World Input-Output Database

Slicing Up Global Value Chains

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Slicing Up Global Value Chains

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Abstract
Using an input-output decomposition technique, we measure the factor income distribution across countries associated with global demand for final manufacturing products. It is based on an analysis of all activities directly and indirectly needed in the production of manufacturing goods in a model where final demand is exogenously given. The empirical analysis is based on the World Input-Output Database (WIOD) that combines national input-output tables, bilateral international trade statistics and data on production factor requirements for 40 countries. It uncovers a number of trends for the periode from 1995 to 2008. First, shares of domestic value added in domestic consumption are declining in all countries, indicating increasing unbundling of production. Second, activities carried out by low- and medium-skilled workers in mature economies decline and activities carried out by high-skilled workers increase. Activities carried out by less-skilled workers in emerging economies boomed, in particular after China's accession to the WTO in 2001. Third, changes in set of activities carried out in global manufacturing production have not been factor-neutral as the share of capital income increases faster than labour income, both in mature and emerging economies.

Introduction

The rise of China, India and other emerging economies is transforming the global economy with deep implications for production, trade, and the distribution of incomes. Fostered by rapid advances in information technology and plummeting costs of communication and coordination costs, production processes are fragmenting internationally and competition increasingly plays itself at the level of activities, rather than at the level of products and industries. Firms in mature economies relocate their unskilled labour intensive production acitivities to lower-wage countries while keeping strategic functions concentrated in a few urban regions where the high-skilled workers and intangible capital they need are available (Feenstra 1998, Baldwin 2006). The rise of China and other emerging economies accelerated the erosion of mature economies' comparative advantage in labour-intensive production activities, while simultaneously offering new opportunities for off-shoring (Hanson, 2012). This has been linked to declines in manufacturing employment and wages in traditional industrial strongholds in Europe, Japan and the US. Deepened by the effects of the financial crisis in 2008, rising unemployment and stagnant wages have fuelled demands for new industrial policies and trade protection around the world (e.g. Autor, Dorn and Hanson, 2012).

To study the effects of production fragmentation on factor income distributions within and across countries, one needs to go beyond an analysis of industries and goods and focus on discrete activities in distinct locations, which altogether form a supply chain starting at the conception of the product and ending at its delivery (Grossman and Rossi-Hansberg 2007). In a global production network, each country will add value depending on the type of activities carried out at a particular stage of production and to analyse this one needs to "slice up the gobal value chain" as put by Krugman (1995). Recent product case studies suggests that European, Japanese and US firms still capture major parts of the value of a product as they specialize in high value–added activities such as management, R&D, software, system integration, marketing, design, branding, logistics and finance. China and other emerging countries are mainly involved in the assembling, testing and packaging activities that are poorly compensated (Dedrick et al., 2010; Ali-Yrkkö, Rouvinen, Seppälä and Ylä-Anttila, 2011).

In this paper we take a macro-perspective and describe the major regional trends in the compensation of labour and capital related to the production of manufacturing goods, in which the process of fragmentation has been most visible. Production of manufacturing goods includes not only activities in the manufacturing sector, but also production activities in all other sectors such as agriculture, utilities and business services that provide inputs in any stage of the production process. The main aim 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. 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 in which final demand is exogenously given, we slice up the value of manufacturing expenditure into incomes for labour and capital in various countries that are 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 intermediate goods and services, such that direct and indirect contributions to production will be taken into account.

Based on this new database, we establish three main trends. First, we find a strong trend in the unbundling of consumption and factor income as the share of domestic value added in domestic consumption is declining in all countries. Second, we confirm the uneven effects on labour groups in mature economies as incomes for low- and medium-skilled workers decline and high-skilled workers gain. On the flip-side, low-skilled workers in emerging economies gained, in particular after China's accession to the WTO in 2001. Third, we find that changes in global manufacturing production have not been factor-neutral as the share of capital income increases faster than labour income, both in mature and emerging economies. This underlines the importance of simultaneously considering fragmentation processes and biased technological change when explaining changes in factor incomes (Feenstra, 2010).

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 analyse trends in the distribution across countries of value added in global expenditure on manufacturing products. In Section 5, we focus on factor income distributions and further decompose value added into compensation for low-, medium- and high-skilled workers and capital. Skills are defined through the level of educational attainment of workers. Section 6 concludes.

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 products 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 factor incomes 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 estimated gross profit margins of the companies involved in production, Dedrick at 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 is 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 in the country ahere the iPod is sold. The remaining halve of the retail price is added in the physical production process of the product. They estimate that about 11% of the retail price is captured as profits by East Asian firms in charge of manufacturing the ten highest-value 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, which could not be broken down further. 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 in today's world of internationally fragmented production an understanding of a country's competitiviness requires the study of the value added by production activities rather than the production of goods. It also suggest a division of tasks between mature and emerging economies in which the former concentrate on activities that require high-skilled labour and capital (both tangible and intangible), while the latter mainly contribute through low-paid labour services. With the increasing opportunities for coordination offered by the evolving communication and information technologies, declining prices for transportation and the opening up of major emerging economies to international trade and investment, this task-division has become more prominent in the past years. This will be studied in this paper.

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[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.

[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.

By introducing our new GVC metric, we aim to offer a macro-economic perspective on the division of tasks in 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 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 and take many forms, such as goods moving in a linear manner from upstream to downstream with value added at each stage, or multiple parts coming together in assembly to form a new component or final product body, described respectively as snakes and spiders by Baldwin and Venables (2010). Most production processes are complex mixtures of the two. 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 expenditure 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] $(I-B)^{-1}$

[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.

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. We will distinguish between four types of production factors: high-, medium- and low-skilled labour and capital. For each country-industry, the remuneration for these four factors of production add up to value added by construction in our data as described in the next section.

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 indicates the levels of 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 over value added by all factors in all countries that are directly and indirectly related to the production of a good consumed in a particular country (a column of K) will be equal to the consumption value of that product. Thus we have completed our decomposition of the value of consumption into the value added by various production factors around the world.[7]

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[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 the value added content of trade flows, we focus on the value added content of final expenditure. See Hummels, Iishi and Yi (2001) and also Bems, Johnson and Yi (2011) for a recent application.

