Incomes and Jobs

in Global Production of Manufactures.

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Abstract

With the increasing international fragmentation of production, traditional measures of competitiveness are becoming obsolete. In this paper we introduce the concepts of GVC income and GVC jobs as two new measures of competitiveness, following Timmer et al. (2013). GVCs are identified by tracing the flow of goods and services across industries and countries as described in a world input-output table. Using a decomposition technique which is built upon the original insights by Leontief (1949), we slice up the value of manufacturing expenditure into incomes for labour and capital that is directly and indirectly needed for the production of the final manufacturing goods. This is done for twenty major mature and emerging countries in the world. The empirical analysis is based on a new database, called the World Input-Output Database (WIOD) that combines national input-output tables, bilateral international trade statistics and data on production factor requirements. The WIOD is a prototype database developed mainly to provide a proof-of-concept and we discuss the various challenges that need to be addressed in the future to bring this work forward.

The paper also presents new evidence on the main trends in GVC income and jobs in the production of manufacturing products since 1995. It is found that GVC income shares generated by capital and high-skilled labour have rapidly increased in advanced countries. GVC jobs for medium- and low-skilled workers declined by 12 million, and are increasingly found in services rather than in the manufacturing sector. Increased high-skilled job opportunities partly counteracted this job loss in Europe and Japan, but not in the US. Emerging economies are taking up increasing shares in global manufactures GVC income, capturing about half of the world total in 2011, of which a third by China

alone. The number of additional GVC jobs created over this period is estimated to be more than 130 million.

1 Introduction

It is frequently argued that globalisation has entered a second phase. In the early 20th century rapidly falling transport costs ended the need for co-location of production and consumption. Competitiveness of countries in the first phase was determined by domestic clusters of firms, mainly competing sector to sector. More recently, fostered by rapidly falling communication and coordination costs, the production process itself was unbundled as the various stages of production need not be performed near to each other anymore. In this new phase, international competition increasingly plays itself at the level of tasks within firms, rather than at the level of products. And trade in goods is increasingly replaced by trade in tasks (Baldwin 2006). This creates new challenges for the way in which competitiveness of nations is analysed.

Traditional measures indicate that China and other emerging countries have rapidly improved competitiveness since the late 1990s, both in quantity and quality as testified by booming exports of technologically sophisticated products. But recent product case studies suggests that European, Japanese and US firms still capture major parts of these value chains as they specialise in high value–added activities such as software, design, branding, and system integration. China and other emerging countries are mainly involved in the assembling, testing and packaging activities that are poorly compensated. A typical finding is that China keeps less than four per cent of a product's export value as income for its labour and capital employed in the production process of electronic goods (Dedrick et al. (2010); Ali-Yrkkö, Rouvinen, Seppälä and Ylä-Anttila (2011)). To reflect

this new reality a new measure of competitiveness is needed that is based on the value added in production by a country, rather than the gross output value of its exports. Or as put by Grossman and Rossi-Hansberg (2007, p.66-67): " [But] such measures are inadequate to the task of measuring the extent of a country's international integration in a world with global supply chains…we would like to know the sources of the value added embodied in goods and the uses to which the goods are eventually put."

Recently, Timmer et al. (2013) introduced a new concept that allows one to analyse the value that is added in various stages of regionally dispersed production processes. It is defined as the income generated in a country by participating in global manufacturing production, abbreviated by the term *GVC income*. Compared to traditional competitiveness indicators like a country's share in world exports, this new metric has three advantages. First, it indicates to what extent a country can compete with other nations in terms of *activities* related to global manufacturing, rather than competing in manufacturing *products* as measured by exports. These activities take place in manufacturing industries, but also in services industries. Second, it is a reflection of an economy's strength to compete in both domestic and global markets. Third, income and employment effects of trade in tasks for separate groups of workers (such as low- and high-skilled) can also be determined in the same unified framework, referring to the concept of *GVC jobs*.

The main aim of this paper is to establish a series of stylised facts on GVC incomes and jobs that can serve as a starting point for deeper analysis of its causes. Whereas Timmer et al. (2013) focused the analysis on trends in European

competitiveness; this paper takes a more global view and provides analyses for twenty major countries in the world including the US, Japan, major economies in Europe, Brazil, China, India and Russia.

In the remainder of this paper we first outline our methodology for slicing up global value chains in section 2 and introduce the concepts of GVC income and GVC jobs. We identify GVCs by tracing the flow of goods and services across industries and countries as described in a world input-output table. Using a decomposition technique which is built upon the original insights by Leontief (1949), we slice up the value of manufacturing expenditure into incomes for labour and capital in various countries. These are the incomes of factors that are directly and indirectly needed for the production of the final manufacturing goods. The empirical analysis is based on a new database, called the World Input-Output Database (WIOD) that combines national input-output tables, bilateral international trade statistics and data on production factor requirements. A crucial characteristic of this database is the explicit measurement of national and international trade in intermediates. In section 3 we discuss the major features of this database.

In Section 4 we provide trends in GVC income shares across regions and major countries in the world. The analysis is based on demand for final manufacturing products, and we show the dependency of countries on domestic and foreign sources of demand. We also show that only about half of the GVC income originates in the manufacturing sector itself, indicating the important of inter-industry linkages in the production of manufacturing goods. In section 5 we focus more in depth on the role of different factors

of production. We show how in advanced countries GVC income generated by capital and high-skilled labour are increasing, while incomes for medium- and low-skilled workers in manufactures production decline. In section 6 we study the amount of jobs involved in manufactures GVC production and find a strong difference between Europe and the US. Low- and medium-skilled jobs are on the decline in all advanced countries, but while in Europe and Japan high-skilled job opportunities increased, they declined in the U.S. since 1995.

2. GVC incomes and jobs: methodology

In this section we outline the method to slice up global value chains (GVCs) as introduced by Timmer et al. (2013). The basic aim of this empirical analysis is to decompose expenditure on a final product into a stream of factor incomes around the world. By modelling the world economy as an input-output model in the tradition of Leontief, we can use his famous insight that links up changes in consumption to changes in the distribution of factor income both within and across countries. Basically, we will provide the macro-economic equivalent of famous product case studies which suggest a new division of labour and value in electronics such as Dedrick at al. (2010) for iPods and notebooks, and Ali-Yrkkö, Rouvinen, Seppälä and Ylä-Anttila (2011) for a study of mobile phones. These studies suggest a division of activities between mature and emerging economies where the former concentrate on activities that require skilled labour and capital (in particular intangible), while the latter mainly contributes through unskilled labour.

The GVC income metric provides a macro-economic complement to the product-case studies described above. It covers a wide set of products, and analyses not only the first-tier suppliers, but also second and higher order suppliers. The method provides a full decomposition of the value of consumption in a country and traces the associated income flows for labour and capital in various regions in the world. We model the global production system through input-output tables and international trade statistics. The approach follows the seminal insight from Leontief (1949) and traces the amount of factor inputs needed to produce a certain amount of final demand. Value is added at

various stages of production through the utilisation of production factors labour and capital. These links between expenditure and income are illustrated in Figure 1.

[Figure 1 about here]

The arrows in Figure 1 indicate flows of products and factor services, which are mirrored by payments that flow in the opposite direction. The central link between income and consumption is the production process in which value is added through the deployment of labour and capital in the various stages of production. This production process can be highly fragmented as the case study of the iPod illustrated. Through international trade, consumption in country B will lead to income for production factors in other countries, either through importing final goods, or through the use of imported intermediates in the production process of B. Through these indirect linkages consumption in A will generate income in C even though C does not trade directly with A. These indirect effects are sizeable as international trade in intermediate goods is high.

To model the international production linkages we use a World Input-output model that obeys the identity that at the global level consumption is equal to all value added generated.[1] Below we will outline how this identity can be used to consistently decompose the value of consumption by a country into income in any country in the world. To do this we rely on the fundamental input-output identity introduced by Leontief (1949) which states that $Q=BQ+C$ where Q denotes outputs, C is consumption and B an input-output matrix with intermediate input coefficients. B describes how a given product

in a country is produced with different combinations of intermediate inputs. The identity states that a good produced is either used as intermediate input in another production process, or consumed. It can be rewritten as $Q= (I-B)^{-1}C$ with I an identity matrix.[2] $(I-B)^{-1}$ is famously known as the Leontief inverse. It represents the total production value in all stages of production that is generated in the production process of one unit of consumption.

To see this, let Z be a vector column with first element representing the global consumption of iPods produced in China, which is equal to the output of the Chinese iPod industry, and the rest zeros. Then BZ is the vector of intermediate inputs, both Chinese and foreign, needed to assemble the iPods in China, such as the hard-disc drive, battery and processors. But these intermediates need to be produced as well. B^2Z indicates the intermediate inputs directly needed to produce BZ, and so on. Thus $\sum_{n=1}^{\infty} B^n Z$ represents all intermediate inputs needed for the iPod production. Then the total gross output value related to the production of Z is given by $Z + \sum_{n=1}^{\infty} B^n Z = (I - B)^{-1} Z$.

