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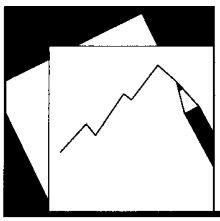

IMF Working Paper

Export Performance in Europe: What Do We Know from Supply Links?

Jesmin Rahman and Tianli Zhao

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Export Performance in Europe: The Role of Vertical Supply Links

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Abstract

One of the most important recent developments in international trade is the increasing interconnectedness of export production through a vertical trading chain network that streches across many countries, with each country specializing in particular stages of a good's production. Using value added trade statistics, this paper tries to dissect and reshape understanding of European exports: where exports values are created, the role of vertical supply links in export growth, what is contributing to the growth in supply links, and how comparative advantages of countries are affected by supply links over time. Our analysis finds strong role of supply links in cross-country export performance in Europe, where these links between countries grew based on physical proximity, cost differential and similarity in export structure.

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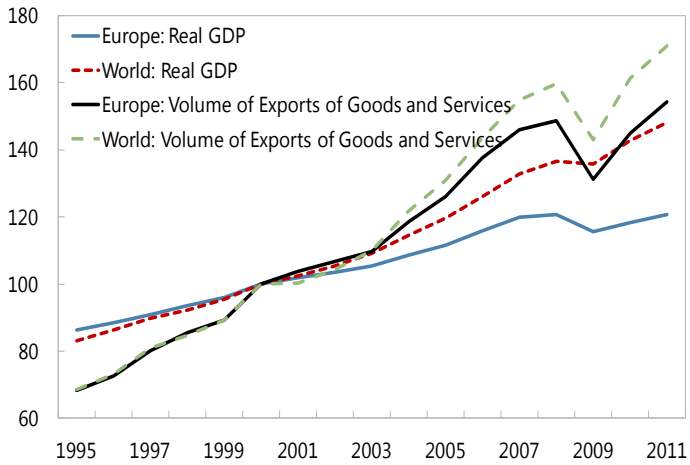
I. MOTIVATION[1]

Over the past few decades, dramatic changes have taken place in the way international trade occurs between countries. Production processes have increasingly involved a sequential, vertical trading chain stretching across many countries, with each country specializing in one or more stages of production. This fragmentation of production has made intra-industry trade dominate world merchandise trade. As products cross border multiple times, this has also resulted in world trade growing faster than both global GDP and global value-added (VA) in manufacturing (Figure 1).

The increasingly fragmented production process in tradables has come with some data and policy challenges. As all official trade statistics are measured in *gross* terms, which include both intermediate inputs and final products, they "double count" a part of the value of goods: the part that crosses international borders more than once. As a result, official trade statistics are becoming increasingly less reliable as a gauge of value contributed by any particular country, reducing its reliability as a tool to measure export competitiveness and form policy advice.

Figure 1. Real GDP and Exports Growth, World and Europe
(Index, 2000 = 100)

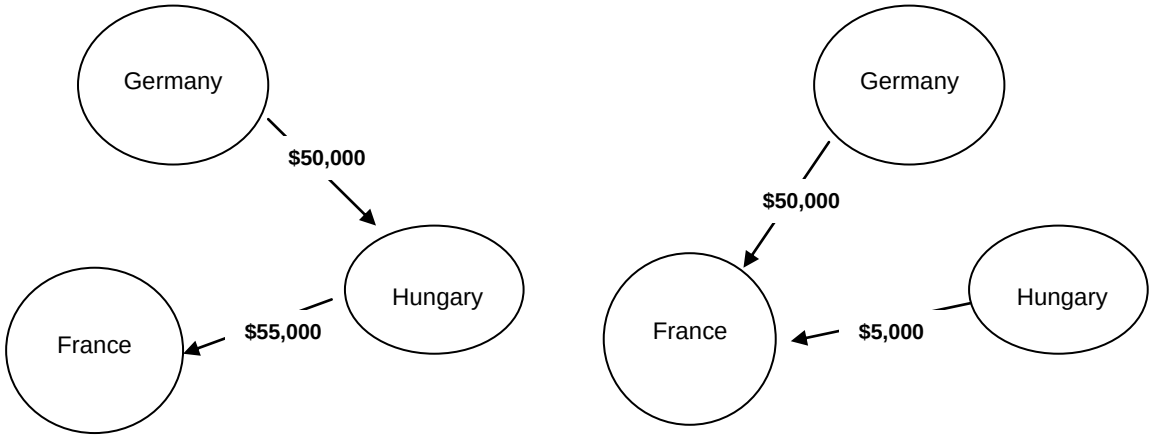


Source: IMF, World Economic Outlook database.

To illustrate the point, suppose a German car maker ships $50,000 worth of car components to its subsidiary in Hungary. A factory in Hungary then assembles the car and sells it to a dealership in France at $55,000.The gross or official trade statistics would record $50,000 worth of exports from Germany to Hungary as well as $55,000 worth of export from Hungary to France (Figure 2). But in VA terms, Hungary's exports to France would be only $5,000.

Figure 2: Trade Flow in Gross Term and Value-Added Term

[1] We gratefully acknowledge comments and useful suggestions from Helge Berger, Bas Bakker, Nisreen Farhan, Alessandro Giustiniani, Michele Hassine, Anna Ivanova, Aurora Mordonu, Antonio Spilimbergo, Andrew Tiffin, Thierry Tressel, Shengzu Wang, Masanori Yoshida and seminar participants in the European department. Jessie Yang and Amara Myaing provided excellent research and word processing assistance.



The shortcomings of gross trade statistics, as well as their inconsistency with the System of National Accounts standards, have been well recognized (Hummels and others, 2001; Ando and Kimura, 2003; Koopman and others, 2008 and 2011; Breda and others, 2008; and Bems and Johnson, 2012). But the problem goes well beyond that of data inconsistency. A bigger role of supply links in exports growth implies a large and possibly increasing role of foreign VA. However, if a country's exports growth is driven mostly by value crossing borders rather than being produced domestically, its impact on growth and employment is negligible. To get a true picture of a country's exports growth, we need to strip the foreign VA component from total exports. At the same time, given the importance of foreign VA or supply links as an engine for exports growth, we need to also understand the symbiotic relationship between foreign and domestic VA components of exports.

A recent paper by Koopman and others (2011) develops the first unified decomposition method that allows a full concordance between VA trade and gross trade statistics. In this paper, we adopt their framework to decompose gross exports data into VA measures using the newly released world input-output table. This enables us to (i) make a connection between gross/official statistics and VA statistics in merchandise and services trade, and (ii) distribute all VA embedded in a country's exports to its original sources at the country and product level. By analyzing trends and developments in the decomposed flow data, this paper aims to reshape our understanding of international trade in Europe: where values are created, the role of vertical supply links in export growth, what factors contribute to the growth of supply links, and how comparative advantages of countries are affected by supply links over time.

Although our sample includes a total of 40 countries, we mainly focus on developments in Europe. Since mid-1990s, a number of Central European economies, such as Czech Republic, Slovak Republic, Hungary and Poland, experienced growth that was led by the export sector. At the same time, a number of other European countries, including some periphery countries in the Euro zone (EZ), travelled a different growth path that relied on domestic demand and fast credit growth. To what extent plugging into the pan-European supply chain helped the first group achieve its export success? What factors helped them to

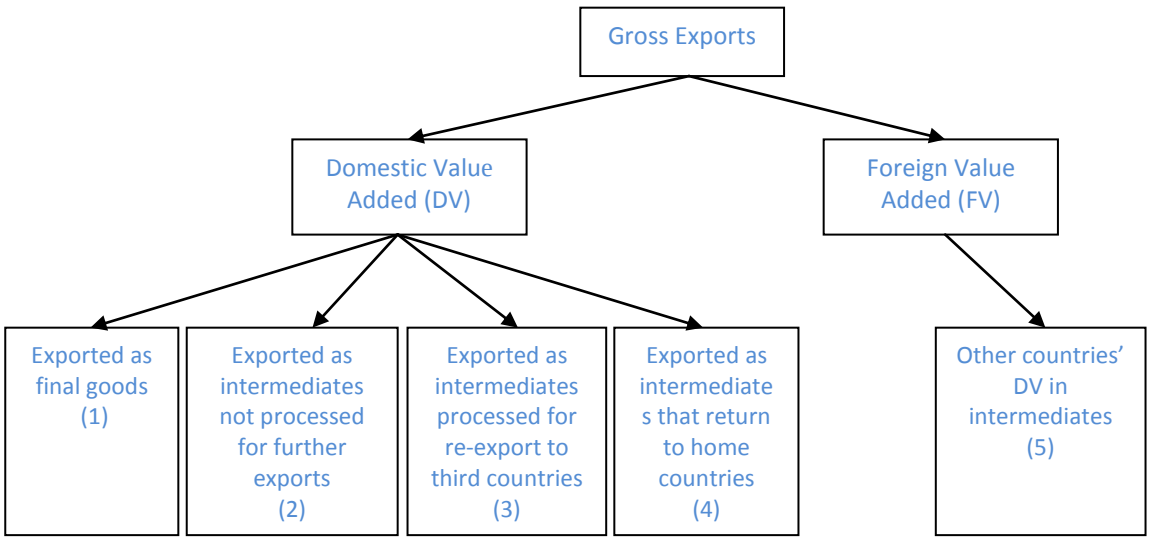
plug into supply links? For countries in the EZ periphery that are desperately looking to increase exports to rebalance their external position and bring back growth, what lessons can be learned from the supply link experience?

We start with a description of our decomposition methodology in Section II. In Section III, we use our decomposed exports statistics to look at the role of vertical supply chain in overall export growth and competitiveness. Section IV uses regression analysis to explore what factors contribute to a firm's decision to locate a part of its production abroad. Section V takes a close look at a set of European countries to see which countries have successfully benefited from being part of the supply network. Finally, conclusions and related policy implications are discussed in Section VI.

II. Dissecting Gross Exports in Europe

We adopt the conceptual framework developed in Koopman and others (2011) to decompose sources of VA in exports. The methodology is described in Annex 1. As shown in Figure 3, we decompose gross exports into five main categories depending on the location of VA and stage of production: (1) domestic VA in final goods, (2) domestic VA in intermediate goods not processed for further exports, (3) domestic VA in intermediate goods processed for exports to third countries, (4) domestic VA that is exported to another country but returns back to the original country for exports to a third country, and (5) VA imported from abroad as inputs into exports, i.e. foreign VA.

Figure 3. Decomposition of Gross Exports into Value Added Exports



Source: Koopman and others (2011).

We compute the 5-category VA decomposition for manufacturing and services exports respectively using data from the world input-output table (Annex 2). Components (1) through (4) give us the value of exports that is created domestically, while component (5) gives us the value of exports created abroad. Components (1-2) tell us how much of a country's exports are created as stand-alone exports, i.e. outside any supply chain, while components (3-5) give us exports generated by supply links. Supply link related exports have two components: *upstream*, which include domestic VA intermediate exports that are processed for further exports (components 3-4), and *downstream*, which include foreign VA exports (component 5). A large share of foreign VA in a country's exports signifies its position as a downstream processor or assembler.

Based on the above decomposition, we discuss some key developments in manufacturing and services exports during 1995–2008. Detailed tables are in Annex 3 (Tables 1a and 1b).[2]

- **The share of domestic VA has declined over time**. During 1995–2008, the average share of domestic VA (components 1-4) in manufacturing exports in our sample countries declined from 72 to 62 percent (Figure 4). Similar declines were visible in Europe and sub-groups of countries in Europe, where the share of domestic VA in total exports declined by 9 to 13 percentage points. The decline in the share of domestic VA in services trade was less pronounced, reflecting a lower degree of fragmentation in international trade in services.

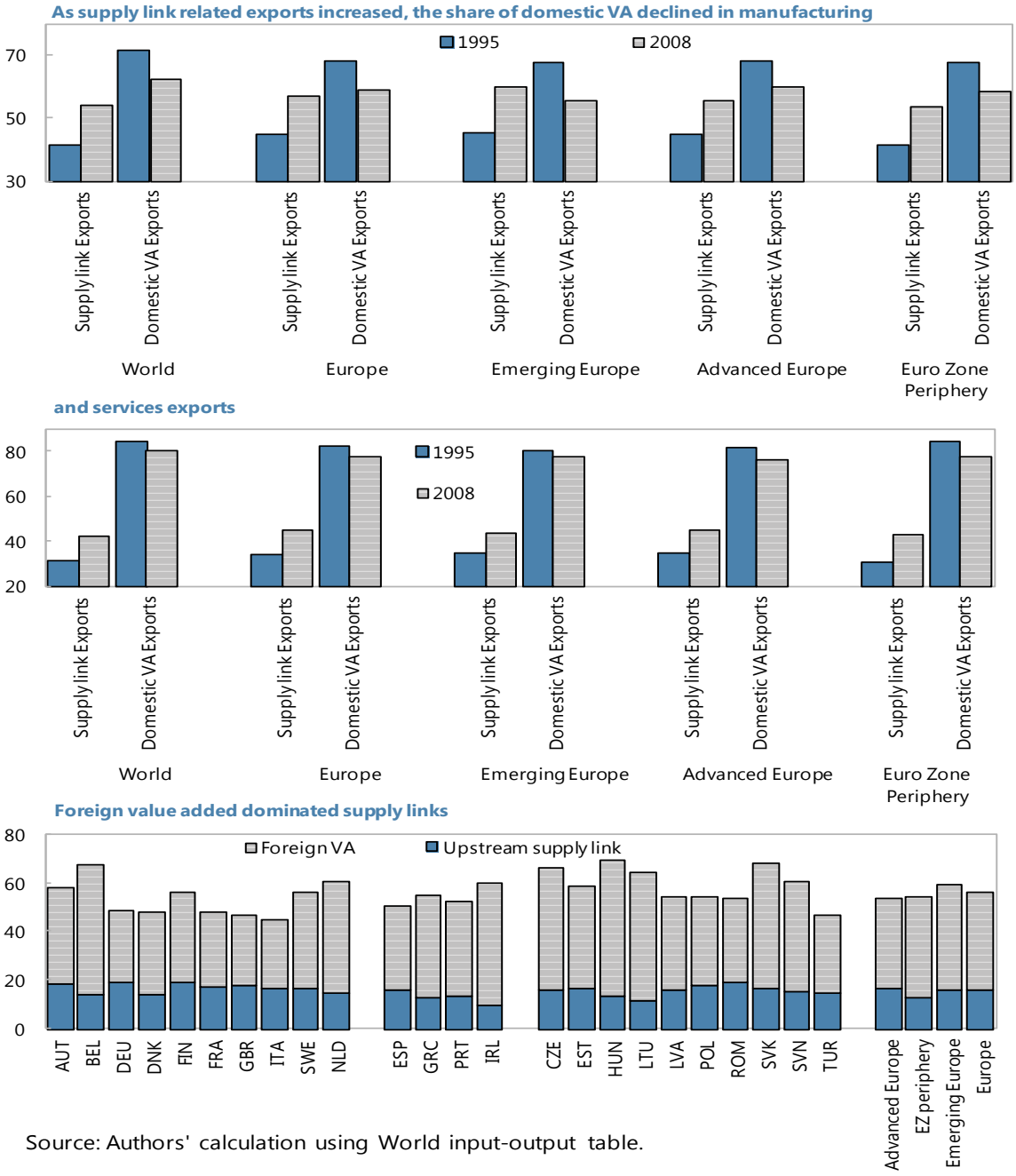
- **The role of supply links increased over time**. During 1995–2008, the average share of world manufacturing exports produced via supply links (components 3-5) went up from 42 to 54 percent (Figure 4). Increases of similar magnitude were experienced by Europe and country sub-groups in Europe. For services, the average share of supply link related exports increased from 32 to 42 percent, implying a pace of increase that is similar to that in manufacturing.

- **Downstream activities dominate supply links**. For example, on average European countries imported 41 percent of their manufacturing exports from abroad in 2008 (Figure 3). For several countries, namely, Slovak and Czech Republics, Hungary, and Lithuania, the share is over 50 percent. Such a high share of foreign VA components in exports indicates that downstream assembly plays a strong role in export growth. For advanced countries in Europe apart from the EZ periphery, the lesser dominance

[2] The choice of the time period is determined by data availability. This period, 1999-2008, may be somewhat atypical in terms of world GDP and exports growth as visible in Figure 1 given the unsustainable demand boom that many countries experienced during this time. Any forward-looking conclusion based on analysis during this time period has to take into possible slowdown of global export growth to more normal rates.

of downstream activities reflects a higher share of domestically produced stand-alone exports.

Figure 4. The Role of Domestic Value-Added and Supply Links in Exports Growth, 1995-2008 (in percent of total exports)



Source: Authors' calculation using World input-output table.