In Table 1 we provide an example of such a decomposition for final expenditures in the US on electrical machinery in 1995 and 2008. The data is at basic prices and hence excluding domestic trade and transport margins. 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 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).

3. World Input-Output Database

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 (see Appendix Table 2). 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. While this type of data is available for most mature 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 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[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 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. Benchmark national SUTs are linked over time through the use of the most recent National Accounts statistics on final demand

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

categories, and gross output and value added by detailed industry.[9] 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.[10]

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)[11] and once released by the national statistical institute revisions are rare. This compromises the consistency and comparability of these tables over time as 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, 2012). 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

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[9] See Appendix 1 for an overview of the benchmark tables used.

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

[11] Though recently, most countries in the European Union have moved to the publication of annual SUTs.

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 mature 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. 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 (such as R&D, software, database development, branding and organisation capital), mineral resources, land and financial capital.

For most mature 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. The great unbundling: empirical results

In this section, we explore trends in the distribution of value added in manufacturing expenditure using the decomposition method introduced in Section 2. We decompose global expenditure on manufacturing products into compensation for factor services that are directly and indirectly needed in the production of these products. Note that this includes not only activities in the manufacturing sector, but also production activities in other sectors such as agriculture, utilities and business services that provide inputs in any stage of the production process. In fact, value added in non-manufacturing production activities frequently make up halve a final product's value, even at basic prices which exclude trade margins. We will return to this issue later.

We start with an overview of the main trends in global expenditure on manufacturing goods. Figure 3 provides a breakdown of global expenditure by product group over the period from 1995 to 2009, which is clearly a boom period in the world economy, characterised by steady growth in Europe and the US and accelerating growth in emerging countries until the onset of the economic crisis in 2008. Expenditures include consumption and investment by households, firms and government and are valued at basic prices in constant 1995 US$.[12] Global manufacturing expenditure slowly declined

[12] Expenditure in national currency is converted to US$ with official exchange rates and deflated to 1995 prices with the overall US Consumer Price Index. Basic price values exclude net taxes on products and trade and transportation margins.

at the end of the 1990s, and dropped again after the burst of the dot.com bubble in 2001. It picked up in 2002 fuelled by rapidly growing demand in emerging markets, and continued until the onset of the financial crisis in 2008, dropping sharply in 2009. 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. In 2008, they were 26% and 13%, declining 2 percentage points each since 1995. 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, with a clear upward trend towards the millenium but quickly settling down again at about 14%. 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.

[Figure 3 here]

Given these developments on the demand side, we next explore the distribution of value added in the production of these goods. We find that in today's world there is only a loose connection between domestic expenditure and domestic value added. In Figure 4, we provide the share of domestic value added in domestic final expenditure on manufacturing products for 34 major countries and 6 product groups (food, non-durables, chemicals, non-electrical machinery, electrical machinery and transport equipment) in 1995 and 2008. In 2008, the highest domestic shares are found for food products (unweighted average 0.54) production of which has relatively strong backward linkages to domestic agriculture. Domestic value added shares in expenditure for other products are 0.30 or lower. Shares for electrical machinery, the paragon of international production fragmentation and trade, are only 0.21. For all the 204 country-product combinations, only 32% of the value of domestic expenditure was added domestically on average (unweighted) in 2008, down from 44% in 1995. This decline was universal as shown in Figure 4 as almost all country-product observations are to the right of the 45 degrees line. Clearly, the link between domestic consumption and domestic value added is weakening world wide, not only by the seperation of consumption and production, but also by the fragmentation of production, together characterised by Baldwin (2006) as "the great unbundling".

[Figure 4 here]

In today's world the income a country can earn in serving demand for manufacturing goods will depend on the value added of its activities in the global networks in which these goods are produced. The decomposition outlined in section 2 provides a way to measure this and results are given in Figure 5. Global expenditure on manufacturing products at basic prices is broken down into the value added by major regions for the period from 1995 to 2009.[13] We distinguish five 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; and BRIIMT consisting of Brazil, Russia, India, Indonesia, Mexico and Turkey.[14] Value added is expressed in US$ using current exchange rates and deflated to 1995 US$ value using the US CPI to allow for comparisons over time and across countries.

The value added by mature economies, defined as East Asia, US and EU together, has been constant over the period from 1995 to 2008, which means that their share declined from almost three quarters to just above halve over this period. While value added by the US has been relatively stable, it has been rising in the EU over the whole period. The initial decrease was mainly due to the faltering performance of Germany, the biggest economy in the region (Sinn, 2006). But as German's decline halted in the 2000s, growth in the smaller European countries including the new member states that joined the European Union in 2004 pushed value added to a high in 2008.[15] In that year, it had a value added level that was higher than the US and East Asia combined. In contrast value added declined in East Asia already in the 1990s, exacerbated by the East Asian financial crisis in 1997, up to the early 2000s stabilizing afterwards until 2008.[16] The drop in the crisis year 2009 was large for all mature economies.

Emerging regions have rapidly increased value added, in particular since the early 2000s. Since 2004 their annual increase was always higher than in mature economies. China is responsible for the major part of this increase, accelerating growth after its WTO accession in 2001. Between 2002 and 2008 it tripled its value added. In 2007 it overtook East Asian levels and withstanding the crisis much better, it was almost equal to the US level in 2009. Value added also rapidly increased in other emerging economies more than doubling in Brazil, Russia, Indian, Indonesia, Mexico and Turkey (BRIIMT) since 2002.

[Figure 5 here]

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[13] This period is dictated by the availability of data. The data for 2008 and 2009 are to be considered as preliminary as the data was compiled in early 2011 and for some emerging economies (in particular China and India) only preliminary national accounts data was available at that time.

[14] 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 manufacturing expenditure rose from 14% in 1995 to 17% in 2008.

[15] The $/euro rate declined sharply over 1995-2001 followed by a steep incline returning near its 1995 value in 2007, explaining its u-shape trend in $ terms but not its higher level in 2007. The euro was introduced in 2001 and we are referring to the $/DM rate before that date.

[16] The Yen/$ rate fluctuated around a long-term constant for this period.

