New measures of European Competitiveness: A Global Value Chain Perspective

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1 Introduction

It is frequently argued that globalisation has entered a new 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, Grossman and Rossi-Hansberg 2008). 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 competitiviness since the late 1990s, both in quantity and quality as testified by booming exports of technologically sophisticated products. These new competitive pressures have been linked to declines in manufacturing employment and wages in traditional industrial strongholds such as Europe, Japan and the US. Fuelled by the effects of the financial crisis in 2008, demands for new industrial policies flourishes.

But recent product case studies suggests that European, Japanese and US firms still capture major parts of the 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)). These findings suggest that in today's world export statistics are a weak indicator for the actual value which a country adds in the global production process.

This paper aims to provide new measures of the value countries add in global manufacturing production. We introduce a new metric that allows us 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.

We identify the emergence of global production networks by tracing the flow of goods and services across industries and countries as described in a world input-output table. Using a decomposition technique introduced by Leontief, 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 consumption 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. Based on this new database, we confirm that global manufacturing production is becoming increasingly fragmented. In almost all countries the share of intermediate imports rose between 1995 and 2008, indicating increasing vertical specialisation. Fragmentation of production occurred across all manufacturing products, in particular for electrical machinery and chemical products.

The main aim of this paper is to establish a series of stylised facts on the effects of increasing fragmentation of global production that can serve as a starting point for deeper analysis of its causes. In the remainder of this paper we first outline our methodology for slicing up global value chains in section 2. In section 3 we discuss the major features of our basic dataset, the World Input-Output Database (WIOD). In Section 4, we trace the increasing integration of manufacturing production processes by measuring the share of imported intermediates in output. Next we introduce our new measures of competitiveness in Section 5, called GVC income. We first indicate the trends in the GVC income shares of various regions and countries over time. Subsequently we analyse the role of labour productivity and employment growth as sources of GVC income. In Section 6, we further decompose income into compensation for low-, medium- and high-skilled workers and capital. Skills are defined through the level of educational attainment of workers. By separating wage and quantity effects, we analyse the effects of global production fragmentation on both incomes and jobs for workers in advanced and emerging countries. In Section 7 we analyse the importance of changes in domestic demand, changes in foreign demand or changes in the organisation of global production for GVC incomes.

Throughout the paper, we will focus the analysis on trends in five major regions: EU27, East Asia (including Japan, South Korea and Taiwan); US; China; and a club of other major emerging markets (BRIIMT: Brazil, Russian Federation, India, Indonesia, Mexico and Turkey). Although we present timeseries for 1995 through 2009, our decompositions

cover the period from 1995 to 2008, as in 2009 the shock effects of the global financial crisis obscure the structural developments we are looking for.

2. Slicing up global value chains: methodology

In this section we outline our method to slice up global value chains (GVCs). The basic aim of this empirical analysis is to decompose expenditure on goods and services by a particular country 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. We use the case study of Apple's iPod[1] by Dedrick at al. (2010) to illustrate some of the concepts involved when studying GVCs.[2]

The production process of the iPod is examplary for the global fragmentation of production processes with intricate regional production networks feeding into each other. It is assembled in China based on several hundreds of components and parts that are sourced from around the world. Based on professional industry sources, Linden et al. decomposed the retail price of the iPod into income for the various participants in the global production network of the iPod. The lead firm in this production network is Apple, a US–based multinational company, which is estimated to capture about a quarter of the retail price of each iPod sold. This can be considered as compensation for Apple's provision of software and designs, market knowledge, intellectual property, system integration and cost management skills and a high-value brand name. Another quarter of the retail price is captured by local distribution and retailing services. These high margins are not uncommon for manufacturing products and are an important element in our GVC metric as explained below.

The Chinese export price is halve the retail price, but is mainly determined by the cost to the Chinese assembler for sourcing the high-value components. Based on estimated gross profit margins of the supplying companies, Dedrick at al. (2010) estimate that about 11% of the retail price is captured as profits by East Asian firms in charge of manufacturing the ten most important components, such as the hard disc drive (HDD) and display manufactured by Toshiba (a company headquartered in Japan) and the memory from Samsung (South Korea). Another 37% of the iPod retail price is covering the costs of basic materials and for labour involved in the production of the components.

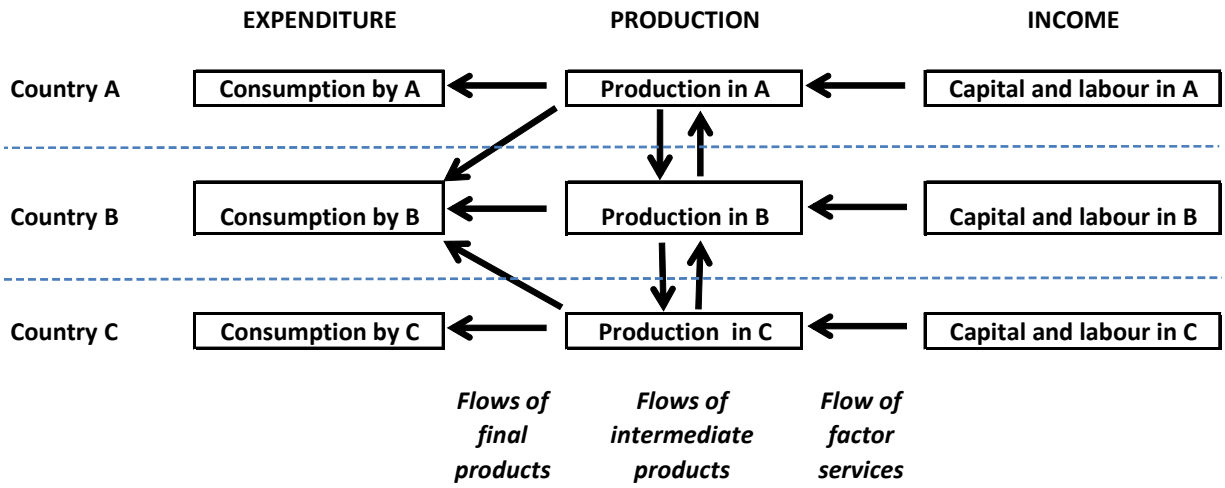
[1] The so-called Video iPod, the 30GB version of Apple's fifth generation iPods

[2] GVC analysis has a longer history, see for example Kaplinsky (2000), Gereffi (1999) and Sturgeon, van Biesebroeck and Gereffi (2008). These studies are qualitative and focus on the development of global production networks in particular industries such as textiles and automobiles, and analyse how interactions in these increasingly complex systems are governed and coordinated.

All in all, the value added by assembling activity in China is estimated to be no more than 2% of the retail price.[3] This example shows that export figures can be highly misleading to analyse a country's competitiveness when production is highly fragmented.

By introducing our new GVC metric, we aim to offer a macro-economic perspective on the effects of international production fragmentation. 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 Links between expenditure, production and income.



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

[3] Dedrick at al. (2010) show similar results for assembling in China of some other high-end electronic products such as notebooks, see also Ali-Yrkkö, Rouvinen, Seppälä and Ylä-Anttila (2011) for a study of mobile phones.

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.[4] 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.[5] $(I-B)^{-1}$ 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 zero's. 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 $K = F(I - B)^{-1} C$, in which C indicated the levels of

[4] 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.

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

consumption[6] 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.[7]

3. Data construction

To implement the new GVC metric, 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 GTAP database is the most widely known and used (Narayanan and Walmsley, 2008). Other datasets are constructed by the OECD (Yamano and Ahmad 2006) 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. Using a novel approach national input-output tables of forty major countries in the world are linked through international trade statistics, covering more than 85 per cent of world GDP. 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, both in quantities and values.

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

[7] Variations of this approach are also used in the bourgeoning literature on trade in value added and our approach is particularly related to the work by Johnson and Noguera (2011). But rather than using Leontief's insight to analyse factor content of trade flows, we focus on analyses of global value distributions.

While this type of data is available for most advanced OECD countries (O'Mahony and Timmer, 2009), it is not for many emerging countries.

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 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				

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[8], 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

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

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, we will use national supply and use tables (SUTs) that are the core statistical sources from which NSIs derive national input-output tables. In short, we derive time series of national SUTs. Benchamrk 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 these 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. The construction of our WIOT has a number of distinct characteristics.

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.[9]

To ensure meaningful analysis over time, we start from industry output and final consumption series given in the national accounts and benchmark national SUTs to these time-consistent series. Typically, SUTs are only available for a limited set of years (e.g. every 5 year)[10] and once released by the national statistical institute revisions are rare. This compromises the consistency and comparability of these tables over time as

[9] As industries also have secondary production a simple mapping of industries and products is not feasible.
[10] Though recently, most countries in the European Union have moved to the publication of annual SUTs.

statistical systems develop, new methodologies and accounting rules are used, classification schemes change and new data becomes available. By benchmarking the SUTs on consistent time series from the National Accounting System (NAS), tables can be linked over time in a meaningful way. This is done by using a SUT updating method (the SUT-RAS method) as described in Temurshoev and Timmer (2011) which is akin to the well-known bi-proportional (RAS) updating method for input-output tables. For this updating data on gross output and value added by industry is used, alongside data on final expenditure categories from the National Accounts.

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 consistence and integrated into a bilateral service trade database (see Stehrer et al., 2010, for details). Although the maximum of existing information is used, there are clear gaps in our knowledge at lower levels of aggregation.

