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Article

Determinants of export and import functions in the EU member countries

Determinants of Export and Import Functions in the EU Member Countries[1]

*Rajmund MIRDALA – Jozefína SEMANČÍKOVÁ – Anna RUŠČÁKOVÁ**

Abstract

Current account imbalances and their sustainability in the EU member countries has been examined in the recent empirical literature since the establishment of the Euro Area. Deeper trade integration within the EU is generally beneficial. However, international fragmentation of production resulting from emergence of global value chains deepens external imbalances due to persisting differences in macroeconomic performance among member countries. The main objective of the paper is to examine effects of price and non-price determinants of exports and imports in 21 EU member countries. We have estimated the determinants of export and import demand functions in the 21 EU member countries. Our results indicate the high role of imports in aggregate export functions, while aggregate functions indicated a high contribution of domestic demand to the imports dynamics. Disaggregated analysis revealed the importance of intermediates in the external trade within and outside the EU from territorial and commodity aspects.

Keywords: *current account, external balance, export, import, global value chains*

JEL Classification: F13, F41, H62

Introduction

Increasing current account imbalances in the Euro Area (Pisani-Ferry, 2012) represent one of the key design failures that has emerged since its establishment (De Grauwe, 2013) and significantly contributed to the emergence of the European debt crisis (Mirdala and Ruščáková, 2015). Moreover, the deepening of external imbalances was associated, according to some authors, with a cross--border expenditure shifting process driven by real exchange rates adjustments in member countries (Belke and Dreger, 2011). However, many authors promoted

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demand drivers (Gaulier and Vicard, 2012) that fuelled asynchronous current account imbalances in the Euro Area, considering price and cost-related determinants as less important. As a result, examination of the most crucial causes of excessive current account imbalances in the Euro Area and possible solutions that would contribute to their reduction still represents a challenging topic.

From the global perspective, maintaining the external macroeconomic equilibrium of the country considering different factors has been difficult, predominantly in recent decades, due to increasing degree of openness and liberalization of foreign trade policies. Moreover, increased specialization, intensified by trade-liberalizing policies and decreasing transport costs, stimulated distribution of individual stages of production across countries that even intensified exports and imports of final goods and intermediate goods, as well as primary inputs with a generally ambiguous effect on the external balance (Cingolani, Felice and Tajoli, 2015). The recent economic crisis induced redistributive effects across countries, which is why the relative importance of traditional current account determinants have changed (Christodoulopoulou and Tkačevs, 2014). As a result, current account sustainability remains a crucial issue in designing a country's sustainable path of economic growth. The main objective of the paper is to examine the effects of price and non-price determinants of exports and imports in 21 European Union (EU) member countries. The main motivation for this research is to: a) identify the key drivers of export and import paths (relative importance price/cost and demand drivers will be examined); b) reveal the mutual relationship between exports and imports (considering that international fragmentation of production chains makes exports and imports mutually dependent and thus affects their long-term convergent/divergent movement); and c) analyse estimated results for the pre-crisis and post-crisis periods to examine changes in export and import function determination following the recent economic crisis. To meet these objectives, we estimate aggregate and disaggregated export and import functions, that are based on the autoregressive distributed lag (ARDL) dynamic model.

The remainder of the paper is organized into five sections. Following the introduction, section 1 provides a brief summary of the recent facts on external imbalances in the Euro Area in terms of global value chains (GVCs). Section 2 presents an overview of the relevant literature. Section 3 describes the data and introduces the methodology. Section 4 presents the main results. The last section summarizes key findings of the paper.

