Jan Hagemejer[1], Mahdi Ghodsi[2]

Up or Down the Value Chain? A Comparative Analysis of the GVC Position of the Economies of the New EU Member States[3]

1 University of Warsaw and Narodowy Bank Polski, corresponding author: j.hagemejer@uw.edu.pl.

2 Vienna Institute for International Economic Studies (wiiw).

Abstract: The pattern of trade of the Central and Eastern European countries has been changing since the beginning of the economic transition in the early 1990s. By the end of the century this process was additionally strengthened by their integration with the European Union and overlapped with the development of global value chains (GVC) spanning across Europe with which the new member states (NMS) have become increasingly integrated.

In this paper, we shed light on these changes by analysing the position of the NMS within the global value chains. We employ the upstreamness measure proposed by Antràs *et al.* (2012) and use the World Input–Output Database. Although we observe a global increasing trend in the upstreamness of all countries, we find that the NMS have in many cases gone against this trend while converging in their production structure within their group and with the EU-15. This convergence is mostly observed in Czech Republic, Hungary, Poland and Slovakia where the level of upstreamness in the most important exporting sectors was close to that of Germany by the end of the analysed period 1995−2011.

Keywords: global chain value, upstreamness, European Union, New Members States

JEL Codes: C67, F10, F15

1 Introduction and motivation

The ongoing trade liberalization and the resulting lowering of tariff and other trade barriers together with harmonization of regulations by international agreements and mega trade deals have facilitated flows of goods and services more than before. Decades of technological advances with the emerging role of information and telecommunication services and popularization of container shipping technology have lowered the traditional high transaction costs doing business (see eg. Hummels 2007). Substantially lower transport costs of trade have led to changes in the organization of production processes. Offshoring strategies, outsourcing activities and global horizontal and vertical fragmentation of production have created new interlinkages between economies through the global value chains (GVC).

While international relocation of production through FDI and licensing of production technology have been present in the economic history of many developing economies for a long time, they were mostly meant to substitute exports in the world of high trading barriers. In many cases, they involved assembly of complete final products for the purpose of the domestic market of the destination country. In fact, such undertakings existed in Central and Eastern Europe even before the democratic revolution of 1989, for example during Poland's attempted industrial modernization of the 1970s. However, the so-called second unbundling (see Baldwin 2013) that involved geographically separating the manufacturing stages has led to increased imports and exports of components and truly integrated the developing countries in the production networks. This has facilitated the industrialization of developing countries where low wages brought about large cost savings from production reallocation. Instead of investing in an integrated production facility, such countries have been able to participate in advanced production processes by specializing in stages where they had a potential comparative advantage, i.e. certain skill structure combined with attractive wage level. GVCs have lead to some de-industrialization in the advanced economies.

The new member states (NMS hereafter) of the European Union have played a special role in the process, as they were relatively industrialized in early 1990s and maintained relatively low wages as compared to the countries in western Europe. By 1995 the privatization and structural change was already advanced and many of the former state-owned enterprises restructured and regained some of their productive capacity, many of them through foreign direct investment. As Fig. 1 shows, in late 1990s, production of primary goods including agricultural products and mining has been gradually losing its importance in the economy of the NMS. Small private businesses were being established in great numbers, mainly in the underdeveloped service sector, which grew in importance since then. Manufacturing has remained important throughout the analysed period from 1995 to 2011, as it played a large role in the centrally planned economies and thanks to proximity to the West European markets (both in terms of physical and cultural distance) and large and growing domestic markets, rapidly attracted foreign investment.

Opening up to the West and integration with the European Union led to a change in trade relations of the NMS with the other former Soviet Union countries
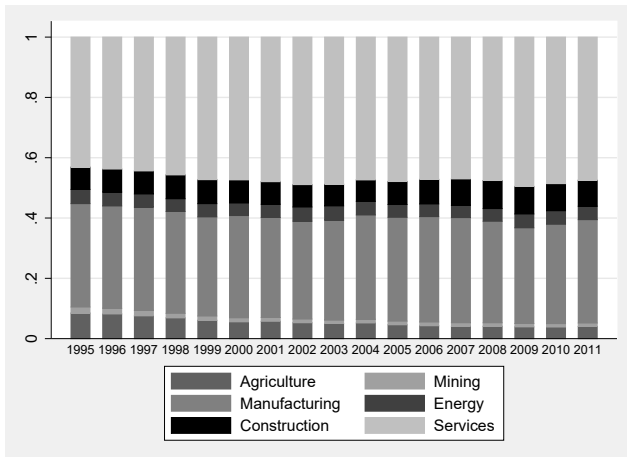
Fig. 1. NMS output shares.
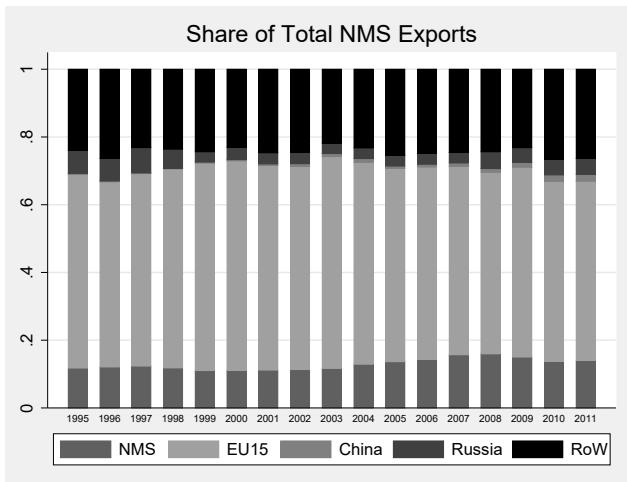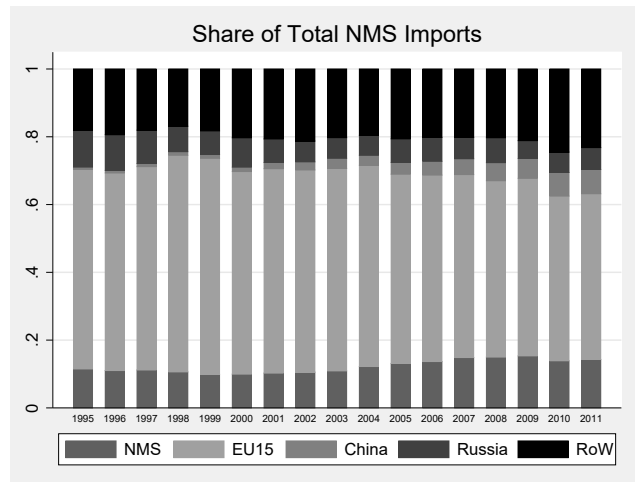
Source: Authors' own calculations using WIOD data.

Fig. 2. Import/export and output.

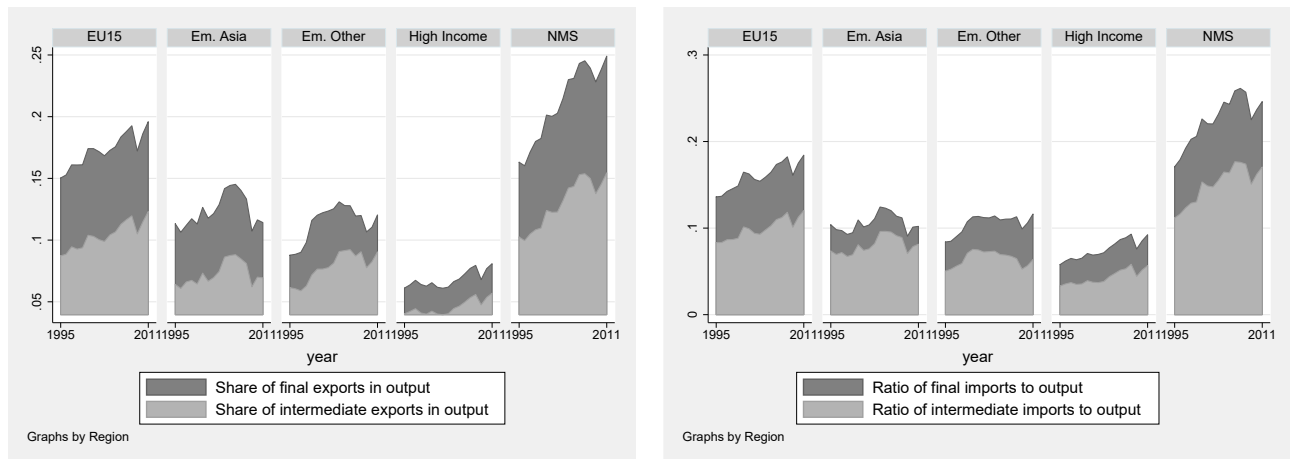Source: Authors' own calculations using WIOD data.

ness following the EU-induced restructuring and inclusion in the pan-EU production processes. Last but not least, one can observe a gradual increase of trade with China, mainly on the part of imports rather than exports.

