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Abstract

This paper examines the competitiveness of industries in six Asian countries—China, India, Indonesia, Japan, South Korea, and Taiwan—using the World Input–Output Database tables from 1995 to 2011. Competitiveness is measured by the value added that industries contribute to the production of final goods, which we refer to as global value chain (GVC) income, rather than by gross exports. We find that the competitiveness of manufacturing is increasing in China, India, and Indonesia, whereas it is decreasing in Japan, South Korea, and Taiwan. Even though we focus on the GVC income rather than gross exports, the increasing competitiveness of Chinese, Indian, and Indonesian manufacturing is remarkable. We also find that, unlike EU countries, Asian countries have generally been able to combine increasing GVC job opportunities with a rise in real income. The GVC income in Asian countries presents a different picture to that in European countries.

Keywords: Global value chain, Competitiveness, Value added, Asia

JEL classification: F6; J2; O57

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1. Introduction

The international competitiveness of industries has long been one of the central issues in the literature on business (e.g., Porter, 1990) and economics (e.g., Fagerberg, 1988). Traditionally, shares in the world export markets are used to measure the competitiveness of industries. However, as a result of increases in the intermediate inputs trade, "the conventional indicators of competitiveness based on gross exports become less informative" (Timmer, Los, Stehrer and de Vries, 2013, p.613). This is because a large export share does not necessarily mean that an industry has a large value added if its main production process consists of simple assembly activities, based on imported intermediate inputs.

A typical example to illustrate this is Chinese exports of the iPod. Dedrick, Kraemer and Linden (2009) focused on the production process of the iPod and examined the distribution of profits across firms that supplied intermediate inputs and other related services. They found that, although the iPod was designed by Apple in the United States (US) and assembled by Inventec Appliances in China, its intermediate goods came from various firms in various countries. As a result, the value added (measured by the operating margin) was distributed across these firms in different countries. Lead firm Apple in the US earned 11.8 percent of the operating margin. The remaining margins were shared by such firms as Samsung in South Korea, which provided primary memory (9.4 percent of the operating margin), TDK in Japan, which provided the battery (7.6 percent), Toshiba-Matsushita Display in Japan, which provided the display (3.9 percent) and Toshiba in Japan, which provided the hard drive (3.8 percent). In China, in contrast, the value added was very low even though the iPod was assembled there.[1] This clearly indicates that the iPod being exported from China does not necessarily mean that all the value added of the iPod is distributed to Chinese factory owners.[2]

In light of the increasing importance of the intermediate inputs trade in Asia, this paper examines the competitiveness of industries in selected Asian countries. In order to

[1] In a related study, Kraemer, Linden and Dedrick (2011) estimated that, even though the retail price of the iPhone 4 (in 2010) was $549, the value captured through assembly in China was around $10 (1.8 percent), whereas the value captured by Apple was $321 (58.5 percent).

[2] Xing (2014) pointed out that "All iPhone components (…) are shipped to Foxconn, a Taiwanese company located in Shenzhen, China, for assembly into final products and then exported to the world market" (p.117). Similarly to Dedrick, Kraemer and Linden (2009), Ali-Yrkkö, Rouvinen, Seppälä and Ylä-Anttila (2011) examined the distribution of value added, focusing on the Nokia smartphone.

measure the competitiveness of the industries, we focus on how much value added they could earn. To do so, we employ the concept of global value chain (GVC) income, which was proposed by Timmer, Los, Stehrer and de Vries (2013). GVC income is defined as the value added that industries contribute to the production of final manufacturing goods. Unlike value added exports, GVC income takes into account the value added that is generated from domestic final demand as well as foreign final demand.[3] As we will discuss, developed countries are facing declining domestic demand, whereas emerging countries are facing increasing domestic demand. If such differences are not taken into account, one could overestimate the competitiveness of industries in developed countries and/or underestimate the competitiveness of industries in emerging countries. This paper also examines the employment involved in the production of final manufacturing goods, which we refer to as GVC workers, to examine the changes in demand for skills in the Asian countries on which we focus.[4]

Note that the definition of competitiveness in this paper is similar to but slightly different from the definition used in Eaton and Kortum (2002) and Bernard, Eaton, Jensen and Kortum (2003). In these studies, the competitiveness of a country is measured by the country's technology state, adjusted for its labor costs. This is, so to speak, an ex ante measure, in the sense that the actual value added that a country can earn depends upon its trade costs. Even if a country is competitive, it may earn a small value added, owing to its remoteness from the market. In contrast, we employ an ex post measure, in the sense that we focus on how much value added the industries in a country could actually earn.[5]

Our study relates to two strands of the existing literature. One comprises the studies on the value added trade in Asian countries.[6] For example, Koopman, Wang and Wei (2014) examined the value added exports of several countries, including Asian countries, in 2004. One of the interesting findings of their study is that both China and India

[3] A more precise definition of GVC income is provided in Section 2.
[4] Following Timmer, Los, Stehrer and de Vries (2013), we use the terms "GVC job opportunities" and "GVC workers" interchangeably.
[5] Note that competitiveness using the ex post measure can reflect not only the country's technology state but also its trade costs. In addition, it can be affected by differences in market structure. The World Economic Forum reports alternative measures of competitiveness, which it defines as the set of institutions, policies and factors that determine the productivity level of an economy. Although using GVC income as a measure of competitiveness remains controversial, this study follows the definition of Timmer, Los, Stehrer and de Vries (2013) to ensure the comparability of our findings with previous studies.
[6] Johnson (2014) summarized recent trends in value added exports and their implications.

exhibited a strong revealed comparative advantage (RCA) if RCA was based on gross exports. However, the RCA ranking of both countries fell dramatically if RCA was based on the exports of domestic value added. Similar results were found by Ceglowski (2015), who examined the competitiveness of 56 countries in five industries, using a trade in value added (TiVA) database developed by the Organization for Economic Co-operation and Development (OECD) and the World Trade Organization (WTO).[7]

The other strand of the literature to which our study relates comprises the studies on the competitiveness of industries, where competitiveness is measured by GVC income rather than value added exports. A pioneering study is Timmer, Los, Stehrer and de Vries (2013). Their study examined the competitiveness of industries, measured by GVC income, in the EU27 countries. Using the World Input–Output Database (WIOD) from 1995 to 2009, they presented two important findings. First, gross exports overestimated competitiveness when industries depended heavily on the imports of intermediate inputs. Second, only a few European countries have been able to combine increasing GVC job opportunities with a substantial rise in real wages. Following Timmer, Los, Stehrer and de Vries (2013), Grodzicki (2014) applied the concept of GVC income to examine the competitiveness of the Visegrad Four economies (i.e., the Czech Republic, Hungary, Poland and Slovakia). Timmer, Dietzenbacher, Los, Stehrer and de Vries (2015) applied this framework to analyze the shifts in competitiveness in automotive production across countries.

These two strands of studies have made significant contributions to the economics and business literature. However, the first strand of studies did not take into account the effect of domestic final demand or the effects on employment, whereas the second strand focuses only on European countries or only on a particular sector.[8] Note that Asian countries may present a different picture to the European countries. For example,

[7] Ceglowski (2015) measured competitiveness using RCA. Similarly, Daudin, Rifflart and Schweisguth (2011) estimated the value added trade for 66 regions and 55 sectors in 1997, 2001 and 2004 using the Global Trade Analysis Project database. The IMF (2015, Chapter 2) examined the value added trade in Asia from 1995 to 2009, using the TiVA database.