1. External Imbalances in the Euro Area and Global Value Chains

Intra-European current account imbalances have grown significantly since the establishment of the Euro Area (Bonatti and Fracasso, 2013). This reflects diverging trends in competitiveness between core countries and periphery countries of

the Euro Area. Introduction of the single currency and the single monetary policy significantly have contributed to this divergent trend. Similarly, Cesaratto (2015) insists that the Euro Area sovereign debt crisis is a balance of payments crisis, tied to current account deficits and capital outflows (Lavoie, 2015). De Grauwe (2013) supports this opinion and argues that the absence of a sovereign central bank caused a liquidity crisis followed by a solvency crisis in the Euro Area. He states that Euro Area member states had to issue debt in a new currency that is not under their control (De Grauwe, 2013; Caseratto, 2015). Additionally, Weeks (2014) argues that when the global financial and economic crisis struck the continent in 2008, the trade-based deficits of the periphery countries of the Euro Area proved unsustainable. However, Brancaccio (2012), for example, states that internal imbalances in the Euro Area are an integral part of a monetary union, attributable to the greater degree of financial integration between the Euro Area member countries, and thus it depends only on the individual countries' theoretical approaches to securing economic growth.

Sinn and Wollmershäuser (2012) emphasize that the root of the current European sovereign debt crisis lies in the external imbalances between its core and periphery countries. They claim that these imbalances occur as a reaction to optimistic expectations about income convergence generated in the Euro Area and as a reaction to an investment boom in the Euro Area periphery, which was accompanied by ballooning current account deficits financed by private capital inflows (Bonatti and Fracasso, 2013).

The economic crisis intensified demand-driven redistributive effects that induced diverse and spurious effects on current account adjustments within the Euro Area. While current accounts temporarily deteriorated (with quite different intensities in each particular economy) at the beginning of the crisis period (Kang and Shambaugh, 2013), at the later stages we have observed a positive trend (either improvement or stable outlook) in almost all Euro Area member countries, reflecting intensified redistributive effects of the crisis on the cross--country expenditure shifting (Gaulier and Vicard, 2012). However, the existing nexus between surpluses in the core with deficits in the periphery addresses issues in both trade and financial linkages (Hobza and Zeugner, 2014). While current accounts between the North and South of the Euro Area do not necessarily have to be balanced, the existence of large and persisting bilateral current account imbalances may induce policy tensions or rigidities (Berger and Nitsch, 2012). The Euro Area is in a vicious circle, and the economic policy of the European Union faces a real challenge.

Intra-Eurozone current account imbalances among countries with different per capita income levels fuel discussions on competitiveness channels under a common currency (Belke and Dreger, 2011). Disinflation followed by deflationary

pressures induced shifts in competitiveness associated with real exchange rate adjustments through relative price levels. While external imbalances in countries on the periphery of the Euro Area were mainly driven by a domestic demand boom fuelled by increasing financial integration (Chen, Milesi-Ferretti and Tressel, 2012), the role of changes in the competitiveness of the Euro Area's core countries may be disputable. As a result, a limited effectiveness of internal devaluation in reducing current account imbalances in the Euro Area could be expected (Sanchez and Varoudakis, 2013). However, asynchronous current account trends between the North and South of the Euro Area were accompanied by significant appreciations in the real exchange rate in the periphery economies, originating in the strong shifts in consumer prices and unit labour costs in these countries relative to the countries of the Euro Area core (Holinski, Kool and Muysken, 2012). As a result, the issue is whether the real exchange rate is a significant driver of persisting current account imbalances in the Euro Area (Lane and Milesi-Ferretti, 2002).

The significant rise of GVCs intensified by trade-liberalizing policies and decreasing transport costs stimulated internationalization of individual stages of production. As a result, increased fragmentation of production chains and its distribution across countries moved economic dependence to a new level. Exports, imports, re-exports and re-imports of final, assembled, semi-final and intermediate goods, altogether deepened current account imbalances (either deficits or surpluses) in many countries (Falzoni and Tajoli, 2015). Moreover, according to many authors (i.e. Gaulier, Lemoine and Ünal-Kesenci, 2007; Fontagné, Freudenberg and Gaulier, 2007; Miroudot, Lanz and Ragoussis, 2009; Cingolani, Felice and Tajoli, 2015; Falzoni and Tajoli, 2015; Ali-Yrkkö, Mattila and Seppälä, 2017), international fragmentation of production chains induced an increase in the share of intermediate goods in total trade relative to the final goods. As a result, individual links between exports and imports become more visible, revealing a possibly bidirectional relationship between exports and imports (Barrell and Dées, 2005). However, under different scenarios that consider the position of the country in the stages of a production process, such a relationship may have a positive, negative or possibly neutral effect on the trade balance.