Based on the national SUTs, National account series and international trade data, international SUTs are prepared for each country. As a final step, international SUTs are transformed into an industry-by-industry type world input-output table. We use the so-called "fixed product-sales structure" assumption stating that each product has its own specific sales structure irrespective of the industry where it is produced (see e.g. Eurostat, 2008). For a more elaborate discussion of construction methods, practical implementation and detailed sources of the WIOT, see Timmer etal. (2012).

3.2 Factor input requirements

For factor input requirements we collected country-specific data on detailed labour and capital inputs for all 35 industries. 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 clasification (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; at best only total hours worked and wages by industry are available from the National Accounts. 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. Capital compensation is derived as gross value added minus labour compensation as defined above.

For most advanced countries labour and capital 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. This is described in full in Erumban et al. (2012).

4. Made in the World

Before we present our global value chain decompositions, we first provide some further evidence on the increasing fragmentation of manufacturing production processes. This is based on a simple measure of vertical specialisation: the share of imported intermediate inputs in manufacturing gross output. This index provides a good indicator of the

backward integration of a country's production. The WIODatabase provides for the first time the opportunity to provide long time trends for a large set of countries for this index.

Figure 3 Imported intermediate inputs as share of gross output.

In Figure 3 we provide the share of imported intermediate inputs as a share of gross output in manufacturing for the major countries. Countries are ranked on their GDP size in 2008. The main result is that for all countries, except Russia, the degree of vertical specialisation has increased between 1995 and 2008 indicating a global trend of production integration. But there are sizeable differences in the speed of vertical specialisation. In Asia, there is a clear two-way integration between Japan, South Korea and Taiwan on the one hand, and China on the other. The share of intermediate imports by Japan almost doubled, in particular from China. Also in South Korea and Taiwan Chinese imports increased rapidly. Conversely, China also rapidly increased the share of intermediate imports from East Asia, as well as from other countries in Asia. Chinese imports of intermediates from the EU and US only slowly increased and are much lower than from Asia.

Intermediate imports also rose rapidly in all European countries. In particular, the index for German manufacturing increased rapidly between 1995 and 2008, and faster than for other major EU countries. This prompted some commentators to characterise the German economy as a Bazaar economy (e.g. Sinn, 2006). But although its import share is somewhat high given its size of the economy, in 2008 it was not much higher than the levels in France, the UK, Italy or Spain. Clearly, smaller countries in the EU are more vertically specialised than the bigger ones, a well-known result (see also Hummels, Ishii and Yi, 2001). The Eastern European countries that joined the EU in 2004, have shown rapid production integration with the old EU countries. The Baltic States also imported significant amounts of inputs from Russia, and Ireland from the US.

On the other hand the integration process of NAFTA countries (Canada, Mexico and US) appears to have lost steam in the mid 1990s. The share of the US in the imports by Canada and Mexico even declined. Big emerging markets like Brazil, Russia and Indonesia seemed to fail to participate in the global fragmentation process, as imported intermediate shares in these countries are still rather small.

We find increasing fragmentation of production not only for overall manufacturing, but also for all manufacturing product groups. In figure 4, we provide imported intermediate input shares in gross output in the production of six manufacturing product groups (weighted over the 40 countries in our dataset). Fragmentation increased steadily for all products. In 2008 the degree of international fragmentation was lowest for food manufacturing which has strong backward linkages to domestic agriculture and this changes only slowly. International fragmentation in non-durables (textile, wearing

apparel and leather) has a long history and took off already in the 1960s when there was a quick move of production to less developed regions (Gereffi, 1994). But this process was halted by the Multi-Fibre Arrangement that restricted exports to developed markets through country quota's. After the ending of the MFA in 2005, international fragmentation declined as production centres became quickly concentrated in major countries like China, India, Mexico and Turkey. On the other hand, international fragmentation in the production of electrical equipment increased steadily. While electronics production is often cited as the paragon of globalisation, it appears that the production of chemicals is even more internationally fragmented. In 2008 it had the highest share of imported intermediate inputs of all manufacturing production.

Figure 4: Imported intermediate inputs as share of gross output, 1995-2008.

5. Trends in GVC incomes

Overall, we found strong evidence of increasing international fragmentation of production. This has consequences for income distribution both within and across countries. 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 competitiviness 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.

GVC incomes all manufacturing

Figures 5 and 6 provide the share of various regions and countries in global manufacturing production for the period from 1995 to 2009. We distinguish six groups of countries, namely the European Union (EU) consisting of the 27 EU member states; East Asia consisting of Japan, South Korea and Taiwan; the US; China; BRIIMT consisting of Brazil, Russia, India, Indonesia, Mexico and Turkey; and 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).

The GVC income share of advanced countries (East Asia plus US plus 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 (Figure 5).

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. After an initial rise, the US share also started to decline after 2002 (see Figure 6). In contrast, the EU GVC income share has been relatively stable, only slowly declining over the period from 1995 to 2008. In 2009 it still had the largest share in world GVC income. 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.

China is responsible for the major part of 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 was higher than that of Brazil, Russia, Indian, Indonesia, Mexico and Turkey (BRIIMT) combined. And it was almost equal to that of the US. BRIIMT GVC income share increased after 2004, see Figures 6 and 7.

Figure 5 GVC incomes in advanced and emerging countries
Figure 6 Regional shares in world GVC income, 1995-2009.
Figure 7 GVC income (in million 1995 US$) in 1995 and 2008.

Shares in world GVC income are expressed in US$ using current exchange rates. Exchange rates have fluctuated wildly over the period considered, e.g. $/euro rate declined sharply over 1995-2001 followed by a steep incline.[11] The choice of this numeraire has no impact on the size of the shares. Expressing incomes in Yen or euro's would give identical shares. For income changes over time we deflate incomes in US$ to the 1995 US$ value using the US CPI. Thus we can compare the levels of GVC incomes over time. This is dicussed in more detail later on. Also, the numbers in this paper refer to values in basic prices, meaning that the trade and transport margins associated with final consumption are not included in GVC incomes (see later).

GVC incomes by product groups

One might hypothesise that shifts the composition of global manufacturing demand in terms of the type of products being demanded might also be 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. Moreover, the share of advanced nations in the production value declined in all product groups. This is shown in Figure 8, with region detail in Figure 9 and Table 1.

In food products and non-durables, the share of advanced countries was already low, and this dropped further. Still, it might be surprising that even in non-durables (textile, wearing apparel, and leather) their share is still more than 40%. When one would include the high domestic retail margins on these goods (so at purchaser's prices), the share increases to more than 50%. Advanced nations still maintain a particular stronghold in transport equipment and machinery which are are highly R&D and brand intensive. And while production of these goods has recently moved to emerging countries, these activities are still mainly carried out in advanced nations. At basic prices, the GVC income share of advanced nations in chemicals is declining fast, but at purchaser's prices this drop would be only minor as Chemical consumer products such as medicines and cosmetics have very large retail margins. The advanced GVC income drop was fastest in electrical machinery (Figure 8).

Emerging countries increased GVC income in all product groups. China has increased GVC income in all products, in particular in electrical machinery. BRIIMT mainly increased GVC incomes in food. Advanced countries' GVC income only substantially increased in chemicals and transport equipment. The East Asian GVC income decline was across all products. GVC income in US increased substantially in chemicals and in food, but not in other products. The EU improved GVC income in all product groups, except non-durables. It holds a particular stronghold in GVCs of transport equipment, see Figure 9.

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

Figure 8 GVC income by product, 1995-2009.
Figure 9 GVC income by products (in million 1995 US$), 1995 and 2008
Table 1 GVC income earned in regions for products groups

Is labour productivity growth driving GVC incomes?

Increasing competitiveness can be achieved through increasing the number of workers in GVC activities and improving their productivity. We decompose changes in GVC income into changes in the number of workers involved and change in the GVC income per worker. The latter is akin to standard measures of labour productivity as it measures the real value added per worker in GVC production. GVC income includes not only wages but also compensation of capital used and is equal to value added by definition.

So far, real GVC incomes of countries have been measured in constant price dollars using the US CPI and current exchange rates (1995 US$). Thus measured, GVC income of a country represents the purchasing power of this income in the US at 1995 prices. While useful to compare GVC incomes across countries and over time, it is less meaningful as an indicator of real value added created. For the latter, we define an alternative and deflate GVC income in a country by the national CPI deflator to 1995 national prices and use the 1995 exchange rate to convert to US$. In this way, real value added better reflects the "quantities" of value added produced in a country. To the extent that exchange rates fully reflect differences in national rates of inflation, the real GVC income will be identical to real value added. The difference between the two is known as the change in the real exchange rate. This is measured as change in exchange rate between 1995 and 2008, adjusted for difference in CPI of country and the US. For example, we will find that relative to 1995, the Japanese Yen is undervalued in 2008, while the Russian rouble is highly overvalued.[12] Not correcting for this would respectively under- and overestimate the growth in real value added per worker.

Using these definitions, we decompose the change in real GVC income of a country (K) using the familiar shift-share method into three elements as follows:

$$\Delta K = [L_{ave}][\ (RER/L_{08}) + \Delta(RVA/L)] + [(K/L)_{ave}][\Delta L],$$

where Δ indicated the difference in levels between 1995 and 2008, *ave*-subscript indicating an average between 1995 and 2008 levels, L is employment, RVA is real value added as defined above and RER the difference between real value added and real GVC income due to changes in the real exchange rate.

[12] Note that the RER is sensitive to the choice of the base year.