Note: Supply link exports include components 3-5 in Figure 3 (domestic VA intermediate exports processed for futher exports and foreign VA), and domestic VA exports include components 1-4 in Figure 3 (domestic VA exports of final and intermediate products). Supply link exports are disaggregated into upstream (domestic VA intermediate exports process for further exports) and downstream components (foreign VA).

The above discussion shows that supply chains have dominated exports of European countries, with a high share of value being produced abroad. When such a high share of a country's exports is created abroad, it is natural to ask how do these countries perform if the foreign VA added component is excluded? What role has foreign VA played in these countries' overall export growth? Has the reliance on supply links been beneficial, or increasing fragmentation of export production simply shifted abroad a part of what was previously produced domestically as firms sought to reduce costs?

To answer these questions, we normalize gross exports, and its two main sub-components, domestic and foreign VA, by GDP. The change in the ratio of exports to GDP is often interpreted as "beyond the trend" growth, where an increasing exports to GDP ratio implies that a country's growth is orienting itself more towards export, and less toward domestic demand. The percentage increase in gross exports over GDP is simply the sum of percentage increase in domestic VA over GDP and percentage increase in foreign VA over GDP.

Figure 5 compares growth in domestic VA exports and gross exports during 1995–2008. While the increase in domestic VA exports is lower than gross exports in all European countries, the difference between the two seems particularly large for Belgium, Bulgaria and Ireland, where large increases in gross exports to GDP ratio during 1995–2008 mostly reflected increasing foreign VA. However, these increases should be considered together with the level of domestic VA. For example, if an economy has a large domestic VA exports to GDP ratio (for example, Ireland), the room for catch-up increase may be less than an economy where this ratio is low (for example, Greece). Figure 5 therefore also shows the average ratio of domestic VA exports to GDP in European countries during 1995–2008.

We divide European countries into four groups based on the increase in the ratio of domestic VA exports of goods and services to GDP during 1995–2008 (Table 1, across columns). An increase in this share implies that a country increased its export orientation in growth during this time period, which is also a sign of increasing competitiveness. We find that most European countries in our sample increased their domestic VA exports to GDP ratio, i.e. their export orientation in growth during this time period. However, as mentioned before, this needs to be contextualized in terms of a country's overall export orientation. Therefore, across rows in Table 1, we also show the average domestic VA exports to GDP ratio in European countries. A position in the north-western corner in Table 1 shows high and increasing export orientation, while a position in the south-eastern corner shows low and declining export orientation during 1995–2008.

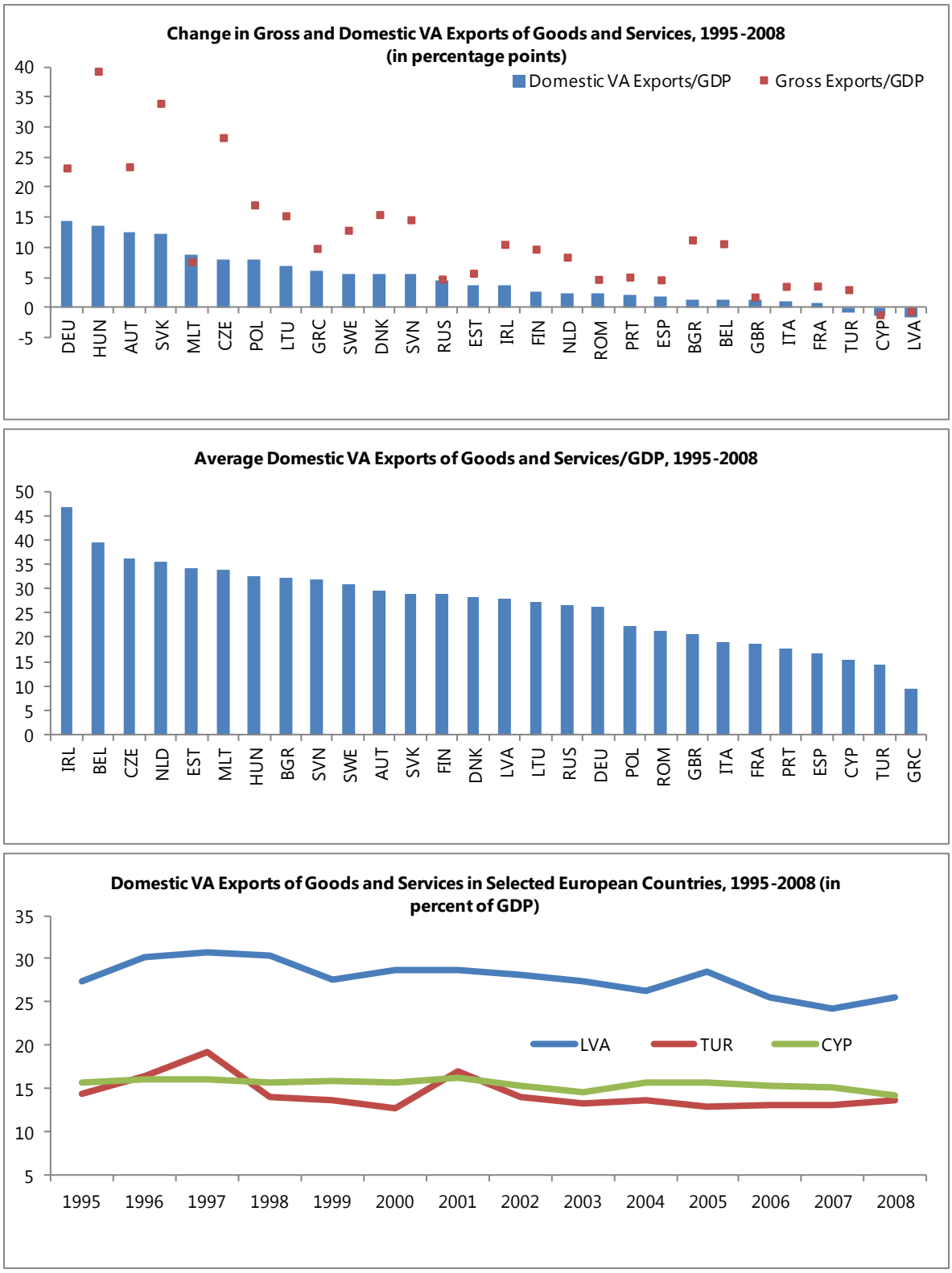
- **Strong growth in export orientation**. These countries experienced a double-digit increase in their domestic VA exports to GDP ratio. Four European countries managed to achieve such increase: Austria, Germany, Hungary and Slovak Republic. During 1995-2008, they also maintained an average domestic VA exports to GDP ratio between 26 to 32.

- **Moderate growth in export orientation**. This group experienced an increase in the domestic VA exports to GDP ratio between 5 and 10 percentage points during 1995-2008. There are eight countries in this group: Czech Republic, Poland, Lithuania, Sweden, Denmark, Malta, Greece and Slovenia. However, the growth masks considerable heterogeneity in the importance of exports across these countries. For example, the average domestic VA exports to GDP ratio was 36 in Czech Republic, while this share was only 9 in Greece (the lowest in our European sample). For the rest, the range was between 22 to 32 percent. So while Czech Republic has a high and increasing export orientation in growth, Greece shows a low but increasing export orientation in growth during this period.

- **Mild growth in export orientation**. This group contains countries where domestic VA exports to GDP ratio increased by less than 5 percentage points during 1995-2008. Thirteen European countries, or about a half of our sample, belong to this group. Just like the previous group, the members are heterogeneous in terms of the importance of exports in growth. For example, the average ratio of domestic VA exports to GDP was 47 in Ireland making it the most export-oriented economy in our sample. This ratio, on the other hand, was only 17 and 18 in Portugal and Spain, respectively reflecting larger room for export-led growth.

- **Declining growth in export orientation**. Three European countries show a decline in domestic VA exports to GDP ratio during 1995-2008. The share of domestic VA exports remained flat during the boom years of 2000s in these countries, which reflect the stronger role played by domestic demand in growth throughout this period (Figure 5). Turkey and Cyprus also show a relatively low share of domestic VA exports in GDP at 14 and 15 percent, making the declining importance of exports more of a concern for export competitiveness than in Latvia, where the average share of domestic VA exports was above 25 percent.

Figure 5. Domestic VA Exports in Europe, 1995-2008



Source: Authors' calculation using world input output tables.

Table 1. Domestic VA Export Performance in Europe, 1995–2008

	Domestic VA exports/GDP increase more than 10 ppts	Domestic VA exports/GDP increase more than 5 ppts	Domestic VA exports/GDP increase less than 5 ppts	Domestic VA exports/GDP decline
Average domestic VA exports/GDP greater than 30 percent	Austria and Hungary	Czech republic, Malta, Slovenia and Sweden.	Belgium, Bulgaria, Estonia, Ireland, and Netherlands	
Average domestic VA exports/GDP between 20-30 percent	Germany and Slovak Republic	Denmark, Lithuania, Malta and Poland	Finland, Romania, Russia and the UK.	Latvia
Average domestic VA exports/GDP less than 20 percent		Greece	France, Portugal, Spain, and Italy	Cyprus and Turkey

Source: Authors' calculation using world input output table.

Next, we try to see to what extent foreign VA, which has been a strong engine of exports growth in much of Europe, helped in increasing domestic VA exports, which is after all what counts for job and economic growth. We see a strong positive relationship between change in a country's foreign VA and domestic VA exports expressed in percent of GDP (Figure 6). We also test for whether increasing foreign VA exports cause domestic VA exports to grow, i.e. the ability of downstream assembly function to create domestic jobs and growth. Specifically, we test the impact of foreign VA growth of up to 5-year lag on domestic VA:

1-year lag: $log\frac{DV_t}{DV_{t-1}} = \beta_0 + \beta_1 log\frac{FV_{t-1}}{FV_{t-2}} + \sum \delta_i Year_i$ ---------- (1)

2-year lag: $log\frac{DV_t}{DV_{t-1}} = \beta_0 + \beta_1 log\frac{FV_{t-2}}{FV_{t-3}} + \sum \delta_i Year_i$ ---------- (2)

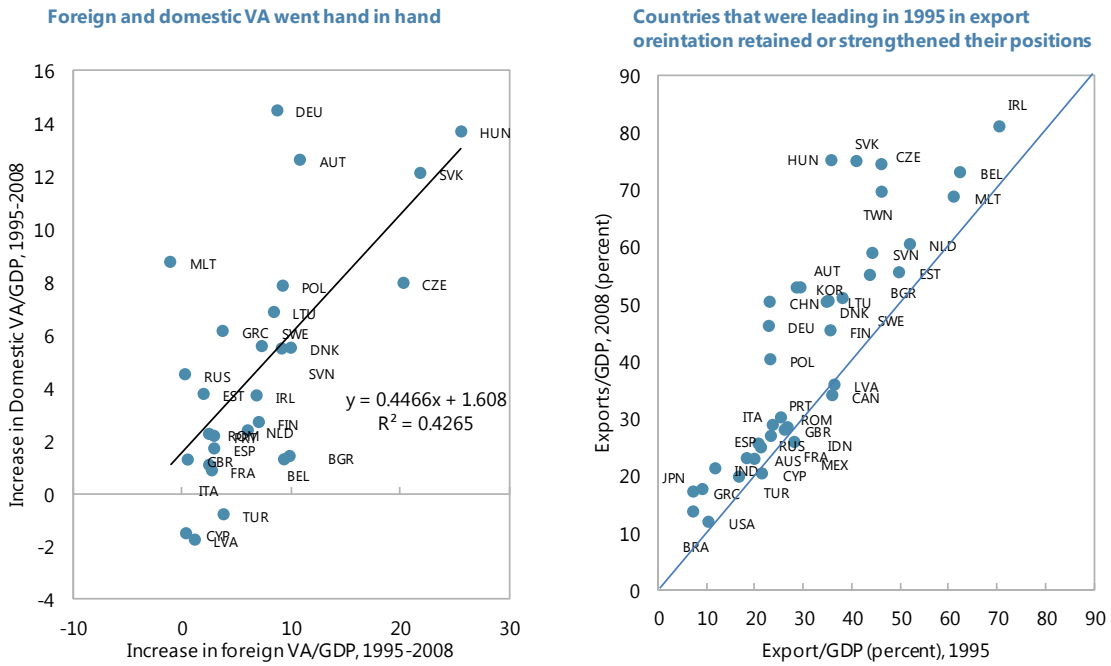
3-year lag: $log\frac{DV_t}{DV_{t-1}} = \beta_0 + \beta_1 log\frac{FV_{t-3}}{FV_{t-4}} + \sum \delta_i Year_i$ ---------- (3)

4-year lag: $log\frac{DV_t}{DV_{t-1}} = \beta_0 + \beta_1 log\frac{FV_{t-4}}{FV_{t-5}} + \sum \delta_i Year_i$ ---------- (4)

5-year lag: $log\frac{DV_t}{DV_{t-1}} = \beta_0 + \beta_1 log\frac{FV_{t-5}}{FV_{t-6}} + \sum \delta_i Year_i$ ---------- (5)

We find a positive and statistically significant relationship between foreign VA and domestic VA export growth for all lag specifications (Table 2). Therefore, increasing foreign VA exports during 1995–2008 resulted in increasing domestic VA exports. As world GDP growth was driven by growth in world trade, and world trade growth was driven by supply links, foreign and domestic VA were complementary to each other creating a virtuous circle for countries that were able to plug into regional or global vertical supply chains.

Figure 6. Exports Growth during 1995-2008



Source: Authors' calculations using World Input Output tables.

Table 2. Impact of Foreign VA Growth on Domestic VA Growth

	(1)	(2)	(3)	(4)	(5)	(6)
Foreign VA Growth in period t-1	0.015					0.078
	(0.47)					(2.2)
Foreign VA Growth in period t-2		0.101				0.089
		(3.26)				(2.6)
Foreign VA Growth in period t-3			0.135			0.116
			(4.32)			(3.64)
Foreign VA Growth in period t-4				0.110		0.099
				(3.55)		(3.33)
Foreign VA Growth in period t-5					0.153	0.116
					(4.95)	(3.79)
R-square	0.59	0.65	0.68	0.70	0.74	0.77

We also notice that the increase in exports to GDP ratio during 1995–2008 was not particularly influenced by low initial values of exports to GDP ratio (Figure 6, second panel). Countries that had a high exports to GDP ratio in 1995, such as Ireland, Czech Republic, China and Taiwan, maintained or further strengthened their position over time.

These two findings, i.e. foreign VA exports contribute positively to domestic VA exports, and countries have retained/strengthened their competitive position in exports, are related. To the extent world trade is dominated by supply links and these links take time to establish, it is not surprising that countries which were already well linked in 1995 are the ones that benefitted disproportionately from growth in exports. What this implies is that success of an export-led growth strategy depends, among other things, on finding an appropriate position in the VA chain and nurturing this vertical relationship over time.

This poses an additional difficulty for countries that are not already well-linked in the European supply chains to increase the role of exports in growth (Box 1). The extent of integration with supply links, measured both by the numbers of links and volume of trade through these links, is low in some EZ periphery countries, such as Greece and Portugal. Given that supply links take time to establish, for these countries to benefit from such links would not be immediate even if conditions are conducive. In the following section, we investigate what factors help establish these supply links.

III. WHAT FACTORS HELP COUNTRIES ESTABLISH SUPPLY LINKS?

The analysis in the previous two sections show that a group of European countries have increased their exports to GDP ratio during 1995-2008 through integration with supply links. Initially, these countries attracted hubs, such as Germany, Austria or Sweden, to locate a part of their downstream production in these countries. Over time, that created a virtuous circle whereby foreign and domestic VA increased hand in hand enhancing the role of exports in growth. To the extent success in export-led growth depends on plugging into this virtuous circle, it is important to investigate what factors contribute to a country's decision to send a part of its production abroad.

We use an augmented gravity model to explore this question empirically. Following McCallum (1995), which has been a corner stone of gravity literature, we consider the following specification:

$$ln(FV_{ijt}) = \beta_0 + \beta_1 \ln(Y_{it} * Y_{jt}) + \beta_2 \ln(G_{it} * G_{jt}) + \beta_3 \ln Dist_{ij} + \sum \lambda_k CX_k + \sum \alpha_n S_n + \sum \mu_t T_t + \varepsilon_{ijt}$$

where *i* and *j* denote countries, and the variables are defined as follows:

- FV_{ij} is the foreign VA from country *i* embodied in country *j*'s export,
- Y is nominal GDP,
- G is GDP per capita,
- $Dist_{ij}$ is the distance between countries *i* and *j*,
- CX_k is the set of controlled gravity variables,
- S_n is the set of structural variables,

- T_t is the set of time control,
- ε_{ij} is the error term.