The opening up of the NMS economies has brought a steady growth of the share of exports and imports to output (Fig. 3). However, the growth of exports of intermediate goods in the NMS was roughly at the same level as the growth of final goods exports was (left panel in Fig. 4). On the other hand, the growth rate of imports of intermediate goods was larger than the growth rate of final goods imports (right panel in Fig. 4). One can observe that most of the increase in imports since 1995 was due to the increase of intermediates imports, evidence of a growing dependence of production and exports of components. Involvement in the GVCs trans-

(USSR), and Russia in particular. The change in the geographical composition of the NMS' international trade is visible in Fig. 2. The late 1990s brought a decline of trade to Russia and the rest of the world (due mainly to a decrease in trade with other former USSR states) and an increase in the trade share with the EU-15. The 2004 and 2007 waves of EU accession have not caused step-wise increase in the trade share of the EU-15 in the total NMS exports and imports. As most of trade of the NMS with the EU was already liberalized in early 2000s and trade has been growing since mid-1990s. As several (parts of) production processes were relocated to the NMS from the EU-15 in the 2000s, EU accession has visibly intensified trade within the NMS group. Moreover, post-accession NMS exports to Russia increased after 2007, which can be seen as the effect of the NMS gaining competitive-

lates to a growing share of intermediate goods in imports of the NMS and a roughly stable share of intermediate goods in exports.[1] It means that the NMS have remained an important source of intermediate goods over the analysed period with more than 60% of intermediate share in exports (left panel in Fig. 4). At the same time their production structure might have moved closer to the final demand in relative terms, as they have imported increasingly intermediate goods that they had either not needed or they had produced it domestically before.

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1 A slight drop in the share of intermediates in exports and imports that was due to the great trade collapse that led to breaking of some of the GVC linkages, see, for example, Amador *et al.* (2013) and Altomonte *et al.* (2012).

Fig. 3. Import/exports and output.
Source: Authors' own calculations using WIOD data.
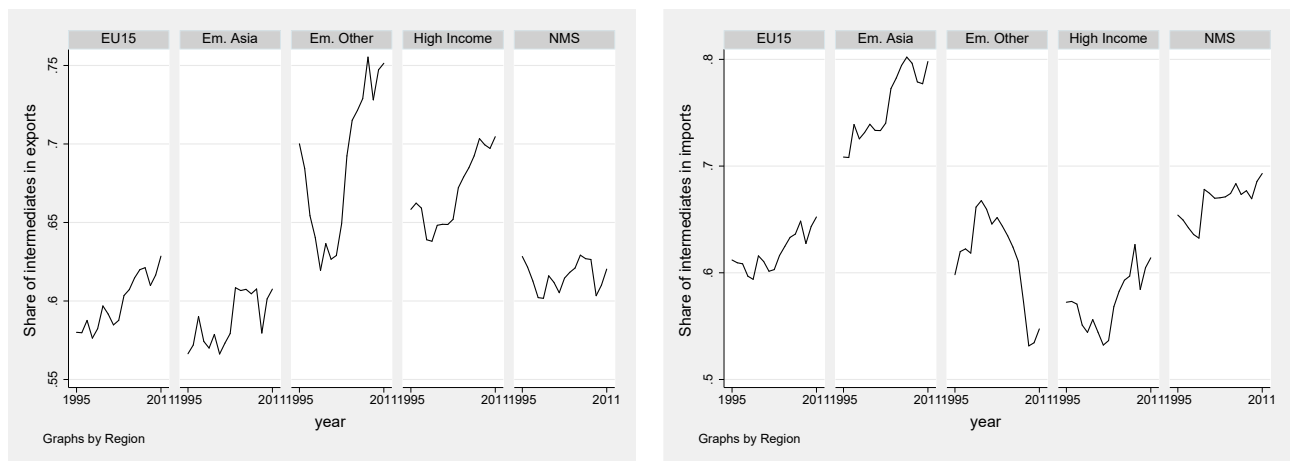
Fig. 4. Share of intermediates in exports and imports.
Source: Authors' own calculations using WIOD data.

However, the share of intermediate goods in trade is not an accurate measure of a country position in the production chain. Instead, this paper uses the upstreamness measure developed by Antràs *et al.* (2012) to provide stylized facts on the ongoing structural change of the new EU member states economies and the changes in the position of those economies in the GVC. By analysing the absolute and relative measures of upstreamness, we are able to compare the processes going on in the economies of the NMS to other groups of countries. We use the World Input-Output Database[2] to compute the measures for all the economies under consideration. While this paper is purely descriptive, it may serve as a motivation for exploring some of the regularities found in a

more rigorous matter. The organization of the rest of the paper is as follows. The second section briefly reviews the literature on GVC and describes the upstreamness measure developed within the existing literature. The third section describes the overall upstreamness of the NMS while the fourth section provides a more detailed, sectoral country-level analysis. Section 5 concludes with a short summary of findings.

2 The upstreamness in GVC

In order to define the concept of upstreamness of production one can go back at least half a century to the concepts of Sraffa (1960) who elaborated on **theory of value** in his book *Production of Commodities by Means of Commodities* or to the basics of input–output economics

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2 A comprehensive description of the WIOD database is provided by Timmer *et al.* (2012).

as laid out by Leontief 1960. Sequentiality of production has been introduced by Hopkins and Wallerstein (1977) in the form of **commodity chains**. **Sequences** of inputs used in production of goods that reach the final consumer included raw materials, intermediates, services, transportation or even food consumed by the labour force. Later on, Gereffi (1994) established a study framework on global commodity chains (GCC) in a meso or micro perspective, which changed the concept from a holistic world system dealing with international division of labour to commodity chains connecting a more complex web of productive activities. Industrial organization and structural governance along various stages of operations were discussed in international business literature by various studies either in the GCC framework or a similar concept of the GVC, which was introduced by Porter (1985).

In a more recent strand of the literature, Dietznebacher *et al.* (2013) and Timmer *et al.* (2012) emphasized the importance of GVC by constructing the international input output tables. Their World Input–Output Database (WIOD) covers 35 sectors across 40 countries. This database distinguished between the intermediate and final use, in addition to gross fixed capital formation and government consumption. Using this data, Timmer *et al.* (2014) find that the increasing fragmentation of production in the global economy lead to a higher share of capital and high-skill labour in value added during the past two decades. While value-added share in advanced economies stayed relatively constant, this share has more than doubled in other parts of the world indicating the benefits of being involved in the GVC. This could be translated into the new concepts of gains from trade in value added. Parallel research on international input output tables and various GVC measures has been undertaken by the Organisation for Economic Co-operation and Development (OECD) and materialized in the form of the TiVA (Trade in Value Added) database.

Johnson and Noguera (2012) argue that plummeting trade costs related to distance or transit time could enhance the integration and fragmentation of production. While their measures (and other measures by Koopman *et al.* 2010; Wang, Wei and Zhu 2013) allow for tracing of value added in the GVC, they are focused on GVC participation and not the sequentiality of production. The value-added share in total exports of a country that is used as intermediate inputs in the production of value added exported by all other countries is used as a proxy for the distance from final demand.

Instead, Dietzenbacher and Romero (2007) propose a measure of the average propagation length, which is the number of production stages an industry can propagate and affect other industries. Building on this framework, Fally (2011) and Antràs *et al.* (2012) establish a methodology to calculate the measure of upstreamness as the distance (number of stages of production) within supply chains to the ultimate consumable item. This framework was then amended by Chor, Manova and Yu (2014) and Miller and Temurshoev (2015) in order to correct for open-economy and net-inventories adjustments within the GVC and to make use of the new sources of data available (the WIOD). De Backer and Miroudot (2013) show that the domestic average length of propagation stays stable during time while the international length increases since 1995. Fally (2011) shows that production of goods on average has been growing since early 2000 as the number of production stages within the GVC increased. In this study, we use the upstreamness measure computed for the global economy at the country-sector level using the WIOD data.

