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Croatia in Global Value Chains

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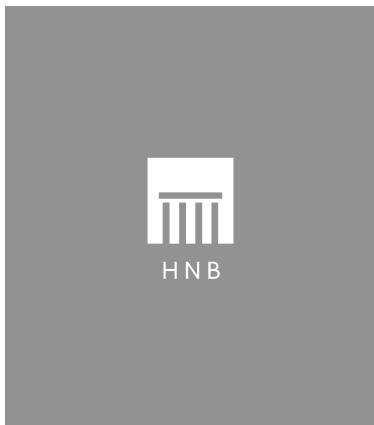
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Abstract

Global value chains have become a powerful source of increased efficiency and firm competitiveness. This paper explores Croatian participation in GVCs. Our results suggest that Croatia's integration in GVCs did not essentially change from 2000 until 2014. Involvement in GVCs did not change in peer countries either, but they significantly increased their backward and decreased forward participation, while the structure of integration in Croatia stayed almost the same. In addition, the analysis of the structure of value added in exports in manufacturing sector shows that the share of domestic value added in gross exports in 2014 was high in the production of food, beverages and tobacco industry, pharmaceutical products, and computers and electronics. Moreover, the pharmaceutical industry is the only industry that significantly increased the share of domestic value added in exports from 2000 to 2014. Finally, our results indicate that Croatia is strongly integrated in GVC trade only with a few countries, with Germany being its most important GVC partner.

Keywords:

global value chains, Croatia, GVC participation index, VAX matrix

JEL:

F14, F60, P52

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1 Introduction to global value chains

International trade flows are one of key factors for a country's economic growth. Conventional trade statistics are used to analyze exports and imports between countries. However, one of the crucial shortcomings of such data is their inability to show the real value created by trade, or which industries create most of the value. The real value added is a difference between the value of output (gross exports) and the value of imports (usually intermediate products). Understanding the role of an economy in global value chains improves policymaking, in particular in the areas related to competitiveness, economic growth and employment. Similarly, not knowing the difference between the gross exports and the gross value of exports can lead to misguided policy decisions.

Global value chains emphasize how export competitiveness relies on the sourcing of efficient inputs and access to final producers and consumers abroad (De Backer et al., 2013). As companies seek to improve their operations by establishing different steps of production across different locations, cross-border transactions in intermediate goods and services have come to prevail in international trade, leading to growth of trade in intermediates that is faster than in final products. Such international fragmentation of production is a powerful source of increased efficiency and firm competitiveness, as production is undertaken wherever the essential materials and competences are available at competitive cost and quality. The ability to identify trade in intermediate products can provide important insights into how countries integrate into GVCs (Ahmad et al., 2017).

Countries can be involved in GVCs in different ways. Those that produce at the beginning of the production chain (upstream) import fewer intermediate goods and services, but export more of them than countries that are located at the end of the chain (downstream). Thus, countries can participate in GVCs by using foreign inputs in exports (backward participation), or can be suppliers of intermediate goods and services that are further used in other countries' exports (forward participation).

New data enable analyzing the value added created in exports on the industry level, which is of high importance because not all industries are positioned the same way along the supply chains. Some industries, such as petroleum production, do not contain as many imported inputs as, for example, motor vehicles, but are involved in GVCs through value added incorporated in goods that are exported (UNCTAD, GVC: Investment and Development, World Investment Report, 2013). The higher the share of the foreign value added component, the less important is the industry for economic growth. A high share of foreign value added undermines the ability of total demand and exports to generate GDP. However, the use of foreign inputs can improve competitiveness and thereby increase the domestic value added, which can significantly contribute to economic growth (Ali-Yrkko et al., 2016).

The purpose of this paper is to analyze Croatian participation in GVCs, and the extent to which it differs from that in its main trading partners and peers. Furthermore, we show which industries generate the most value in exports and, finally, what countries are Croatia's main GVC partners. In this respect, the GVC data for Croatia can be considered as a valuable complementary tool to traditional trade statistics.

To the best of our knowledge, this is the first paper that studies Croatian integration in GVCs, and is based on the most recent data by World Input-Output Database that includes Croatia.

The paper is structured as follows. Section 2 provides an explanation on the limitations of traditional trade statistics measures. Section 3 offers a brief description of the data used in the paper. Section 4 discusses the destinations of Croatian exports of final and intermediate goods and services, and which countries are the main sources of goods and services in Croatia. In addition, it offers some stylized facts from analysis of intermediate products trade. Section 5 summarizes main findings on Croatia's participation in GVCs. Section 6 concludes.

2 Traditional trade statistics measures: what are the limitations?

Global value chains challenge the way trade and output statistics are collected (De Backer et al., 2013). The traditional approach of documenting cross-border transactions, such as data on imports and exports, does not provide sufficient information about involvement in globalized production. Higher exports no longer guarantee higher output or adequate production-associated benefits, such as employment creation and industrialization (Banga, 2013). The products purchased by consumers are made of inputs originating from separate locations around the world. However, neither goods nor services are appropriately captured within traditional trade statistics because the value of intermediate inputs traded along the value chain is recorded several times. Furthermore, the trade data cannot reveal from which industry the value was added or from

which industries they were imported.

There are many issues that arise because of the fact that trade data are supplied in gross value terms. Specifically, the domestic as opposed to the foreign value added of traded products is effectively being overlooked. According to the traditional trade statistics, a country producing a crucial element of a foreign-assembled good is not recognized as highly integrated into the global market. In contrast, an assembling economy is considered as internationally highly-integrated, solely by virtue of importing inputs and exporting final products. Such reasoning neglects the value added of the input-producing country being inherent in the value of the final product, irrespective of the final export location.

The role of the economy, and in particular of the industrial

sector that plays a key role in the global production process, is not properly accounted for by traditional trade statistics. The key difficulty is that the conventional approach to analysis of trade does not track the sequence of value added generation – from product invention to the final consumption.

For the above reasons, there is increasing recognition that analysis based on gross trade statistics can result in inaccurate

assessments of international trade. In order to assess the actual contribution of trade to economic growth, one should identify the actual value traded using international input-output tables, which combine national accounts and bilateral trade statistics linking production processes within and across countries and industries, avoiding the double-counting problem that affects conventional trade statistics (Ahmad et al., 2017).

3 Data description and sources

While the term “value chain” stands for the complete set of activities, such as design, production, marketing, distribution and support to the final consumer, the term “global” emphasizes interconnectedness among countries (De Backer & Miroudot, 2014). While the notion of GVC is not new, quantitative evaluation became feasible only recently as a result of an improvement of inter-country input-output tables by, among others, the Organisation for Economic Co-operation and Development’s (OECD) Trade in Value Added (TIVA) and World Input-Output Database (WIOD). The importance of GVC is further noticeable from the effort and resources dedicated to computing GVC participation indices by leading organizations like the OECD, International Monetary Fund (IMF), Bank of International Settlements (BIS), along with various central banks around the world.

For the purpose of trade statistics and Croatia’s participation in GVC analysis, this paper employs data from WIOD as in Timmer, Los, Stehrer, & de Vries (2016). The database provides annual time series of national input-output tables, interconnected by bilateral international trade flows. Apart from domestic flows captured by national input-output tables, world

input-output tables provide necessary inputs for the analysis of both domestic and international product rows, keeping track of the initial point in global chain. The key assumption used in integrating national input-output tables into the global input-output network is that each product is produced either by a domestic industry or by a foreign industry. The data cover the period from 2000 through 2014. WIOD covers a total of 44 countries (28 EU countries, 15 world major economies and a residual representing “Rest of the World”) and 56 industries (product groups) based on the 2-digit International Standard Industrial Classification (ISIC) (for all industries and countries covered see Appendix C.). The value of trade comprises trade in both goods and services, measured in current prices. Together, the countries involved account for more than 85% of the world GDP (Timmer et al., 2016).

An issue with assessing Croatian value added trade is that WIOD does not include Bosnia and Herzegovina, Serbia and Montenegro, which are countries that belong to the group of Croatia’s major trading partners. These countries are included as a part of the “Rest of the world” component.

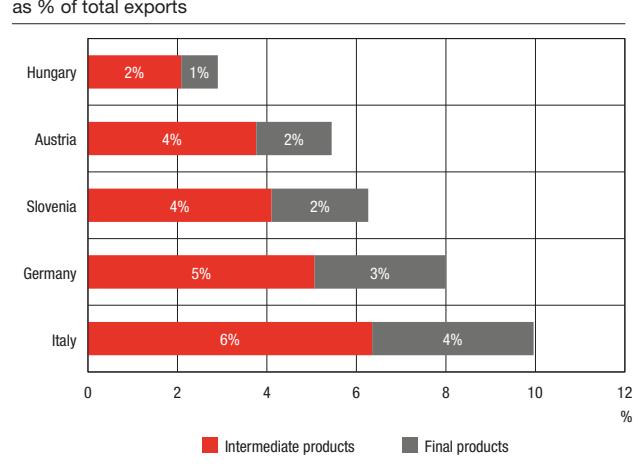
4 Trade statistics overview

Moving different stages of production to different countries has become profitable, so the importance of intermediate goods and services in global trade has increased. This section gives an overview of Croatian trade with an emphasis on the movement of intermediate and final goods and services across Croatia’s major trading partners. Furthermore, since intermediate goods and services dominate international trade, the section examines the positions of different countries in the intermediates’ trade. We conclude the section by discussing how the share of intermediate goods and services has changed between two points in time, 2000 and 2014.