The international fragmentation of production and a related higher share of intermediate goods has led economists not only to revise the obvious measures of external trade across countries, but also to examine the implications associated with widening trade imbalances and excessive trade fluctuations before and during the crisis period (Cingolani, Felice and Tajoli, 2015). The latest global financial and economic crisis significantly affected not only international trade and GVCs, but also the overall macroeconomic situation of countries running larger foreign imbalances, notably within the Euro Area (Cingolani, Felice and Tajoli,

2015; Falzoni and Tajoli, 2015). In this context, the analysis of the role of GVCs in the shaping of the economic integration process and its contribution to the external imbalances in the Euro Area member countries has drawn the attention of an increasing number of scholars (Amador, Cappariello and Stehrer, 2015). Understanding the determinants of external imbalances provides crucial evidence (Brumm, Georgias and Gräb, 2016).

2. Research Motivation behind Overview of Empirical Literature

According to Goldstein and Khan (1985), who estimated the long-run income and price elasticity of export and import of the largest industrialized economies, empirical analysis of trade flows is traditionally based on a partial equilibrium model and the hypothesis of imperfect substitutes between foreign and domestic goods. In a simple example of two economies, the partial equilibrium model assumes that each country produces only one tradable good, which is an imperfect substitute for goods produced in the other country. Based on the partial equilibrium model, the most widely used method for estimating aggregate export and import demand functions is the method based on the Marshallian demand function (Gozgor and Oktay, 2012). The model can also be expanded to "n" number of economies, where the symmetry between import and export demand functions disappears. The total import of the economy faces only the competition from domestic producers, whereas the overall export of the economy is subject to competition not only from domestic producers in the importing country or region, but also from other countries or regions exporting to the given country or region. Therefore, it can be assumed that the relative price competition between exporters, expressed as a ratio of export prices to export prices of the competitor adjusted for the exchange rate, is in this case dominant. Consequently, a standard function of the aggregate export can be expressed as follows:

$$X_d = f\left(Y^*,\ \frac{P_x}{ER}.P^*\right) \tag{1}$$

where X_d is the volume of export required by foreign countries, Y^* is the economic activity of the world economy, P_x are the export prices, P^* are the export prices of competitors, and *ER* is the nominal exchange rate in units of foreign currency per unit of domestic currency. The relative price indicator $\left(\frac{P_x}{ER}.P^*\right)$ represents terms of trade or a real exchange rate. The indicator of economic activity should have a positive sign with a positive effect on export development, while the real exchange rate should have a negative sign for export promotion.

Similarly, import demand can be expressed as follows:

$$M_d = f\left(Y,\ P_M / P\right) \tag{2}$$

where M_d is the total import volume requested by domestic consumers, Y is the domestic economic activity, P_M are the import prices in domestic currency, and P is the price of products that are domestic substitutes for import (Camarero and Tamarit, 2004). Models (1) and (2) can be used for both aggregate and disaggregated data.

Stern, Francis and Schumacher (1976) provide another concept regarding demand-supply relationships in the export and import functions. The theory assumes that the system of export and import demand and supply functions should consider the simultaneous relationship between quantity and price, and avoid bias. However, most empirical studies focus on estimating export and import demand functions, while supply relationships are analysed under the assumption of infinite price elasticity. Infinite price elasticity is legitimate in the case of an import supply, though considering the small open economy, it is hard to believe that infinite price elasticity also applies to the export supply. In particular, when considering the increase in world demand for the goods of a small open economy, this economy is unlikely to be able to meet this demand without changing export prices (unless there are large supplies of inexhaustible resources) (Goldstein and Khan, 1985). However, an important condition of this assumption is that it allows the estimation of export and import functions by methods of a single equation in which price variables are exogenous (Mervar, 1994).