Using this insight, we can derive production factor requirements for any vector Z. Let **F** be the direct factor inputs per unit of *gross output*. An element in this matrix indicates the share in the value of gross output of a production factor used directly by the country to produce a given product. These are country- and industry-specific, for example the value of low-skilled labour used in the Chinese electronics industry to produce one dollar of output, and add up to value added by construction in our data. The elements in **F** are direct factor inputs in the industry, because they do not account for value embodied in intermediate inputs used by this industry. To include the latter as well, we multiply F by

the total gross output value in all stages of production that is generated in the production process defined above, such that

$$K = F(I - B)^{-1}C \qquad (1)$$

in which C indicated the levels of consumption[3] and **K** is the matrix of amounts of factor inputs attributed to each consumption level. A typical element in K indicates the amount of a production factor *f* from country *i*, embodied in consumption of product *g* in country *j*. By the logic of Leontief's insight, the sum of all elements in a column of K will be equal to the consumption of this product. Thus we have completed our decomposition of the value of consumption into the value added by various production factors around the world.[4]

For the purpose of this paper we are also interested in the effects of foreign versus domestic final demand for growth in GVC income and jobs. For a particular country *i*, we define foreign final demand (C^{FOR}) and domestic final demand (C^{DOM}) such that C^{FOR} $+C^{DOM}$ = C. Substituting this in the linear system given above one can now derive the gross output generated due to final demand from home country *i*, and due to final demand from other countries, such that

$$K = F(I - B)^{-1}C^{DOM} + F(I - B)^{-1}C^{FOR} = K^{DOM} + K^{FOR} \qquad (2)$$

In this equation, we have decomposed the amount of factors used in each sector of the home economy as given by K into the amount used to satisfy domestic final demand (K^{DOM}) and used to satisfy foreign demand (K^{FOR}). The latter measures *value added exports* defined by Johnson and Noguera (2012) as the amount of value added produced in a given source country that is ultimately embodied in final products absorbed abroad.

In Table 1 we provide an example of a GVC decomposition for final expenditures in the US on electrical machinery in 1995 and 2008. The expenditure value is given at the basic price concept. A key distinction in the System of National Accounts is between a value at basic prices and at purchasers' prices. The latter is the price paid by the final consumer and consists of the basic price plus trade and transport margins in the handling of the product and any (net) product taxes. The basic price can thus be considered as the price received by the producer of the good. In 1995, the share of the value added in the US was over 50%, but this swiftly dropped in the period after. Instead, value was increasingly added in other parts in the world, both within NAFTA and outside. China in particular benefitted from US demand for electrical machinery, and captured more than 20% of the value in 2008. Partly this was by exporting final goods to the US produced in China (direct contribution), but also indirectly through the production of intermediates (such as parts and components) that are used in the US and elsewhere to produce final goods destined for the US market. The decline in value added in Japan, South Korea and Taiwan is illustrative of the major shifts in production stages across Asia as China was increasingly used as a production location by East Asian multinationals (Fukao et al. 2003), an issue we will return to later.

3. The World Input-Output Database (WIOD)

To implement the new GVC metrics, one needs to have a database with linked consumption, production and income flows within and between countries. For individual countries, this type of information can be found in input-output tables. However, national tables do not provide any information on bilateral flows of goods and services between countries. For this type of information researchers have to rely on datasets constructed on the basis of national input-output tables in combination with international trade data. Various alternative datasets have been built in the past of which the Global Trade Analysis Project (GTAP) database is the most widely known and used (Narayanan and Walmsley 2008). Other datasets are constructed by the Organisation for Economic Co-operation and Development (OECD, see Yamano and Ahmad 2006, Ahmad *this volume*) and IDE-JETRO (2006). However, all these databases provide only one or a limited number of benchmark year input-output tables which preclude an analysis of developments over time. And although they provide separate import matrices, there is no detailed break-down of imports by trade partner.

For this paper we use a new database called the World Input-Output Database (WIOD) that aims to fill this gap. The WIOD provides a time-series of world input-output tables from 1995 onwards, distinguishing between 35 industries and 59 product groups. The construction of the world input-output tables will be discussed in section 3.1. Another crucial element for this type of analysis are detailed value-added accounts that provide

information on the use of various types of labour (distinguished by educational attainment level) and capital in production. This is discussed in section 3.2.

3.1 World Input-Output Tables (WIOTs): concepts and construction

In this section we outline the basic concepts and construction of our world input-output tables. Basically, a world input-output table (WIOT) is a combination of national input-output tables in which the use of products is broken down according to their origin. In contrast to the national input-output tables, this information is made explicit in the WIOT. For each country, flows of products both for intermediate and final use are split into domestically produced or imported. In addition, the WIOT shows for imports in which foreign *industry* the product was produced. This is illustrated by the schematic outline for a WIOT in Figure 2. It illustrates the simple case of three regions: countries A and B, and the rest of the world. In WIOD we will distinguish 40 countries and the rest of the World, but the basic outline remains the same.

[Figure 2 about here]

The rows in the WIOT indicate the use of output from a particular industry in a country. This can be intermediate use in the country itself (use of domestic output) or by other countries, in which case it is exported. Output can also be for final use[5], either by the country itself (final use of domestic output) or by other countries, in which case it is exported. Final use is indicated in the right part of the table, and this information can be

used to measure the C matrix defined in section 2. The sum over all uses is equal to the output of an industry, denoted by Q in section 2.

A fundamental accounting identity is that total use of output in a row equals total output of the same industry as indicated in the respective column in the left-hand part of the figure. The columns convey information on the technology of production as they indicate the amounts of intermediate and factor inputs needed for production. The intermediates can be sourced from domestic industries or imported. This is the B matrix from section 2. The residual between total output and total intermediate inputs is value added. This is made up by compensation for production factors. It is the direct contribution of domestic factors to output. We prepare the F matrix from section 2 on this information after breaking out the compensation of various factor inputs as described in Section 3.2.

As building blocks for the WIOT, national supply and use tables (SUTs) were used that are the core statistical sources from which NSIs derive national input-output tables. In short, we derive time series of national SUTs. Benchmark national SUTs are linked over time through the use of the most recent National Accounts statistics on final demand categories, and gross output and value added by detailed industry. This ensures both intercountry and intertemporal consistency of the tables. As such the WIOT is built according to the conventions of the System of National Accounts and obeys various important accounting identities. National SUTs are linked across countries through detailed international trade statistics to create so-called international SUTs. This is based on a classification of bilateral import flows by end-use category (intermediate, consumer

or investment), intermediate inputs are split by country of origin. These international SUTs are used to construct the symmetric world input-output of the industry-by-industry type. For a more elaborate discussion of construction methods, practical implementation and detailed sources of the WIOT, see Timmer et al. (2012). Dietzenbacher et al. (2013) provides an in-depth technical discussion.

The construction of the WIOT has a number of distinct characteristics. First, we rely on national supply and use tables (SUTs) rather than input-output tables as our basic building blocks. SUTs are a natural starting point for this type of analysis as they provide information on both products and industries. A supply table provides information on products produced by each domestic industry and a use table indicates the use of each product by an industry or final user. The linking with international trade data, that is product based, and factor use that is industry-based, can be naturally made in a SUT framework.[6]

Ideally, we would like to use official data on the destination of imported goods and services. But in most countries these flows are not tracked by statistical agencies. Nevertheless, most do publish an import IO table constructed with the import proportionality assumption, applying a product's economy-wide import share for all use categories. For the US it has been found that this assumption can be rather misleading in particular at the industry-level (Feenstra and Jensen 2009; Strassner, Yuskavage and Lee 2009). Therefore we are not using the official import matrices but use detailed trade data to make a split. Our basic data is bilateral import flows of all countries covered in WIOD from all partners in the world at the HS6-digit product level taken from the UN

COMTRADE database. Based on the detailed description products are allocated to three use categories: intermediates, final consumption, and investment, effectively extending the UN Broad Economic Categories (BEC) classification. We find that import proportions differ widely across use categories and importantly, also across country of origin. For example, imports by the Czech car industry from Germany contain a much higher share of intermediates than imports from Japan. This type of information is reflected in our WIOT by using detailed bilateral trade data. The domestic use matrix is derived as total use minus imports.

Another novel element in the WIOT is the use of data on trade in services. As yet no standardised database on bilateral service flows exists. These have been collected from various sources (including OECD, Eurostat, IMF and WTO), checked for consistency and integrated into a bilateral service trade database.

Clearly, the validity of the findings in this paper relies heavily on the quality of the databases used. The WIOD has been constructed with the aim of making maximum use of the publicly available data on national input-output tables, international trade statistics and production factor incomes. In the process of consolidating these separate databases, inconsistencies have been found and compromises made to arrive at an internally consistent World Input-Output table. For example, the well-known inconsistency between mirror trade flows in the COMTRADE data was resolved by focusing on import flows only. Other issues relate to re-exports of goods and trade in services that are not very well reflected in today's trade statistics. It is clear that present day statistical systems are lagging behind the developments in today's world. In particular, trade in services and

intangibles such as royalties and licences are still poorly reflected (see e.g. Feenstra et al. 2010; Houseman and Ryder 2010). This should have priority in the future development of international trade statistics.