4.1 What does Croatia export and where?

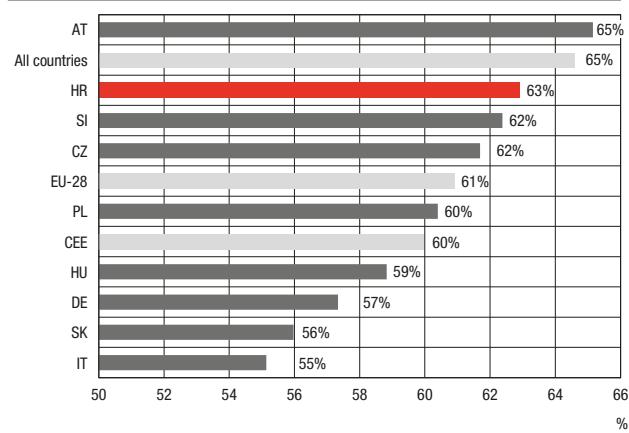
Croatia exports most of its products, both final and intermediate goods and services to Italy, Germany, Slovenia, Austria and Hungary, accounting for one third of total exports (Figure 1). Intermediates account for 63% of total exports on average.

Figure 1 Croatian main export markets in 2014, by product type
as % of total exports



Source: Authors’ calculations, based on WIOD (2016 vintage database).

Figure 2 Intermediates export as a percentage of total exports
in 2014



Source: Authors' calculations, based on WIOD (2016 vintage database).¹

The share of intermediates in total Croatian exports (63%) is slightly lower than the world average (65%) (Figure 2). However, Croatian trade partners have higher shares, with Austria being the only exception. Among Croatia's major trading partners included in the WIOD, Italy has the lowest share of intermediates in total exports (that is, highest share of final goods). Croatia has the highest share of intermediates in total exports among peer countries.²

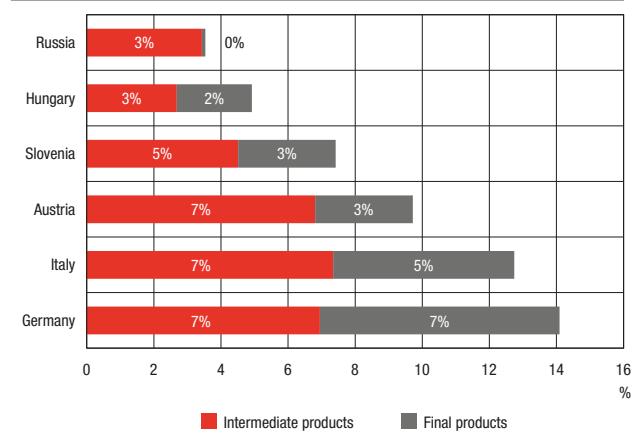
Both intermediate and final goods and services are similarly represented in exports to Croatian main export markets, as shown in Figure 3 (see page 4). The figure also shows that 10% of total intermediate and also final goods and services are exported to Italy. Germany is the most important export market for both the intermediate and final goods and services for peer countries. Moreover, the Czech Republic, Hungary and Poland export about a third of total intermediates to Germany. Croatia accounts as an important export market only for Slovenia.

4.2 What does Croatia import?

Croatia imports most of its products from Germany, Italy, Austria, Slovenia, Hungary, and Russia, in that order (Figure 4). Imports of intermediate goods and services is higher than of final ones. This is most noticeable in the structure of imports from Russia. Almost 3% of total Croatian imports comes from Russia, and almost all are intermediates (mostly natural gas).

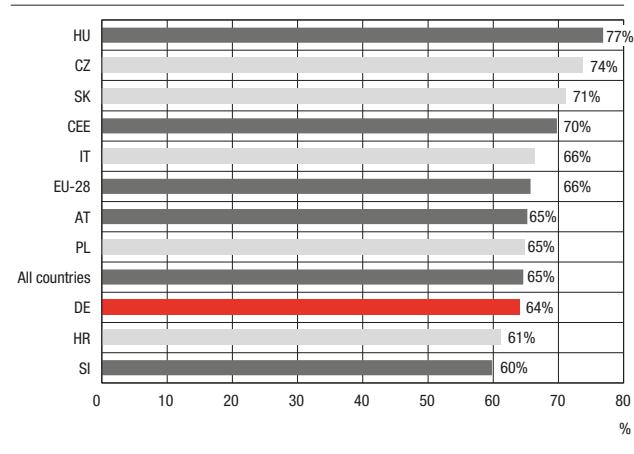
Intermediates account for a higher share of imports than final goods and services in all countries (Figure 5). Croatia has a lower share of intermediates in total imports (61%) than the

Figure 4 Croatian main import sources in 2014, by product type
as % of total imports



Source: Authors' calculations, based on WIOD (2016 vintage database).

Figure 5 Intermediates imports as a percentage of total imports
in 2014



Source: Authors' calculations, based on WIOD (2016 vintage database).

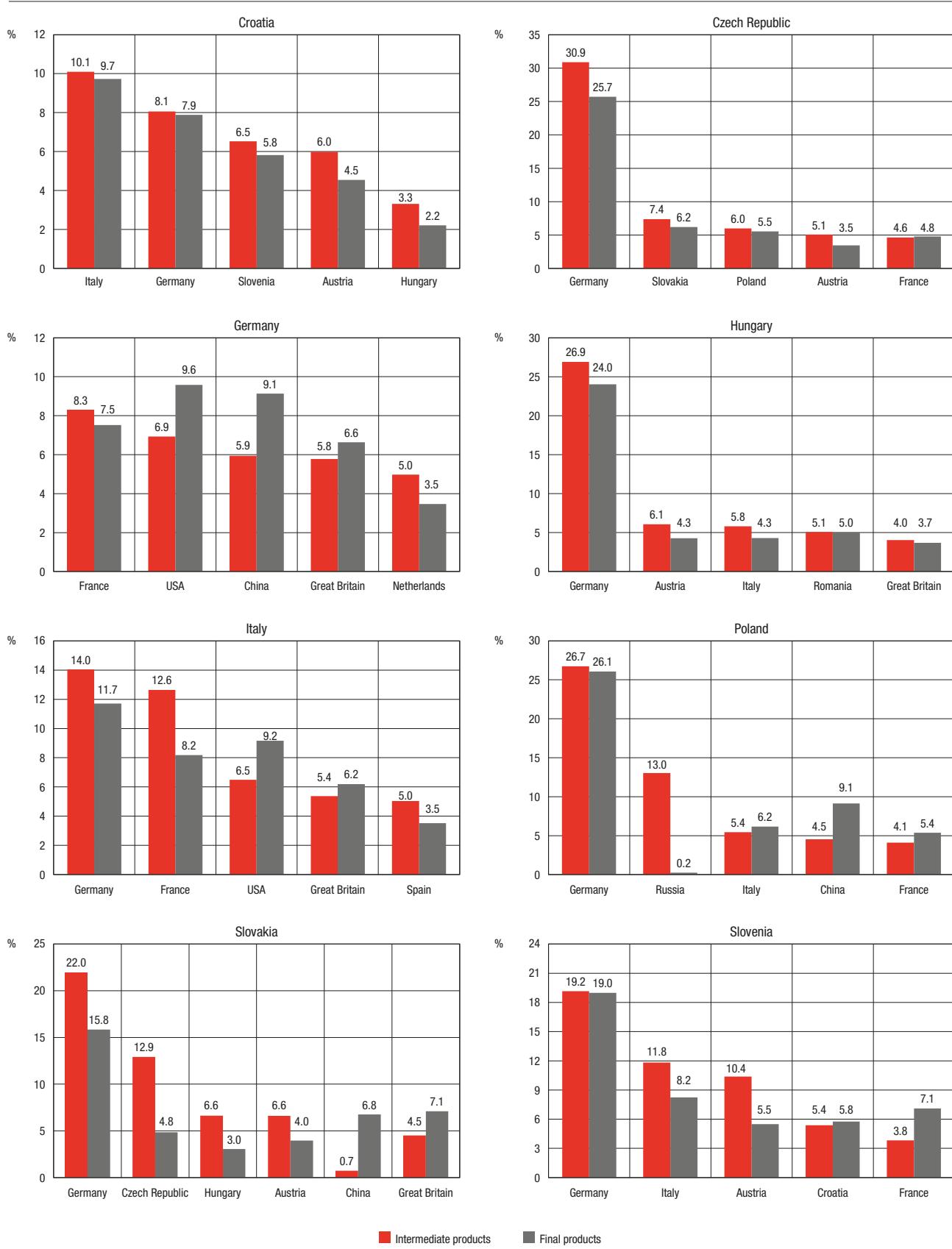
world average (65%), and its major trade partners and peers (CEE countries on average have 70%).

Major Croatian trading partners in imports of both intermediate and final products are the same as for exports (Figure 6): Italy, Germany, Austria and Slovenia. Russia is added due to its importance when it comes to imports of intermediates. Germany seems to be the most important source of products for all Croatian major trading partners and peers. China was one of the most important sources for final goods and services in all observed countries except for Slovakia.