2.1 Open-economy upstreamness

We follow the definition of output upstreamness proposed by Antràs *et al.* (2012) for a closed economy and then applied to the global economy by Chor, Manova and Yu (2014) and Miller and Temurshoev (2015). This measure indicates the intensity of the different stages of intermediate use of a sector in the production of other sectors before it reaches the final user (consumption by households, government and investors). When a product is upstream, it means that it is used at the beginning of the production line. For example, it can be used in the production of another product, which is again used in the production of some other products. Such a good will reach the final use in two stages. When good's production is observed at sector level, this picture may become slightly more complicated. Products coming from a particular sector can potentially be used in various stages of production of many other sectors and they can also be used as final products. Therefore to synthetically measure the upstreamness of a good, one has to take into account all the various production stages that those products take part in.

Starting from the framework by Antràs *et al.* (2012), let us consider a closed economy with N industries. In each industry $i \in \{1, 2, \ldots, N\}$ the value of gross output (Y_i) should be equal to its final use (X_i) plus its interme-

diate use as input in other industries (Z_i). Considering z_{ij} being the input–output coefficient of sector i's as an intermediate input of industry j's, the total intermediate sale of sector i is $Z_i = \sum_{j=1}^{N} z_{ij}Y_j$. Since any industry j might be also used as an intermediate input in any other industry, by iterating the output identity of each sector $Y_i = X_i + \sum_{j=1}^{N} z_{ij}Y_j$ into intermediate input of any other sector, we can express the output of sector i as follows:

$$
Y_i = X_i + \sum_{j=1}^{N} z_{ij}X_j + \sum_{j=1}^{N}\sum_{k=1}^{N} z_{ij}z_{jk}X_j \\
+ \sum_{j=k}^{N}\sum_{k=1}^{N}\sum_{l=1}^{N} z_{ij}z_{jk}z_{kl}X_j + \cdots
\tag{1}
$$

The subsequent terms on the right-hand side of Equation (1) correspond to stages of production. Numbering the stages by natural numbers, the first term is a direct final use of output of industry i and the distance from final demand will be set to 1 (stage). By that logic, second term has the distance equal to two (stages), third term has a distance equal to 3, and so on. After multiplying each term in Equation (1) by their distances from the final good use of industry i to the final demand (X_i), and then dividing by gross output (Y_i), one obtains the following measure of distance of industry i from the final demand:

$$
u_i = 1 \cdot \frac{X_i}{Y_i} + 2 \cdot \frac{\sum_{j=1}^{N} z_{ij}X_j}{Y_i} + 3 \cdot \frac{\sum_{j=1}^{N}\sum_{k=1}^{N} z_{ij}z_{jk}X_j}{Y_i} \\
+ 4 \cdot \frac{\sum_{j=1}^{N}\sum_{k=1}^{N}\sum_{l=1}^{N} z_{ij}z_{jk}z_{kl}X_j}{Y_i} + \cdots
\tag{2}
$$

According to Equation (2) $u_i \geq 1$. If a good is purely produced for final use, $u_i = 1$, otherwise u_i will increase with the number of production stages where the product is used. Since the number of sectors is finite (N) and assuming that $z_{ij} < 1$, one needs to compute an infinite power series in Equation (2) in order to compute u_i. As shown by Fally (2011), $u_i = 1 + \sum_{j=1}^{n} \delta_{ij}u_j$ meaning that when industry i is selling part of its output to an upstream industry j, then sector i itself should be relatively upstream itself, where $\delta_{ij} = \frac{z_{ij}Y_j}{Y_i}$ is the output share of sector i being purchased and used in the production of sector j. Accordingly we can calculate the upstreamness of each sector in the closed economy as follows:

$$
U = [I - \Delta]^{-1} \mathbf{1}
\tag{3}
$$

where U is a $N \times 1$ matrix compromising upstreamness of each sector, Δ is a $N \times N$ matrix whose (i, j)-th element is $\delta_{ij} = \frac{z_{ij}Y_j}{Y_i}$, and $\mathbf{1}$ is a column vector of ones.

While this measure is correct for a closed economy, one needs to account for imports and exports. This is the required approach when using country-specific input–output tables. However, when global input–output tables are available, one can treat the world as one closed economy (see Chor, Manova and Yu 2014; Miller and Temurshoev 2015). This approach has two major advantages: (1) one does not have to make simplifying assumptions about the production structure of imports and exports (as discussed by Antràs *et al.* 2012) and (2) such a measure shows the distance from global final demand instead of domestic final demand.

We use the World Input–Output Database (WIOD) sectoral aggregation for all the periods from 1995 to 2011. We consider the whole world as a closed economy encompassing 41 regions and 35 sectors. Forty-one regions include the European Union and the OECD members and the rest of the world (RoW). Thirty-five industries are based on the CPA and NACE rev. 1 (ISIC rev. 2) classifications. For each year, we obtain (41 × 35 = 1435) distinct values of u_i where i spans across all sectors and countries. In order to produce country-level aggregates of upstreamness, we weight the observations either by their shares in output (output upstreamness) or shares in the relevant flow of international trade (export or import upstreamness). We also show relative upstreamness measures that are normalized by the world average upstreamness to account for global trends and find the movements along the value chain.

2.2 Upstreamness of world production

Fig. 5 shows the development of upstreamness globally in addition to the share of major sectors in global output. In the top panel, one can observe that the upstreamness in both output and exports have increased during the analysed period. This increase clearly accelerated in 2002 after the accession of China to the World Trade Organization (WTO). In fact, China's liberalization in trade and its attraction of FDI facilitated the offshoring and outsourcing activities to China, which consequently led to the larger fragmentation of production via excessive trade flows globally. Production of iPod and iPhone is the most relevant example of this global fragmentation, which is reflected by upstream designing activities in the United States, middle-stream assembly lines in China, and downstream marketing activities in all geographical locations.
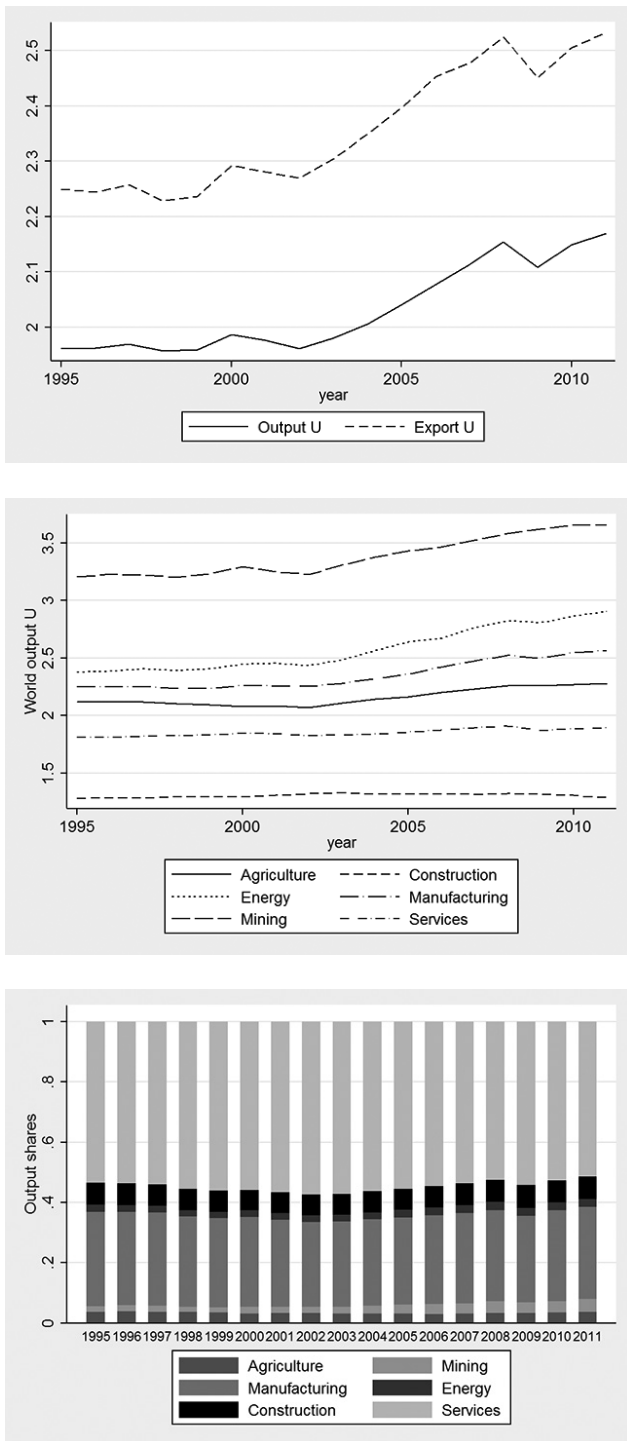
Fig. 5. Global vs sector-level upstreamness (U).
Source: Authors' own calculations using WIOD data.