[8] In this connection, Foster-McGregor and Stehrer (2013) and Kwon and Ryou (2015) examined the value added trade, using the WIOD. However, their main objectives were to propose an approach to decompose the value added content of trade into the foreign and domestic content, when intermediate inputs are traded (Foster-McGregor and Stehrer, 2013), and to develop a new index of vertical specialization (Kwon and Ryou, 2015). The scope of their studies is different from the studies on GVC income. Foster-McGregor, Stehrer and de Vries (2013) examined skill demand, using the WIOD. Their sample consisted of 40 countries, including Asian countries. However, as noted, they focused on the determinants of skill demand and, although they examined offshoring, GVC income is beyond the scope of their study.

Kimura (2006) argued that the development of cross-border production sharing is more advanced in East Asia than in North America and Europe.[9] Similarly, Baldwin and Lopez-Gonzalez (2015) pointed out that "Factory Asia" is more like a network and much less like the hub-and-spoke pattern that is observed in "Factory North America" and "Factory Europe". This is because the processing of manufacturing products often involves stops in multiple nations. Therefore, it is interesting to ask whether there are similar patterns in GVC income and GVC workers in Asia to those found in Europe. A detailed analysis of the competitiveness of industries in Asian countries is needed to better inform the policy debates on globalization.

Given this background, this paper attempts to fill the gap between the above two strands of literature. We examine the competitiveness of industries in six Asian countries: China, India, Indonesia, Japan, South Korea and Taiwan. Following the methodology developed by Timmer, Los, Stehrer and de Vries (2013), we measure the competitiveness of industries using GVC income. To compute GVC income, we utilize the latest version of the WIOD, which covers the period between 1995 and 2011.[10] This framework enables us to trace the source of the value added for the six Asian countries. Moreover, it allows us to examine the effects of changes in the production of final manufacturing goods on skill demand. Thus, our study contributes to the above two strands of literature, takes into account the effect of domestic final demand and the effects on employment, and adds another regional perspective to the available evidence.

The major findings of this paper are twofold. First, the competitiveness of manufacturing is increasing in China, India and Indonesia, whereas it is decreasing in Japan, South Korea and Taiwan. Even though we focus on GVC income rather than gross exports, the increasing competitiveness of Chinese, Indian and Indonesian manufacturing is remarkable. Second, unlike the EU countries, Asian countries have generally been able to combine an increase in GVC job opportunities with a rise in real income. The correlation between the change in real income per worker and the change in the number of workers is 0.55 for the six Asian countries studied, whereas it is –0.26 for the EU27 countries. This indicates that Asian countries have generally been able to

[9] Kimura (2006) commented, "Although we observe similar cross-border production sharing in the US–Mexico nexus and the Western Europe–Central/Eastern Europe corridor, they have not yet reached the level of development that East Asia has accomplished" (p.326).

[10] Although the TiVA database compiles the value-added trade data for many countries, it reports only on the trade data. It does not allow us to examine the effects on employment. This paper utilizes the WIOD rather than the TiVA database because we focus not only on GVC income but also on GVC workers.

combine increasing GVC job opportunities and rising real incomes, whereas the EU countries have not.

The rest of the paper is organized as follows. Section 2 explains the methodology and data used in this paper. In Section 3, we present the estimation results. A summary and concluding remarks are presented in Section 4.

2. GVC Income: Concept, Methodology and Data[11]

2.1. The concepts of GVC income and GVC workers

Before describing our methodology, it is useful to explain the concept of the GVC intuitively and discuss why GVC income can provide a measure of competitiveness. GVC income, which is proposed by Timmer, Los, Stehrer and de Vries (2013) as a measure of competitiveness, is defined as the value added that industries contribute to the production of final manufactured goods. Note that some of the final goods are used as intermediate inputs for other final goods. Moreover, some of the intermediate inputs come from sectors in foreign countries. These are the main challenges in measuring GVC income.

The concept of GVC income is based on a global input–output (IO) table. A national IO table reports the amount and type of intermediate inputs needed in the production of one unit of final demand in one country. A global IO table reports the domestic and imported intermediate inputs separately, and reports the exports for the intermediate and the final demands separately. This enables us to trace the gross output in all stages of production that is needed to produce one unit of final demand in each industry in each country. Once we trace the gross output flows needed to produce one unit of final demand, we can derive the value added that is involved in the production of final manufacturing goods by multiplying these gross output flows with the share of the value added to the gross output for each industry in each country. By the same logic, one can trace the number of workers that are directly and indirectly involved in the production of one unit of final demand. We extend this idea to measure how much value added and employment are involved in the production of final manufactured goods, to measure the GVC income and GVC workers, respectively.

The key differences between GVC income and gross exports are twofold. First, the GVC income focuses on the value added transactions. Like the value added trade,

[11] This section is based on Kiyota (2016), Section 2.

therefore, GVC income excludes intermediate inputs, whereas the gross exports measure includes them. Second, unlike the value added trade, GVC income includes value added in the production of domestic as well as final demand. This is to capture the net effects on domestic and foreign demand because income can be generated from both domestic and foreign final demand. If a country has a large domestic market, measures based on gross exports (or foreign final demand) miss the effects of the domestic market. In other words, gross exports (and foreign demand) allow us to measure shares in the world export markets (excluding the domestic market), whereas GVC income allows us to measure the shares in world markets (including the domestic market).

Note that, conceptually, GVC income can cover not only final manufactured goods but also final non-manufactured goods, including services. However, as Timmer, Los, Stehrer and de Vries (2013) pointed out, the WIOD is not detailed enough to examine actively traded services. For example, consultancy services are one of the services actively traded across borders but they are included in business services in the WIOD. Because most business services are non-tradables, it is difficult to capture precisely the trade in consultancy services. As a compromise, therefore, this paper focuses on GVC income generated by the demand for final manufactured goods. In this paper, therefore, the GVC income means the manufacturing GVC income.

2.2. Methodology

Following the methodology of Timmer, Los, Stehrer and de Vries (2013), we calculate GVC income for six Asian countries: China, India, Indonesia, Japan, South Korea and Taiwan. We also compute GVC income for Germany and the US as a reference point. This section provides the mathematical exposition of the methodology, which follows a standard global IO analysis approach, as in Timmer, Los, Stehrer and de Vries (2013).[12]

Suppose that there are M production factors and S industries in N countries. Although we will apply annual data in our empirical analysis below, time subscripts are left out for ease of exposition. Output in each country–industry is produced using domestic production factors and intermediate inputs, which are sourced domestically or

[12] Note that the standard IO model is based on a static framework, with a number of restrictive assumptions, including constant returns to scale, as well as fixed input and labor coefficients. Moreover, the analysis is based on a static and demand-driven framework. For more detailed discussion of common critiques, see Baldwin (1994) and Kiyota (2012). OECD (1992) summarizes the advantages and limitations of IO analysis in a comprehensive way.

from abroad. Output is used to satisfy final demand (either at home or abroad) or is used as an intermediate input in production (either at home or abroad as well).

