\mathbf{TiVA}^{*}$ represents the supply-driven inducements associated with gross production **Y**, instead of gross exports **E**. Then, we can rewrite equation (3) in the following form.

$$\mathbf{TiVA}^{*} = \hat{\mathbf{A}}^{v}\mathbf{L}\hat{\mathbf{Y}} \tag{4}$$

In reference to a supply-driven IO model or the Ghosh model[12] that uses the Ghosh inverse (**G**) to specify gross output **Y** subject to output coefficient matrix (say, $\mathbf{B} = \hat{\mathbf{Y}}^{-1}\mathbf{Z}$) and the row vector of value-added $\mathbf{V}'$, it follows that

$$\mathbf{G} = \left(\mathbf{I} - \mathbf{B}\right)^{-1} \tag{5}$$

and

$$\mathbf{Y}' = \mathbf{V}'\mathbf{G} \tag{6}$$

Now, using the definitions of matrices, **A**, **B**, **L, G** and equation (a6) of Appendix 1, we have:

[12] See Ghosh (1958) and Miller and Blair (2009), pp. 543-544 for the details on the supply-driven Ghosh model.

$$\mathbf{L} = \hat{\mathbf{Y}}\mathbf{G}\hat{\mathbf{Y}}^{-1} \tag{7}$$

Substituting equation (7) in TiVA equation (4), we obtain:

$$\mathbf{TiVA}^{*} = \hat{\mathbf{A}}^{v}\hat{\mathbf{Y}}\mathbf{G}\hat{\mathbf{Y}}^{-1}\hat{\mathbf{Y}} = \hat{\mathbf{V}}\mathbf{G} \tag{8}$$

Finally, summing up along column, we get:

$$(1 \quad 1 \quad 1)\mathbf{TiVA}^{*} = (1 \quad 1 \quad 1)\hat{\mathbf{V}}\mathbf{G} = \mathbf{V}'\mathbf{G} = \mathbf{Y}' \tag{9}$$

Equations (6) and (9) show that the TiVA model can be explicitly represented by the supply-driven IO model. The supply-driven IO model and the demand-driven IO price model, as illustrated by Dietzenbacher (1997), yield exactly the same result. However, the basic assumption of the Leontief price model or the supply-driven IO model (i.e., the TiVA model) is different from the demand-driven model.[13] The demand-driven model captures the change in production caused by the change in final demand, whereas the price model deals with the change in sectoral unit costs due to the change in primary input (i.e., value-added) prices. Moreover, the magnifying effect of demand shock become ineffective in the TiVA model. Thus, applying the supply-driven model to an analysis of the GFC impact that is intrinsically the demand-driven shock may lead to ambiguous conclusions.

3. Data: GIO Table

3.1 Construction of the GIO Table

We have constructed a new dataset of the GIO Table, our own internationally-linked IO table, for sixteen years spanning from 1997 through 2012. Specifically, the GIO Table includes twenty-nine endogenous countries and fifty-nine exogenous countries with thirty-five industrial classifications.[14] Fifty-nine exogenous countries are grouped into Hong Kong (HK), Rest of Asia (ROA), Rest of Europe

[13] See Miller and Blair (2009), pp. 43-44.
[14] See Appendices 2 and 3 for the list of the endogenous and exogenous countries, and for that of the production sectors in the GIO Table.

(ROE), Oil producing countries (OPEC), and the rest of the world (ROW). To construct the annual GIO Tables, we use (1) the National Input-Output tables (NIOTs, basically published by OECD)[15] for years 2000, 2005 and/or nearest one; (2) annual national accounts data obtained from the United Nations Statistics Division's National Accounts Main Aggregates Database; (3) annual manufacturing industry-specific output and value-added data taken from UNIDO Industry Statistics Database (UNIDO INDSTAT); and (4) annual bilateral trade data (with intermediate goods and finished goods breakdown) downloaded from the United Nations Comtrade Database website.

While a single-country IO table does not provide us with any information on source countries for imported intermediate and finished goods, the internationally-linked IO table links single-country IO tables between endogenous countries using the international trade data by source/destination country and by industry. We conform the import blocks of the OECD IO table (both for imported intermediate and final goods) to the GIO classification. Consequently, the GIO Table has thirty-five production industries, twenty-nine endogenous countries and fifty-nine exogenous countries.

We utilize trade data to estimate the industry-specific bilateral trade structures for both intermediate and finished goods trade among endogenous and exogenous countries. We collect the source country breakdown trade data (from UN Comtrade Database) on imports of each endogenous country at the 4- or 5- digit SITC3 level (3,121 categories). These data are classified into three types of goods, namely intermediate, consumption and capital goods, by matching the SITC3 code with the BEC (Broad Economic Categories) code. We also conform the SITC3 categories to the ISIC3 ones to convert the trade classification into the industry classification.[16] Among 3,121 SITC3 categories, 1,933 categories correspond to intermediate goods, while the remaining 1,188 categories are regarded as the final demand in the IO and GIO framework.[17] In addition, each of the intermediate and final demand transactions is converted into the ISIC classification at the 4-digit level, which amounts to 145 categories. By aggregating the 4-digit level of ISIC3, we obtain the 2-digit level of ISIC3 (62 classifications), which is in turn converted into the OECD IO classification

[15] For the countries OECD NIOTs are unavailable, the national tables were collected from the respective national statistics office

[16] UN web pages http://unstats.un.org/unsd/cr/registry/regsale.asp?Lg=1 and http://unstats.un.org/unsd/cr/registry/regdnld.asp?Lg=1 provide links for code conversion from SITC3 to ISIC3 and from SITC3 to BEC respectively.

[17] Final demand (1,188 categories) is decomposed into consumption goods (713 categories) and capital goods (475 categories).

(48 categories[18]) and then into the 35 GIO industries. Finally, by using the import data by source country and by industry, we obtain the import share of each endogenous country for both intermediate and final goods. Thus, we can overcome a drawback of the conventional approach, such as Hummels *et al*. (2001) and Ng (2010), which uses the bilateral trade data without distinguishing intermediate goods trade from final goods trade.[19]

3.2 Comparison between IIO Tables

The WIOD and ICIO Table have a broader country coverage than the GIO Table.[20] For the purpose of comparison, we first calculate induced effects of domestic and foreign final demand in all endogenous countries using the Leontief inverse based on three different IIO tables. Second, we summarize the intra-regional inducements in Asia (nine countries),[21] Europe (12 countries) and North America (three countries). Third, we estimate regional linkage as a share of intra-regional inducements (excluding domestic inducements) on the regional final demand. Finally, a time-series change in regional linkages are presented in Figure 2, which illustrates that three IIO tables exhibit almost the same movements of regional linkages. However, the WIOD evidently underestimates the Asian linkage, while the GIO tends to underestimate the European linkage, reflecting the difference in country coverage between the WIOD and GIO Table. In the context of Asian integration, both the ICIO and GIO Tables can fully capture the degree of regional linkages,[22] indicating that the GIO Table is sufficiently capable of addressing the Asian economic and trade structures.

[Insert Figure 2 around here.]

It is well known that growing production network and value chains in Asia have been driven mainly by the Electrical Machinery industry (Ferrarini, 2013). Since a large variety of products are included, it is necessary to use the disaggregated data for the Electrical Machinery industry.[23] As will be shown in Section 4, both WIOD

[18] See http://www.oecd.org/dataoecd/32/56/47059256.pdf for the conversion rule from the ISIC3 to OECD IO classification.
[19] See Sato and Shrestha (2014) for details on estimation process of the GIO table.
[20] See Appendix 4 for comparison of three IIO tables.
[21] Only six Asian countries are included in the WIOD table.
[22] In Figure 2, we aggregated the results of eleven individual Asian countries obtained from the ICIO Table. If we summarize the results of all 14 Asian countries covered by the ICIO Table, obviously, the GIO underestimates the Asian linkage to some extent.
[23] In Asia, the electrical machinery industry is one of the major exporting industry (see Table 1 of Sato

and ICIO Table tend to mask a possible difference in negative impacts of the GFC shock between sub-sectors of the Electrical Machinery industry. We will discuss more of such possible differences using the GIO Table that provides the data of four sub-sectors in the Electrical Machinery industry.