What was driving these changes in value added? Figure 4 suggested that domestic demand played a minor role for most countries, as value added shares in domestic expenditure were low. Extending the decomposition technique introduced above we can analyse the changes in value added and relate it to changes in the structure of domestic and foreign demand, and in the organisation of production in global networks. We decompose the change in a country's value added (K) into a part related to changing domestic demand (C_{dom}), changing foreign demand (C_{for}) and changes in the structure of global production (T, which is defined as $F(I-B)^{-1}$). This is done in a standard decomposition analysis keeping demand structures constant (demand for manufacturing products by each country) and determining the effects of changing production structures on value added by countries, and vice versa. Using the period-average as weights the decomposition of the change in value added between 1995 and 2008 (indicated by Δ) is given by

$$\Delta K = \tfrac{1}{2}(C_{08} + C_{95})\,(\Delta T) \; + \; \tfrac{1}{2}(T_{08} + T_{95})(\Delta C_{for} + \Delta C_{dom})$$

The first element on the right-hand side basically indicates to what extent a country has increased its value added by changes in the global production system, that is all activities that are needed to produce a given demand. This might be due to changes in domestic production structures in a country such as increasing use of imported intermediates which would have a negative effect, ceteris paribus, or increasing use of its intermediate products elsewhere which would have a positive effect. The second element measures the changes in value added due to changes in demand structures. It is split into changes in domestic demand and foreign demand. The latter is similar to the measure of value-added exports introduced by Johnson and Noguera (2012) and indicates to what extent value added in a country is ultimately absorbed in foreign final demand.

The results of the decomposition are given for 20 major economies in Table 2 and major regions in Figure 6. We decompose the long-term trend in the period from 1995 to 2008 and find a striking difference between emerging and mature economies. Emerging economies benefitted from changes in the organisation of global production, in particular China, while most mature economies lost. China increased its value added share in global manufacturing expenditure through increased participation in global production networks, producing an increasing number of intermediates used elsewhere and capturing a larger share of value added in domestic production. In contrast, in most mature economies a reverse process of substitution took place in which domestically produced intermediates were substituted for by imported intermediates. This affected all major economies, and in particular Japan. Exceptions to this are Australia and Canada that benefitted from the increasing value of their exports of natural resources.

For emerging economies, changes in demand have been dominant though, as they strongly benefitted from growth in domestic expenditure on manufacturing. This was the main driver of value added growth in Brazil, Russia, India and Mexico. Only in China, the increase in foreign demand was even more important than in domestic demand as it quickly captured foreign markets for final products after its entry to the WTO. 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. Germany, France, Spain and Italy all benefitted increasingly from serving foreign demand, stressing the importance of foreign markets for value added growth in European countries.

Figure 6 here
Table 2 here

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 halve the basic price value of a good, and is declining over time. In Table 3 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%. In European economies and Japan, the share of services industries increased. 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[17] 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

[17] 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.

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 which were 40% or higher in 2008.

Table 3 here

5. Factor income distributions in global value chains

Increasing trade and integration of product and factor markets around the world is hypothesized to have various distributional effects both across and within countries (see Feenstra 2010 for an overview). To study the trends in factor income distributions in global value chains, we decompose 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 reproducible tangible capital such as machinery, ICT equipment and buildings, non-reproducible capital such as mineral resources and land, as well as intangible capital such as R&D, software, brand and organisational capital that has become increasingly important in mature economies (Corrado and Hulten, 2010). The shares of these factors in gross output can be considered as cost shares and are used in the decomposition outlined in section 2.

The results of the factor income decomposition of value added in global manufacturing expenditure are given in Table 4. We find changes in the factor income distribution in mature and emerging economies that broadly confirm existing theoretical predictions concerning remuneration of skilled and unskilled workers. Labour income increased in emerging economies for all workers, with the biggest increases for low- and medium-skilled workers as expected given their comparative advantages. On the other hand, mature economies are steadily specializing in activities that mainly require high-skilled labor. Income for high-skilled workers increased, while for medium- and low-skilled workers declined (Table 3). This is unlikely to be only the result of an increased supply of higher skilled labour in these economies, replacing less-skilled workers, but essentially carrying out the same activities. If this was the case, relative wages for high-skilled workers should have dropped but this is not confirmed in our data.

Interestingly, we find a clear factor bias in the remuneration of activities carried out in the production of manufacturing goods. Based on incomes in all 40 countries covered in the database, activities carried out by medium- and low-skilled workers are getting less rewarded than activities involving high-skilled workers and capital. Global expenditure on manufacturing products increased by about 1,600 billion US$ over the period from 1995 to 2008, of which 1,100 billion ended up as additional income for capital, 380 billion for high-skilled workers, 170 billion for medium-skilled workers and zero for low-skilled workers. Interpreting factor income shares as cost shares in a translog production function, it is clear that technological change has not been factor neutral at the global level.

Broadly speaking we find four groups of countries. First, mature economies that have been active participants in the process of production fragmentation, such as Japan, Germany, South Korea, Taiwan and the US. In all these countries capital income has increased much more than labour income. In contrast, in mature economies that were less active such as France, Italy, Spain and the UK, labour income increased more than capital income, and in particular medium-skilled workers income has been less affected than in the previous group of countries. Emerging countries on the receiving side of the unbundling process have also seen greater increases in capital income than in labour income, most prominently in China where capital income increase made up 60% of the overall increase in value added. Similar results, but at a lower scale are found for India, Mexico and Poland. With high FDI flows from advanced to emerging countries, part of the capital on these countries' territory is owned by firms headquartered in mature nations. Data on foreign ownership is needed to allow for an income analysis on a national rather than a domestic basis as in this paper.

Emerging economies that mainly grew out of domestic demand (Brazil, Russia and Turkey) had no clear capital bias in their value added growth. The found patterns of the distribution of factor income in value chains put new challenges for explaining their drivers. So far, theories on the distribution of income in global supply chains have focused solely on labour (Costinot, Vogel and Wang (2012); Jones and Kierzkowski, 2000; Fujita and Thisse, 2006).