To trace the transactions of intermediate and final goods, it is necessary to define source and destination country–industries.[13] For a particular good, let i be the source country, let j be the destination country, let s be the source industry and t be the destination industry. Let $y_i(s)$ be the value of the output of industry s of country i, let $f_{ij}(s)$ be the value of the output exported from industry s in country i for final use in any country j and let $x_{ij}(s,t)$ be the value of the output exported from industry s in country i for intermediate use by industry t in country j. If $j = i$ $(j \neq i)$, goods are used at home (abroad). The goods market-clearing condition is written as:

$$y_i(s) = \sum_j \sum_t x_{ij}(s,t) + \sum_j f_{ij}(s). \quad (1)$$

For illustrative purposes, Figure 1 presents the structure of the global IO table for a three-country case (i.e., $N = 3$), where $v_j(t)$ indicates the value added of industry t in country j. As Figure 1 shows, the global IO table reports domestic and imported intermediate inputs separately (from top to bottom), and it reports the exports for intermediate use and for final use (from left to right). For example, part of Country 1's output is for intermediate use by domestic industries ($x_{11}(s,t)$) as well as intermediate use by Country 2 ($x_{12}(s,t)$) and by Country 3 ($x_{13}(s,t)$). Country 1's output also goes to final use in the domestic market ($f_{11}(s)$) and to final use by Country 2 ($f_{12}(s)$) and by Country 3 ($f_{13}(s)$). Similarly, imports (for final use) by Country 1 are captured by $f_{21}(s)$ and $f_{31}(s)$.

=== Figure 1 ===

Let **y** be the vector of production of dimension $(SN \times 1)$, which is obtained by stacking output levels $y_i(s)$ in each country–industry. We define **f** as the vector of dimension $(SN \times 1)$ that is constructed by stacking world final demand for output by each country–industry $f_i(s) \equiv \sum_j f_{ij}(s)$. Let **A** be a global intermediate input coefficient matrix of dimension $(SN \times SN)$, the elements of which are $a_{ij}(s,t) \equiv x_{ij}(s,t)/y_j(t)$. The elements represent the output from industry s in country i used as an intermediate input by industry t in country j as a share of country j's output in

[13] In this study, goods, products, industries and sectors are regarded as interchangeable.

industry t. Therefore, the matrix $\mathbf{A}$ describes how each of the country–industry goods are produced, using a combination of domestic and foreign intermediate inputs.

Equation (1) is rewritten as $\mathbf{y} = \mathbf{A}\mathbf{y} + \mathbf{f}$. Rearranging this, the following fundamental IO identity is obtained:

$$\mathbf{y} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f}, \tag{2}$$

where $\mathbf{I}$ is an identity matrix of dimensions $(SN \times SN)$ and $(\mathbf{I} - \mathbf{A})^{-1}$ is the so-called Leontief inverse (Leontief, 1936). In this matrix, an element in row s and column t represents the total value of production by industry s that is required to produce one unit of final output in industry t.

Note that, given that $(\mathbf{I} - \mathbf{A})^{-1}$ is the Leontief inverse, which characterizes intermediate input transactions between industries across countries, Equation (2) captures all the direct and indirect effects because it accounts for the domestic vertical linkages between industries within a country (i.e., $j = i$) and the international vertical linkages between countries (i.e., $j \neq i$).

Let $p_i(s)$ be the value added per gross output produced by industry s in country i. Let $\hat{\mathbf{p}}$ be a diagonal matrix of dimensions $(SN \times SN)$, the elements of which are $p_i(s)$, where the hat designates that it is a diagonal matrix. The GVC income is the value added that is involved in manufacturing the final demand of the industries, both directly and indirectly. Let the vector of the GVC income of dimensions $(SN \times 1)$ be $\mathbf{v}$, the elements of which are the value added produced by industry s in country i, $v_i(s)$.

Note that we focus on the manufacturing GVC. Let the vector of the manufacturing final demand $(SN \times 1)$ be $\mathbf{f^m}$, where $f_i^m(s) = f_i(s)$ for industry s in country i if industry s is manufacturing and $f_i^m(s) = 0$ otherwise. From Equation (2), GVC income (i.e., the manufacturing GVC income) can be rewritten as:

$$\mathbf{v} = \hat{\mathbf{p}}(\mathbf{I} - \mathbf{A})^{-1}\mathbf{f^m}. \tag{3}$$

Similarly, let $L_i(s)$ be the number of workers in industry s in country i and let $l_i(s)$ be the labor-input coefficient, where $l_i(s) \equiv L_i(s)/y_i(s)$. Let $\mathbf{n}$ denote a vector of dimensions $(SN \times 1)$, the elements of which are $L_i(s)$, and let $\hat{\mathbf{L}}$ denote a diagonal

matrix of dimensions ($SN \times SN$), the elements of which are $l_i(s)$. The GVC workers are the workers who contribute to producing the final demand of the industries both directly and indirectly. From Equation (2), GVC workers are written as:

$$\mathbf{n} = \hat{\mathbf{L}}(\mathbf{I} - \mathbf{A})^{-1}\mathbf{f}^{\boldsymbol{m}}. \quad (4)$$

Equations (3) and (4) are used to measure GVC income and GVC workers, respectively.

2.3. Data

This paper utilizes WIOD data for the period from 1995 to 2011.[14] The WIOD is built on national accounts data that were developed within the Seventh Framework Program of the European Commission. The WIOD provides time-series information on the global IO tables for the EU27 countries, 13 other major countries and the rest of the world (ROW). The 13 countries include non-EU OECD member countries, including Japan and the US, and emerging economies, including China, Indonesia and Mexico.[15] These tables are constructed on the basis of officially published IO tables, in conjunction with national accounts and international trade statistics.

The simplified structure of the world IO table is presented in Figure 2, which has the same structure as Figure 1. As Figure 2 shows, the WIOD reports domestic and imported intermediate inputs separately, and reports exports for intermediate use and final use. For example, Country 1's exports consist of exports for intermediate use by Country 2 and by the ROW, and exports for final use by Country 2 and by the ROW. Thus, it enables us to focus on exports for final use. The database consists of 35 industries. The values given in the tables are available at current prices and at the previous year's prices.

[14] The WIOD and all satellite accounts are available at http://www.wiod.org. The satellite accounts include the National IO Tables, the Socio Economic Accounts (i.e., data on employment, capital stocks and so on) and the Environmental Accounts. In this paper, we utilize the World IO Tables released in November 2013 and the Socio Economic Accounts data released in July 2014. For a detailed description of the database construction, see Dietzenbacher, Los, Stehrer, Timmer and de Vries (2015).

[15] The list of countries in the WIOD is as follows. The European Union: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, the Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden and the United Kingdom. North America: Canada and the United States. Latin America: Brazil and Mexico. Asia and the Pacific: China, India, Japan, South Korea, Australia, Taiwan, Turkey, Indonesia and Russia. The regional classification follows Timmer (2012, Table 1).