We use the OLS model with time dummies as our baseline equation. To check for the robustness of our estimated results, we also use two other estimation strategies, namely, OLS with no control and two-way fixed effect with both time and country-pair dummies.[3]

Augmented Gravity Variables

The original gravity equation includes GDP, per capita GDP and the distance between each pair countries. Empirical applications of the gravity equation over time have expanded to cover a wide range of issues, such as the impact of free trade arrangements (Matyas and others, 1997; Egger and Egger, 2004), currency unions (Pakko and Wall, 2001; Glick and Rose, 2002), and common border (McCallum, 1995; Anderson and Wincoop, 2003) on trade.

Following the literature, we also include these variables, i.e. common language, common border, free-trade-agreement, and a dummy variable to capture whether a country is a resource exporter or not. The purpose is to control for as many variables as possible that may explain trade flows between two countries.[4]

$$\sum \lambda_k CX_k = \lambda_1 Comlang_{ij} + \lambda_2 ComBorder_{ij} + \lambda_3 FTA_{ij} + \lambda_4 ResourceExporter_i$$

Our estimation results show all gravity variables to be statistically significant with the expected signs (Table 3). Higher GDP level, lower distance, the presence of a common

[3] We chose a two-way Fixed Effect model as opposed to Random Effect model since the results from the Hausman test were in favor of the former. However, we do not use the Fixed Effect model as a baseline, but to check for robustness of our results, due to shortcomings. For example, in the Fixed Effect model, one cannot distinguish between the FTA dummy and the country-pair effects, since the former incorporates the latter. All time and country-pair dummy variables were statistically significant in our estimation.

[4] *Common Language ($Comlang_{ij}$)* Common language dummy variable is a binary variable which is set to be 1 if there is a common language that is spoken in both countries that have bilateral trade activities. Common language variable is the second proxy for travel costs.

Common Border ($ComBorder_{ij}$) Common border dummy variable is a binary variable which is set to be 1 if two countries that have bilateral trade relationship share the same border. Common border variable serves as a proxy for travel costs.

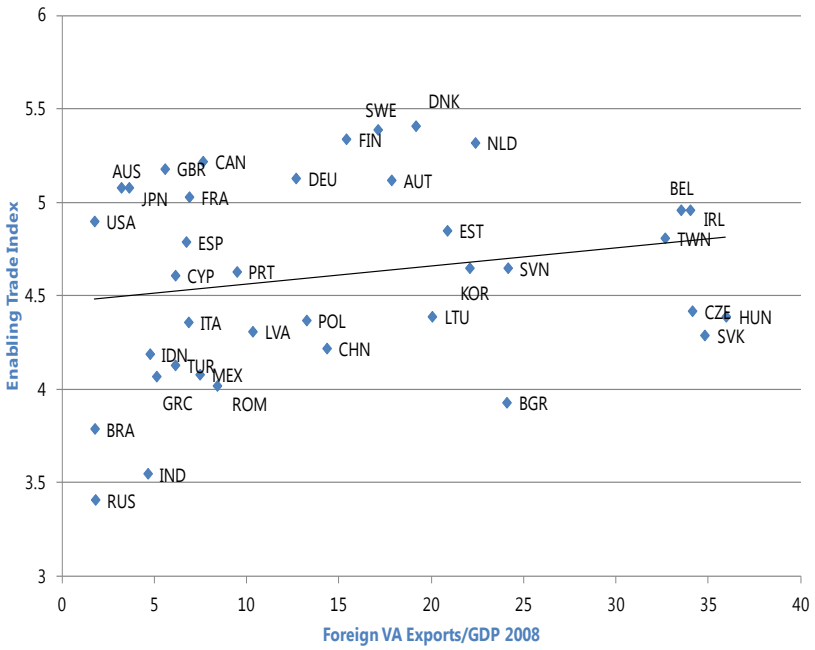
Free Trade Agreement (FTA_{ij}) Free trade agreement dummy variable is a binary variable which is set to be 1 if two countries that have free trade agreement.

Resource Exporter ($ResourceExporter_i$) Resource exporter dummy variable is a binary variable which is set to be 1 if the source country is a major natural resource exporter in our sample. (e.g. Russia, Brazil, Australia, Canada)

border and common language positively affect a country's decision to locate a part of its export production in another country. Lower tariff and free trade agreements also influence this decision positively. For example, reducing distance between countries by 1 percent increases the value of foreign VA exports by 0.5 percent. Similarly, increasing host country's market size (i.e. GDP) by 1 percent increases foreign VA exports by 0.6 percent.

A recent study (World Economic Forum, 2013) argues industry case studies show that non-tariff trade barriers, such as market access, border administration, telecommunications and transportation infrastructure and business environment, play an important role in hindering supply links. This may very well be the case: investors are likely to locate a part of their export production in a place where customs agencies work round the clock resulting in no delays in processing than in a place encumbered with interrupted service and frequent inspections. The lack of a long enough time-series prevents us from including this variable in our regression. Also, for our sample of countries which include a large number of European Union and OECD countries, the value of non-tariff barriers is likely to show low variability across countries. Nonetheless, a scatter plot of foreign VA and the value of World Economic Forum's Enabling Trade Index, which is a composite of market access, border administration, telecommunication and transportation infrastructure and business environment, shows a mild positive relationship. In other words, lower non-tariff barriers help with supply links.

Figure 7. Foreign VA exports and Non-tariff barriers



Source: World Economic Forum (2011) and Authors' calculation.

Structural Variables:

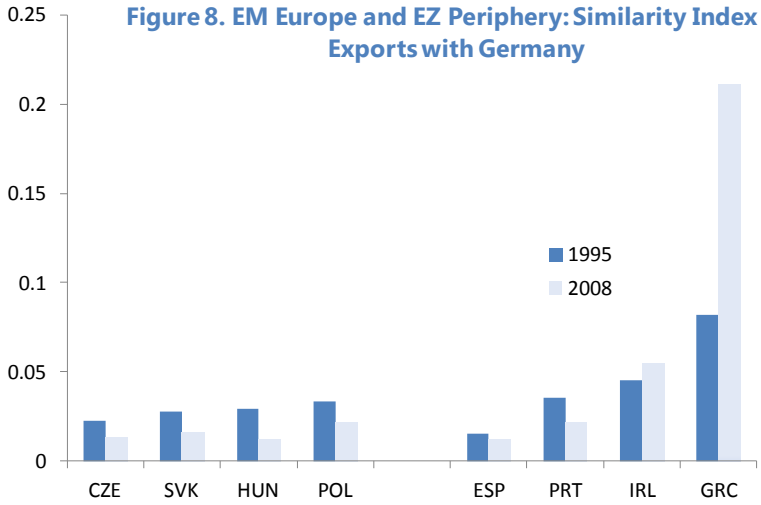
In addition, we include a list of structural variables that are commonly thought to drive fragmentation of export production. These include labor cost differential, initial level of similarities in industrial structure, and exchange rate volatility.[5]

$$\sum \alpha_n S_n = \alpha_1(ULC_{it} - ULC_{jt}) + \alpha_2 Sim_{ijt} + \alpha_3 VolatilityEX_{ijt}$$

Unit labor cost differential is equal to the unit labor cost in country *i* minus the unit labor cost in country *j*. Our estimation results show a statistically significant positive coefficient for this variable: countries with higher unit labor cost would locate more downstream production process to counties with lower unit labor cost (Table 3). This result implies that cross country differences in factor prices is effectively utilized in the formation of vertical production chains. This is consistent with Sinn (2004, 2006) which argues that Germany's high wages and rigid labor market stimulated a wave of international relocation of production to seek lower cost, especially in the automotive sector, to neighboring eastern European countries in the early 1990s.

We also estimate the impact of industrial similarity on foreign VA export from country *i* and *j*. [6] Since fragmentation within a product or intra-industry trade is an important driver of supply links, two countries with a similar initial export structure are more likely to link. In manufacturing trade, this may also be driven by the likely availability of skilled labor if two countries have a similar export or industrial structure.

Figure 8. EM Europe and EZ Periphery: Similarity Index of Exports with Germany



Note: A higher value indicates lower export similarity. Authors' calculation using world input-output table.

[5] We had also included a variable capturing statutory corporate tax differential between source and recipient country in our regression. The variable showed a positive relationship with foreign VA exports, meaning higher taxes in source country cause exporters to locate abroad. However, the coefficient was very small and statistically significant at 10 percent in two of estimation methods. It was included from the final version of the regression.

[6] This index is constructed using the sum of square of the differences between country A's exports and Germany's (See Annex 4 for computation details). A low value indicates high similarity.

The "similarity index" is calculated relative to Germany, where a lower value implies higher export similarity with Germany (Annex 4). This index shows a strong similarity between the export structure of Germany and four highly export-oriented central European countries in 1995, which grew stronger by 2008. For EZ periphery countries, while Spain and Portugal increased their similarities with Germany's exports structure during 1995-2008, Ireland and Greece decreased theirs (Figure 8). Two caveats that need to be mentioned for this index. First, although Germany is the largest hub in Europe, which is why we choose Germany as a benchmark, it is not the only hub. Second, our disaggregation divides total exports of goods and services into only 35 sectors. Therefore, it does not take into account quality differences or level of refinements within a particular product. An index with more disaggregated product level data and taking into account different hubs may better capture the degree of industrial similarity between a hub and a host.

Our estimation shows a strong negative coefficient for initial industrial similarity index: vertical integration is likely to occur between countries with similar industrial structure (Table 3). This result is statistically robust across estimation methods.

In the voluminous literature on exchange rate volatility and trade, there is no consensus on the appropriate method for measuring such volatility. The most widely used measure of exchange rate volatility is the standard deviation of the first difference of log of the exchange rate. This measure has the property that it will equal zero if the exchange rate follows a constant trend, which presumably could be anticipated and therefore would not be a source of uncertainty. Clark and others (2004) argue that real rates are preferable on theoretical grounds. We measure exchange rate volatility by the standard deviation of the first difference of log of real bilateral exchange rate.

Our results show a negative and statistically significant relationship between foreign VA export and volatility of the bilateral exchange rate. One reason that cross-border joint production might be adversely affected by exchange rate volatility stems from the assumption that firms cannot alter factor inputs in order to adjust optimally to take account movements in exchange rates. We also find the same negative relationship in OLS estimation with no control, but not in the two-way fixed effects.

The strong significance of gravity variables and industrial similarity index imply that among EZ periphery countries, Spain holds the strongest potential to increase its links with European hubs, such as Germany, provided there is a similar industrial structure. For other countries, supply links provide limited prospects in the short run. However, more competitive wages may open up opportunities with other hubs in the region.

The variables in above regression analysis are measured in different units of measurement. For example, foreign VA trade is measured in million U.S. dollars whereas the Industry Dissimilarities are indices in the scale of 0.01. Therefore, it is difficult to compare which of

the independent variables have a greater effect on the dependent variable from the results in Table 3.

Table 3. Regression Results of Determinants of Foreign VA

Variable	OLS with no Control	OLS with Time Control (Baseline)	Two-way Fixed Effects
	(1)	(2)	(3)
Log of GDP_1	0.8255**	0.8272**	0.6695**
	(0.0057)	(0.0057)	(0.0957)
Log of GDP_2	0.6127**	0.6100**	-0.8357**
	(0.0057)	(0.0058)	(0.0986)
Log of GDP per capita_1	-0.1052**	-0.1018**	-0.0127
	(0.0102)	(0.0104)	(0.0910)
Log of GDP per capita_2	0.1656**	0.1807**	1.2998**
	(0.0120)	(0.0121)	(0.0934)
Log of Distance	-0.5378**	-0.5370**	
	(0.0111)	(0.0112)	
Common Language Dummy	0.6847**	0.6731**	
	(0.0399)	(0.0398)	
Common Border Dummmy	0.7629**	0.7618**	
	(0.0370)	(0.0368)	
Resource-rich Dummry	0.3089**	0.3088**	
	(0.0262)	(0.0261)	
FTA Dummy	0.3350**	0.3507**	0.0731**
	(0.0245)	(0.0261)	(0.0115)
Down Stream Tariff	-0.0179**	-0.0112**	-0.0359**
	(0.0035)	(0.0037)	(0.0020)
Exchange Rate Volatility	-1.5051**	-1.6656**	0.9182**
	(0.3819)	(0.3851)	(0.1423)
Difference in Unit Labor Costs	0.8801**	0.8872**	0.5983**
	(0.0908)	(0.0903)	(0.0801)
Industry Similarity	-1.7370**	-1.8217**	
	(0.2458)	(0.2450)	

Notes: 1 denotes source country and 2 denotes recipient country

** denotes 1% significance level

* denotes 10% significance level

Number of observations: 17640

To evaluate the contribution of each variable on foreign-value-added trade, we compute the standardized coefficient for our baseline model (OLS with time control).[7] Standardized coefficients are the estimates resulting from an analysis carried out on independent variables that have been standardized so that their standard deviations are all one. Thus, standardized coefficients tell us how many standard deviations a dependent variable will change, per standard deviation increase in the independent variable.

Table 4. The Standardized (Beta) Coefficients

Variable	Standardized Coefficient
Log of GDP_1	0.672
Log of GDP_2	0.496
Log of GDP per capita_1	-0.048
Log of GDP per capita_2	0.085
log of distance	-0.266
Common Language Dummy	0.066
Common Border Dummy	0.089
Resource-rich Dummy	0.052
FTA Dummy	0.071
Downstream Tariff	-0.015
Exchange Rate Volatility	-0.018
Unit Labor Costs differentials	0.044
Industry similarity Index	-0.029

For example, the standardized coefficient for ULC differential is 0.044, which means that one standard deviation increase in ULC differential results in 0.044 standard deviation increase in bilateral value-added trade (Table 4). We can see that the traditional gravity variables are dominant in explaining supply links as captured by foreign VA, compared to the effects of structural variables. In other words, without help from gravity variables, such as a large economic size or close distance to supply hubs, countries have to undergo large structural adjustments if they want to meaningfully increase the supply chain linkages.

IV. Supply Links and Revealed Comparative Advantage

Revealed comparative advantage (RCA) proposed by Balassa (1965) is defined as the share of a sector in a country's total exports relative to the world average of the same sector in world exports. If the value of RCA exceeds one, the country has a revealed comparative advantage in that sector while a value below one signifies a revealed comparative

[7] In some literature, the standardized coefficients are referred as "Beta coefficients". Each variable is standardized by subtracting its mean from each of its values and then dividing these new values by the standard deviation of the variable.

disadvantage in that sector. Koopman and others (2011) show that the problem of multiple counting in official trade statistics makes the computation of RCA misleading. An RCA based on the VA decomposition of exports eliminates the distortion of multiple counting by focusing on domestic VA.

We look at the four successful central European countries that pursued export-led growth through greater integration with supply links to see how their tradable sector evolved during 1995–2008 in terms of comparative advantage. We disaggregate domestic VA exports into manufacturing and services, further dividing each category into labor-, capital- and knowledge-intensive sectors. The classification of sectors is documented in Annex 3, Table 2. Here we present a few key observations (Figure 9):

- **Central European countries enhanced their comparative advantage in manufacturing over time.** In 1995, none of the four countries had a comparative advantage in knowledge-based manufacturing. By 2008, they all acquired such advantage in addition to retaining/improving their RCA in labor- and capital-intensive manufacturing. Strong and growing supply links with European hubs enabled these countries to move up the value ladder.

- **Enhanced comparative advantage in manufacturing in central Europe has not necessarily come at the expense of services**. Some of these countries show strong RCA in services exports as well. For example, Hungary and Poland have a RCA higher than 1 in two of the three categories of services exports. Czech Republic and Slovakia, on the other hand, started with a RCA in all three services category in 1995 but over time moved to recreate comparative advantage in manufacturing. Over time, Czech Republic and Slovakia's RCA became closer to that of Germany's in line with their stronger supply link relationship. The harmonization of RCA reflects the dominance of intra-industry in supply links between these two countries and Germany.