3.2 Factor input requirements

For factor input requirements we collected country-specific data on detailed labour and capital inputs. This includes data on hours worked and compensation for three labour types and data on capital stocks and compensation. Labour types are distinguished on the basis of educational attainment levels as defined in the ISCED classification (low-skilled: ISCED 1 + 2; medium-skilled: ISCED 3 + 4 and high-skilled: ISCED 5 + 6). These series are not part of the core set of national accounts statistics reported by NSIs and additional material has been collected from employment and labour force statistics. For each country covered, a choice was made of the best statistical source for consistent wage and employment data at the industry level. In most countries this was the labour force survey (LFS). In most cases this needed to be combined with an earnings surveys as information wages are often not included in the LFS. In other instances, an establishment survey, or social-security database was used. Care has been taken to arrive at series which are time consistent, as most employment surveys are not designed to track developments over time, and breaks in methodology or coverage frequently occur.

Labour compensation of self-employed is not registered in the National Accounts, which as emphasised by Krueger (1999) leads to an understatement of labour's share. This is particularly important for less advanced economies that typically feature a large share of self-employed workers in industries like agriculture, trade, business and personal

services. We make an imputation by assuming that the compensation per hour of self-employed is equal to the compensation per hour of employees. For most advanced countries labour data is constructed by extending and updating the EU KLEMS database (www.euklems.org) using the methodologies, data sources and concepts described in O'Mahony and Timmer (2009). For other countries additional data has been collected according to the same principles.

Capital compensation is derived as gross value added minus labour compensation as defined above. It is the gross compensation for capital, including profits and depreciation allowances. Being a residual measure it is the remuneration for capital in the broadest sense, including tangible capital (such as machinery and buildings), intangible (such as R&D, software, database development, branding and organisation capital), mineral resources, land and financial capital.

4. Trends in manufactures GVC incomes

In this section, we explore trends in the distributions of value in global production chains using the decompositions introduced in Section 2. We decompose global expenditure on manufacturing products into compensation for factor services that are directly or indirectly needed in the production of these products. Throughout the paper we use the phrase "global manufacturing" to indicate the set of all production activities directly or

indirectly needed in producing final manufacturing goods. Note that this includes not only activities in the manufacturing sector, but also production activities in all other sectors such as agriculture, utilities, business services etc. that provide inputs in any stage of the production process. Next we define "GVC income" as the income of all production factors that have been directly and indirectly used in the production of final manufacturing goods. World GVC income is the GVC income summed over all countries and will be equal to world expenditure on manufacturing goods as we model all regions in the world in our empirical analysis. By definition, any dollar spent on final goods must end up as income for production factors somewhere in world.

The share of a country in world GVC income is a novel indicator of the competitive strength of a nation. Compared to traditional competitiveness indicators like a country's share in world exports, it has three advantages. First, it indicates to what extent a country can compete with other nations in terms of *activities* related to global manufacturing, rather than competing in manufacturing *products* as measures by exports. Second, it is a reflection of an economy's strength to compete in both domestic and global markets. Countries might gain income by serving foreign demand, but might at the same time loose income in production for the domestic market. The income share of a country in global manufacturing measures the combined net effect. Third, income and employment effects of trade in tasks for separate groups of workers (such as low- and high-skilled) can also be determined in the same unified framework as shown in the next section.

Throughout the paper we will focus on GVC income in the production of final manufacturing goods. We denote these goods by the term "manufactures". Production

systems of manufactures are highly prone to international fragmentation as activities have a high degree of international contestability: they can be undertaken in any country with little variation in quality. It is important to note that GVCs of manufactures do not coincide with all activities in the manufacturing sector, and neither with all activities that are internationally contestable. Some activities in the manufacturing sector are geared towards production of intermediates for final non-manufacturing products and are not part of manufactures GVCs. On the other hand, GVCs of manufactures also include value added outside the manufacturing sector, such as business services, transport and communication and finance, and in raw materials production. These indirect contributions will be explicitly accounted for through the modelling of input-output linkages across sectors.

Ideally, to measure competitiveness one would like to cover value added in all activities that are internationally contestable, and not only those in the production of manufactures.[7] GVCs of services cannot be analysed however, as the level of observation for services in our data is not fine enough to zoom in on those services that are heavily traded, such as for example consultancy services. The lowest level of detail in the WIOD is "business services" which for the major part contains activities that are not internationally traded, and hence are much less interesting to analyse from a GVC perspective. This is all the more true for other services, such as for example personal or retail services. They require a physical interaction between the buyer and provider of the service and a major part of the value added in these chains is effectively not internationally contestable. More detailed data on trade in, and production of, services is needed before meaningful GVC analyses of final services can be made.

Manufactures GVC incomes

Figure 3, panel A provides a comparison of the GVC incomes in advanced and emerging regions in the production of final manufacturing goods. The GVC income share of advanced countries (East Asia plus US, Canada, Australia and the EU15) has been declining from almost three quarters in 1995 to just above halve of world GVC income. Emerging regions have rapidly increased their shares and almost all of this increase was realised after 2003. Since 2004 the increase in the GVC income in emerging countries was always higher than in advanced countries, reaching a peak in 2008 at a time when advanced countries GVC income stalled. The drop in the crisis year 2009 was large for all countries but recovery much faster in the emerging economies (Panel B, Figure 3).

One might hypothesise that shifts the composition of global manufacturing demand in terms of the type of products being demanded might also be a determinant of the decline if the advanced nations in the global manufacturing production. The product structure of global demand remained stable over the period 1995 to 2009 however. Following Engel's law, the expenditure shares of food and other non-durable goods such as wearing apparel, shoes, furniture and toys, were on a long-term declining trend. Expenditure on machinery and transport equipment was relatively stable around 16% of total, as increasing consumer and investment demand from emerging markets was counteracted by declining demand from mature economies. Also demand for electrical machinery was stagnant in the long run. The only clear upward trend is found for chemical products, including gasoline, cosmetics and medicines, demand for which steadily increased around the world

from 12% in 1995 to 15% of global manufacturing expenditure in 2008. But these global demand shifts are too small to account for the decline in advanced nations GVC income. Instead, this decline is due to losses in the value added in each product GVC and this will be analysed in more detail in the remainder of this section.

In Figure 4 we provide shares of regions in world GVC income in the production of manufactures for the period from 1995 to 2011. It provides figures for five groups of countries, namely NAFTA (Canada, Mexico and the US), the European Union (EU) consisting of the 27 EU member states; East Asia consisting of Japan, South Korea and Taiwan; China; BRIIAT includes Brazil, Russia, India, Indonesia, Australia, and Turkey. In Table 2, additional data for 20 major individual economies can be found for 1995 and 2008. It should be kept in mind that international competition is not a zero-sum game and declining shares in global GVC do not necessarily mean an absolute decline in GVC income in a region. On the contrary, in real terms world GVC income on manufactures (deflated by the US CPI index) has increased by about one-third over the period 1995 to 2008.

Figure 4 shoes that the share of the NAFTA countries in world GVC income increased during the ICT bubble years, up to 30% when its share was even higher than the EU. But it rapidly declined after 2001 to 20% in 2008. The decline of the advanced nations is particularly due to the demise of East Asia which share has been declining rapidly since the mid-1990s. While South Korea and Taiwan are still increasing their shares, the GVC income share of Japan has been declining rapidly. In contrast, the EU GVC income share has been relatively stable, only slowly declining over the period from

1995 to 2008. France, Italy and the UK slowly lost some shares. The German share dropped rapidly in the latter 1990s, but was stabilising afterwards. These drops were compensated by increasing shares for other EU countries, in particular the new member states. As is well-known, the aftermath of the global financial crisis hit Europe in particular and its share dropped sharply to 24% in 2011. On the flipside, the share of other regions in the world rapidly increased. China is mainly responsible for the increase of the emerging countries' share, accelerating after its WTO ascension in 2000. In 2007 it overtook the share of East Asia. In 2009, the Chinese GVC income share overtook that of BRIIAT combined. And in 2011 it was almost equal to that of the NAFTA region.[8]

One might argue that these shifts in regional GVC income shares are unsurprising, given the faster growth of China and other emerging economies vis-à-vis advanced regions. Higher consumption in the home economy would naturally lead to higher GVC incomes. But this is only true to the extent that demand for manufactures has a strong home production bias, that is, mainly geared towards goods with a high level of domestic value added. Given the high tradability of manufacturing goods, this home bias is not obvious however. Increased Chinese demand for say chemicals or electronic equipment can be as easily served by imports as by Chinese domestic production. And in the latter case a sizeable share could still be captured by advanced countries through the delivery of key intermediate inputs and services. Falling shares in global GVC income for advanced regions in Figure 3 indicate that they failed to capture a large part of the value of the increased market for manufacturing goods in emerging economies. And at the same time

the domestic value added content of their own production declined. Both trends can be interpreted as a loss of competitiveness.