=== Figure 2 ===

An advantage of the WIOD is that it provides Socio Economic Accounts, which include annual data on employment at the industry level.[16] This enables us to examine more precisely the effects of exports on employment. Moreover, throughout the data collection effort, harmonization procedures were applied to ensure international comparability of the data. This ensures data quality and enables us to conduct comparative analysis at the industry and national levels. One disadvantage of the WIOD data is that, among the 35 industries covered, the *Private Households with Employed Persons* industry does not necessarily report information. In our analysis, if an entry is missing, we replace it with a zero. If input coefficients are not defined because of zero gross output, we also replace them with a zero.[17]

Figure 3 presents the share of imported intermediate inputs in total intermediate inputs, which is often used as an indicator of offshoring, for the six Asian countries, Germany and the US. Two findings stand out from this table. First, the share of imported intermediate inputs increased in all the countries from 1995 to 2011. This result means that the expansion of offshoring activities is observed in developed countries and Asian countries. Second, developed countries do not necessarily have higher shares of imported intermediate inputs than the emerging countries. Although, in 2011, the share of imported intermediate inputs was more than 20 percent in Germany and the US, in Japan it was around 15 percent, with the shares of the five Asian countries falling in between. The results suggest that developed countries do not necessarily have a higher share of imported intermediate inputs than emerging economies.

[16] A global IO table has also been developed by the Institute of Developing Economies–Japan External Trade Organization (IDE-JETRO). Although the IDE-JETRO international IO table covers other Southeast Asian countries, including Thailand, and is available from 1985, it is only available at five year intervals (2005 is the latest year available). Its industry classification is less detailed (covering 24–26 industries) than that of the WIOD (which covers 35 industries) and is not harmonized throughout the period. Moreover, data on employment are not available. Consequently, this paper utilizes the WIOD. For more detail about the IDE-JETRO international IO table, see Meng, Zhang and Inomata (2013).

[17] One may ask whether this method is superior to imputation (e.g., estimating the missing category as a residual or, alternatively, assuming that the contribution of this element is similar for similar countries). Note, however, that the imputation of missing values in IO tables will break the balance in the sum of rows and that of columns. Therefore, imputation is not applicable. Another problem with the WIOD data is that there may be exports to the ROW that take negative values (e.g., *Mining and Quarrying* in South Korea in 2009). This is because the exports to the ROW are defined as the residual of the total exports minus exports summed over the set of WIOD countries in the national supply and use tables. We use the negative values as they are stated.

=== Figure 3 ===

Note that the share of imported intermediate inputs does not necessarily capture the GVC income because, as we discussed in Section 1, the transaction of intermediate inputs is complicated in Asia. For example, the share of imported intermediate inputs cannot capture the case where Japanese firms offshore their production activities in China and then export their final manufactured goods to the US. To overcome this problem, the next section examines GVC income and GVC workers.

3. Results

3.1. Competitiveness of the selected Asian countries

Table 1 shows GVC income for the six Asian countries.[18] The GVC incomes of Germany and the US are also reported for reference. The sixth and seventh columns in Table 1 report the share of GVC income resulting from domestic and foreign demand, where the GVC income resulting from foreign demand is identical to what Johnson and Noguera (2012) referred to as value added exports. The last three columns report the ratio of real manufacturing GVC income in 2011 to that in 1995, based on total, domestic and foreign demand.

=== Table 1 ===

We highlight four results. First, the share of developed countries in the world manufacturing GVC income declined rapidly between 1995 and 2011. The share of GVC income for Japan, South Korea, Taiwan, Germany and the US declined between 1995 and 2011. In particular, the decline of the Japanese GVC income is notable, as it fell from 16.9 percent of the world total in 1995 to 7.3 percent in 2011. A recent study by Suganuma (2016), using the WIOD, found that the "upstreamness" of industries, which is defined as the average distance from the final use in terms of the production stages that a particular good goes through, increased in Japan from 1995 to 2011. Our results suggest that, despite Japan increasing the upstreamness of its industries, it nevertheless lost manufacturing GVC income rapidly.

[18] Note that, although we present results for six Asian countries, Germany and the US, our analysis utilized data for all 41 countries (including the ROW) in the WIOD. That is, matrices and vectors such as $(\mathbf{I}-\mathbf{A})^{-1}$ and $\mathbf{f}^{\boldsymbol{m}}$ include the 41 countries in the WIOD.

Second, in contrast to the developed countries, the share of the emerging economies expanded rapidly. In particular, the Chinese GVC income grew from 4.1 percent of the world total in 1995 to 16.2 percent in 2011. It is notable that the share of the Chinese GVC income in 2011 (16.2 percent) exceeded that of the Japanese GVC income (7.3 percent). Similarly, the share of the Indian GVC income in 2011 (3.4 percent) exceeded that of the South Korean GVC income (2.1 percent). These findings confirm the growing importance of the emerging economies in the GVC income. Even though we focus on the GVC income rather than gross exports, the increasing competitiveness of Chinese, Indian and Indonesian manufacturing is remarkable.

Third, the share of the GVC income resulting from foreign demand increased between 1995 and 2011 for all countries in Table 1. In particular, in South Korea and Taiwan, the share of the GVC income resulting from foreign demand accounted for more than two-thirds of these countries' total GVC income (67.7 percent in South Korea and 80.7 percent in Taiwan).

Finally, in the developed countries, the GVC manufacturing income resulting from domestic demand declined from 1995 to 2011. For example, in Japan, the GVC income resulting from domestic demand in 2011 was 63 percent of the 1995 level. These results suggest that the increasing importance of foreign demand is common to both the developed countries and the Asian emerging countries.

Note that the IO accounting framework is a linear system of equations. As was pointed out by Timmer, Los, Stehrer and de Vries (2013), we can decompose the changes in the GVC manufacturing income into the changes in production structures and those in final demand. Let $\mathbf{B} \equiv (\mathbf{I} - \mathbf{A})^{-1}$. Then, $\Delta\mathbf{v} = \hat{\mathbf{p}}\left(\bar{\mathbf{B}}\Delta\mathbf{f}^{\boldsymbol{m}} + \bar{\mathbf{f}}^{\boldsymbol{m}}\Delta\mathbf{B}\right)$, where the upper bar indicates the period average.[19] This decomposition enables us to investigate more explicitly the contribution of changes in the production structure and in final demand to the changes in GVC income.

Table 2 presents the decomposition results. Two findings stand out from this table. First, when the production structures are kept constant, all countries, except for Japan, show

[19] Although we decompose the changes in the GVC manufacturing income into the changes in production structures and those in final demand, following Timmer, Los, Stehrer and de Vries (2013), it is possible to take into account the changes in value added per gross output ($\Delta\hat{\mathbf{p}}$). For example, Kiyota (2013) conducted a similar decomposition to examine the changes in the skill content of Japanese trade.

positive change in GVC incomes. This is the result of growing final demand, especially in the emerging economies. For Japan, the decline in domestic final demand was so rapid (Table 1) that the positive effect of foreign final demand could not offset the negative effect of the decline in domestic final demand.[20]

=== Table 2 ===

Second, when final demand is kept constant, China, India and Indonesia show positive changes in GVC incomes, whereas Japan, South Korea and Taiwan show negative changes, as do Germany and the US. These results imply that not only the changes in final demand but also changes in the production structure have contributed to the growth of GVC manufacturing income in China, India and Indonesia.

Table 3 presents the growth of real exports and of real GVC income. One of the notable results is the difference between these growth rates. In all of the eight countries, the growth of GVC income was smaller than that of exports, implying that the growth of trade in intermediate inputs was very rapid.[21] Another notable result is the growth of the Japanese GVC income. Whereas Japanese exports grew 19.2 percent, the growth rate of the GVC income was –36.6 percent. This result clearly suggests that the growth of exports does not necessarily mean growth of the value added. Owing to increasing international transactions of intermediate inputs, the growth of exports could overestimate that of value added.