The middle panel of Fig. 5 shows that in many sectors, especially in manufacturing, the level of upstreamness has increased over time. Construction sector has the lowest and stable level of upstreamness. As depicted in the bottom panel of Fig. 5, while con-

struction covers a larger share of output than energy, mining, and agriculture sectors do, its non-tradability makes it a very downstream sector. In fact, construction is usually a local service activity that is very close to the domestic final demand. The services sector has the largest share in the global output and is the second most downstream sector. Services provision tends to be not fragmented. However due to an increase in the use of services in manufacturing ('servicification' of manufacturing), on average they also moved further away from final demand.

The increase of upstreamness in mining and energy as the two most upstream sectors seems to be mostly due to an increased use of fuels and energy in the manufacturing and services (a shift of shares from final demand use). Last but not least, one can also observe an increase in upstreamness of the third most upstream sector, manufacturing, which is due to the increasing fragmentation of production. The upstreamness indicators are in line with the broad intuition of distances from the final demand. The sectors closely related to natural resources and relatively 'raw' products such as mining, metal and chemical industry are upstream in the ranking of industries and so is the water transport that is mostly in the wholesale use. Services (especially health and social services, education, but also real estate, hotels and restaurants etc.) and construction are in general downstream. Retail trade sector is more downstream than the wholesale trade is. Manufacturing sectors have medium upstreamness, but there are large differences between sectors. Final consumption goods such as the food industry are relatively less upstream than the investment goods such as the machinery and equipment are.

3 Upstreamness of the New Member States

The evolution of upstreamness for the five analyded country groups are presented in Fig. 6.[3] The region-level aggregates are output-weighted. One striking outlier is the group of the emerging Asian countries where the most upstream production is relocated. This is true both from the point of view of the economy as a whole (all sectors) as well as the manufacturing alone and such a division of tasks could be observed already in 1995. In

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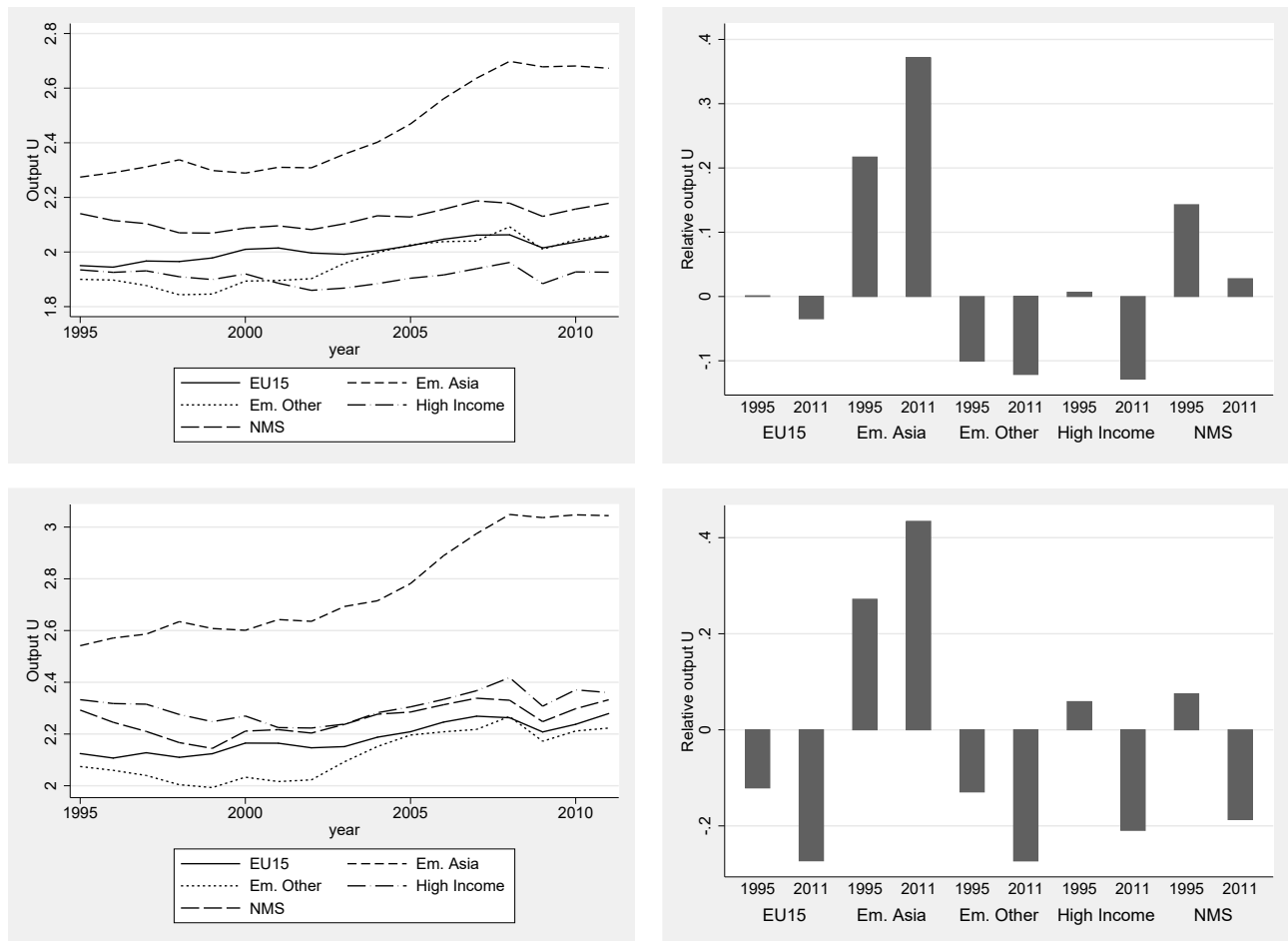**3** For countries in each group refer to Table D in the Appendix.

Fig. 6. Overall upstreamness (top) vs upstreamness of manufacturing (bottom). Note: Right hand-side figures show average diffe-rences between world and country level of upstreamness calculated for individual sectors.
Source: Authors' own calculations using WIOD data.

the NMS, there is a period of decreasing upstreamness before 1999 and after that the trend of upstreamness is similar to the one of the EU-15, although at a conside-rably higher upstreamness level. The difference in levels is partially due to the difference of the sectoral structure of the EU-15 and the NMS economies. While the NMS have had an increasing share of services in output, this share has remained below that of the EU-15. The changes relative to the world's average upstreamness (right hand-side figures) show that while in the EU-15 the change over the years was rather minimal and upstre-amness has been close to the world average, the NMS have largely converged to that average as well.[4] Other emerging economies and the remaining high income

countries have shifted much closer to the final demand over the analysed period.

In order to control for this broad structural differ-ence in the share of manufacturing and services in gener-ating output, we focus on manufacturing. This compar-ison even leads to a more polarized picture of world's production. First of all, as far as manufacturing output is concerned, since 1995 all but one of the analysed country groups have shifted towards the final demand in relative terms (while slightly more upstream due to the common upwards upstreamness trend). At the same time the emerging Asian countries have become more upstream according to both measures. Another important conclu-sion is that when such broad regions are concerned in 2011, the differences between all the regions except Asia diminished over time showing a clear division of tasks between emerging Asia and the rest of the world.

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4 Due to relative measures being calculated at the sector rather than aggregate measure, the differences and the ordering of regions on the right hand-side and the left-hand-side figures may not be the same.
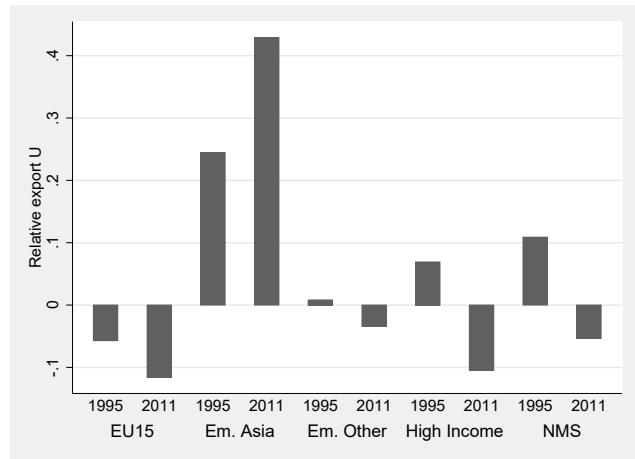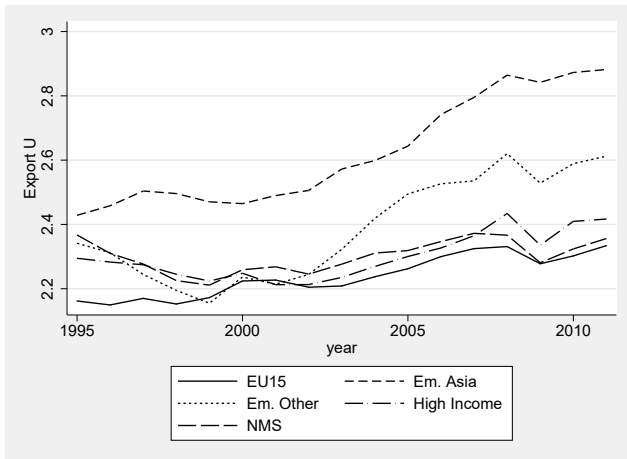
Fig. 7. Overall upstreamness of exports. Note: Right-hand side figure shows average differences between world and country level of upstreamness calculated for individual sectors.
Source: Authors' own calculations using WIOD data.