1 See Appendix C, Table 1 for country definition.

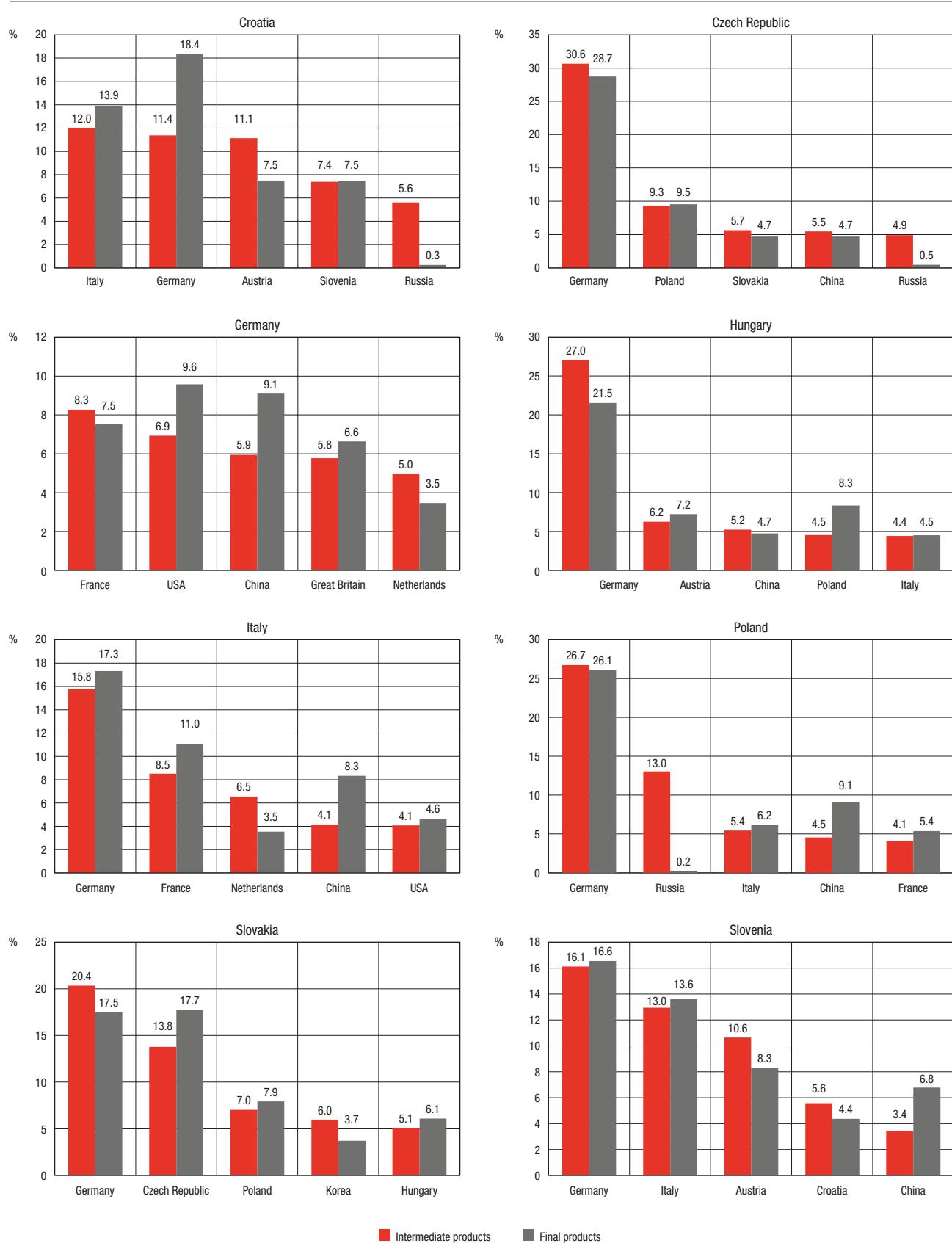
2 According to the WIOD, Croatia's main trading partners are Austria, Germany, Hungary, Italy, and Slovenia. However, this paper analyzes countries more comparable to Croatia to get a better insight into how much Croatia differs from peer countries. Peer countries include countries in the Central and Eastern Europe (the Czech Republic, Hungary, Poland, Slovakia and Slovenia) and main trading partners (Austria, Germany, Italy and Slovenia).

Figure 3 Major export destinations for intermediate and final products
in 2014



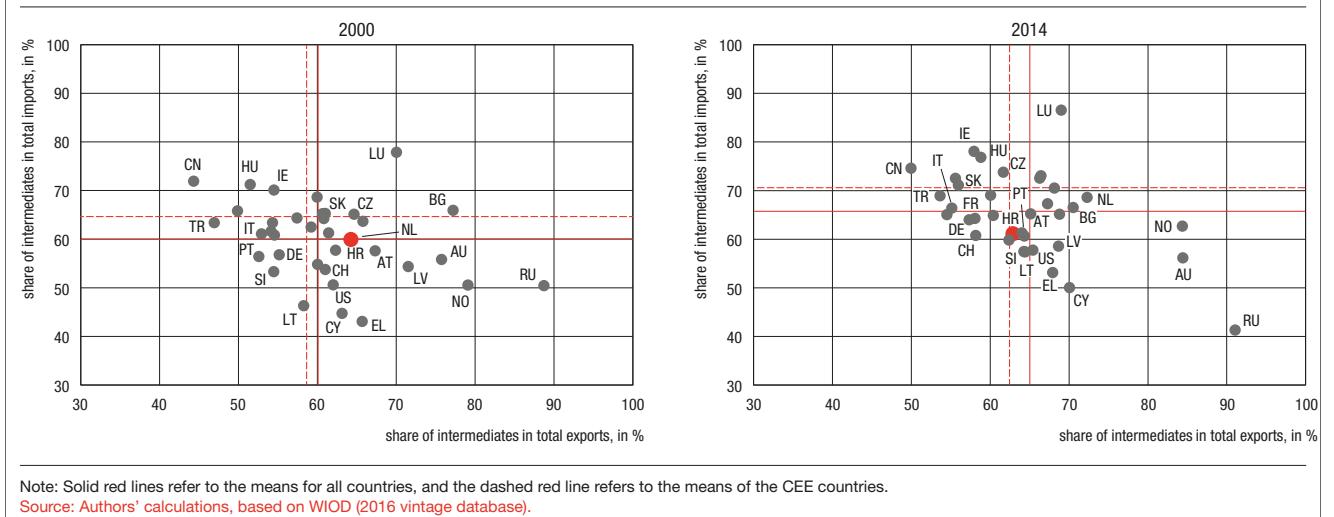
Source: Authors' calculations, based on WIOD (2016 vintage database).

Figure 6 Imports of intermediates – major destinations in chosen countries in 2014
share of intermediate imports



Source: Authors' calculations, based on WIOD (2016 vintage database).

Figure 7 Share of intermediates in total imports and total exports



4.3 Stylized facts from intermediate products trade

Countries with high shares of intermediates in imports participate more in the last stages of production (downstream), while countries with high share of intermediates in exports are considered to be positioned in the early production stages (upstream). Pure trade statistics alone cannot confirm this statement, but there are certain patterns among countries with respect to shares of intermediates in total exports and total imports. Figure 7 shows countries clustered by the share of intermediates in exports and imports, as in Ali-Yrkko, Rouvinen, Sinko and Tuhkuri (2016).

Small open economies (top right quadrant). Countries characterized by the above average share of intermediates, both in total exports and total imports. These countries are highly integrated in the GVCs, with Luxembourg having the highest ratio of intermediates, both in imports and exports in 2000 and 2014. Croatia fitted in this group in 2000.

Assembly countries (top left quadrant). Typical for countries with large assembly plants with the share of imported intermediates higher than the average, while the share of intermediates exports is lower than the average. A typical example is China, whose share of intermediates in exports was above 70%, while it had a below average share of intermediates in imports, although this is increasing. Of Croatian peers, Slovakia and Hungary belong to this group of countries. This is probably related to an increase in car production in Slovakia started in the middle of the 2000s, while Hungary invested in factories in the early transition period

Domestic market driven (bottom left quadrant). Countries where intermediates account for a lower than average share of

imports and exports. For these countries the emphasis is on final products trade. Examples are large size countries, such as France and Italy. Although a small open economy, Croatia ranked among these in 2014.

Raw materials exporters (bottom right quadrant). Countries where the share of intermediates of total imports is lower, but of total exports is higher than the average of all countries. Typically, resource rich countries belong to this group: Russia, Australia, Norway.

Figure 7 also shows that almost all countries increased the share of intermediates both in exports and in imports, which resulted in a change of the average of *all countries* (up and right). CEE also increased the intermediates trade, so their average moved to the right by 2 percentage points (intermediates in total exports), and up by 5 percentage points (intermediates in total imports). While Slovakia and the Czech Republic slightly decreased their intermediates exports, they both increased intermediates imports, suggesting that they improved their position in the downstream part of the value chain. Hungary, Poland and Slovenia increased the significance of intermediates in both exports and imports. The figure suggests that Croatia “moved” from the group of *small open economies* to that of *domestically driven economies* due to the changed significance of intermediates in total trade. However, the shift of lines was a result of a change in the averages of selected countries, while Croatia did not move its position along the supply chain. Its share of intermediates in total exports increased slightly, but the structure of imports did not change. The relatively high proportion of intermediates in total Croatian exports has more to do with a historically high proportion of intermediaries than with integration in the global chains.³

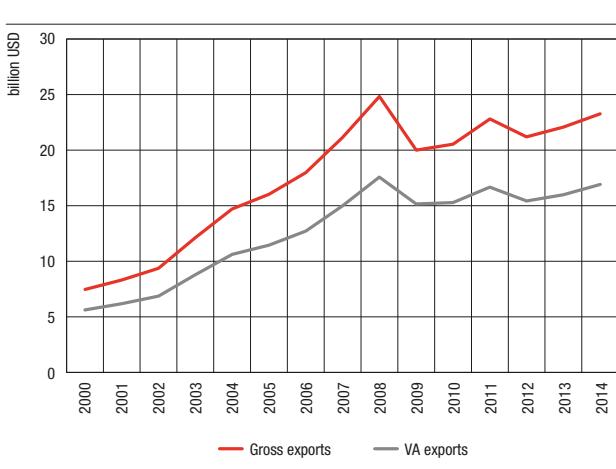
3 Formal discussion of this claim requires further analysis and is beyond the scope of this paper.

