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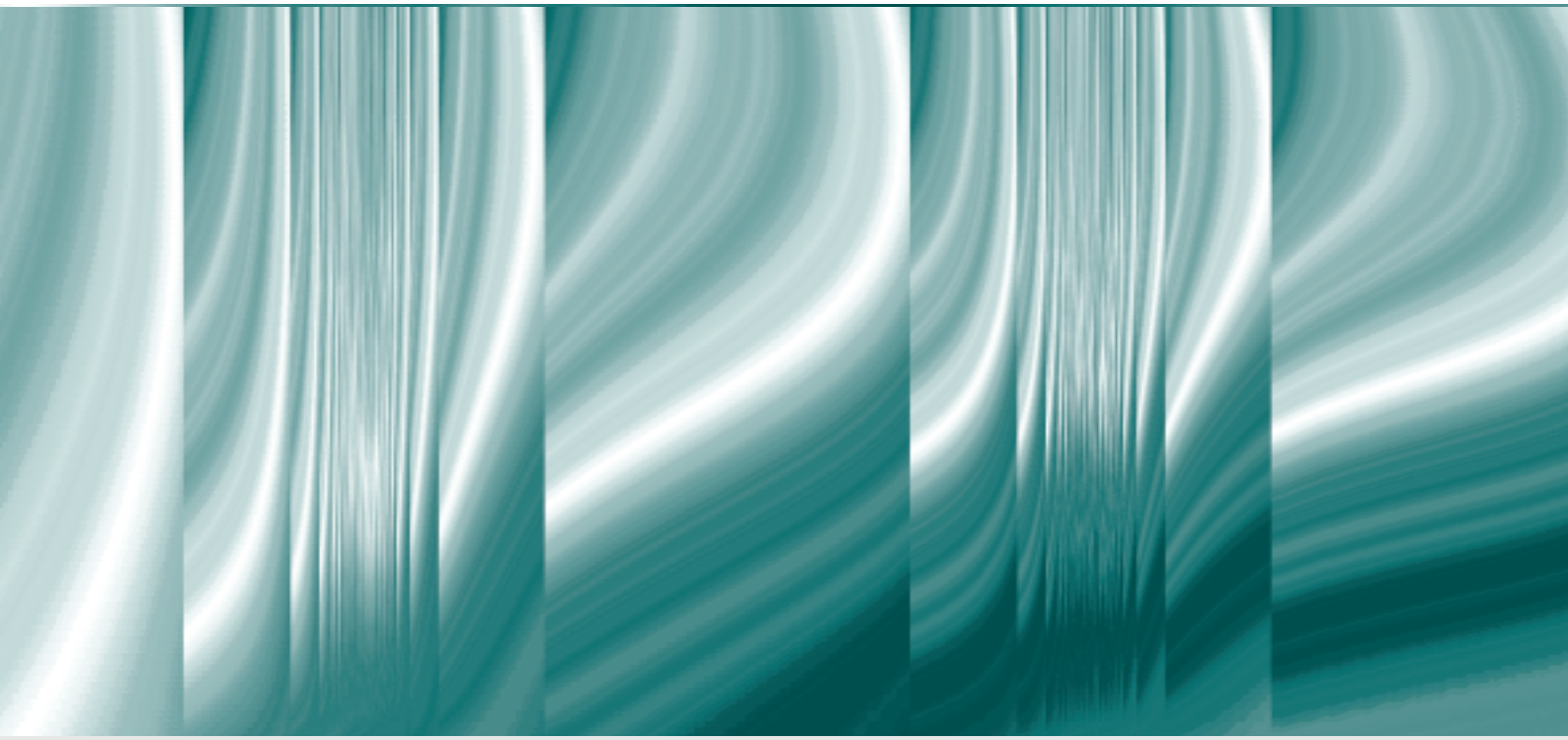
STRUCTURE AND COMPETITIVENESS OF THE SLOVENIAN ECONOMY IN THE WORLD OF INCREASING PRODUCTION FRAGMENTATION



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Structure and Competitiveness of the Slovenian Economy in the World of Increasing Production Fragmentation

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This paper investigates the structure of Slovenian export activity in the world of increasingly fragmented production processes that span across several country borders. In particular, we revisit the conventional notion of Slovenian export activity through the perspective of trade in value added. Moreover, by decomposing Slovenian gross exports into various value added components, we examine how participation and relative positioning of the Slovenian economy in global value chains evolved through time. In addition, we analyze which production factors are most affected by increasing globalization forces influencing trade and production. Our results show that Slovenian participation in global value chains increased mostly on the back of backward engagement, indicating room for further improvements in competitiveness and gains to be created in international trade. This is confirmed by a detailed value added decomposition of gross exports and factor content of trade, which points towards relative downstream positioning of the Slovenian economy, especially when compared to countries of similar characteristics and of arguably comparable development paths.

JEL-Codes: F13, F14, F40, F63, F62

Keywords: Slovenian exports, Global value chains, Trade in value added, World Input-Output Database

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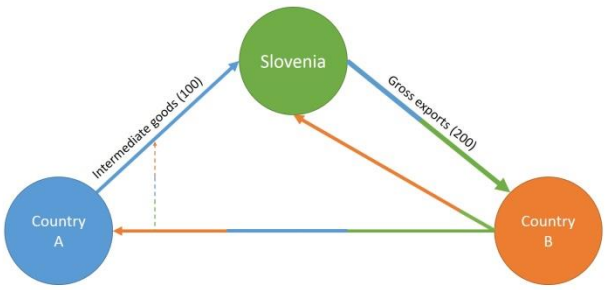
1. Introduction

Slovenia has conventionally been perceived as a small open and export driven economy. This has very much been supported by recent developments, where Slovenian current account surplus has increased by almost 4 percentage points since 2013, mostly on the back of soaring export growth. However, a common look on international trade has fundamentally changed in the past two decades, with trade moving away from flows in goods towards exchange in tasks and production activities, which stretch across multiple sectors and countries. This has most prominently been reflected in rapidly increasing trade in intermediate goods, which accounts for more than two thirds of the overall global trade. In this respect, the official trade statistics, based on gross trade flows, offers us little or arguably even misleading implications of recent exports developments in Slovenia for the real economy, competitiveness, and actual trade balances.

Figure 1, in a very simplistic way, illustrates how official trade statistics can potentially lead to multiplication issues in exports accounting. The first instance of double counting occurs through imported inputs needed for the production of Slovenian exports. Namely, in our example, 200 units of Slovenian exports embed 100 units of intermediate goods imported from country A, meaning the actual value added content amounts to only half of the Slovenian gross exports to country B. The second source of double counting in official trade statistics arises from a part of the domestic value added in exports that eventually returns home after it has been processed and incorporated into products imported from either country A or B. In the framework of vertical stages of cross-country production, the Slovenian economy could therefore be seen as being backward linked to country A, through import content of export production, and forward linked to country B through intermediate exports entering sequential stages of production abroad.

Figure 1: Double counting in gross exports



Source: *Authors*

It turns out that origin and size of double-counted component of gross exports importantly determine country's competitiveness and gains produced in international trade. Namely, the larger share of foreign value added in gross exports could be associated with a country's greater dependency on intermediate goods produced in upper stages of sequential inter-country production process, pushing that country downstream in global value chain (hereafter GVC). Conversely, higher share of domestic content that returns to a country after processing abroad, implies country's relative upstream positioning within GVC. Namely, returned value added is typically associated with upstream activities such as design, marketing, R&D, which can be associated with technologically enhanced products and thus with more beneficial engagement in GVC as compared to participation through assembly stages of production chain.

In order to understand the degree of integration and relative upstream/downstream positioning of the Slovenian economy in GVC, it is therefore essential to identify domestic and foreign value added components encapsulated in the gross export data. To do that, we borrow extensively from Koopman, Wang, and Wei (2014), hereafter KWW. Their accounting framework enables detailed decomposition of gross exports into components related to domestic value-added embedded in exports of final and intermediate goods, returned domestic value-added in import content of exports, and pure foreign content of exports. This kind of framework provides a generalization of previous literature related to the GVC phenomenon.

In particular, the foreign content of gross exports exactly equals the vertical specialization (VS) measure defined by Hummels, Ishii and Yi (HIY, 2001), which can be considered as one of the first formal measures related to intensity of participation in GVC. Relating to Figure 1, however, the VS measure only captures the backward aspect of inter-country vertical trade. To capture the overall GVC integration we have to, therefore, additionally consider the forward participation, that is, the scope of domestic intermediate products embedded in third country export production. While forward participation in GVC had been discussed and recognized by HIY under VS1 denotation, the formal characterization and tractability within inter-country input-output tables was only provided by KWW[1]. Examining the intensity of integration through backward and forward engagement has received a wide coverage in applied research related to GVC. For instance, GVC participation index capturing VS and VS1 is part of officially published GVC statistics by the OECD. A similar index was used by WTO (2014) to show that participation in GVC increased for almost all countries in the world in the past two decades, most notably for India, China, Republic of Korea, and Philippines. Bang (2013) and De Backer and Miroudot (2013) discuss forward over backward participation ratio in the context of

[1] Koopman, Wang and Wei (2014) represents a published version of the study, which was in years 2010 and 2012 discussed in form of conference and working paper series.

relative gains produced within GVC, with countries with higher proportion of forward participation exhibiting more beneficial engagement in vertical trade.