4. Global and Regional Linkages, Shock Transmission, and Trade in Value-added

4.1 Global and Regional Linkages

First, we show how inter- and intra-regional linkages[24] with respect to intermediate inputs and value-added contents in manufacturing industries have changed from 1997 to 2012 in Figure 3. The far left line graphs exhibit a remarkable growth in Asian regional procurements of intermediate inputs from 21.4 percent in 1997 to 26.5 percent (highest at 30.8 percent in 2006) in 2012, which supports the recent findings that regional economic integration in Asia has been mainly driven by growing regional production network and fragmentation.

[Insert Figure 3 around here.]

The regional linkage for Europe in Figure 3 indicates that the level of regional procurements of intermediate inputs is still somewhat higher in Europe than in Asia, but European procurement of intermediate goods from Asia shows a marked increase. North American countries increased their procurements of intermediate inputs from Asian countries, while the level of regional procurements declined to a large extent from early 2000s and then started to increase from 2009. In the world procurements of intermediate inputs, the share of Asia increased substantially from 1997 and exceeded that of Europe in 2010 and again in 2012.

Although less evident than the case of intermediate input procurements, the share of value-added contents from Asia increased not only in Asian region but also in North America. Even in the world, the share of value-added contents from Asia increased steadily and became more or less similar to that of value-added contents from Europe in 2012. The above observation suggests that Asia shows the significant

et al., 2013), and it has also played a major role in Asian economic integration and intra-regional trade (Hasebe and Shrestha, 2006, Koopman *et al*., 2008, 2012, and Athukorala, 2009).

[24] Inter- and intra-regional linkages are estimated as a share of inter- and intra-regional production inducements (excluding the domestic economy) on the regional final goods export respectively.

progress of regional economic linkages and also becomes more integrated into global production network through intermediate input and value-added trade.

Second, using equations (1) and (2), we compute the extent of shock transmission of the GFC to all endogenous countries in terms of both intermediate inputs and value-added contents. For this calculation, we used the actual decline of final goods exports to the world during 2008-2009 obtained from UN Comtrade and 2009 GIO Table. We present the results for all 29 endogenous countries in Table 2.

Tables 2(a) and (b) show the shock transmissions of the GFC shock through intermediate goods and value-added channels. Table 2(C) is the actual size of the GFC shock. The diagonal elements in Table 2(a) and (b) are amounts of impact transmitted to domestic economy through intermediate inputs and value-added channels, respectively. It is evident from Table 2(a) that Japanese domestic intermediate goods sector experienced highest negative impact (US$150.3 billion) by the GFC compared to that experienced by China (US$132.1 billion), Germany (US$130.2 billion) and the United States (US$96.1 billion). Even in value-added terms, Japan is the only country that experienced negative impact of over US$100 billion. Compared to Japan, shock of US$90.3 and 97.0 billion transmitted to Germany and the United States, respectively, through the value-added channels (see Table 2(b)). Notably, China experienced limited negative impact of US$59.8 billion.

The GFC shock effects transmitted to foreign countries are shown along the respective columns of Tables 2(a) and (b). For example, in the intermediate goods sector, Japan transmits negative shock of US$7.8 and 3.7 billion to China and the United States, respectively. It is interesting to note that large negative final goods export shock in Germany (US$134.1 billion, Table 2(c)) induces relatively less negative impact to its domestic economy compared to Japan. As illustrated in Figure 3, regional procurements of intermediate inputs and value-added in Europe is high, Germany tends to transmit more negative shocks to regional or global partners.

[Insert Table 2 around here.]

Third, we also calculate the degree of shock transmission in terms of TiVA by equation (3), and compare the results of shock transmission between three approaches. The results of shock transmission are presented in the following sub-sections only for selected manufacturing industries and three major economies in Asia, namely Japan, China and Korea.

4.2 All Manufacturing Industries

Figure 4 shows the industry-breakdown of the GFC shock effect transmitted directly and indirectly to the domestic economies in Japan, China and Korea. Korea is included in Figure 4 as a representative of other Asian countries. The GFC shock is measured by the actual change in gross exports (for TiVA approach) and finished goods exports (for *ST* approach) to the world from 2008 to 2009 with respect to each endogenous country.

The TiVA approach indicates the following negative impact of the GFC: US$158.9 billion on Japan, US$171.7 billion on China, and US$26.9 billion on Korea, indicating that China was the hardest hit by the GFC. In contrast, when using the *ST* model, the extent of negative impact becomes larger in Japan than in China for both intermediate goods and value-added contents. For example, a decline in Chinese GDP from 2008 to 2009 can be attributed to smaller negative shock transmission in Chinese value-added contents (US$59.8 billion) compared to higher degree of negative shock transmission to Japanese value-added contents (US$101.1 billion). In the intermediate goods contents, the degree of negative impact becomes larger in Japan (US$150.3 billion) than in China (US$132.1 billion).

Thus, the *ST* approach based on the demand-driven model evidently shows that Japan experienced greater negative impact of the GFC than China. The TiVA approach, as discussed in Section 2.2, is based on the supply-driven model that reallocates the gross exports into embodied domestic and foreign contents with respect to value-added coefficient and the Leontief inverse, and the model does not estimate the magnifying inducement effects of the demand shock. As a consequence, the effect of large negative gross export shock remains large in China than in Japan.

[Insert Figure 4 around here.]

Figure 4 also shows industry-specific impacts of the GFC on the domestic economies in Japan, China, and Korea. The largest portion of shock effect transmitted to Japanese economy through the Motor Vehicle industry and the General Machinery industry. In China, the shock is transmitted through a number of industries including the Office and Computing industry, the General Machinery industry, the Textile industry, and the Motor Vehicle industry. Surprisingly, the TiVA approach shows that the largest portion of the total shock transmission to China is due to the Other

industries.[25] As shown in Appendix 5, Chinese gross exports of the Other industries declined by US$126.6 billion (In particular, US$65.8 billion decline in in Metal and non-metals industry), while China's final goods exports of the Other industries fell only by US$27.9 billion (US$ 0.8 billion in Metal and non-metal industry). As we explained in Section 2.2, the TiVA model cannot capture the magnifying induced effect of the economic shock and only reallocates the gross exports. Thus, the impacts based on the TiVA model simply reflect the larger extent of gross exports in Chinese Other industries. In contrast, the *ST* model fully captures the shock transmission due to inducements generated by small final goods export shock and, hence, can correctly estimates impact of the GFC.

[Insert Table 3 around here.]

We present the summary result of the industry-specific shock transmission structure in Table 3, which clearly illustrates the difference in shock transmission between the demand-driven and supply-driven models. In the All Manufacturing industries (Table 3), the degree of shock transmission is larger in China than in Japan when using the TiVA approach as well as gross exports. When using the *ST* approach, however, the extent of shock transmission is much larger in Japan than in China in terms of both intermediate goods and value-added contents. The additional observation by industry is presented in the following sub-sections.

4.3 Motor Vehicle and General Machinery Industries

Table 3 illustrates that the largest portion of negative impact of GFC in both Japanese intermediate goods and value-added contents comes from the decline in finished goods exports of the Motor Vehicle industry by US$60.9 billion and in those of the General Machinery industry by US$35.8 billion. These two industries induced a decline by US$133.4 billion and by US$86.8 billion in Japanese intermediate goods and value-added contents, respectively.[26] However, the TiVA approach shows that

[25] The Other industries consist of All Manufacturing industries (see Appendix 3 for the list of industries) except four Electrical machinery, two Transport Equipment and General Machinery industries.

[26] See the results obtained from the *ST* (Int) model in Table 3. A decline in US$133.4 billion is the sum of declines by US$94.5 billion in the Motor Vehicle industry and by US$38.9 billion in the General Machinery industry. See also the value-added inducements obtained from the *ST* (VA) model. The sum of declines in the Motor Vehicle by US$54.0 billion and in the General Machinery by US$32.8 billion amounts to a decline in US$ 86.8 billion in Japan.

these two industries contributed to the negative impact only by US$60.7 billion and by US$38.7 billion, respectively, which is far smaller than the corresponding estimated impact obtained by the demand-driven *ST* model. The impact on the Motor Vehicle industry and the General Machinery industry in China and Korea is much smaller than the corresponding impact in Japan.

4.4 Electrical Machinery Industries

Let us observe the four sub-categories in the Electrical Machinery industry presented in Table 3. When using the TiVA approach, China is affected by the negative shock transmission ranging from US$10.3 billion to US$13.5 billion in the three sub-categories, though the effect is relatively small in the Optical Instrument sector. When using the demand-driven *ST* model, however, far larger negative impact (US$25.1 billion in terms of intermediate goods and US$8.8 billion in terms of value-added) is transmitted through the Office and Computing sector.