Comparing upstreamness of manufacturing may be slightly misleading. The relatively more closed countries would naturally be more downstream due to the overall importance of domestic demand. Moreover, large countries are generally less open than small countries. Therefore, some of the previous results may in fact be due to size differences in the country composition of the analysed aggregates. In order to overcome this problem, we measure upstreamness of exports and imports by aggregating the sector-country upstreamness using the exports or imports weights. Similar trends to the ones observed for output-weighted measures can be observed in the case of imports and exports. However, there are some visible changes in the levels of upstreamness (Fig. 7). Comparing to Fig. 6 after 2002 exports upstreamness of other emerging economies turns out to be much higher than in other country groups, making them the second most upstream country group in the comparison.

As far as export-weighted upstreamness is concerned, the NMS and the EU-15 have converged over time (left panel of Fig. 7). While the EU-15 was initially the most downstream, by early 2000s the differences between the two country groups are rather mild. In particular, the levels of upstreamness in the EU-15 and the NMS are roughly the same by the end of the analysed period. When distance from the final demand is related to the world's average, the NMS are still slightly more upstream than both the EU-15 and the remaining high-income countries.

The analysis of the bilateral trade within and across the five analysed country groups provides a decomposition of the above effects (Fig. 8). First of all, intra-NMS trade has become increasingly downstream from the

beginning of the period (top-left panel of Fig. 8). This suggests that the structure of trade among the NMS has shifted to the final products closer to the ultimate final user. At the same time, exports to the NMS from all other economies have become upstream. For other emerging economies, the fastest growing upstreamness of exports to the NMS is mostly due to the higher trade in natural resources from the countries of the former USSR and mainly Russia. Overall, the top-left panel of Fig. 8 suggests that the NMS have been importing increasingly upstream products from other emerging economies while the NMS themselves have been moving downstream relative to the world average.

Top-right panel of Fig. 8 shows the geographical decomposition of upstreamness imports to the EU-15. Imports to the EU-15 have become more upstream since the beginning of the century. This also suggests that the imported intermediate products are used in relatively more stages of production in the EU-15. Again, the two top panels show that upstreamness of trade between the NMS and the EU-15 has converged to a similar level by 2009−2010.

In all three bottom panels of Fig. 8, upstreamness of exports from the NMS and from the EU-15 to other three economic groups is subject to similar and small fluctuations. It is indicating signs of economic and structural convergence across the whole EU. Emerging Asian economies have the highest upstreamness of exports to the three economic groups, which is increasing over time. At the same time emerging Asian economies' imports from both the EU-15 and the NMS are relatively downstream. This shows a clear division of tasks: the upstream goods at the beginning stages of production are manufactured and
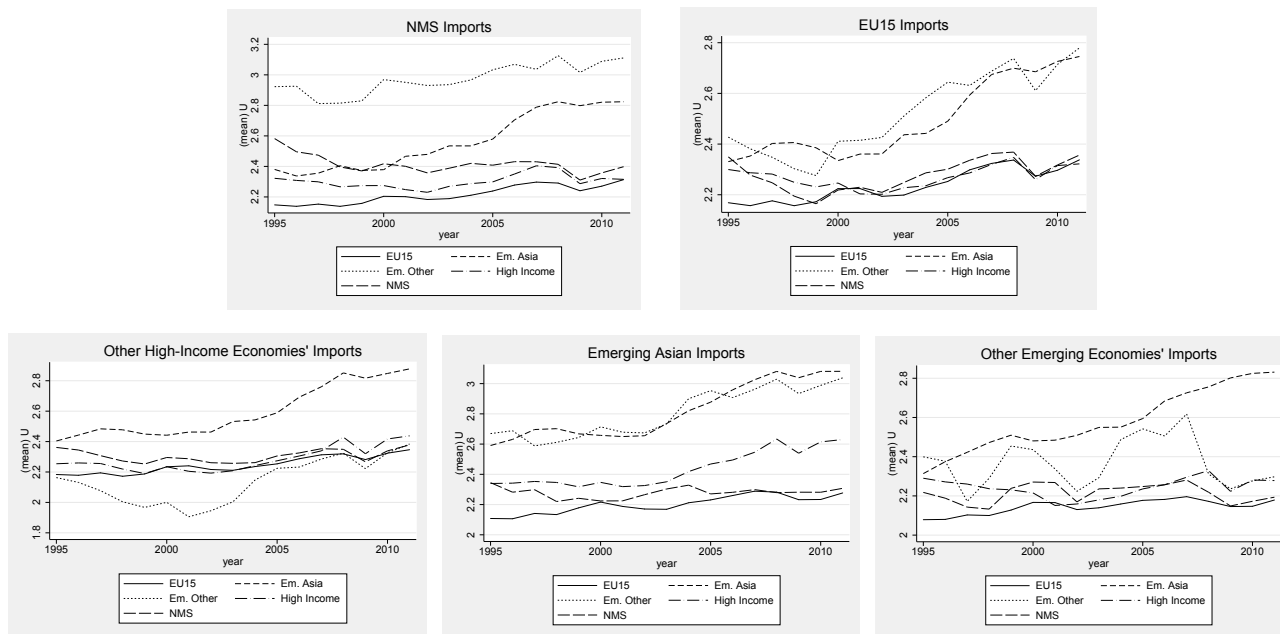
Fig. 8. Upstreamness of imports by source.
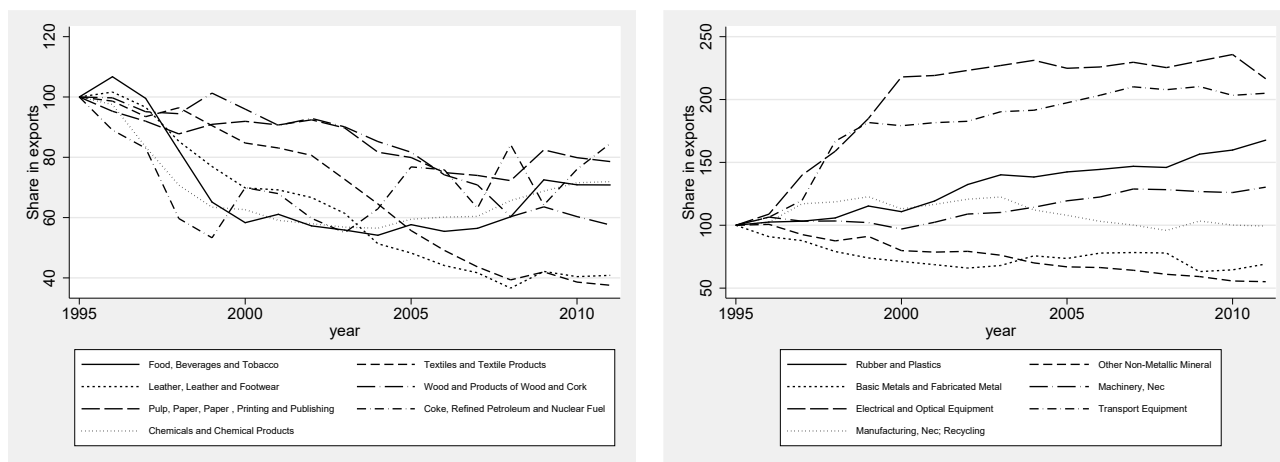Source: Authors' own calculations using WIOD data.