Progressively increasing GVC participation calls for updated interpretation of the official gross trade statistics, especially in the part related to bilateral trade balances, concentration of trade and domestic component of export activity. To shed light on these issues, Johnson and Noguera (2012) formalized the value-added export in the context of inter-country input-output tables, which traces domestic value-added embedded in exports, according to the country of absorption. Considering the destination of absorption as opposed to first border crossing allows observing true export exposures and regionalization patterns of inter-country production, where a particular country can represent an entry point to third markets. The value-added export formulized by Johnson and Noguera (2012), however, only considers export flows entirely consumed abroad. KWW additionally trace domestic value-added embedded in gross exports that eventually returns home, after being processed in sequential production stages abroad. Thus, by slicing gross exports into value-added exports, returned value added and foreign value added, KWW importantly advance the debate on country's participation and gains produced within GVC. This paper utilizes this framework to derive GVC participation and relative positioning measures for Slovenia and to provide comparison with other comparable countries.

To derive GVC indicators for Slovenia, we rely on the World Input-Output Database (WIOD). Inter-country input-output tables have been developed under various data initiatives[2], however, we deem the European Commission's WIOD project, as the one with the most distinguishable comparative advantages. Namely, it is a publicly available data source[3], has the widest time and country scope, and it is gaining increasing application in the field of GVC research. For example, Timmer et al (2015) analyze input factor distribution of export to show rapidly increasing regional and global fragmentation in automotive industry. Similarly, Timmer et al (2013) show how relying on gross exports data and traditional revealed comparative advantages indicators can lead to misleading conclusions related to competitiveness of a particular sector. Fajgelbaum and Khandelwal (2016) use bilateral sector flows from the WIOD tables to show considerable variation in trade gains among high-income and low-income countries. Timmer et al (2014) examine how specialization patterns differ depending on countries' income and how the factor content in export changes as production fragmentation deepens. Los, Timmer, and de Vries (2015) observe the development of foreign value added in the export production and show that it has been consistently increasing over the past 20 years. Their study shows evidence of reverse regionalization patterns for the majority of countries as the

[2] For example, the Asian International Input-Output Tables (Meng et al, 2013), the database constructed under Global Trade Analysis Project (GATP) initiative (Trefler and Zhu, 2010), the EORA database (Lenzen et al, 2013), the OECD-WTO database on TiVA (OECD, 2013).
[3] http://www.wiod.org/home

increase in foreign value added has mainly been driven by content outside the region of country-of-completion.

Using the concepts described above in combination with the WIOD, this paper characterizes the structure of Slovenian exports from the global value chain perspective. In particular, the paper attempts to address the following research questions:

- How integrated is Slovenian economy in global-value chains and how has its participation evolved through time?
- How different is Slovenian trade in value added compared to the traditional notion provided by official trade statistics?
- What is the relative upstream/downstream positioning of Slovenian economy in global-value chains?
- Which production factors in Slovenia are most affected by the deepening global value-chain and globalization process?

Concretely, Section 2 formally describes inter-country input-output tables, provides decomposition of gross exports into various value added components and derives indicators related to GVC participation and positioning; Section 3 revisits Slovenian bilateral country trade balances from the perspective of trade in value added and examines how Slovenian GVC participation evolved through time; in Section 4 we slice the gross exports data in various value-added components with the purpose of determining relative upstream/downstream positioning of the Slovenian economy in GVC; Section 5 examines which are the production factors most affected by the increased involvement in GVC; Section 6 concludes.

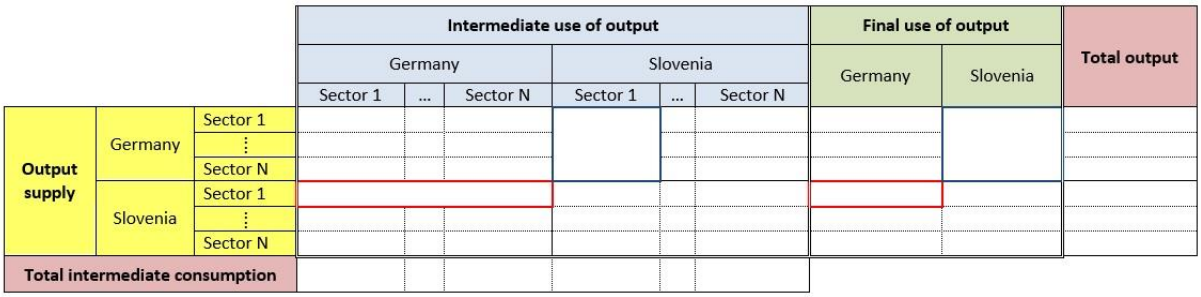
2. Data and methodology

To appropriately capture Slovenian trade in GVC context, the World Input-Output Database (WIOD) is used throughout the paper. The WIOD incorporates two datasets, the World Input-Output tables (WIOT) and the Socio-Economic Accounts (SEA). The WIOT are constructed on the basis of national input-output tables and official trade and national accounts statistics (Timmer et al, 2015). In order to extract the most up-to-date information related to Slovenian trade in the context of GVC, where possible, we rely on second vintage of the WIOD, which spans the period from 2000 to 2014, 56 sectors, and 43 countries. The factor decomposition of export production, implemented in Section 5, is

based on the Supply-and-Use tables (SUT), which are only available for the first WIOD vintage, comprising period from 1995 to 2011, 35 sectors, and 40 countries.

Outline of the WIOT can best be summarized by Figure 2. The rows in the WIOT represent the output supplied by a particular country and industry. The columns in turn represent in which country and industry the output is being absorbed. The supplied output can either be used as an intermediate input in other industries or it can enter a particular country's final consumption. The sum across all columns represents the total gross output supplied by a particular country and industry. The sum across rows in turn represents the total intermediate consumption by a particular country and sector. Excluding final domestic consumption and the output absorbed by domestic production sectors offers individual industry exports. For example, in the two-country example depicted in Figure 2 the exports corresponding to Slovenian Sector 1 is summarized by the sum over red cells. Sum over all exports across all industries provides country's total exports. Conversely, the intermediate and final use of output supplied by foreign industries provide country's import (blue cells in Figure 2).

Figure 2: WIOD table in a two-country layout



Source: *WIOD, Authors*

2.1 Value-added decomposition of gross exports

Figure 1 illustrated particular components of gross exports that represent double counting in the official trade statistics. Proper identification of these components can therefore enable us to examine trade from the perspective of domestic value-added. Moreover, detailed decomposition of gross exports into domestic and foreign value-added components can shed light on the level of integration and positioning of a country in GVC. To perform a detailed decomposition of gross exports we rely on the accounting framework provided by KWW.

The starting point of such decomposition is an input-output analysis. Let M determine the number of countries in the WIOD table (43 plus the rest of the world), and let N be the number of industry

sectors in particular country (56 in the WIOD). The world input-output framework depicted in Figure 2 can then formally be described as:

$$\underbrace{\begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_M \end{bmatrix}}_{Gross\ output} = \underbrace{\begin{bmatrix} c_{11} & c_{12} & \dots & c_{1M} \\ c_{21} & c_{22} & \dots & c_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ c_{M1} & c_{M2} & \dots & c_{MM} \end{bmatrix}}_{Intermediate\ consumption} \mu + \underbrace{\begin{bmatrix} Y_{11} & Y_{12} & \dots & Y_{1M} \\ Y_{21} & Y_{22} & \dots & Y_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ Y_{M1} & Y_{M2} & \dots & Y_{MM} \end{bmatrix}}_{Final\ Consumption} \nu \tag{1}$$

Where X is a *NMx1* partitioned vector with individual element X_s representing a Nx1 vector of country's gross output by sector, matrix C is a *NMxNM* matrix with individual *NxN* block c_{sr} representing country *s'* input used in production of country *r*, μ is a *NMx1* partitioned vector with individual *Nx1* row vectors of ones, *Y* is a *NMxM* matrix, with individual element Y_{sr} being a Nx1 vector of country *s*' final good products consumed in country *r*, and ν being a *Mx1* partitioned vector of ones.

By dividing each country's intermediate consumption with its total gross product we can obtain a matrix of direct input-output (I-O) coefficients, where individual *NxN* block A_{sr} represents country *r*'s production dependency on inputs provided by country *s*. More specifically, the individual element of block matrix, $a_{si,rj} = \frac{c_{si,rj}}{X_{rj}}$, expresses the proportion of the total output of a sector *j* in country *r* produced with inputs provided by sector *i* in country *s*.

$$\underbrace{\begin{bmatrix} A_{11} & A_{12} & \dots & A_{1M} \\ A_{21} & A_{22} & \dots & A_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ A_{M1} & A_{M2} & \dots & A_{MM} \end{bmatrix}}_{Direct\ input-output\ coefficients} = \begin{bmatrix} c_{11} & c_{12} & \dots & c_{1M} \\ c_{21} & c_{22} & \dots & c_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ c_{M1} & c_{M2} & \dots & c_{MM} \end{bmatrix} \begin{bmatrix} diag(\overrightarrow{X_1}) & 0 & \dots & 0 \\ 0 & diag(\overrightarrow{X_2}) & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & diag(\overrightarrow{X_M}) \end{bmatrix}^{-1} \tag{2}$$

Using matrix of direct I-O coefficients we can re-express equation (1) as:

$$X = AX + F \tag{3}$$

Where $F = \sum_r^M Y_{sr}$. Following Leontief's seminal work, solution for equation (3) is given by the Leontief inverse, which represents both direct and indirect output generated in different stages of production to meet additional unit of final consumption:

$$X = (I - A)^{-1}F = BF \tag{4}$$

The starting point of the trade in value-added analysis is the augmentation of the basic input-output identity captured by Equation (4). In particular, the right-hand side is pre-multiplied with direct value-added coefficients corresponding to each particular sector in individual country. The direct value added coefficients capture the difference between a unit of final product, produced by a particular sector, less the share of intermediate goods used in the process, i.e. $V_{rj} = 1 - \sum_{i=1}^{N} \sum_{s \neq r}^{M} a_{si,rj}$. Moreover, let V_s be a *NxN* diagonal matrix with direct sectoral value-added coefficients for particular country on diagonal. The matrix representation of the value-added based input-output identity is then given by the following identity:

$$VBY = \begin{bmatrix} V_1 & 0 & \dots & 0 \\ 0 & V_2 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & V_M \end{bmatrix} \begin{bmatrix} B_{11} & B_{12} & \dots & B_{1M} \\ B_{21} & B_{22} & \dots & B_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ B_{M1} & B_{M2} & \dots & B_{MM} \end{bmatrix} \begin{bmatrix} Y_{11} & Y_{12} & \dots & Y_{1M} \\ Y_{21} & Y_{22} & \dots & Y_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ Y_{M1} & Y_{M2} & \dots & Y_{MM} \end{bmatrix} \tag{5}$$

The VBY characterizes a MN by M value-added production matrix. This kind of framework is particularly useful as it allows us to observe where the value-added produced in particular country is eventually absorbed. Namely, the diagonal elements of the VBY matrix represent domestic value-added consumed at home, while off-diagonal elements represent exported value added.