[Insert Figure 5 around here.]

Figure 5 shows to what extent the shock transmission impact on the Electrical Machinery industry accounts for in the impact on All Manufacturing industries in Japan, China, and Korea. If we use the WIOD and ICIO Table, the Electrical Machinery industry accounts for only a small portion of the overall shock transmission impact in Japan and Korea. If using the GIO Table, however, a large negative impact of the Radio Television sector (23.3%) is offset by a large positive impact (28.4%) of the Optical Instrument sector, which results in a small impact of the Electrical Machinery industry on the overall Korean manufacturing industries. Thus, the WIOD and ICIO Table do not necessarily show the actual shock transmission mechanism in Asia, especially in the Electrical Machinery industry.

Finally in Figure 6, we assess the degree of shock transmissions to foreign economies from Japan, China and Korea, which is normalized to the respective final goods export shocks in 2009. Figure 6 shows a clearly different pattern of the shock transmission between countries and between industries. Among others, Japan exhibits the lowest degree of shock transmission to foreign countries through both intermediate goods and value-added channels in All Manufacturing and three major machinery industries. On the other hand, both China and Korea show a lareger extent of shock transmission to other coutnries. Japanese firms tends to export key parts and

components from Japan to other countries, whie they do import relatively small amount of intermediate inputs from abroad. Even if hit by the negative world demand shock, the negative shock effects tend to be absorbed in Japanese domestic production sectors, because Japanese machinery firms procure intermediate inputs not from abroad but from the domestic sectors. In contrast, machinery firms in China tend to import and export intermediate inputs regionally and globally. Such active transactions of intermediate inputs along value chains enable China to transmit the negative world demand shock to foreign countries.

5. Concluding Remarks

We construct new global input-output (GIO) data and use a demand-driven shock transmission model to measure the impact of demand shock on domestic economy through the induced transactions of intermediate inputs and value-added inputs. We show that the GIO industrial classification has advantage over the WIOD and ICIO classification, especially in the Electrical Machinery industry. Only the GIO classification is able to figure out large positive and negative impacts on Korean domestic economy in Radio Television and Optical Instrument industries, respectively. The other two types of classification only reports the relatively smaller aggregated impact.

We also demonstrate that the results based on demand-driven model (our approach) are more realistic than that based on the supply-driven (TiVA) approach. In measuring the negative impact of the GFC, the supply-driven approach shows China was more severely affected by GFC than Japan, because this approach masks the magnifying effect of induced transactions in response to the demand shock. In contrast, our demand-driven model demonstrates that Japanese domestic production was worst hit, which is also supported by a sharp decline in GDP growth rates in Japan than in China during and after the GFC period.

Industry-specific results suggest that Japan and Korea suffered largely by negative demand shock in Motor Vehicle and General Machinery industries. In these industries, Japanese firms do not import intermediate inputs from abroad, while key parts and components are actively exported from Japan to other countreis. Thus, even if hit by the negative world demand shock, the negative shock effects tend to be absorbed in Japanese domestic production sector through intermediate imputs and value-added channels. On the other hand, the negative GFC demand shock to the

Electrical Machinery industry in China did have less severe impact on the China's domestic economy, because Electrical Machinery firms in China actively import and export intermediate inputs regionally and globally, which implies that negative GFC shock was transmitted along regional and global value chains centered on China. Such a different pattern of shock transmission between Japan and China implies that Japan is more vulnerable to regional and world demand shocks than China and, hence, Japan tends to suffer more from the GFC than China, even though Chinese gross exports experience a larger decline than Japan.

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Appendix 1. Three-Country IIO Model

Let us assume a three-country IIO table presented in Figure A1, where each country produces in a single tradable sector. Each country produces a good that can be consumed as a final good or used as an intermediate input.[27] Here, for three countries *i* and *j*, $\mathbf{Z} = \left(Z^{ij}\right)$ and $\mathbf{F} = \left(F^{ij}\right)$ are matrices of intermediate goods and final goods transactions respectively; $\mathbf{Y} = \left(Y^{i}\right) = \left(Y^{j}\right)'$ is a vector of gross output and $\mathbf{V} = \left(V^{j}\right)'$ is vector of value-added inputs. Then we can easily derive the demand-driven Input-Output equation in matrix form as

$$\mathbf{Y} = \left(\mathbf{I} - \mathbf{A}\right)^{-1}\mathbf{F}\mathbf{u} = \mathbf{L}\mathbf{F}\mathbf{u} \tag{a1}$$

where $\mathbf{A} = \mathbf{Z}\hat{\mathbf{Y}}^{-1}$ is 3x3 global intermediate input coefficient matrix, $\mathbf{L} = \left(\mathbf{I} - \mathbf{A}\right)^{-1}$ is the global Leontief inverse matrix of size 3x3 and **u** is a 3x1 vector of ones .

Figure A1. Internationally-Linked Input-Output Table: Three-Country Model

		Intermediate goods purchased/imported by			Final goods purchased/imported by			Gross Production ($\mathbf{Y}^i$)
		Country 1	Country 2	Country 3	Country 1	Country 2	Country 3	
Goods sold/exported by	Country 1	Z^{11}	Z^{12}	Z^{13}	F^{11}	F^{12}	F^{13}	Y^1
	Country 2	Z^{21}	Z^{22}	Z^{23}	F^{21}	F^{22}	F^{23}	Y^2
	Country 3	Z^{31}	Z^{32}	Z^{33}	F^{31}	F^{32}	F^{33}	Y^3
Value-added inputs ($\mathbf{V}^j$)		V^1	V^2	V^3				
Gross Production ($\mathbf{Y}^j$)		Y^1	Y^2	Y^3				

In a similar manner, supply-driven IO equation (also known as Ghosh Model) can be derived as

$$\mathbf{Y}' = \mathbf{V}'\left(\mathbf{I} - \mathbf{B}\right)^{-1} = \mathbf{V}'\mathbf{G} \tag{a2}$$

where $\mathbf{B} = \hat{\mathbf{Y}}^{-1}\mathbf{Z}$ is 3x3 global intermediate output coefficient matrix (or, allocation coefficient) and $\mathbf{G} = \left(\mathbf{I} - \mathbf{B}\right)^{-1}$ is the global Ghosh inverse matrix of size 3x3.

[27] We assume that each country has only one production sector. This assumption can be easily extended to a multi-production sector model with the same matrix and vector notations.

Vectors of gross export (**E**) and final goods export ($\mathbf{E}^F$) are calculated from the IIO table in the following manner.

$$\mathbf{E} = \begin{bmatrix} Z^{12} + Z^{13} \\ Z^{21} + Z^{23} \\ Z^{31} + Z^{32} \end{bmatrix} + \begin{bmatrix} F^{12} + F^{13} \\ F^{21} + F^{23} \\ F^{31} + F^{32} \end{bmatrix} \tag{a3}$$

and

$$\mathbf{E}^F = \begin{bmatrix} F^{12} + F^{13} \\ F^{21} + F^{23} \\ F^{31} + F^{32} \end{bmatrix} \tag{a4}$$

Here, we show that column sum of matrix multiplication of $\hat{\mathbf{A}}^{v}\mathbf{L}$ in equation (4) results in row vector of ones. From the IIO table in Figure A1, we have

$$\mathbf{A} = \mathbf{Z}\hat{\mathbf{Y}}^{-1}, \quad \mathbf{A}^{v'} = \mathbf{V}'\hat{\mathbf{Y}}^{-1}, \text{ and } \quad \mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$$

