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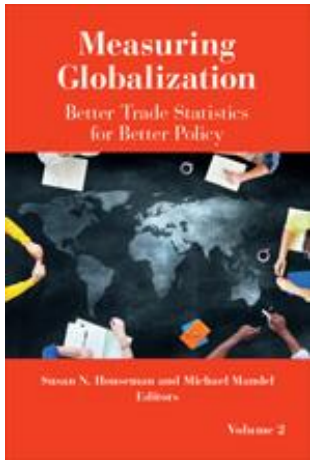
Incomes and Jobs in Global Production of Manufactures: New Measures of Competitiveness Based on the World Input-Output Database



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5
Incomes and Jobs in Global Production of Manufactures

New Measures of Competitiveness Based on the World Input-Output Database

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OVERVIEW

It is frequently argued that globalization has entered a second phase. In the early twentieth century, rapidly falling transport costs ended the need for colocation 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 each other anymore. In this new phase, international competition increasingly plays itself out at the level of tasks within firms, rather than at the level of products. And trade in goods is increasingly replaced by trade in tasks (Baldwin 2006). This creates new challenges for the way in which the competitiveness of nations is analyzed.

Traditional measures indicate that China and other emerging countries have rapidly improved in competitiveness since the late 1990s, both in quantity and in quality, as attested to by booming exports of technologically sophisticated products. But recent product case studies suggest that European, Japanese, and U.S. firms still capture major parts of these value chains, as they specialize 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, which are poorly compensated. A typical finding is that China keeps less than 4 percent of a product's export value as income for its labor and capital employed in the production process of electronic goods (Ali-Yrkkö et al. 2011; Dedrick, Kraemer, and Linden 2010). To reflect this new reality, a new measure of competitiveness is needed that is based on the value added in production by a country, rather than the gross output value of its exports. Or, as put by Grossman and Rossi-Hansberg (2006, pp. 66–67), "Such measures are inadequate to the task of measuring the extent of a country's international integration in a world with global supply chains. . . . We would like to know the sources of the value-added embodied in goods and the uses to which the goods are eventually put."

Recently, Timmer et al. (2013) introduced a new concept that allows one to analyze 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" (for global value chain income). Compared to traditional competitiveness indicators such as 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 by competing in manufacturing *products* as measured by exports. These activities take place in manufacturing industries but also in services industries. Second, it is a reflection of an economy's strength to compete in both domestic and global markets. Third, income and employment effects of trade in tasks for separate groups of workers (such as low- and high-skilled) can also be determined in the same unified framework, referring to the concept of "GVC jobs."[1]

The main aim of this chapter is to establish a series of stylized facts on GVC incomes and jobs that can serve as a starting point for deeper analysis of the causes of global manufacturing production. Whereas Timmer et al. (2013) focused their analysis on trends in European competitiveness, this chapter takes a more global view and provides analyses for 20 major countries in the world, including the United States, Japan, major economies in Europe, Brazil, China, India, and Russia.

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

Section Four, "Trends in Manufactures' GVC Incomes," provides trends in GVC income shares across regions and major countries in the world. The analysis is based on demand for final manufacturing products, and we show the dependency of countries on domestic and foreign sources of demand. We also show that only about half of the GVC income originates in the manufacturing sector itself, which indicates the importance of interindustry linkages in the production of manufacturing goods. In Section Five, "Manufactures' GVC Income by Production Factor," we focus more in-depth on the role of different factors of production. We show how in advanced countries GVC income generated by capital and high-skilled labor is increasing, while incomes for medium- and low-skilled workers in manufactures production are declining. In Section Six, "Manufactures' GVC Jobs," we study the number of jobs involved in GVC production of manufactures and find a strong difference between Europe and the United States. Low- and medium-skilled jobs are on the decline in all advanced countries, but whereas in Europe and Japan high-skilled job opportunities have increased, they have declined in the United States since 1995.

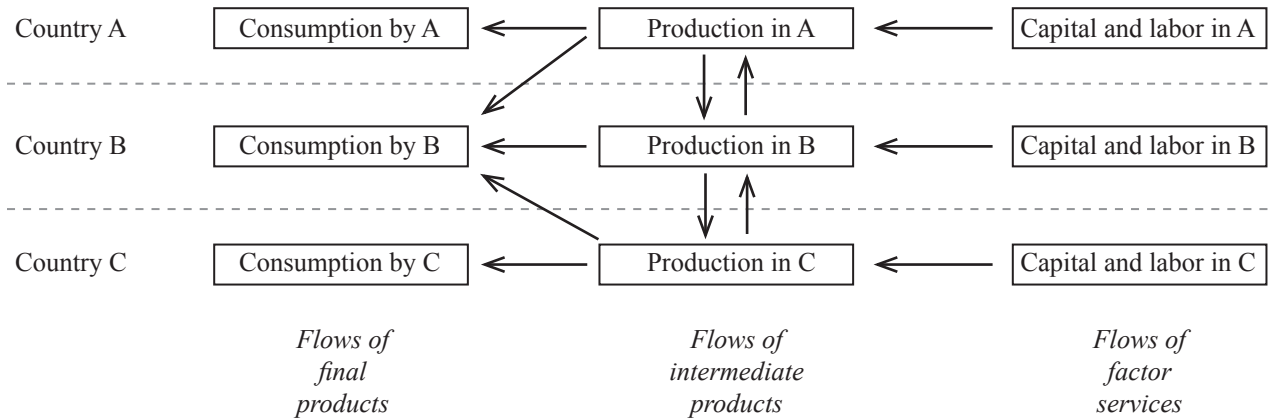
GVC INCOMES AND JOBS: METHODOLOGY

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

The GVC income metric provides a macroeconomic complement to the product case studies described above. It covers a wide set of products and analyzes not only the first-tier suppliers but also second-tier and higher-order suppliers. The method provides a full decomposition of the value of consumption in a country and traces the associated income flows for labor 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 utilization of production factors such as labor and capital. These links between expenditure and income are illustrated in Figure 5.1.