Moreover, we can differentiate among three types of value added exports (hereafter VAE) according to intermediate or final good exports and according to country of absorption. In the first instance, we can refer to value added exports of country s, consumed as a final good in country r (hereafter VAF). The second type refers to value added embedded in intermediate goods used by country r to produce final goods for domestic consumption (hereafter VAI). In the third case, the intermediate exports is used in the production of final goods shipped from country r to country t (hereafter VAZ). The expression below formally summarizes the value added exports and its accounting decomposition in country s:

$$VAE_s = \underbrace{V_s \sum_{r \neq s}^{M} B_{ss} Y_{rs}}_{VAF} + \underbrace{V_s \sum_{r \neq s}^{M} B_{sr} Y_{rr}}_{VAI} + \underbrace{V_s \sum_{r \neq s}^{M} \sum_{t \neq r,s}^{M} B_{sr} Y_{rt}}_{VAZ} \tag{6}$$

Dividing the expression above with total gross exports leads to the value added to export ratio (the VAX ratio) as proposed by Johnson and Noguera (2012). The difference between the gross exports and value-added exports in turn represents the double counted component in the official trade statistics. As it was already illustrated by Figure 1, sources of double counting can be twofold. The first instance of double counting arises from initially exported domestic value added that returns home as part of country's imports. The returned value added (hereafter RVA) can return in form of imported

final goods consumed at home (hereafter RVF), as an intermediate imports used for domestic production of final goods (hereafter RVI), and finally the returned value added as a part of re-imported intermediate goods which are then processed and further exported (RVZ). The latter case importantly differs from the former two cases of returned domestic value added. Namely, since domestically consumed GDP along with exported value added forms 100 % of a country's GDP, both the RVF and RVI components essentially constitute part of the domestic GDP counted once. In contrast, while the RVZ components belongs to the part of domestic output, from an accounting perspective, it cannot be part of any country's GDP and it is therefore treated as a pure double counted term. Equation below provides formal description of returned value added:

$$RVA_s = \underbrace{V_s \sum_{r \neq s}^{M} B_{sr} Y_{rs}}_{RVF} + \underbrace{V_s \sum_{r \neq s}^{M} B_{sr} Y_{rs} (1 - A_{ss})^{-1} Y_{ss}}_{RVI} + \underbrace{V_s \sum_{r \neq s}^{M} B_{sr} Y_{rs} (1 - A_{ss})^{-1} E_s}_{RVZ} \tag{7}$$

Therefore, the VAE along with RVF and RVI forms a domestic value added in exports and in that respect extends the concept of value added exports and the VAX ratio provided by Johnson and Noguera (2012). The sum of VAE and RVA represents the domestic content of exports, which due to the double counted component goes beyond the pure GDP concept incorporated in a country's exports. The residual between gross exports and domestic component therefore represents the foreign part of domestic exports (hereafter FVA). The formal derivation of foreign component is analogous to returned value added. Namely, it can similarly be decomposed into a part of foreign GDP used for production of domestic exports and a part that constitutes foreign output but cannot uniquely be assigned to any country's GDP:

$$FVA_s = \underbrace{\sum_{t \neq s}^{M} \sum_{s \neq r}^{M} V_t B_{ts} Y_{sr}}_{FVF} + \underbrace{\sum_{t \neq s}^{M} \sum_{s \neq r}^{M} V_t B_{ts} A_{sr} (1 - A_{rr})^{-1} Y_{rr}}_{FVI} + \underbrace{\sum_{t \neq s}^{M} V_t B_{ts} Y_{sr} \sum_{s \neq r}^{M} (1 - A_{rr})^{-1} E_r}_{FVZ} \tag{8}$$

The WIOD, however, allows us further granulation of the gross export statistics. In particular, the Socio-Economic Accounts of the WIOD provide information on value-added contribution provided by a particular production factor, more specifically labor (according to skill classification) and capital. In Section 5, we therefore examine factor content of Slovenian export production by replacing value-added coefficients with direct value-added coefficients corresponding to respective production input factor component.

2.2 Measures of participation and positioning in GVC

In the accounting framework provided above, all subcomponents of VAE, RVA, and FVA, respectively, add up to a country's gross exports:

$$gross\ exports = \underset{(1)}{VAF} + \underset{(2)}{VAI} + \underset{(3)}{VAZ} + \underset{(4)}{RVF} + \underset{(5)}{RVI} + \underset{(6)}{RVZ} + \underset{(7)}{FVF} + \underset{(8)}{FVI} + \underset{(9)}{FVZ} \qquad (9)$$

This identity provides a rich set of information related to country's participation and positioning within the GVC. In particular, the bilateral trade balances can be re-examined in the GVC context through a country's value-added exports (sum of components 1, 2, and 3) according to absorption destination, as defined by Johnson and Noguera (2012). In contrast, components 7, 8, and 9 capture the foreign content of export. In fact, HIY characterized import content of export as the degree of specialization in particular production stages, while relying on foreign suppliers to provide intermediate inputs related to upper (earlier) stages in production chain. In this respect, the sum of components 7, 8, and 9 exactly equals characterization of GVC participation measured by the degree of vertical specialization (VS) provided in HIY:

$$VS = A^m(I - A^d)^{-1}\frac{E_s}{\tau' E_s} \qquad (10)$$

where VS is a Nx1 vector of vertical specialization share by each sector in a particular country. $A^d = A_{ss}$ is a NxN matrix of direct inputs provided by domestic sectors in production, while the multiplicator $\left(\mathrm{I} - A^d\right)^{-1}$ represents the overall production, that is, production directly or indirectly influenced by the additional unit of final demand. The NxN matrix $A^m = \sum_{s \neq r}^{M} A_{sr}$ represents direct dependency of domestic production on imported inputs. The total export demand for output produced in country s is given by the sum of all intermediate and final goods consumed outside country s, $E_s = (\sum_{r \neq s}^{M} C_{sr})\tau + \sum_{r \neq s}^{M} Y_{sr}$. The total exports of a country *s* is given by the sum of exports across domestic sectors, $\tau' E_s$, where τ is a Nx1 vector of ones. The aggregate VS of a country s is given by $\tau' A^m \left(\mathrm{I} - A^d\right)^{-1} E_s / \tau' E_s$.

The VS, however, only provides the backward participation. To capture the overall engagement in GVC, we have to additionally account for forward participation or the use of country's intermediate inputs in exports of a third country. The forward participation is partly captured by components 3 to 7. KWW provide a formal expression encapsulating forward participation as:

$$VS1 = V_s \sum_{r \neq s}^{M} B_{sr} E_{r*} / \tau' E_s \quad (11)$$

The expression above is the formalization of the VS1 measure, already discussed but not defined in HIY. The sum of VS and VS1 thus offers a complete GVC participation index that can be found in a wide range of applied publications related to GVC (e.g. OECD (2013), WTO (2014)).

Bang (2013) and De Backer and Miroudot (2013) consider the proportion of forward over backward participation as a rough measure of relative upstream/downstream positioning within GVC. However, as we discuss later in the text, this kind of measure may not be the most suitable for deducting gains and technological intensity of the export activity and GVC engagement of a particular country. Alternatively, KWW argue that understanding the origins of double counting in gross exports (components 4-9) can help to provide an intuitive information on GVC positioning. In particular, they show that a prevailing foreign content in double counted component offers a good indication of relative downstream positioning of a country within GVC. In contrast, high shares of returned domestic value-added in double counted component seem to be highly correlated with relative upstream positioning of a country. Formally we can define the GVC positioning measure as a ratio between domestic content of exports (components 1-6) over value-added exports (components 1-3):

$$GVC\ positioning = \frac{domestic\ content\ of\ exports}{value\ added\ exports} = \frac{VAE + RVA}{VAE} \quad (12)$$

In the following section, the concepts of participation and measures of GVC positioning are applied to the Slovenian economy with purpose of understanding export dynamics in the context of deepening GVCs.