Employment estimates for the agricultural sector are difficult to make. In particular for developing countries with a large agricultural labour force, average labour productivity numbers are not very meaningful. Rather we want to focus on the productivity of non-agricultural activities in GVCs. We decompose the change in GVC income in non-food manufacturing products, thus leaving out food products. Results are given in Figure 10. We find that the sources of GVC income growth vary widely across countries. In Japan and the US improvements in labour productivity are cancelled out by declines in the GVC employment. GVC income in the EU increases due to strong productivity growth, but employment growth is negligible. While GVC employment growth was strong in Germany and Spain it was negative in France and in particular in the UK. In China, Brazil, India and Mexico, employment in GVCs is growing strongly. China additionally benefits from strong labour productivity growth. This is from a very low level: real value added per worker in GVCs was 3% of the US level in 1995, up to 6% in 2008, based on current exchange rates.

Figure 10 Change in GVC income by source between 1995 and 2008.

6. 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, 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 2 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 sections. 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. 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. This is less clear for capital income. With high FDI flows from advanced to emerging countries, part of the capital on these countries' territory is owned by firms headquartered in advanced nations. Data on foreign ownership is needed to allow for an income analysis on a national rather than a domestic basis.

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 Japan, 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.

Table 2 Income earned in global manufacturing by production factor and region
Figure 11 GVC Income by production factor (in million 1995 US$),

The jobs related to global manufacturing have been declining slowly in the advanced region, but very uneven across regions and skill types. In East Asia low skilled jobs quickly disappeared by many HS jobs were created. US employment dropped for all workers, in particular medium,-skilled. Total workers in global manufacturing in the EU

went even up for HS and MS (the latter especially outside Germany). Also, there is a clear shift is in the sector of employment as the number of non-manufacturing jobs is increasing, while jobs in manufacturing industries are vanishing. For example, in 2008, about halve of the jobs related to global manufacturing in the EU is in the non-manufacturing sector (see Table 3).

7. GVC income and the role of demand

In a previous section we decomposed growth in GVC income in labour productivity and employment growth. This is a supply-side decomposition. The WIOD also allows decomposition from the demand side. A demand side perspective opens up the possibility to investigate the impact of changing global demand structures on a country's GVC income. It also offers the opportunity to analyse the potential for future GVC income growth by analysing the geographical sources of demand.

In Figure 12, we split GVC income in 2008 into income due to final demand from emerging countries (EMER), from advanced countries (ADV) and domestic dem (DOM). It is shown that Europe as a whole is strongly dependent on final demand from within Europe, and much less on foreign demand. Less than a quarter of European GVC income is related to final demand from emerging markets. This indicates that Europe is not particularly well positioned to benefit from future growth in these countries. This is also true for the US and Japan. Within Europe Germany and the UK are better linked to emerging market demand than other countries.

We can analyse the changes in GVC income over the period related to changes in the structure of global demand and in the organisation of production in global networks. We decompose the change in a country's GVC income (K) into a part related to changing domestic demand (C_{dom}), changing foreign demand (C_{for}) [13] and changes in the structure of global production (A). The latter basically indicates to what extent a country has improved its GVC income by serving global demand through exporting intermediate products that are used in production by other countries. Using the definitions of GVC income given in section 2 we define two polar case decompositions of the change in GVC income between 0 and t (indicated by Δ):

$\Delta K = \Delta A\ (C_0) + A_t\, \Delta C_{for} + A_t \Delta C_{dom}$ and
$\Delta K = \Delta A\ (C_t) + A_0\, \Delta C_{for} + A_0 \Delta C_{dom}$

As there is no unique decomposition we take the average of the two polar cases. These are shown in Figure 13.

[13] This measure is akin to the measure of value-added exports introuced by Johnson and Noguera (2012).

Advanced countries all lost GVC income due to the changes in the organisation of global production (indicated by OTHER in the figure). Basically, a strong process of substitution took place in which domestically produced intermediates were substituted for by imported intermediates (see section 4). This source of GVC income hence contributed negatively. In addition, domestic demand was increasingly served by imports. Domestic demand was not a source of GVC income source in the US, and contributed strongly negative in Japan as the import substitution took place at the background of stagnating domestic demand. Increasing foreign demand made up only some of this. Only in the EU domestic demand suffered less from import substitution and contributed strongly to GVC income growth. The opposite is found for the emerging countries which benefitted from strong domestic demand growth and from the changes in global production by serving the global demand for intermediates. China benefitted in particular from serving foreign final demand. This source contributed to almost halve of its GVC income increase.

Within the EU large differences are found. Germany, France and Italy GVC incomes suffered from substitution of domestic intermediates by foreign. But at the same time they benefitted much more from serving foreign final demand than the UK and Spain. This suggests that they were successful in slicing up their domestic value chains and benefitted from the global fragmentation process. This process was particular strong in Germany, and the increase in foreign demand more than made up the negative impact of slow domestic demand that additionally suffered from import competition. Growth in GVC income in the BRIM countries was mainly fuelled through increased domestic demand. Russia also benefitted from increased demand for its oil and gas serving as intermediate input in European production.

Figure 12 GVC income earned by demand source in 2008

Figure 13 Sources of change in GVC income, change over period 1995-2008.

8. 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. Increasingly a country's competitiveness and growth is about capturing larger share of global value chains, in particular in products for which global demand is growing (Porter 1990). In this paper we proposed a new metric that is based on analysis of vertically integrated industries both

within and across countries. This metric traces the origin of a region's factor income to demand for manufacturing products worldwide. We applied this metric to a newly developed database called WIOD that contains a World Input-Output Table and a set of industry-and-country specific labour and capital income shares. A number of conclusions stand out:

- Increasing fragmentation of production requires a new metric of competitiveness
- Growth in GVC income in advanced countries is slow, while accelerating in emerging countries since 2002.
- Competitiveness of Europe is steady
- European GVC income supported by growth in labour productivity, but not in employment
- Increasing fragmentation is benefiting high-skilled workers and capital
- Employment in services activities for global manufacturing increased

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. We gave priority to data on exports and import of goods and services from national supply and use tables that provide additional detail. Also, it is notoriously hard to determine the use category of imports. Instead of applying row-proportionality, we relied on applying a new BEC classification at a detailed 6-digit level to estimate intermediate and final use shares of imports. Nevertheless, 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).

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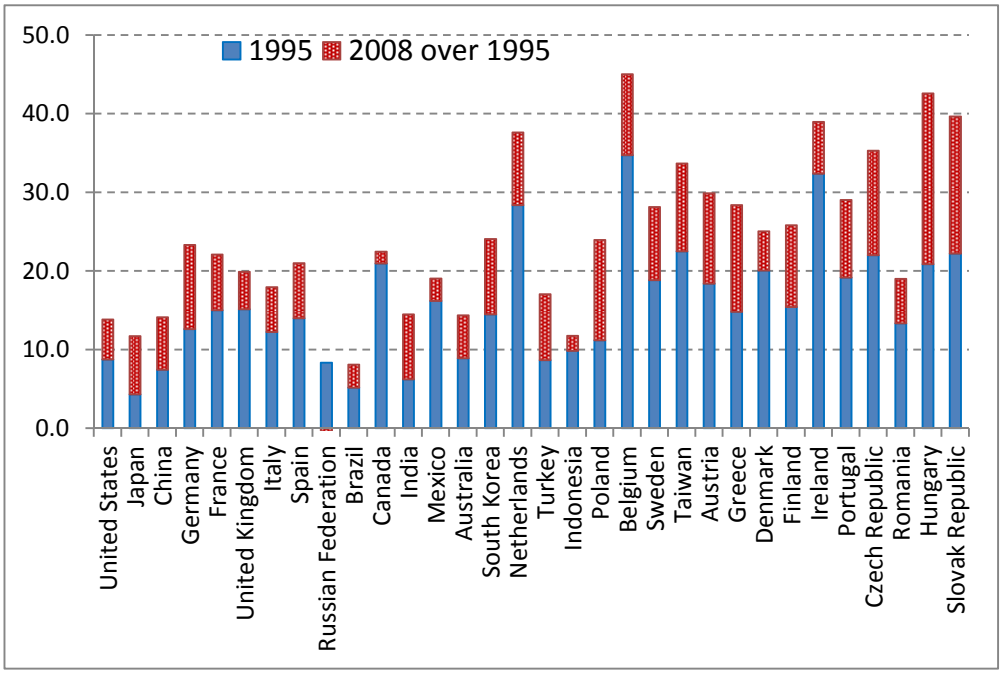
Figure 3

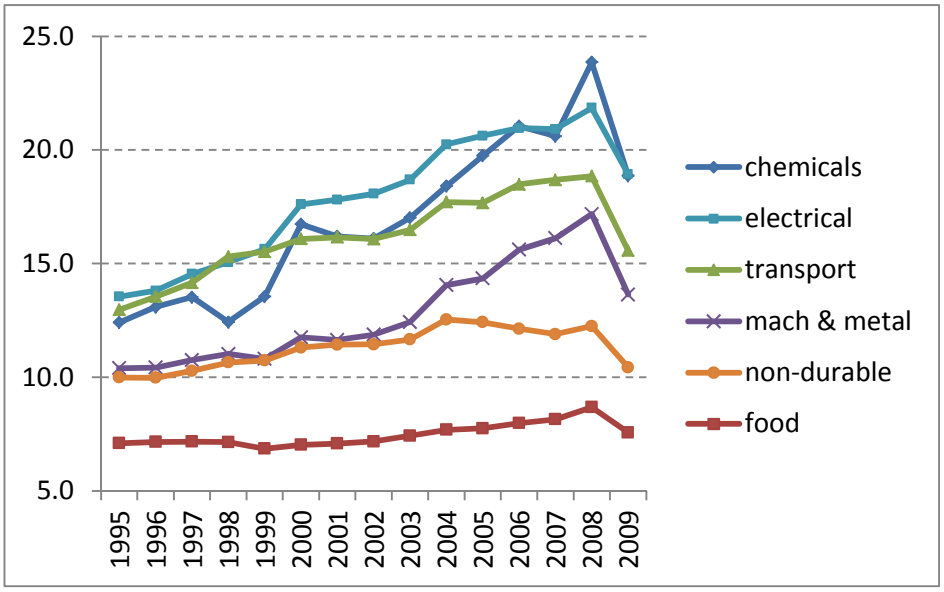
Imported intermediate inputs as share of gross output in manufacturing industry, by country (in %), 1995 and change between 1995 and 2008.