Table 4 here
Figure 7 here

6. Concluding remarks

Concluding, in this paper we introduced a new analysis of the effects of the great unbundling of consumption and production on the distribution of factor incomes around the world. We decomposed the value of global consumption on manufacturing goods into incomes for all activities that are directly and indirectly needed to produce these goods (in manufacturing and other sectors of the economy). We find clear trends in the factor income distribution in global value chains that broadly confirm existing theoretical predictions concerning remuneration of skilled and unskilled workers. We find that the mature economies have not been able to benefit from the increasing global demand for manufacturing goods. Activities intensive in the use of high-skilled labor and capital increased, but use of low- and medium-skilled workers declined. In contrast, labour income derived from global manufacturing production by emerging economies boomed in the early 2000s. They benefitted most from the deepening of production networks between advanced and emerging regions.

The analysis also highlights the important and increasing role of capital in global production networks which has been less studied so far. The great unbundling was not neutral in the redistribution of value added across labour and capital. For all mature economies together, the income of labour in manufacturing value chains has declined, whereas remuneration for domestic capital has steadily increased. Whereas the built of of capital in emerging economies through foreign direct investment is well documented, we know less about the use and formation of intangible capital stocks in mature economies, but see Brynjolffson and Hitt (2003) and Corrado and Hulten (2011).

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 (see e.g. Feenstra et al. 2010). 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 intangibles such as royalties and licences is still poorly reflected.

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Figure 1 Links between expenditure, production and income.

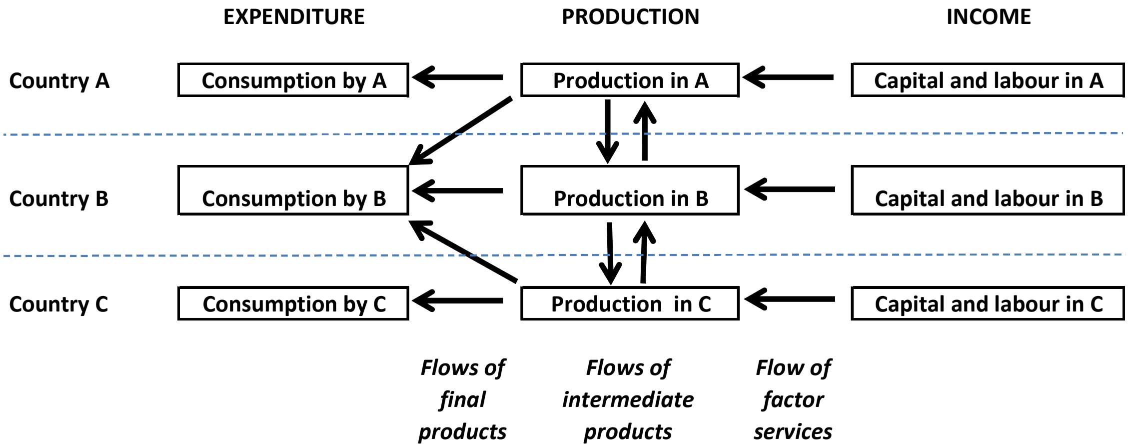
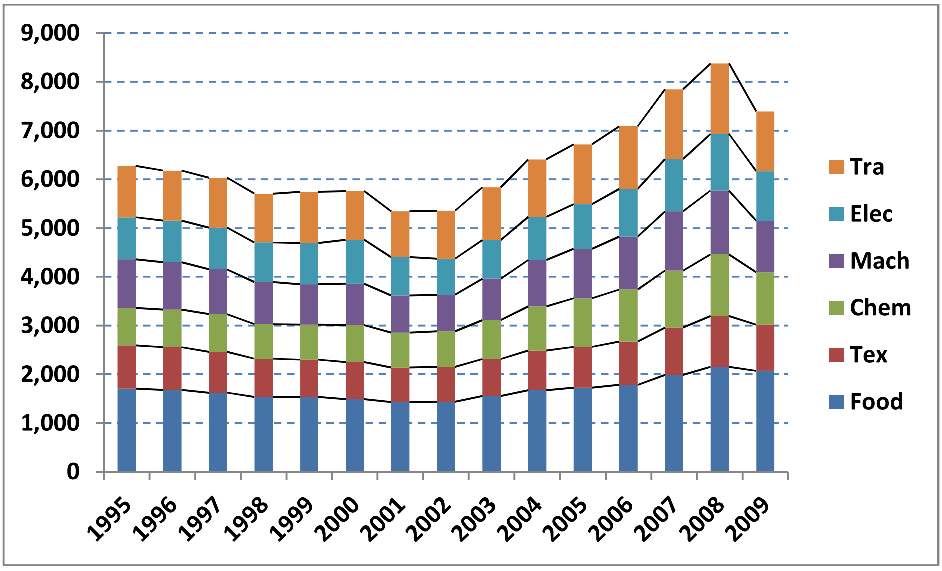