=== Table 3 ===

3.2. Sectoral differences

Some of the services can be traded not only directly but also indirectly (i.e., through the manufactured products). For example, Kiyota (2015) examined the services content of Japanese trade between 1985 and 1995, using a detailed IO table for Japan, and found that 84.3 percent of R&D services exports occurred through machinery exports. In addition, the R&D services content of Japanese machinery exports to East and Southeast Asia grew rapidly over this period. Similarly, a recent study by Francois, Manchin and Tomberger (2015) emphasized the increasing importance of services

[20] Part of the decline in domestic final demand can be attributed to the Great East Japan Earthquake on March 11, 2011.

[21] A similar pattern is found when we focus on real income (real value added) and the number of workers. The results are presented in Table A3.

inputs in value added exports. Therefore, it is interesting to examine GVC income by industry, as well as by the skill type of workers (as in this section).

Table 4 presents the sectoral decomposition of real GVC income in 1995 and 2011. The sixth column and the last column in Table 4 correspond to the second columns in Tables 1 and 3, respectively. Note that the real GVC income is computed from equation (3). GVC income, which is generated from the manufacturing final demand, can be ultimately distributed to each sector in each country. The sectoral decomposition indicates how much GVC income is obtained by each sector.

=== Table 4 ===

We highlight three results. First, in terms of industry levels as a proportion of GVC income, the share of agriculture remains large in China, India and Indonesia in 2011, exceeding 10 percent, whereas it is less than 5 percent in the other countries examined. In China, India and Indonesia, agriculture remains an important source of GVC income. Second, in terms of changes in GVC income from 1995 to 2011, China, India and Indonesia show positive figures in all sectors, whereas Japan, South Korea and Taiwan show different patterns. In South Korea, the real manufacturing GVC income decreased in agriculture, whereas it increased in manufacturing and services. In Taiwan, it decreased in agriculture and manufacturing, but increased in services. In Japan, the real manufacturing GVC income decreased in all sectors. The results indicate the heterogeneity of the changes in the GVC income across Asian countries. Finally, the increases in real GVC income in services either exceeded (or were very close to) the changes in agriculture and manufacturing in India, Indonesia, Taiwan and Germany. This result indicates the increasing importance of services in manufacturing GVC, which is consistent with the finding of Francois, Manchin and Tomberger (2015).

3.3. Skill structure of GVC workers

Table 5 presents GVC workers in 1995 and 2011 by sector, corresponding to the GVC income results reported in Table 3. One important finding is that the changes in the sectoral employment structure vary across countries. Although Timmer, Los, Stehrer and de Vries (2013) found that GVC workers shifted from manufacturing to services activities in many EU countries, for the six Asian countries that we study, this pattern occurs only for South Korea. China, India, Indonesia and Taiwan shifted their employment activities from agriculture to the manufacturing and services sectors. In

Japan, employment activities declined in all sectors (agriculture, manufacturing and services), which is a pattern also observed in the US. These results together suggest that the shifts in employment activities vary across the Asian countries and differ greatly between Asian and European countries.

=== Table 5 ===

Timmer, Los, Stehrer and de Vries (2013) found that, in the EU27 countries, there were increases in high- and medium-skilled workers and decreases in low-skilled workers, when examining manufacturing GVC workers. However, this pattern is not necessarily repeated in the six Asian countries. Table 6 presents the growth of GVC workers by skill level. In the WIOD, skill level is defined by the level of educational attainment as in the International Standard Classification of Education (ISCED): low-skilled (ISCED categories 1 and 2), medium-skilled (ISCED 3 and 4) and high-skilled (ISCED 5 and 6).[22] Table 6 indicates that GVC workers declined for all types of skills in Japan, and this pattern is also observed in the US. In contrast, GVC workers increased for all types of skills in China and India. These results imply that, in China and India, even low-skilled workers can benefit from growth in the production of final manufacturing goods.

=== Table 6 ===

Timmer, Los, Stehrer and de Vries (2013) found a negative correlation between jobs and real wage increases in the largest 19 EU countries, suggesting that "only a few countries have been able to combine increasing GVC job opportunities with a substantial rise in real wages" (p.648). Figure 4 presents the change in real income per worker and the change in the number of workers between 1995 and 2009 for countries in the WIOD for which we have CPI data (33 countries).[23] The real income per worker is defined as the average labor income per worker in manufacturing GVC, deflated by the national CPI.

=== Figure 4 ===

[22] ISCED category 1 is primary education, category 2 is lower-secondary education, category 3 is upper-secondary education, category 4 is post-secondary, non-tertiary education, category 5 is short-cycle tertiary education and category 6 is a bachelor degree or equivalent level.
[23] Note that the change in the number of workers in Figure 4 is measured from 1995 to 2009, whereas that in Table 5 is measured from 1995 to 2011.

Figure 4 seems to indicate that there is no correlation between the change in real income per worker and the change in the number of workers. Indeed, the correlation between them is 0.06, implying that there is no systematic relationship. However, if we focus on the six Asian countries (i.e., China, India, Indonesia, Japan, South Korea and Taiwan), we can confirm a strong positive relationship. The correlation between the change in real income per worker and the change in the number of workers becomes 0.55 for the six Asian countries, whereas it is –0.26 for the EU27 countries.[24] Although a more detailed analysis is needed to discuss causality further, the results imply that, unlike workers in the EU countries, workers in the Asian countries benefit from the growth of the GVC income. Asian countries have generally been able to combine increasing GVC job opportunities with rises in real income.

4. Concluding Remarks

In light of the increasing importance of the intermediate inputs trade, this paper has examined the competitiveness of industries in six Asian countries—China, India, Indonesia, Japan, South Korea and Taiwan. We measured competitiveness using GVC income: the value added that industries contribute to the production of final manufactured goods. Unlike value added exports, GVC income takes into account the value added generated from domestic final demand as well as foreign final demand. To compute GVC income, we utilized world IO tables, covering the period 1995 to 2011.

The major findings of this paper are twofold. First, the competitiveness of manufacturing has declined in Japan, South Korea and Taiwan, whereas it has increased in China, India and Indonesia. Even though we focus on GVC income rather than gross exports, the increasing competitiveness of Chinese, Indian and Indonesian manufacturing is remarkable. Second, unlike the EU countries, the Asian countries have generally been able to combine increasing GVC job opportunities with rises in real income. The correlation between the change in the real income per worker and the change in the number of workers is 0.55 for the six Asian countries, whereas it is –0.26 for the EU27 countries. This indicates that the Asian countries have generally been able to combine increasing GVC job opportunities with a rise in real income, whereas the European countries have not.

[24] The correlation is –0.50 for EU15 countries; 0.35 for Asia, excluding China; and 0.21 for Asia, excluding China and India. If we focus on the period between 1995 and 2007, the correlation is –0.087 for all countries, –0.35 for EU27 countries and 0.46 for Asia.

Our results indicate that the GVC income and GVC worker patterns in Asian countries present a different picture compared with those of the European countries. In particular, the positive correlation between increasing GVC job opportunities and rising real incomes in Asia is notable. An important task for policy makers as well as academic researchers is to identify the sources of this positive correlation and to investigate which policies can help sustain this virtuous cycle.