The arrows in Figure 5.1 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 labor and capital in the various stages of production. This production process can be highly fragmented, as the case study of the iPod illustrates. Through international trade, consumption in Country B will lead to income for

Figure 5.1 Links between Expenditure, Production, and Income



SOURCE: Authors' construction.

production factors in other countries, either through importing final goods, or through the use of imported intermediates in the production process of Country B. Through these indirect linkages, consumption in Country A will generate income in Country C even though Country C does not trade directly with Country A. These indirect effects are sizable, 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.[2] 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 is 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 an intermediate input in another production process or is consumed. It can be rewritten as $Q = (I - B)^{-1}C$, with I being an identity matrix.[3] $(I - B)^{-1}$ 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 the first element representing the global consumption of iPods produced in China, which is equal to the output of the Chinese iPod industry, and the rest zeros. Then BZ is the vector of intermediate inputs, both Chinese and foreign, needed to assemble the iPods in China, such as the hard-disc drive, battery, and processors. But these intermediates need to be produced as well. B^2Z indicates the intermediate inputs directly needed to produce BZ, and so on. Thus

$$\sum_{n=1}^{\infty} B^n Z$$

represents all intermediate inputs needed for the iPod production. Then the total gross output value related to the production of Z is given by

$$Z + \sum_{n=1}^{\infty} B^n Z = (I - B)^{-1} Z .$$

Using this insight, we can derive production factor requirements for any vector Z. Let F be the direct factor inputs per unit of gross output. An element in this matrix indicates the share in the value of gross output of a production factor used directly by the country to produce a given product. These are country- and industry-specific—one example would be the value of low-skilled labor used in the Chinese electronics industry to produce one dollar of output and to 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, so that

$$(5.1) \quad K = F(I - B)^{-1}C\,,$$

in which C indicates the levels of consumption[4] 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.[5]

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

$$(5.2) \quad K = F(I - B)^{-1}C^{DOM} + F(I - B)^{-1}C^{FOR} = K^{DOM} + K^{FOR}\,.$$

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

produced in a given source country that is ultimately embodied in final products absorbed abroad.

In Table 5.1 we provide an example of a GVC decomposition for final expenditures in the United States on electrical machinery in 1995 and 2008. The expenditure value is given at the basic price concept. A key distinction in the System of National Accounts is between a value at basic prices and at purchasers' prices. The latter is the price paid by the final consumer and consists of the basic price plus trade and transport margins in the handling of the product and any (net) product taxes. The basic price can thus be considered as the price received by the producer of the good. In 1995, the share of the value added in the United States was over 50 percent, but this swiftly dropped in the period following that year. Instead, value was increasingly added in other parts in the world, both within NAFTA and outside. China in particular benefited from U.S. demand for electrical machinery and captured more than 20 percent of the value in 2008. Partly this was by exporting final goods to the United States that had been produced in China (direct contribution), but also it was accomplished indirectly through the production of intermediates (such as parts and components) that are used in the United States and elsewhere to produce final goods destined for the U.S. mar-

Table 5.1 Value-Added in Final Expenditure on Electrical Products in United States (billions of 1995 US$)

	1995	2008	Change
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: Table shows breakdown of final expenditure by households, firms, and government in the United States 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 billions of U.S. dollars, deflated to 1995 prices with the overall U.S. CPI. "East Asia" includes Japan, South Korea, and Taiwan. "EU 27" includes all countries of the European Union.

SOURCE: Authors' calculations based on World Input-Output Database, April 2012.

ket. The decline in value-added in Japan, South Korea, and Taiwan is illustrative of the major shifts that occurred in production stages across Asia as China was increasingly used as a production location by East Asian multinationals (Fukao, Ishido, and Ito 2003), an issue we will return to later.

THE WORLD INPUT-OUTPUT DATABASE (WIOD)

To implement the new GVC metrics, one needs to have a database with linked consumption, production, and income flows within and between countries. For individual countries, this type of information can be found in input-output tables. However, national tables do not provide any information on bilateral flows of goods and services between countries. For this type of information, researchers have to rely on data sets constructed on the basis of national input-output tables in combination with international trade data. Various alternative data sets have been built in the past, of which the Global Trade Analysis Project (GTAP) database is the most widely known and used (Narayanan and Walmsley 2008). Other data sets are constructed by the Organisation for Economic Co-operation and Development (OECD; see Ahmad, Chapter 6 of this volume; IDE-JETRO (2006); and Yamano and Ahmad [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 breakdown of imports by trade partner.

For this chapter, we use a new database, called the World Input-Output Database (WIOD), that aims to fill this gap. The WIOD provides a time series of world input-output tables from 1995 onwards, distinguishing between 35 industries and 59 product groups. The construction of the world input-output tables will be discussed in the following subsection. Another crucial element for this type of analysis comes from detailed value-added accounts that provide information on the use of various types of labor (distinguished by educational attainment level) and capital in production. This is discussed in the subsection titled "Factor Input Requirements."

World Input-Output Tables: Concepts and Construction

In this subsection 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, for imports, the WIOT shows which foreign *industry* produced the product. This is illustrated by the schematic outline for a WIOT in Table 5.2. It illustrates the simple case of three regions: 1) Country A, 2) Country B, and 3) the rest of the world. In the World Input-Output Database we will distinguish between 40 individual countries and the rest of the world, but the basic outline remains the same.

The rows in the WIOT indicate the use of output from a particular industry in a country. This can be intermediate use either 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,[6] either by the country itself (final use of domestic output) or by other countries (in which case it is exported). Final use is indicated on the right side of the table, and this information can be used to measure the *C* matrix defined in Section Two, "GVC Incomes and Jobs: Methodology." The sum of all of the uses is equal to the output of an industry, denoted by *Q* in Section Two.

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 table. 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 Two. 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 Two on this information after breaking out the compensation of various factor inputs as described in the next subsection, "Factor Input Requirements."

As building blocks for the WIOT, national supply-and-use tables (SUTs) were used; these are the core statistical sources from which

Table 5.2 Schematic Outline of World Input-Output Table (WIOT), Three Regions

	Intermediate industry			Final domestic			
	Country A	Country B	Rest of world	Country A	Country B	Rest of world	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				

SOURCE: Authors' compilation.

national statistical institutes (NSIs) derive national input-output tables. In short, we derive time series from national SUTs. Benchmark national SUTs are linked over time through the use of the most recent National Accounts statistics on final demand categories, as well as through the use of gross output and value-added by detailed industry. This ensures both intercountry and intertemporal consistency of the tables. As such, the WIOT is built according to the conventions of the System of National Accounts and obeys various important accounting identities. National SUTs are linked across countries through detailed international trade statistics to create so-called international SUTs. This is based on a classification of bilateral import flows by end-use category (intermediate, consumer, or investment), in which intermediate inputs are split by country of origin. These international SUTs are used to construct the symmetric world input-output of the industry-by-industry type. See Timmer (2012) for a more elaborate discussion of construction methods, practical implementation, and detailed sources of the WIOT. Dietzenbacher et al. (2013) provide an in-depth technical discussion.

The construction of the WIOT has a number of distinct characteristics. First, we rely on national supply-and-use tables 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, which is product-based, and with factor use, which is industry-based, can be naturally made in an SUT framework.[7]

Ideally, we would like to use official data on the destination of imported goods and services. However, in most countries these flows are not tracked by statistical agencies. Nevertheless, for imports, most do publish an input-output table constructed with the import proportionality assumption, applying a product's economy-wide import share for all use categories. For the United States, researchers have found that this assumption can be rather misleading, in particular at the industry level (Feenstra and Jensen 2012; Strassner, Yuskavage, and Lee 2009). Therefore, we are not using the official import matrices but instead use detailed trade data to make a split. Our basic data are the 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: 1) intermediates, 2) final consumption, and 3) 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 standardized database on bilateral service flows exists. These flows have been collected from various sources—including the OECD, Eurostat, the International Monetary Fund (IMF), and the World Trade Organization (WTO)—checked for consistency, and integrated into a bilateral service trade database.