Fig. 9. NMS exports. Note: Export is relative in total manufacturing exports and normalized to 100 in 1995.
Source: Authors' own calculations using WIOD data.

traded in the emerging Asia, while the downstream stages take place in the EU. Those manufactures in part return to the emerging countries in the form of final goods.

4 Sectoral and country-level analysis

In order to identify the most important sectors in the NMS, we analyse the structure of manufacturing exports and output of the NMS over time. Over 50% of manu-

facturing output of the NMS is supplied by only four industries. They are 'Food, Beverages and Tobacco' with over 15%, 'Transport Equipment' with 14%, 'Basic and Fabricated Metals' with over 13% and 'Electrical and Optical Equipment' with about 12% of total manufacturing output. With the exceptions of the food sector, which is mostly targeted at final and domestic use, the above sectors are also highly export-oriented. In fact, the three largest sectors cover 49.7% of total manufacturing exports from the NMS. Other notable export sectors include chemicals and the machinery production, where the share in overall manufacturing exports
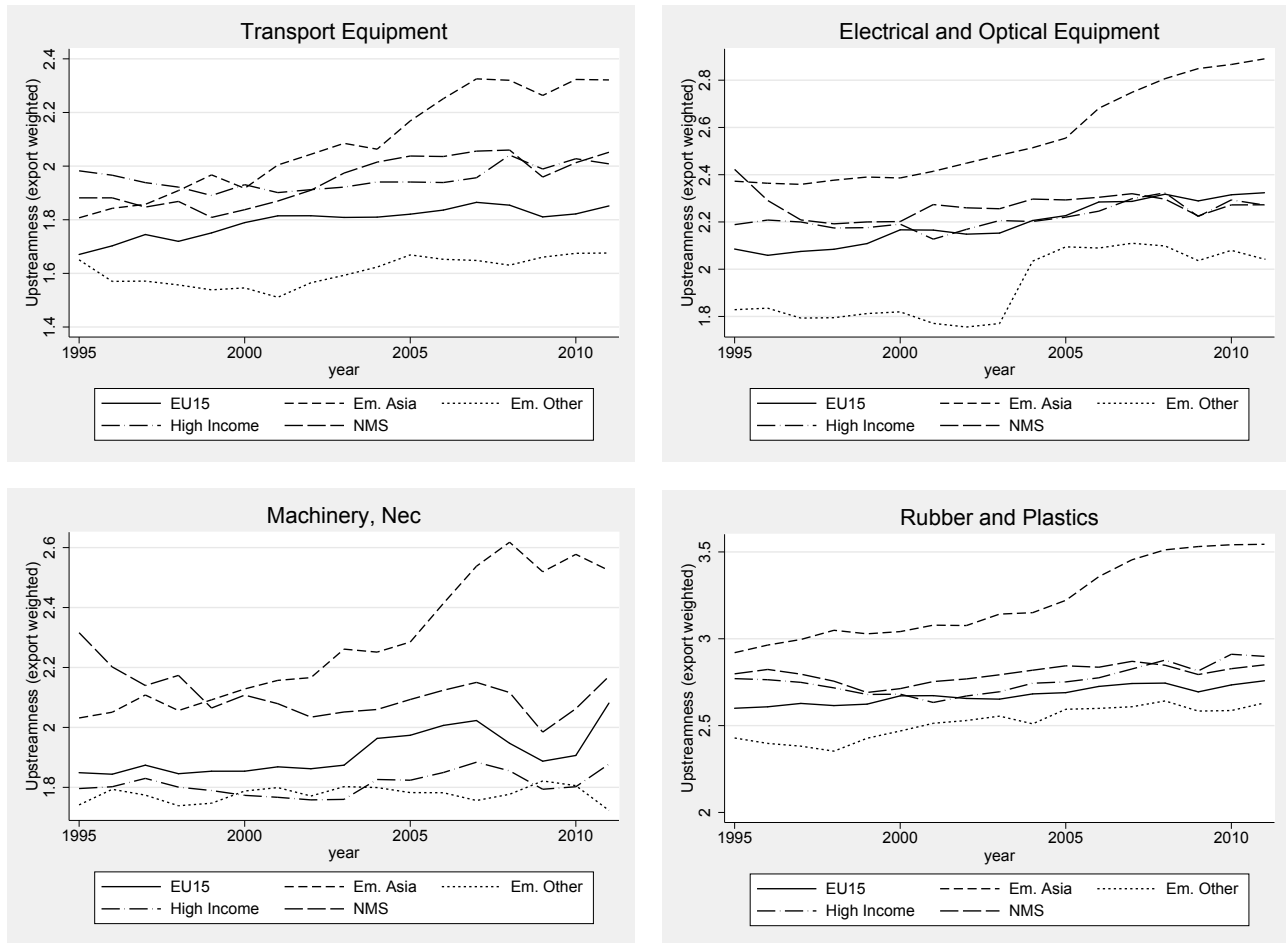
Fig. 10. Sectoral upstreamness.
Source: Authors' own calculations using WIOD data.

largely exceeds the respective share in the manufacturing output.

Fig. 9 shows the evolution of sectoral exports relative to total manufacturing exports (normalized to 100 in 1995, the corresponding figures for output are shown in Fig. A in the Appendix).[5] Just a few sectors have gained on importance in exports. The two sectors standing out are the high-tech sector of electrical equipment and medium high-tech sector of transport equipment, where the shares of exports more than doubled since the beginning of the period. Large foreign direct investment and inflows of multinational enterprises to these sectors in the NMS are the most relevant reasons for a relative increase in exports. The only two other sectors where exports grew over time are 'Machinery, nec' and 'Rubber and Plastics'. These results indicate that the

NMS substantially gained competitiveness in the production and exports of these four manufacturing during the period. The importance of manufacturing nec. had also increased until 2007, but decreased to a level slightly below 1995 at the end of the period.

How is upstream the most important NMS export sectors? We consider the four large sectors with substantial growth in exports. They include 'Electrical and Optical Equipment', 'Transport Equipment', 'Rubber and Plastics' and 'Machinery, nec'. In Fig. 10, we show the evolution of exports upstreamness of these sectors by five country groups. Both levels of upstreamness and the evolution of upstreamness over time differ substantially across the country groups.

The initial differences in the levels of upstreamness of exports of transport equipment across country groups was relatively low. Production of motor vehicles has gradually become fragmented, i.e. many stages of production have been located in different countries. Pro-

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5 Table C in the Appendix also shows the NMS exports and output shares in 2011.

duction of intermediate inputs of transport equipment increasingly relocated towards the emerging Asian countries, while the intermediate levels of processing such as composite car parts or car engines ended up in either the NMS or the high-income countries outside of the EU. The advanced final stages of production are located in the EU-15 while the remaining emerging economies remain concentrated on either assembly line or production of transport vehicles that is not highly integrated in the GVCs.

The evolution of upstreamness in electrical and optical equipment and rubber and plastic also followed a similar pattern. However, the differences between the EU-15, other high-income countries and the NMS were small even in the beginning of the period and the gap has further narrowed by the end of the sample. The differences between the country groups are more pronounced in the machinery production. The NMS was initially the most upstream in this sector. While emerging Asian economies have become increasingly upstream in this sector, the NMS became more downstream over time. Upstreamness convergence between the NMS and the EU-15 by the end of the period indicates that the structural changes in manufactures within the EU shifted the stages of production of the NMS to a similar level as of the EU-15.

Further analysis of the sectoral division of tasks is performed at the country/sector level. Fig. 11 shows the level of upstreamness of the world's most important 20 economies in a given sector (according to the share of world output, left panels) and the NMS economies (right panels). The horizontal axis shows the level of upstreamness of a given sector in 1995 while the vertical axis shows the upstreamness in 2011. The size of the bubble is proportional to the share of world output of a particular country/sector in world output in that sector (the size of the bubbles on the left and right panels is not comparable). The fitted line shows the overall relationship between upstreamness in that sector in 1995 and 2011 (regression is weighted by the output of the sector to account for different sizes of the sector in different countries). If a country is located below the fitted line, it means that it has moved considerably more downstream in that particular sector between 1995 and 2011 than would stem from the average change in world upstreamness and if a country is located above the fitted line, it indicates a move upstream.