Figure 2 **Schematic outline of World Input-Output Table (WIOT), three regions**

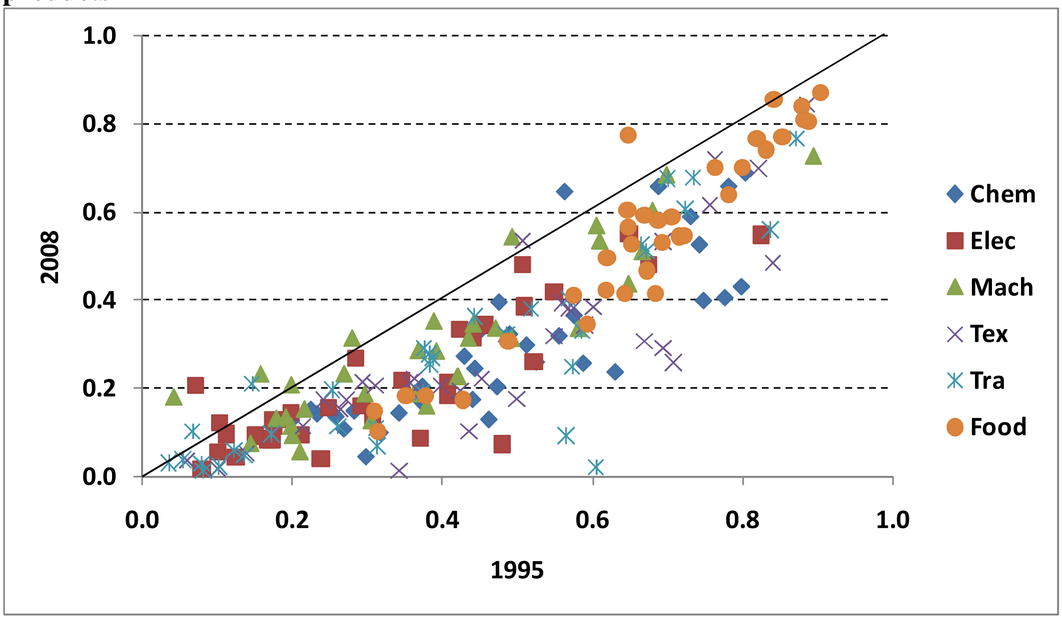
		Country A Intermediate *Industry*	Country B Intermediate *Industry*	Rest of World Intermediate *Industry*	Country A Final domestic	Country B Final domestic	Rest of Final domestic	Total
Country A	*Industry*	Intermediate use of domestic output	Intermediate use by B of exports from A	Intermediate use by 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 Global expenditure on manufacturing products, 1995-2009 (in billion 1995 US$).



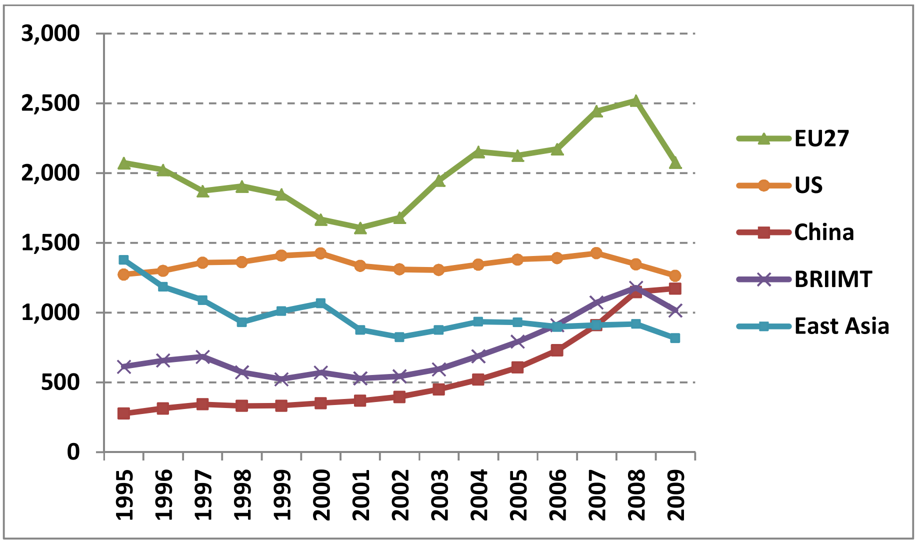
Note: Global expenditures on manufacturing products at basic prices. Expenditure in national currencies converted to US$ with official exchange rates, deflated to 1995 prices with the US CPI. Food manufacturing products (Food: produced in ISIC rev.3 industries 15 & 16), Other non-durable products (Tex: 17 to 20, 36, 37); Chemical products (Chem: 23 to 26), Machinery & metal products (Mach: 27 to 29); Electrical machinery products (Elec: 30 to 33) and Transport equipment (Tra: 34, 35).
Source: Author's calculations based on World Input-Output Database, April 2012.

Figure 4 Share of domestic value added in domestic final expenditure on manufacturing products



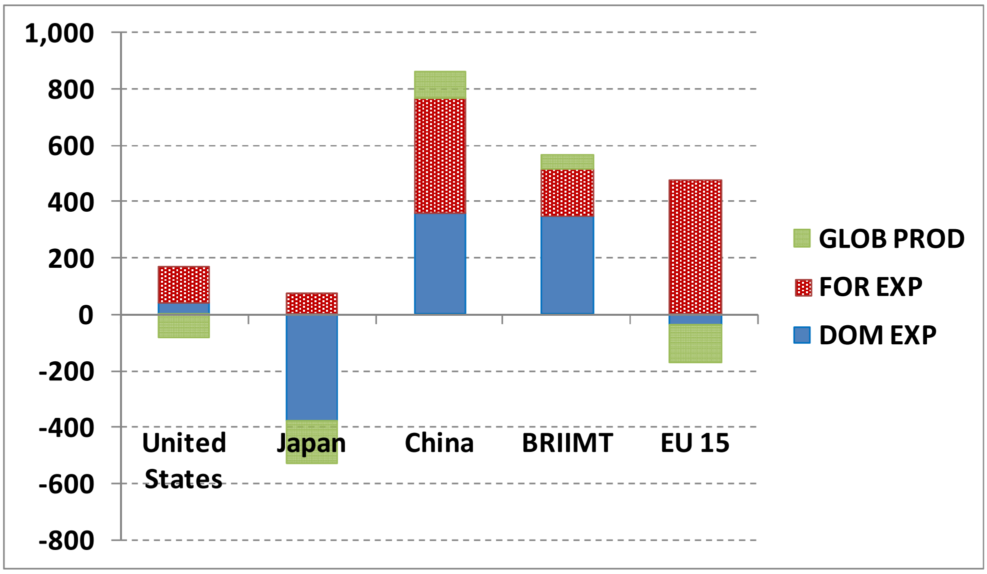
Note: See Figure 3 for abbreviations.
Source: Author's calculations based on 34 biggest countries in World Input-Output Database, April 2012.

Figure 5 Value added by countries in global expenditure on manufacturing products, 1995-2009 (in billion 1995 US$).