While empirical literature provides rich evidence of studies examining determinants of export (e.g., Ca' Zorzi and Schnatz, 2007; European Commission, 2010; Bayoumi, Harmsen and Turunen, 2011) and import (e.g., Barrell and Dées, 2005; Stirböck, 2006), an increased scholarly attention to the estimation of import functions can be recently seen in the literature (e.g., Kostoska and Petreski, 2009; Bussière et al., 2013). However, only a few studies examined both functions simultaneously to deal with possible causes of converging and diverging trends in the external balance in terms of revealed interactions between imports and exports (e.g., Hooper, Johnson and Marquez, 2000; Allard et al., 2005).

Considering aggregate analysis, our paper is based on the findings of studies examining simultaneously aggregate export and import functions. Regarding aggregate functions, it is worth mentioning the study of Comunale and Hessel (2014), who examined the relative importance of price competitiveness and domestic demand as a source of current account imbalances in the Euro Area countries. The results confirm the significant effect of price competitiveness, although they also reported a much more significant impact of the domestic demand boom

driven by the financial cycle. The authors emphasize an increased significance of price competitiveness, especially in export performance, considering that the effect of foreign export demand is much larger. Moreover, they confirm that domestic demand is the most important determinant of import. In addition, the authors excluded that import is a determinant in the export equation, as they did not consider this variable as significant. The results of Comunale and Hessel (2014) are also endorsed by Christodoulopoulou and Tkačevs (2014), who emphasize the effect of price competitiveness on export rather than on import. Similarly, the study of Hooper, Johnson and Marquez (2000) examined trade elasticities in the G7 countries using short-term and long-term cointegration techniques. Their results agree with the results of Christodoulopoulou and Tkačevs (2014), which show that the most important determinant of export is foreign demand, while the most important determinant of import is domestic demand. The authors also state that the price elasticities for import are much lower than those previously mentioned in the literature.

Considering disaggregated analysis, our paper focuses on patterns of final production and trade in intermediate products. Intermediate goods may be used as inputs to the manufactory production for final consumers. This paper points to the significant trend related to the GVCs, as the fragmentation of production obviously causes multiple exports and imports of individual components and semi-finished products until the final product is produced and traded on the markets of the final production (Fukumoto, 2012; Jlassi, 2015). For this reason, we apply the Broad Economic Categories (BEC) classification (i.e. reclassification of the SITC classification, or the Standard International Trade Classification) revision no. 4 (in March 2016, the 5th revision of the BEC classification was introduced, and services were added to the BEC classification; as this paper is mainly interested in foreign trade in goods, it uses the BEC revision no. 4 and does not consider the category of so-called "unclassified".), which was implemented by the United Nations in 2002, which divides the goods into three categories depending on the end use, namely capital goods, intermediate products and consumer goods. The BEC classification is becoming more and more popular thanks to its usage in more than 300 research studies since 2000 and its link to the GVCs, where the analysis is focused mainly on the trade with intermediate goods. The BEC classification has been so far used mainly in emerging market economies for the estimation of export and import functions, including examples of empirical studies covering Turkey, China and India, or other areas of foreign trade.

Table 1 provides an overview of selected empirical studies that examine aggregate and disaggregated export and import functions based on the BEC classification.