[Figure 3 about here]

[Figure 4 about here]

[Table 2 about here]

A number of caveats are in order. Shares in world GVC income are expressed in US$ using current exchange rates. For income changes over time we deflate incomes in US$ to the 1995 US$ value using the US CPI. Exchange rates have fluctuated over the period considered: the $/euro rate[9] declined sharply over 1995-2001 followed by a steep incline returning near its 1995 value in 2007. The Yen/$ rate fluctuated around a long-term constant for this period. The Yuan/US$ was effectively constant over this period, slightly appreciating at the end of the 2000s. The choice of the US$ as numeraire has no impact on the GVC income measure of a country relative to other countries. E.g. expressing GVC incomes shares in Yen or euros would give identical results. But it will impact the absolute levels of GVC incomes and hence comparisons over time within a country.

Secondly, one has to keep in mind that the location where the value is being added is not necessarily identical to where the generated income will eventually end up. The building of global production chains is not only through arms-length trade in intermediate inputs, but also involves sizeable flows of investment and part of the value added in emerging regions will accrue as income to multinational firms headquartered in advanced regions through the ownership of capital. To analyse capital income on a

national rather than a domestic basis as in this paper data on foreign ownership is needed. This type of information is notoriously hard to acquire, not in the least due to the notional relocation of profits for tax accounting purposes, and further research is needed in this area and not pursued here (Baldwin and Kimura 1998; Lipsey 2009). The decline in East Asian GVC income is likely overestimated as it is also related to the offshoring of activities to China, which effectively became the assembly place of East Asia. Income earned by East Asian capital is allocated to the place of production (in this case China), and not by ownership as discussed in section 2. This difference is probably larger for East Asian countries than for NAFTA or the EU which have larger FDI flows within the region such that they net out in regional aggregate numbers.

The role of domestic and foreign demand

By splitting the final demand vector in the decomposition given in equation (2), we can analyse the importance of domestic versus foreign final demand in the generation of GVC income in a country. The GVC income due to foreign demand is identical to what Johnson and Noguera (2012) refer to as "exports of value added".[10] Table 3 provides the share of manufactures GVC income due to foreign demand for twenty major economies in the world. The overriding conclusion is that all countries have become increasingly dependent on foreign demand to generate manufactures GVC income, with the exception of Canada. For all major mature economies, increases in foreign demand have been a necessary counterweight to slow or even negative growth in their value added shares in domestic demand. Domestic demand was not a source of growth in the US, and contributed strongly negative in Japan as import substitution took place at the background

of stagnating domestic demand. The direction of this trend for advanced countries was to be expected as the income elasticity of demand for manufactures is low and domestic demand was increasingly served through imports with high foreign value added in most countries. But this domestic decline was more than counteracted by a rapid increase in exports of value added. The most extreme example of this shift towards foreign demand dependence is to be found in Germany given the large size of its domestic market. While in 1995 46 per cent of its GVC income was due to foreign final demand, this increased to 70 per cent in 2008. Also foreign demand dependence in Japan, South Korea, Spain and the UK rapidly increased over this period.

For emerging economies, changes in foreign demand have been important, but they also strongly benefitted from growth in domestic expenditure on manufacturing. The share of GVC income due to foreign demand increased from 35 to 49 per cent in China which is high, but not outstanding when compared that of countries of comparable size such as Japan or Germany. The share of foreign demand in Mexico and Russia did barely increase over this period, and also the share for India, while growing, is still at a relatively low level indicating that the integration of these major emerging economies into world markets is still limited.

Sectoral origin of manufactures GVC income

The production of manufacturing goods involves a wide range of activities which not only take place in the manufacturing sector. Using the decomposition technique outlined above one can trace not only the country but also the sector in which value is added during the production process. Typically the value added through activities in the

manufacturing sector itself is around half the basic price value of a good, and is declining over time. In Table 4 we provide for each country the share of a sector in the total value added by the country in global manufacturing expenditure. This is done for twenty major economies in 1995 and 2008, distinguishing between three broad sectors: natural resource, including agriculture and mining industries (ISIC rev. 3 industries A to C), manufacturing including all manufacturing industries (D) and services including all other industries (E to Q). It is shown that the share of manufacturing has declined between 1995 and 2008 in all countries, except in South Korea. The unweighted average share across all twenty countries declined from 54% to 50%. This is partly reflecting a shift away from traditional manufacturing activities, such as carried out by blue-collar production workers, but also the outsourcing of white-collar activities by manufacturing firms to domestic services firms. Contributions from the natural resources sector are high and have increased over 1995-2008 in countries such as Australia, Canada, Indonesia, Mexico, Russia[11] and Turkey. This pattern of value added suggests that for resource-abundant countries, activities within manufacturing production networks are reinforcing their comparative advantage. Given its low level of development, services contribute relatively much in India, reflecting its well developed business services sector that deliver intermediate services to both domestic and foreign manufacturing firms. In China, the share of natural resources is declining, and activities in the services sector start to contribute more, but this is still well below services' contributions in Europe and the US.

[Table 3 here]

[Table 4 here]

5. Manufactures GVC income by production factor

Our income data on labour and capital allows us to study which production factors have benefitted from the changes in the regional distribution of global value added. Increasing trade and integration of world markets has been related to increasing unemployment and stagnating relative wages of low- and medium-skilled workers in developed regions. On the other hand, it offered new opportunities for developing regions to employ their large supply of low-skilled workers. To study these trends, we decomposed value added into four parts: income for capital and income for labour, further split into low-, medium- and high-skilled labour. High-skilled labour is defined as workers with college degree or above. Medium skilled workers have secondary schooling and above, including professional qualifications, but below college degree, and low-skilled have below secondary schooling. An estimate for the income of self-employed workers is included in labour compensation. The income for capital is the amount of value added that remains after subtracting labour compensation. It is the gross compensation for capital, including profits and depreciation allowances. Being a residual measure it is the remuneration for capital in the broadest sense, including tangible, intangible, mineral resources, land and financial capital.

In Table 5 we provide a breakdown of GVC income by labour and capital for major regions. This is a breakdown of the GVC income discussed in the previous section. At the global level, the share of GVC income that goes to labour is coming down, while the share of capital is increasing. In all regions, the compensation for capital is increasing

relative to labour. In particular in emerging regions this increase is important and faster than the labour income increase. This might be related to the low wage-rental ratios in these regions that were still characterised by an abundant surplus of low-skilled workers from agricultural and informal urban sectors. In advanced regions, the increasing importance of capital might be a reflection of the increased investment in so-called intangible assets that are becoming increasingly important for growth in advanced nations (Corrado and Hulten 2010).

It is important to note that the share captured by capital in emerging markets is known to be overestimated. Our approach is based on domestic production accounting for the location of the production factor, and is silent on the ownership as discussed before. In the case of labour income, this is unproblematic as for most countries cross-border labour migration is relatively minor. Hence labour income paid out in a particular country mostly benefits the workers of the country in which production takes place.

Worldwide, medium- and low-skilled workers are losing out on high-skilled workers as shares of the latter in GVC income is increasing. As expected, GVC income for low-skilled workers increased strongly in China and in other emerging economies, while declining in the advanced regions. In the US and East Asia, the decline was particularly pronounced for medium-skilled workers. Within Europe medium-skilled workers in Germany lost the biggest share and in other European countries the income share going to low-skilled workers also declined. Income for high-skilled workers related to global manufacturing went up in most EU countries. This is not simply the result of a strong supply of higher skilled labour, simply replacing medium skilled workers, but essentially

carrying out the same activities. If this was the case, the wages for high-skilled workers should have dropped and the increase in GVC income of HS workers would be limited. However, relative wages for HS workers did not show this pattern (see Timmer et al. 2013).

[Table 5 about here]

6. Manufactures GVC jobs

Many policy concerns surrounding globalisation issues are ultimately about jobs - good jobs in particular. The disappearance of manufacturing jobs in advanced nations is occasionally linked to production fragmentation and associated offshoring of activities, see contributions in Bardhan, Jaffee and Kroll (2013) for an overview. It is thus useful to look at the structure of employment in global value chains and analyse the changes in the characteristics of workers directly and indirectly involved in the production of manufacturing goods, in short manufactures GVC jobs.[12] For each country, we will measure the number of workers involved on the domestic territory. As the mobility of labour is much lower than of capital, GVC jobs will be closer to a national concept than GVC income. We will characterise GVC workers by sector of employment and level of skills. In section 6.1 we show that only about half of the workers in manufacturing GVCs are actually employed in the manufacturing sector. The other half is employed in non-manufacturing industries delivering intermediates and this share is growing. In most countries, GVC job increase in services is even higher than job loss in manufacturing. In

section 6.2 we analyse the skill structure of GVC workers and find a shift away from low-skilled towards high-skilled workers for advanced nations. This increase is faster than the overall economy trend, suggesting increased specialisation of advanced countries in GVC activities performed by high-skilled workers. This is in line with broad Heckscher-Ohlin predictions of comparative advantage when possibilities for international production fragmentation increase.