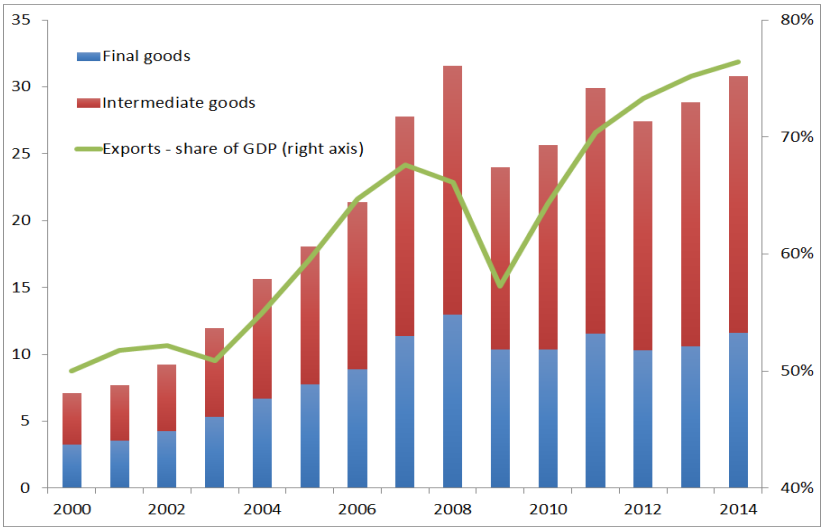
3. Slovenian trade in value added and GVC participation

This section explores stylized facts of the Slovenian trade in light of internationally increasing specialized production process. The emergence of global supply chains has had a dramatic effect on the level and composition of the international trade around the world. Slovenian trade has closely followed the global patterns with an increase in its exports, measured as a share of GDP, from 50 % in 2000 to 76 % in 2014. The rapid growth has been driven by trade in intermediates at the expense of final demand products, indicating progressive involvement in vertically fragmented production processes that stretch across several countries. The rapid growth in trade, especially in intermediates, strongly resembles lower costs and trade liberalization following the Slovenian accession in the European Union and the euro area.

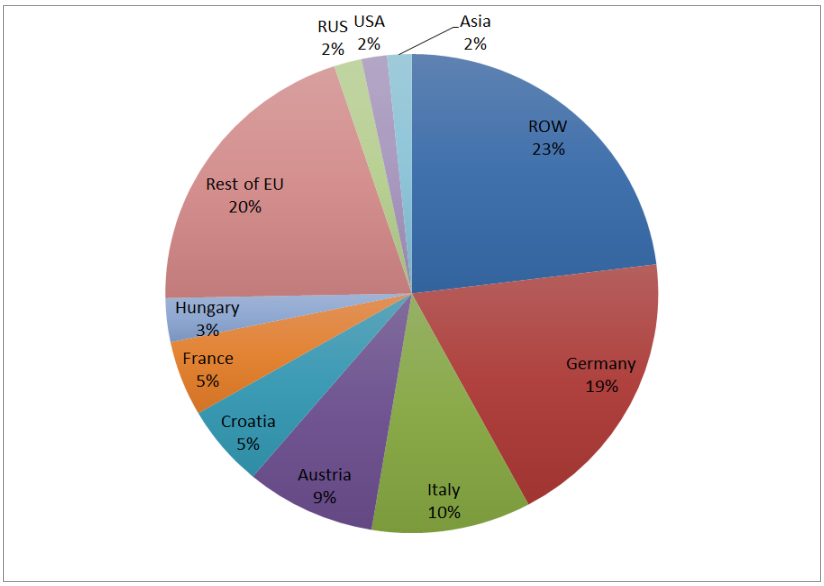
A related feature of the EU accession has been a high involvement of Slovenian industries in regional supply networks, apparent from a fairly concentrated intraregional gross trade flows. For example, exempting the five largest trading partners, the share of exports to other EU countries has increased by 10 percentage points compared to the year 2000. By observing Figure 7 in the Appendix, we can see that the changing patterns are largely coinciding with the main trade liberalization milestones. In contrast, the EU accession seems to be associated with some trade diverting patterns, with trade moving away from the regional ex-Yugoslavia partners (e.g. Croatia) towards the EU members that accessed the EU at the same time as Slovenia did.

Figure 3: Slovenian exports and main exports destinations

(a) Slovenian exports (bn EUR)



(b) Main export destinations in 2014



Source: *WIOD, Authors*

The country composition of Slovenian exports has so far been described on the basis of gross trade flows. However, with trade being ever more associated with inter-country vertical production process, foreign inputs take increasingly larger share in exports, which can potentially lead to a distorted picture associated with the actual trade balances. The export exposures can instead be re-examined from the perspective of value-added exports, described in Section 2, which allows tracking bilateral trade flows according to the destination of value added absorption. Table 1 presents Slovenian bilateral trade balances in terms of both, gross and value-added exports. First thing to note is that

Slovenian exports is more diverse than suggested by the gross trade flows. Namely, value added exports to key trading partners such as Germany, Austria, and Italy is more than 50 % lower compared to the gross exports figures. In contrast, value-added exports to the USA, China, and Japan is significantly higher than observed by the gross flows. The reason for shifts in bilateral balances is twofold. First, exports to key trading partners is highly concentrated in manufacturing sectors, where fragmentation in production process is deeper and therefore the ratio between value-added and gross exports ratio (VAX) is lower. Second, the EU trading partners, especially the western cluster, evidently forms a production hub and entry point for US and Asian markets. The latter points towards an integrated production process within the EU and consequently a portion of Slovenian intermediate exports to the EU that is eventually consumed in the US and Asia. This kind of indirect route of export associated with US and Asian markets explains why several bilateral VAX ratios are taking the value above 1.

Table 1: Slovenian export destinations in 2014

	Exports in mio $			*Share of total exports*		
Partner country	Gross exports	Value-added exports	VAX ratio	Gross exports	Value-added exports	Difference
Total	30812	19269	0.63			
DEU	5883	2621	0.45	19	14	-5
ITA	3225	1545	0.48	10	8	-2
AUT	2632	1058	0.40	9	5	-3
HRV	1702	821	0.48	6	4	-1
FRA	1559	1006	0.65	5	5	0
HUN	912	340	0.37	3	2	-1
POL	851	541	0.64	3	3	0
BEL	623	325	0.52	2	2	0
CZE	614	281	0.46	2	1	-1
CHE	595	384	0.65	2	2	0
GBR	574	580	1.01	2	3	1
RUS	560	449	0.80	2	2	1
USA	517	862	1.67	2	4	3
ROU	416	291	0.70	1	2	0
NLD	373	251	0.67	1	1	0
ESP	350	292	0.83	1	2	0
SWE	348	230	0.66	1	1	0
TUR	297	202	0.68	1	1	0
CHN	240	565	2.35	1	3	2
JPN	50	172	3.45	0	1	1
ROW	8490	6453	0.76	28	33	6

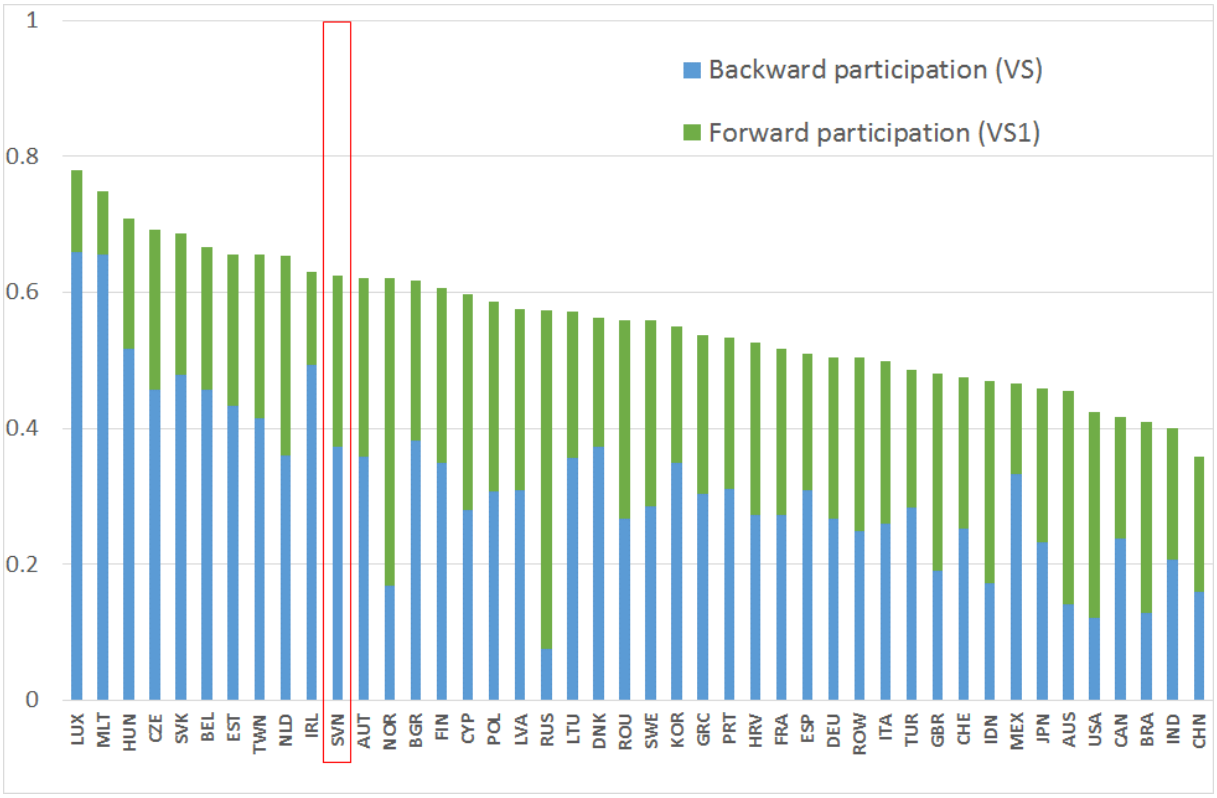
Source: *WIOD, Authors*

In 2014, the total Slovenian value-added exports stood at 19 bn $, or 11.5 bn $ lower than the gross exports. The average VAX ratio for Slovenia was therefore 63 %. Note that the VAX ratio itself does

not imply country's competitiveness or its relative upstream positioning within GVC. Instead, the VAX ratio offers a good indication of the degree of a country's involvement into GVC. Johnson and Noguera (2012) show that the VAX ratio can be associated with the size of a country, its resource abundance, and sectors in which the export production is concentrated. In general, smaller countries to a larger extent rely on production inputs and natural resources from abroad. In addition, production in manufacturing sectors is commonly more fragmented than in agriculture, natural resource processing and services, allowing for greater degree of cross-country vertical trade. The VAX ratio in this respect represents the degree of integration and dependency on GVC. In fact, if we add the share of returned value-added (see eq. 12) to the VAX ratio we obtain a complement to vertical specialization (VS) measure, proposed by HIY, which observes the degree of backward participation in GVC by measuring the use of foreign inputs in export production. To fully capture the degree of country's involvement in GVC, the use of domestic intermediates in third country exports, or forward participation, needs to be additionally observed.