Note: Countries ranked on GDP in $ 2008 (32 biggest countries).
Source: World Input-Output Database, April 2012.

Figure 4

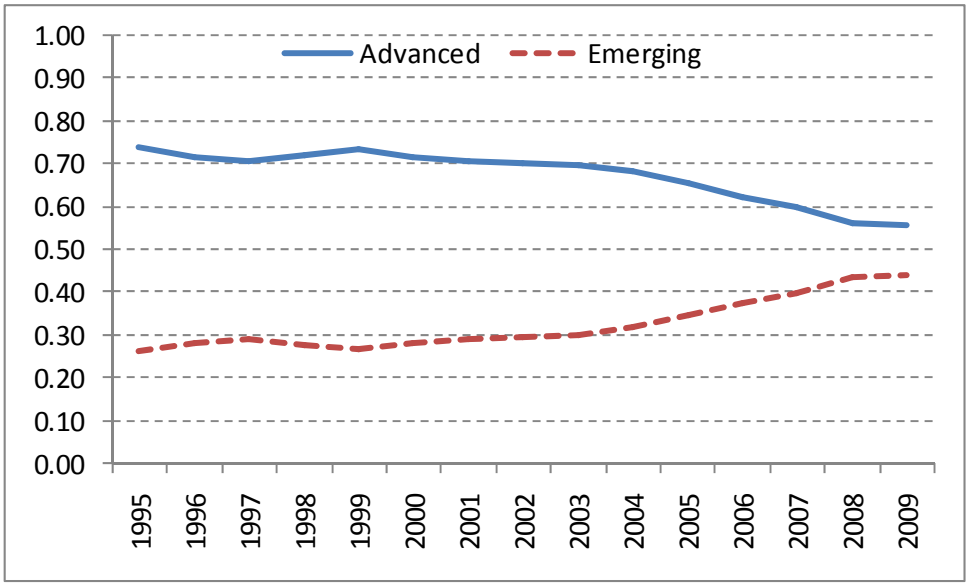
Imported intermediate inputs as share of gross output, manufacturing industries, world (in %), 1995-2009.



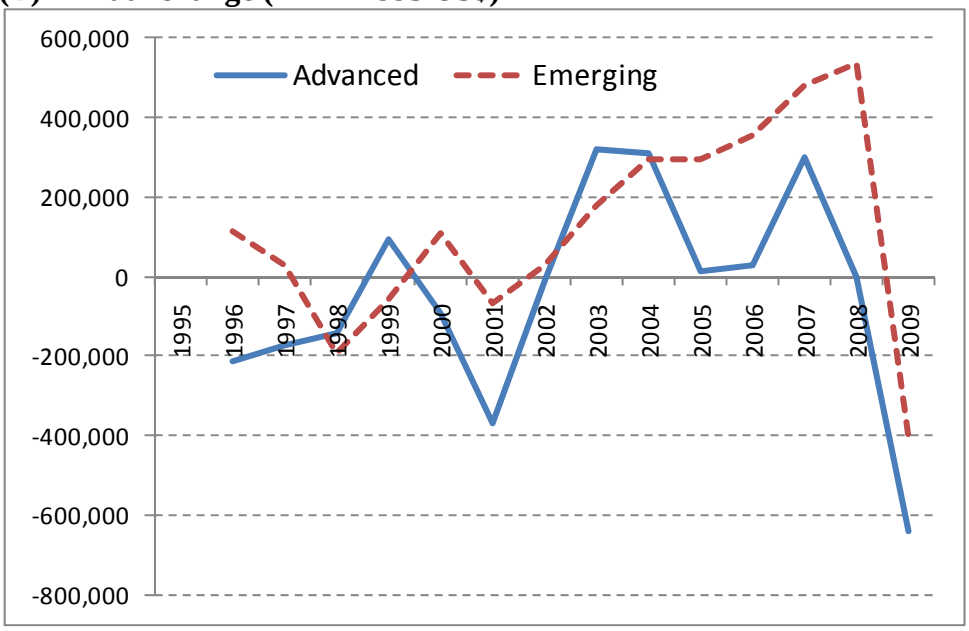
Note: weighted average over 40 countries in WIOD. Food manufacturing products (produced in ISIC rev.3 industries 15 & 16), Non-durable products (17, 18, 19, 36, 37); Chemical products (23-26), Machinery & metal products (27-29); Electrical machinery products (30-33); Transport equipment (34, 35).

Figure 5
GVC incomes in advanced and emerging countries

(A) Shares in world income, 1995-2009.

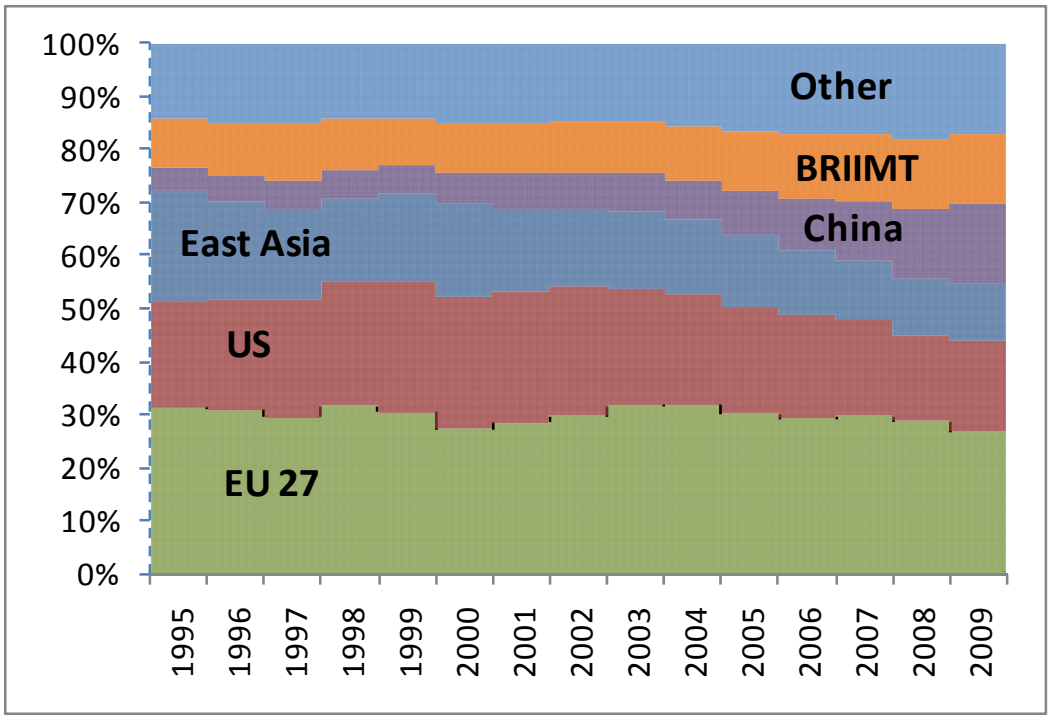


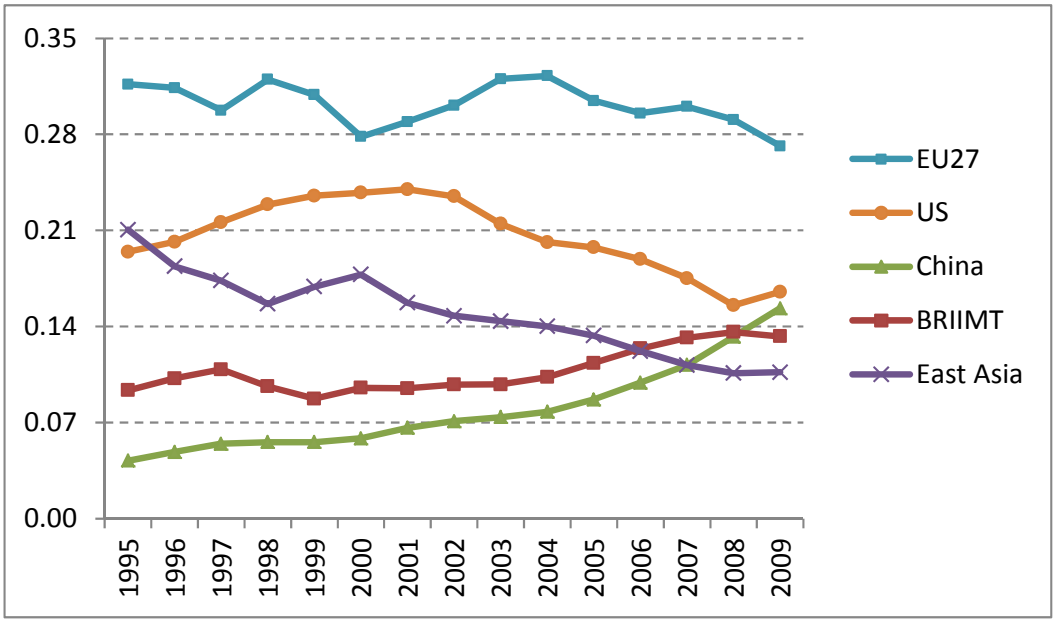
(B) Annual change (in mil 1995 US$)



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.