6.1 The shift towards services jobs in manufactures GVCs

By using the number of workers rather than value added per unit of output in each industry-country as the requirement vector in equation (1), we can trace the number of workers directly and indirectly involved in the production of manufacturing goods, and their sector of employment. Developments in the main twenty countries over the period from 1995 to 2008 are shown in Table 6. The first two columns indicate the share of manufacturing GVC workers as a percentage of the overall work force in the economy. In the next columns the sectoral structure of employment of these workers is shown. Three sectors are considered: agriculture, manufacturing and services (also including mining, construction and utilities). The first set of columns refers to the absolute number of GVC workers by sector in 2008, while the last four columns refer to the change over the period 1995-2008. Two main facts clearly stand out. First, the declining importance of global production of manufactures for overall employment in most advanced nations. And second, the strong shift of the sector of employment of these workers, away from the manufacturing sector towards the services sector.

The first two columns of Table 6 show the decline in importance of manufactures GVCs in providing jobs in the economy in all countries, except in China and Turkey. The job losses in Japan and the US are major, round 2.9 and 4.6 million respectively. Also job loss in the UK stands out, as more than 1.6 million GVC jobs disappeared in this country alone. The only exception to this trend in advanced countries is Germany. In 2008, 26 per cent of the German employment was involved in the global production of manufactures which is by far the highest share across all advanced countries.

Another important finding on the basis of Table 6 is the strong shift towards services jobs in the global production of manufactures since 1995. Faster growth (or slower declines) in services jobs than in manufacturing can be seen in all major advanced countries. As a result, in 2008, the manufacturing sector accounted for about half of the total number of manufactures GVC jobs in advanced countries. The other half is employed in agriculture and in particular in services. They are involved in the production of intermediate goods and services used in the manufacturing process. These findings testify to the increasing intertwines of manufacturing and services activities.

Following Baumol's cost disease hypothesis, one might argue that this shift in the sectoral distribution of the GVC jobs might be interpreted as the result of differential productivity growth in manufacturing and services. But while there is clear evidence that productivity growth in manufacturing is higher than in services overall, this does not necessarily hold for the services activities in manufactures GVCs. These only form a sub-set of the services sector, and involve in particular intermediate services such as wholesaling, transportation, finance and several business services.[13] These activities are

generally open for international competition and likely to have much higher rates of innovation and productivity growth than services activities for domestic demand which are dominated by personal services, education, health and public administration. Hence it seems more likely that our findings are indicative of a fundamental shift in the type of activities carried out by advanced countries in the global production of manufactures, away from blue-collar manufacturing to white-collar services activities. This hypothesis is confirmed when one analyses the skill-content of GVC jobs as is done in the next section.

In the major emerging economies, most of the jobs are still added in the manufacturing sector as was to be expected. For China, India, Mexico and Turkey job increases in manufacturing outnumbered those in the services sector. In Brazil however services job growth appeared to be more important. Even more strongly, in Indonesia and Russia the number of manufacturing jobs in manufactures' production declined. These countries actually lost jobs over the period 1995-2008 overall and seem to have entered a premature de-industrialisation phase.

[Table 6 about here]

6.2 Specialisation in high-skilled activities in advanced countries

In a world with international production fragmentation, the broad Heckscher-Ohlin predictions will still hold: countries will carry out activities which local value added content is relatively intensive in their relatively abundant factors. In fact increased opportunities for international production fragmentation may have the tendency to

magnify comparative advantage of countries as suggested by Baldwin and Evenett (2012). A simple example will illustrate. Assume two goods A and B which are both produced with two activities: a low-skilled (LS) and a high-skilled (HS) activity. Before unbundling, goods A and B are bundles of production activities with different skill intensities. Assume that good A is on average more skill intensive than B as the HS activity is more important in production of A than B. A relatively skill-abundant country would specialise in production of A, and a skill-scarce country in B. After unbundling, each nation specialises in specific production activities. The skill-abundant country will specialize in the HS activities in production of both goods, and a skill-scarce country in the LS activities. As a result, the potential range of comparative advantages across countries in activities will be greater than in final products (see e.g. Deardorff 2001).[14]

To test this prediction we analyse the number of workers by skill type needed in manufactures GVCs using equation (1) in combination with a skill requirement vector. This vector is based on a characterisation of workers in each industry and country by their observable educational attainment levels, as described in section 3. This delivers the number of low- (LS), medium- (MS) and high-skilled (HS) GVC workers for a particular year. We find that during 1995-2008 in all advanced countries combined the increase in high-skilled jobs was 4.6 million. Medium-skilled jobs declined by 3.8 million, and the drop in low-skilled jobs by 9.7 million was even bigger. This pattern of high-skilled growing faster (or declining slower) than medium- and low-skilled can be found for most countries. But there are some regional differences. In the US employment in manufactures global production dropped for all workers, in particular the medium-skilled. This is a well-known phenomenon that characterises a broader segment of the US

economy and has been extensively studied (see e.g. Autor 2010). More surprising is the finding that also the number of high-skilled jobs has declined. This is in stark contrast to Japan and major EU countries, where less skilled jobs also dwindled, but this was at least in part compensated for by increasing opportunities for high-skilled jobs.

[Table 7 about here]

7. Concluding remarks

A global value chain perspective has profound implications for one's thinking of competitiveness and growth. It highlights the importance of global production networks and the increasing interrelation of consumption, production and income across national boundaries through the trade of goods and services. Enhancing competitiveness and growth is increasingly about capturing a larger share of global value chains, in particular in products for which global demand is growing (Porter 1990). This rise of global value chains (GVCs) is also posing new challenges to analyses of international trade and measures of countries' competitiveness.

In this paper, we take a macro-perspective, and analyze the value added of production for a wide set of manufacturing product groups. This is done through a newly developed accounting method, building upon an input-output modelling of the world economy in the tradition of Leontief (1949). The novelty of our approach is that we trace the value added by all labor and capital that is directly and indirectly used for the

production of final manufactures. We call this GVC income. We also introduce the related concept of GVC jobs which is the number of jobs directly and indirectly needed in the production of final goods. To measure GVC incomes and jobs for a wide set of countries in the world, we use the global input-output tables and supplementary labour accounts from the World Input-Output Database, available at www.wiod.org and described in Timmer (ed. 2012).

The paper presents new evidence on the main changes in GVC income and jobs across both mature and developing countries. Taken together, the results show that international fragmentation in the production of manufactures has been accompanied by a rapid shift towards higher-skilled activities in advanced nations. These activities are increasingly carried out in the services sector, and no longer in the manufacturing sector itself. As such, it contributes to the so-called job polarization in advanced economies as the displaced manufacturing workers are likely to be absorbed in personal and distributional services where low-skilled employment opportunities are still growing (Goos, Manning and Salomons 2011). Emerging economies are taking up increasing shares in global GVC income, much of which is driven by rapid growth in China after accession to the WTO in 2001. We also find increasing intertwines of manufacturing and services activities, which argues against a myopic view on manufacturing jobs in discussions on GVC issues. Rather than focusing on the particular sector in which jobs are lost or created, the discussion should be led by a view towards the activities which are carried out in GVCs, irrespective of the sector in which they are ultimately classified. Thinking in terms of sectors is basically a relic of a world where fragmentation of production, both domestically and international, had not progressed far.

Although the model to measure GVC income and jobs is relatively straightforward it is clear that the validity of the findings relies heavily on the quality of the database used. The WIOD is a prototype database developed mainly to provide a proof-of-concept and it is up to the statistical community to bring international input-output tables into the realm of official statistics. The development work done by the OECD (Ahmad 2013) is certainly a step in the right direction. Various weak areas in data remain, in particular in the measurement of trade in services and intangibles. In addition, due to lack of firm-level data matching national input-output tables, one currently has to rely on the assumption that all firms in an industry have a similar production structure. If various types of firms, in particular exporters, have a different production technology and input sourcing structure (i.e. importing larger shares), more detailed data might reveal a bias in the results presented here. More information on the ownership of capital income, which is currently measured on a domestic basis rather than on a national basis, is also desirable. This is far from easy though and pursuing this line of investigation, one needs to trace not only the nationality of the firms involved, but also the nationality of the ultimate claimants of residual profits.

Arguably the most important area where more study is needed is in tracing where in the value chain the profits from lead firms are realised. And how these are recorded in the current statistical system. For example, the product case studies by e.g. Dedrick et al. (2010) suggest that the profits made by the lead firms in the chains can only be inferred by comparing the final purchase and ex-factory prices of the product, which include the trade margins. The use of brand names, software, knowledge systems and other

intangibles of the lead firm by other firms in the chain is typically not compensated for by a direct money flow from the users. Rather the compensation is realised indirectly through the ability of the lead firm to have the exclusive right to sell the particular product with a premium through its own, or other tightly controlled, sale channels. This indirect compensation takes place in value chains that are completely within a multinational enterprise, but also arises in chains that are to a larger extent organised through arms' length transactions. When the residual profits are realised when manufacturing firms sell to final consumers, this is picked up in our GVC income measure. But alternative value chain arrangements are feasible.