Clearly, the validity of the findings in this chapter 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 UN Comtrade data was resolved by focusing on import flows only. Other issues relate to reexports of goods and trade in services that are not very well reflected in today's trade statistics. It is clear that present-day statistical systems are lagging behind the developments in today's world. In particular, trade in services and intangibles such as royalties and licences are still poorly reflected (see, e.g., Feenstra et al. [2010]; Houseman and Ryder [2010]). This should have priority in the future development of international trade statistics.

Factor Input Requirements

For factor input requirements, we collected country-specific data on detailed labor and capital inputs. This includes data on hours worked and on compensation for three labor types, as well as data on capital stocks and compensation. Labor types are distinguished on the basis

of educational attainment levels, as defined in the International Standard Classification of Education (ISCED) (low-skilled: ISCED 1 + 2; medium-skilled: ISCED 3 + 4; and high-skilled: ISCED 5 + 6). These series are not part of the core set of national accounts statistics reported by NSIs, and additional material has been collected from employment and labor force statistics. For each country covered, we chose what we considered the best statistical source for consistent wage and employment data at the industry level. In most countries, this was the labor force survey (LFS). In most cases this needed to be combined with an earnings survey, as information on wages is 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 that are time-consistent, as most employment surveys are not designed to track developments over time, and breaks in methodology or coverage frequently occur.

Labor compensation of self-employed persons is not registered in the National Accounts, which, as emphasised by Krueger (1999), leads to an understatement of labor's share. This is particularly important for less advanced economies, which 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-employment is equal to the compensation per hour of employees. For most advanced countries, labor data is constructed by extending and updating the EU KLEMS database (www.euklems.net) using the methodologies, data sources, and concepts described in O'Mahony and Timmer (2009). For other countries additional data has been collected according to the same principles.

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

TRENDS IN GVC INCOMES OF MANUFACTURES

In this section, we explore trends in the distributions of value in global production chains using the decompositions introduced in Section Two. 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 chapter 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, and so on, 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; it 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 the world.

The share of a country in world GVC income is a novel indicator of the competitive strength of a nation. Compared to traditional competitiveness indicators like a country's share in world exports, it has three advantages. First, it indicates to what extent a country can compete with other nations in terms of *activities* related to global manufacturing, rather than competing in manufacturing *products* as measured 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 lose 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 later on.

Throughout the chapter we will focus on GVC income in the production of final manufacturing goods. We denote these goods by the

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

Ideally, to measure competitiveness one would like to cover value-added in all activities that are internationally contestable, and not only those in the production of manufactures.[8] GVCs of services cannot be analyzed, however, as the level of observation for services in our data is not fine enough to zoom in on those services that are heavily traded, such as consultancy services. The lowest level of detail in the WIOD is "business services," which for the most part contains activities that are not internationally traded, and hence are much less interesting to analyze from a GVC perspective. This is all the more true for other services, such as personal or retail services. They require a physical interaction between the buyer and the provider of the service, and a major part of the value-added in these chains is effectively not internationally contestable. More detailed data on trade in, and production of, services is needed before meaningful GVC analyses of final services can be made.

GVC Incomes of Manufactures

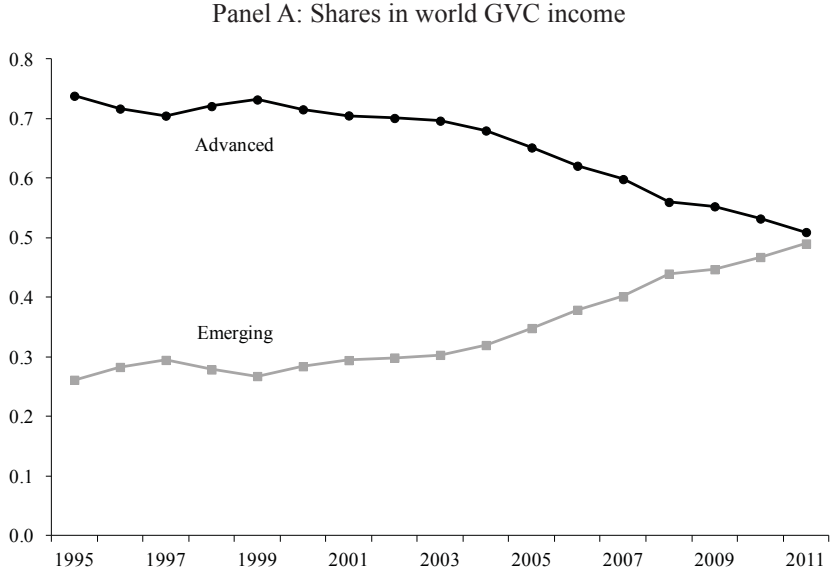
Figure 5.2, Panel A, provides a comparison of the GVC incomes in advanced and emerging regions in the production of final manufacturing goods. The GVC income share of advanced countries (East Asia plus the United States, Canada, Australia, and the EU15) has declined from almost three-quarters in 1995 to just above half of world GVC income today. Emerging regions have rapidly increased their shares,

and almost all of this increase was realized after 2003. Since 2004 the increase in the GVC income of emerging countries has always been higher than that of advanced countries, reaching a peak in 2008 at a time when advanced countries' GVC income stalled. The drop in the crisis year of 2009 was large for all countries, but recovery occurred much faster in the emerging economies (Figure 5.2, Panel B).

One might hypothesize that shifts in the composition of global manufacturing demand in terms of the type of products being demanded might also be a determinant of the decline of the advanced nations in global manufacturing production. However, the product structure of global demand remained stable over the period 1995 to 2009. Following Engel's law, the expenditure shares of food and other nondurable goods, such as apparel, shoes, furniture, and toys, were on a long-term declining trend. Expenditure on machinery and transport equipment was relatively stable, around 16 percent of the total, as increasing consumer and investment demand from emerging markets was counteracted by declining demand from mature economies. Also, demand for electrical machinery was stagnant in the long run. The only clear upward trend is found for chemical products—including gasoline, cosmetics, and medicines—demand for which has steadily increased around the world, going from 12 percent of global manufacturing expenditures in 1995 to 15 percent in 2008. But these global demand shifts are too small to account for the decline in advanced nations' GVC income. Instead, this decline is due to losses in the amount of value-added in each product's GVC. This will be analyzed in more detail in the remainder of this section.