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Figure 1. Two-Country Global Input-Output Table.

		Country 1 Intermediate *Industry*	Country 2 Intermediate *Industry*	Country 3 Intermediate *Industry*	Country 1 Final demand	Country 2 Final demand	Country 3 Final demand	Total
Country 1	*Industry*	$x_{11}(s,t)$	$x_{12}(s,t)$	$x_{13}(s,t)$	$f_{11}(s)$	$f_{12}(s)$	$f_{13}(s)$	$y_1(s)$
Country 2	*Industry*	$x_{21}(s,t)$	$x_{22}(s,t)$	$x_{23}(s,t)$	$f_{21}(s)$	$f_{22}(s)$	$f_{23}(s)$	$y_2(s)$
Country 3	*Industry*	$x_{31}(s,t)$	$x_{32}(s,t)$	$x_{33}(s,t)$	$f_{31}(s)$	$f_{32}(s)$	$f_{33}(s)$	$y_3(s)$
Value added		$v_1(t)$	$v_2(t)$	$v_3(t)$				
		$y_1(t)$	$y_2(t)$	$y_3(t)$				

Note: $y_i(s)$ is the value of output in industry s of country i; $f_{ij}(s)$ is the value of output exported from industry s in country i for the final use in any country j; $x_{ij}(s,t)$ is the value of output exported from industry s in country i to the intermediate use by industry t in country j; $v_j(t)$ indicates the value added of industry t in country j. For more detail about the notations, see main text.

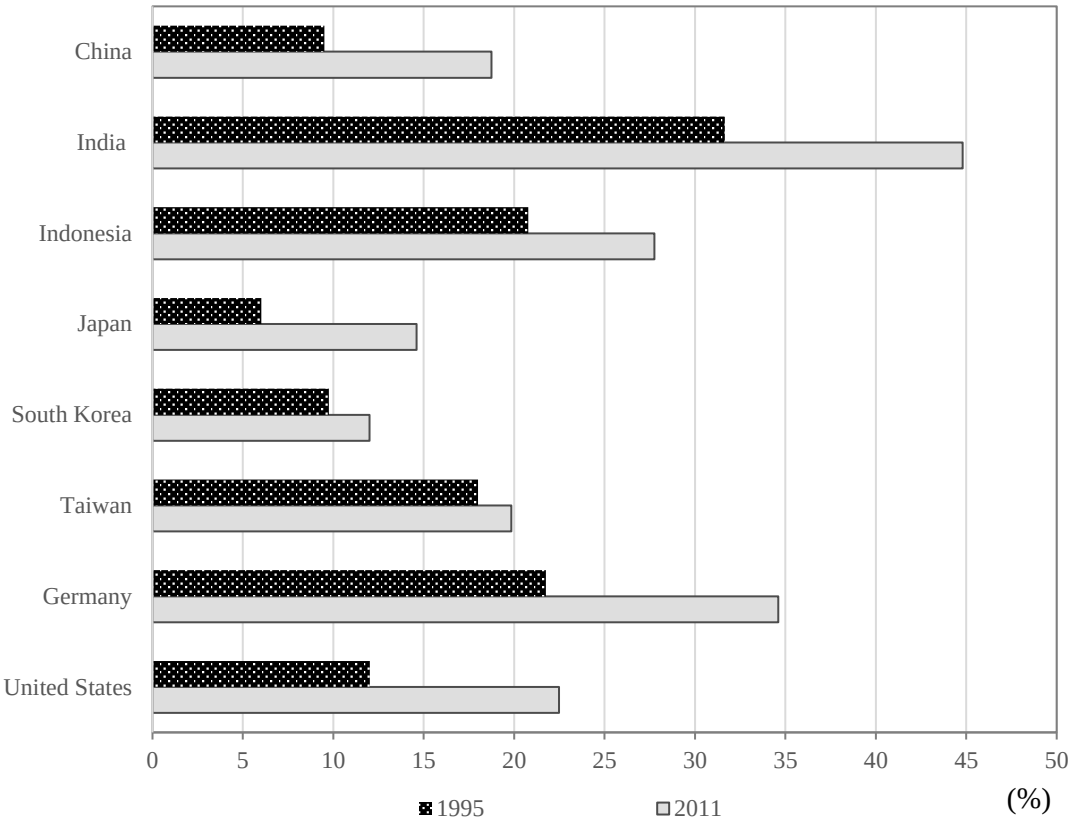
Source: Kiyota (2016).

Figure 2. Structure of World Input-Output Table: Two Countries and the Rest of the World.

		Country 1	Country 2	ROW	Country 1	Country 2	ROW	Total
		Intermediate	Intermediate	Intermediate	Final demand	Final demand	Final demand	
		Industry	*Industry*	*Industry*				
Country 1	*Industry*	Intermediate use of domestic output	Intermediate use by Country 2 of exports from Country 1	Intermediate use by ROW of exports from Country 1	Final use of domestic output	Final use by Country 2 of exports from Country 1	Final use by ROW of exports from Country 1	Output in Country 1
Country 2	*Industry*	Intermediate use by Country 1 of exports from Country 2	Intermediate use of domestic output	Intermediate use by ROW of exports from Country 2	Final use by Country 1 of exports from Country 2	Final use of domestic output	Final use by ROW of exports from Country 2	Output in Country 2
Rest of the World (ROW)	*Industry*	Intermediate use by Country 1 of exports from ROW	Intermediate use by Country 2 of exports from ROW	Intermediate use of domestic output	Final use by Country 1 of exports from ROW	Final use by Country 2 of exports from ROW	Final use of domestic output	Output in ROW
Value added		Value added	Value added	Value added				
		Output in Country 1	Output in Country 2	Output in ROW				

Source: Timmer (2012, Figure 2).