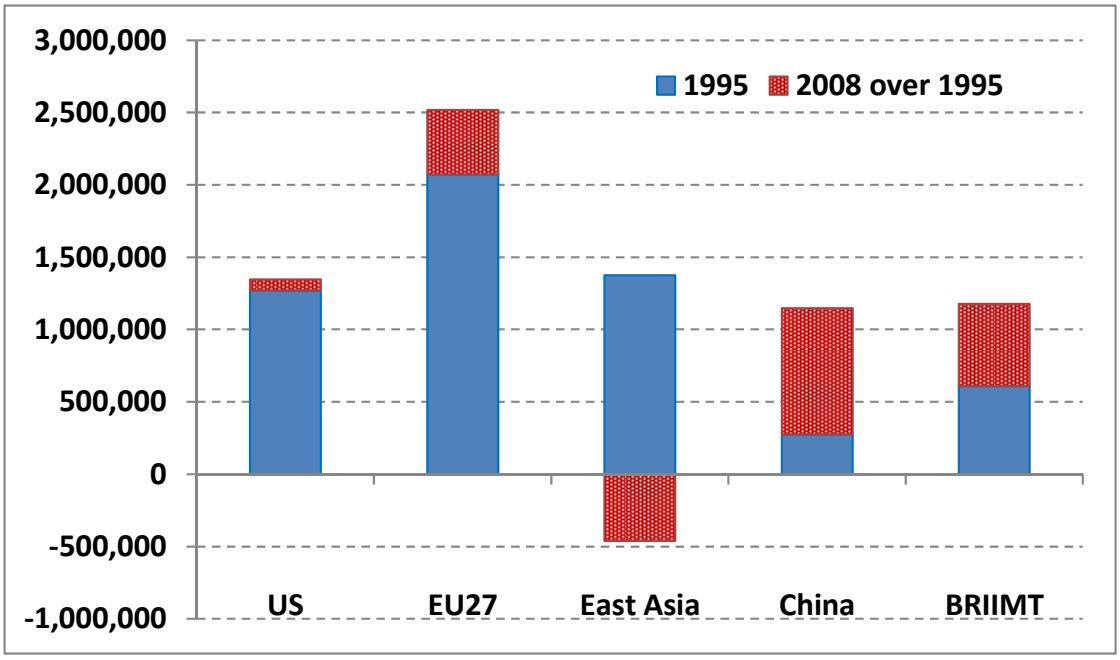
Figure 6
Regional shares in world GVC income, 1995-2009.

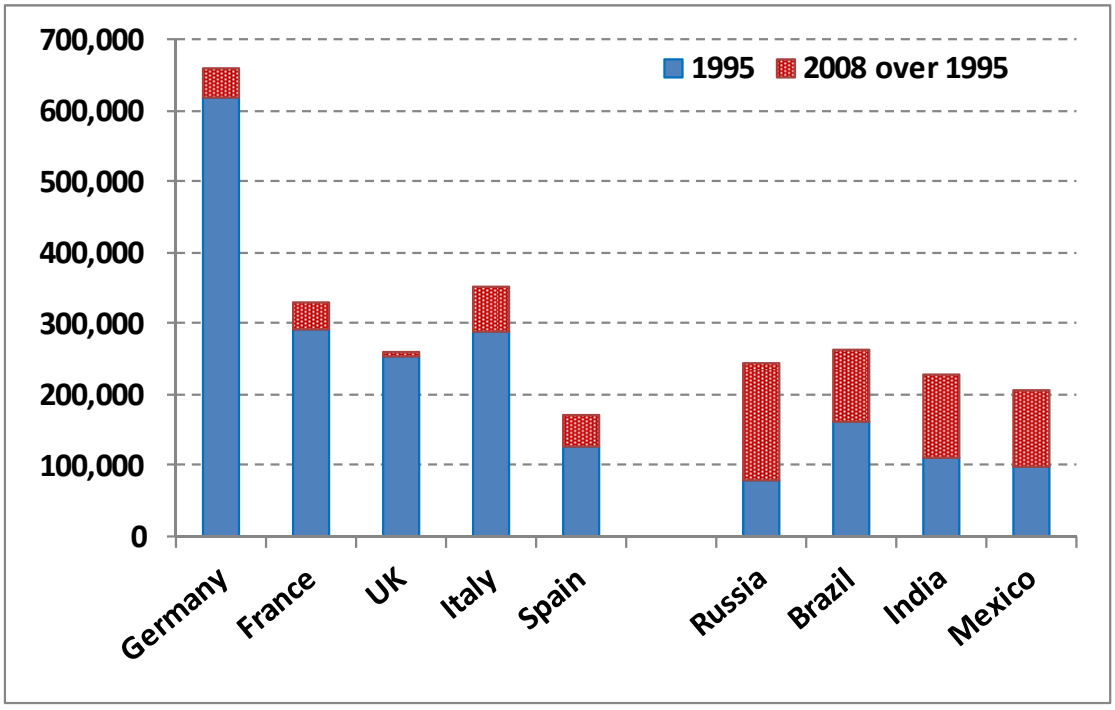




Note: East Asia includes Japan, South Korea and Taiwan. BRIIMT includes Brazil, Russia, India, Indonesia, Mexico and Turkey. EU27 includes all European countries that have joined the European Union. "Other" includes all other countries in the world. World GVC income is equal to world expenditures on manufacturing products at basic prices.

Figure 7 GVC income in 1995 and 2008 (in million 1995 US$).

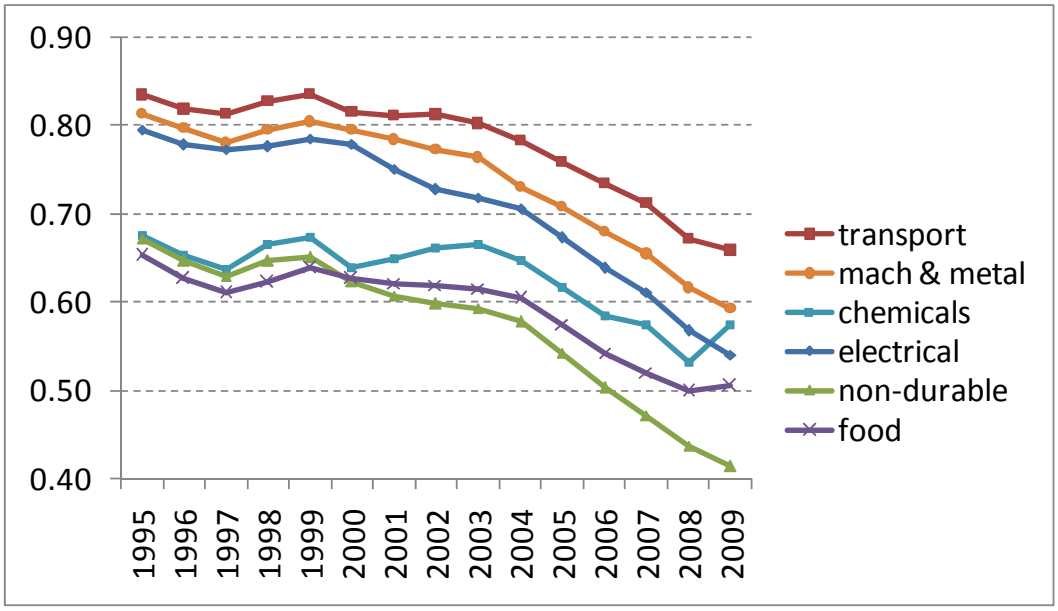




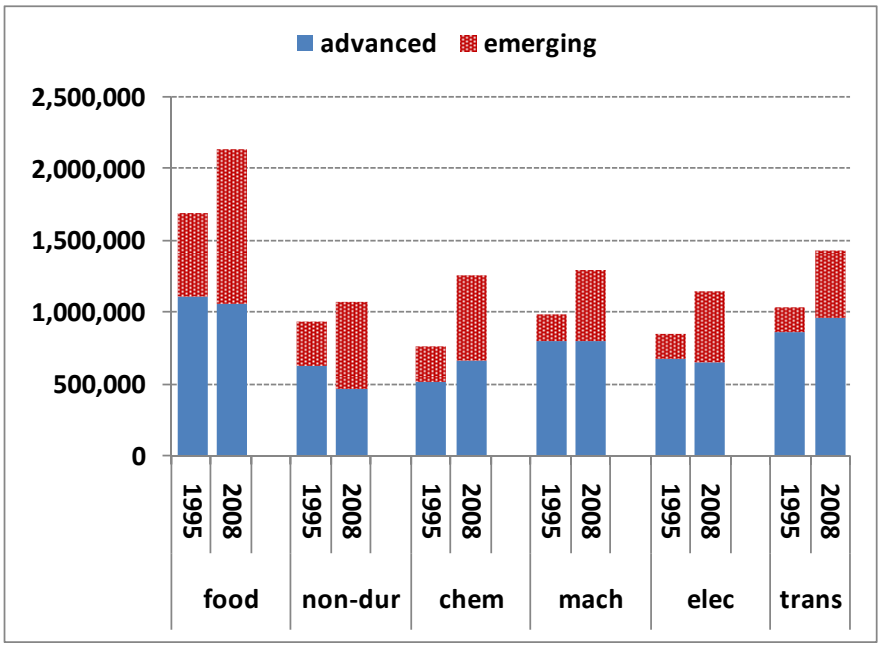
Note: see figure 6.