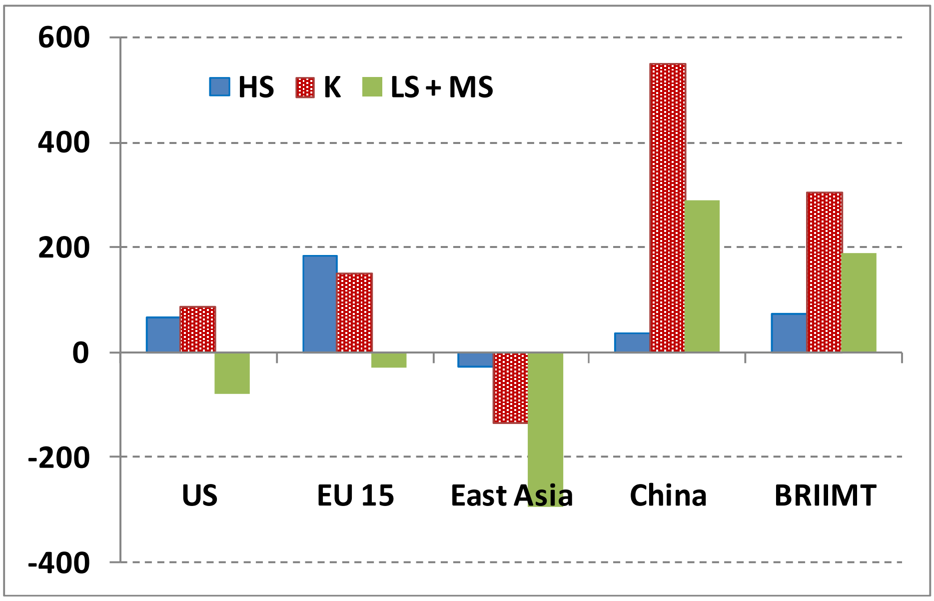
Note: Breakdown of global expenditures on manufacturing products at basic prices into value added in countries. East Asia includes Japan, South Korea and Taiwan. BRIIMT includes Brazil, Russia, India, Indonesia, Mexico and Turkey. EU27 includes all European countries that have joined the European Union.
Source: Author's calculations based on World Input-Output Database, April 2012.

Figure 6 Decomposition of change in value added in global expenditure on manufacturing products (in billion 1995 US$), 1995-2008.



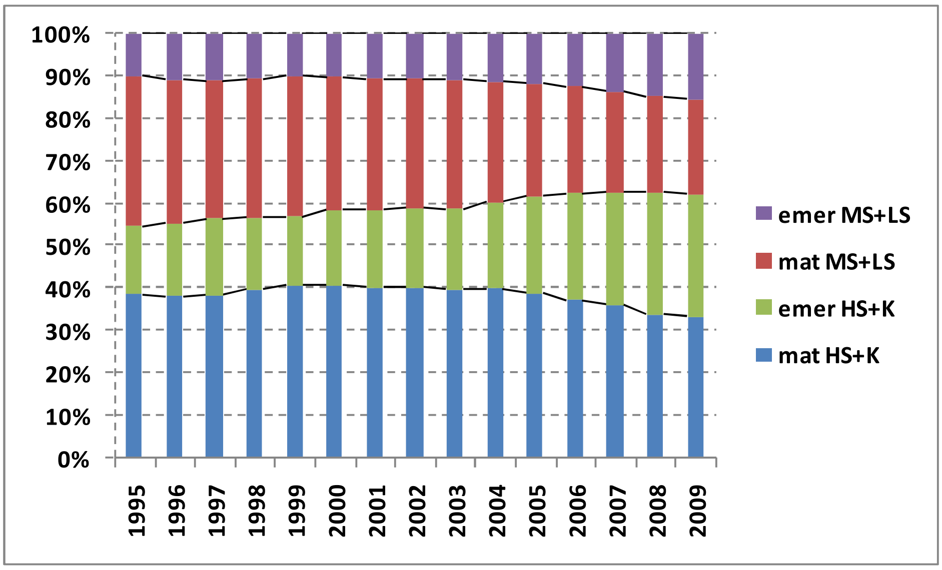
Notes: Change in value added in global manufacturing expenditure over 1995-2008 due to changes in domestic expenditure (DOM EXP), in foreign expenditure (FOR EXP) and reorganisation of global production (GLOB PROD). EU15 and BRIIMT country groups include intra-trade.
Source: Author's calculations based on World Input-Output Database, April 2012.

Figure 7 Value added by production factor in global expenditure on manufacturing products, change between 1995 and 2008 (in billion 1995 US$).



Notes: Change in value added by high-skilled workers (HS), medium- and low-skilled workers (MS + LS) and capital (K) in global expenditure on manufacturing products.
Source: Author's calculations based on World Input-Output Database, April 2012.

Figure 8 Value added by production factor in global expenditure on manufacturing products (share in total expenditure).



Notes: Value added in global expenditure on manufacturing products by mature (mat) and emerging economies (emer), split by high-skilled workers and capital (HS+K) and medium- and low-skilled workers (MS + LS).
Source: Author's calculations based on World Input-Output Database, April 2012.

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 Decomposition of value added by countries in global manufacturing expenditure

	Value added in global manufacturing expenditure (bil 1995 US$)			Change in 1995-2008 due to change in		
	1995	2008	2008 over 1995	domestic expenditure	foreign expenditure	global production
United States	1,326	1,411	85	41	126	-83
China	274	1,134	860	359	407	95
Japan	1,156	696	-460	-380	71	-152
Germany	610	653	43	-80	181	-58
Italy	287	354	67	32	55	-21
France	288	322	34	14	55	-35
Brazil	164	261	97	68	26	2
United Kingdom	249	257	8	-29	37	0
Russian Federation	82	251	170	91	39	39
India	114	227	114	80	35	-1
Mexico	96	204	108	65	30	13
Canada	123	188	66	24	26	15
Spain	130	179	49	20	34	-5
South Korea	142	159	18	-8	45	-20
Turkey	72	122	49	35	23	-9
Netherlands	94	120	25	-3	29	-1
Australia	67	116	49	16	16	17
Indonesia	83	111	28	7	14	6
Poland	34	86	52	17	31	4
Taiwan	82	75	-7	-11	13	-9
Mature economies	4,854	4,908	54	-356	775	-365
Emerging economies	974	2,543	1,569	746	661	162

Notes: Change in value added over 1995-2008 decomposed into change due to changes in domestic expenditure, in foreign expenditure and reorganisation of global production. Twenty biggest countries ranked on value added in 2008. Mature economies include Australia, Canada, Japan, South Korea, Taiwan, US, and 15 countries that joined the EU before 2004. Emerging economies include Brazil, China, Russia, India, Indonesia, Mexico and Turkey and 12 countries that joined the EU in 2004.
Source: Author's calculations based on World Input-Output Database, April 2012.