5 Croatia's participation in GVCs

Conventional gross trade statistics have been useful for analyzing the gross trade among countries. However, as already mentioned, they suffer from double accounting and record the value added created abroad (intermediates exports of another country). They do not reveal how much value added has been generated in a country, or which industries have created the value.

Export performance in Croatia is less pronounced when measured in value added rather than in gross terms (Figure 8). While gross exports of goods and services in Croatia in 2000 were 7.5 billion USD, only part of them, 5.6 billion USD, contributed to the GDP. In 2009, with the crisis, the value added of exports (that is, the income generated by exporting) decreased by less than 14 p.p., while the gross exports decreased by almost 20 p.p. In 2014 total gross exports were 23.3 billion USD, while the value added of exports was 6.4 billion USD lower.

Figure 8 Value added exports vs gross exports in Croatia



Source: Authors' calculations, based on WIOD (2016 vintage database).

When assessing the actual contribution of each country and industry to economic growth, the gross value of exports can be decomposed into foreign and domestic value added. While the foreign value added as a share of exports indicates what part of a country's gross exports consists of imported inputs, the domestic value added is a part of the exports created within the country. Furthermore, the domestic value added can be further split into three components: exported directly final goods and intermediates (direct domestic VA), exported intermediates to a country that exports it further to the third countries (indirect domestic VA) and re-imported domestic intermediates.

Assessing domestic and foreign value added further enables analyzing the most commonly used indicators of the involvement of countries in the GVC: the *GVC participation index* developed by Koopman et al (2011) and *VAX matrix* introduced by Johnson and Noguera (2012) (for methodology on estimating trade in value – added see Appendix A).

5.1 International comparison

One of the most widely used indicators for analyzing the involvement of a country in GVCs is the *GVC participation index* (Koopman, Powers, Wang & Wei, 2011), which is defined as follows:

$$GVC \text{ participation}_i = \frac{IVAi}{EXi} + \frac{FVAi}{EXi}$$

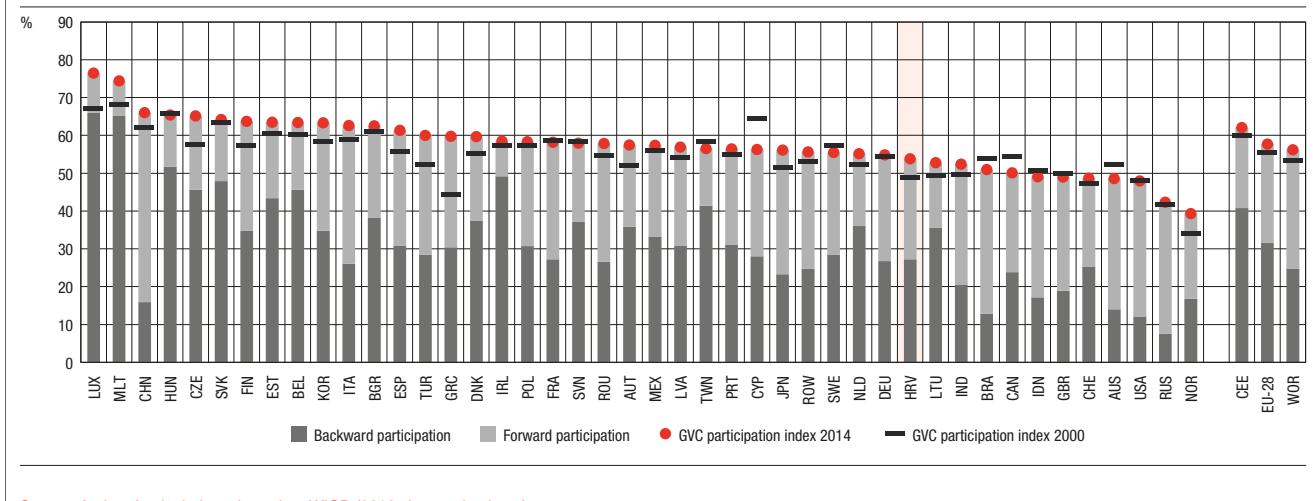
where $IVAi$ stands for indirect value added (value added that reflects the contribution of domestic suppliers whose exported goods and services are built into later exported products to the third countries), $FVAi$ foreign value added of exports in country i , and EXi represents its gross exports.

A country either provides inputs for other countries' exports (forward participation) or uses other countries' inputs to generate exports (backward participation). While a forward linkage indicator is given by the indirect domestic value added, a backward linkage indicator refers to the import content of exports (foreign value added).

Countries with high rates of specialization have larger backward linkage components, while economies that are resource rich tend to have higher forward linkage components. In 2014 China was one of the countries with the highest participation in GVCs, particularly due to the forward participation (that is, downstream links) (Figure 9). Hungary, the Czech Republic and Slovakia were also highly involved in the GVCs, but mostly due to backward participation. Taking into account the evolution of backward participation in GVC between 2000 and 2014, most countries increased their backward participation (particularly the Czech Republic, Japan and Turkey), while only few countries, Cyprus, Canada, Russia and Australia, decreased their backward participation index (changes in forward and backward participation between 2000 and 2014 are presented in Figure 17, Appendix B).

Croatia's participation in GVCs in 2014 was slightly below the world average and significantly below five Central and Eastern Europe countries and the EU average (Figure 9). As for Croatia's major trading partners, Italy had the highest GVC participation index, with dominant forward participation. Due to more pronounced backward participation in 2014, Austria was also more involved in GVCs than Croatia. Finally, Germany's GVC participation index was most similar to the Croatian, having both forward and backward linkages very much alike. However, Germany increased its backward participation significantly between 2000 and 2014, while the forward participation index decreased. At the same time, the backward participation index for Croatia slightly increased between 2000 and 2014, while the forward participation index stayed roughly the same (Appendix B, Figure 17). In other words, the capacity of the Croatian firms to perform in the downstream parts of value chains has remained limited.

Figure 9 GVC participation across countries in 2014



Source: Authors' calculations, based on WIOD (2016 vintage database).

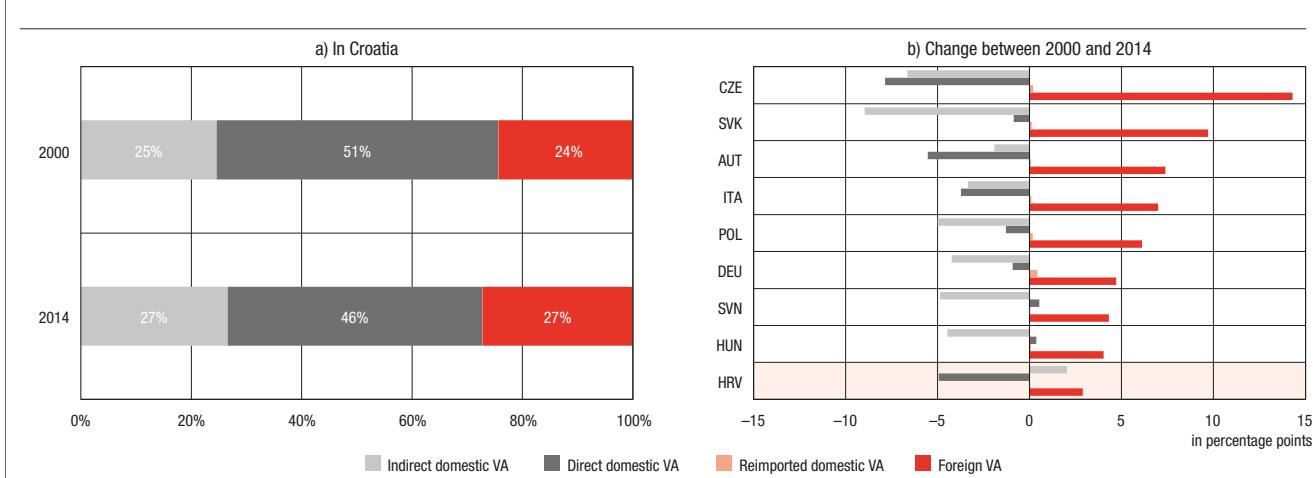
5.2 Decomposition of value added in exports

When compared to its key competitive markets, Croatia only marginally changed its overall position in GVCs from 2000 until 2014. However, there were some changes in the structure of the value added content of gross exports: both indirect domestic value added and foreign value added increased, while direct domestic value added decreased (Figure 10). The Czech Republic and Slovakia had the most pronounced increase in the foreign content of exports.

As the direct domestic value added is directly absorbed by the importers in the partnering economy, the picture is similar to that in gross trade statistics. By contrast, exported intermediates re-exported to third countries (indirect domestic value added) are a measure of forward participation. China had the highest share of indirect domestic value added in 2014, followed by Italy and the United States (Figure 11). Analogously to Figure 9, those countries participate in GVCs mostly due to the forward linkage component.