Figure 8 GVC income by product, 1995-2009.

(A) Earned in advanced countries (as share of world)



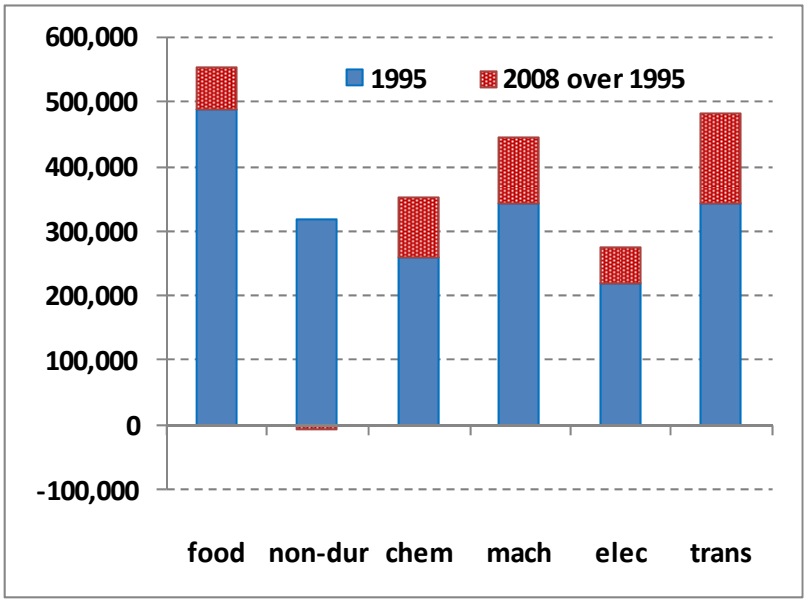
(B) In million 1995 US$



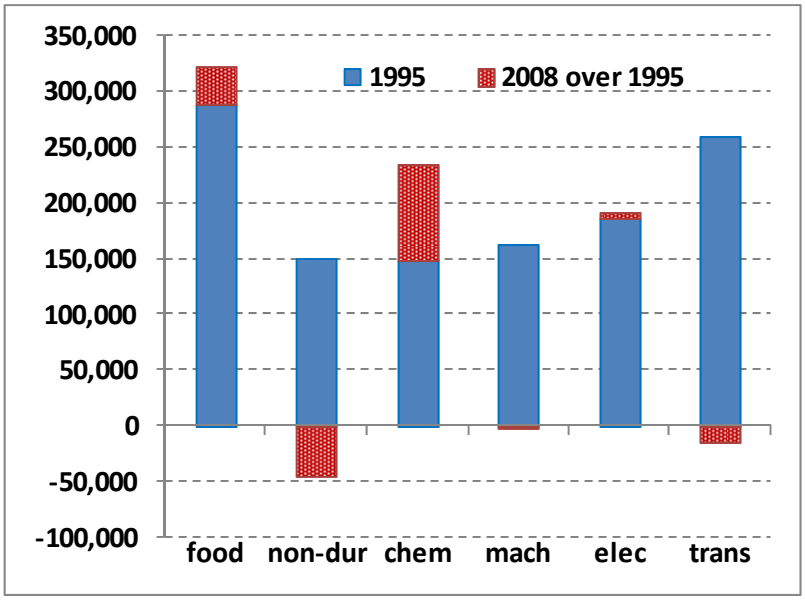
Note: Food manufacturing products (produced in ISIC rev.3 industries 15 & 16), Non-durable products (17 to 20, 36, 37); Chemical products (23 to 26), Machinery & metal products (27 to 29); Electrical machinery products (30 to 33); Transport equipment (34, 35). World GVC income is equal to world expenditures on manufacturing products at basic prices.

Figure 9 GVC income by products (in million 1995 US$), 1995 and 2008

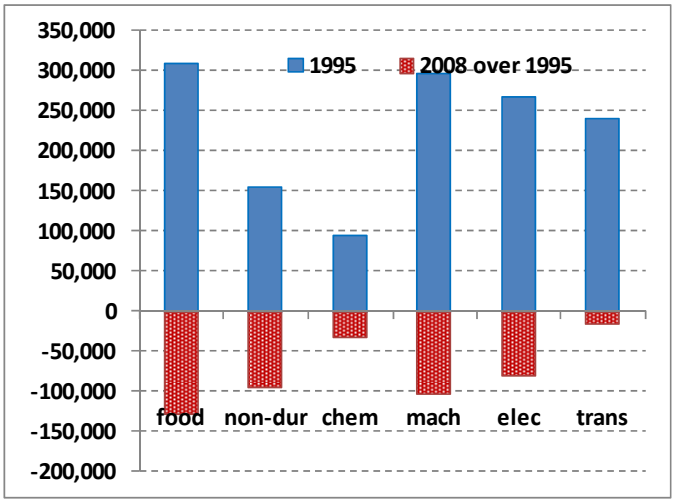
(a) EU 27



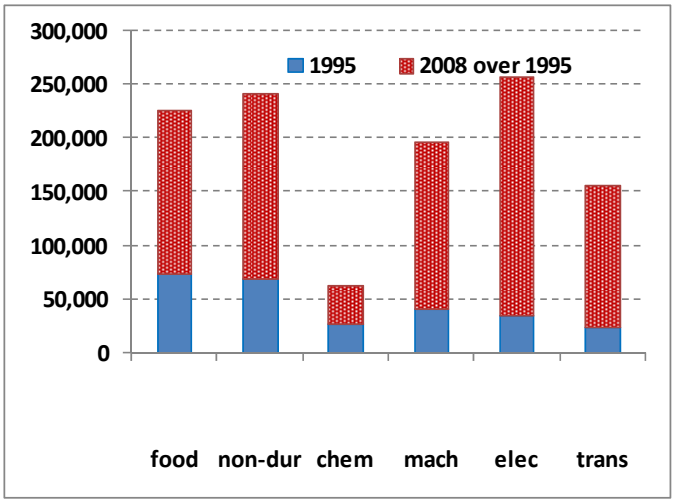
(b) US



(c) East Asia



(d) China



(e) **BRIIMT**

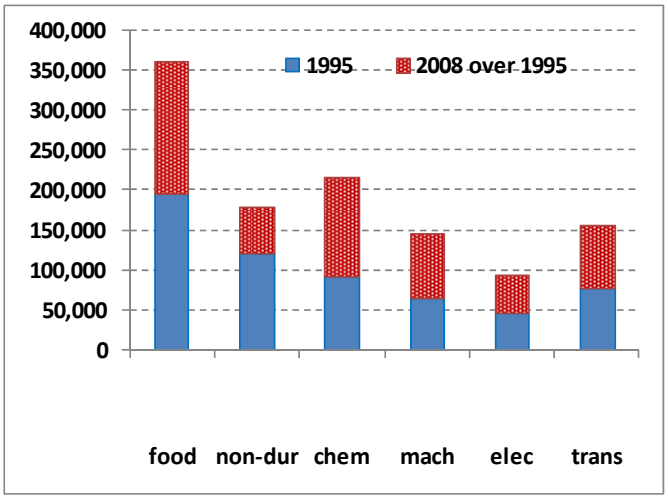
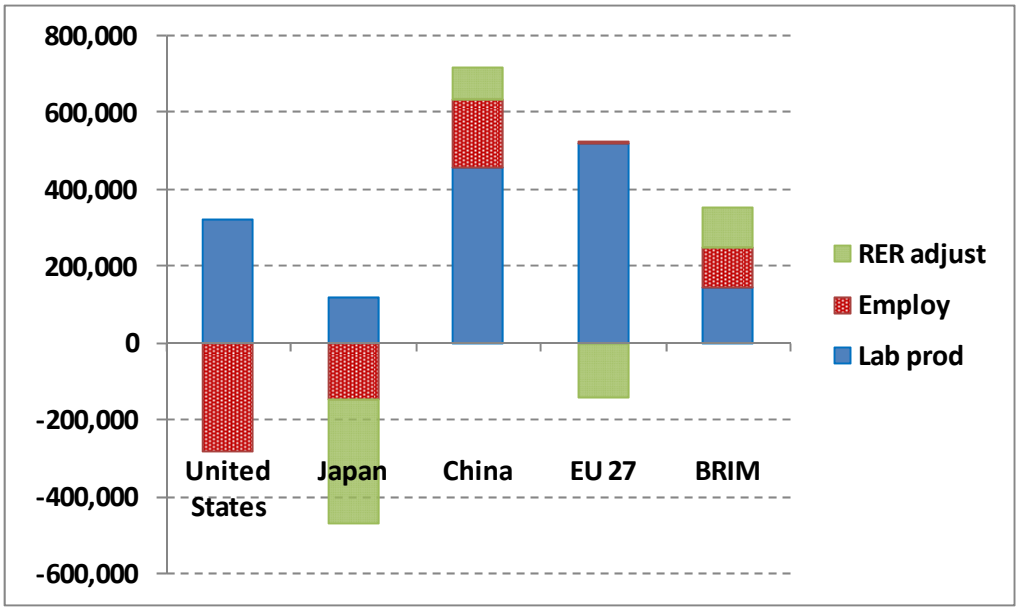
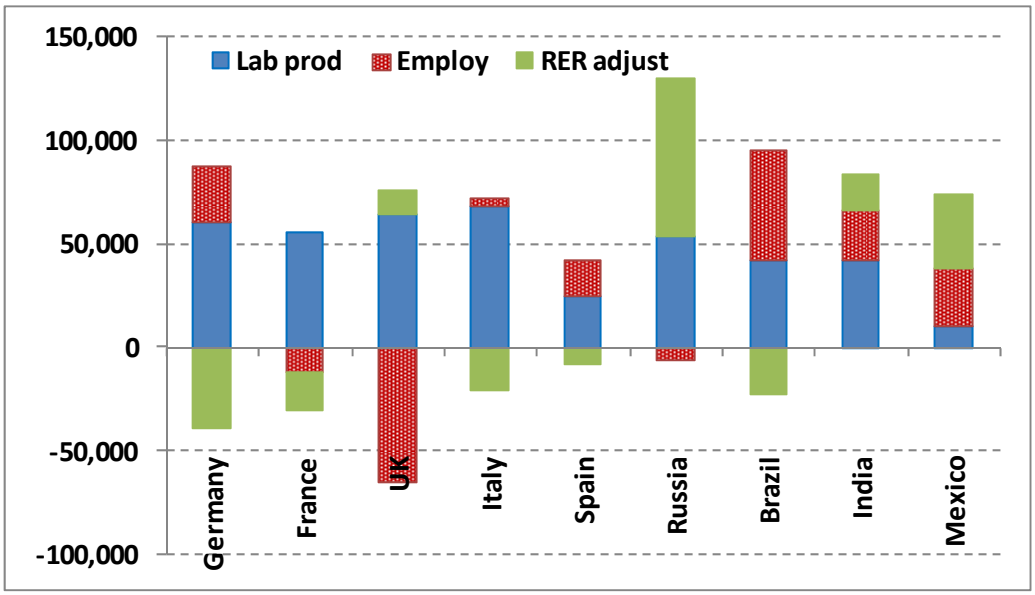