In the transport equipment industry, the division of tasks in the world economy seems to be straightforward. The bulk of final and downstream intermediate production is located in major industrialized economies, including the large producers such as the USA, France and Germany as well as Canada, Spain, Mexico and Brazil. The most upstream countries in that sector include Japan and China providing upstream intermediate inputs. Changes over time are mild, most notable shifts are Korea moving strongly upstream and USA moving visibly downstream. More apparent changes can be seen within the group of the NMS economies. There, the largest transport equipment producers (Poland, Slovakia, Hungary and Czech Republic) have converged over time to the level of upstreamness slightly higher than that of Germany, from relatively distant positions in 1995 (in particular Poland has become significantly upstream). On the other hand, Romania stands out as an economy that had shifted downstream that involved in setting up a complete production process of motor vehicles. It is also worth noting that both Poland and the Czech Republic are among the top 20 world economies in the production of transport equipment.

A similar pattern of production fragmentation can be seen in the electrical and optical equipment sector where the Asian economies (China, Taiwan, Korea and Japan) provide intermediate inputs while more downstream stages of production take place in the rest of the world. The NMS have largely converged over time and their position in 2011 was roughly in line with that of Germany. Most of the analysed NMS economies have moved downstream over time. In the machinery sector in 2011, China, Korea, Thailand (and Finland) supplied the bulk of upstream intermediate inputs. The downstream intermediate inputs where mostly supplied by the advanced economies (including some EU-15 countries and the largest NMS). In Czech Republic, Poland, Slovakia and Slovenia, the upstreamness was at the similar level as in Germany. However, Hungary was considerably more upstream while Romania the most downstream. There has also been a considerable degree of convergence of usptreamness of the NMS over time.

5 Conclusions

In this paper, we studied the structural changes of the new member states of the European Union related to their integration with the global value chains. After transition of the NMS in 1990s from centralized to market economies, the liberalization of NMS trade relations has continuously changed the pattern of productions within these countries. Structural changes have accompanied
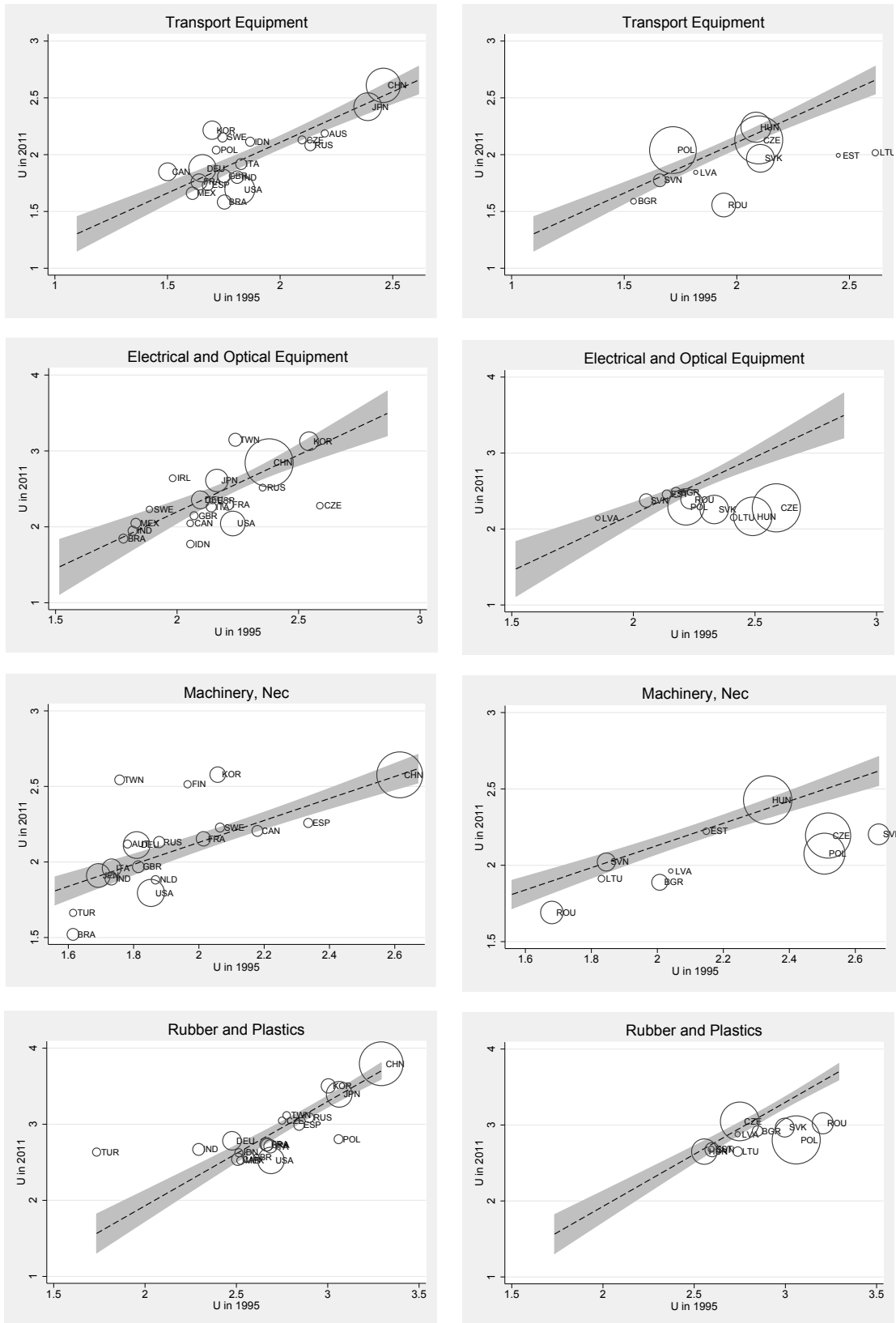
Fig. 11. Upstreamness (U) in 1995 and 2011. Note: Left panel: Top 20 economies according to output on a given sector. Right panel: NMS. Size of the bubble proportional to country output in a given sector. Bubbles not to scale across figures. Fitted line weighted by sector/country output. Source: Authors' own calculation using WIOD data.

the process of the Central and Eastern European countries integrating with the EU during the first decade of the 21st century. The export share of natural resource-based sectors has diminished while at the same time the manufacturing industry became highly integrated in the GVC, partially thanks to the increasing presence of multi-national corporations and foreign direct investment.

In order to assess the position of NMS countries in the GVC, we employed the upstreamness measure of industry production using a comprehensive World Input–Output table. We have shown that since 1995, the intermediates share of imports to the NMS has grown fast. Moreover, the share of intermediates exports from the NMS has remained at a higher level than a corresponding share of the EU-15. Exporting intermediate goods was an important economic activity of the NMS even relatively early in the transition period but the interlinkages with the other countries through imports of intermediate goods grew even stronger over time as world production has become increasingly fragmented. This process manifests itself in the upward trend of upstreamness across analysed country groups.

We have confirmed the previous findings in the literature that show the increasing degree of outsourcing and relocation of parts and component production to the Asian economies. Our measures have shown, both on aggregate and within the analysed sectors, that Asian countries have been visibly more upstream than others. On the other end of the production line, some other emerging economies, including the Latin American countries but also to some extent Romania, have focused on final assembly of products. At the same time, the bulk of the advanced countries (including most of the EU-15 countries) are specializing in the production of downstream intermediate products (which may include both final assembly and production of some of the advanced parts and components of the final product).

We have shown that the NMS economies have structurally changed over time. The upstreamness of exports have converged to that of the EU-15 over time and by the end of the analysed period in 2011, the level of upstreamness was close to that of the EU-15. While the world production has become increasingly fragmented and on average more upstream, the NMS economies have moved against this trend to become relatively closer to the final consumer. This also involved a reduction in the share of resources in exports and increasing share of advanced intermediate products of manufacturing.

Major manufacturing producers in the NMS group, Czech Republic, Hungary, Poland, Slovakia and Slovenia, have largely converged over time as far as their production structure is concerned. This process is visible in the four large and growing export-oriented sectors that we analyse in detail. These include 'Transport Equipment', 'Optical and Electrical Equipment', 'Rubber and Plastic' and 'Other Machinery' sectors. We show that in most of the analysed cases, upstreamness of these four countries was at a similar level by the end of the analysed period. Moreover, the position of those sectors was found to be also either similar or slightly more upstream than Germany, the largest manufacturing producer in Europe. On the other hand, Romania and Bulgaria, while supplying a high share of output in the analysed sectors, are visibly more downstream due to specializing in the assembly of final products.