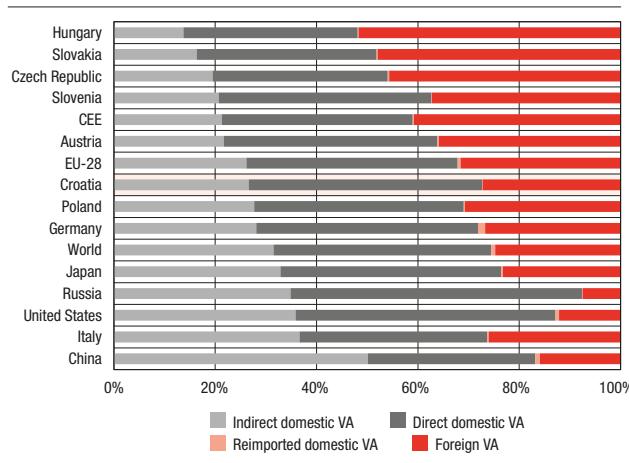
Given that the indirect content of domestic value added was not ultimately destined to one country, rather used for re-export to third countries, it is particularly important for real economic growth and job creation. Almost one third of Croatia's domestic value added is indirect value, and is somewhat higher than in the CEE countries (21% and 22%, respectively). Croatia is the only country in which the indirect component of domestic value added increased from 2000 to 2014, followed by a larger decrease in the direct domestic component. This could be related to improved relations of Croatian companies with trade partners (or new agreements concluded), who exported Croatian goods further to the third countries. However, an increase in indirect domestic value added could also be a result of some large companies establishing firms and facilities in neighboring countries (Bosnia & Herzegovina, Serbia and Macedonia) which were used for exports to third countries; some Croatian manufacturers undertook certain measures before entering the EU, within which they moved their production to other countries in order to take advantage of duty-free

Figure 10 Evolution of value added content of gross exports



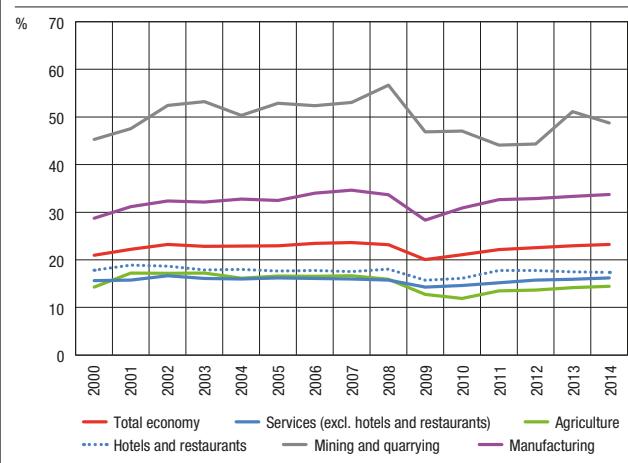
Source: Authors' calculations, based on WIOD (2016 vintage database).

Figure 11 Value added content of gross exports in 2014, by country



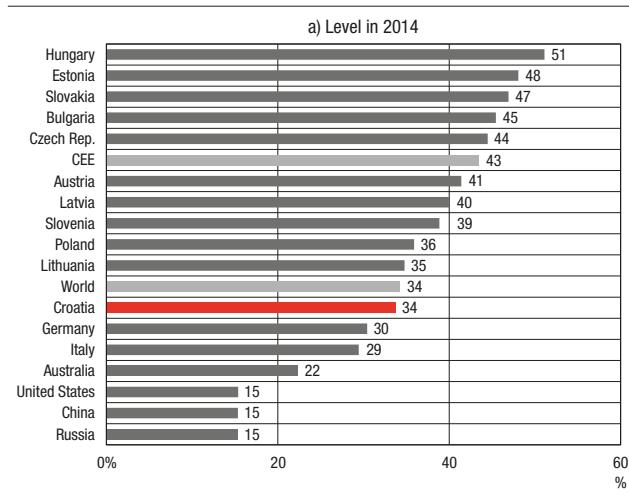
Source: Authors' calculations, based on WIOD (2016 vintage database).

Figure 12 Evolution of foreign value added in Croatia by sector⁴



Source: Authors' calculations, based on WIOD (2016 vintage database).

Figure 13 Share of foreign value added in gross exports in manufacturing



Source: Authors' calculations, based on WIOD (2016 vintage database).

placement of goods in the free trade area once Croatia entered the EU (Ranilović, 2016; Ćudina and Sušić, 2013).

5.2.1 GVC participation by sector

In most of the countries, the growth of GVC participation was not homogenous across industries, due in particular to the low foreign value added (that is high domestic value added) component in services. Therefore, apart from general international comparison, the focus is on further emphasis of the role of industrial heterogeneity with regard to the domestic and foreign origin of value added.

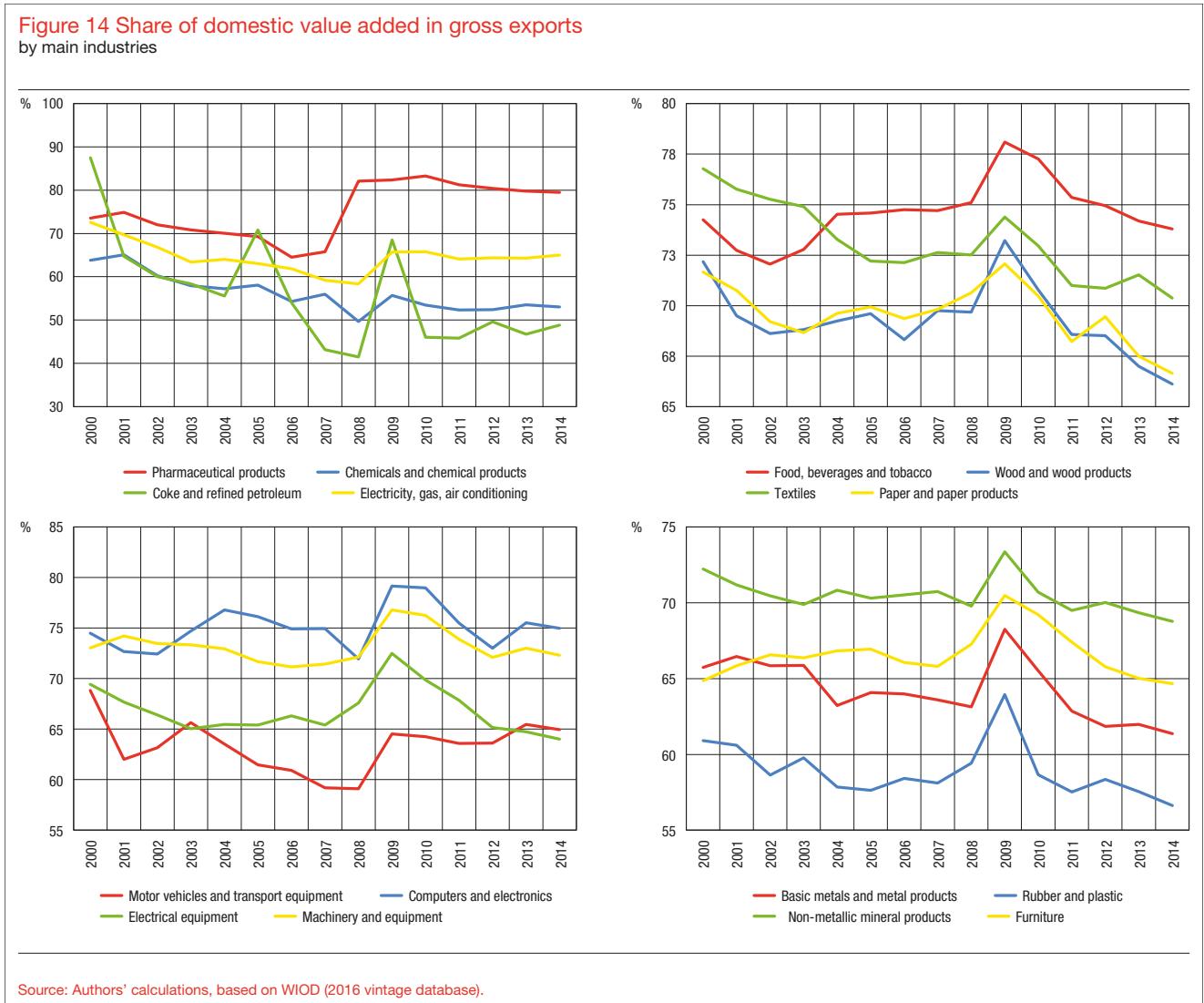
The share of foreign value added in Croatia is higher in manufacturing sector than in the overall economy which is, of course, to be expected due to international fragmentation, which initially started as an industry-demanded process. Exports of services are generally made up of less foreign value

added than manufactured products (Figure 12), although foreign value added in the sector of hotels and restaurants (tourism service) is somewhat higher than in other services. Agriculture, as expected, also contains a low share of foreign value added.

Analysis of foreign value added in manufacturing in Croatia indicates that one third was generated abroad, which is somewhat lower than the world average (34%), but significantly lower than the average of the CEE countries (43%) (Figure 13a). From 2000 to 2014 Croatia made smaller progress than all its major trading partners and peers. At the same time, Slovakia and the Czech Republic improved their backward participation position more than any of selected countries (Figure 13b).

When it comes to domestic value added as a content of gross exports, it is mostly high in agriculture, raw materials and services (Ali-Yrkko et al., 2016). As can be seen in Figure

4 Industries included in each sector are listed in Appendix C3, Table 3.

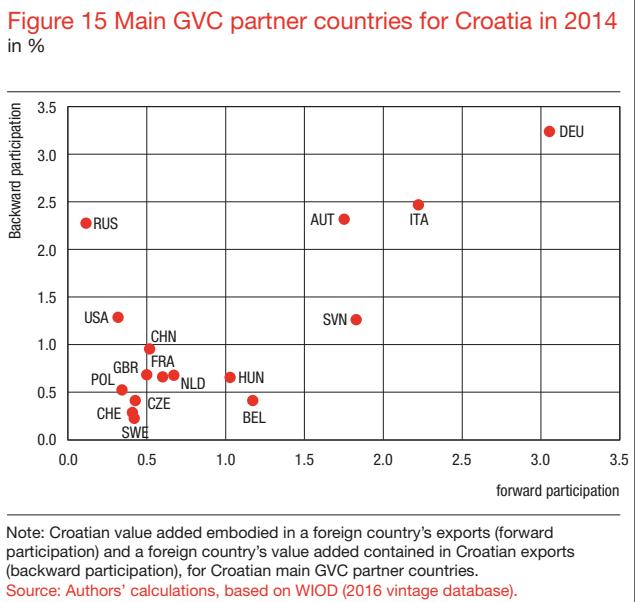


12, this is the case in Croatia: the highest share of domestic value added is in agriculture and services. Looking more closely at the structure of the manufacturing sector in 2014, the share of domestic value added in gross exports was particularly high (more than 75%) in water supply, food, beverages and the tobacco industry, production of pharmaceutical products, computers and electronics, and water supply and waste collection (Figure 14).