Table 3 Value added by countries in global manufacturing expenditure (sectoral shares in 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
China	0.21	0.17	0.58	0.57	0.22	0.26
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
Italy	0.05	0.03	0.57	0.52	0.38	0.44
France	0.07	0.04	0.48	0.45	0.46	0.51
Brazil	0.13	0.17	0.55	0.46	0.32	0.37
United Kingdom	0.07	0.07	0.60	0.48	0.34	0.45
Russian Federation	0.20	0.21	0.42	0.39	0.38	0.40
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
Canada	0.12	0.19	0.54	0.44	0.34	0.37
Spain	0.09	0.05	0.54	0.51	0.37	0.43
South Korea	0.10	0.04	0.62	0.67	0.28	0.29
Turkey	0.09	0.13	0.64	0.52	0.27	0.36
Netherlands	0.11	0.12	0.49	0.42	0.40	0.45
Australia	0.20	0.26	0.42	0.34	0.37	0.39
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
Taiwan	0.04	0.02	0.58	0.53	0.38	0.45

Notes: Share of sector in total value added by a country in global manufacturing expenditure. Twenty biggest countries ranked on value added in 2008. 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 4 Value added by production factor in global manufacturing expenditure, change between 1995 and 2008 (in billion 1995 US$).

	Change between 1995 and 2008 (in bil 1995 US$)					
	Value added	*of which*		*Labour of which*		
		Capital	Labour	low-skilled	medium-skilled	high-skilled
United States	85	98	-13	-25	-59	71
China	860	541	319	171	114	34
Japan	-460	-155	-305	-83	-176	-46
Germany	43	56	-13	-15	-29	31
Italy	67	17	50	-25	52	23
France	34	10	24	-20	10	34
Brazil	97	30	67	8	35	23
United Kingdom	8	-6	13	-19	5	27
Russian Federation	170	79	91	3	68	21
India	114	67	47	12	18	17
Mexico	108	87	21	1	17	3
Canada	66	31	34	-2	21	15
Spain	49	18	30	-5	13	22
South Korea	18	19	-2	-16	-3	17
Turkey	49	20	29	15	9	5
Netherlands	25	15	11	-3	0	14
Australia	49	26	23	4	10	8
Indonesia	28	21	6	-1	4	3
Poland	52	29	23	-1	15	9
Taiwan	-7	3	-10	-11	-2	2
mature economies	54	171	-117	-233	-136	252
emerging economies	1,569	910	658	223	307	129

Notes: Change in value added by high-skilled workers (HS), medium- and low-skilled workers (MS + LS) and capital (K) in global expenditure on manufacturing products. Twenty biggest countries ranked on value added in 2008. Mature economies include Australia, Canada, Japan, South Korea, Taiwan, US, and 15 countries that joined the EU before 2004. Emerging economies include Brazil, China, Russia, India, Indonesia, Mexico and Turkey and 12 countries that joined the EU in 2004.

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

Appendix Table 1 National supply-use and input-output tables used for construction of WIOD

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Australia		SUT (106c * 106i)							SUT (233c * 53i)	SUT (233c * 53i)					
Austria	SUT (59c * 59i)		SUT (59c * 59i)		SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
Belgium	SUT (59c * 59i)		SUT (59c * 59i)		SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
Brazil						SUT (110c * 55i)	SUT (110c * 55i)	SUT (110c * 55i)	SUT (110c * 55i)	SUT (110c * 55i)	SUT (110c * 55i)	SUT (110c * 55i)	SUT (110c * 55i)	SUT (110c * 55i)	
Bulgaria						SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)					
Canada			SUT (BP) (473c * 122i)	SUT (BP) (473c * 122i)	SUT (BP) (473c * 122i)	SUT (BP) (473c * 122i)	SUT (BP) (473c * 122i)	SUT (BP) (473c * 122i)	SUT (BP) (473c * 122i)	SUT (BP) (473c * 122i)	SUT (BP) (473c * 122i)	SUT (BP) (473c * 122i)			
China			SUT (PR) (40c * 40i) & IO (PR) (124c * 124c)					SUT (PR) (42c * 42i) & IO (PR) (122c * 122c)					SUT (PR) (42c * 42i) & IO (PR) (135c * 135c)		
Cyprus*							SUT (59c * 59i)								
Czech Republic	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
Denmark		SUT (59c * 59i)			SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
Estonia			SUT (59c * 59i)		SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
Finland	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
France	SUT (59c * 59i)		SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
Germany	SUT (59c * 59i)		SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
Greece						SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)
Hungary				SUT (59c * 59i)	SUT (59c * 59i)			SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
India				SUT (FC) (115c * 115i)					SUT (FC) (130c * 130i)			SUT (FC) (130c * 130i)			
Indonesia	IO (172c * 172c)					IO (172c * 172c)					IO (172c * 172c)				
Ireland							SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
Italy	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
Japan	IO(PR) (108i * 108i)					IO(PR) (108i * 108i)					IO(PR) (108i * 108i)				
Korea	IO(PR) (402c * 402i)					IO(PR) (404c * 404i)					IO(PR) (403c * 403i)				

Appendix Table 1 (continued) National supply-use and input-output tables used for constructing of WIOD