By definition of input coefficients and value-added coefficients, we have

$$\mathbf{u}'\mathbf{A} + \mathbf{A}^{v'} = \mathbf{u}'$$

$$\Rightarrow \mathbf{A}^{v'} = \mathbf{u}' - \mathbf{u}'\mathbf{A}$$

$$\Rightarrow \mathbf{A}^{v'} = \mathbf{u}'(\mathbf{I} - \mathbf{A})$$

$$\Rightarrow \mathbf{A}^{v'}(\mathbf{I} - \mathbf{A})^{-1} = \mathbf{u}'$$

$$\Rightarrow \mathbf{A}^{v'}\mathbf{L} = \mathbf{u}' \tag{a5}$$

Now, for given input coefficient matrix **A**, Leontief inverse matrix **L**, output coefficient matrix **B** and Ghosh inverse matrix **G**, we derive equation (6) in Section 2.3

$$\mathbf{A} = \mathbf{Z}\hat{\mathbf{Y}}^{-1} \text{ and } \mathbf{B} = \hat{\mathbf{Y}}^{-1}\mathbf{Z}$$

$$\mathbf{A}\hat{\mathbf{Y}} = \hat{\mathbf{Y}}\mathbf{B}$$

$$\Rightarrow \hat{\mathbf{Y}} - \mathbf{A}\hat{\mathbf{Y}} = \hat{\mathbf{Y}} - \hat{\mathbf{Y}}\mathbf{B}$$

$$\Rightarrow (\mathbf{I} - \mathbf{A})\hat{\mathbf{Y}} = \hat{\mathbf{Y}}(\mathbf{I} - \mathbf{B})$$

$$\Rightarrow \left[(\mathbf{I}-\mathbf{A})\hat{\mathbf{Y}}\right]^{-1} = \left[\hat{\mathbf{Y}}(\mathbf{I}-\mathbf{B})\right]^{-1}$$

$$\Rightarrow \hat{\mathbf{Y}}^{-1}(\mathbf{I}-\mathbf{A})^{-1} = (\mathbf{I}-\mathbf{B})^{-1}\hat{\mathbf{Y}}^{-1}$$

$$\Rightarrow (\mathbf{I}-\mathbf{A})^{-1} = \hat{\mathbf{Y}}(\mathbf{I}-\mathbf{B})^{-1}\hat{\mathbf{Y}}^{-1}$$

$$\Rightarrow \mathbf{L} = \hat{\mathbf{Y}}\mathbf{G}\hat{\mathbf{Y}}^{-1} \qquad \text{(a6)}$$

Appendix 2: Endogenous and Exogenous Countries of the GIO Table

Country/ Group	List of countries
Endogenous Countries	
Asia (11)	Japan (JP), China (CH), Korea (KR), Taiwan (TW), Singapore (SG), Malaysia (MY), Thailand (TH), Indonesia (ID), Philippines (PH), Vietnam (VT) and India (IN)
N. America (3)	USA (US), Canada (CA) and Mexico (MX)
Europe (12)	France (FR), Germany (GR), Austria (AT), Belgium (BG), Finland (FN), Ireland (IR), Italy (IT), Luxembourg (LX), Netherlands (NL), Portugal (PT), Spain (SP) and United Kingdom (UK)
Others (3)	Australia (AU), Brazil (BR) and South Africa (SA)
Exogenous Countries	
HK (1)	Hong Kong
ROA (30)	Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, Pakistan, Sri Lanka, Armenia, Azerbaijan, Bahrain, Brunei Darussalam, Cambodia, Macau, North Korea, Georgia, Israel, Jordan, Kazakhstan, Kyrgyzstan, Lao PDR, Lebanon, Mongolia, Myanmar, Oman, Syria, Tajikistan, Turkey, Turkmenistan, Uzbekistan and Yemen
ROE (16)	Russia, Bulgaria, Cyprus, Czech Rep., Denmark, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia and Sweden
OPEC (12)	Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, UAE and Venezuela
ROW	Rest of the World

Note: Numbers in parenthesis represents number of countries treated in the GIO Database. N. America, ROA, ROE and OPEC represent North America, Rest of Asia, Rest of Europe and Oil producing Countries respectively.

Appendix 3: List of production industries of the GIO table

Industry Code	Name of Industry	Abbreviated Name
Primary industry		
Y01	Agriculture, hunting, forestry and fishing	
Y02	Mining and quarrying	
Manufacturing industry		
Y03	Food products, beverages and tobacco	
Y04	Textiles, textile products, leather and footwear	Textile
Y05	Wood and products of wood and cork	
Y06	Pulp, paper, paper products, printing and publishing	
Y07	Coke, refined petroleum products and nuclear fuel	
Y08	Chemicals and pharmaceuticals	
Y09	Rubber and plastics products	
Y10	Other non-metallic mineral products	
Y11	Basic metals	
Y12	Fabricated metal products, except machinery and equipment	
Y13	Machinery and equipment	General Machinery
Y14	Office, accounting and computing machinery	Office and Computing
Y15	Electrical machinery and apparatus	Electrical Equipment
Y16	Radio, television and communication equipment	Radio Television
Y17	Medical, precision and optical instruments	Optical Instrument
Y18	Motor vehicles, trailers and semi-trailers	Motor Vehicle
Y19	Other transport equipment	
Y20	Other Manufacturing; recycling (include Furniture)	
Service industry		
Y21	Electricity, Gas and Water supply	
Y22	Construction	
Y23	Wholesale and retail trade; repairs	
Y24	Hotels and restaurants	
Y25	Transport	
Y26	Post and telecommunications	
Y27	Finance and insurance	
Y28	Real estate activities	
Y29	Renting of machinery and equipment	
Y30	Computer and related activities	
Y31	Research and development	
Y32	Other Business Activities	
Y33	Public administration and defense; compulsory social security	
Y34	Education	
Y35	Health, social work and other services	

Appendix 4. Comparison of three IIO tables

	GIO	WIOD	ICIO
Endogenous Countries	29	40 (+1)	61 (+1)
Asia	11	6	14
North America	3	1	3
Europe	12	29	33
Others	3	2	11
Exogenous Countries	59 (+1)	-	-
Industry Classifications	35	35	34
Primary	2	2	2
Manufacturing	18	14	16
Electrical Machinery	4	1	2
Service	15	19	16
Special Input Structure	-	-	China and Mexico
Period Coverage	1997 to 2012	1995 to 2011	1995, 2000, 2005, 2008 to 2011

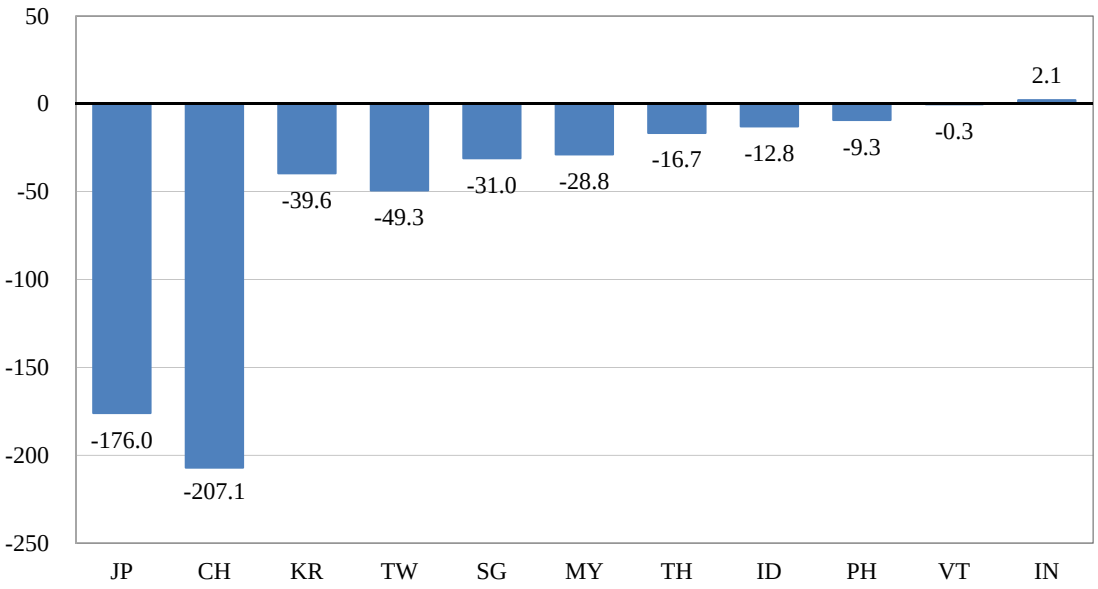
Note: (+1) indicates how ROW (Rest of the World) is treated in the respective IIO tables

Appendix 5. Change in Gross export and final goods export during 2008-2009 in Japan, China and Korea (US$ billion)