In Figure 5.3 we show the shares of regions in world GVC income in the production of manufactures for the period from 1995 to 2011. The figure plots measures for five groups of countries: 1) members of the North American Free Trade Agreement (NAFTA) (Canada, Mexico, and the United States); 2) the European Union (EU), consisting of the 27 EU member states; 3) East Asia, consisting of Japan, South Korea, and Taiwan; 4) China; and 5) BRIIAT, which includes Brazil, Russia, India, Indonesia, Australia, and Turkey. In Table 5.3, additional data for 20 major individual economies can be found for 1995 and 2008. It should be kept in mind that international competition is not a zero-sum game, and declining shares in global GVC do not necessarily mean an absolute decline in GVC income in a region. On the contrary, in real

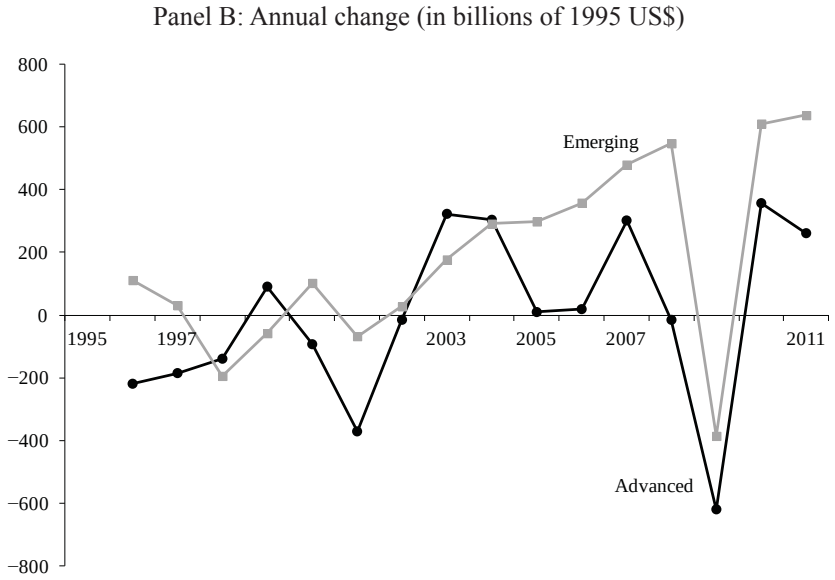
Figure 5.2 GVC Incomes in Advanced and Emerging Countries, All Manufactures, 1995–2011



terms, world GVC income on manufactures (deflated by the U.S. Consumer Price Index) rose by about one-third over the period 1995–2008.

Figure 5.3 illustrates that the share of the NAFTA countries in world GVC income increased during the ICT bubble years, climbing as high as 30 percent, at which point their share was even higher than that of the EU. But it rapidly declined after 2001, reaching a low of 20 percent in 2008. The decline of the advanced nations taken as a whole is particularly due to the demise of East Asia, whose share has been dropping rapidly since the mid-1990s. While the shares of South Korea and Taiwan are still increasing, the GVC income share of Japan has been declining precipitously. In contrast, the EU's GVC income share has been relatively stable, only declining slowly over the period from 1995 to 2008. France, Italy, and the United Kingdom slowly lost some shares. The German share dropped rapidly in the latter 1990s but stabilized afterwards. These drops were compensated for by increasing shares for other EU countries, in particular the new member states. As is well known, the aftermath of the global financial crisis hit Europe par-

Figure 5.2 (continued)



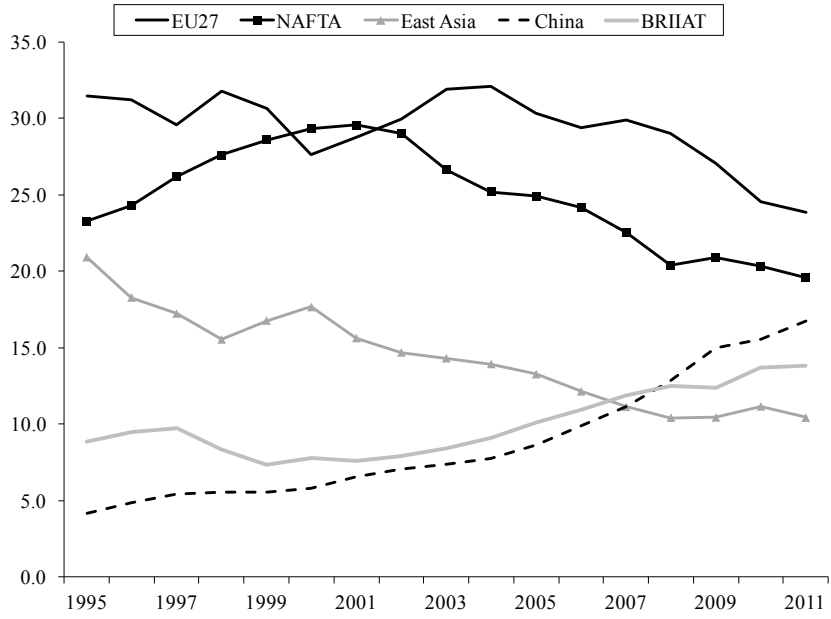
NOTE: "Advanced" nations include the EU15, Japan, Korea, Taiwan, Australia, Canada, and the United States. "Emerging" nations include all other countries in the world. National currencies have been converted to U.S. dollars with official exchange rates, deflated to 1995 prices with the U.S. Consumer Price Index (CPI). World GVC income is equal to world expenditures on manufacturing products at basic prices.

SOURCE: Authors' calculations based on World Input-Output Database. Series updated to 2011 in April 2012.

ticularly hard, and its share dropped sharply, from 32 percent in 2003 to 24 percent in 2011. On the flip side, the share of other regions in the world rapidly increased. China is mainly responsible for the increase of the emerging countries' share, because its share accelerated after its ascension to the WTO in 2000. In 2007 it overtook East Asia in terms of share. In 2009 the Chinese GVC income share overtook that of the combined countries of BRIIAT. And in 2011 its share was almost equal to that of the NAFTA region.[9]

One might argue that these shifts in regional GVC income shares are unsurprising, given the faster growth of China and other emerg-

Figure 5.3 Regional Shares in World GVC Income, All Manufactures, 1995–2011 (%)



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

SOURCE: Authors' calculations based on World Input-Output Database, April 2012, updated to 2011.

ing economies vis-à-vis advanced regions. Higher consumption in the home economy would naturally lead to higher GVC incomes. But this is only true to the extent that demand for manufactures has a strong home production bias—that is, a bias mainly geared toward goods with a high level of domestic value-added. Given the high tradability of manufacturing goods, this home bias is not obvious, however. Increased Chinese demand for, say, chemicals or electronic equipment can be as easily served by imports as by Chinese domestic production. And in the latter case, a sizable share could still be captured by advanced countries

Table 5.3 Real GVC Income, All Manufactures (in billions of 1995 US$)

Country	1995	2008	Change
Advanced nations			
United States	1,312	1,373	62
Japan	1,154	676	−478
Germany	618	664	46
France	292	330	37
United Kingdom	254	260	6
Italy	289	353	64
Spain	126	171	44
Canada	124	190	66
Australia	68	112	45
South Korea	142	157	15
Netherlands	94	119	25
Other 10 advanced	390	459	69
Total 2l advanced	4,863	4,864	1
Emerging nations			
China	277	1,114	837
Russian Federation	80	246	166
Brazil	164	265	101
India	114	229	115
Mexico	99	208	109
Turkey	73	122	49
Indonesia	83	113	30
Poland	33	86	52
Czech Republic	14	41	27
Rest of world	786	1,396	610
Total emerging countries	1,723	3,820	2,097
World	6,586	8,684	2,098

NOTE: Real GVC indicates the value-added in countries to global output of final manufactures. It includes all manufactures and is in constant 1995 prices using the U.S. Consumer Price Index (CPI) as the deflator. Some numbers in "Change" column may be off by 1 because of rounding.