T a b l e 1

Overview of Empirical Studies of Aggregate and Disaggregated Foreign Trade Analysis in EU/Euro Area Member Countries

	Authors	Area of research	Key results
1	Allard et al. (2005)	Analysis of the traditional determinants of export and import of four largest EU economies – Germany, Italy, France and Spain. (sample size: 1992 – 2004)	Imports were well explained by the import content of domestic and foreign demand, while competitiveness played only a secondary role. For exports, all countries benefited from rising global demand, with Spain profiting the most and France the least. Similarly, all countries endured real exchange rate appreciation, with Italy suffering the most and Germany the least. Interestingly, the unexplained part of exports was positive for Germany – thus exports behaved stronger than expected – and negative for the other three countries.
2	Bayoumi, Harmsen and Turunen, J. (2011)	Analysis of export performance determinants in the Euro Area. The link between exports and trends in competitiveness is also examined. (sample size: 1995 – 2009)	Intra-euro area trade is several times more sensitive to changes in relative prices than extra-euro area trade. The difference in elasticities is potentially important as it is much more difficult to adjust relative prices to restore competitiveness within a currency union. This result highlights the need for structural reforms to increase domestic wage and cost flexibility in euro area countries.
3	Comunale and Hessel (2014)	Investigation of the relative role of price competitiveness and domestic demand as drivers of the current account imbalances in the Euro Area via analysis of the determinants of export and import functions together with the trade balance function. (sample size: 1994 – 2012)	Price competitiveness has a clear influence on current account imbalances, but that domestic demand booms driven by the financial cycle have been more important than is realized in the policy debate and much of the literature. The influence of price competitiveness is clearest on export performance, but at the same time, the influence of external demand on differences in exports performance is larger.
4	Wierts, van Kerkhoff and de Haan (2014)	Analysis of the composition of exports and its relation to the export performance of the Euro Area countries using a data set on exports from the oldest Euro Area countries to their top 20 trade partners (sample size: 1988 – 2009)	Higher share of high technology exports in total exports is positively related to total exports. Export composition also conditions the effects of the real exchange rate and partner income growth. The effect of partner income on exports becomes larger the higher the share of high technology exports in total exports.
5	Giordano and Zollino (2015)	Analysis of price and non-price determinants of export and import in the four largest countries in the Euro Area – Germany, Italy, France and Spain. (sample size: 1983 – 2012)	In Italy ULC-based indicators play a less relevant role relative to price-deflated measures in explaining exports; the opposite holds true for Germany and France, whereas in Spain exports are insensitive to prices. Non-price competitiveness proves important in explaining Italian, German and, in particular, Spanish exports. Imports react to price-competitiveness dynamics only in Italy; considering the participation in global value chains is useful to correctly identify import sensitivity to domestic and foreign demand.

Source: Authors' processing.

3. Methodology

The analysis is carried out on the panel data of 21 EU member states (Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Lithuania, Latvia, Nederland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom). The rest of the EU member countries are excluded from analysis due to data inconsistency. The quarterly time series that are employed in the model cover the period 1995Q4 – 2016Q2 (83 observations) for aggregate export and import functions estimation and 1999Q1 – 2016Q4 (72 observations) for disaggregated export and import functions estimation. The number of observations is limited due to the availability of data and the need to preserve the integrity of the panel as a balanced model. In both cases, the export and import of goods, as components of the trade balance, represent dependent variables. The variables are constructed as the position of the individual country against the rest of the world and expressed in fixed prices. The data in EUR are drawn from the Eurostat database, and the data in USD are drawn from the International Monetary Fund – Direction of Trade Statistics (IMF DOTS) database (IMF, 2017). In order to obtain nominal values in EUR, the average exchange rate of the ECU/USD and EUR/USD from the Eurostat database is used (the annual averages are an average of the 12 monthly exchange rates). We apply the quarterly Harmonised Index of Consumer Prices (HICP 2005-100) as a deflator (import and export price indices were not available for more than half of the countries analysed in the sample). The data are seasonally adjusted using Census X-13 Arima-SEATS. Seasonally adjusted data are used in logarithm due to the need to reduce the variability of the data. Disaggregated data for the BEC classification are drawn from the Eurostat database in seasonally adjusted form. Consequently, these data are deflated and transformed into the logarithm.