Industry description	Japan		China		Korea	
	Gross	Final goods	Gross	Final goods	Gross	Final goods
All Manufacturing	**-176.0**	**-112.2**	**-207.1**	**-72.2**	**-39.6**	**-14.6**
Electrical Machinery	**-31.0**	**-13.1**	**-47.6**	**-25.5**	**-7.4**	**-0.7**
Office and Computing	-2.5	-1.8	-16.8	-11.0	-3.4	-2.3
Electrical Equipment	-7.8	-2.1	-12.5	-5.3	0.2	0.7
Radio Television	-14.5	-6.1	-12.9	-4.5	-4.9	-4.1
Optical Instrument	-6.2	-3.2	-5.4	-4.7	0.6	5.0
Transport Equipment	**-69.2**	**-61.0**	**-11.0**	**-5.7**	**-10.5**	**-8.3**
Motor Vehicles	-68.4	-60.9	-16.3	-11.9	-11.8	-9.6
Other transport	-0.8	-0.2	5.3	6.2	1.4	1.3
General Machinery	**-42.2**	**-35.8**	**-21.8**	**-13.2**	**-6.3**	**-5.1**
Other industry	**-33.6**	**-2.2**	**-126.6**	**-27.9**	**-15.4**	**-0.5**
Textile	-1.1	-0.1	-21.3	-16.3	-1.6	-0.4
Chemical	-9.2	0.5	-17.3	-0.5	-6.0	0.1
Metal and Non-metals	-17.9	-0.4	-65.8	-0.8	-6.8	-0.1
Rest of industries	-5.4	-2.3	-22.3	-10.3	-1.0	0.0

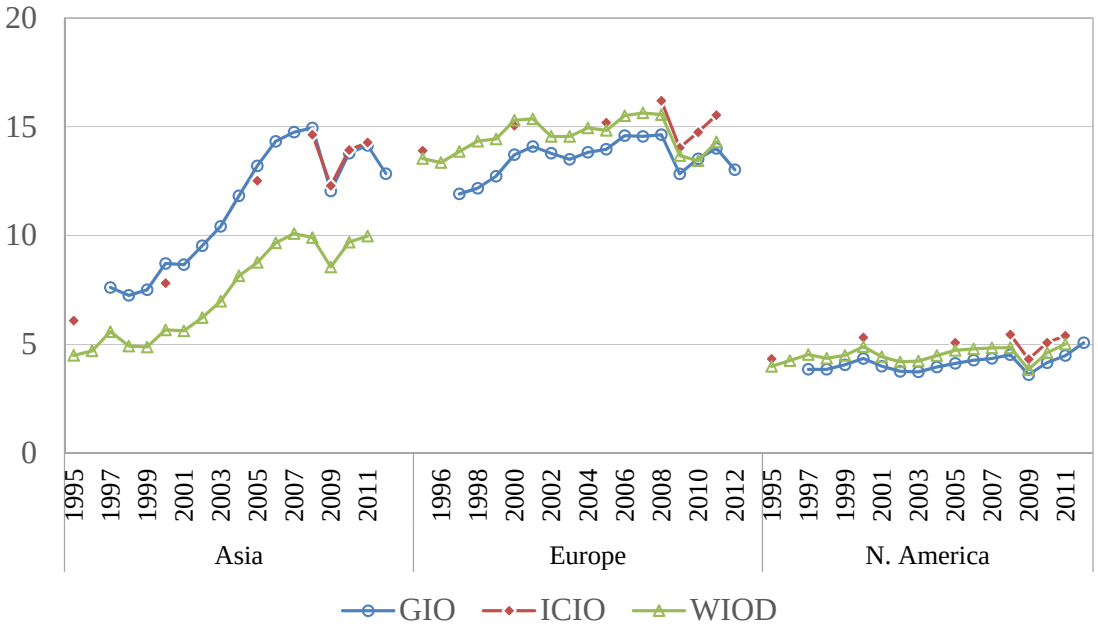
Source: Authors' calculation from UN Comtrade

Figure 1. Change in gross export from 2008 to 2009 in Asia
(All manufacturing industries, US$ billion)



Note: Country names and abbreviations are listed in Appendix 2.
Source: Authors' calculation from UN Comtrade

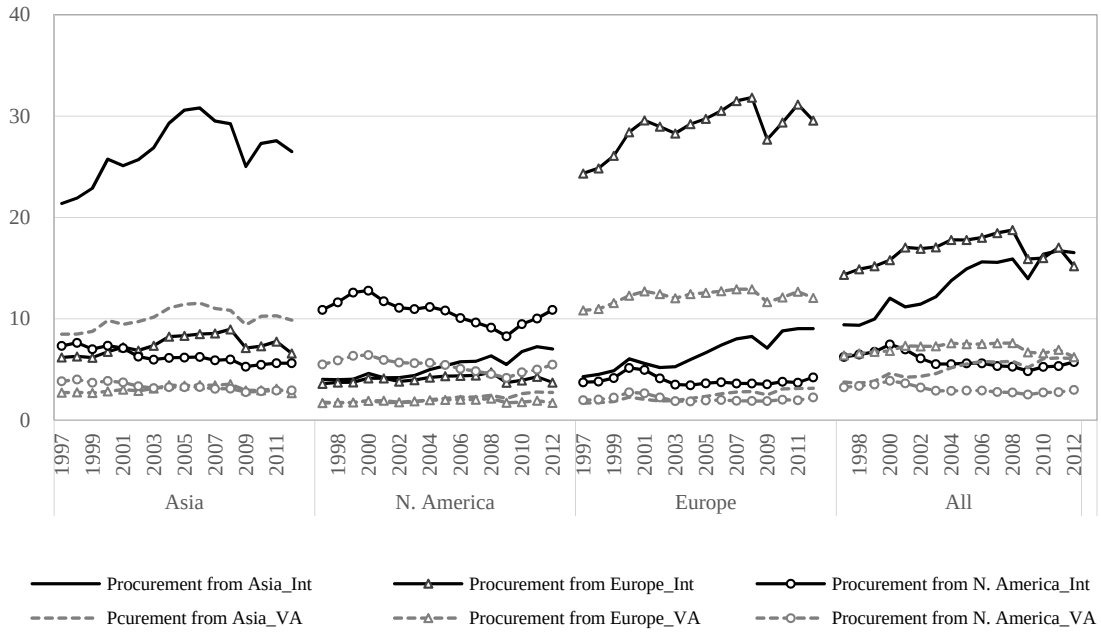
Figure 2. Changes in intra-regional linkages
(All industries, 1995-2012, percent of regional finished goods export)



Note: Intra-regional linkage is defined as percent share of the intra-regional inducements generated by domestic and foreign final demand in all endogenous countries on the regional final demand. Production inducements are calculated from the Leontief inverses based on three different IIO tables. See section 3 also.
Source: Authors' calculation from ICIO (1995, 2000, 2005, 2008-2011), WIOD (1995-2011) and GIO (1997-2012) Tables.

Figure 3. Changes in regional linkages

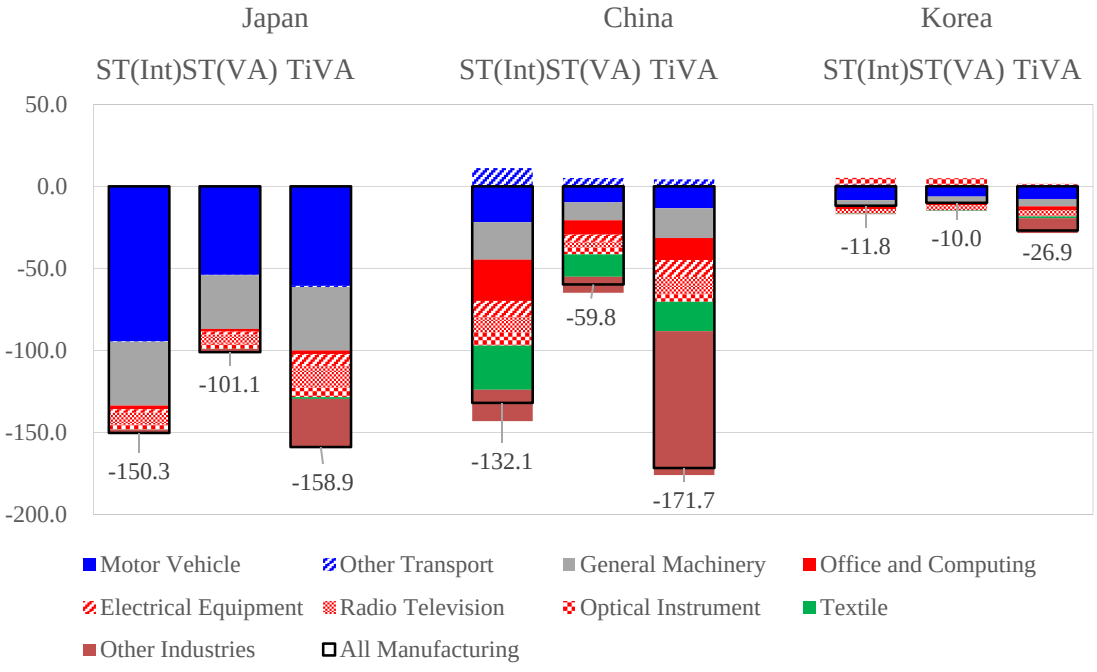
(All manufacturing industries, 1997-2012, percent of regional finished goods export)



Note: Inter-regional linkage is defined as percent share of the inter-regional inducements generated by final goods export by all endogenous countries normalized to the regional final goods export. Production inducements are calculated from the Leontief inverses based on three different IIO tables. 'All' represents all 29 endogenous countries covered by the GIO table.