Figure 4 presents GVC participation index across available countries in the WIOD, with clear distinction between backward (import content of exports - VS) and forward participation (domestic value added embedded in exports of other countries - VS1). The index is expressed in proportions of total gross export. The intensity of participation seems to be correlated with size and resource abundance of countries. Small open economies tend to be more reliant on foreign suppliers, hence the larger dependency on GVC that arises predominantly from backward participation. In contrast, large and resource abundant economies seem to be less dependent on sourcing inputs from abroad and therefore to a higher extent engage in vertical trade through forward participation. Moreover, sizeable domestic markets imply on average lower overall participation values for large countries.

Figure 4: GVC participation index by country (VS+VS1)

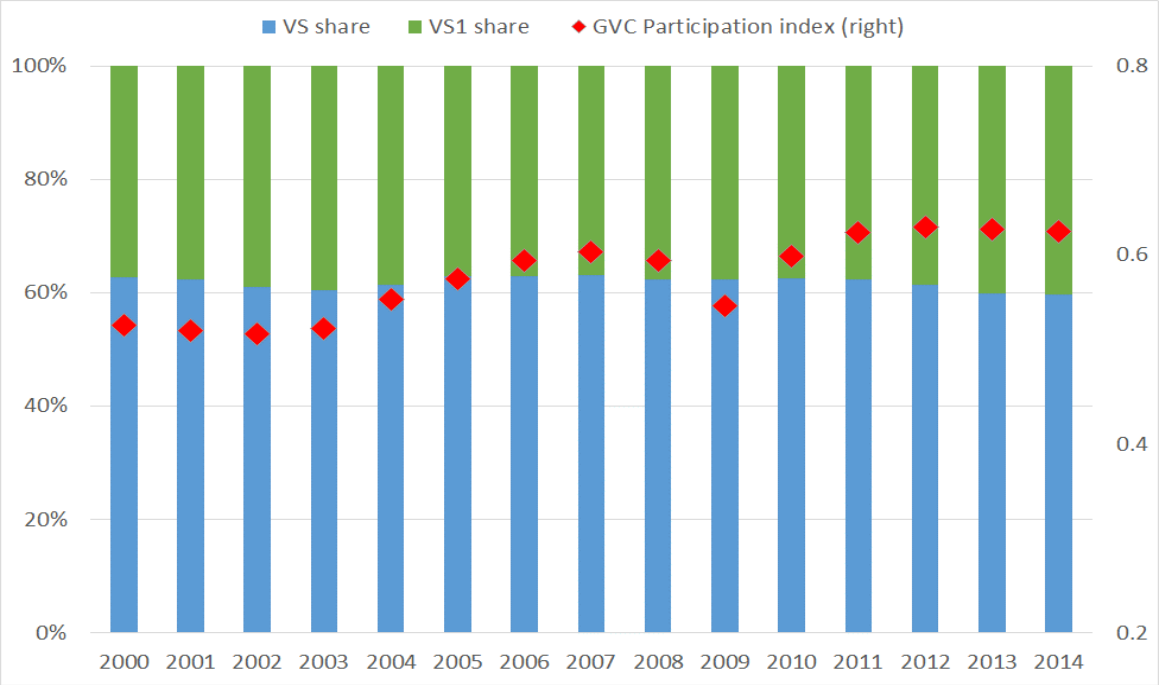


Source: *WIOD, Authors*

According to KWW, Bang (2013), and WTO (2014), high value of forward participation relative to backward should indicate a relatively more beneficial engagement into GVC. This would imply specialization in upstream segments of production for large and natural resource abundant countries, for example the USA, China, Australia, Russia and Norway. The correlation between the ratio of forward over backward participation and relative upstreamness, however, is not robust and in some cases even offers puzzling patterns by not accounting for the length of value chains (see De Backer and Miroudot (2013), Antras and Chor (2018)). Namely, a high forward participation relative to backward may be a consequence of processing expensive raw materials in a production chain of few stages. In this respect, the ratio may not offer a complete insight into progressively fragmented production process, especially within manufacturing sector through which most industrialized countries engage into GVC. The net forward participation alone may thus not offer an insight into upstream positioning from the perspective of relevant production activities that may point towards country's competitiveness and technologically more advanced export activity. For example, an ideal measure should provide information on upstream positioning on the basis of technologically rich initial phases of industrial production such as R&D and design as oppose to other upstream activities such as agriculture or natural resource processing (see Section 4).

Nevertheless, measures of backward and forward participation can be used to get a rough idea on how Slovenian participation and potential net gains produced within GVC evolved over time. Figure 5 shows that trade liberalization and lower transaction costs, associated with the EU accession in 2004, ignited rapid integration of Slovenian economy into GVC. The increasing engagement was mainly driven by increased sourcing of intermediate inputs from foreign suppliers. The global financial crisis and general trade collapse in 2009 caused the abruption in integration of Slovenian economy into GVC. The following recovery period indicates a slight shift towards forward participation in the composition of the GVC participation index, implying more beneficial engagement in the post-crisis period. However, in 2014, backward engagement still represented 60 % of the overall GVC participation.

Figure 5: Evolution of Slovenian GVC participation over time

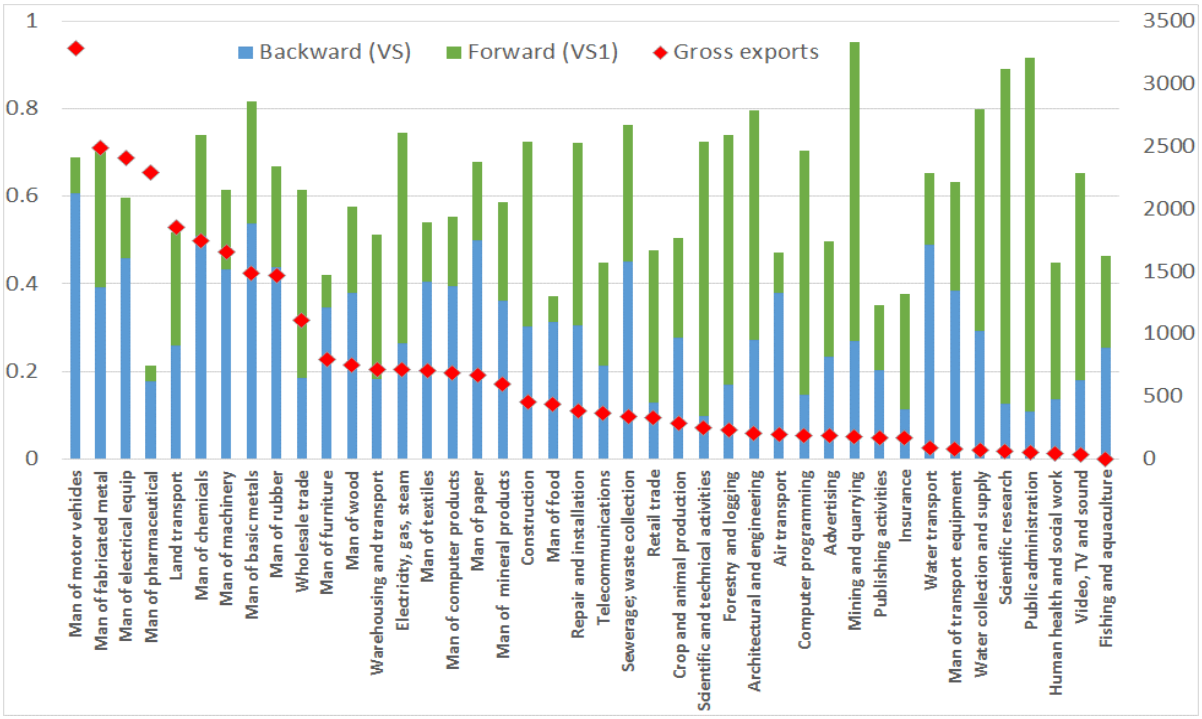


Source: *WIOD, Authors*

This is consistent with the GVC participation observed on a sectoral level, depicted in Figure 6. Slovenian export is primarily concentrated within manufacturing sectors, with dominating backward participation. In contrast, positive forward over backward participation ratio is observed in sectors with relatively low shares in the overall Slovenian gross exports. A combination of high export activity and dominating forward GVC participation can be observed in some service sectors, e.g. land transport, wholesale trade, electricity power distribution and construction. Some sectors on the other hand, e.g. manufacturing of pharmaceutical products, exhibit high gross export volumes and low overall GVC participation, which indicate their orientation toward final good production.