The definition of export and import functions is based on the standard reduced form of dynamic trade equations presented by Goldstein and Khan (1985) and later reviewed by Sawyer and Sprinkle (1996). The export and import functions of these studies are based on a partial pattern of international trade balance. We apply not only traditional business determinants, but also custom variables (e.g., foreign demand expressed in the form of the export demand index proposed by Hubrich and Karlsson, 2010), as well as explanatory variables to determine the significance of an export and import destination or commodity structure.

In the previous years, there has been a great interest in dynamic panel models with many cross-sectional units and many observations. However, there are several problems with models using such datasets. According to Pesaran and Smith (1995), Im, Pesaran and Shin (2003) and other authors, one of these problems, for example, is the inability to assume the homogeneity of the parameters of the

slopes. Also, another problem may be the non-stationarity of dynamic panel models. To estimate non-stationary dynamic panels characterized by the heterogeneity of parameters within groups, Pesaran, Shin and Smith (1997; 1999) propose two estimation techniques, namely the Mean Group estimator (MG) and the Pooled Mean Group estimator (PMG).

For the reasons expressed previously, the paper regarding the analysis of aggregate and disaggregated export and import functions is based on the so-called Autoregressive Distributed Lag dynamic model (ARDL) $(p, q_1,\ldots,q_k)$, which can be expressed as follows:

$$y_{it} = \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=1}^{p} \delta_{ij}' X_{i,t-j} + \mu_i + \epsilon_{it} \tag{3}$$

where $i = 1,\ldots,N$ is the number of cross-section units, $i = 1,\ldots,T$ is the number of observations, X_{it} is $k\times1$ vector of explanatory variables, δ_{ij}' is $k\times1$ vector of coefficients, λ_{ij} are scalars, and μ_i is an individual effect. The ARDL model assumes a sufficient number of *T*.

If variables are integrated of order $I(1)$ and cointegrated, then the error term process is $I(0)$ for all *i*. The basic feature of cointegrated variables is their response to any deviation from long-term equilibrium, what indicates usability of the error correction model (ECM). In this model, the short-term dynamics of the variables in the system are affected by the equilibrium deviation. For this reason, the common practice is to re-parametrize Equation (3) into the error correction equation as follows:

$$\Delta y_{it} = \phi_i \left(y_{i,t-j} - \theta_i' X_{it} \right) + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta y_{i,t-j} + \sum_{j=1}^{q-1} \delta_{ij}^{*'} \Delta X_{i,t-j} + \mu_i + \epsilon_{it} \tag{4}$$

where the parameter ϕ_i represents an error-correcting speed of adjusted component. If it is true that $\phi_i = 0$, then the long-term relationship is not present. This parameter should be significantly negative on the underlying assumption that variables show the return to long-term equilibrium. The vector θ_i' contains long--term relationships among variables.

Aggregate export function, with the implementation of the panel dynamic ARDL model, is defined in this paper as follows:

$$\begin{aligned} lx_{it} = {} & \lambda_{ij} lx_{i,t-j} + \delta_{10i} lreer_{it} + \delta_{11i} lreer_{i,t-1} + \delta_{20i} lfd_{it} + \delta_{21i} lfd_{i,t-1} + \delta_{30i} lm_{it} + \\ & + \delta_{31i} lm_{i,t-1} + \mu_i + \epsilon_{it} \end{aligned} \tag{5}$$

where the export is expressed as a function of export (lagged), two indicators (current and lagged) of price competitiveness $(lreer)$, foreign demand (lfd) and import (lm). All variables are expressed in logarithm.

Two different real effective exchange rate (REER) indicators are used to measure price competitiveness. REER is calculated against a group of 37 trade partners deflated by the consumer price index (CPI) and unit labour costs (ULC) of the particular country, a similar approach taken to that of Comunale and Hessel (2014) and Darvas (2012). We have employed two measures of REER because ULC covers only domestically produced goods, while CPI includes prices of imported goods as well. Moreover, with the development of GVCs, the share of intermediate goods has significantly increased in international trade (and hence in external balance) (Lemoine and Ünal-Kesenci, 2003). Prices of intermediate production are better covered in ULC than CPI. Similarly, CPI covers non-tradable goods more broadly, whereas ULC tends to reflect mostly tradable goods (Ahn, Mano and Zhou, 2017). We assume that growth in price competitiveness, associated with REER decline, would support export growth. The fall in relative domestic prices due to exchange rate depreciation makes exports cheaper in international markets, which is why the export of the country tends to increase.