One particular example is the existence of so-called factoryless goods producers (FGPs), which are proliferating in the US. These are firms that are manufacturing-like in that they perform many of the tasks and activities found in manufacturing establishments themselves, except for the actual manufacturing production process. In the current US statistical system they are classified in wholesaling, and their output is recorded as a wholesale margin, rather than manufacturing sales. The value added of these firms should clearly be part of manufactures GVC incomes but are currently not picked up as GVC income is measured at basic prices, such that trade and transport margins associated with final consumption are not included in GVC incomes. This might bias downwards the total GVC income for the US compared to other countries to the extent that FGP production is more prominent than in other countries. The scope for this bias is not particularly large though. Bernard and Fort (2013) suggest that reclassifying the FGPs to the manufacturing sector would increase reported manufacturing output in 2007 by about 5 per cent in a conservative estimate, and maximal 17 per cent using a more liberal set of assumptions.

A deeper understanding of the workings of global value chains is clearly needed before our measurement systems will adequately reflect all its intricacies.

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Figure 1 Links between expenditure, production and income.

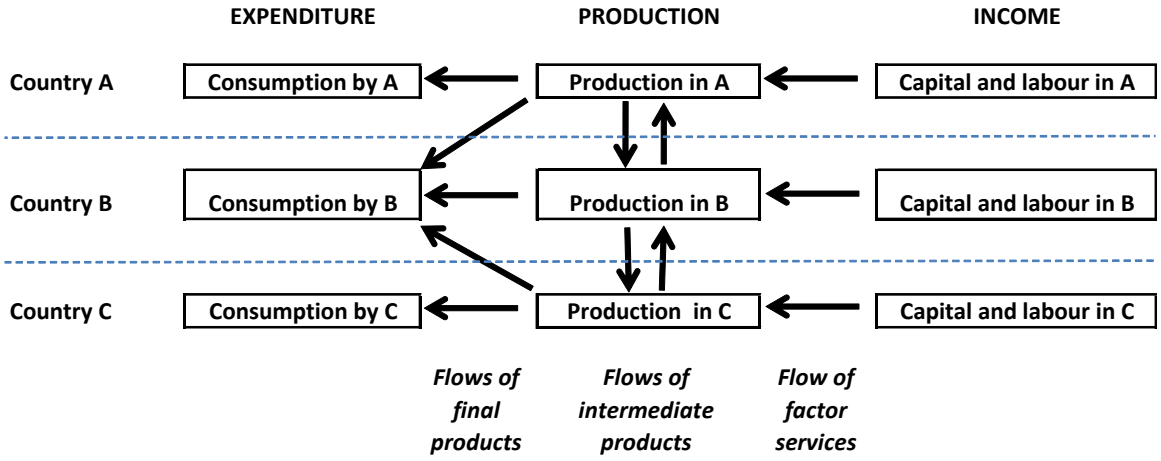


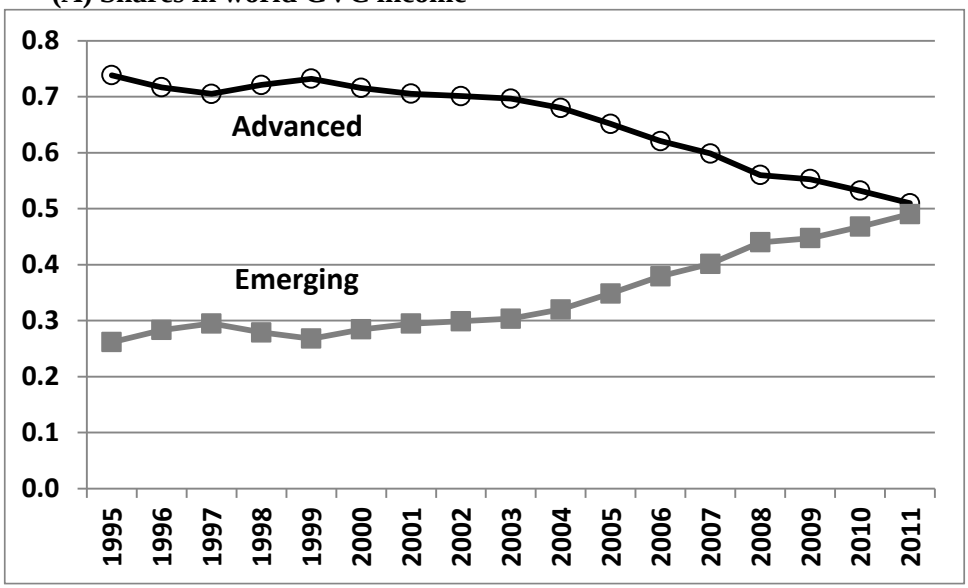
Figure 2 Schematic outline of World Input-Output Table (WIOT), three regions

		Country A Intermediate *Industry*	Country B Intermediate *Industry*	Rest of World Intermediate *Industry*	Country A Final domestic	Country B Final domestic	Rest of Final domestic	Total
Country A	*Industry*	Intermediate use of domestic output	Intermediate use by B of exports from A	Intermediate use by RoW of exports from A	Final use of domestic output	Final use by B of exports from A	Final use by RoW of exports from A	Output in A
Country B	*Industry*	Intermediate use by A of exports from B	Intermediate use of domestic output	Intermediate use by RoW of exports from B	Final use by A of exports from B	Final use of domestic output	Final use by RoW of exports from B	Output in B
Rest of World (RoW)	*Industry*	Intermediate use by A of exports from RoW	Intermediate use by B of exports from RoW	Intermediate use of domestic output	Final use by A of exports from RoW	Final use by B of exports from RoW	Final use of domestic output	Output in RoW
		Value added	Value added	Value added				
		Output in A	Output in B	Output in RoW				

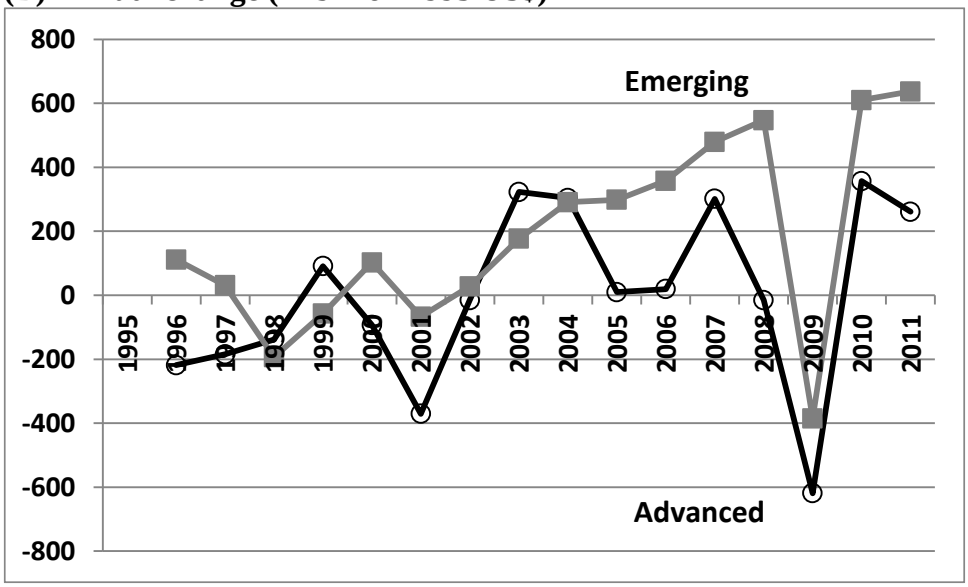
Figure 3

GVC incomes in advanced and emerging countries, all manufactures, 1995-2011

(A) Shares in world GVC income

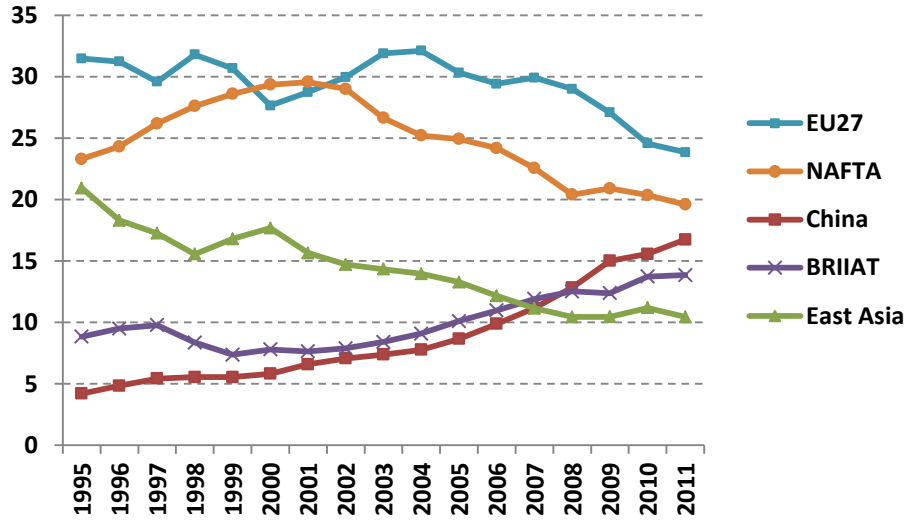


(B) Annual change (in billion 1995 US$)



Note: Advanced includes EU-15, Japan, Korea, Taiwan, Australia, Canada and the U.S. Emerging includes all other countries in the world. National currencies converted to US$ with official exchange rates, deflated to 1995 prices with the US CPI. World GVC income is equal to world expenditures on manufacturing products at basic prices.
Source: Author's calculations based on World Input-Output Database, April 2012, updated to 2011.