Figure 9. Evolution of Revealed Comparative Advantage in Manufacturing and Services: Emerging Europe and EZ Periphery, 1995–2008

	Manufacturing, 1995			*Manufacturing, 2008*		
	Labor-intensive	Capital-intensive	Knowledge-Intensive	Labor-intensive	Capital-intensive	Knowledge-Intensive
Portugal	3.42	0.94	0.57	2.40	1.25	0.72
Spain	0.93	1.21	1.04	1.04	1.40	1.07
Ireland	0.34	1.79	1.01	0.13	0.83	0.87
Greece	1.6	1.3	0.0	0.4	0.7	0.2
Czech Republic	1.29	1.30	0.56	1.10	1.28	1.28
Hungary	0.68	1.06	0.50	0.42	0.85	1.26
Poland	1.95	1.39	0.59	1.72	1.41	1.01
Slovakia	1.05	1.61	0.60	1.09	1.41	1.14
China	3.55	1.03	0.64	2.61	0.70	1.28
Germany	0.64	1.07	1.48	0.69	1.16	1.61

	Services, 1995			*Services, 2008*		
	Labor-intensive	Capital-intensive	Knowledge-Intensive	Labor-intensive	Capital-intensive	Knowledge-Intensive
Portugal	0.67	2.09	0.86	1.26	2.45	0.89
Spain	0.54	1.09	0.81	0.55	1.26	1.59
Ireland	0.39	0.23	1.82	1.69	0.54	3.90
Greece	2.9	3.0	0.5	2.0	9.0	0.6
Czech Republic	1.89	1.53	1.09	0.79	1.11	0.55
Hungary	2.50	2.39	1.62	2.27	1.07	0.82
Poland	1.32	0.90	0.58	1.08	1.16	0.48
Slovakia	1.88	1.32	1.05	1.14	0.88	0.62
China	0.86	0.74	0.12	1.34	1.10	0.54
Germany	0.55	0.63	0.51	0.55	0.84	0.71

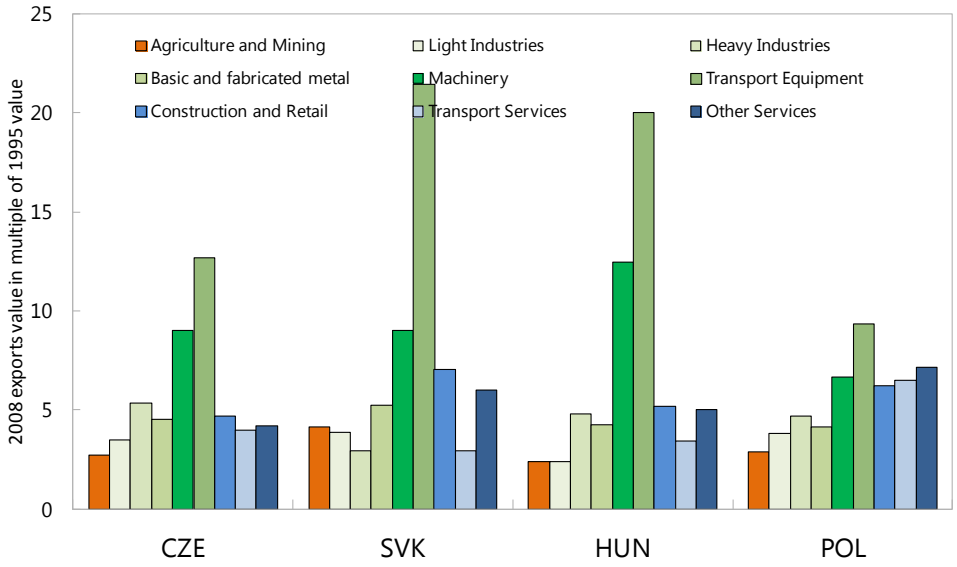
	RCA<0.5		2<RCA<3
	0.5 < RCA < 1		RCA > 3
	1 < RCA < 2		

Source: Authors' calculation using world input-output table.

We further zoom in on product level export data to see whether performance was driven by particular products (Figure 10, Annex 3 Tables 3a-3d). Indeed, we see the importance of transport equipment and machinery industries in the export success story of these countries. During 1995–2008, exports of all major categories more than doubled in these four countries. But exports of machinery and transport equipment increased by 7–22 times. The dominance of machinery and transport equipment exports is overwhelming. The share of these products

in total exports of goods and services increased from around 10 percent to over 20 percent during this time period in Hungary, Czech, and Slovak Republics. This attests to the role of finding a niche few sectors to secure success in a supply link driven trade environment.

Figure 10. Sectoral Export Performance in Selected Central European Countries, 1995-2008



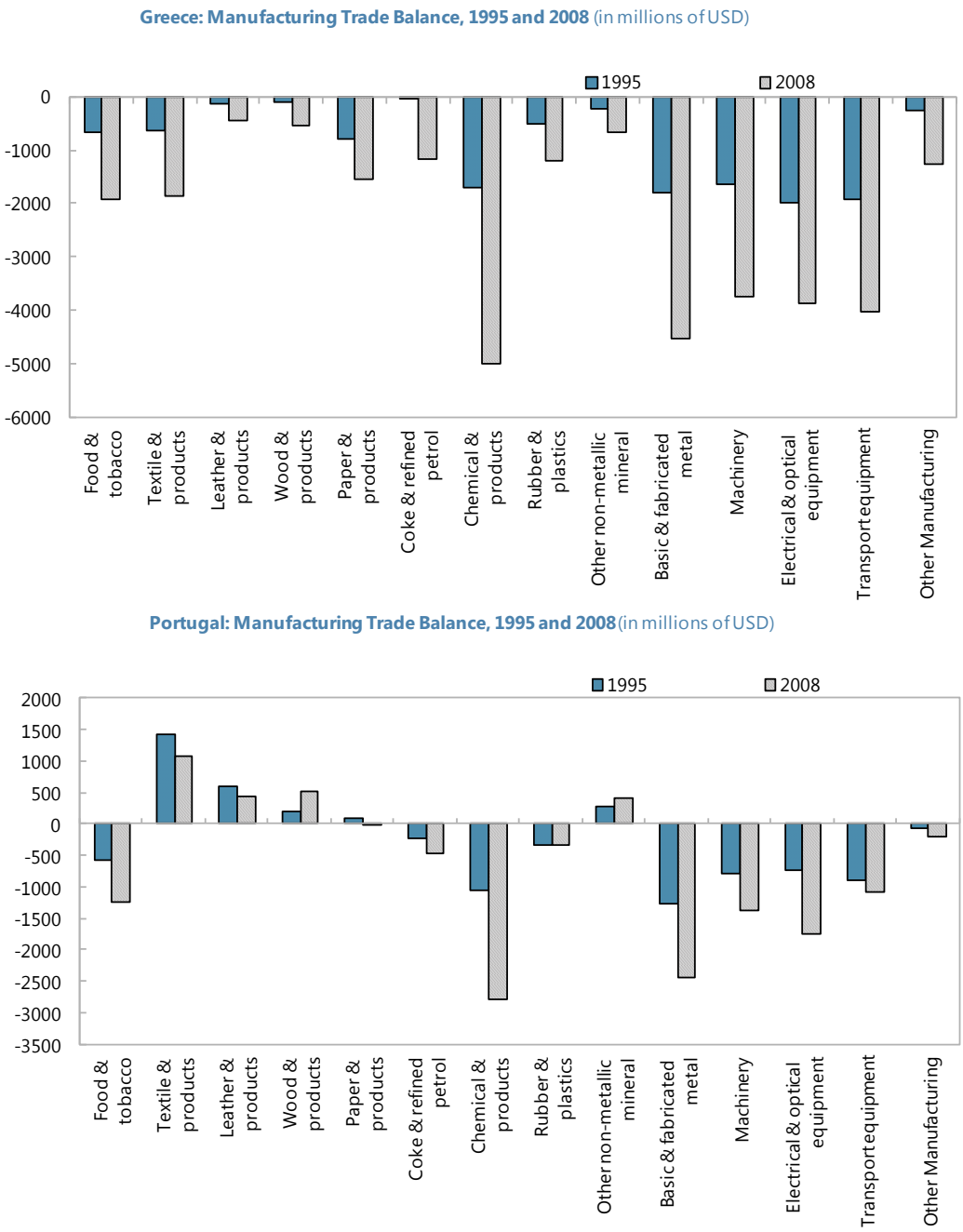
Sources: Authors' calculation using world input output table.

We compare sectoral export evolution of four central European countries with that of EZ periphery countries which, apart from Ireland, are much less dependent on supply links than the central European countries.

- **During 1995–2008, the role of manufacturing decreased in some EZ periphery countries.** These countries showed RCA in some manufacturing categories in 1995. For example, Greece showed RCA in labor and capital-intensive manufacturing, and Ireland in capital and knowledge-intensive manufacturing in 1995. Over time, both of these countries lost RCA in manufacturing. On the other hand, Spain and Portugal increased their RCA in labor-intensive manufacturing.

- **EZ periphery has a higher comparative advantage in services production.** As of 2008, all four countries show a RCA value higher than one in two out of three categories of services exports. The dominance of services industry is most relevant for Greece, which has run a deficit in all major manufacturing export sub-categories during 1995–2008 (Figure 11, Annex 3 Tables 3e). Spain and Portugal, on the other hand, show some comparative advantage in manufacturing products.

Figure 11. Greece and Portugal: Manufacturing Sectoral Trade Balance, 1995-2008



Source: Authors' calculation using world input output table.

What lessons can be learnt from the analysis of RCA? Supply links are more dominant in manufacturing and successful linking often involves finding niche manufacturing sectors. Although Ireland's experience would testify that successful linking could take place through services as well. Most EZ periphery countries have RCA in services. Improving exports would need to lever this services sector RCA. For this to happen through intra-Europe trade, further liberalization of services trade in Europe and finding niche sectors in services trade would be helpful. For example, Germany does not demonstrate a RCA in services. Liberalizing services trade in surplus countries like Germany would be one channel through which service-heavy periphery countries could benefit in terms of improving trade balance and growth.

V. CONCLUSION

One of the most important recent changes in the global economy involves increasing interconnectedness of production processes in a vertical trading chain that stretches across many countries, with each country specializing in particular stages of a good's production sequence. Because of vertical production linkages, intermediate products move across borders multiple times before being assembled to a final good. This phenomenon challenges the traditional wisdom of international trade theory, as well as the ability for gross trade data to provide an accurate picture regarding countries' export performance and competitiveness.

In this paper, we use a newly released world input-output table to characterize the development of vertical integration as well as to investigate its impact on countries' exports. Our purpose is to reshape our understanding of trade in Europe based on VA trade statistics. To accomplish this, we adopt a cutting-edge framework developed by Koopman and others (2011) to decompose each country's gross exports according to its VA sources. We try to see the performance on domestic VA exports over time, the role of supply links in export performance, and factors determining success in a trade set up dominated by supply links.

Our analysis shows that strongest export performance globally and in Europe during 1995-2008 has been the result of successful integration with supply links. This integration often relied on a few niche sectors, rather than the entire spectrum of tradable products. Our empirical investigation shows that the ability to link depends on gravity variables, such as the size of the GDP, per capita income, and distance from the hub country, but also cost differential and similarlities in industrial structure. This result is consistent with our conjecture that firms have incentive to unbundle the production process and putting fragments of it abroad to take advantage of low-cost foreign factors of production. Our analysis also shows that successful linking helps countries in Europe move up the value chain.

What prospects or lessons do we have for Euro zone periphery countries? Success in exports growth would depend on successfully linking to supply chains. Greater links with upstream export hubs in Europe can greatly help these countries improve their export prospects.

Benefiting through supply links hold the strongest prospects for Spain among these countries, because of its larger size, sizable existing links, geographical proximity to Germany as well as an export structure that is similar, and perhaps the weakest for Greece, due to its small size, service-heavy export structure, low level of links and geographic location. For the latter, further liberalization of services trade in Europe, in addition to finding niche sectors and maintain competitive wages, would offer some prospects of stronger export-led growth.

Box 1. Supply Links in Europe

The bilateral flows in VA exports allow us to have a glimpse of regional joint-production networks and individual countries' participation (Box Figure). The size of the dot in the figure below for each coutnry depends on the country's total participation in the VA network, which is captured by the sum of downstream and upstream supply link exports. The arrows represent the flows of VA exports between two countries. To make the plot informative, only bilateral value-added flows above 2 billion U.S. dollar are plotted.[1] For example, an arrow from Germany to Poland indicates that Germany's value-added embodied in Poland's exports is above 2 billion U.S dollar.

Box Figure: The Joint-Production Network in Europe

As shown in the Figure above, Germany is the most important hub in the export supply network of Europe in terms of value of trade, followed by Italy, Netherlands, the UK and France. Moreover, Germany also has the largest number of arrows in both directions linking with other countries (Table 1). Germany provides upstream inputs to 33 countries and receives inputs from 33 countries as well making it the most connected country in world trade above China and the USA. Italy, France, the UK, Netherlands, Belgium, Spain are Poland are other big hubs in Europe with strong upstream and downstream links. Russia also plays an important role in the region's network but only because of its role as a supplier of oil and gas.

[1] If all VA flows are plotted, there would be arrows between almost every pair of countries. The threshold level of 2billion U.S dollar is the authors' arbitrary choice.

Box Table. Degree of Interconnectedness in Europe

	VA export flow >=$200m		VA export flow >=$800m		VA export flow >=$2000m		VA export flow >=$4000m	
Country	Degree (Input)	Degree (Out)	Degree (Input)	Degree (Out)	Degree (Input)	Degree (Out)	Degree (Input)	Degree (Out)
DEU	25	26	22	22	17	17	11	15
ITA	23	24	14	19	8	10	4	3
FRA	21	23	15	17	8	11	7	6
GBR	21	23	13	15	8	10	3	7
BEL	22	21	15	13	8	6	4	3
NLD	21	22	13	14	7	10	5	4
ESP	20	22	11	15	6	8	3	2
AUT	19	20	12	9	2	2	1	1
POL	19	20	11	14	4	3	1	1
RUS	13	25	1	20	0	13	0	4
SWE	20	16	11	9	7	2	2	1
HUN	19	16	9	2	1	1	1	0
CZE	18	16	11	7	3	1	1	1
IRL	16	16	9	7	6	3	2	0
DNK	17	14	10	5	4	2	1	1
TUR	13	16	5	5	2	1	0	0
ROM	12	13	2	2	0	0	0	0
SVK	13	12	6	5	2	1	1	0
FIN	16	7	4	4	2	2	0	0
LUX	12	8	7	2	6	0	2	0
PRT	8	8	3	3	1	0	0	0
GRC	8	6	3	1	0	0	0	0
SVN	8	5	2	1	0	0	0	0
BGR	7	4	1	0	0	0	0	0
EST	3	3	0	0	0	0	0	0
LTU	3	3	1	0	1	0	0	0
LVA	2	1	0	0	0	0	0	0
MLT	1	0	0	0	0	0	0	0
CYP	0	0	0	0	0	0	0	0

Source: Authors' calculation using world input output Table.

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ANNEX 1. DECOMPOSITION METHODOLOGY

A. Decomposing Gross Trade Statistics

We adopt the conceptual framework developed in Koopman and others (2011) to decompose the sources of VA in global production of tradables. The decomposition methods are summarized below.

Assume an *m*-country world, in which each country produces goods in *n* differentiated tradable sectors. The *m*-country production and trade system can be written as an Inter-County Input-Output model in the form of block partitioned matrix

$$(1)\ \begin{bmatrix} X_1 \\ \vdots \\ X_m \end{bmatrix} = \begin{bmatrix} A_{11} & \cdots & A_{1m} \\ \vdots & \ddots & \vdots \\ A_{m1} & \cdots & A_{mm} \end{bmatrix} \begin{bmatrix} X_1 \\ \vdots \\ X_m \end{bmatrix} + \begin{bmatrix} Y_{11} + \ldots Y_{1m} \\ \vdots \\ Y_{m1} + \ldots Y_{mm} \end{bmatrix}$$

where X_m is the $n\times1$ gross output vector of country *m*, Y_{ij} is the $n\times1$ final demand vector that shows demand in country *j* for final goods produced in country *i*, and $A_{ij}$is the $n\times n$ IO coefficient matrix, giving intermediate use in country *j* of goods produced in country *i*.

Deriving the Leontief inverse matrix from equation (1) and pre-multiplying it with the final demand matrix, we get:

$$(2)\ \begin{bmatrix} I - A_{11} & \cdots & -A_{1m} \\ \vdots & \ddots & \vdots \\ -A_{m1} & \cdots & I - A_{mm} \end{bmatrix}^{-1} \begin{bmatrix} Y_{11} & \cdots & Y_{1m} \\ \vdots & \ddots & \vdots \\ Y_{m1} & \cdots & Y_{mm} \end{bmatrix}$$

$$= \begin{bmatrix} B_{11} & \cdots & B_{1m} \\ \vdots & \ddots & \vdots \\ B_{m1} & \cdots & B_{mm} \end{bmatrix} \begin{bmatrix} Y_{11} & \cdots & Y_{1m} \\ \vdots & \ddots & \vdots \\ Y_{m1} & \cdots & Y_{mm} \end{bmatrix} = \begin{bmatrix} X_{11} & \cdots & X_{1m} \\ \vdots & \ddots & \vdots \\ X_{m1} & \cdots & X_{mm} \end{bmatrix}$$

where B_{ij}denotes the $n\times n$ block Leontief inverse matrix, which is the total requirement matrix giving the amount of gross output produced in country *i* required for a one-unit increase in final demand in country *j*. It follows that, X_{ji} is the output of country *j* used to produce goods eventually consumed in country *i*.