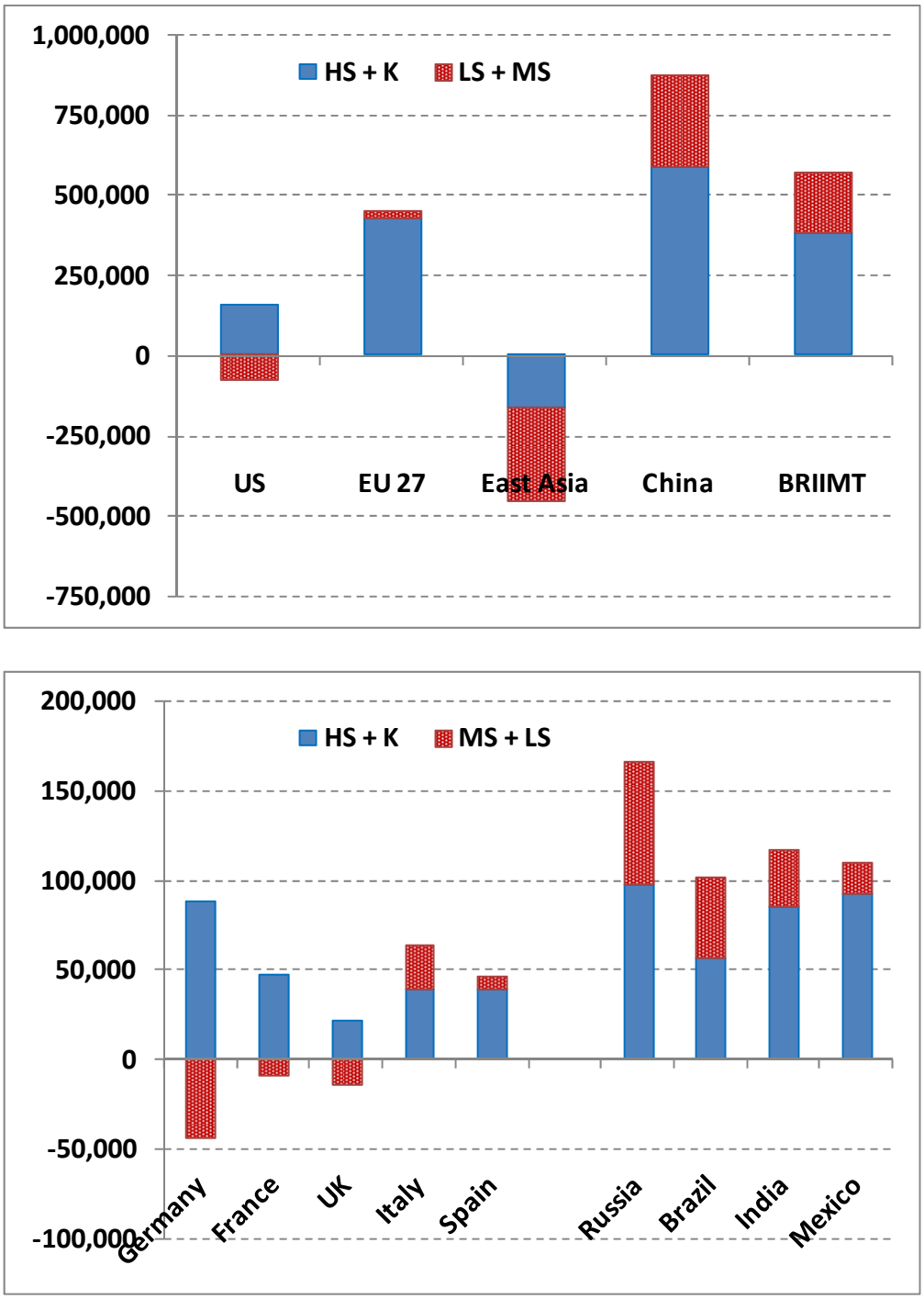
Figure 10 Change in GVC income by source (in million 1995 US$), between 1995 and 2008.





Note: Determinants of change in GVC income earned in non-food manufacturing between 1995 and 2008 (in million 1995 US$) based on shift-share analysis. Change split into change in labour productivity (Lab prod), change in number of workers (Employ) and change in real exchange rate (RER). Labour productivity is measured as value added per worker at constant local prices (CPI deflated and 1995 exchange rates). The RER adjustment is based on the change in exchange rate between 1995 and 2008, adjusted for difference in CPI of country and the US.

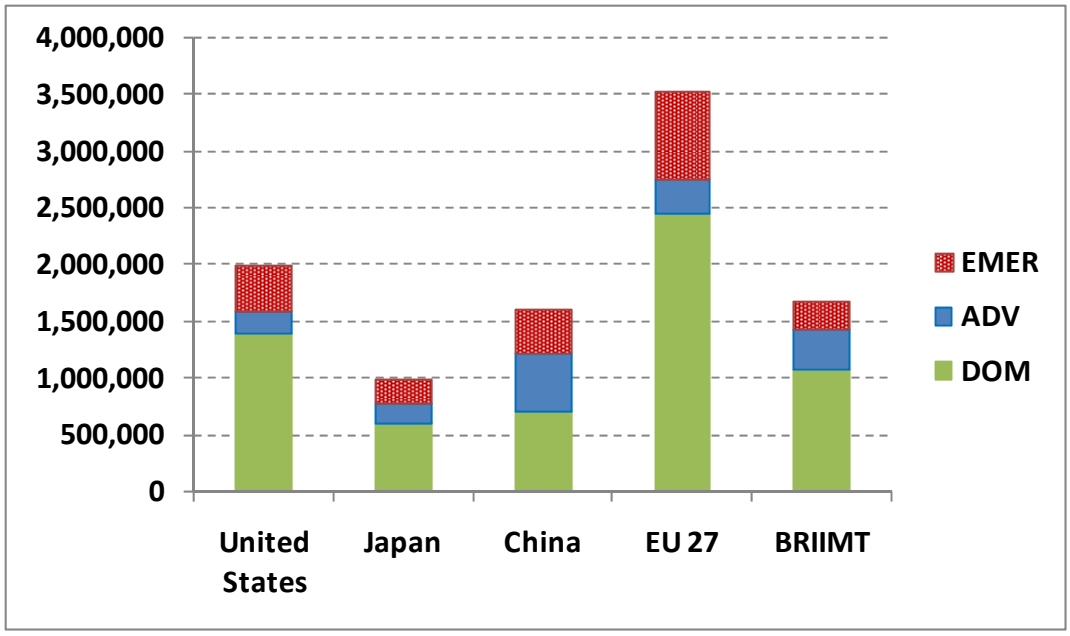
Figure 11 GVC Income by production factor (in million 1995 US$), change between 1995 and 2008.