It is interesting to notice that industries that are traditionally marked as crucial in Croatia, such as the production of coke and refined petroleum, and chemicals and chemical products had the highest drop in the share of domestic value added between 2000 and 2014 in favor of foreign value added (from 88% to 49% and 64% to 63%, respectively). On the other hand, the pharmaceutical industry was the only industry to increase the share of domestic value added in the same period, from 74% to 79%. However, in order to draw conclusions on its importance for the local economy, one should scale these proportions by total volume of corresponding industries' exports, which is beyond the scope of this paper. The proportion of domestic or foreign value added in gross exports should only serve as information that helps to identify trade-offs from industry specific integration into GVCs and, therefore, calibrate policy accordingly.

5.2.2 GVC participation by partner country

Subsequent to the analysis of foreign and domestic value added embodied in trade, this section focuses on countries that



are the main Croatian GVC partners.

Croatia is strongly integrated with six partner countries (Figure 15). However, there is room for improvement, especially with Russia, the US and China, where forward participation is several times smaller than backward participation. Enabling both forward and backward linkages, Germany is Croatia's main GVC trading partner (Figure 15). Italy, Austria and Slovenia were respectively the second, third and fourth most important countries in terms of both forward and backward linkages. As expected, Russia is an important GVC partner country due to the backward linkage, implying that Croatia imports Russian intermediaries, and then further exports them to third countries.

5.3 Final destinations for Croatia's goods and services

So far, only the gross exports measure was used in analyzing the value added component of Croatia's exports. The

question is to estimate the dependence of the Croatian economy on final demand in different countries. Traditional trade statistics report only bilateral transactions (imports and exports) without the notion on where Croatian goods and services are finally consumed. *Value added in final demand* or VAX matrix is a measure that captures the connection between industries and consumers, be they foreign or domestic, even if they are not directly or closely connected (Johnson & Noguera, 2012).⁵ The highlighted row in Table 1 shows the contribution of other countries' final demand to Croatian GDP. According to the VAX matrix, the most important drivers of Croatia's GDP growth are Germany and Italy (1.8 billion dollars of Croatia's GDP is attributable to meeting final demand in these two countries). It also shows that Croatia's exports depend on Chinese and US final demand, similarly to the Austrian and Slovenian, which is not visible from the traditional trade statistics. An obvious remark for the Croatian economy is that it is mostly domestically driven economy with almost 80% of total demand in 2014 being domestically driven (40.7 billion dollars out of 51.2 billion dollars).⁶

6 Conclusion

Empirical evidence demonstrates that joining GVCs brings positive and significant gains in productivity. Accordingly, this paper analyzes Croatians participation in GVCs, compares Croatia with its main trading partners and peer countries, and shows which exporting industries generate the most of Croatia's value added.

Our results show that Croatia's integration in GVCs from 2000 until 2014, measured by the GVC participation index, essentially stayed unchanged. Moreover, its composition also did not change. Although the GVC participation index did not increase much in the CEE countries and Croatia's major trading partners either (except in the Czech Republic and Italy), they changed their position along the GVCs. Namely, all the observed countries significantly increased their backward and decreased their forward participation. This means they improved their position in the global value chains by increasing the foreign content of exports and therefore improving their position in the downstream part of the value chain, which might have resulted in improving their competitiveness. At the same time, Croatia slightly increased its backward component, while the growth of indirect domestic value in exports was negligible.

This study also shows that Croatia's growth is mostly domestically driven. Almost 80% of value added in gross exports is created domestically. However, between 2000 and 2014

direct domestic value added decreased in favour of the indirect component. Moreover, Croatia is the only one among analyzed countries that increased the indirect part of domestic value added, while the foreign content grew least among the peer countries. Therefore, Croatia could improve its backward participation by using cheaper foreign inputs while improving its competitiveness.

Analysis of the structure of value added in exports in the manufacturing sector shows that the share of domestic value added in gross exports in 2014 was particularly high in the production of food and beverages and in the tobacco industry, pharmaceutical products, and computers and electronics. Moreover, the pharmaceutical industry is the only industry that significantly increased the share of domestic value added from 2000 to 2014.

Croatia is strongly integrated with a few countries, Germany being the most important GVC partner, followed by Italy, Austria and Slovenia, in that order. Russia is an important GVC partner country due to the backward linkage, implying that Croatia imports Russian intermediaries, and then further exports them to third countries.

Finally, the VAX matrix also shows that Croatia's growth is mostly domestically driven, and that the highest contribution of foreign final demand comes from Germany and Italy.

5 For methodology see Appendix A.

6 The figures for all countries included in WIOD are presented in Appendix C, Table C4.

Table 1 The importance of trading partners based on the VAX matrix
in 2014 (in billion USD)

	AUT	BGR	CHE	CHN	CZE	DEU	EST	HRV	HUN	IRL	ITA	LTU	LVA	POL	ROU	RUS	SVK	SVN	TUR	USA	Other countries	Total	Domestically driven (in %)
AUT	319.4	0.3	3.5	4.1	1.8	20.0	0.1	0.8	2.0	0.3	5.5	0.1	0.1	1.9	0.9	1.5	1.0	0.7	1.0	5.1	35.3	405	79
BGR	0.3	39.2	0.1	0.7	0.2	1.1	0.0	0.1	0.1	0.7	0.0	0.0	0.2	0.5	0.3	0.1	0.1	0.8	0.6	0.6	7.7	53	74
CHE	2.4	0.1	545.0	7.4	0.8	17.6	0.1	0.1	0.6	1.2	7.1	0.1	0.1	1.3	0.3	2.0	0.3	0.1	1.0	16.3	94.7	699	78
CHN	2.5	0.5	4.0	9,440.4	4.0	36.3	0.5	0.3	3.1	2.4	13.9	0.4	0.3	6.0	1.6	15.1	1.8	0.5	10.3	126.2	728.6	10,399	91
CZE	2.2	0.2	0.9	2.2	143.8	13.1	0.1	0.2	1.4	0.2	2.1	0.1	0.1	2.8	0.5	1.8	2.6	0.2	0.7	2.6	20.7	198	73
DEU	22.3	1.4	21.8	52.5	14.7	2,956.8	0.7	1.2	10.5	4.4	34.7	0.7	0.5	21.5	5.4	18.4	6.2	1.5	11.3	61.0	372.7	3620	82
EST	0.1	0.0	0.1	0.2	0.0	0.4	17.5	0.0	0.0	0.0	0.1	0.1	0.3	0.1	0.0	0.4	0.0	0.0	0.0	0.3	5.0	25	70
HRV	0.4	0.0	0.1	0.4	0.1	0.9	0.0	40.7	0.2	0.0	0.9	0.0	0.0	0.1	0.1	0.1	0.1	0.4	0.1	0.4	6.1	51	80
HUN	1.6	0.2	0.5	1.2	0.9	6.9	0.0	0.3	92.6	0.3	2.1	0.0	0.0	1.0	1.3	0.6	0.8	0.2	0.4	1.9	13.7	127	73
IRL	0.4	0.1	2.8	3.5	0.3	4.0	0.0	0.3	157.4	2.7	0.0	0.0	0.6	0.2	0.4	0.1	0.0	0.3	10.8	52.7	237	67	
ITA	3.8	0.8	7.8	10.1	2.3	26.9	0.2	0.9	2.0	1.7	1,766.8	0.2	0.1	5.0	3.0	4.6	1.3	0.9	5.3	19.3	134.9	1,998	88
LTU	0.1	0.0	0.1	0.4	0.1	1.0	0.2	0.0	0.1	0.0	0.3	33.3	0.4	0.5	0.0	0.7	0.0	0.0	0.1	0.6	8.1	46	72
LVA	0.1	0.0	0.2	0.0	0.5	0.3	0.0	0.0	0.0	0.1	0.2	21.9	0.2	0.0	0.4	0.0	0.0	0.1	0.2	4.4	29	76	
POL	2.0	0.3	1.7	3.6	4.1	21.8	0.4	0.2	1.7	0.7	4.5	0.6	0.4	408.2	1.2	3.2	1.9	0.3	1.5	4.8	490	512	80
ROU	1.2	0.5	0.5	1.3	0.4	5.2	0.0	0.1	1.0	0.2	2.6	0.0	0.0	0.6	148.7	0.6	0.3	0.1	1.1	1.8	20.5	187	80
RUS	3.9	0.6	5.0	42.8	3.8	23.7	0.5	0.6	1.4	1.5	12.0	1.7	0.9	14.1	3.1	1,309.1	1.8	0.3	8.0	24.4	265.0	1,724	76
SVK	1.3	0.1	0.3	0.7	1.9	4.5	0.0	0.1	1.0	0.2	1.3	0.0	0.0	1.3	0.3	1.0	71.8	0.1	0.3	0.8	10.4	97	74
SVN	0.8	0.0	0.3	0.4	0.2	1.8	0.0	0.5	0.3	0.0	1.2	0.0	0.0	0.2	0.1	0.2	0.1	33.3	0.2	0.4	5.1	45	74
TUR	0.7	0.8	0.6	5.1	0.5	7.4	0.1	0.1	0.5	0.3	3.9	0.1	0.1	1.2	1.2	4.7	0.3	0.1	656.2	6.4	60.3	751	87
USA	3.9	0.5	9.7	84.0	2.6	47.1	0.2	0.4	2.6	29.1	16.7	0.3	0.2	4.2	1.4	5.0	1.1	0.3	7.0	16,384.4	815.9	17,417	94
Other countries	25.3	7.6	49.8	899.6	20.9	285.2	3.3	4.0	17.9	48.6	139.0	4.5	2.5	39.9	16.7	61.0	13.2	4.0	69.4	875.6	9,641.5	12,229	79

Note: Other countries include Rest of the world and other countries that are not in this table, but are included in WIOD.