The prevailing backward participation in sectors with the highest export activity should point towards relative downstream positioning of Slovenian economy within the GVCs. However, as pointed out above, the correlation between the ratio of forward over backward participation and GVC positioning is not always clear and does not enable comparison among countries. In the next Section, the discussion on relative upstream/downstream positioning of Slovenian economy is elaborated through several alternative measures proposed by recent literature.

Figure 6: Slovenian GVC participation index by sector



Source: *WIOD, Authors*

4. GVC positioning and revealed comparative advantages

The previous section pointed towards growing participation of Slovenian economy in GVC. As we could have observed this may considerably change the existing patterns according to which Slovenian economy engage into international trade. For example, we showed that Slovenian value-added export amounts to only 63 % of the total gross exports, with less pronounced concentration among partner countries than suggested by gross figures. However, as it was discussed above, interpretation of the VAX ratio is limited to analyzing the degree of a country's involvement in GVC and it predominantly depends on the size and the resource abundance. As such, it tells us little about the gains and competitiveness of Slovenian economy in GVC. We can assume that countries lined relatively upstream engage in more competitive and gainful production stages as oppose to downstream countries whose export activity is associated with assembly stages of production. An idea about

relative "upstreamness" of Slovenian economy within GVC was in the previous section given by the ratio between forward and backward participation. However, as recent literature pointed out, i.e. Wang et al (2017) or De Backer and Miroudot (2013), this kind of GVC positioning does not allow a country pair comparison and may not rank countries according to technological input and competitiveness of exports, which this paper is primarily interested in.

Instead, KWW argue that relative GVC positioning of a country could be deducted from the part of gross exports that is not captured by value added exports (VAX). In particular, they show that two countries can have identical VAX ratio but significantly different composition of the double-counted part in gross trade exports (the 1-VAX component). Example given, lets assume that in a two-country world, Country A and Country B both have the same VAX ratio, where Country A exports intermediate and final goods and Country B only exports final goods. This will necessarily imply that Country A's imports contain part of the domestically produced value-added that is initially exported to country B and is essentially part of the Country A's GDP after returning home. In contrast, the Country B's import content will entirely consist of the value-added from Country A. In the global value chain context, this will push Country B downstream in the production process relative to Country A. A famous real world example of latter is the production of Apple products, which are essentially assembled in China, but are in part consumed in the USA and incorporate initially exported US value-added in form of know-how and design.

To properly place Slovenian economy within GVC, we therefore need to decompose the gross exports into **value added exports** (VAX), **re-imported domestic value added** (RVA), **foreign value added** (FVA), and a **pure double counted terms**. For a detailed derivation of individual components see Section 2. This kind of decomposition allows us to observe to what extent can the 1-VAX component be explained by re-imported domestic value-added and what part is actually attributable to foreign value-added. In general, higher share of returned domestic value added (RVA) indicates a country's positioning at the top of the GVC, whereas dominating foreign value added (FVA) rate in 1-VAX component pushes country towards assembly stages of the inter-country production process. In addition, the GVC participation can more accurately be characterized by further partitioning of RVA and FVA with respect to country's intermediate and final-good production. Namely, a foreign value added content that is predominantly embedded in the final-good exports would indicate engagement in inter-country vertical trade at the very end of the GVC. The composition of re-imported domestic value added on the other hand seems to display a country's natural resource endowment and size. For example, it is reasonable to expect that RVA in countries abundant in natural resources is to a larger extent embodied in exports of intermediate goods.

The decomposition of gross exports to domestic and foreign contents for selected countries is available in Table 2 (due to conservation of space the detailed distinction between intermediate and final demand products is secluded to Appendix, Table 8). The first column represents the value-added exports (VAX) as defined in Johnson and Noguera (2012). The second and third columns represent the import content of exports with clear distinction between a domestic content that is initially exported but consumed at home (RVA) and a pure foreign content (VS). In addition to VS rate, the fourth column provides the vertical specialization measurement given by the export side (VS1). Note that the returned domestic content of exports in accounting perspective forms part of domestic GDP and importantly resembles how particular country participate within GVC. As argued above, the relative difference between domestic content and value added exports indicates country's position within GVC. What we can observe from column 5 is that the relative ranking is strongly related to the size and country's income per capita, with USA, China and majority of Western EU economies being positioned at the top of the production chain. A relatively high difference between domestic content and value added exports reflects the trade in upstream intermediate goods with some of the value-added embedded in goods returned home after they have been processed by other countries. In addition, the detailed decomposition (Table 8) of returned value added confirms the upstream positioning related to natural resource endowment, with countries like China, Russia, Norway, and Australia, all exhibiting relatively larger share in returned value embedded in intermediate goods.

Table 2: Export decomposition by domestic and foreign content and GVC ranking

	Domestic content		Foreign content	Vertical trade	
	VAX	Returned value added	VS	VS1	$\frac{domestic}{VAX} - 1$
1. USA (upstream)	80.79	7.06	12.16	30.30	8.74
2. DEU	69.77	3.47	26.75	23.70	4.98
3. CHN	80.72	3.37	15.91	19.90	4.17
4. FRA	71.06	1.69	27.26	24.49	2.37
5. NLD	62.59	1.36	36.05	29.39	2.17
6. GBR	79.34	1.69	18.97	29.00	2.13
7. CAN	74.74	1.46	23.81	17.79	1.95
8. JPN	75.43	1.30	23.27	22.59	1.72
9. ITA	72.90	1.05	26.05	23.77	1.44
10. BEL	53.62	0.73	45.65	21.02	1.37
⋮			⋮		
33. ROU	73.11	0.27	26.62	29.21	0.37
34. EST	56.45	0.19	43.36	22.26	0.33
35. LUX	33.94	0.11	65.96	12.00	0.31
36. LTU	64.16	0.18	35.66	21.42	0.28
37. SVN	62.54	0.17	37.30	25.23	0.27
38. HRV	72.56	0.17	27.27	25.35	0.23
39. GRC	69.47	0.15	30.38	23.26	0.22
40. BGR	61.75	0.09	38.16	23.60	0.15
41. CYP	71.88	0.10	28.02	31.67	0.14
42. MLT (downstream)	34.50	0.04	65.46	9.30	0.11

Source: *WIOD, Authors*

In the case of Slovenia, the double counted part of gross exports can almost entirely be ascribed to the foreign content, reflecting Slovenian relative downstream positioning in inter-country production and exports of intermediate goods. Downstream positioning of Slovenian exports is also confirmed by substantially larger VS share compared to VS1, indicating that vertical specialization in production and trade comes predominantly from import side. A relatively low VAX ratio, driven mainly by intermediate good exports (63 %) indicates that specialization is largely concentrated in manufacturing sectors. Namely, as argued by Johnson and Noguera (2012), industrialized countries are usually characterized with exports highly concentrated within manufacturing sectors, which typically resemble more segmented cross-country production process and thus lower domestic value-added ratio compared to other activities (e.g. agriculture and services). Within different manufacturing sectors, however, richer countries tend to specialize in sectors with on average higher VAX ratios. To further shed light on positioning within GVC and Slovenian export competitiveness, value-added exports needs to be examined from the perspective of individual manufacturing sectors.

4.1 Sectoral export decomposition and revealed comparative advantages

Table 3 analyzes which manufacturing sectors does Slovenian economy specialize and exhibits comparative advantage in and how VAX ratios in these sectors deviate from the world's average, new EU countries[4], and other EU countries[5]. The two sets of countries should best represent the geographic production clusters, which Slovenia is deeply integrated in. Traditionally, comparative advantages in a particular sector are examined as a ratio between the share of a sector's gross exports in total country exports relative to the world average share (Balassa, 1965). However, in the manufacturing sectors, where production is most segmented and divided across country borders, the gross flow perspective would very likely lead to a noisy comparative advantage indicators. In that respect, revealed comparative advantages have to be corrected for domestic value added. In other words, Slovenian economy is set to have revealed comparative advantage (RCA) in sectors where corresponding value-added exports relative to the overall country's gross exports exceeds the ratio of trading partners.

What we can see in Table 3 is that on average highest value-added exports are observed for sectors dealing with manufacturing of fabricated metals, followed by wood production and manufacturing of mineral products. In contrast, among all countries, the lowest value-added exports is observed for sectors that are to a larger extent characterized by assembly stages of production, for example manufacturing of transport equipment, computer components and motor vehicles. As argued by Johnson and Noguera (2012), the Western EU countries tend to exhibit higher value added share in gross exports in sectors with highest on average VAX ratio. For example, 85 % of Western EU exports of fabricated metal products is represented by domestic value-added consumed abroad, which is 24 basis points more than in case of the new EU countries and 33 basis points more than in case of Slovenian exports. The highest VAX ratios for Slovenia are observed in manufacturing of pharmaceutical products and transport equipment, where more than 60 % of exports is amounted to domestic value-added. The lowest value-added of 28 % is as expected attained in deeply fragmented production of motor vehicles. Similarly, with exception of pharmaceutical industry, Slovenian comparative advantages are to a larger extent secluded to industries with deeper assembly structure of production. The strongest comparative advantage vis-a-vis Western EU countries can be observed in exports of transport equipment, whereas compared to the new EU members Slovenia is most competitive in sector of computer components, electronics and optical products.