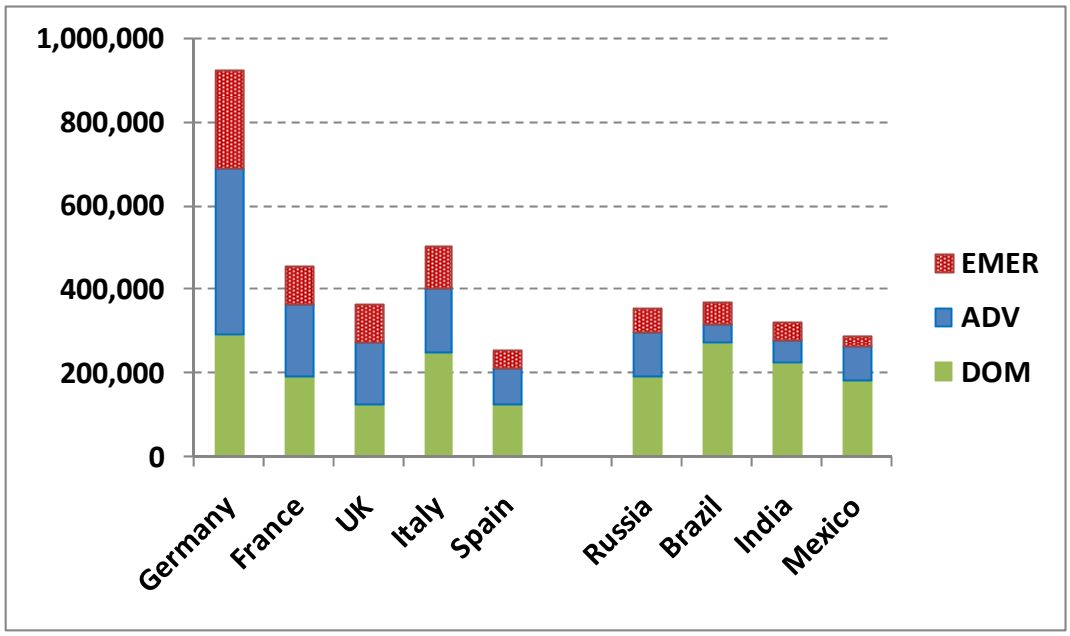


Note: factor income earned by high-skilled labour and capital (HS + K) and by medium- and low-skilled labour (MS + LS).

Source: World Input-Output Database (WIOD).

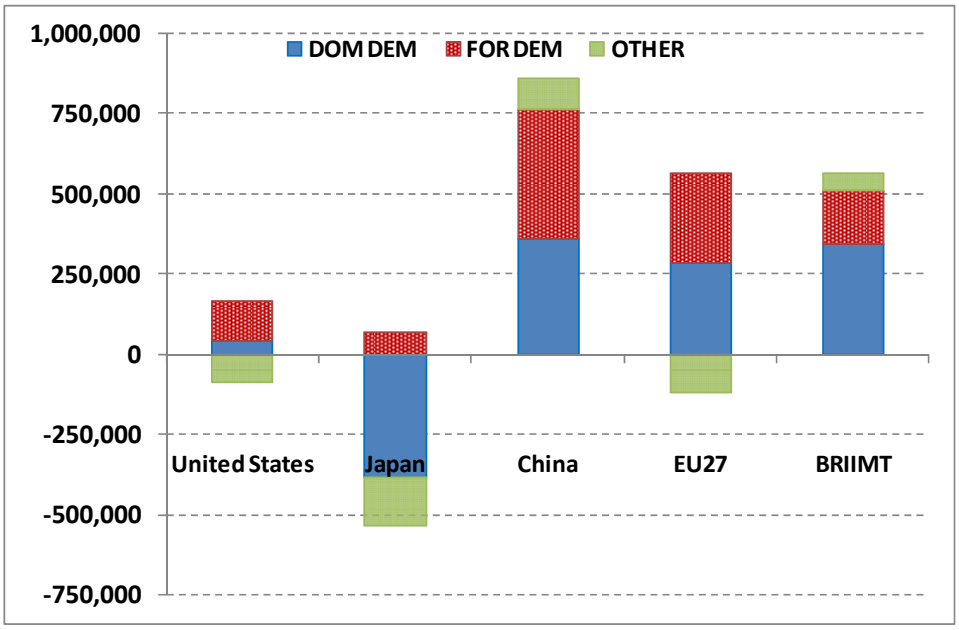
Figure 12 GVC income earned by demand source in 2008 (million US$)

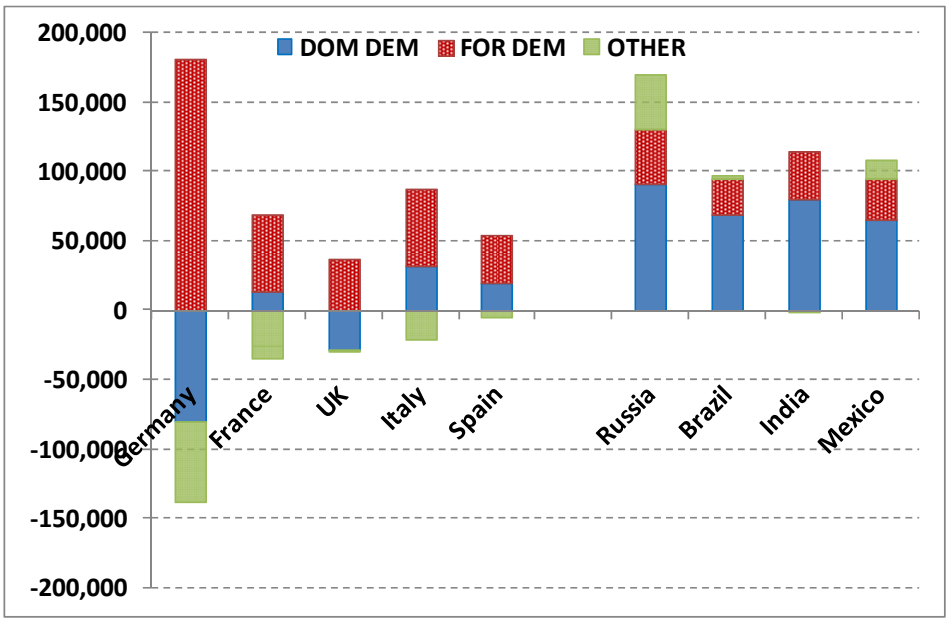




Note: GVC income split into income due to demand from emerging countries (EMER), from advanced countries (ADV) and domestic dem (DOM).

Figure 13
Sources of change in GVC income (in million 1995 US$), change over period 1995-2008.





Note: change in global income decomposed into change due to changes in domestic demand (DOM DEM), in foreign demand (FOR DEM) and reorganisation of global production (OTHER). World GVC income is equal to world expenditures on manufacturing products at basic prices.

Table 1 GVC income earned in regions for products groups (share in world income), 1995 and 2008.

	food products		non-durable products		chemicals		non-electrical machinery & metal		electrical machinery		transport equipment		All manufac-turing products	
	1995	2008	1995	2008	1995	2008	1995	2008	1995	2008	1995	2008	1995	2008
East Asia	18.2	8.4	16.6	5.6	12.4	5.0	29.7	14.7	31.3	16.3	23.1	15.8	21.1	10.6
US	16.9	15.0	15.9	9.6	19.5	18.5	16.3	12.4	21.7	16.5	24.8	17.0	19.4	15.5
EU27	28.7	25.8	34.0	28.8	34.1	27.7	34.4	33.9	25.4	23.8	32.7	33.4	31.6	29.1
China	4.4	10.6	7.4	22.5	3.7	5.0	4.2	15.1	4.1	22.2	2.3	10.9	4.2	13.3
BRIIMT	11.6	16.9	12.9	16.6	12.1	17.1	6.5	11.3	5.4	8.1	7.5	10.9	9.4	13.6
Other	20.3	23.3	13.2	16.9	18.3	26.7	8.9	12.6	12.1	13.1	9.6	12.1	14.3	17.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Advanced	65.3	49.9	67.2	43.7	67.6	53.2	81.4	61.6	79.5	56.8	83.4	67.2	73.7	56.0
Emerging	34.7	50.1	32.8	56.3	32.4	46.8	18.6	38.4	20.5	43.2	16.6	32.8	26.3	44.0

Note: World GVC income is equal to world expenditures on manufacturing product group at basic prices.

Note: Food manufacturing products (produced in ISIC rev.3 industries 15 & 16), Non-durable products (17 to 20, 36, 37); Chemical products (23 to 26), Machinery & metal products (27 to 29); Electrical machinery products (30 to 33); Transport equipment (34, 35). World GVC income is equal to world expenditures on manufacturing products at basic prices.

Table 2 Income earned in global manufacturing by production factor and region (shares in world income), 1995 and 2008.

	Value added by labour		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 3 Number of non-agricultural workers related to global production of manufacturing products by level of educational attainment and sector of employment (thousands)

		total		manufacturing		Non-manufacturing	
		1995	2008	1995	2008	1995	2008
East Asia	low-skilled	5,041	2,666	3,944	1,957	1,097	709
	medium-skilled	11,705	10,744	7,740	6,676	3,965	4,067
	high-skilled	3,684	5,317	2,154	2,576	1,530	2,741
	total	20,430	18,727	13,839	11,210	6,592	7,517
EU15	low-skilled	13,714	9,781	9,082	5,777	4,632	4,004
	medium-skilled	15,876	17,055	9,412	8,980	6,464	8,075
	high-skilled	5,161	8,167	2,705	3,695	2,456	4,472
	total	34,751	35,003	21,199	18,452	13,552	16,551
US	low-skilled	2,674	1,644	1,934	1,038	740	606
	medium-skilled	12,968	9,865	7,935	5,675	5,033	4,189
	high-skilled	4,691	4,608	2,432	2,387	2,259	2,221
	total	20,333	16,116	12,301	9,100	8,032	7,016