Source: Authors' calculations, based on WIOD (2016 vintage database).

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Appendices

Appendix A: Estimating trade in value added

Given that conventional statistical records on trade data do not provide adequate information concerning the degree of involvement in the process of globalized production, this section proposes a methodology appropriate for tracking trade in value added. The methodology used to estimate trade in value added stems from Leontief (1936). The author demonstrated that, once the interconnections between different industries and different countries are familiar, total output required for production of one unit of final goods is easily tracked. The quantity and type of intermediary goods that are necessary for the one unit of final good of interest is determined using input-output tables across industries and countries. Namely, \$1 of exports creates value added in trade directly, that is exactly the first-round domestic value added part of exports. Furthermore, \$1 of exports is produced with the use of intermediate products, each of which creates value added itself, and that is how indirect (second round) value added is generated. This procedure is repeated with intermediate products, and after a finite number of iterations, it gets to the raw materials used in the production process. Now, total domestic value added in trade is given as a sum of all indirect (second-round) value added terms and one direct term, generated through \$1 of exports.

The formalization of an accounting structure used for the estimation of value added component, as in Johnson and Noguera (2012) is presented below. Every industry sector $s \in S$ within a country $i \in N$ produces tradable good with the use of domestic inputs and imported intermediate goods. The amount of good produced by sector s in country i is denoted as $q_i(s)$; that is either used further as an intermediate good in the production process, or consumed as a final product. The main characteristic of the global input-output structure is that it separates bilateral flows of $q_i(s)$ for intermediate and final use. In order to capture these four dimensions appropriately (2 different sectors \times 2 different countries), source countries are denoted by i , and destination countries by j . The amount of final goods from production sector s in source country i designated for country j is denoted as $q_{ij}^c(s)$; while the amount of intermediary products from industry s in country i used in sector t of country j is marked as $q_{ij}^m(s, t)$: These flows satisfy market clearing conditions for goods, therefore:

$$q_i(s) = \sum_j q_{ij}^c(s) + \sum_j \sum_t q_{ij}^m(s, t)$$

Assuming a common price $p_i(s)$; the market clearing condition can be rewritten in value terms as:

$$y_i(s) = \sum_j c_{ij}(s) + \sum_j \sum_t m_{ij}(s, t), \quad (1)$$

where values of production, final consumption and intermediate goods flows are $y_i(s) \equiv p_i(s)q_i(s)$, $c_{ij}(s) \equiv p_i(s)q_{ij}^c(s)$ and $m_{ij}(s, t) \equiv p_i(s)q_{ij}^m(s, t)$. If $x_{ij}(s)$ denotes gross bilateral exports, $\chi_{ij}(s) = c_{ij}(s) + \sum_t m_{ij}(s, t)$ meaning that gross bilateral exports incorporate goods both of intermediate and final use out of the country.

Intuitively, (1) says that total output $y_i(s)$ is thus divided

between domestic final use, domestic intermediate use, and gross exports.

Presuming many countries (N) and industrial sectors (S) involved in the analysis of global trade, introducing compact notation facilitates formalization. In particular: $Sx1$ vector y_i stands for total (both intermediate and final use) value of output in each industrial sector; $Sx1$ vector c_{ij} denotes final goods flows from country i to country j , and $Sx1$ vector c_i denotes final demand of country i for its own products. Assuming SxS input-output matrix A , the use of intermediary goods from country i in country j would be $A_{ij}y_j$; Common matrix element of direct technical coefficients $A_{ij}(s; t)$ has a major role: it characterizes international association of inputs and outputs. For instance, it illustrates the value of $s=$ steel imported by $j=$ Croatia from $i=$ Germany needed for the production of $t=$ boats, as a ratio of total production of boats in Croatia. Compactly written, with A being the global input-output matrix, it comes up as follows:

$$A \equiv \begin{bmatrix} A_{11} & A_{12} & \cdots & A_{1N} \\ A_{21} & A_{22} & \cdots & A_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ A_{N1} & A_{N2} & \cdots & A_{NN} \end{bmatrix}, Y \equiv \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_N \end{bmatrix}, c_j \equiv \begin{bmatrix} c_{1j} \\ c_{2j} \\ \vdots \\ c_{Nj} \end{bmatrix}.$$

Now, the goods market clearing condition is:

$$y = Ay + \sum_j c_j, \quad (2)$$

that is the typical description of an input-output system, having total output distributed between intermediate and final consumption. Solving this system of equations for y :

$$y = \sum_j (I - A)^{-1} c_j, \quad (3)$$

where $(I - A)^{-1}$ is the so-called Leontief inverse of the input-output matrix A , which calculates the direct and indirect output value needed to satisfy final demand in country j . In order to visualize direct versus indirect terms, Leontief inverse is expressed as $(I - A)^{-1} = \sum_{k=0}^{\infty} A^k$, infinite sequence, where the zero order term multiplied with the vector of final consumption, c_j , represents direct output consumed as final goods. The first order term stands for direct output plus inputs used in the production of that particular direct final output: $[I + A]c_j$. The second order term, in addition, contains intermediates needed for production of first round intermediate goods: $[I + A + A^2]c_j$: The same logic applies for the third round, fourth round terms, and continues until it gets to the raw materials used in production process. In that way, output from country i is disintegrated into the quantity of output from i used to produce final consumption goods in j ; that is a different concept from gross exports. While exports from country i to country j are detected directly, output flows are rather estimated with the use of information provided by the global input demand for final goods consumed in particular country. In order to get the value added streaming from aforementioned bilateral trade transactions, the share of value added to output is determined for each industrial sector within a country i as $\eta_i = 1 - \sum_j \sum_s A_{ji}(s, t)$ that is the GDP to gross exports ratio, for each industrial sector level. Now, the value added exports

and value added share of exports (VAX ratio) are defined as follows:

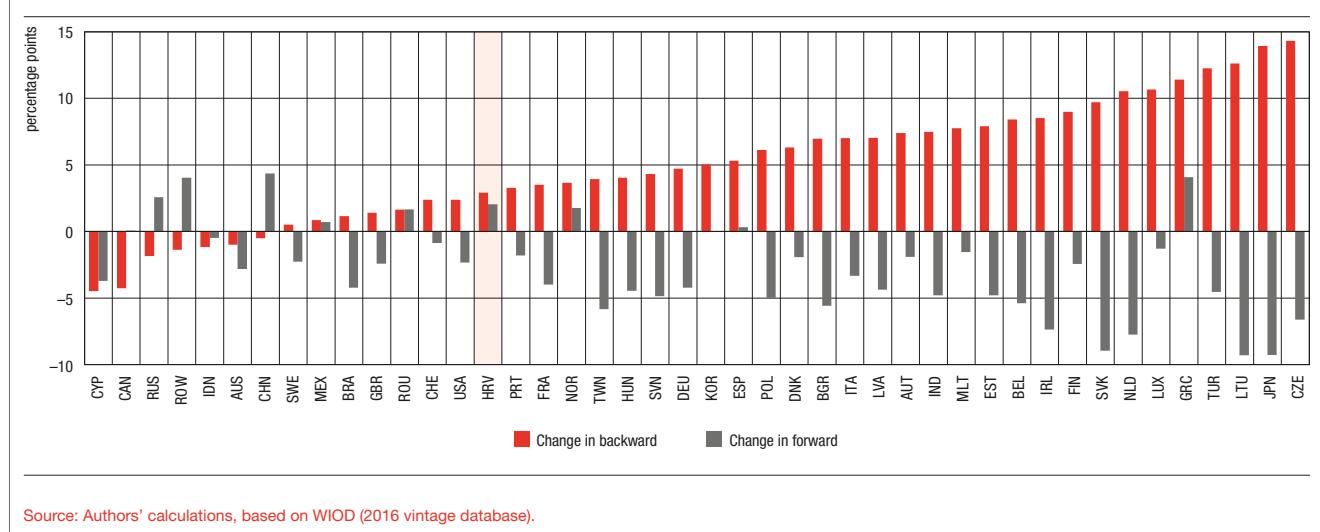
- *Value added exports* equals the absolute value added produced by industry s in country i destined to country j : $va_{ij}(s) = r_i(s)y_{ij}(s)$, while total value added produced in country i is easily calculated as $va_{ij} = \sum_s va_{ij}(s)$.

- *VAX ratio* equals $va_{ij}(s)/x_{ij}(s)$, $x_{ij}(s)$ being the gross bilateral exports.

For more on specific indicators on GVCs see Ahmad, Bohn, Mulder, Vaillant, and Zalcicever (2017).