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Latvia		SUT (59c * 59i)		SUT (59c * 59i)											
Lithuania		SUT (59c * 59i)		SUT (59c * 59i)					SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)				
Luxembourg	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)			
Malta						SUT (59c * 59i)	SUT (59c * 59i)								
Mexico									SUT (79c * 79i)						
Netherlands	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
Poland		SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
Portugal	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)			
Romania						SUT (59c * 59i)			SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)			
Russia	SUT (110c * 59i)														
Slovak Republic	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
Slovenia						SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
Spain	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
Sweden	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)		
Taiwan		IO (596c * 160i)					IO (596c * 160i)					IO (596c * 160i)			
Turkey		SUT (PR) (97c * 97i)		SUT (PR) (97c * 97i)				SUT (PR) (97c * 97i)							
United Kingdom	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	SUT (59c * 59i)	
USA				SUT (PR) (66c * 65i)	SUT (PR) (66c * 65i)	SUT (PR) (66c * 65i)	SUT (PR) (66c * 65i)	SUT (PR) (66c * 65i)	SUT (PR) (66c * 65i)	SUT (PR) (66c * 65i)	SUT (PR) (66c * 65i)	SUT (PR) (66c * 65i)	SUT (PR) (66c * 65i)	SUT (PR) (66c * 65i)	SUT (PR) (66c * 65i)

Note: All tables are at purchasers' prices unless otherwise indicated (PR stands for producer prices, FC for factor cost and BP for basic price), i stands for industry dimension and c for commodity. * Cyprus SUTs based on Greece.

Appendix Table 2 Industries and columns in Use table

Columns in USE Table		
Code	**NACE**	**Description**
1	AtB	Agriculture, Hunting, Forestry and Fishing
2	C	Mining and Quarrying
3	15t16	Food, Beverages and Tobacco
4	17t18	Textiles and Textile Products
5	19	Leather, Leather and Footwear
6	20	Wood and Products of Wood and Cork
7	21t22	Pulp, Paper, Paper , Printing and Publishing
8	23	Coke, Refined Petroleum and Nuclear Fuel
9	24	Chemicals and Chemical Products
10	25	Rubber and Plastics
11	26	Other Non-Metallic Mineral
12	27t28	Basic Metals and Fabricated Metal
13	29	Machinery, Nec
14	30t33	Electrical and Optical Equipment
15	34t35	Transport Equipment
16	36t37	Manufacturing, Nec; Recycling
17	E	Electricity, Gas and Water Supply
18	F	Construction
19	50	Sale, Maintenance and Repair of Motor Vehicles Retail Sale of Fuel
20	51	Wholesale Trade and Commission Trade, Except of Motor Vehicles
21	52	Retail Trade, Except of Motor Vehicles ; Repair of Household Goods
22	H	Hotels and Restaurants
23	60	Inland Transport
24	61	Water Transport
25	62	Air Transport
26	63	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
27	64	Post and Telecommunications
28	J	Financial Intermediation
29	70	Real Estate Activities
30	71t74	Renting of M&Eq and Other Business Activities
31	L	Public Admin and Defence; Compulsory Social Security
32	M	Education
33	N	Health and Social Work
34	O	Other Community, Social and Personal Services
35	P	Private Households with Employed Persons
36		Financial intermediation services indirectly measured (FISIM)
37		**Total**
38		Final consumption expenditure by households
39		Final consumption exp. by non-profit organisations serving households
40		Final consumption expenditure by government
41		**Final consumption expenditure**
42		Gross fixed capital formation
43		Changes in inventories and valuables
44		Gross capital formation
45		Exports
46		**Final uses at purchasers' prices**
47		**Total use at purchasers' prices**

Appendix Table 3 Products and rows in Use table

Code	CPA	Description
1	1	Products of agriculture, hunting and related services
2	2	Products of forestry, logging and related services
3	5	Fish and other fishing products; services incidental of fishing
4	10	Coal and lignite; peat
5	11	Crude petroleum and natural gas; services incidental to oil and gas extraction excluding s
6	12	Uranium and thorium ores
7	13	Metal ores
8	14	Other mining and quarrying products
9	15	Food products and beverages
10	16	Tobacco products
11	17	Textiles
12	18	Wearing apparel; furs
13	19	Leather and leather products
14	20	Wood and products of wood and cork (except furniture); articles of straw and plaiting mat
15	21	Pulp, paper and paper products
16	22	Printed matter and recorded media
17	23	Coke, refined petroleum products and nuclear fuels
18	24	Chemicals, chemical products and man-made fibres
19	25	Rubber and plastic products
20	26	Other non-metallic mineral products
21	27	Basic metals
22	28	Fabricated metal products, except machinery and equipment
23	29	Machinery and equipment n.e.c.
24	30	Office machinery and computers
25	31	Electrical machinery and apparatus n.e.c.
26	32	Radio, television and communication equipment and apparatus
27	33	Medical, precision and optical instruments, watches and clocks
28	34	Motor vehicles, trailers and semi-trailers
29	35	Other transport equipment
30	36	Furniture; other manufactured goods n.e.c.
31	37	Secondary raw materials
32	40	Electrical energy, gas, steam and hot water
33	41	Collected and purified water, distribution services of water
34	45	Construction work

Appendix Table 3 Products and rows in Use table (continued)

35	50	Trade, maintenance and repair services of motor vehicles and motorcycles; retail sale of a
36	51	Wholesale trade and commission trade services, except of motor vehicles and motorcycle
37	52	Retail trade services, except of motor vehicles and motorcycles; repair services of person
38	55	Hotel and restaurant services
39	60	Land transport; transport via pipeline services
40	61	Water transport services
41	62	Air transport services
42	63	Supporting and auxiliary transport services; travel agency services
43	64	Post and telecommunication services
44	65	Financial intermediation services, except insurance and pension funding services
45	66	Insurance and pension funding services, except compulsory social security services
46	67	Services auxiliary to financial intermediation
47	70	Real estate services
48	71	Renting services of machinery and equipment without operator and of personal and house
49	72	Computer and related services
50	73	Research and development services
51	74	Other business services
52	75	Public administration and defence services; compulsory social security services
53	80	Education services
54	85	Health and social work services
55	90	Sewage and refuse disposal services, sanitation and similar services
56	91	Membership organisation services n.e.c.
57	92	Recreational, cultural and sporting services
58	93	Other services
59	95	Private households with employed persons
60		**Total**
61		Cif/ fob adjustments on exports
62		Direct purchases abroad by residents
63		Purchases on the domestic territory by non-residents
64		**Total intermediate consumption/final use at purchasers' prices**
65		Compensation of employees
66		Other net taxes on production
67		Operating surplus, gross
68		**Value added at basic prices**
69		**Output at basic prices**