Source: Authors' calculation from GIO (1997-2012) tables and UN Comtrade.

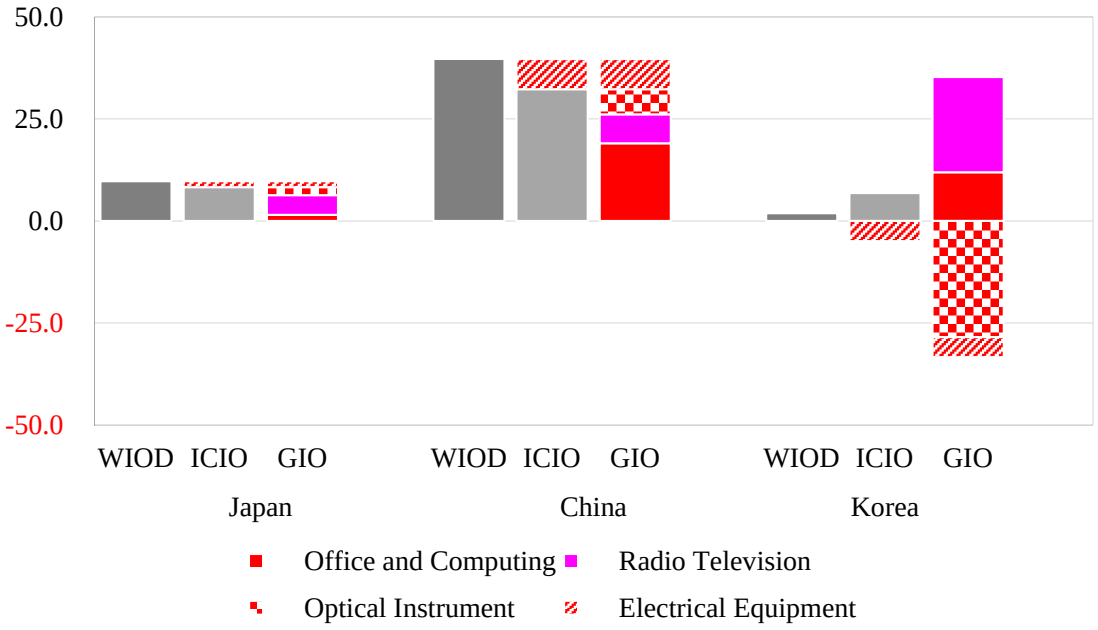
Figure 4. Industry-specific impact of GFC on Japan, China and Korea (US$ billion)



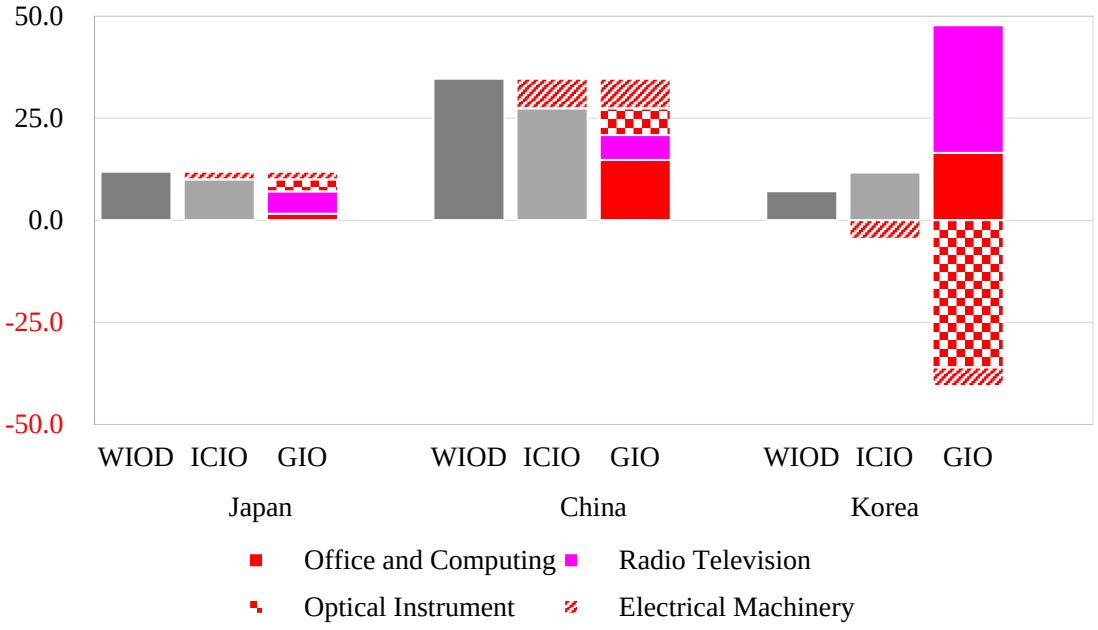
Source: Authors' calculation from the 2009 GIO Table and UN Comtrade

Figure 5. Degree of Shock Transmissions to domestic economies
(Electrical Machinery industry, percent of total impact on manufacturing)

(a) Intermediate inputs contents

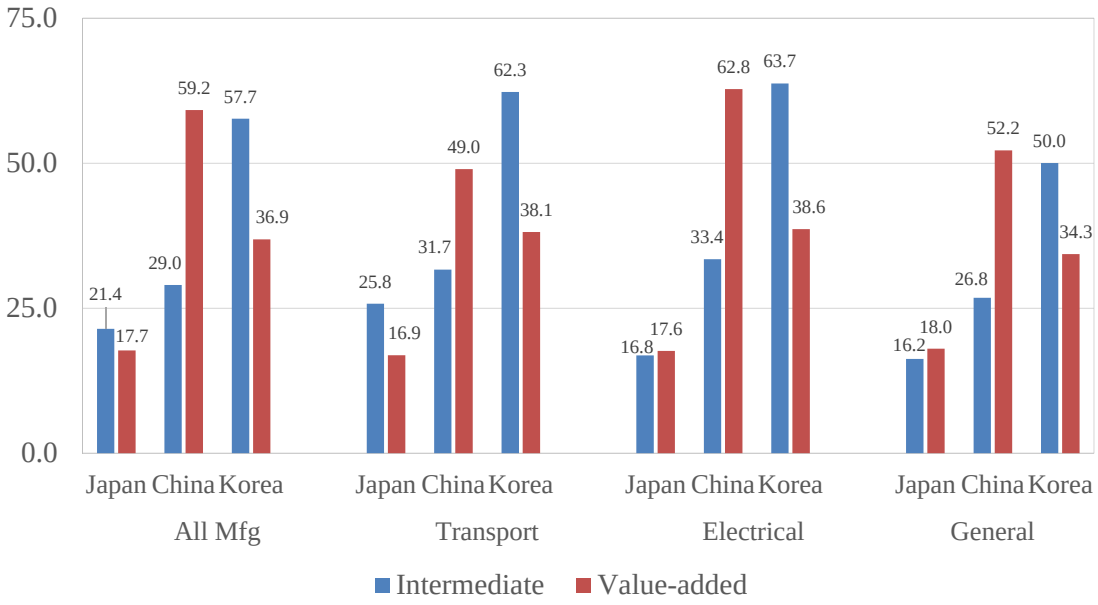


(b) Value added contents



Note: As total impact of All Manufacturing industries is negative, the positive impacts takes the negative value in the graph. All four sub classifications are aggregated as single Electrical Machinery industry in WIOD, whereas, three sub categories (excluding Electrical Equipment) are aggregated as Other Electrical Machinery industry in ICIO Table.
Source: Authors' calculation from 2009 GIO Table using WIOD, ICIO and GIO industrial classification system, and UN Comtrade.