Appendix B: Additional figures

Figure 17 Change in backward participation index and forward participation index 2000-2014 across countries



Appendix C: Additional tables

Table C1 Countries included in WIOD

Code	Description
AUS	Australia
AUT	Austria
BEL	Belgium
BGR	Bulgaria
BRA	Brazil
CAN	Canada
CHE	Switzerland
CHN	China
CYP	Cyprus
CZE	Czech Republic
DEU	Germany
DNK	Denmark
ESP	Spain
EST	Estonia
FIN	Finland
FRA	France
GBR	United Kingdom
GRC	Greece
HRV	Croatia
HUN	Hungary
IDN	Indonesia
IND	India
IRL	Ireland
ITA	Italy
JPN	Japan
KOR	Korea
LTU	Lithuania
LUX	Luxembourg
LVA	Latvia
MEX	Mexico
MLT	Malta
NLD	Netherlands
NOR	Norway
POL	Poland
PRT	Portugal
ROU	Romania
RUS	Russia
SVK	Slovakia
SVN	Slovenia
SWE	Sweden
TUR	Turkey
TWN	Taiwan
USA	United States
ROW	Rest of the World

Table C2 Industries included in WIOD

Code	Description
A01	Crop and animal production, hunting and related service activities
A02	Forestry and logging
A03	Fishing and aquaculture
B	Mining and quarrying
C10-C12	Manufacture of food products, beverages and tobacco products
C13-C15	Manufacture of textiles, wearing apparel and leather products
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
C17	Manufacture of paper and paper products
C18	Printing and reproduction of recorded media
C19	Manufacture of coke and refined petroleum products
C20	Manufacture of chemicals and chemical products
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
C22	Manufacture of rubber and plastic products
C23	Manufacture of other non-metallic mineral products
C24	Manufacture of basic metals
C25	Manufacture of fabricated metal products, except machinery and equipment
C26	Manufacture of computer, electronic and optical products
C27	Manufacture of electrical equipment
C28	Manufacture of machinery and equipment n.e.c.
C29	Manufacture of motor vehicles, trailers and semi-trailers
C30	Manufacture of other transport equipment
C31_C32	Manufacture of furniture; other manufacturing
C33	Repair and installation of machinery and equipment
D35	Electricity, gas, steam and air conditioning supply
E36	Water collection, treatment and supply
E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services
F	Construction
G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
G46	Wholesale trade, except of motor vehicles and motorcycles
G47	Retail trade, except of motor vehicles and motorcycles
H49	Land transport and transport via pipelines
H50	Water transport
H51	Air transport
H52	Warehousing and support activities for transportation
H53	Postal and courier activities
I	Accommodation and food service activities
J58	Publishing activities

Table C3 Decomposition of sectors

Code	Description	Code	Industries	Sectors
J59_J60	Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities	A01 -A03	Agriculture	Primary production
J61	Telecommunications	B	Mining and quarrying	Primary production
J62_J63	Computer programming, consultancy and related activities; information service activities	C10-C12	Food, beverages and tobacco	Manufacturing
K64	Financial service activities, except insurance and pension funding	C13-C15	Textiles	Manufacturing
K65	Insurance, reinsurance and pension funding, except compulsory social security	C16	Wood and wood products	Manufacturing
K66	Activities auxiliary to financial services and insurance activities	C17	Paper and paper products	Manufacturing
L68	Real estate activities	C18	Recorded media	Manufacturing
M69_M70	Legal and accounting activities; activities of head offices; management consultancy activities	C19	Coke and refined petroleum	Manufacturing
M71	Architectural and engineering activities; technical testing and analysis	C20	Chemicals and chemical products	Manufacturing
M72	Scientific research and development	C21	Pharmaceutical products	Manufacturing
M73	Advertising and market research	C22	Rubber and plastic	Manufacturing
M74_M75	Other professional, scientific and technical activities; veterinary activities	C23	Non-metallic mineral products	Manufacturing
N	Administrative and support service activities	C24-C25	Basic metals and metal products	Manufacturing
O84	Public administration and defence; compulsory social security	C26	Computers and electronics	Manufacturing
P85	Education	C27	Electrical equipment	Manufacturing
Q	Human health and social work activities	C28	Machinery and equipment	Manufacturing
R_S	Other service activities	C29-C30	Motor vehicles and transport equipment	Manufacturing
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	C31_C32	Furniture	Manufacturing
U	Activities of extraterritorial organizations and bodies	C33	Repair and installation equip	Manufacturing
		D35	Electricity, gas, air conditioning	Manufacturing
		E36-E39	Water and sewerage	Services
		F	Construction	Services
		G45-G47	Retail trade	Services
		H49-H53	Transport	Services
		I	Hotels and restaurants	Services
		J58-J63	Communication and computer programming	Services
		K64-K66	Financial and insurance activities	Services
		L68	Real estate	Services
		M69_M75	Professional scientific and technical activities	Services
		N; O84; R_S	Administration; public administration and defense; other service activities	Services
		P85	Education	Services
		Q	Human health and social work	Services

Table C4 Interdependencies between different countries in 2014

The following Surveys have been published

No.	Date	Title	Author(s)
S-1	March 2000	Banking Sector Problems: Causes, Solutions and Consequences	Ljubinko Jankov
S-2	April 2000	Banking System in 1998	
S-3	December 2000	The Lending Policies of Croatian Banks: Results of the Second CNB Bank Interview Project	Evan Kraft with Hrvoje Dolenc, Mladen Duliba, Michael Faulend, Tomislav Galac, Vedran Šošić and Mladen Mirko Tepuš
S-4	December 2000	What Has Been the Impact of Foreign Banks in Croatia	Tomislav Galac and Evan Kraft
S-5	September 2001	Currency Crises: Theoretical and Empirical Overview of the 1990s	Ante Babić and Ante Žigman
S-6	April 2002	An Analysis of the Operation of Building Societies in the Republic of Croatia	Mladen Mirko Tepuš
S-7	April 2002	Ten Years of Transition Central Banking in the CEE and the Baltics	Warren Coats and Marko Škreb
S-8	May 2002	Fiscal Consolidation, External Competitiveness and Monetary Policy: A Reply to the WIIW	Evan Kraft Tihomir Stučka
S-9	November 2004	Survey and Analysis of Foreign Direct Investment in the Republic of Croatia	Alen Škudar
S-10	February 2005	Does Croatia Need Risk-Based Deposit Insurance Premia?	Tomislav Galac
S-11	February 2005	How Can Croatia's Deposit Insurance System Be Improved?	Michael Faulend and Evan Kraft
S-12	April 2005	An Analysis of Housing Finance Models in the Republic of Croatia	Mladen Mirko Tepuš
S-13	July 2005	EU Criteria with Special Emphasis on the Economic Convergence Criteria – Where is Croatia?	Michael Faulend, Davor Lončarek, Ivana Curavić and Ana Šabić
S-14	December 2005	Results of the Third CNB Bank Survey: Croatian Banking in the Consolidation and Market Positioning Stage, 2000 – 2002	Tomislav Galac
S-15	November 2008	Results of the Fifth CNB Bank Survey	Lana Ivičić, Mirna Dumičić, Ante Burić, Ivan Huljak
S-16	December 2008	Results of the Fourth CNB Bank Survey	Tomislav Galac and Lana Dukić
S-17	September 2014	Framework for Monitoring Macroeconomic Imbalances in the European Union – Significance for Croatia	Mislav Brkić and Ana Šabić
S-18	August 2015	A Brief Introduction to the World of Macroprudential Policy	Mirna Dumičić
S-19	October 2015	Features of the Labour Market and Wage Setting in Croatia: Firms Survey Results	Marina Kunovac and Andreja Pufnik
S-20	November 2016	Are Shadow Banks Hiding in Croatia as Well?	Mirna Dumičić and Tomislav Ridzak
S-21	December 2016	A Note on Kuna Lending	Igor Ljubaj and Suzana Petrović
S-22	July 2017	Microeconomic Aspects of Productivity Developments during the Great Recession in Croatia – the CompNet Productivity Module Research Results	Miljana Valdec and Jurica Zrnc
S-23	August 2017	Price Competitiveness of the Manufacturing Sector – a Sector Approach Based on Technological Intensity Level	Enes Đozović
S-24	October 2017	Exposure of the Private Non-financial Sector to Interest Rate Risk: Analysis of Results of the Survey on Interest Rate Variability	Mate Rosan
S-25	August 2017	CNB Transparency and Monetary Policy	Katja Gattin Turkalj and Igor Ljubaj
S-26	October 2017	Adoption of the Euro in Croatia: Possible Effects on International Trade and Investments	Maja Bukovšak, Andrijana Ćudina and Nina Pavić
S-27	November 2017	Effects of the Adoption of the Euro on Consumer Prices and Inflation Perceptions: An Overview of Experiences and Assessment of the Possible Impact in Croatia	Andreja Pufnik
S-28	November 2017	Can the Adoption of the Euro in Croatia Reduce the Cost of Borrowing?	Davor Kunovac and Nina Pavić
S-29	November 2017	Estimating Potential Growth and Output Gap in Croatia	Goran Jovičić
S-30	January 2018	Is the Euro the Optimum Currency for Croatia: An Assessment Using the Optimum Currency Area Theory	Mislav Brkić and Ana Šabić
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After the submission, the manuscripts shall be subject to peer review and classification by the Manuscript Review and Classification Committee. The authors shall be informed of the acceptance or rejection of their manuscript for publication within two months following the manuscript submission.

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The first page of the manuscript should contain the article title, first and last name of the author and his/her academic degree, name of the institution with which the author is associated, author's co-workers, and the complete mailing address of the corresponding author to whom a copy of the manuscript with requests for corrections shall be sent.

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The second page should contain the abstract and the key words. The abstract is required to be explicit, descriptive, written in third person, consisting of not more than 250 words (maximum 1500 characters). The abstract should be followed by maximum 5 key words.

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