Regarding exports, let E_{ij} be the $n\times1$ vector of gross exports from *i* to *j*. Gross exports from *i* to *j* is divided into final good $Y_{ij}$and intermediates $A_{ij}X_j$. The intermediates are further divided into goods that are processed and consumed by country *j* ($A_{ij}X_{jj}$), goods that are processed and re-exported by *j* to third countries ($\sum_{k\neq i,j} A_{ij}X_{jk}$), and intermediate goods exported from *i* to *j* then processed and exported back to *j* $\left(A_{ij}X_{ji}\right)$:

(3) $E_{ij} = Y_{ij} + A_{ij}X_j = Y_{ij} + A_{ij}X_{jj} + \sum_{k\neq i,j} A_{ij}X_{jk} + A_{ij}X_{ji}$

Equation (3) traces the *downstream* use of exports from country *i* to country *j*, however, it does not provide information on the *upstream* contribution from other countries to the exports of country *i*. Thus, we still need to compute the upstream VA of country *i*'s exports in order to derive a complete picture of supply links and disaggregation of VA.

Formally, we define V_i to be the *1×n* direct VA coefficient vector. Each element of V_i gives the share of direct domestic VA in total output. This is equal to one minus the intermediate input share from all countries (including domestically produced intermediates):

(4) $V_i = u\left(I - \sum_j A_{ji}\right)$

Where, *u* is a 1×n unity vector.

Combining the VA coefficient vector with the partitioned Leontief inverse matrix provides information regarding the VA share. For example, each element in the 1×n vector V_iB_{ii} gives the domestic VA share of a particular sector in country *i*. Similarly, the corresponding element in vector $V_jB_{ji}$is the share of country *j*'s VA in the same sector produced in country *i*.

Let E_{i*} be the total export from *i*, i.e. $E_{i*} = \sum_{j\neq i} E_{ij} = \sum_{j\neq i}(A_{ij}X_j + Y_{ij})$

The gross exports from country *i* can be divided into domestic VA export (DV_i) and foreign VA export $(FV)_i$.

(5) $E_{i*} = DV_i + FV_i$

Using the derived information on VA share, Koopman and others (2011) shows that:

(6) $FV_i = \sum_{j\neq i} V_j B_{ji} E_{i*}$

(7) $DV_i = V_iB_{ii}E_{i*}$

Combining the downstream use of export in equation (3) with the VA decomposition in equation (5), we can decompose gross exports into five VA categories (Figure 3):

(8) $E_{i*} = DV_i + FV_i$

$$= V_iB_{ii}\sum_{j\neq i} Y_{ij} + V_iB_{ii}\sum_{j\neq i} A_{ij}Y_{jj} + V_iB_{ii}\sum_{j\neq i}\sum_{k\neq i,j} A_{ij}X_{jk} + V_iB_{ii}\sum_{j\neq i} A_{ij}X_{ji} + FV_i$$

For country i, the terms in equation (8) correspond to the following, respectively:

(A: $V_i B_{ii} \sum_{j \neq i} Y_{ij}$): DV in the form of final goods and services consumed by the direct importer;

(B: $V_i B_{ii} \sum_{j \neq i} A_{ij} Y_{jj}$): DV in the form of intermediate inputs used by the direct importer to produce its domestically consumed products;

(C: $V_i B_{ii} \sum_{j \neq i} \sum_{k \neq i,j} A_{ij} X_{jk}$): DV in the form of intermediate exports used by the direct importer to produce goods for third countries

(D: $V_i B_{ii} \sum_{j \neq i} A_{ij} X_{ji}$): DV in the form of intermediate exports used by the direct importer to produce goods shipped back to source country;

(E: FV_i): VA by foreign countries embodied in country i's gross exports.

B. Measuring Vertical Integration

In previous literature, measures of vertical integration have been developed. Most of these proposed measures are easily taken to the data, specifically with the use of the input-output tables.

Earlier literature such as Feenstra and Hanson (1996 and 1999), Feenstra (1998), Campa and Goldberg (1997), use the share of imported intermediate input (in total input or in gross output) to measure the level of outsourcing. However, these measures fail to fully capture the supply links as countries are grouped either as producers in intermediate stages or as exporters of final goods while in reality the links are more complex.

Hummels and others (2001) suggest a measure of vertical specialization, focusing on those imported goods that are used as inputs to produce a country's exports. (Hummels and others, 2001) Their measure emphasizes the twin ideas that the production sequence of a good involves at least two countries, and that, during this sequencing, the good-in-process crosses at least two international borders. The same approach is followed in Chen and others (2005), European Central Bank (ECB, 2005a), Breda and others (2008), and Koopman and others (2010).

Following the more recent group of literature originated from Hummels and others (2001), we define vertical integration or supply links as occurring when two or more countries provide VA in a good's production sequence; at least one country must use imported inputs in its production process, and the resulting output must be exported.

Note that the notion of vertical integration is only sensible in at least a bilateral context. Thus, it has both an upstream side and a downstream side. The upstream supplier exports intermediate goods to a downstream producer who uses these intermediates to add value for further export. As an upstream supplier, a country's participation in the global production chain depends on its VA to other countries' exports. As a downstream assembler, a country's participation in the global production chain depends on the foreign VA in its exports.

To evaluate this bilateral relation in supply links, we need to measure, for all country-pairs, the embedded foreign VA from one country in another country's export. Koopman and others (2011) has shown that the matrix of VA by source in gross exports (VAS_E) can be specified as:

$$VAS\_E = \begin{bmatrix} V_1 B_{11} E_{1*} & \cdots & V_1 B_{1m} E_{m*} \\ \vdots & \ddots & \vdots \\ V_m B_{m1} E_{1*} & \cdots & V_m B_{mm} E_{m*} \end{bmatrix}$$

The elements of this matrix provide VA by source in gross exports between each country pair. For example, the element $VAS\_E_{ij} = V_i B_{ij} E_{j*}$ gives country i's VA embodied in country j's export. Therefore, diagonal elements of VAS_E matrix correspond to the domestic VA in each country's exports. Off-diagonal elements give the foreign VA embodied in each country's exports.

To link this bilateral VA relation with the country-level decomposition of export, note that the sum of off-diagonal elements along a column is the measure of VA from foreign sources embodied in a particular country's gross exports, which is just equal to FV defined in equation (8). Here, we call it Downstream Participation (DP) and use it to measure a country's participation in global VA chain as a downstream producer:

$$DP_i = FV_i = \sum\nolimits_{j \neq i} V_j \, B_{ji} E_{i*}$$

Similarly, the sum of off-diagonal elements along a row provides information on a country's VA embodied as intermediate inputs in all other countries' gross exports. It can be used to measure the country's participation in global VA chains as an upstream supplier. We call it Upstream Participation (UP):

$$UP_i = \sum\nolimits_{j \neq i} V_i \, B_{ij} E_{j*}$$

C. Measuring Contribution of Vertical Integration to Overall Exports Growth

Note that the above analysis attempts to measure countries' overall importance to global/regional VA networks. To capture the "intensity" of a country's vertical specialization, we normalize country's DP and UP by its gross exports.

Once we normalize DP with the country's gross exports, we can use it to measure the degree of a country's participation in global VA chain as a downstream producer (denoted by DDP).

$$DDP_i = \frac{DP_i}{E_{i*}} = \frac{\sum_{j \neq i} V_j B_{ji} E_{i*}}{E_{i*}}$$

Similarly, we normalize UP with the country's gross export, which can be used as a measure of a country's participation in upstream global VA chain (denoted by DUP).

$$DUP_i = \frac{UP_i}{E_{i*}} = \frac{\sum_{j \neq i} V_i B_{ij} E_{j*}}{E_{i*}}$$

Previous literature that looks at "import content of exports" as a proxy to measure a country's degree of vertical specialization only takes into account participation as a downstream producer, giving an incomplete analysis.[8] If a country is a major upstream supplier in the global VA network, it may have a fairly low foreign VA share in its export (e.g. Japan and Germany for example). In this case, the foreign content of exports will understate the country's participation in supply links. To avoid this problem, in our paper, we measure a country's degree of vertical integration in global VA chains by summing up DDP_i *and* DUP_i. In doing so, we essentially look at the country's role in global production from both angles.

[8]The literature however does not use a uniform term: outsourcing (Feenstra, and Hanson, 1996), international fragmentation of production (Jones and Kierzkowski, 2001), vertical specialization (Hummels and others, 2001; Goh and Olivier, 2004), delocalization (Leamer, 1998), vertical production networks (Hanson and others, 2005), production sharing (Feenstra, 1998).

ANNEX 2: THE WORLD INPUT-OUTPUT TABLE

The World Input-Output Table used in our study is based on a newly released world Input-Output Table (WIOT) by Timmer and others (2012). The database covers 27 EU countries and 13 other major countries in the world for the period 1995 to2009.[9] The 40 countries included in our world input-output table cover more than 85 percent of world GDP.

Differing from previous databases such as GTAP, OECD and IDE-JETRO, the construction of WIOT relies on the national supply and use tables (SUTs) rather than input-output tables as its basic building blocks. Timmer and others (2012) argues that SUTs are a more natural starting point as they provide information on both products and (using and producing) industries.[10] Moreover, the input-output table is often constructed on the basis of an underlying SUT, requiring additional assumptions.

Besides national SUTs, the construction of the WIOT also uses National Accounts time series data for industry output and final use, and bilateral international trade data in goods and services.

In the first step of the construction process, time-consistent output and final consumption series in the national accounts are used to benchmark national SUTs to ensure meaningful analysis over time.[11] In the second step, the national SUTs are combined with information from international trade statistics to construct so-called international SUTs. Basically, a split is made between use of products that were domestically produced and those that were

[9] Nevertheless to complete the WIOT and make it suitable for various modeling purposes, they also added a region called the Rest of the World (RoW) that proxies for all other countries in the world. The RoW needs to be modeled due to a lack of detailed data on input-output structures. Production and consumption in the ROW is modeled based on totals for industry output and final use categories from the UN National Accounts, assuming an input-output structure equal to that of an average developing country. Imports from RoW are given as share of imports from RoW from trade data applied to the imports in the supply table. Hence, exports from the RoW are simply the imports by our set of countries not originating from the set of WIOT countries. Exports to RoW for each product and country from the set of WIOT countries are defined residually to ensure that exports summed over all destination countries is equal to total exports as given in the national SUTs. This sometimes resulted in negative exports to the rest of the World. In those cases they added additional constraints to prevent negativity

[10] A supply table provides information on products produced by each domestic industry and a use table indicates the use of each product by an industry or final user. In contrast, an input-output table is exclusively of the product or industry type.

[11] Typically, SUTs are only available for a limited set of years and once released by the national statistical institute revisions are rare. This compromises the consistency and comparability of these tables over time. By benchmarking the SUTs on consistent time series from the National Accounting System (NAS), tables can be linked over time in a meaningful way. In their database, for some countries full time-series of SUTs are available, but for other countries only some years are available. In Appendix Table 1 we provide an overview of the SUTs used in WIOT.

imported. Finally, the international SUTs for each country are combined into a world input-output table.

For services trade, no standardized database on bilateral flows exists. These have been collected from various sources (including OECD, Eurostat, IMF and WTO), checked for consistency and integrated into a bilateral service trade database. As services trade is taken from the balance of payments statistics it is originally reported at Balance of Payments codes.

ANNEX 3: BACKGROUND TABLES

Table 1a. Value-Added Decomposition of Exports in Manufacturing

Country or Region	Decomposition in export of Manufactoring Good 1995							Decomposition in export of Manufactoring Good 2008						
	Gross manufacturing export (million $)	DVA in direct exports of final goods	DVA in intermediates absorbed by direct importer	Indirect DVA exports to third countries	Returned DVA	FVA	Total	Gross manufacturing export (million $)	DVA in direct exports of final goods	DVA in intermediates absorbed by direct importer	Indirect DVA exports to third countries	Returned DVA	FVA	Total
		(1)	(2)	(3)	(4)	(5)	(6)		(1)	(2)	(3)	(4)	(5)	(6)
CHN	136325	50.6%	22.6%	8.9%	0.4%	17.5%	100%	1803921	35.4%	19.8%	11.8%	1.5%	31.4%	100%
Rest of the world	418354	30.3%	25.9%	9.7%	2.4%	31.8%	100%	1647992	19.9%	21.2%	11.1%	3.6%	44.2%	100%
DEU	511451	36.3%	28.3%	14.3%	2.7%	18.3%	100%	1434387	29.5%	22.2%	16.5%	2.1%	29.8%	100%
USA	479211	35.6%	31.4%	11.0%	8.9%	13.1%	100%	1001641	30.9%	27.5%	14.8%	6.8%	20.1%	100%
JPN	399313	39.3%	38.0%	14.3%	1.6%	6.7%	100%	723610	29.2%	28.7%	21.1%	1.3%	19.8%	100%
FRA	261160	37.1%	25.6%	13.8%	1.4%	22.1%	100%	576334	32.8%	19.7%	15.5%	1.2%	30.9%	100%
ITA	219179	41.7%	25.0%	11.9%	0.8%	20.6%	100%	515486	34.3%	21.1%	15.6%	0.9%	28.1%	100%
KOR	119391	29.5%	29.6%	13.5%	0.4%	26.9%	100%	424822	18.8%	20.7%	16.2%	0.4%	43.9%	100%
GBR	225865	36.3%	25.6%	13.8%	1.3%	23.0%	100%	403728	32.3%	21.5%	16.4%	1.1%	28.6%	100%
NLD	148442	28.9%	21.2%	12.9%	0.7%	36.4%	100%	329863	24.0%	15.5%	13.8%	0.5%	46.2%	100%
CAN	158479	27.6%	34.4%	7.1%	0.8%	30.2%	100%	300671	26.3%	30.9%	9.9%	1.0%	32.0%	100%
ESP	86279	37.8%	24.9%	12.9%	0.6%	23.7%	100%	269583	30.3%	19.7%	14.5%	0.9%	34.7%	100%
BEL	134844	24.0%	19.2%	12.3%	0.5%	44.0%	100%	267975	18.0%	14.7%	13.4%	0.3%	53.7%	100%
TWN	108406	28.7%	24.8%	10.4%	0.2%	35.9%	100%	254976	10.6%	19.8%	20.8%	0.2%	48.6%	100%
MEX	54824	31.5%	25.4%	7.6%	0.3%	35.2%	100%	199372	28.3%	23.4%	9.4%	0.5%	38.5%	100%
IND	32005	40.8%	36.1%	10.8%	0.1%	12.2%	100%	176800	32.9%	24.3%	14.1%	0.4%	28.3%	100%
SWE	77872	29.1%	27.7%	15.3%	0.4%	27.5%	100%	176392	23.7%	20.7%	16.1%	0.3%	39.2%	100%
POL	23293	36.4%	27.7%	16.4%	0.2%	19.3%	100%	168624	28.6%	17.7%	16.9%	0.4%	36.4%	100%
AUT	47262	27.1%	27.9%	16.1%	0.5%	28.4%	100%	156202	23.1%	19.0%	17.7%	0.4%	39.8%	100%
BRA	41011	24.4%	50.0%	16.3%	0.3%	9.0%	100%	145530	32.8%	32.6%	18.6%	0.4%	15.6%	100%
TUR	24664	50.2%	23.4%	11.2%	0.1%	15.1%	100%	136191	31.7%	22.1%	13.9%	0.2%	32.1%	100%
CZE	16880	23.5%	25.5%	15.4%	0.7%	34.9%	100%	135925	19.8%	14.5%	15.0%	0.2%	50.5%	100%
IRL	40338	33.2%	16.6%	8.5%	0.1%	41.6%	100%	117948	26.1%	14.3%	9.2%	0.1%	50.3%	100%
RUS	27595	14.7%	47.9%	24.8%	0.6%	12.0%	100%	111251	13.2%	43.5%	32.1%	1.0%	10.3%	100%
FIN	39298	23.6%	34.4%	17.1%	0.3%	24.7%	100%	102544	18.5%	25.9%	18.4%	0.2%	37.0%	100%
IDN	36721	30.4%	38.6%	11.7%	0.2%	19.1%	100%	97085	19.3%	38.9%	20.3%	0.3%	21.2%	100%
AUS	30659	30.7%	39.4%	13.9%	0.2%	15.8%	100%	94421	21.6%	33.9%	20.8%	0.5%	23.1%	100%
DNK	48727	44.8%	19.1%	9.9%	0.2%	26.1%	100%	94058	35.6%	17.0%	13.3%	0.2%	33.8%	100%
HUN	8703	29.4%	22.0%	13.2%	0.1%	35.4%	100%	86360	18.7%	12.1%	12.9%	0.2%	56.1%	100%
SVK	7467	18.1%	27.5%	17.7%	0.5%	36.1%	100%	60929	18.7%	13.7%	15.8%	0.2%	51.6%	100%
PRT	21379	40.0%	19.3%	9.3%	0.2%	31.2%	100%	51345	28.7%	19.1%	13.0%	0.3%	38.9%	100%
ROM	6475	30.1%	28.5%	14.4%	0.1%	26.9%	100%	38436	25.7%	20.9%	18.4%	0.3%	34.7%	100%
SVN	7850	30.8%	21.3%	11.1%	0.0%	36.7%	100%	26238	24.2%	15.9%	15.0%	0.1%	44.9%	100%
GRC	4282	42.1%	22.4%	10.9%	0.2%	24.4%	100%	17847	26.7%	18.6%	12.3%	0.3%	42.2%	100%
BGR	3444	28.7%	22.8%	9.7%	0.0%	38.8%	100%	17499	17.5%	16.0%	13.2%	0.1%	53.2%	100%
LTU	1660	24.9%	23.3%	10.9%	0.0%	40.9%	100%	14435	20.3%	15.6%	11.3%	0.2%	52.7%	100%
LUX	6635	11.2%	21.5%	16.5%	0.1%	50.8%	100%	13346	11.6%	15.3%	17.5%	0.1%	55.5%	100%
EST	1380	28.7%	20.3%	10.7%	0.1%	40.2%	100%	8650	20.9%	21.1%	16.2%	0.1%	41.7%	100%
LVA	871	29.5%	28.4%	13.5%	0.0%	28.6%	100%	5598	24.4%	21.6%	14.9%	0.3%	38.8%	100%
MLT	1363	15.9%	11.7%	7.3%	0.0%	65.1%	100%	2763	17.5%	13.5%	12.7%	0.0%	56.4%	100%
CYP	848	42.9%	13.9%	3.9%	0.0%	39.2%	100%	1457	29.7%	18.3%	10.7%	0.1%	41.2%	100%