Involvement of foreign demand (FD) as an explanatory endogenous variable in Equation (5) is followed by the idea that trade balance and current account balance are affected by the destination and composition of exports (Belessiotis and Carone, 1997; Chen, Milesi-Ferretti and Tressel, 2012; Comunale and Hessel, 2014). Construction of the foreign demand indicator is based on the calculation proposed by Hubrich and Karlsson (2010), who define the foreign demand of a country as an export demand index (WDR_k) that is calculated as the geometric average of the import volumes of the trading partners of country *k* as follows:

$$log\left[WDR_k(t)\right] = \sum_j x_{kj}(t)\, log\left[MTR_j(t)\right] \tag{6}$$

where MTR_j is the total real import of the country *j* and x_{kj} is the three-year moving average of the exports' share of country *k* flowing to the country *j*. The weight x_{kj} can be interpreted as the elasticity of the export demand of the country *k* in relation to the import of the trade partner *j*. Bilateral trade data of the individual economy against its partners are drawn from the IMF DOTS database (IMF, 2017) (the partners are the EU, Japan, the US and the Commonwealth of Independent States – CIS, Emerging and Developing Asia – EDA, Middle East and North Africa – MENA, Subsaharan Africa – SSA, Latin America and Carribean – LAC, the Rest (see Table 8 in the Appendix)). We assume that growth in foreign demand would have a favourable effect on export growth.

Aggregate import function, with the implementation of the panel dynamic ARDL model, is defined in the paper as follows:

$$lm_{it} = \lambda_{ij} lm_{i,t-j} + \delta_{10i} lreer_{it} + \delta_{11i} lreer_{i,t-1} + \delta_{20i} ldd_{it} + \delta_{21i} ldd_{i,t-1} + \delta_{30i} lx_{it} + \\ + \delta_{31i} lx_{i,t-1} + \mu_i + \epsilon_{it} \quad (7)$$

where the import is expressed as a function of import (lagged), two indicators (current and lagged) of price competitiveness $(lreer)$, domestic demand (ldd) and export (lx). All variables are expressed in logarithm.

Domestic demand (DD) is calculated as a difference of GDP and net export. We expect that the increase in domestic demand would positively affect the growth of import. Changes in domestic demand and associated effects on external balance have been recently discussed, for example, in the studies of Wyplosz (2013) and Gabrish and Staehr (2012).

On the other hand, competitiveness growth (associated with REER decline) may negatively affect import because domestic goods become less expensive for consumers relatively to the imported goods. The impact of price competitiveness and domestic demand are discussed, for example, by Wyplosz (2013) and Christodoulopoulou and Tkačevs (2014).

Involvement of variable lm (current and lagged) into Equation (5) as the determinant of export and variable lx (current and lagged) into equation (7) as the determinant of import follows the idea that the internationalization of production activities, together with the emergence of GVCs, strengthens the mutual relationship and dependence between exports and imports.

3.1. ARDL Dynamic Panel Model Estimation Methods

The estimation of the ARDL dynamic panel model is based on three estimation methods that are used in the empirical literature, namely the Dynamic Fixed Effects Method (DFE), MG and PMG. The first two estimation methods can be considered as extreme. Regarding the DFE method, the time series for each group of countries are pooled, and only intercepts can be changed across groups. However, if the coefficients of the slopes are not the same, the DFE approach produces inconsistent and misleading results. Furthermore, the MG method introduced by Pesaran and Smith (1995) calculates the different coefficients in each cross-sectional unit and results in a simple arithmetic average of individual coefficients. In comparison to the DFE method, intercepts, slopes and error terms may vary within cross-sectional units. Finally, the PMG method, proposed by Pesaran, Shin and Smith (1997; 1999), combines the previous two methods (pooling and averaging). This estimator allows the intercepts, short-term coefficients

and error terms within the cross-section units of the panel to be different (as in the case of the DFE method). Since Equation (4) is nonlinear in the parameters, Pesaran, Shin and Smith (1999) introduced the method of maximum probability to estimate the parameters of the model (Blackburne and Frank, 2007).