SOURCE: Authors' calculations based on World Input-Output Database, April 2012.

through the delivery of key intermediate inputs and services. The occurrence of falling shares in global GVC income for advanced regions in Figure 5.2 indicates that these regions failed to capture a large part of the value of the increased market for manufacturing goods in emerging

economies. At the same time, the domestic value-added content of their own production declined. Both trends can be interpreted as a loss of competitiveness.

A number of caveats are in order. Shares in world GVC income are expressed in U.S. dollars using current exchange rates. For income changes over time, we deflate incomes in U.S. dollars to the 1995 U.S. dollar value using the U.S. Consumer Price Index (CPI). Exchange rates have fluctuated over the period considered: The dollar-to-euro rate[10] declined sharply over 1995–2001, followed by a steep rise, which by 2007 had returned it to near its 1995 value. The yen-to-dollar rate fluctuated around a long-term constant for this period. The yuan-to-dollar rate was effectively constant over this period, slightly appreciating at the end of the 2000s. The choice of the U.S. dollar as numéraire has no impact on the GVC income measure of a country relative to other countries. For example, expressing GVC income shares in yen or euros would give identical results. But it *will* affect the absolute levels of GVC incomes and hence comparisons over time within a country.

Second, one has to keep in mind that the location where the value is being added is not necessarily identical to where the generated income will eventually end up. The building of global production chains is not only through arms-length trade in intermediate inputs; it also involves sizable flows of investment, and part of the value-added in emerging regions will accrue as income to multinational firms headquartered in advanced regions through the ownership of capital. What is needed is to analyze capital income on a national rather than a domestic basis, as this chapter does in its data on foreign ownership. This type of information is notoriously hard to acquire, not least because of the notional relocation of profits for tax accounting purposes. Hence, further research is needed in this area (Baldwin and Kimura 1998; Lipsey 2010). The decline in East Asian GVC income is likely overestimated, as it is also related to the offshoring of activities to China, which effectively became the assembly place of East Asia. Income earned by East Asian capital is allocated to the place of production (in this case China) and not by ownership, as discussed in Section Two. This difference is probably larger for East Asian countries than for NAFTA or the EU, which have larger FDI flows within the region, so that they net out in regional aggregate numbers.

The Role of Domestic and Foreign Demand

By splitting the final demand vector in the decomposition given in Equation (5.2), we can analyze the importance of domestic versus foreign final demand in the generation of GVC income in a country. The GVC income due to foreign demand is identical to what Johnson and Noguera (2012) refer to as "exports of value-added."[11] Table 5.4 provides the share of GVC income of manufactures due to foreign demand for 20 major economies in the world. The overriding conclusion is that all countries have become increasingly dependent on foreign demand

Table 5.4 Percentage of Real GVC Income Due to Foreign Demand, All Manufactures

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

NOTE: Numbers represent real GVC income for all manufactures and in constant 1995 prices using the U.S. Consumer Price Index (CPI) as a deflator. Some numbers in the "Change" column may be off by 0.1 because of rounding.

SOURCE: Authors' calculations based on World Input-Output Database, April 2012.

to generate GVC income of manufactures, with the exception of Canada. For all major mature economies, increases in foreign demand have been a necessary spur for slow or even negative growth in their value-added shares in domestic demand. Domestic demand was not a source of growth in the United States, and it contributed strongly to negative growth in Japan, as import substitution took place against a backdrop of stagnating domestic demand. The direction of this trend for advanced countries was to be expected, as the income elasticity of demand for manufactures is low, and in most countries domestic demand is increasingly served through imports with high foreign value-added. But this domestic decline was more than counteracted by a rapid increase in exports of value-added. The most extreme example of this shift toward foreign demand dependence is to be found in Germany, given the large size of its domestic market. In 1995, 46 percent of its GVC income was due to foreign final demand, and by 2008 this had increased to 70 percent. Also, dependence upon foreign demand in Japan, South Korea, Spain, and the United Kingdom rapidly increased over this period.

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

Sectoral Origin of GVC Income of Manufactures

The production of manufacturing goods involves a wide variety of activities, which do not take place only 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 that is added through activities in the manufacturing sector itself is around half the basic price value of a good, and declines over time. In Table 5.5 we provide for each country the share of a sector in the total value added by the country in

Table 5.5 Sectoral Shares in Total GVC Income, All Manufactures (% of total)

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

NOTE: The numbers represent the share of that sector in total value-added by a country's production of final manufacturing products. "Natural resource" includes the 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: Authors' calculations based on World Input-Output Database, April 2012.

global manufacturing expenditure. This is done for 20 major economies in 1995 and 2008, distinguishing between three broad sectors: 1) natural resources, including the agriculture and mining industries (ISIC Rev. 3 industries A to C), 2) manufacturing, including all manufacturing industries (D), and 3) services including all other industries (E to Q). The table shows that the share of manufacturing has declined between 1995 and 2008 in all countries except South Korea and Mexico. The

unweighted average share across all 20 countries declined from 54 percent to 50 percent. This partly reflects a shift away from traditional manufacturing activities, such as those 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 the 1995–2008 period in countries such as Australia, Canada, Indonesia, Mexico, Russia,[12] and Turkey. This pattern of value-added suggests that for resource-abundant countries, activities within manufacturing production networks are reinforcing their comparative advantage. Given India's low level of development, services contribute relatively much in that country, reflecting its well-developed business services sector, which delivers intermediate services to both domestic and foreign manufacturing firms. In China, the share of natural resources is declining, and activities in the services sector are starting to contribute more, but the level is still well below the contributions of services in Europe and the United States.