Table 1b. Value-Added Decomposition of Service Exports

	Decomposition in export of Service 1995							Decomposition in export of Service 2008						
Country or Region	Gross service export (million $)	DVA in direct exports of final goods	DVA in intermediates absorbed by direct importer	Indirect DVA exports to third countries	Returned DVA	FVA	Total	Gross service export (million $)	DVA in direct exports of final goods	DVA in intermediates absorbed by direct importer	Indirect DVA exports to third countries	Returned DVA	FVA	Total
		(1)	(2)	(3)	(4)	(5)	(6)		(1)	(2)	(3)	(4)	(5)	(6)
USA	248726	16.6%	61.2%	14.7%	4.4%	3.2%	100%	617547	14.5%	52.6%	21.2%	5.1%	6.5%	100%
Rest of the world	89683	14.6%	54.4%	14.1%	3.4%	13.6%	100%	442483	10.7%	49.2%	15.8%	6.0%	18.4%	100%
CHN	20901	23.2%	48.2%	18.3%	0.4%	9.8%	100%	441337	17.2%	47.0%	16.5%	1.7%	17.5%	100%
GBR	58304	16.3%	55.9%	18.3%	1.4%	8.1%	100%	287800	14.3%	47.1%	27.8%	1.8%	8.9%	100%
DEU	58908	20.9%	49.7%	19.3%	3.0%	7.1%	100%	220775	17.6%	45.3%	22.5%	1.9%	12.6%	100%
RUS	32298	16.3%	55.2%	23.3%	0.7%	4.5%	100%	167853	10.6%	38.0%	43.9%	0.8%	6.7%	100%
NLD	49993	18.3%	43.9%	15.1%	0.6%	22.0%	100%	131606	15.3%	40.4%	21.5%	0.6%	22.1%	100%
JPN	83224	21.7%	58.0%	14.0%	1.9%	4.2%	100%	131166	21.5%	47.2%	20.7%	1.5%	9.1%	100%
FRA	57946	18.6%	55.6%	14.7%	1.2%	10.0%	100%	102687	13.8%	49.2%	23.7%	1.3%	12.0%	100%
BEL	38945	17.3%	39.9%	20.8%	0.9%	21.2%	100%	94687	14.9%	36.6%	23.5%	0.5%	24.5%	100%
IRL	6008	17.5%	48.5%	13.6%	0.1%	20.3%	100%	94096	12.4%	40.4%	15.4%	0.1%	31.7%	100%
ITA	40154	26.8%	47.4%	15.5%	0.9%	9.4%	100%	94062	22.4%	40.5%	23.7%	1.0%	12.4%	100%
ESP	15773	20.0%	50.9%	19.4%	0.7%	9.1%	100%	79944	15.9%	44.2%	24.8%	1.0%	14.1%	100%
LUX	12602	10.3%	35.6%	11.7%	0.1%	42.4%	100%	77065	7.4%	21.1%	8.7%	0.0%	62.8%	100%
SWE	17722	19.3%	45.8%	16.4%	0.4%	18.1%	100%	68015	16.0%	42.3%	21.7%	0.3%	19.7%	100%
DNK	11646	13.9%	41.7%	13.9%	0.2%	30.3%	100%	67967	9.9%	28.7%	13.7%	0.2%	47.5%	100%
KOR	27502	20.4%	51.4%	15.7%	0.4%	12.1%	100%	67097	16.5%	38.7%	16.4%	0.4%	28.0%	100%
CAN	27100	21.7%	57.4%	10.7%	0.5%	9.7%	100%	62590	21.8%	52.6%	15.5%	0.6%	9.5%	100%
IND	5733	22.9%	56.0%	14.6%	0.1%	6.3%	100%	59792	27.0%	46.1%	17.5%	0.4%	9.0%	100%
AUT	22111	17.3%	50.0%	17.9%	0.4%	14.4%	100%	59598	16.6%	43.2%	21.3%	0.4%	18.5%	100%
AUS	17511	27.8%	49.9%	12.6%	0.3%	9.4%	100%	43318	22.1%	46.5%	18.9%	0.4%	12.1%	100%
GRC	3913	27.1%	43.0%	12.9%	0.1%	16.9%	100%	41407	18.2%	38.6%	18.9%	0.1%	24.2%	100%
POL	5512	32.5%	42.8%	13.2%	0.1%	11.3%	100%	35846	20.5%	36.8%	22.5%	0.4%	19.8%	100%
MEX	16658	16.4%	58.8%	17.2%	0.2%	7.5%	100%	32927	17.4%	46.2%	28.5%	0.4%	7.5%	100%
BRA	8202	21.5%	54.4%	19.8%	0.3%	4.0%	100%	28666	15.9%	44.7%	32.9%	0.5%	6.0%	100%
HUN	6428	24.5%	40.5%	13.2%	0.1%	21.7%	100%	25789	20.6%	36.6%	19.2%	0.2%	23.3%	100%
TWN	16556	32.1%	38.8%	12.5%	0.2%	16.5%	100%	21942	17.2%	37.4%	17.2%	0.1%	28.1%	100%
CZE	7290	19.8%	43.9%	15.6%	0.4%	20.4%	100%	21259	21.2%	37.5%	20.8%	0.4%	20.2%	100%
ROM	2176	20.4%	50.1%	14.6%	0.0%	14.9%	100%	19966	19.1%	43.0%	21.9%	0.2%	15.8%	100%
FIN	6703	17.2%	49.8%	15.9%	0.2%	17.0%	100%	19763	16.6%	39.8%	24.7%	0.3%	18.6%	100%
PRT	5680	17.1%	49.9%	17.4%	0.2%	15.4%	100%	19373	17.2%	43.4%	21.1%	0.2%	18.2%	100%
IDN	8146	19.8%	54.6%	14.6%	0.2%	10.8%	100%	13715	21.4%	42.3%	22.0%	0.2%	14.1%	100%
SVK	2512	16.1%	45.6%	18.7%	0.4%	19.2%	100%	11242	22.6%	33.7%	21.9%	0.3%	21.5%	100%
LTU	864	27.9%	39.8%	12.8%	0.0%	19.5%	100%	8576	20.5%	38.9%	22.1%	0.1%	18.5%	100%
BGR	1804	32.1%	33.7%	10.0%	0.0%	24.2%	100%	8526	19.2%	32.0%	19.1%	0.1%	29.7%	100%
LVA	884	15.2%	46.5%	16.1%	0.0%	22.2%	100%	5876	21.4%	36.3%	22.8%	0.1%	19.3%	100%
SVN	1296	23.9%	44.6%	13.7%	0.0%	17.8%	100%	5442	17.2%	39.6%	19.7%	0.1%	23.4%	100%
EST	659	16.1%	26.4%	22.6%	0.1%	34.9%	100%	3997	12.3%	35.7%	22.5%	0.1%	29.5%	100%
CYP	865	32.6%	39.3%	12.0%	0.0%	16.1%	100%	3221	21.8%	34.4%	18.2%	0.0%	25.6%	100%
MLT	813	18.8%	39.3%	14.7%	0.0%	27.2%	100%	3051	16.5%	33.9%	17.2%	0.0%	32.4%	100%
TUR	183	22.1%	52.6%	17.8%	0.2%	7.4%	100%	1830	30.1%	26.2%	19.4%	0.3%	24.1%	100%

Table 2: Classification of Merchandise and Services Exports		
Categories	**Sector number**	**Sector name**
Primary and Natural resources	1,2	Agriculture, Hunting, Forestry and Fishing
		Mining and Quarrying
labor-intensive manufacuring	4,5,6,16	Textiles and Textile Products
		Leather, Leather and Footwear
		Wood and Products of Wood and Cork
		Manufacturing, Nec; Recycling
capital-intensive manufacuring	3,7,8,10,11,12	Food, Beverages and Tobacco
		Pulp, Paper, Paper , Printing and Publishing
		Coke, Refined Petroleum and Nuclear Fuel
		Rubber and Plastics
		Other Non-Metallic Mineral
		Basic Metals and Fabricated Metal
knowledge-intensive manufacuring	9,13,14,15	Chemicals and Chemical Products
		Machinery, Nec
		Electrical and Optical Equipment
		Transport Equipment
labor-intensive service	18,19,20,21,22,26,35	Construction
		Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel
		Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
		Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods
		Hotels and Restaurants
		Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
		Private Households with Employed Persons
capital-intensive service	17,23,24,25,27,29	Electricity, Gas and Water Supply
		Inland Transport
		Water Transport
		Air Transport
		Post and Telecommunications
		Real Estate Activities
knowledge-intensive service	28,30	Financial Intermediation
		Renting of M&Eq and Other Business Activities
health/education/public service	31,32,33,34	Public Admin and Defence; Compulsory Social Security
		Education
		Health and Social Work
		Other Community, Social and Personal Services

Table 3a. Trade Balance by Product, Merchandise and Services: Czech Republic, 1995–2009

	1995			2000			2008		
	Export	Import	Balance	Export	Import	Balance	Export	Import	Balance
Agriculture, Hunting, Forestry and Fishing	894	853	41	722	692	29	2368	2665	-297
Mining and Quarrying	586	842	-256	398	1236	-839	1706	6750	-5045
Food, Beverages and Tobacco	495	457	38	495	482	13	2173	2105	68
Textiles and Textile Products	664	482	182	619	472	147	1298	1188	110
Leather, Leather and Footw ear	126	136	-10	71	126	-54	192	321	-129
Wood and Products of Wood and Cork	243	126	118	300	141	159	1132	442	690
Pulp, Paper, Paper , Printing and Publishing	399	546	-148	516	605	-90	1911	1551	360
Coke, Refined Petroleum and Nuclear Fuel	246	236	10	161	341	-180	360	1059	-699
Chemicals and Chemical Products	618	1117	-499	817	1205	-388	2796	4039	-1242
Rubber and Plastics	190	427	-237	558	528	30	3180	1481	1700
Other Non-Metallic Mineral	483	279	205	727	308	419	1913	929	984
Basic Metals and Fabricated Metal	1692	1379	313	1632	1491	141	7655	4872	2783
Machinery, Nec	816	1305	-490	1132	1332	-200	5522	4410	1113
Electrical and Optical Equipment	621	1616	-995	1487	1999	-512	7400	4368	3032
Transport Equipment	548	640	-92	1329	771	558	6955	3112	3843
Manufacturing, Nec; Recycling	393	274	119	474	297	177	1902	1093	809
Electricity, Gas and Water Supply	733	481	251	478	451	27	2912	1932	980
Construction	432	251	181	392	252	140	1585	739	847
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	338	168	170	340	194	146	1622	683	939
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	860	1141	-282	1442	1535	-92	5768	4743	1025
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	518	654	-136	716	738	-22	3509	2277	1232
Hotels and Restaurants	717	356	361	533	260	273	1539	1245	294
Inland Transport	1136	899	237	944	819	125	4569	2882	1687
Water Transport	18	47	-29	14	68	-55	14	275	-261
Air Transport	119	197	-78	154	143	11	529	411	118
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	413	318	96	431	348	83	1571	1015	556
Post and Telecommunications	396	449	-54	452	364	88	1437	1184	253
Financial Intermediation	457	841	-384	543	887	-344	1841	2710	-869
Real Estate Activities	447	496	-49	461	532	-71	1611	1868	-257
Renting of M&Eq and Other Business Activities	1353	2097	-744	1584	2910	-1327	6899	9156	-2257
Public Admin and Defence; Compulsory Social Security	159	173	-14	114	166	-52	363	491	-128
Education	109	55	54	127	85	42	335	307	27
Health and Social Work	142	25	117	106	35	71	424	163	260
Other Community, Social and Personal Services	289	381	-92	355	446	-91	1234	1296	-61
Private Households w ith Employed Persons	0	1	-1	0	1	-1	0	2	-2
Total: Labor-intensive menufacturing	1427	1018	409	1465	1037	428	4523	3043	1480
Total: capital-intensive menufacturing	3506	3324	182	4089	3756	333	17193	11997	5196
Total: know ledge-intensive menufacturing	2602	4677	-2075	4764	5307	-543	22674	15929	6745
Total: merchandised trade	9015	10715	-1700	11437	12028	-591	48463	40384	8078
Total: service trade	9028	9304	-276	9662	10533	-871	39664	34473	5192
Total trade	17650	19744	-2095	20626	22264	-1638	86226	73765	12461

Table 3b. Trade balance by Product, Merchandise and Services: Hungary, 1995–2009

	1995			2000			2008		
	Export	Import	Balance	Export	Import	Balance	Export	Import	Balance
Agriculture, Hunting, Forestry and Fishing	1133	427	706	705	433	272	2720	1624	1096
Mining and Quarrying	59	1004	-945	41	1030	-988	168	4845	-4678
Food, Beverages and Tobacco	482	233	249	357	266	91	977	1593	-617
Textiles and Textile Products	272	239	33	434	462	-28	459	835	-376
Leather, Leather and Footw ear	66	55	10	97	106	-9	156	273	-117
Wood and Products of Wood and Cork	103	102	1	112	143	-31	266	379	-113
Pulp, Paper, Paper , Printing and Publishing	158	480	-322	213	570	-358	752	1208	-456
Coke, Refined Petroleum and Nuclear Fuel	320	163	157	248	208	39	1397	927	470
Chemicals and Chemical Products	622	907	-284	632	1111	-479	2653	3468	-815
Rubber and Plastics	162	255	-93	259	481	-222	1252	1297	-45
Other Non-Metallic Mineral	165	191	-26	192	264	-72	817	695	122
Basic Metals and Fabricated Metal	621	904	-283	645	1259	-613	2648	3861	-1213
Machinery, Nec	303	729	-426	420	1005	-585	2084	3086	-1002
Electrical and Optical Equipment	521	905	-384	2266	1819	447	8178	3624	4555
Transport Equipment	256	490	-233	1118	774	344	5143	3033	2111
Manufacturing, Nec; Recycling	64	140	-76	116	221	-105	371	632	-261
Electricity, Gas and Water Supply	355	372	-18	392	451	-59	1348	1711	-364
Construction	244	127	117	227	185	42	772	688	85
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	130	113	17	225	162	63	1045	572	472
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	546	799	-252	761	1349	-589	4221	3887	335
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	739	423	316	769	622	147	3004	1864	1140
Hotels and Restaurants	55	99	-43	142	115	27	358	470	-112
Inland Transport	880	535	345	838	693	145	2292	2124	168
Water Transport	21	23	-2	12	48	-37	27	192	-164
Air Transport	72	38	34	66	61	6	125	340	-215
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	175	142	33	273	235	38	1488	1037	451
Post and Telecommunications	355	231	124	443	333	110	1236	1101	135
Financial Intermediation	554	670	-116	521	789	-268	1751	2035	-284
Real Estate Activities	263	297	-34	415	426	-11	1933	1498	434
Renting of M&Eq and Other Business Activities	1262	2114	-852	1923	2562	-639	7627	8227	-600
Public Admin and Defence; Compulsory Social Security	143	153	-10	196	159	37	606	499	106
Education	71	27	44	98	55	42	397	238	159
Health and Social Work	45	14	31	35	21	14	95	93	2
Other Community, Social and Personal Services	378	229	149	502	377	125	1718	1439	279
Private Households w ith Employed Persons	0	1	-1	0	1	-1	0	2	-2
Total: Labor-intensive menufacturing	505	537	-32	759	932	-173	1252	2118	-866
Total: capital-intensive menufacturing	1907	2225	-318	1913	3049	-1135	7843	9581	-1738
Total: know ledge-intensive menufacturing	1702	3030	-1327	4435	4708	-272	18059	13211	4848
Total: merchandised trade	5307	7222	-1916	7854	10151	-2297	30041	31379	-1338
Total: service trade	6353	6548	-195	7952	8864	-911	30414	28651	1764
Total trade	11596	13630	-2034	15690	18794	-3104	60084	59398	686