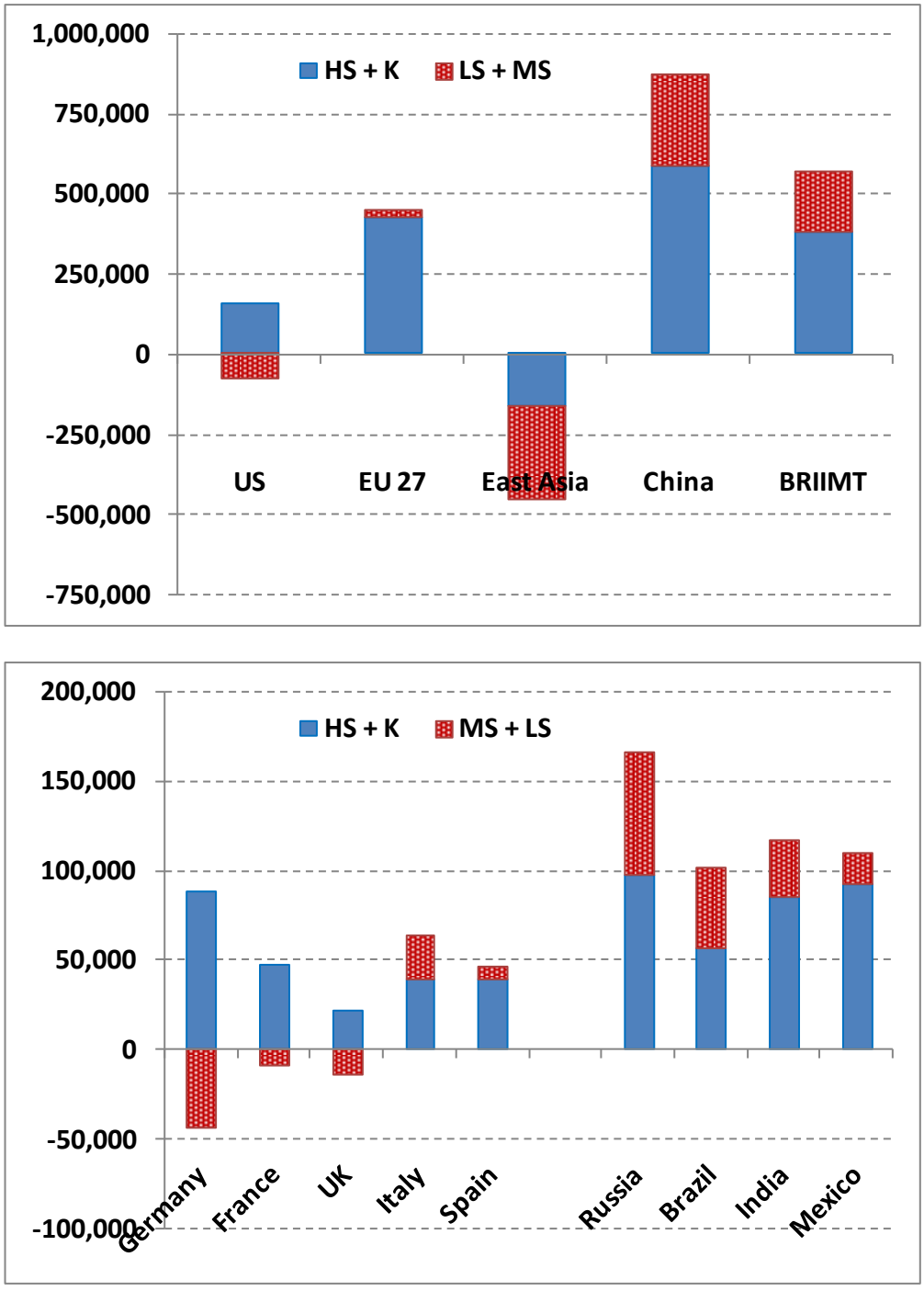
Figure 4 Regional shares in world GVC income, all manufactures, 1995-2011 (%)



Note: Value added by regions in the production of final manufacturing goods. East Asia includes Japan, South Korea and Taiwan. BRIIAT includes Brazil, Russia, India, Indonesia, Australia, and Turkey. EU27 includes all European countries that have joined the European Union. NAFTA includes Canada, Mexico and the US. Shares do not add up to 100% as the remainder is the share of all other countries in the world.

Source: Author's calculations based on World Input-Output Database, April 2012, updated to 2011.

Figure 5 GVC Income by production factor (in million 1995 US$), change between 1995 and 2008.



Note: factor income earned by high-skilled labour and capital (HS + K) and by medium- and low-skilled labour (MS + LS).
Source: Author's calculations based on World Input-Output Database, April 2012, updated to 2011.

Table 1 Value added in final expenditure on electrical products in US (bil 1995 US$)

	1995	2008	2008 over 1995
Total expenditure in US , *of which*	217	253	36
Domestic value added	119	106	-13
Foreign value added, *of which*	98	147	49
Canada and Mexico	10	15	5
China	7	53	46
East Asia	37	24	-13
EU 27	19	28	9
Other	25	27	2

Note: Breakdown of final expenditure by households, firms and government in the US on electrical machinery products (ISIC rev.3 industries 30 to 33) into value added in regions. At basic prices, excluding domestic trade and transport margins, and in billion US$, deflated to 1995 prices with the overall US CPI. East Asia includes Japan, South Korea and Taiwan. EU 27 includes all countries of the European Union.
Source: Author's calculations based on World Input-Output Database, April 2012.

Table 2 Real GVC income, all manufactures (in billion 1995 US$).

	1995	2008	2008 over 1995
United States	1,312	1,373	62
Japan	1,154	676	-478
Germany	618	664	46
France	292	330	37
United Kingdom	254	260	6
Italy	289	353	64
Spain	126	171	44
Canada	124	190	66
Australia	68	112	45
South Korea	142	157	15
Netherlands	94	119	25
Other ten advanced	390	459	69
Total 2l advanced	4,863	4,864	1
China	277	1,114	837
Russian Federation	80	246	166
Brazil	164	265	101
India	114	229	115
Mexico	99	208	109
Turkey	73	122	49
Indonesia	83	113	30
Poland	33	86	52
Czech Republic	14	41	27
Rest of world	786	1,396	610
Total other countries	1,723	3,820	2,097
World	6,586	8,684	2,098

Note: Real GVC indicates the value added in countries to global output of final manufactures. It includes all manufactures and is in constant 1995 prices using US CPI as deflator.
Source: Author's calculations based on World Input-Output Database, April 2012.

Table 3 Percentage of real GVC income due to foreign demand, all manufactures.

	1995	2008	2008 over 1995
United States	25.9	33.0	7.1
Japan	24.6	41.8	17.2
Germany	46.3	69.9	23.6
France	53.1	60.0	7.0
United Kingdom	52.6	68.5	15.8
Italy	45.2	52.8	7.6
Spain	39.1	53.3	14.2
Canada	65.8	65.8	0.0
Australia	43.9	55.3	11.3
South Korea	45.2	67.8	22.6
Netherlands	79.3	87.8	8.5
China	35.3	48.7	13.5
Russian Federation	42.6	47.3	4.7
Brazil	15.7	26.0	10.3
India	17.7	29.3	11.6
Mexico	32.9	36.5	3.5
Turkey	22.5	35.3	12.8
Indonesia	28.5	38.7	10.2
Poland	42.7	63.0	20.3

Note: Real GVC income for all manufactures and in constant 1995 prices using US CPI as deflator. Decomposed into part due to domestic demand and part due to foreign demand.
Source: Author's calculations based on World Input-Output Database, April 2012.