GVC INCOME OF MANUFACTURES BY PRODUCTION FACTOR

Our income data on labor and capital allow us to study which production factors have benefited from the changes in the regional distribution of global value-added. Increasing trade and integration of world markets have been related to increasing unemployment and stagnating relative wages of low- and medium-skilled workers in developed regions. On the other hand, those factors have offered new opportunities in developing regions for countries to employ their large supply of low-skilled workers. To study these trends, we decomposed value-added into four parts: 1) income for capital and income for labor, further split into 2) low-, 3) medium- and 4) high-skilled labor. High-skilled labor is defined as workers with a college degree or above. Medium-skilled workers have secondary schooling or above, including professional qualifications but below a college degree, and low-skilled have below secondary schooling. An estimate for the income of self-employed workers is included in labor compensation. The income for capital is

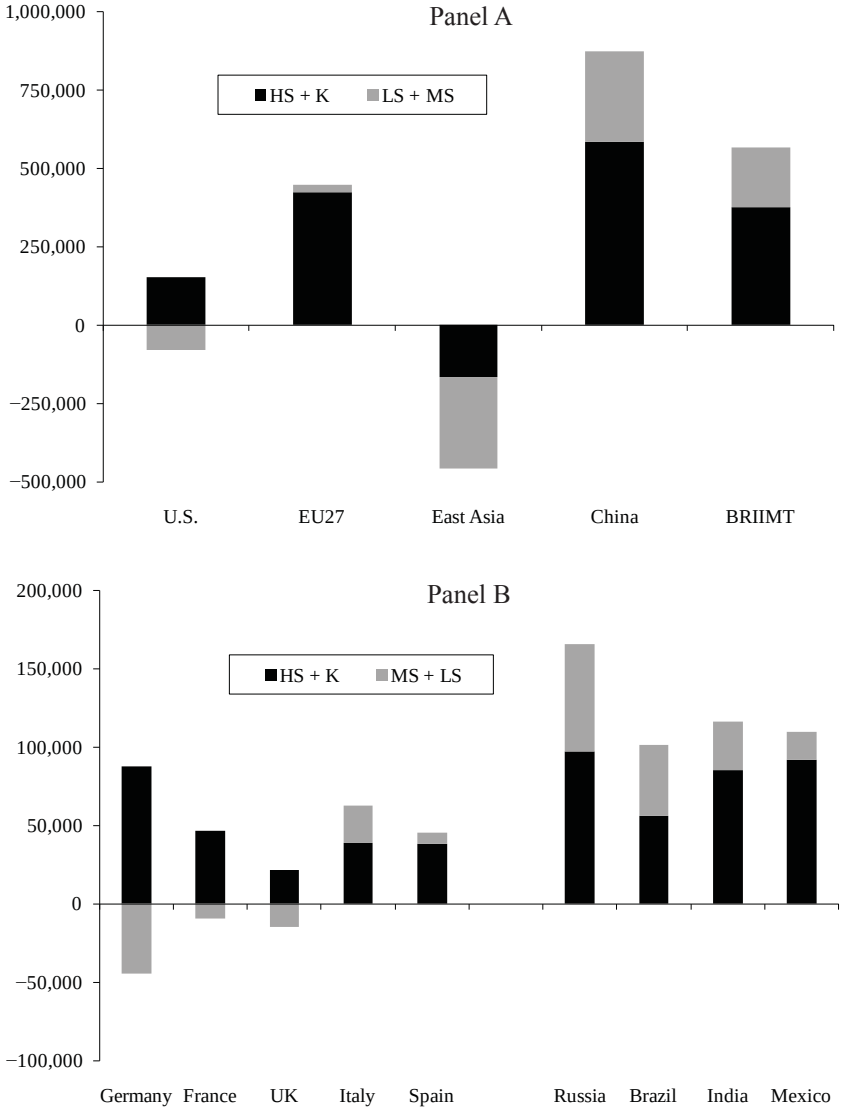
the amount of value-added that remains after subtracting labor compensation. It is the gross compensation for capital, including profits and depreciation allowances. As a residual measure, it is the remuneration for capital in the broadest sense, including tangible, intangible, mineral resources, land, and financial capital.

In Figure 5.4 and Table 5.6 we provide a breakdown of GVC income by labor and capital for major regions. This is a breakdown of the GVC income discussed in the previous section, "Trends in Manufactures' GVC Incomes." At the global level, the share of GVC income that goes to labor is coming down, while the share of capital is increasing. In all regions, the compensation for capital is increasing relative to labor. Particularly in emerging regions, this increase is important and occurs faster than the labor income increase. This might be related to the low wage/rental ratios in these regions, which are still characterized 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, which are becoming increasingly important for growth in advanced nations (Corrado and Hulten 2010).

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

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

Figure 5.4 GVC Income by Production Factor (in millions of 1995 US$), Change between 1995 and 2008



NOTE: Figure shows factor income earned by high-skilled labor and capital (HS + K) and by medium- and low-skilled labor (MS + LS). "EU27" includes all countries in the European Union. "BRIIMT" includes Brazil, Russia, India, Indonesia, Mexico, and Turkey.

SOURCE: Authors' calculations based on World Input-Output Database, April 2012, updated to 2011.

Table 5.6 GVC Income by Production Factor and Region (shares in world GVC income)

	Value-added by labor		Value-added by capital		Value-added total	
	1995	2008	1995	2008	1995	2008
EU27	21.5	18.9	9.7	9.8	31.2	28.7
United States	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
EU27	4.8	6.0	10.0	8.9	6.6	4.0
United States	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. "EU27" designates the countries that had joined the EU as of January 1, 2013. "BRIIMT" includes Brazil, Russia, India, Indonesia, Mexico, and Turkey. "Other" is the rest of the world. Skill categories classify workers by their educational attainment levels. World income is equal to world expenditures on manufacturing products at basic prices. Some numbers may not sum to total because of rounding.

SOURCE: Authors' calculations based on World Input-Output Database, April 2012.

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

GVC JOBS IN MANUFACTURES

Many policy concerns surrounding globalization issues are ultimately about jobs—good jobs in particular. The disappearance of manufacturing jobs in advanced nations is occasionally linked to production fragmentation and the associated offshoring of activities; see Bardhan, Jaffee, and Kroll (2013) for an overview. It is thus useful to look at the structure of employment in global value chains and analyze the changes in the characteristics of workers directly and indirectly involved in the production of manufacturing goods—in short, GVC jobs in manufactures.[13] For each country, we will measure the number of workers involved in the domestic territory. As the mobility of labor is much lower than that of capital, GVC jobs will be closer to a national concept than GVC income. We will characterize GVC workers by sector of employment and level of skills. In the next subsection, "The Shift toward Service Jobs in GVCs of Manufactures," we show that only about half of the workers in manufacturing GVCs are actually employed in the manufacturing sector. The other half are employed in nonmanufacturing industries delivering intermediates, and this share is growing. In most countries, GVC job increase in services is even higher than job loss in manufacturing. In the subsection titled "Specialization in High-Skilled Activities in Advanced Countries," on p. 154, we analyze the skill structure of GVC workers and find that there has been a shift away from low-skilled toward high-skilled workers for advanced nations. This increase is faster than the trend in the overall economy, suggesting increased specialization of advanced countries in GVC activities performed by high-skilled workers. This is in line with broad Heckscher-Ohlin predictions of which countries will see a comparative advantage when possibilities for international production fragmentation increase.