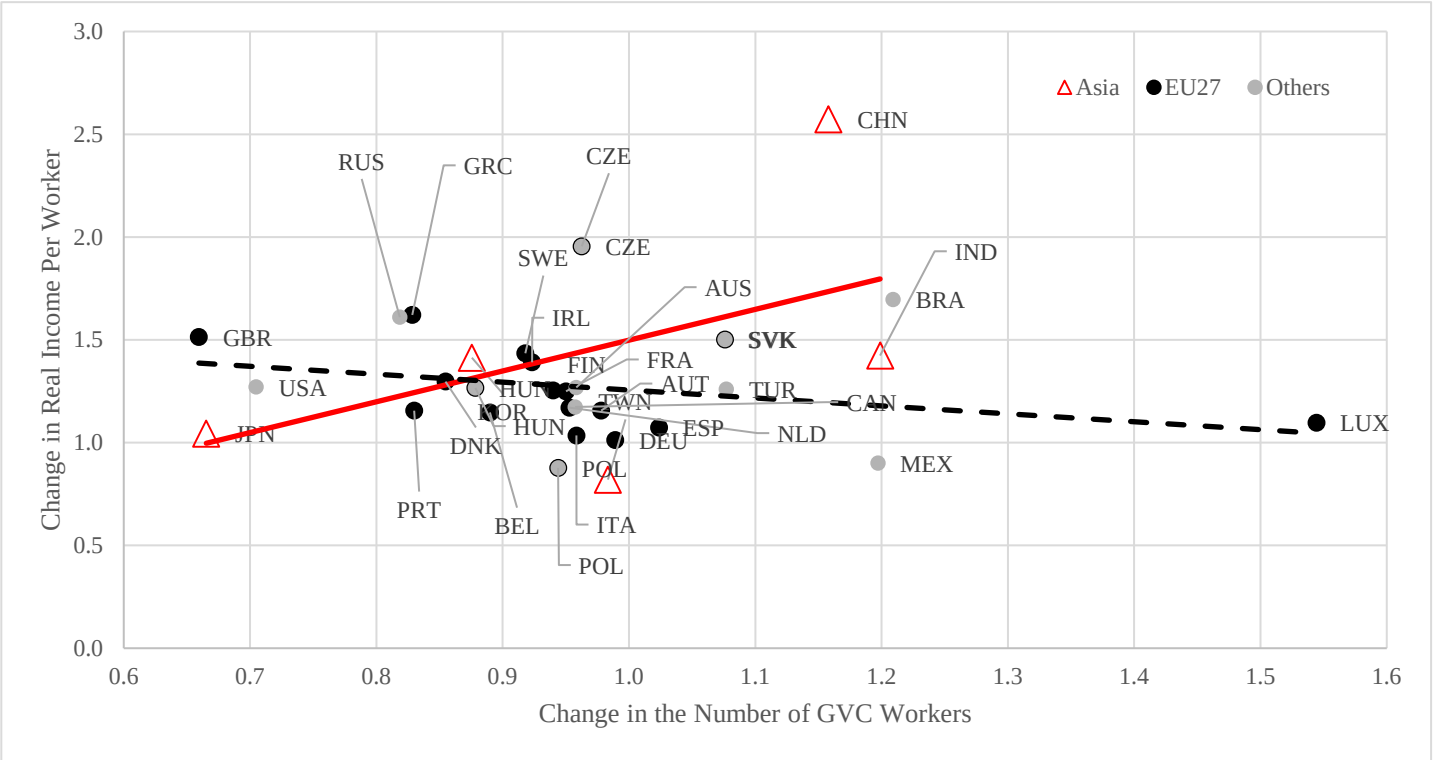
Figure 3. International Fragmentation of Production



Note: The figure shows the shares of imported intermediate inputs in total intermediate inputs in manufacturing industries in 1995 and in 2011.

Source: Author's calculations based on *World Input-Output Tables, November 2013* and *Socio Economic Accounts, July 2014* .

Figure 4. Change in Employment versus Change in Real Income per Worker in Manufactures GVCs, 1995-2009 (1995 = 1)



Notes: Change in number of workers and real income per worker between 1995 and 2009 in manufactures GVCs. Real income is measured as GVC labor income per worker deflated by the national CPI.

Source: Author's calculations based on *World Input-Output Tables, November 2013* and *Socio Economic Accounts, July 2014* .

Table 1. Real Manufactures GVC Income in Asian Countries

	Real manufactures GVC income (in 1995 US$m)		Share in world manufactures GVC income		Real manufactures GVC income share due to foreign demand		Ratio of real manufactures GVC income in 2011 to in 1995 (1995 = 100%)		
	1995	2011	1995	2011	1995	2011	Total	Domestic	Foreign
China	280,325	1,626,578	4.1%	16.2%	35.3%	42.7%	580.2%	513.9%	701.8%
India	124,483	336,877	1.8%	3.4%	17.5%	28.4%	270.6%	234.8%	439.5%
Indonesia	84,716	168,601	1.2%	1.7%	28.4%	36.0%	199.0%	177.9%	252.3%
Japan	1,159,456	734,694	16.9%	7.3%	24.6%	37.6%	63.4%	52.4%	96.9%
South Korea	156,577	214,578	2.3%	2.1%	45.2%	67.7%	137.0%	80.7%	205.2%
Taiwan	88,338	85,086	1.3%	0.8%	61.0%	80.7%	96.3%	47.7%	127.5%
Germany	663,129	682,369	9.7%	6.8%	46.1%	67.5%	102.9%	62.1%	150.5%
United States	1,325,204	1,456,101	19.3%	14.5%	25.9%	33.8%	109.9%	98.1%	143.6%

Notes: Real manufactures GVC income is manufactures GVC income in constant 1995 prices (deflated by the US CPI). The last two columns show the share of real manufactures GVC income due to foreign demand in total manufactures GVC income in the economy.

Sources: Author's calculations based on *World Input-Output Tables, November 2013* and *Socio Economic Accounts, July 2014* . The US CPI is obtained from *OECD National Accounts Statistics* .

Table 2. Decomposition of Change in Manufactures GVC Income Due To Change in Production Structure and Final Demand

	Change in real GVC income (US$m)	% of change (1995-2011)	
		keeping production structures constant	keeping final demand constant
China	1,346,252	89.7	10.3
India	212,394	99.7	0.3
Indonesia	83,885	78.8	21.2
Japan	-424,762	-62.1	-37.9
South Korea	58,001	120.0	-20.0
Taiwan	-3,252	196.3	-296.3
Germany	19,240	450.4	-350.4
United States	130,897	194.2	-94.2

Notes: Change in real GVC income from Table 1. The change is decomposed by keeping the production structures constant while final demand changes, and by keeping the final demand constant, while production structures change. This additive decomposition can be done keeping 1995 or 2011 levels constant, and average weights are used. Real manufactures GVC income is valued at constant 1995 US prices. All values are deflated by the US CPI.

Sources: Author's calculations based on *World Input-Output Tables, November 2013* and *Socio Economic Accounts, July 2014* . The US CPI is obtained from *OECD National Accounts Statistics* .

Table 3. Growth Rates in Real Manufuactures Exports and Real Manufuactures GVC Income between 1995 and 2011 (%)

	Growth in real gross manufactures exports	Growth in real manufactres GVC income	Difference
China	772.9	480.2	292.7
India	393.8	170.6	223.2
Indonesia	146.1	99.0	47.1
Japan	19.2	-36.6	55.8
South Korea	198.8	37.0	161.8
Taiwan	94.2	-3.7	97.9
Germany	81.1	2.9	78.2
United States	58.0	9.9	48.1

Notes: Real gross manufactures exports are the gross exports of all manufacturing goods in constant 1995 US prices. Real manufactures GVC income is valued at constant 1995 US prices. All values are deflated by the US CPI.

Sources: Author's calculations based on *World Input-Output Tables, November 2013* and *Socio Economic Accounts, July 2014* . The US CPI is obtained from *OECD National Accounts Statistics* .

Table 4. Real manufactures GVC Income by Sector

	Share (%) of manufactures GVC income in total income		Real manufactures GVC income in 2011 by sector				Change in real manufactures GVC income by sector decomposition between 1995 and 2011(in %)			
	1995	2011	Agriculture (% of total)	Manufacturing (% of total)	Services (% of total)	Total (in US$m)	Agriculture	Manufacturing	Services	Total
China	38.2	32.5	11.7	57.7	30.6	1,626,578	51.7	276.9	151.7	480.2
India	33.5	26.4	12.9	44.3	42.8	168,601	17.9	73.9	78.8	170.6
Indonesia	34.8	29.1	17.1	51.4	31.5	336,877	16.9	41.1	41.0	99.0
Japan	22.1	18.4	3.5	62.6	33.9	734,694	-1.2	-25.3	-10.0	-36.6
South Korea	30.4	29.2	3.4	70.5	26.0	214,578	-4.4	32.1	9.3	37.0
Taiwan	32.5	27.3	1.6	55.9	42.5	85,086	-2.0	-6.1	4.4	-3.7
Germany	27.7	28.9	1.5	59.5	39.0	682,369	-1.0	-0.9	4.7	2.9
United States	17.8	14.2	4.4	55.9	39.7	1,456,101	1.1	4.9	3.9	9.9

Notes: The first two colums show the share of manufactures GVC incom in the total income in the economy. Next four columns show real manufactures GVC income by sector in 2011. The last three columns show the change in the real manufacturing GVC income by sector decomposition between 1995 and 2011.