Table 4 Sectoral shares in total GVC income, all manufactures (% of total)

	Natural resource		Manufacturing		Services	
	1995	2008	1995	2008	1995	2008
United States	0.06	0.09	0.56	0.52	0.38	0.39
Japan	0.04	0.03	0.65	0.62	0.31	0.35
Germany	0.03	0.02	0.61	0.56	0.36	0.42
France	0.07	0.04	0.48	0.45	0.46	0.51
United Kingdom	0.07	0.07	0.60	0.48	0.34	0.45
Italy	0.05	0.03	0.57	0.52	0.38	0.44
Spain	0.09	0.05	0.54	0.51	0.37	0.43
Canada	0.12	0.19	0.54	0.44	0.34	0.37
Australia	0.20	0.26	0.42	0.34	0.37	0.39
South Korea	0.10	0.04	0.62	0.67	0.28	0.29
Netherlands	0.11	0.12	0.49	0.42	0.40	0.45
China	0.21	0.17	0.58	0.57	0.22	0.26
Russian Federation	0.20	0.21	0.42	0.39	0.38	0.40
Brazil	0.13	0.17	0.55	0.46	0.32	0.37
India	0.22	0.18	0.42	0.41	0.35	0.40
Mexico	0.21	0.22	0.49	0.49	0.30	0.29
Turkey	0.09	0.13	0.64	0.52	0.27	0.36
Indonesia	0.22	0.30	0.61	0.54	0.18	0.16
Poland	0.15	0.10	0.53	0.49	0.32	0.42

Notes: Share of sector in total value added by a country production of final manufacturing products. Natural resource includes agriculture and mining industries (ISIC rev. 3 industries A to C), manufacturing includes all manufacturing industries (D) and services all other industries (E to Q).
Source: Author's calculations based on World Input-Output Database, April 2012.

Table 5 GVC income by production factor and region (shares in world GVC income)

	Value added by labor		Value added by capital		Value added total	
	1995	2008	1995	2008	1995	2008
EU 27	21.5	18.9	9.7	9.8	31.2	28.7
US	12.8	9.5	7.4	6.7	20.2	16.2
East Asia	12.9	6.1	8.1	4.6	21.0	10.7
China	2.0	5.2	2.1	7.8	4.2	13.0
BRIIMT	4.1	6.1	5.1	7.4	9.3	13.5
Other	6.4	7.3	7.9	10.6	14.3	17.9
World	59.7	53.1	40.3	46.9	100.0	100.0
Advanced	47.1	34.4	25.5	21.2	72.6	55.5
Emerging	12.6	18.8	14.9	25.7	27.4	44.5

	Value added by high-skilled		Value added by medium-skilled		Value added by low-skilled	
	1995	2008	1995	2008	1995	2008
EU 27	4.8	6.0	10.0	8.9	6.6	4.0
US	4.3	4.1	7.4	4.9	1.1	0.5
East Asia	3.2	2.1	7.2	3.3	2.5	0.6
China	0.1	0.4	0.7	1.8	1.3	3.0
BRIIMT	0.8	1.4	1.7	3.0	1.7	1.7
Other	0.8	1.5	2.3	2.9	3.4	3.0
World	14.0	15.5	29.1	24.8	16.6	12.8
Advanced	12.4	12.2	24.8	17.2	10.0	5.0
Emerging	1.6	3.3	4.3	7.6	6.6	7.8

Note: *East Asia* includes Japan, South Korea and Taiwan. EU 15 are the countries that joined the EU before 2004. *BRIIMT* includes Brazil, Indonesia, India, Mexico, Russia and Turkey. *Other* is rest of the world. Skill categories based on workers classified by educational attainment levels. World income is equal to world expenditures on manufacturing products at basic prices.

Source: Calculations based on World Input-Output Database.

Table 6 Manufactures GVC workers, 1995 and 2008

	Manufactures GVC workers as (%) share of all workers in the economy		Manufactures GVC workers in 2008 (in thousands) employed in				Change in manufactures GVC workers between 1995 and 2008 (in thousands) employed in			
	1995	2008	Agriculture	Manufacturing	Services	All sectors	Agriculture	Manufacturing	Services	All sectors
United States	16.0	11.1	1,143	8,837	6,892	16,872	-331	-3,144	-1,138	-4,612
Japan	22.6	19.4	1,298	6,491	4,417	12,207	-794	-2,225	148	-2,871
Germany	26.8	26.4	400	5,481	4,766	10,647	-161	-666	1,388	561
France	22.0	18.7	303	2,195	2,355	4,853	-96	-423	368	-151
United Kingdom	20.1	12.6	115	1,946	1,931	3,992	-128	-1,148	-347	-1,624
Italy	29.1	25.5	333	3,553	2,559	6,444	-192	-234	517	91
Spain	23.2	17.5	271	1,827	1,494	3,592	-97	185	353	440
Canada	20.8	16.0	157	1,138	1,482	2,777	-102	-136	193	-45
Australia	18.2	14.5	165	641	855	1,661	-48	3	196	150
South Korea	29.7	22.8	655	2,646	2,077	5,378	-468	-735	524	-679
Netherlands	22.8	19.0	89	643	929	1,661	-42	-87	158	29
China	31.7	33.3	121,342	87,568	49,468	258,378	9,963	20,508	11,965	42,436
Russian Federation	24.7	21.9	4,259	6,749	6,228	17,237	-1,403	-2,120	2,198	-1,325
Brazil	29.6	28.7	8,347	9,490	9,823	27,660	-705	2,450	4,118	5,863
India	27.9	27.3	57,926	41,933	26,483	126,343	2,118	10,896	7,025	20,039
Mexico	30.3	24.4	2,817	6,128	3,205	12,150	-400	1,403	1,121	2,124
Turkey	27.1	30.4	1,778	3,115	1,554	6,446	-341	620	584	863
Indonesia	32.1	25.6	13,921	7,427	5,725	27,073	-1,899	-425	1,380	-944
Poland	31.0	28.8	917	2,278	1,347	4,542	-468	81	368	-19
Czech Republic	30.8	30.9	93	990	553	1,636	-59	74	35	50

Note: GVC workers are workers directly and indirectly involved in the production of manufacturing goods. First four columns indicate the change in the number of GVC workers by sector between 1995 and 2008. Next four columns indicate the total number of GVC workers by sector in 2008. Last column is the total number of workers in the economy.

Source: Author's calculations based on World Input-Output Database, April 2012.

Table 7 Change in number of workers in global production of final manufactures by skill type, 1995 and 2008 (in thousands)

	Low	Medium	High	Total
United States	-1,125	-3,286	-201	-4,612
Japan	-1,834	-1,399	361	-2,871
Germany	-168	115	614	561
France	-768	52	566	-151
United Kingdom	-1,236	-560	172	-1,624
Italy	-1,201	853	439	91
Spain	-507	391	556	440
Canada	-118	-105	177	-45
Australia	-84	141	94	150
South Korea	-1,110	-335	766	-679
Netherlands	-119	-54	202	29
Other ten advanced	-1,441	425	840	-176
Total 21 advanced	-9,711	-3,762	4,587	-8,886
All other countries	56,214	64,370	19,393	139,977
World	46,503	60,607	23,981	131,091

Notes: number of workers (including employees and self-employed) involved in global production of final manufactures. Split into number of high-skilled workers, medium- and low-skilled workers based on educational attainment.
Source: Author's calculations based on World Input-Output Database, April 2013.

[1] This identity does not hold true at the country level as countries can have current account imbalances driving a wedge between value added produced and final consumption value.

[2] See Miller and Blair (2009) for an introduction to input-output analysis.

[3] Throughout the paper, we analyse final expenditure, including private and government consumption, and investment.

[4] Variations of this approach are also used in the bourgeoning literature on trade in value added and our approach is related to the work by Koopman et al. (2013) and in particular Johnson and Noguera (2012). But rather than using Leontief's insight to analyse factor content of trade flows, we focus on analyses of global value distributions.

[5] Final use includes consumption by households, government and non-profit organisations, and gross capital formation.

[6] As industries also have secondary production a simple mapping of industries and products is not feasible.

[7] In the limit, GVC income of a country is equal to gross domestic product when final demand for all goods and services in the world economy are taken into account. Hence for a meaningful analysis, one has to limit the group of products and we focus on those products for which production processes are most fragmented and which can be analysed with the data at hand.

[8] We do not show the value added by the Rest of the World consisting of all countries not covered individually in the world input-output database but for which an estimate has been made as a group (see section 3). Its share in global GVC income rose from 14% in 1995 to 17% in 2008.

[9] The euro was introduced in 2001. For the period before 2001 we are referring to the DM.

[10] Johnson and Noguera focused on foreign final demand for all goods and services, not only final manufactures as we do here.

[11] The share of natural resource sector in Russia is severely underestimated as part of the oil and gas production is classified under wholesale services rather than mining in the Russian national accounts. Adding the wholesale sector would almost double the natural resource share in 2008.

[12] We will use the term "jobs" instead of "number of workers" to be parsimonious. But the underlying data pertains to number of workers rather than jobs. Ideally, one would like to measure hours worked.

[13] It should be noted that these numbers exclude any jobs involved in the retailing of manufacturing goods as we analyse final demand at the basic price concept.

[14] Following this traditional international trade theory, having a greater range of comparative advantages across countries would generate higher welfare improvements from trade. These models are essentially comparative static of nature and disregard any dynamic effects. In the innovation and business literature, it is recently argued that the separation of high-skilled, innovative activities in advanced countries from production in emerging economies will in the long-run lead to a decline of innovation activity. In this literature the spillovers from manufacturing and innovation activities are central (see e.g. Pisano and Shih, 2012).