The Shift Toward Service Jobs in GVCs of Manufactures

By using the number of workers rather than value-added per unit of output in each industry-country as the requirement vector in Equation (5.1), we can trace the number of workers directly and indirectly involved in the production of manufacturing goods, and their sector of employment. Developments in the 20 main countries over the period from 1995 to 2008 are shown in Table 5.7. The first two columns indicate the share of manufacturing GVC workers as a percentage of the overall workforce in the economy. In the next columns the sectoral structure of employment of these workers is shown. Three sectors are considered—1) agriculture, 2) manufacturing and 3) services (which also include mining, construction, and utilities)—followed by a fourth column for "All sectors." The first set of four columns refers to the absolute number of GVC workers by sector in 2008, while the latter set of four columns refers to the change over the period 1995–2008. Two main facts clearly stand out:

1) The declining importance of global production of manufactures for overall employment in most advanced nations
2) The strong shift in the sector of employment of these workers away from the manufacturing sector toward the services sector

The first two columns of Table 5.7 show the decline in importance of GVCs of manufactures in providing jobs in the economies of all countries except China and Turkey. The job losses in Japan and the United States are major, around 2.9 and 4.6 million, respectively. Also, job loss in the United Kingdom stands out, as more than 1.6 million GVC jobs disappeared in that country alone. The only exception to this trend in advanced countries is Germany: In 2008, 26 percent of German employment was involved in the global production of manufactures, which is the highest share across all advanced countries.

Another important finding on the basis of Table 5.7 is the strong shift toward service jobs in the global production of manufactures since 1995. Faster growth (or slower declines) in service jobs than in manufacturing can be seen in all major advanced countries. As a result, in 2008, the manufacturing sector accounted for about half of the total number of GVC jobs in manufactures in advanced countries. The other

Table 5.7 GVC Workers in Manufactures, 1995 and 2008

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

Turkey	27.1	30.4	1,778	3,115	1,554	6,446	−341	620	584	863
Indonesia	32.1	25.6	13,921	7,427	5,725	27,073	−1,899	−425	1,380	−944
Poland	31.0	28.8	917	2,278	1,347	4,542	−468	81	368	−19
Czech Republic	30.8	30.9	93	990	553	1,636	−59	74	35	50

NOTE: GVC workers are workers directly or indirectly involved in the production of manufacturing goods. Columns 3 through 6 indicate the total number of GVC workers by sector in 2008; columns 7 through 10 indicate the change in the number of GVC workers by sector between 1995 and 2008. The last column shows the change in the total number of workers in the economy for that period. Some numbers in the "All sectors" columns may be off by 1 because of rounding.

SOURCE: Authors' calculations based on World Input-Output Database, April 2012.

half of those jobs are found in agriculture and even more so in services—workers who are involved in the production of intermediate goods and services used in the manufacturing process. These findings testify to the increasing intertwining of manufacturing and service activities.

Following Baumol's cost disease hypothesis, one might argue that this shift in the sectoral distribution of the GVC jobs might be interpreted as the result of differential productivity growth in manufacturing and services. But while there is clear evidence that productivity growth in manufacturing is higher than in services overall, this does not necessarily hold for the service activities in GVCs of manufactures. These only form a subset of the services sector, and they involve in particular intermediate services such as wholesaling, transportation, finance, and several business services.[14] These activities are generally open for international competition and likely to have much higher rates of innovation and productivity growth than service activities for domestic demand, which are dominated by personal services, education, health, and public administration. Hence, it seems more likely that our findings are indicative of a fundamental shift in the type of activities carried out by advanced countries in the global production of manufactures—a shift away from blue-collar manufacturing to white-collar service activities. This hypothesis is confirmed when one analyzes the skill content of GVC jobs, as is done in the next subsection.

In the major emerging economies, most of the jobs are still added in the manufacturing sector, as is to be expected. For China, India, Mexico, and Turkey, job increases in manufacturing outnumber those in the services sector. In Brazil, however, services job growth appears to be more important. Even more strongly, in Indonesia and Russia the number of jobs in the production of manufactures has declined. These countries actually lost jobs overall for the period 1995–2008 and seem to have entered a premature deindustrialization phase.

Specialization in High-Skilled Activities in Advanced Countries

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

the comparative advantage of countries, as suggested by Baldwin and Evenett (2012). A simple example will illustrate. Assume two goods, A and B, which are both produced with two activities: a low-skilled (LS) and a high-skilled (HS) activity. Before unbundling, Goods A and B are bundles of production activities with different skill intensities. Assume that Good A is on average more skill-intensive than Good B, as the HS activity is more important in the production of A than of B. A relatively skill-abundant country would specialize in the production of A, and a skill-scarce country in the production of B. After unbundling, each nation specializes in specific production activities. The skill-abundant country will specialize in the HS activities in the production of both goods, and the skill-scarce country in the LS activities for those goods. As a result, the potential range of comparative advantages across countries in activities will be greater than in the final products (see, e.g., Deardorff [2001]).[15]

To test this prediction, we analyze the number of workers by skill type needed in GVCs of manufactures using Equation (5.1) in combination with a skill requirement vector. This vector is based on a characterization of workers in each industry and country by their observable educational attainment levels, as described in Section Three, "The World Input-Output Database (WIOD)." This delivers the number of low- (LS), medium- (MS) and high-skilled (HS) GVC workers for a particular year. Results are given in Table 5.8. We find that during 1995–2008, in all advanced countries combined, the increase in high-skilled jobs was 4.6 million. Medium-skilled jobs declined by nearly 3.8 million, and the drop in low-skilled jobs was even bigger—9.7 million. This pattern of high-skilled jobs growing faster (or declining slower) than medium- and low-skilled jobs can be found for most countries. But there are some regional differences. In the United States, employment in global production of manufactures dropped for all workers, in particular the medium-skilled. This is a well-known phenomenon that characterizes a broader segment of the U.S. economy and has been extensively studied (see, e.g., Autor [2010]). More surprising is the finding that the number of high-skilled jobs has also declined. This is in stark contrast to Japan and the major EU countries: There, less-skilled jobs also dwindled, but this was at least in part compensated for by increasing opportunities for high-skilled jobs.