Sources: Author's calculations based on *World Input-Output Tables, November 2013* .The US CPI is obtained from OECD National Accounts Statistics.

Table 5. Manufactures GVC Workers by Sector

	Share (%) of manufactures GVC workers in total workers		Manufactures GVC workers in 2011 by sector				Change in manufactures GVC workers by sector decomposition between 1995 and 2011 (in %)			
	1995	2011	Agriculture (% of total)	Manufacturing (% of total)	Services (% of total)	Total (in thousands)	Agriculture	Manufacturing	Services	Total
China	31.7	30.2	42.6	36.2	21.3	244,136	-3.5	9.8	6.7	13.1
India	27.9	27.4	39.0	39.4	21.6	131,735	-4.2	19.6	8.5	23.9
Indonesia	32.1	24.4	49.6	28.7	21.7	27,967	-6.9	0.6	6.1	-0.2
Japan	22.6	17.4	13.1	51.5	35.4	10,042	-5.1	-23.5	-4.7	-33.4
South Korea	29.7	23.7	10.7	49.1	40.2	5,743	-8.4	-9.3	12.5	-5.2
Taiwan	30.9	28.2	4.0	62.5	33.5	3,025	-6.8	5.2	5.9	4.3
Germany	26.8	25.1	3.2	49.5	47.3	10,555	-2.2	-9.2	16.0	4.6
United States	16.0	10.9	7.0	51.5	41.5	15,867	-1.7	-17.7	-6.7	-26.1

Notes: Manufactures GVC workers are workers who contribute directly and indirectly to the production of final manufacturing goods. The first two colums show the share of manufactures GVC workers in the total workers in the economy. Next four columns show the number of manufactures GVC workers by sector in 2011. The last four columns show the change in the number of manufacturing GVC workers by sector decomposition between 1995 and 2011.

Sources: Author's calculations based on *World Input-Output Tables, November 2013* and *Socio Economic Accounts, July 2014* .

Table 6. Growth in Manufactures GVC Workers (in %), by Skill Level, 1995-2009

	High skilled	Medium skilled	Low skilled
China	211.2	35.6	6.3
India	106.8	49.4	4.4
Indonesia	150.0	61.2	-12.3
Japan	-7.7	-29.8	-65.7
South Korea	52.6	-12.9	-66.5
Taiwan	93.0	21.5	-36.7
Germany	32.4	-6.0	-17.7
United States	-9.6	-32.9	-46.6

Note: Manufactures GVC workers are workers who contribute directly and indirectly to the production of final manufacturing goods.

Sources: Author's calculations based on *World Input-Output Tables, November 2013* and *Socio Economic Accounts, July 2014* .

Table A1. List of Industries in the World Input-Output Tables

Code	Industry	Code	Industry
c1	Agriculture, Hunting, Forestry and Fishing	c19	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel
c2	Mining and Quarrying	c20	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
c3	Food, Beverages and Tobacco	c21	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods
c4	Textiles and Textile Products	c22	Hotels and Restaurants
c5	Leather, Leather and Footwear	c23	Inland Transport
c6	Wood and Products of Wood and Cork	c24	Water Transport
c7	Pulp, Paper, Paper , Printing and Publishing	c25	Air Transport
c8	Coke, Refined Petroleum and Nuclear Fuel	c26	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
c9	Chemicals and Chemical Products	c27	Post and Telecommunications
c10	Rubber and Plastics	c28	Financial Intermediation
c11	Other Non-Metallic Mineral	c29	Real Estate Activities
c12	Basic Metals and Fabricated Metal	c30	Renting of M&Eq and Other Business Activities
c13	Machinery, Nec	c31	Public Admin and Defence; Compulsory Social Security
c14	Electrical and Optical Equipment	c32	Education
c15	Transport Equipment	c33	Health and Social Work
c16	Manufacturing, Nec; Recycling	c34	Other Community, Social and Personal Services
c17	Electricity, Gas and Water Supply	c35	Private Households with Employed Persons
c18	Construction		

Source: Author's calculations based on *World Input-Output Tables, November 2013* .

Table A2. List of Countries in the World Input-Output Tables

Code	Country	Code	Country
AUS	Australia	ITA	Italy
AUT	Austria	JPN	Japan
BEL	Belgium	LTU	Lithuania
BGR	Bulgaria	LUX	Luxembourg
BRA	Brazil	LVA	Latvia
CAN	Canada	MEX	Mexico
CHN	China	MLT	Malta
CYP	Cyprus	NLD	Netherlands
CZE	Czech Republic	POL	Poland
DEU	Germany	PRT	Portugal
DNK	Denmark	ROU	Romania
ESP	Spain	RUS	Russia
EST	Estionia	SVK	Slovak Republic
FIN	Finland	SVN	Slovenia
FRA	France	KOR	South Korea
GBR	United Kingdom	SWE	Sweden
GRC	Greece	TUR	Turkey
HUN	Hungary	TWN	Taiwan
IDN	Indonesia	USA	United States
IND	India	RoW	Rest of the World
IRL	Ireland		

Source: Author's calculations based on *World Input-Output Tables, November 2013* .

Table A3. Growth Rates in Manufuacturing Sector Workers and Manufuactures GVC Workers, Real Manufacturing Sector Income, and Real Manufuactures GVC Income between 1995 and 2011 (%)

	Income (value added)			Number of workers		
	Growth in real manufactring sector income	Growth in real manufactres GVC income	Difference	Growth in manufacturing sector workers	Growth in manufactres GVC workers	Difference
China	547.7	480.2	67.5	44.9	13.1	31.9
India	178.1	170.6	7.5	68.1	23.9	44.1
Indonesia	82.4	99.0	-16.6	21.8	-0.2	22.0
Japan	-36.9	-36.6	-0.2	-37.7	-33.4	-4.3
South Korea	62.3	37.0	25.2	-8.3	-5.2	-3.1
Taiwan	1.2	-3.7	4.9	20.1	4.3	15.8
Germany	0.9	2.9	-2.0	-12.9	4.6	-17.5
United States	9.6	9.9	-0.3	-31.6	-26.1	-5.5

Notes: Real manufacturing sector income is the value added produced in the manufacturing sector of each country and valued at constant 1995 US prices. Real manufactures GVC income is valued at constant 1995 US prices. All values are deflated by the US CPI. Manufacturing sector workers are workers who contribute directly to the production of intermediate and final manufacturing goods. Manufactures GVC workers are workers who contribute directly and indirectly to the production of final manufacturing goods.

Sources: Author's calculations based on *World Input-Output Tables, November 2013* and *Socio Economic Accounts, July 2014* . The US CPI is obtained from *OECD National Accounts Statistics* .