Table 3c. Value-Added Trade balance by Product, Merchandise and Services: Poland, 1995–2009

	1995			2000			2008		
	Export	Import	Balance	Export	Import	Balance	Export	Import	Balance
Agriculture, Hunting, Forestry and Fishing	1757	1114	644	1174	1421	-247	5005	5676	-671
Mining and Quarrying	2149	1345	803	1553	2651	-1098	6205	15006	-8802
Food, Beverages and Tobacco	1000	645	355	1034	759	276	5906	3742	2164
Textiles and Textile Products	1634	308	1326	1577	660	917	3440	2622	818
Leather, Leather and Footw ear	228	73	155	238	189	48	343	618	-275
Wood and Products of Wood and Cork	537	110	427	838	265	572	2298	878	1421
Pulp, Paper, Paper , Printing and Publishing	520	819	-299	804	1303	-498	2923	3107	-184
Coke, Refined Petroleum and Nuclear Fuel	524	240	283	360	485	-125	2155	2427	-272
Chemicals and Chemical Products	1259	1705	-445	987	2725	-1739	4702	9432	-4730
Rubber and Plastics	583	533	49	743	1067	-324	4113	3510	603
Other Non-Metallic Mineral	542	366	177	707	640	67	2619	1729	890
Basic Metals and Fabricated Metal	2102	1451	651	1906	2919	-1013	8730	10703	-1973
Machinery, Nec	1035	1458	-423	1104	2390	-1286	5773	8481	-2709
Electrical and Optical Equipment	783	1618	-835	1536	3374	-1838	6373	10138	-3765
Transport Equipment	929	592	337	1559	1851	-292	8721	7604	1117
Manufacturing, Nec; Recycling	576	207	369	1009	495	515	3965	1633	2332
Electricity, Gas and Water Supply	837	495	341	939	834	105	3575	3726	-151
Construction	1097	191	906	1544	958	586	4864	1845	3020
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	689	193	497	871	365	507	4061	1317	2744
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	1224	1370	-146	2662	2788	-127	10760	9429	1331
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	1356	699	657	1916	1359	556	9589	4554	5035
Hotels and Restaurants	222	114	107	177	253	-77	586	881	-295
Inland Transport	1032	834	198	2070	1830	240	8032	5920	2112
Water Transport	125	203	-79	108	239	-131	282	740	-458
Air Transport	79	193	-114	108	310	-202	444	743	-299
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	357	515	-159	662	890	-228	1572	2298	-725
Post and Telecommunications	429	411	18	840	924	-85	2395	2483	-89
Financial Intermediation	968	1513	-545	1239	2025	-786	3518	5401	-1883
Real Estate Activities	882	487	395	519	958	-439	2959	3906	-946
Renting of M&Eq and Other Business Activities	972	1991	-1019	2536	4700	-2164	11838	17924	-6085
Public Admin and Defence; Compulsory Social Security	0	156	-156	210	228	-18	816	858	-42
Education	21	56	-35	49	137	-89	306	611	-305
Health and Social Work	24	28	-4	62	54	7	290	249	41
Other Community, Social and Personal Services	179	288	-109	550	669	-120	2783	2488	295
Private Households w ith Employed Persons	0	1	-1	0	2	-2	0	5	-5
Total: Labor-intensive menufacturing	2974	698	2276	3661	1609	2052	10047	5750	4297
Total: capital-intensive menufacturing	5270	4054	1216	5555	7172	-1617	26446	25218	1228
Total: know ledge-intensive menufacturing	4006	5372	-1366	5186	10340	-5155	25569	35656	-10087
Total: merchandised trade	16156	12584	3572	17129	23194	-6064	73272	87307	-14035
Total: service trade	11067	9946	1121	18068	20019	-1951	72636	67009	5627
Total trade	26648	22322	4325	34189	42718	-8530	141943	152683	-10740

Table 3d. Value-Added Trade balance by Product, Merchandise and Services: Slovak Republic, 1995–2008

	1995			2000			2008		
	Export	Import	Balance	Export	Import	Balance	Export	Import	Balance
Agriculture, Hunting, Forestry and Fishing	301	321	-20	230	300	-69	1298	1457	-159
Mining and Quarrying	83	420	-337	76	500	-424	294	3310	-3015
Food, Beverages and Tobacco	157	166	-10	174	236	-62	797	1262	-465
Textiles and Textile Products	195	111	83	277	213	64	645	652	-7
Leather, Leather and Footw ear	64	28	36	123	44	79	186	157	29
Wood and Products of Wood and Cork	96	36	60	108	50	58	660	260	400
Pulp, Paper, Paper , Printing and Publishing	267	164	103	257	206	51	719	794	-75
Coke, Refined Petroleum and Nuclear Fuel	266	67	199	245	95	151	655	515	140
Chemicals and Chemical Products	490	385	105	294	471	-178	1006	1969	-964
Rubber and Plastics	151	113	38	136	195	-59	821	772	49
Other Non-Metallic Mineral	168	96	72	168	106	62	695	457	238
Basic Metals and Fabricated Metal	767	417	350	753	440	313	4019	2433	1586
Machinery, Nec	315	444	-129	332	490	-158	1506	1849	-344
Electrical and Optical Equipment	199	498	-299	422	541	-119	3129	2990	139
Transport Equipment	196	248	-52	527	274	253	4210	1426	2784
Manufacturing, Nec; Recycling	92	60	32	114	95	18	612	525	87
Electricity, Gas and Water Supply	306	229	77	222	177	45	1369	957	412
Construction	145	107	38	198	96	102	973	502	471
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	36	74	-38	63	78	-14	384	361	23
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	358	408	-51	636	628	8	3302	2525	777
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	274	201	73	272	334	-62	1985	1284	701
Hotels and Restaurants	82	45	37	75	95	-20	492	1082	-591
Inland Transport	510	343	167	630	343	286	1961	1307	654
Water Transport	8	13	-5	4	24	-20	13	177	-164
Air Transport	4	46	-42	2	36	-34	21	211	-190
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	341	169	172	110	102	8	541	522	19
Post and Telecommunications	135	155	-20	169	127	41	476	594	-118
Financial Intermediation	430	305	125	120	252	-132	507	1355	-849
Real Estate Activities	170	152	17	225	188	37	1009	1169	-160
Renting of M&Eq and Other Business Activities	286	616	-329	567	855	-288	3493	3974	-481
Public Admin and Defence; Compulsory Social Security	15	61	-47	43	49	-6	173	376	-203
Education	16	14	2	24	30	-6	141	160	-19
Health and Social Work	8	13	-5	30	13	16	318	84	234
Other Community, Social and Personal Services	74	98	-24	133	134	-1	701	682	19
Private Households w ith Employed Persons	0	0	0	0	0	0	0	1	-1
Total: Labor-intensive menufacturing	447	235	212	622	401	220	2103	1594	509
Total: capital-intensive menufacturing	1777	1024	752	1734	1278	456	7706	6233	1473
Total: know ledge-intensive menufacturing	1200	1575	-375	1574	1776	-202	9850	8235	1615
Total: merchandised trade	3808	3576	232	4236	4255	-19	21252	20829	423
Total: service trade	3290	3110	179	3636	3658	-22	18469	17848	621
Total trade	7006	6627	380	7758	7817	-59	39109	38151	957

Table 3e. Trade balance by Product, Merchandise and Services: Ireland, 1995–2008

	1995			2000			2008		
	Export	Import	Balance	Export	Import	Balance	Export	Import	Balance
Agriculture, Hunting, Forestry and Fishing	2744	614	2131	1599	702	897	1927	2454	-528
Mining and Quarrying	198	1004	-806	146	1529	-1383	545	6615	-6069
Food, Beverages and Tobacco	2553	699	1854	2354	967	1387	8100	3224	4876
Textiles and Textile Products	506	655	-149	304	847	-543	265	1386	-1121
Leather, Leather and Footw ear	40	121	-80	29	130	-101	44	208	-165
Wood and Products of Wood and Cork	85	130	-45	109	229	-120	171	460	-290
Pulp, Paper, Paper , Printing and Publishing	1482	763	719	3506	1048	2458	5561	1700	3861
Coke, Refined Petroleum and Nuclear Fuel	152	285	-134	138	396	-259	413	1256	-843
Chemicals and Chemical Products	4595	1353	3241	9591	1356	8235	17951	3464	14487
Rubber and Plastics	269	442	-172	262	630	-369	579	1355	-776
Other Non-Metallic Mineral	302	268	34	330	383	-53	301	754	-453
Basic Metals and Fabricated Metal	541	1037	-496	717	1468	-751	1114	3345	-2232
Machinery, Nec	554	701	-147	543	999	-456	1162	2027	-864
Electrical and Optical Equipment	4081	1453	2627	8455	2397	6058	10007	3825	6181
Transport Equipment	231	713	-482	361	1472	-1111	646	2940	-2294
Manufacturing, Nec; Recycling	125	215	-91	152	391	-239	415	914	-499
Electricity, Gas and Water Supply	366	352	14	319	475	-156	1225	2118	-893
Construction	152	138	15	263	236	28	607	634	-27
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	239	161	78	305	250	55	883	706	178
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	1482	1372	110	2119	2882	-763	9256	7574	1682
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	790	597	193	961	907	53	2422	2259	162
Hotels and Restaurants	360	202	158	995	474	520	2976	2367	608
Inland Transport	410	418	-8	565	685	-120	914	1882	-968
Water Transport	69	32	37	108	65	43	300	232	68
Air Transport	241	94	146	535	196	338	2083	611	1473
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	286	264	23	630	491	139	1176	1079	97
Post and Telecommunications	358	393	-35	1026	774	252	1799	1916	-117
Financial Intermediation	2694	1401	1293	5231	2652	2579	21704	8336	13368
Real Estate Activities	76	440	-364	168	837	-669	979	2216	-1237
Renting of M&Eq and Other Business Activities	2319	2721	-402	6190	5972	218	25471	20365	5107
Public Admin and Defence; Compulsory Social Security	123	118	5	109	133	-24	320	506	-186
Education	188	45	144	116	104	13	617	334	282
Health and Social Work	81	24	57	58	50	8	345	138	207
Other Community, Social and Personal Services	289	291	-2	450	593	-143	1304	1919	-615
Private Households w ith Employed Persons	0	2	-2	0	3	-3	0	6	-6
Total: Labor-intensive menufacturing	756	1121	-365	594	1597	-1003	895	2969	-2074
Total: capital-intensive menufacturing	5299	3494	1805	7306	4893	2413	16068	11634	4434
Total: know ledge-intensive menufacturing	9461	4221	5240	18950	6224	12727	29766	12256	17510
Total: merchandised trade	18458	10454	8004	28596	14944	13652	49201	35928	13273
Total: service trade	10648	9278	1370	20298	18170	2128	74797	56113	18684
Total trade	28981	19517	9464	48742	32723	16019	123582	91126	32456

Table 3f. Trade Balance by Product, Merchandise and Services: Greece, 1995–2008

	1995			2000			2008		
	Export	Import	Balance	Export	Import	Balance	Export	Import	Balance
Agriculture, Hunting, Forestry and Fishing	1379	1570	-191	1066	1421	-355	1246	3670	-2425
Mining and Quarrying	218	1336	-1118	239	2799	-2559	-1235	12466	-13700
Food, Beverages and Tobacco	266	1004	-738	278	954	-676	930	2849	-1919
Textiles and Textile Products	611	1130	-518	517	1149	-631	599	2473	-1873
Leather, Leather and Footw ear	8	119	-111	8	148	-140	32	495	-463
Wood and Products of Wood and Cork	64	146	-82	47	163	-116	62	610	-547
Pulp, Paper, Paper , Printing and Publishing	58	800	-741	81	890	-808	246	1792	-1546
Coke, Refined Petroleum and Nuclear Fuel	101	277	-176	355	399	-44	925	2095	-1170
Chemicals and Chemical Products	147	1983	-1837	249	1961	-1712	955	5977	-5022
Rubber and Plastics	71	531	-460	96	620	-524	319	1532	-1214
Other Non-Metallic Mineral	125	368	-242	143	389	-246	275	947	-672
Basic Metals and Fabricated Metal	354	1886	-1532	414	2218	-1804	1517	6067	-4551
Machinery, Nec	99	1427	-1328	123	1758	-1634	423	4176	-3753
Electrical and Optical Equipment	-43	1209	-1252	-71	1923	-1994	467	4357	-3890
Transport Equipment	-88	1100	-1188	-20	1916	-1936	340	4387	-4047
Manufacturing, Nec; Recycling	77	301	-224	104	375	-271	103	1380	-1277
Electricity, Gas and Water Supply	187	561	-374	171	640	-469	719	2342	-1623
Construction	122	286	-164	221	488	-266	316	1040	-724
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	235	239	-4	285	285	1	631	799	-168
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	793	1536	-743	917	2136	-1219	2962	6143	-3181
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	529	943	-414	596	1120	-524	1771	2850	-1079
Hotels and Restaurants	45	146	-102	95	240	-145	234	612	-378
Inland Transport	177	789	-612	188	1002	-814	468	3494	-3026
Water Transport	565	50	516	3055	97	2957	17341	331	17010
Air Transport	211	120	91	219	254	-35	1047	527	520
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	184	628	-443	638	965	-328	1885	2746	-861
Post and Telecommunications	201	455	-254	444	851	-406	1113	1857	-744
Financial Intermediation	208	1186	-978	451	1988	-1537	1593	4430	-2837
Real Estate Activities	242	552	-310	317	806	-489	1004	2255	-1250
Renting of M&Eq and Other Business Activities	376	2071	-1695	701	3491	-2790	1961	9631	-7670
Public Admin and Defence; Compulsory Social Security	32	293	-261	67	530	-464	169	598	-429
Education	37	70	-34	113	162	-49	76	389	-313
Health and Social Work	28	49	-21	87	105	-17	73	219	-145
Other Community, Social and Personal Services	68	388	-320	157	686	-529	393	1830	-1437
Private Households w ith Employed Persons	0	1	-1	0	2	-2	0	4	-4
Total: Labor-intensive menufacturing	760	1695	-935	676	1835	-1158	797	4957	-4160
Total: capital-intensive menufacturing	976	4866	-3890	1368	5470	-4102	4212	15283	-11071
Total: know ledge-intensive menufacturing	115	5719	-5604	281	7557	-7276	2185	18897	-16712
Total: merchandised trade	3447	15186	-11738	3631	19081	-15450	7204	55273	-48068
Total: service trade	4316	10663	-6348	8826	16222	-7396	33860	43477	-9617
Total trade	7687	25548	-17862	12353	34928	-22575	40961	97370	-56409

Table 3g. Trade Balance by Product, Merchandise and Services: Portugal, 1995–2008