Figure 6. Summary of shock transmission to foreign countries
(selected industries, percent of final demand shock)



Note: All Mfg: All Manufacturing, Transport: Transport Equipment, Electrical: Electrical Machinery and General: General Machinery industries. Intermediate: transmission of shocks to foreign countries through intermediate inputs channels and Value-added: transmission of shocks to foreign countries through value-added channels.
Source: Authors' calculation from 2009 GIO Table and UN Comtrade

Table 1. Annual real GDP growth rate in Asia
(Percent, 2008-2011)

Year	JP	CH	KR	TW	SG	MY	TH	ID	PH	VT	IN
2008	-1.0	9.6	2.8	0.7	1.8	4.8	2.5	6.0	4.2	5.7	3.9
2009	-5.5	9.2	0.7	-1.6	-0.6	-1.5	-2.3	4.6	1.1	5.4	8.5
2010	4.7	10.6	6.5	10.6	15.2	7.4	7.8	6.2	7.6	6.4	10.3
2011	-0.5	9.5	3.7	3.8	6.2	5.2	0.1	6.2	3.7	6.2	6.6

Note: See Appendix 2 for country names and its abbreviation.
Source: World Development Indicator, World Bank except for Taiwan (CEIC database)

Table 2. Shock transmissions and Final demand export (to the World) shock due to GFC.

(a) Shock transmissions through the intermediate goods channel (US$ billion)

	JP	CH	KR	TW	SG	MY	TH	ID	PH	VT	IN	AU	US	CA	MX	BR	UK	GR	FR	IT	SP	NL	BG	AT	FN	IR	LX	PT	SA
JP	-150.3	-3.0	-1.4	-1.3	-1.0	-0.7	-1.8	0.0	-0.1	0.1	0.1	-0.1	-1.0	-0.3	-0.2	-0.1	-0.4	-1.4	-0.2	-0.2	-0.1	-0.4	-0.5	-0.1	-0.2	0.0	0.0	0.0	-0.1
CH	-7.8	-132.1	-2.8	-2.8	-4.0	-2.3	-2.0	-0.1	-0.2	0.0	0.9	-0.2	-2.9	-0.8	-0.5	-0.3	-1.0	-5.1	-0.7	-1.9	-0.4	-1.4	-1.3	-0.3	-0.7	-0.6	0.0	-0.1	-0.4
KR	-1.4	-2.4	-11.8	-0.5	-0.4	-0.3	-0.3	0.0	0.0	0.0	0.2	0.0	-0.4	-0.1	-0.1	0.0	-0.1	-0.5	-0.1	-0.1	0.0	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0
TW	-0.4	-1.2	-0.2	-12.4	-0.4	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	-0.1	-0.3	0.0	-0.1	0.0	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0
SG	-0.3	-0.8	-0.1	-1.3	-2.6	-1.2	-0.4	0.0	-0.2	0.0	0.1	-0.1	-0.3	0.0	0.0	0.0	-0.2	-0.4	-0.1	0.0	0.0	-0.2	-0.3	0.0	0.0	0.0	0.0	0.0	0.0
MY	-0.7	-0.7	-0.1	-0.5	-1.8	-11.4	-0.6	0.0	-0.1	0.0	0.1	0.0	-0.2	0.0	0.0	0.0	-0.1	-0.3	0.0	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
TH	-1.3	-0.9	-0.1	-0.3	-0.6	-0.6	-12.5	0.0	0.0	0.0	0.1	-0.1	-0.2	0.0	0.0	0.0	-0.1	-0.3	-0.1	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
ID	-0.5	-0.4	-0.1	-0.1	-0.4	-0.3	-0.2	-0.8	0.0	0.0	0.1	0.0	-0.1	0.0	0.0	0.0	0.0	-0.2	0.0	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
PH	-0.4	-0.3	0.0	-0.3	-0.2	-0.1	-0.1	0.0	-3.1	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VT	-0.3	-0.2	0.0	-0.1	-0.1	-0.1	-0.2	0.0	0.0	0.4	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IN	-0.2	-0.7	-0.2	-0.1	-0.3	-0.2	-0.3	0.0	0.0	0.0	14.4	0.0	-0.3	-0.1	0.0	0.0	-0.2	-0.8	-0.1	-0.3	-0.1	-0.2	-0.3	0.0	0.0	0.0	0.0	0.0	-0.1
AU	-0.8	-0.7	-0.2	-0.1	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.2	-5.7	-0.1	0.0	0.0	0.0	-0.1	-0.2	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
US	-3.7	-2.2	-0.7	-1.2	-2.4	-1.0	-0.6	0.0	-0.1	0.0	0.3	-0.2	-96.1	-5.3	-2.1	-0.3	-1.5	-4.1	-1.3	-0.8	-0.3	-1.5	-1.4	-0.2	-0.3	-0.2	0.0	0.0	-0.2
CA	-0.2	-0.3	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.5	-22.1	-0.1	0.0	-0.1	-0.2	-0.1	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
MX	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.2	-0.4	-9.9	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
BR	-0.1	-0.5	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	-0.1	-11.3	-0.1	-0.5	-0.1	-0.1	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
UK	-0.4	-0.3	-0.1	-0.1	-0.3	-0.1	-0.2	0.0	0.0	0.0	0.1	0.0	-0.7	-0.3	0.0	0.0	-38.4	-4.0	-0.7	-0.6	-0.3	-1.1	-1.4	-0.2	-0.2	-0.8	0.0	-0.1	-0.1
GR	-2.0	-1.9	-1.2	-0.3	-0.7	-0.5	-0.4	0.0	0.0	0.0	0.2	-0.1	-1.3	-0.2	-0.4	-0.2	-2.2	-130.2	-2.8	-3.0	-1.5	-4.3	-4.9	-3.3	-1.2	-0.1	-0.1	-0.3	-0.3
FR	-0.4	-0.4	-0.1	-0.1	-0.3	-0.1	-0.1	0.0	0.0	0.0	0.1	0.0	-0.5	-0.1	0.0	-0.1	-0.9	-4.4	-46.4	-1.4	-0.9	-1.0	-2.2	-0.2	-0.2	0.0	-0.1	-0.1	-0.1
IT	-0.3	-0.6	-0.2	-0.1	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.1	0.0	-0.5	-0.1	-0.1	-0.1	-0.7	-4.7	-1.3	-65.6	-0.6	-0.6	-1.0	-0.6	-0.2	0.0	0.0	-0.1	-0.1
SP	-0.2	-0.2	0.0	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	-0.1	-0.1	-0.4	-2.7	-1.2	-0.9	-23.4	-0.4	-0.8	-0.1	-0.1	0.0	0.0	-0.6	0.0
NL	-0.3	-0.2	-0.1	-0.1	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.1	0.0	-0.2	0.0	0.0	0.0	-1.0	-3.9	-0.7	-0.8	-0.3	-18.7	-3.7	-0.2	-0.2	-0.1	0.0	-0.1	0.0
BG	-0.1	-0.2	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.2	0.0	0.0	0.0	-0.5	-2.4	-1.0	-0.6	-0.2	-1.5	-22.9	-0.1	-0.1	0.0	-0.1	0.0	0.0
AT	-0.1	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-3.0	-0.2	-0.5	-0.1	-0.2	-0.2	-12.3	-0.1	0.0	0.0	0.0	0.0
FN	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.4	-0.1	-0.1	0.0	-0.2	-0.1	0.0	-13.2	0.0	0.0	0.0	0.0
IR	-0.1	-0.1	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	-0.5	-1.1	-0.2	-0.1	-0.1	-0.1	-0.6	0.0	0.0	-1.6	0.0	0.0	0.0
LX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.5	-0.1	-0.1	0.0	-0.1	-0.2	0.0	0.0	0.0	-0.2	0.0	0.0
PT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.4	-0.1	-0.1	-0.3	-0.1	-0.1	0.0	0.0	0.0	0.0	-4.0	0.0
SA	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.5	0.0	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-5.7
HK	0.0	-0.1	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
ROA	-0.3	-0.4	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.1	0.0	-0.2	-0.1	0.0	0.0	-0.2	-0.9	-0.2	-0.5	-0.1	-0.2	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0
ROE	-0.5	-0.5	-0.2	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.1	0.0	-0.3	-0.1	0.0	0.0	-0.8	-8.8	-0.8	-1.5	-0.4	-1.2	-1.7	-0.7	-1.0	-0.1	0.0	-0.1	-0.1
OPEC	-0.1	-0.2	0.0	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.2	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
ROW	-0.5	-1.0	-0.2	-0.2	-0.2	-0.3	-0.2	0.0	0.0	0.0	0.2	-0.1	-0.6	-0.3	-0.1	-0.2	-1.0	-4.3	-0.7	-1.1	-0.4	-1.0	-0.7	-0.5	-0.2	-0.1	0.0	-0.1	-0.1