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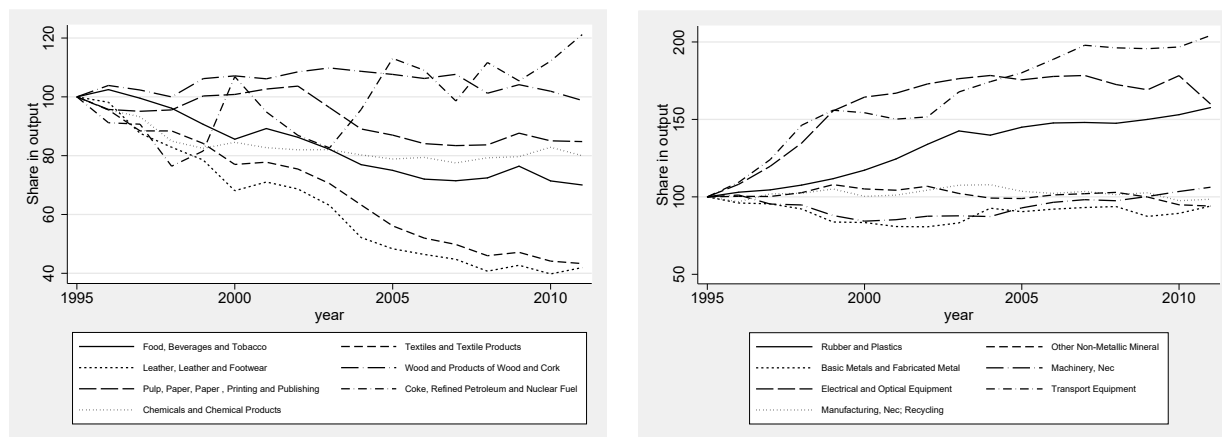
Appendix

Fig. A. NMS Output. Note: Output is relative to total manufacturing output and normalized to 100 in 1995.
Source: Authors' own calculations using WIOD data.

Tab. A. Upstreamness of world sectors. Note: R-columns show the world ranking.

Sector	1995	2005	2011	R1995	R2005	R2011
Agriculture. Hunting. Forestry and Fishing	2.1	2.2	2.3	18	17	17
Mining and Quarrying	3.2	3.4	3.7	1	1	1
Food. Beverages and Tobacco	1.6	1.6	1.8	28	28	27
Textile and Textile Products	1.9	2.0	2.3	20	21	16
Leather. Leather and Footwear	1.7	1.7	2.0	25	27	23
Wood and Products of Wood and Cork	2.6	2.8	3.0	8	5	5
Pulp, Paper, Printing and Publishing	2.8	2.7	2.9	3	7	7
Coke. Refined Petroleum and Nuclear Fuel	2.5	2.6	2.8	11	10	9
Chemicals and Chemical Products	2.7	2.8	3.1	5	4	4
Rubber and Plastics	2.8	2.9	3.1	4	3	3
Other Non-Metallic Mineral	2.5	2.6	2.6	10	12	12
Basic Metals and Fabricated Metal	3.0	3.1	3.3	2	2	2
Machinery. Nec	1.9	2.0	2.2	23	20	19
Electrical and Optical Equipment	2.2	2.3	2.6	16	14	13
Transport Equipment	1.9	1.9	2.0	22	22	22
Manufacturing, Nec; Recycling	1.7	1.7	1.8	26	25	26
Electricity, Gas and Water Supply	2.4	2.6	2.9	12	9	8
Construction	1.3	1.3	1.3	31	31	31
Sale, Maintenance and Repair of Vehicles	1.9	1.9	2.0	21	23	24
Wholesale Trade and Commission Trade	2.1	2.1	2.2	17	18	20
Retail Trade, Except of Motor Vehicles	1.6	1.7	1.7	27	26	28
Hotels and Restaurants	1.5	1.5	1.6	29	29	29
Inland Transport	2.2	2.3	2.4	15	13	14
Water Transport	2.6	2.8	2.9	9	6	6
Air Transport	2.0	2.0	2.1	19	19	21
Other Supporting and Auxiliary Transport	2.6	2.7	2.7	6	8	10
Post and Telecommunications	2.3	2.2	2.2	14	16	18
Financial Intermediation	2.3	2.3	2.4	13	15	15
Real Estate Activities	1.5	1.5	1.5	30	30	30
Renting of M&Eq and Other Business Activities	2.6	2.6	2.7	7	11	11
Public Administration and Defence	1.1	1.1	1.1	33	34	34
Education	1.1	1.2	1.1	34	32	32
Health and Social Work	1.1	1.1	1.1	35	35	35
Other Community. Social and Personal Services	1.7	1.8	1.9	24	24	25

Source: Authors' own calculations.

Tab. B. Structure of the NMS manufacturing in 2011.

Sector	Share in output	Share in exports
Leather, Leather and Footwear	0.6%	1.0%
Wood and Products of Wood and Cork	3.0%	2.0%
Textiles and Textile products	3.0%	4.0%
Manufacturing, Nec; Recycling	3.7%	4.3%
Other Non-Metallic Mineral	4.1%	2.0%
Pulp, Paper, Printing and Publishing	4.7%	2.6%
Rubber and Plastics	5.5%	5.5%
Chemicals and Chemical Products	6.4%	8.1%
Coke, Refined Petroleum and Nuclear Fuel	6.9%	4.4%
Machinery, Nec	7.6%	9.7%
Electrical and Optical Equipment	11.8%	19.0%
Basic Metals and Fabricated Metal	13.2%	11.9%
Transport Equipment	14.0%	18.8%
Food, Beverages and Tobacco	15.4%	6.7%

Source: Authors' own calculations using WIOD data.

Tab. C. Share of manufacturing exports in 2011.

Sector	BGR	CZE	EST	HUN	LTU	LVA	POL	ROU	SVK	SVN
Food, Beverages and Tobacco	6.1%	3.1%	6.8%	3.1%	8.6%	7.0%	8.3%	1.7%	3.4%	2.9%
Textiles and Textile Products	5.2%	2.1%	4.8%	0.9%	4.8%	2.4%	3.6%	7.3%	2.4%	3.0%
Leather, Leather and Footwear	0.3%	0.4%	0.4%	0.6%	0.2%	0.1%	0.5%	2.9%	1.3%	1.1%
Wood and Products of Wood and Cork	0.9%	0.9%	7.8%	0.3%	2.6%	7.8%	1.8%	2.2%	1.6%	2.2%
Pulp, Paper, Printing and Publishing	1.0%	2.2%	2.9%	1.1%	1.3%	1.0%	2.4%	0.5%	2.6%	3.4%
Coke, Refined Petroleum and Nuclear Fuel	7.9%	1.3%	1.7%	2.8%	15.3%	0.0%	4.1%	2.9%	3.7%	0.1%
Chemicals and Chemical Products	4.7%	5.4%	4.3%	7.5%	6.9%	4.1%	6.1%	4.6%	3.9%	12.7%
Rubber and Plastics	1.6%	4.3%	2.7%	4.0%	2.6%	1.2%	5.1%	2.7%	3.4%	5.0%
Other Non-Metallic Mineral	2.3%	1.8%	1.9%	1.1%	0.6%	1.0%	1.7%	0.5%	1.6%	1.7%
Basic Metal and Fabricated Metal	13.6%	9.6%	6.1%	5.0%	2.2%	6.6%	10.2%	7.9%	11.5%	11.3%
Machinery, Nec	5.3%	9.4%	3.2%	10.5%	2.1%	1.8%	5.4%	5.6%	5.9%	12.0%
Electrical and Optical Equipment	4.1%	21.1%	12.2%	21.7%	3.8%	2.9%	8.3%	9.5%	18.7%	9.6%
Transport Equipment	2.3%	17.3%	2.9%	13.5%	1.9%	4.2%	15.2%	9.2%	19.1%	12.4%
Manufacturing, Nec; Recycling	2.2%	3.3%	5.2%	0.8%	4.0%	2.9%	4.7%	3.2%	2.6%	2.3%

Source: Authors' own calculations using WIOD data.

Tab. D. Country groupings

Country	Group
AUS	High Income
AUT	EU-15
BEL	EU-15
BGR	NMS
BRA	Em. Other
CAN	High income
CHN	Em. Asia
CYP	NMS
CZE	NMS
DEU	EU-15
DNK	EU-15
ESP	EU-15
EST	NMS
FIN	EU-15
FRA	EU-15
GBR	EU-15
GRC	EU-15
HUN	NMS
IDN	Em. Asia
IND	Em. Asia
IRL	EU-15
ITA	EU-15
JPN	High Income
KOR	Em. Asia
LTU	NMS
LUX	EU-15
LVA	NMS
MEX	Em. Other
MLT	NMS
NLD	EU-15
POL	NMS
PRT	EU-15
ROU	NMS
RUS	Em. Other
SVK	NMS
SVN	NMS
SWE	EU-15
TUR	Em. Other
TWN	Em. Asia
USA	High Income