Table 5.8 Change in Number of Workers in Global Production of Final Manufactures by Skill Type, 1995 and 2008 (in thousands)

Country	Low	Medium	High	Total
United States	−1,125	−3,286	−201	−4,612
Japan	−1,834	−1,399	361	−2,871
Germany	−168	115	614	561
France	−768	52	566	−151
United Kingdom	−1,236	−560	172	−1,624
Italy	−1,201	853	439	91
Spain	−507	391	556	440
Canada	−118	−105	177	−45
Australia	−84	141	94	150
South Korea	−1,110	−335	766	−679
Netherlands	−119	−54	202	29
Other 10 advanced	−1,441	425	840	−176
Total 21 advanced	−9,711	−3,762	4,587	−8,886
All other countries	56,214	64,370	19,393	139,977
World	46,503	60,607	23,981	131,091

NOTE: Figures represent changes in the number of workers (including both employees and self-employed) involved in global production of final manufactures between 1995 and 2008, split into the number of low-skilled, medium-skilled, and high-skilled workers based on educational attainment. Some numbers may be off by 1 because of rounding.

SOURCE: Authors' calculations based on World Input-Output Database, April 2012.

CONCLUSION

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

In this chapter, we take a macro perspective and analyze the value-added of production for a wide set of manufacturing product groups. This is done through a newly developed accounting method in which we build upon an input-output modeling of the world economy in the tradition of Leontief (1949). The novelty of our approach is that we trace the value added by all labor and capital that is directly and indirectly used for the production of final manufactures. We call this "GVC income." We also introduce the related concept of "GVC jobs," which connotes the number of jobs directly and indirectly needed in the production of final goods. To measure GVC incomes and jobs for a wide set of countries in the world, we use the global input-output tables and supplementary labor accounts from the World Input-Output Database, available at www.wiod.org and described in Timmer (2012).

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

Although the model to measure GVC income and jobs is relatively straightforward, it is clear that the validity of the findings relies heavily on the quality of the database used. The WIOD is a prototype database developed mainly to provide a proof-of-concept, and it is up to the sta-

tistical community to bring international input-output tables into the realm of official statistics. The development work done by the OECD (Ahmad, Chapter 6 of this volume) is certainly a step in the right direction. Various weak areas in data remain, particularly in the measurement of trade in services and intangibles. In addition, because of the lack of firm-level data matching national input-output tables, one currently has to rely on the assumption that all firms in an industry have a similar production structure. If various types of firms, in particular exporters, have a different production technology and input sourcing structure (i.e., they import larger shares), more detailed data might reveal a bias in the results presented here. More information on the ownership of capital income, which is currently measured on a domestic basis rather than on a national basis, is also desirable. This is far from easy, though, and in pursuing this line of investigation one needs to trace not only the nationality of the firms involved but also the nationality of the ultimate claimants of residual profits.

Arguably the most important area where more study is needed is in tracing where in the value chain the profits from lead firms are realized, as well as how these are recorded in the current statistical system. For example, the product case studies by Dedrick, Kraemer, and Linden (2010), among others, suggest that the profits made by the lead firms in the chains can only be inferred by comparing the final purchase and exfactory prices of the product, which include the trade margins (see also Gereffi 1999). The use of brand names, software, knowledge systems, and other intangibles of the lead firm by other firms in the chain is typically not compensated for by a direct money flow from the users. Rather, the compensation is realized indirectly through the ability of the lead firm to have the exclusive right to sell the particular product with a premium through its own (or through other tightly controlled) sales channels. This indirect compensation takes place in value chains that are completely within a multinational enterprise, but it also arises in chains that are to a large extent organized through arm's-length transactions. When the residual profits are realized—in other words, when manufacturing firms sell to final consumers—this is picked up in our GVC income measure. But alternative value-chain arrangements are feasible.

One particular example is the existence of so-called factoryless goods producers (FGPs), which are proliferating in the United States.

These are firms that are manufacturer-like in that they perform many of the tasks and activities found in manufacturing establishments themselves, except for the actual manufacturing production process. In the current U.S. statistical system they are classified in wholesaling, and their output is recorded as a wholesale margin rather than as manufacturing sales. The value-added of these firms should clearly be part of GVC incomes of manufactures but are currently not picked up, since GVC income is measured at basic prices, which means that trade and transport margins associated with final consumption are not included in GVC incomes. This might bias downwards the total GVC income for the United States compared to other countries to the extent that FGP production is more prominent in this country than in other countries. The scope for this bias is not particularly large, however. Bernard and Fort (2013) suggest that reclassifying the FGPs to the manufacturing sector would increase reported U.S. manufacturing output in 2007 by about 5 percent in a conservative estimate and by a maximum of 17 percent using a more liberal set of assumptions. A deeper understanding of the workings of global value chains is clearly needed before our measurement systems will adequately reflect all of their intricacies.

Notes

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1. Additional applications of the GVC income concept and analysis of fragmentation can be found in Timmer et al. (2014) and Los, Timmer, and de Vries (2014).
2. 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.
3. See Miller and Blair (2009) for an introduction to input-output analysis.
4. Throughout the paper, we analyze final expenditure, including private and government consumption, and investment.

5. Variations of this approach are also used in the burgeoning literature on trade in value-added, and our approach is related to the work by Koopman, Wang, and Wei (2014) and in particular the work by Johnson and Noguera (2012). But rather than using Leontief's insight to analyze factor content of trade flows, we focus on analyses of global value distributions.
6. Final use includes consumption by households, government and nonprofit organizations, and gross capital formation.
7. Because industries also have secondary production, a simple mapping of industries and products is not feasible.
8. When considering all goods and services produced, the GVC income of a country is equal to gross domestic product when final demand for all goods and services in the world economy are taken into account. Hence, for a meaningful analysis, one has to limit the group of products, and we focus on those products for which production processes are most fragmented and which can be analyzed with the data at hand.
9. 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 Three, "The World Input-Output Database [WIOD]"). Its share in global GVC income rose from 14 percent in 1995 to 17 percent in 2008.
10. The euro was introduced in 2001. For the period before 2001, we are referring to the Deutsche Mark.
11. Johnson and Noguera (2012) focused on foreign final demand for all goods and services, not only on final manufactures as we do here.
12. The share of the natural resource sector in Russia is severely underestimated, since part of the oil and gas production is classified under wholesale services rather than under mining in the Russian national accounts. Adding the wholesale sector would almost double the natural resource share in 2008.
13. We will use the term "jobs" instead of "number of workers" as shorthand. But the underlying data pertains to number of workers rather than jobs. Ideally, one would like to measure hours worked.
14. It should be noted that these numbers exclude any jobs involved in the retailing of manufacturing goods, as we analyze final demand at the basic price concept.
15. Following this traditional international trade theory, having a greater range of comparative advantages across countries would generate higher welfare improvements from trade. These models are essentially comparative, static of nature, and they disregard any dynamic effects. In the innovation and business literature, it has been recently argued that the separation of high-skilled, innovative activities in advanced countries from production in emerging economies will in the long run lead to a decline of innovation activity. In this literature, the spillovers from manufacturing and innovation activities are central (see, e.g., Pisano and Shih [2012]).

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Measuring Globalization

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Volume 2

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