[4] Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, and Slovakia
[5] Austria, Belgium, Luxembourg, Netherlands France, Germany, Italy, Spain, and Portugal

Table 3: VAX ratios and revealed comparative advantages for Slovenian manufacturing sectors

	VAX ratio				RCA vis-a-vis	
Manufacture of:	World	Slovenia	West_EU	New_EU	West_EU	New_EU
fabricated metals	0.69	0.52	0.85	0.61	0.62	0.86
wood without furniture	0.69	0.46	0.59	0.48	0.78	0.94
mineral products	0.65	0.54	0.56	0.56	0.96	0.96
rubber and plastic products	0.54	0.46	0.52	0.47	0.88	0.98
paper	0.52	0.34	0.43	0.41	0.80	0.84
pharmaceuticals	0.50	0.60	0.51	0.51	1.16	1.16
furniture	0.46	0.47	0.48	0.42	0.99	1.12
machinery and equipment	0.45	0.41	0.43	0.38	0.94	1.06
basic metals	0.42	0.34	0.31	0.30	1.11	1.13
chemical products	0.41	0.33	0.33	0.33	1.02	1.02
food, beverage, tobacco	0.40	0.37	0.34	0.33	1.10	1.12
textiles, leather, clothing	0.40	0.43	0.39	0.43	1.09	0.99
electrical equipment	0.39	0.37	0.47	0.33	0.80	1.14
transport equipment	0.38	0.62	0.33	0.42	1.89	1.46
computer products	0.37	0.50	0.43	0.23	1.16	2.18
motor vehicles	0.34	0.28	0.35	0.25	0.81	1.14

Source: *WIOD, Authors*

5. Factor content of Slovenian trade

So far, we have shown that Slovenian economy is ever more integrated in cross-country production chains and is becoming increasingly specialized in manufacturing of intermediate export goods. This has inevitably resulted in the lower share of domestic value added in the total gross exports. In this section, we examine trends in the factor content of value-added export dynamics. Note that the available WIOD supply-and-use tables, through which the factor content of trade is derived, is only available for the period 1995-2011. Table 4 decomposes the value-added exports into the individual factor categories employed in production of export goods, with the distinction among different skill types of labor. The skill types are distinguished on the basis of educational attainment according to International Standard Classification of Education[6] (see Table 7 in the Appendix for skill-type description).

What we can observe is that the decline in exported domestic value-added reflects predominantly lower shares of less-skilled workers and domestic capital. This means that with increasing globalization in production, some parts of routinized processes were sourced abroad. Namely, according to the routinization hypothesis introduced by Autor et al (2003), the increasingly automated

[6] http://uis.unesco.org/en/topic/international-standard-classification-education-isced

production stages are reflected in combination of lower foreign wages and increased capital income abroad. In contrast, the income share of high-skilled workers in production of export increased by 2.4 percentage points between years 2000 and 2009. However, due to its relative positioning down the global value chain, the impact of globalizing production fragmentation on Slovenia is much lower than in larger economies placed further upstream. For example, Timmer et al (2014) report 12 percentage points decrease in domestic income share of low- and medium-skilled workers for Germany in period between 1995 and 2008.

Table 4: Factor content of Slovenian exports (in %)

	2000	2009	P.p. Change
Labor:	49.5	48.3	-1.2
Low-skilled	7.5	5.3	-2.2
Medium-skilled	29.1	27.7	-1.4
High-skilled	12.8	15.3	2.4
Capital	17.5	15.7	-1.8
VAX	67	64	-3

Source: *WIOD, Authors*

To analyze which industries in Slovenia have been most impacted by increasingly longer production chain, Table 5 reports relative changes in factorial income shares for selected industries between 2000 and 2009. Lower contribution of low- and medium-skilled workers in combination with drained domestic capital share indicates that production characterized by routinized jobs was at least partly sourced to countries with cheaper labor force in majority of manufacturing sectors. The exceptions are sectors dealing with production of transport equipment and chemical products, where low- and medium-skilled workers remained unaffected with the simultaneous increase in contributions from high-skilled labor and domestic capital. This indicates a sustainable growth of competitiveness and income generated from GVC in these industries and goes in line with the comparative advantage analysis in the previous section. In contrast, industries that seem to be most affected by increasing globalization of production process are manufacturing of textiles, footwear and leather, wood products, and production of other non-metallic mineral products. Manufacturing of coke and refined petroleum seems to be the industry with the clearest shift towards automation in production process, with an increase of 33 percentage points in capital income share which was largely attained at the expense of low- and medium-workers whose contribution reduced by 16 percentage points in 10 years period. Sectors with largest increase in contribution of high-skilled workers in value-added exports are sectors dealing with production of basic metals and manufacturing or recycled products, reflecting their move up the global value chain.

Table 5: Change in factor content in Slovenian exports between 2000-2009 (in percentage points)

Manufacture of:	Labor			Capital
	Low-skill	Medium-skill	High-skill	
Food, Beverages and Tobacco	-0.8	1.2	0.0	-0.6
Textiles and Textile Products	-3.6	-4.3	-3.1	-3.0
Leather, Leather and Footwear	-2.1	3.0	-0.2	-2.0
Wood Products	-3.8	-8.1	-1.9	-4.2
Paper, Printing and Publishing	-2.0	-2.3	0.1	-4.8
Coke, Refined Petroleum and Fuel	-5.9	-10.1	-1.5	33.0
Chemicals and Chemical Products	-0.8	1.1	1.2	2.1
Rubber and Plastics	-1.7	-1.0	0.6	-1.5
Other Non-Metallic Mineral	-2.1	-1.8	0.5	-5.6
Basic Metals and Fabricated Metal	-1.4	0.9	1.6	-7.9
Machinery	-0.8	0.5	1.0	-1.9
Electrical and Optical Equipment	-1.3	-0.9	0.6	-4.8
Transport Equipment	-0.1	1.9	1.3	4.7
Recycling	-0.4	7.7	2.1	-2.7

Source: *WIOD, Authors*

Apart from analyzing developments in factor content of Slovenian exports, it is also important to examine how different input factors populate the import content of foreign exports and towards which countries is Slovenian economy loosing/gaining share in global production. To simplify the analysis we examine how has employment of Slovenian input factors changed in the output of German manufacturing industries. According to the general notion and stylized facts, Slovenian industrial production in many segments enter the global value chain through the German economy, given the fact that it is Slovenian largest trading partner and being the largest economy and exporter in the EU. What we can observe from Table 6 is that contribution of Slovenian value added embedded in German exports grew by approximately 30 % predominantly due to input coming from Slovenian high-skilled workers whose share in German output increased by more than 60 %. The rate of increase for Slovenia, however, is much slower than the one documented for the other new EU members, where German import content from these countries almost doubled. Slovenian low-skilled labor was almost entirely left out from increase in German output sourced abroad. Namely, majority of production populated by low-skilled workers is increasingly being shifted from other EU to the new EU members and to a much lesser extent to Asia. The new EU members also provide relatively cheaper high-skilled labor to global manufacturing chain whose share in the German output increased 3 times faster than it was the case for Slovenia.

Finally we can conclude that the low-skilled workers are the most vulnerable segment of Slovenian production that is getting increasingly left out from the global value chain and Slovenian trade in general, the latter being predominantly a consequence of shifting domestic and foreign production to

regions abundant with cheap labor force. In contrast, medium and especially high-skilled workers are getting ever more integrated in global supply chain, but their contribution is getting outpaced by production from regions with more affordable labor and with earlier stage of development catching-up.

Table 6: Change in factor inputs employed by German manufacture sectors in period 2000-2009 (p.p.)

	Labor			
	Low-skill	Medium-skill	High-skill	Capital
SVN	0.5	32.5	66.8	31.9
New EU	53.0	104.7	199.0	100.2
West EU	-10.7	20.1	58.0	12.0
Other EU	22.0	59.0	108.7	29.8
Asia	14.4	41.5	142.2	63.7
Other	-21.1	-0.1	10.0	6.5

Source: *WIOD, Authors*

6. Conclusion and policy implications

In the past two decades, the Structure of Slovenian trade has strongly resembled a progressive engagement of the Slovenian economy into global value chains. This is evident from substantial increases in exports of intermediate goods and vertical specialization measured as the import content of the exports. The relatively large share of vertical specialization goes in line with natural characteristics of Slovenian economy and orientation of exports towards manufacturing sectors. An increasing inter-country fragmentation of production process can however be spotted in other sectors, in particular in financial services, video/sound production, and postal activities, where GVC participation doubled over the period 2000 to 2014, mostly through forward participation. The sectoral international linkages showed that industries with strongly fragmented production processes are more affected by the external demand shock than producers of final demand products.

Although the integration in GVC progressively increased in the past two-decades, the participation has only mildly shifted towards a larger share of forward engagement, indicating a relatively slow learning curve and transition towards more beneficial GVC participation. This was confirmed by the detailed value-added decomposition of gross exports, which points towards relative downstream positioning of Slovenia within the GVC, especially when compared to other countries of similar characteristics and seemingly comparable development path, e.g. other members accessing the EU in 2004 (New EU). A relative downstream positioning of Slovenian economy within GVC is also evident from the revealed comparative advantages vis-a-vis other EU members, which seem to be resorted to manufacturing sectors with on average lower value-added to exports ratio. Related to specific input factors, deeper

integration of Slovenian economy seems to have most negatively impacted the low-skilled workers, showing outsourcing patterns of routinized production process. In contrast, the income of high-skilled workers increased, however to a significantly lesser extent than for countries positioned upstream. On a sectoral level, industries that seem to exhibit most sustainable growth in competitiveness are production of transport equipment and chemical products, where high-skilled workers employed in export production increased, while the share populated by low-skilled workers remained unchanged, confirming the narrative offered by revealed comparative advantage analysis.