	1995			2000			2008		
	Export	Import	Balance	Export	Import	Balance	Export	Import	Balance
Agriculture, Hunting, Forestry and Fishing	974	2031	-1057	807	1829	-1022	1550	3966	-2416
Mining and Quarrying	233	1364	-1130	117	2620	-2502	621	9052	-8431
Food, Beverages and Tobacco	396	972	-575	496	1051	-555	1420	2657	-1237
Textiles and Textile Products	2270	832	1438	1922	891	1031	2641	1554	1087
Leather, Leather and Footw ear	792	188	605	640	199	441	885	433	452
Wood and Products of Wood and Cork	358	168	190	422	245	177	965	442	523
Pulp, Paper, Paper , Printing and Publishing	882	777	104	827	885	-58	1483	1486	-4
Coke, Refined Petroleum and Nuclear Fuel	79	305	-226	88	386	-298	570	1047	-478
Chemicals and Chemical Products	635	1687	-1052	536	1788	-1252	1263	4052	-2789
Rubber and Plastics	242	587	-344	337	718	-382	969	1302	-333
Other Non-Metallic Mineral	611	325	286	494	417	77	1142	720	422
Basic Metals and Fabricated Metal	723	1992	-1269	809	2290	-1481	2266	4713	-2447
Machinery, Nec	379	1177	-799	525	1515	-990	1455	2840	-1386
Electrical and Optical Equipment	986	1724	-738	1122	2196	-1075	2370	4111	-1741
Transport Equipment	686	1594	-908	1219	2189	-970	2398	3482	-1084
Manufacturing, Nec; Recycling	225	304	-79	271	434	-163	749	950	-202
Electricity, Gas and Water Supply	525	679	-154	390	611	-221	1224	2017	-793
Construction	142	246	-104	211	259	-48	679	661	18
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	270	274	-4	474	320	154	971	679	292
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	1327	1626	-299	1418	2051	-633	3017	4367	-1350
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	659	1067	-408	689	1291	-603	1870	2570	-700
Hotels and Restaurants	198	428	-230	435	461	-26	1096	880	216
Inland Transport	801	776	25	791	882	-91	2344	2165	179
Water Transport	145	61	85	103	90	13	345	261	84
Air Transport	532	281	250	442	369	73	1094	642	451
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	592	440	152	528	514	15	1740	1351	390
Post and Telecommunications	630	650	-20	480	623	-143	1411	1398	13
Financial Intermediation	1390	1360	30	1470	1428	42	3152	3301	-149
Real Estate Activities	322	610	-288	313	763	-450	684	1912	-1228
Renting of M&Eq and Other Business Activities	1364	3082	-1718	1599	3789	-2190	4798	8569	-3771
Public Admin and Defence; Compulsory Social Security	192	245	-53	322	168	155	607	427	180
Education	223	58	165	92	126	-34	177	293	-115
Health and Social Work	23	37	-14	28	79	-52	55	181	-127
Other Community, Social and Personal Services	161	555	-395	219	710	-491	485	1629	-1145
Private Households w ith Employed Persons	0	1	-1	0	3	-3	1	6	-6
Total: Labor-intensive menufacturing	3645	1492	2153	3256	1769	1487	5240	3380	1860
Total: capital-intensive menufacturing	2933	4958	-2025	3052	5747	-2696	7850	11926	-4076
Total: know ledge-intensive menufacturing	2686	6183	-3496	3402	7689	-4287	7486	14486	-6999
Total: merchandised trade	10471	16027	-5555	10634	19653	-9020	22747	42809	-20062
Total: service trade	9719	12779	-3060	10276	14971	-4694	26497	34259	-7761
Total trade	19965	28502	-8536	20639	34190	-13552	48496	76118	-27622

Table 3h. Trade Balance by Product, Merchandise and Services: Spain, 1995–2008

	1995			2000			2008		
	Export	Import	Balance	Export	Import	Balance	Export	Import	Balance
Agriculture, Hunting, Forestry and Fishing	7035	6954	82	7063	5826	1237	13695	16245	-2550
Mining and Quarrying	595	6500	-5905	583	12015	-11432	1340	46888	-45548
Food, Beverages and Tobacco	2350	3306	-955	2837	3544	-707	8077	10283	-2206
Textiles and Textile Products	1866	2277	-411	2304	2967	-664	5221	8555	-3334
Leather, Leather and Footw ear	900	393	508	923	510	414	1437	1768	-332
Wood and Products of Wood and Cork	579	707	-127	714	948	-234	1488	2027	-539
Pulp, Paper, Paper , Printing and Publishing	2461	3040	-579	2878	3470	-591	5728	6291	-562
Coke, Refined Petroleum and Nuclear Fuel	844	1098	-254	1523	1698	-176	4614	7306	-2692
Chemicals and Chemical Products	4719	6681	-1961	5294	7352	-2058	14196	19810	-5615
Rubber and Plastics	2204	2066	138	2715	2567	147	5611	5898	-287
Other Non-Metallic Mineral	2065	1197	868	2183	1456	728	3958	3361	596
Basic Metals and Fabricated Metal	7018	6951	67	7463	8433	-969	20341	21761	-1420
Machinery, Nec	3335	4454	-1119	3947	5969	-2023	8223	13835	-5612
Electrical and Optical Equipment	3760	7198	-3438	4324	10251	-5928	8031	23476	-15444
Transport Equipment	8455	5624	2831	9316	8709	607	17102	16368	734
Manufacturing, Nec; Recycling	901	1045	-144	1530	1534	-4	3495	4437	-941
Electricity, Gas and Water Supply	2227	2166	61	2084	2250	-166	7180	7792	-612
Construction	1037	771	266	1000	971	28	3887	2520	1368
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	1167	886	281	1327	1163	164	3303	3084	219
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	3491	6141	-2650	4454	8449	-3995	10929	21542	-10612
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	3702	3562	141	4181	4563	-382	10752	10511	241
Hotels and Restaurants	776	591	185	757	1070	-313	1761	3104	-1343
Inland Transport	4104	2791	1312	5384	4088	1296	12298	11621	677
Water Transport	567	218	350	482	417	64	1117	1471	-354
Air Transport	1102	778	323	1512	1027	485	3404	2496	907
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	2590	1722	868	3013	2181	832	8214	6237	1977
Post and Telecommunications	1753	1610	143	2069	2344	-275	4745	6287	-1542
Financial Intermediation	3990	4026	-36	4133	5743	-1610	13945	16932	-2987
Real Estate Activities	1742	2139	-397	1935	2963	-1028	6471	8337	-1866
Renting of M&Eq and Other Business Activities	6738	11138	-4400	9824	17388	-7565	34424	49858	-15435
Public Admin and Defence; Compulsory Social Security	533	947	-413	923	605	318	3276	1741	1534
Education	135	227	-92	385	476	-91	957	1335	-378
Health and Social Work	221	102	119	338	188	150	833	529	304
Other Community, Social and Personal Services	1239	2142	-903	1744	2767	-1024	5240	6693	-1453
Private Households w ith Employed Persons	0	5	-5	0	8	-8	0	18	-18
Total: Labor-intensive menufacturing	4247	4421	-174	5471	5959	-488	11641	16787	-5146
Total: capital-intensive menufacturing	16942	17659	-717	19599	21167	-1568	48329	54900	-6571
Total: know ledge-intensive menufacturing	20269	23957	-3688	22880	32282	-9401	47552	73489	-25937
Total: merchandised trade	49089	59491	-10402	55597	77248	-21652	122556	208310	-85754
Total: service trade	38016	43007	-4992	47074	60197	-13124	136231	166546	-30314
Total trade	86204	101453	-15250	101141	135912	-34771	255292	370419	-115126

ANNEX 4: COMPUTATION DETAILS OF THE "SIMILARITY INDEX" OF INDUSTRIAL STRUCTURE

This annex shows the computation procedure for the industrial similarity index discussed in section IV. The similarity index aims to measure how different the industrial structure is between Germany and the country in question. Here, Germany is used as the benchmark country. We compute this index for eight selected European countries: Czech Republic, Hungary, Poland, Slovak Republic, Ireland, Greece, Portugal and Spain. The basic procedure can be summarized into following four steps. Annex 4 Table shows the construction of the similarity index for 2008 for these countries.

1. We first compute the VA share of a sector in each country's total gross exports, (i.e. the VA export in each of the 35 sectors divided by the country's total VA export) for each sector. For example, the sector shares of VA export for Germany in year 1995 is listed in column 1, these numbers must sum to 100%.

2. We then compute the square of difference between the share of a sector in Germany with the share of the same sector in each country. Those numbers are reported in the right panel of the table.

3. We take the sum of these squared differences across all 35 sectors, yielding the similarity index between Germany and the relevant country. These similarity indices are shown at the bottom of the table. A smaller value indicates greater similarity.

Table. Construction of Industrial Similarity Index, 2008

	Sector share in the country's total VA export									Square of differnece to Germany's sector share							
Industry\Country	DEU	CZE	ESP	GRC	HUN	IRL	POL	PRT	SVK	CZE	ESP	GRC	HUN	IRL	POL	PRT	SVK
Agriculture, Hunting, Forestry and Fishing	1%	3%	5%	3%	5%	2%	4%	3%	3%	2.8E-04	1.8E-03	3.9E-04	1.2E-03	2.4E-05	6.0E-04	4.5E-04	5.0E-04
Mining and Quarrying	0%	2%	1%	-3%	0%	0%	4%	1%	1%	2.9E-04	5.9E-06	1.1E-03	6.9E-10	2.5E-06	1.7E-03	1.0E-04	2.2E-05
Food, Beverages and Tobacco	2%	3%	3%	2%	2%	7%	4%	3%	2%	1.9E-05	1.2E-04	3.4E-06	2.1E-05	2.0E-03	4.3E-04	7.1E-05	2.2E-07
Textiles and Textile Products	1%	2%	2%	1%	1%	0%	2%	5%	2%	1.7E-05	9.1E-05	1.4E-05	1.1E-05	7.7E-05	1.8E-04	1.9E-03	3.1E-05
Leather, Leather and Footwear	0%	0%	1%	0%	0%	0%	0%	2%	0%	2.1E-07	1.5E-05	9.5E-07	7.0E-07	2.0E-06	4.3E-07	2.7E-04	8.9E-06
Wood and Products of Wood and Cork	1%	1%	1%	0%	0%	0%	2%	2%	2%	6.2E-05	3.0E-07	1.4E-05	7.4E-07	1.5E-05	1.2E-04	2.1E-04	1.3E-04
Pulp, Paper, Paper , Printing and Publishing	3%	2%	2%	1%	1%	4%	2%	3%	2%	9.5E-06	7.9E-06	3.7E-04	1.6E-04	3.9E-04	2.2E-05	2.8E-05	4.7E-05
Coke, Refined Petroleum and Nuclear Fuel	1%	0%	2%	2%	2%	0%	2%	1%	2%	8.8E-06	1.2E-04	2.4E-04	2.6E-04	1.4E-05	6.5E-05	2.1E-05	9.2E-05
Chemicals and Chemical Products	7%	3%	6%	2%	4%	15%	3%	3%	3%	1.3E-03	1.7E-04	2.0E-03	5.9E-04	5.9E-03	1.3E-03	1.8E-03	1.8E-03
Rubber and Plastics	3%	4%	2%	1%	2%	0%	3%	2%	2%	1.3E-04	1.3E-05	3.2E-04	2.2E-05	4.4E-04	1.2E-05	3.1E-05	2.1E-05
Other Non-Metallic Mineral	1%	2%	2%	1%	1%	0%	2%	2%	2%	1.3E-04	2.3E-05	1.6E-05	8.4E-06	6.8E-05	6.0E-05	1.7E-04	5.0E-05
Basic Metals and Fabricated Metal	8%	9%	8%	4%	4%	1%	6%	5%	10%	1.3E-04	5.0E-06	1.6E-03	1.1E-03	4.7E-03	2.5E-04	9.4E-04	6.4E-04
Machinery, Nec	9%	6%	3%	1%	3%	1%	4%	3%	4%	6.7E-04	3.3E-03	6.3E-03	3.0E-03	6.5E-03	2.4E-03	3.6E-03	2.6E-03
Electrical and Optical Equipment	8%	9%	3%	1%	14%	8%	4%	5%	8%	2.3E-06	2.8E-03	5.3E-03	2.7E-03	1.1E-05	1.6E-03	1.3E-03	1.8E-05
Transport Equipment	9%	8%	7%	1%	9%	1%	6%	5%	11%	2.6E-05	3.5E-04	6.0E-03	3.3E-08	6.5E-03	5.9E-04	1.3E-03	4.8E-04
Manufacturing, Nec; Recycling	1%	2%	1%	0%	1%	0%	3%	2%	2%	9.4E-05	1.8E-06	9.7E-05	3.8E-05	8.1E-05	2.4E-04	9.5E-06	1.1E-05
Electricity, Gas and Water Supply	3%	3%	3%	2%	2%	1%	3%	3%	4%	4.7E-05	1.4E-06	8.8E-05	2.0E-05	2.9E-04	3.1E-06	2.9E-06	6.5E-05
Construction	1%	2%	2%	1%	1%	0%	3%	1%	2%	1.2E-04	6.1E-05	9.8E-08	3.0E-05	6.2E-06	7.2E-04	4.3E-05	3.1E-04
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	1%	2%	1%	2%	2%	1%	3%	2%	1%	7.0E-05	6.2E-06	2.5E-05	4.8E-05	1.1E-05	3.3E-04	9.2E-05	4.0E-07
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	5%	7%	4%	7%	7%	7%	8%	6%	8%	3.7E-04	2.4E-05	6.1E-04	5.1E-04	7.4E-04	7.9E-04	2.1E-04	1.3E-03
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	3%	4%	4%	4%	5%	2%	7%	4%	5%	1.1E-04	1.4E-04	1.7E-04	4.0E-04	1.1E-04	1.4E-03	7.2E-05	4.3E-04
Hotels and Restaurants	0%	2%	1%	1%	1%	2%	0%	2%	1%	1.9E-04	7.7E-06	2.5E-06	3.4E-06	4.0E-04	1.2E-11	3.4E-04	7.1E-05
Inland Transport	2%	5%	5%	1%	4%	1%	6%	5%	5%	1.1E-03	8.0E-04	7.0E-05	3.4E-04	1.5E-04	1.4E-03	8.1E-04	9.2E-04
Water Transport	1%	0%	0%	42%	0%	0%	0%	1%	0%	9.3E-05	3.0E-05	1.7E-01	8.8E-05	5.4E-05	6.1E-05	7.3E-06	9.0E-05
Air Transport	0%	1%	1%	3%	0%	2%	0%	2%	0%	1.7E-06	7.2E-05	4.3E-04	7.6E-06	1.4E-04	2.9E-06	3.1E-04	1.9E-05
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	3%	2%	3%	5%	2%	1%	1%	4%	1%	9.7E-05	1.7E-05	3.2E-04	1.1E-05	3.4E-04	2.9E-04	6.1E-05	2.0E-04
Post and Telecommunications	1%	2%	2%	3%	2%	1%	2%	3%	1%	3.5E-05	6.1E-05	2.7E-04	9.7E-05	1.4E-05	3.7E-05	3.4E-04	2.0E-06
Financial Intermediation	2%	2%	5%	4%	3%	18%	2%	6%	1%	6.8E-06	9.4E-04	2.2E-04	2.7E-05	2.3E-02	6.8E-07	1.7E-03	1.2E-04
Real Estate Activities	4%	2%	3%	2%	3%	1%	2%	1%	3%	4.8E-04	2.4E-04	2.6E-04	7.3E-05	1.1E-03	3.9E-04	7.1E-04	2.2E-04
Renting of M&Eq and Other Business Activities	16%	8%	13%	5%	13%	21%	8%	10%	9%	7.2E-03	8.9E-04	1.4E-02	1.4E-03	1.7E-03	6.6E-03	4.3E-03	5.7E-03
Public Admin and Defence; Compulsory Social Security	1%	0%	1%	0%	1%	0%	1%	1%	0%	5.1E-06	4.0E-05	5.6E-06	1.3E-05	1.5E-05	5.3E-07	3.7E-05	4.2E-06
Education	0%	0%	0%	0%	1%	0%	0%	0%	0%	1.1E-06	1.4E-06	9.3E-06	2.8E-06	5.0E-09	7.6E-06	1.6E-06	1.7E-06
Health and Social Work	0%	0%	0%	0%	0%	0%	0%	0%	1%	1.9E-05	7.3E-06	1.5E-06	1.0E-06	5.0E-06	2.2E-06	3.2E-07	5.7E-05
Other Community, Social and Personal Services	2%	1%	2%	1%	3%	1%	2%	1%	2%	2.7E-05	1.1E-06	9.8E-05	8.3E-05	8.0E-05	1.6E-08	9.0E-05	2.4E-06
Private Households with Employed Persons	0%	0%	0%	0%	0%	0%	0%	0%	0%	1.6E-19	1.6E-19	2.4E-18	1.6E-19	3.1E-15	1.4E-19	3.8E-10	1.6E-19
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	0.013	0.012	0.211	0.012	0.055	0.021	0.021	0.016

ANNEX 5: SOURCE AND CALCULATION OF INDEPENDENT VARIABLES

Variable	Source
GDP	WDI
GDP per Capita	WDI
Distance	Glick and Rose (2002)
Common Language Dummy	Glick and Rose (2002)
Common Border Dummy	Glick and Rose (2002)
Resource-Exporter Dummy	WTO
FTA Dummy	WTO
Exchange Rate Volatility	INS data and authors' calculation*
Unit Labor Cost	United Nation statistics and authors' calculation*

*Author's calculation is discussed below

Unit Labor Cost

Following the BLS guideline, the unit labor costs are calculated by dividing total labor compensation by real output or – equivalently -- by dividing hourly compensation by productivity. That is, unit labor costs = total labor compensation / real output ; or equivalently, unit labor cost = hourly compensation / productivity = [total labor compensation / hours] / [output / hours]

Thus, increases in productivity lower unit labor costs while increases in hourly compensation raise them. If both series move equally, unit labor costs will be unchanged.

To be able to compare the result internationally as well as over time, the unit labor costs is computed as the ratio of total nominal labor compensation (in USD) and GDP measured in PPP term.

Exchange Rate Volatility

The exchange rate volatility is computed as the standard deviation of the first difference of logarithms of the exchange rate. Following the practice in most other studies, the change in the exchange rate is computed over one month, using end of month data. The standard deviation is calculated over a one-year period, as an indicator of short-run volatility.