Notes: Shaded cells are transmission of the shock to the domestic economies.
Source: Authors' calculation from 2009 GIO table and UN Comtrade

(b) Shock transmissions through the value-added channel (US$ billion)

	JP	CH	KR	TW	SG	MY	TH	ID	PH	VT	IN	AU	US	CA	MX	BR	UK	GR	FR	IT	SP	NL	BG	AT	FN	IR	LX	PT	SA
JP	-101.1	-1.4	-0.6	-0.7	-0.5	-0.3	-0.7	0.0	-0.1	0.0	0.1	0.0	-0.5	-0.1	-0.1	0.0	-0.2	-0.7	-0.1	-0.1	0.0	-0.2	-0.2	0.0	-0.1	0.0	0.0	0.0	0.0
CH	-2.4	-59.8	-0.8	-0.8	-1.1	-0.7	-0.6	0.0	-0.1	0.0	0.3	-0.1	-1.0	-0.3	-0.2	-0.1	-0.3	-1.6	-0.3	-0.6	-0.1	-0.5	-0.4	-0.1	-0.2	-0.2	0.0	0.0	-0.1
KR	-0.6	-1.0	-10.0	-0.2	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.1	0.0	-0.2	0.0	0.0	0.0	0.0	-0.2	0.0	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
TW	-0.2	-0.6	-0.1	-16.3	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SG	-0.1	-0.2	0.0	-0.3	-2.9	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
MY	-0.2	-0.2	0.0	-0.1	-0.5	-4.9	-0.2	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TH	-0.4	-0.3	0.0	-0.1	-0.2	-0.2	-6.9	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ID	-0.3	-0.2	0.0	-0.1	-0.2	-0.2	-0.1	-1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PH	-0.1	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	-1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VT	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IN	-0.1	-0.3	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	8.7	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.3	0.0	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
AU	-0.4	-0.3	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.1	-3.7	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
US	-2.0	-1.1	-0.3	-0.7	-1.3	-0.5	-0.3	0.0	-0.1	0.0	0.2	-0.1	-97.0	-2.6	-1.0	-0.2	-0.8	-2.1	-0.7	-0.4	-0.1	-0.8	-0.8	-0.1	-0.1	-0.1	0.0	0.0	-0.1
CA	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	-16.8	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MX	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.2	-8.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BR	-0.1	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-12.6	0.0	-0.2	0.0	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
UK	-0.2	-0.1	0.0	0.0	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	-0.4	-0.1	0.0	0.0	-31.4	-1.8	-0.3	-0.3	-0.1	-0.5	-0.6	-0.1	-0.1	-0.3	0.0	0.0	0.0
GR	-0.7	-0.8	-0.4	-0.1	-0.3	-0.2	-0.1	0.0	0.0	0.0	0.1	0.0	-0.6	-0.1	-0.1	-0.1	-0.9	-90.3	-1.2	-1.3	-0.6	-1.9	-1.9	-1.4	-0.5	0.0	-0.1	-0.1	-0.1
FR	-0.2	-0.2	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	-0.4	-2.0	-33.5	-0.6	-0.4	-0.5	-1.0	-0.1	-0.1	0.0	0.0	-0.1	0.0
IT	-0.1	-0.2	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	-0.3	-1.8	-0.5	-40.2	-0.2	-0.2	-0.4	-0.2	-0.1	0.0	0.0	-0.1	0.0
SP	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.2	-1.1	-0.5	-0.4	-14.1	-0.2	-0.3	-0.1	0.0	0.0	0.0	-0.3	0.0
NL	-0.1	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.5	-1.7	-0.3	-0.4	-0.1	-14.8	-1.7	-0.1	-0.1	-0.1	0.0	0.0	0.0
BG	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.2	-0.9	-0.4	-0.2	-0.1	-0.6	-15.6	0.0	0.0	0.0	0.0	0.0	0.0
AT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-1.3	-0.1	-0.2	0.0	-0.1	-0.1	-10.1	0.0	0.0	0.0	0.0	0.0
FN	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	-0.1	-0.1	0.0	-10.9	0.0	0.0	0.0	0.0
IR	-0.1	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.2	-0.5	-0.1	-0.1	0.0	-0.1	-0.3	0.0	0.0	-0.1	0.0	0.0	0.0
LX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.2	0.0	0.0
PT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-2.7	0.0
SA	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.9

Notes: Shaded cells are transmission of the shock to the domestic economies. 'Shock' in the bottom of the table denotes the actual amount of negative or positive change in final goods export from 2008 to 2009.
Source: Authors' calculation from 2009 GIO table and UN Comtrade

(c) Final demand shocks due to the GFC (US$ billion)

	JP	CH	KR	TW	SG	MY	TH	ID	PH	VT	IN	AU	US	CA	MX	BR	UK	GR	FR	IT	SP	NL	BG	AT	FN	IR	LX	PT	SA
Shock	-112.2	-72.2	-14.6	-21.0	-9.5	-9.0	-10.5	-1.2	-1.9	0.3	12.0	-4.8	-104.1	-22.1	-17.7	-16.7	-43.6	-134.1	-46.0	-53.9	-18.1	-24.4	-28.9	-15.0	-14.6	-1.4	-0.5	-3.7	-4.3

Source: Authors' calculation from 2009 GIO table and UN Comtrade

Table 3. Summary of shock transmissions and trade in value-added

(Selected industries, US$ billion)

Industry Economy	Final demand	ST (Int)	ST (VA)	Gross Export	TiVA
All Manufacturing	Shock	Domestic	Domestic	Shock	Domestic
Japan	**-112.2**	**-150.3**	**-101.1**	-176.0	-158.9
China	-72.2	-132.1	-59.8	**-207.1**	**-171.7**
Korea	-14.6	-11.8	-10.0	-39.6	-26.9
Motor Vehicle	Shock	Domestic	Domestic	Shock	Domestic
Japan	**-60.9**	**-94.5**	**-54.0**	**-68.4**	**-60.7**
China	-11.9	-21.9	-9.8	-16.3	-13.4
Korea	-9.6	-8.4	-6.3	-11.8	-7.7
General Machinery	Shock	Domestic	Domestic	Shock	Domestic
Japan	**-35.8**	**-38.9**	**-32.8**	**-42.2**	**-38.7**
China	-13.2	-22.8	-10.9	-21.8	-18.1
Korea	-5.1	-4.1	-3.6	-6.3	-4.5
Office and Computing	Shock	Domestic	Domestic	Shock	Domestic
Japan	-1.8	-2.3	-1.6	-2.5	-2.3
China	**-11.0**	**-25.1**	**-8.8**	**-16.8**	**-13.5**
Korea	-2.3	-1.4	-1.7	-3.4	-2.4
Electrical Equipment	Shock	Domestic	Domestic	Shock	Domestic
Japan	-2.1	-2.2	-1.9	-7.8	-7.1
China	**-5.3**	**-9.8**	**-4.3**	**-12.5**	**-10.3**
Korea	0.7	0.6	0.5	0.2	0.1
Radio Television	Shock	Domestic	Domestic	Shock	Domestic
Japan	**-6.1**	-7.2	**-5.6**	**-14.5**	**-13.3**
China	-4.5	**-9.4**	-3.7	-12.9	-10.5
Korea	-4.1	-2.8	-3.1	-4.9	-3.7
Optical Instrument	Shock	Domestic	Domestic	Shock	Domestic
Japan	-3.2	-2.9	-3.0	**-6.2**	**-5.8**
China	**-4.7**	**-8.2**	**-3.9**	-5.4	-4.5
Korea	5.0	3.4	3.6	0.6	0.5

Note: Shaded cells represent the hardest hit country by the GFC in respective industry among Japan, China and Korea. Shock indicates the exogenous shock due to the GFC. Domestic represents the transmission of shock to the domesticeconomies.

Source: Authors' calculation from 2009 GIO Table and UN Comtrade