The above conclusions carry several potential policy implications:

- The increasing share of vertical specialization and import dependency suggest that trade policies should not only be concerned with providing access to foreign markets for domestic producers, but should also ensure openness and accessibility of domestic markets to foreign suppliers. The reverse regionalization patterns revealed by import content decomposition and indirect export routs show that these policies should span beyond existing free trade agreements;
- The sectoral participation index suggests that small enterprises, deeply integrated in GVC, tend to be disproportionally affected by the external demand shock as compared to large final-good exporters. In this respect, policies should evoke financing schemes and services that would provide flexibility to small- and medium-enterprises governing manufacturing processes in GVC;
- Dominating backward participation and relative downstream positioning within the GVC of Slovenian economy point towards sensitivity of integration process of Slovenian economy, especially when compared to other EU countries. To ensure robustness, policies should seek openness to foreign direct investments to enable knowledge, capital transfer, and robust GVC integration throughout the crisis period;
- Revealed comparative advantages in case of Slovenia are concentrated in industries exhibiting on average lower VAX ratios. In that respect, tailor-made education policies and skill trainings aimed towards cutting edge industries with higher on average VAX ratio should be promoted;
- As the deepening of GVC integration process adversely affects low-skilled workers, appropriate safety-nets and retraining programs should be put forward.

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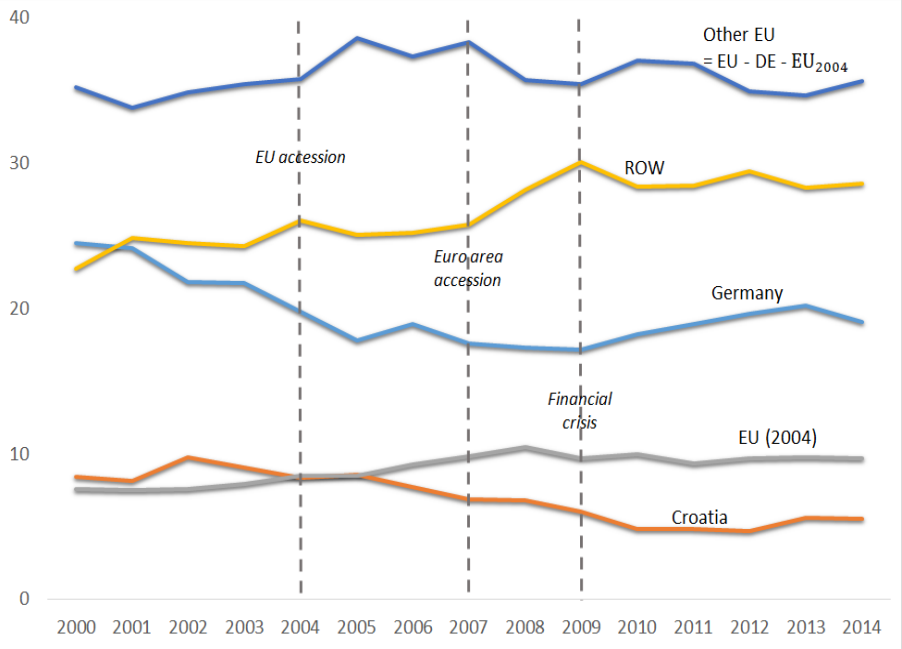
Appendix

Figure 7:Main export destinations through time



Source: *WIOD, Authors*

Table 7: Labor skill type description

Skill type	***Description***
Low	*Primary or lower secondary stage of education.*
Medium	*Upper secondary or post-secondary and non-tertiary education.*
High	*First or second stage of tertiary education.*

Source: *WIOD Socio-Economic Accounts: Sources and Methods (2012)*

Table 8: Detailed export decomposition by country

	Domestic content of exports						Foreign content of exports			
		VAX		Returned domestic content			Foreign content			
GVC-position/ Cntry	Final-good	Intermediate	3rd cntry export	Final-good	Intermediate	Pure doub. count	Final-good	Intermediate	Pure doub. count	$\frac{domestic}{VAX} - 1$
1. USA	30.39	42.23	8.17	3.18	3.18	0.70	5.98	4.09	2.09	8.74
2. DEU	31.58	30.33	7.86	1.24	0.84	1.39	17.23	7.28	2.24	4.98
3. CHN	42.05	32.30	6.36	0.85	1.58	0.94	6.92	2.78	6.22	4.17
4. FRA	30.11	32.28	8.66	0.67	0.56	0.46	17.63	7.27	2.35	2.37
5. NLD	17.01	36.17	9.41	0.33	0.23	0.80	17.95	13.04	5.06	2.17
6. GBR	28.92	40.95	9.47	0.79	0.61	0.29	10.00	5.92	3.05	2.13
7. CAN	21.27	48.17	5.29	0.48	0.55	0.42	13.56	8.84	1.41	1.95
8. JPN	32.13	35.28	8.02	0.46	0.52	0.32	5.52	3.78	13.97	1.72
9. ITA	34.01	29.58	9.31	0.39	0.34	0.32	16.15	7.24	2.66	1.44
10. BEL	18.89	27.55	7.17	0.18	0.15	0.39	23.96	15.33	6.36	1.37
11. SWE	25.67	35.42	9.58	0.31	0.21	0.28	16.36	9.07	3.08	1.14
12. RUS	7.86	70.41	13.20	0.49	0.40	0.14	2.22	3.79	1.49	1.13
13. KOR	25.45	31.06	7.89	0.15	0.23	0.35	12.05	7.39	15.42	1.13
14. ESP	32.30	28.89	7.18	0.27	0.23	0.26	18.99	8.81	3.06	1.12
15. POL	27.56	29.89	11.10	0.27	0.22	0.27	18.97	8.24	3.48	1.11
16. AUT	22.98	30.09	10.38	0.25	0.16	0.29	20.51	11.63	3.72	1.10
17. TWN	13.92	33.94	10.08	0.11	0.11	0.40	7.87	8.92	24.65	1.08
18. CZE	20.18	23.80	9.80	0.15	0.10	0.33	29.53	12.24	3.87	1.07
19. NOR	12.03	58.10	12.32	0.21	0.29	0.25	6.95	7.31	2.53	0.91
20. AUS	13.56	62.24	9.39	0.27	0.37	0.14	4.38	7.89	1.76	0.91
21. IDN	20.27	52.83	9.11	0.13	0.40	0.11	5.93	4.06	7.15	0.79
22. SVK	20.59	22.82	8.29	0.11	0.06	0.20	34.74	9.71	3.49	0.71
23. CHE	30.76	35.45	7.94	0.19	0.14	0.20	15.39	8.15	1.77	0.71
24. IND	35.42	36.69	6.75	0.09	0.33	0.11	7.18	6.17	7.26	0.66
25. BRA	22.22	54.76	9.68	0.17	0.32	0.06	5.28	4.93	2.57	0.64
26. HUN	18.88	21.10	8.03	0.07	0.05	0.16	34.78	13.62	3.31	0.58
27. DNK	27.96	27.73	6.59	0.10	0.09	0.17	23.82	10.30	3.24	0.58
28. FIN	20.70	35.21	8.84	0.10	0.12	0.12	19.70	12.09	3.11	0.53
29. TUR	33.57	29.96	7.68	0.12	0.13	0.13	16.23	7.08	5.10	0.52
30. PRT	24.84	35.43	8.35	0.13	0.08	0.09	17.74	10.99	2.33	0.44
31. IRL	20.48	25.08	4.99	0.06	0.04	0.13	31.69	16.02	1.51	0.43
32. LVA	21.62	38.41	8.80	0.09	0.08	0.10	16.60	12.20	2.12	0.38
33. ROU	24.10	37.36	11.64	0.10	0.10	0.07	14.42	9.91	2.29	0.37
34. EST	16.44	32.64	7.37	0.05	0.04	0.09	24.13	16.06	3.17	0.33
35. LUX	10.43	19.36	4.15	0.02	0.01	0.08	34.55	29.34	2.07	0.31
36. LTU	24.96	31.97	7.23	0.09	0.03	0.05	18.12	14.41	3.13	0.28
37. SVN	23.79	29.03	9.71	0.06	0.03	0.08	21.91	10.92	4.47	0.27
38. HRV	27.55	36.14	8.87	0.06	0.06	0.05	15.80	9.45	2.02	0.23
39. GRC	23.18	38.87	7.42	0.06	0.06	0.04	13.85	13.50	3.03	0.22
40. BGR	19.28	33.74	8.73	0.04	0.03	0.03	13.60	13.55	11.00	0.15
41. CYP	22.33	38.83	10.72	0.02	0.04	0.04	13.88	11.04	3.09	0.14
42. MLT	17.71	13.57	3.22	0.00	0.00	0.03	41.95	21.81	1.70	0.11

Table 9: Shares of factor inputs in Slovenian gross exports through time

	Labor				
	Low-skill	Medium-skill	High-skill	Capital	VAX
2000	7.5	29.1	12.8	17.5	67
2001	8.1	31.2	9.7	17.9	67
2002	7.7	30.3	11.2	18.8	68
2003	7.0	27.9	12.7	20.4	68
2004	5.8	26.9	13.0	20.3	66
2005	5.7	26.1	13.2	18.9	64
2006	5.0	25.1	12.7	19.1	62
2007	5.1	24.2	12.2	19.5	61
2008	5.4	25.6	13.4	18.6	63
2009	5.3	27.7	15.3	15.7	64

Source: *WIOD, Authors*