However, Blackburne and Frank (2007) state that if the model is heterogeneous, PMG estimates are not consistent, and thus it is necessary to apply the Hausman test to determine the appropriate model. At the same time, Baltagi, Griffin and Xiong (2000) note that dynamic DFE models can lead to a bias of the simultaneous equation due to the endogeneity of the error term and the lagged dependent variable. Therefore, we have decided to not include the DFE method in this analysis. In addition, the authors recommend using a traditional Hausman test to determine the appropriate estimation method, as stated above. The null hypothesis of the Hausman test is that the difference in the coefficients is not systematic.

According to Bayoumi, Harmsen and Turunen (2011), aggregate trade panels are non-stationary, that is, integrated of order $I(1)$ and cointegrated. Therefore, the identification of integration order is based on IPS (Im-Pesaran-Shin) and CIPS (cross-sectional augmented IPS IPS) stationary tests, similar to the approach of Comunale and Hessel (2014). At the same time, a cross-sectional dependency test is performed concerning the determination of the appropriate method for stationary testing, since in the case of a larger number of observations *T* than the number of cross-sectional units *N*, the presence of cross-sectional dependence is highly probable. As a consequence of the above statements, the situation may be that some variables act as a common factor for export, and as a common factor for import, respectively. Consequently, the Westerlund cointegration test, based on structural dynamics, is applied.

At the same time, Comunale and Hessel (2014) and Blackburne and Frank (2007) state that assuming dynamic panel data with more observations *T* compared to the number of cross-sectional units *N*, it is usual to apply the fixed effects (FE) estimator. However, the authors point out that in the presence of non-stationarity and cointegration in a dynamic model, it is normal to reparametrize the model into an ECM model. Subsequently, after the ARDL dynamic panel re-parametrization into an ECM model, the export and import functions would have the following forms:

$$\Delta lx_{it} = \phi_i \left(lx_{i,t-1} - \theta_{01}^{'} - \theta_{1i}^{'} lreer_{it} - \theta_{2i}^{'} lfd_{it} - \theta_{3i}^{'} lm_{it} \right) + \delta_{11i}^{'*} \Delta lreer_{it} + \delta_{21i}^{'*} \Delta lfd_{it} + \\ + \delta_{31i}^{'*} \Delta lm_{it} + \mu_i + \epsilon_{it} \tag{8}$$

$$\Delta lm_{it} = \phi_i \left(lm_{i,t-1} - \theta_{01}^{'} - \theta_{1i}^{'} lreer_{it} - \theta_{2i}^{'} ldd_{it} - \theta_{3i}^{'} lx_{it} \right) + \delta_{11i}^{'*} \Delta lreer_{it} + \delta_{21i}^{'*} \Delta ldd_{it} + \\ + \delta_{31i}^{'*} \Delta lx_{it} + \mu_i + \epsilon_{it} \tag{9}$$

Later, we estimate the non-stationary panel with the application to a smaller number of cross-sectional units *N* compared to the number of observations *T* using two methods, namely, the MG estimator and the PMG estimator.

3.2. Robustness Check of Estimated ARDL Results

The robustness of the ARDL results can be carried out by re-estimating the elasticities of the aggregate and disaggregated export and import equations using dynamic OLS (DOLS) and fully modified OLS (FMOLS) techniques. The dynamic ordinary least squares (DOLS) estimator, proposed by Stock and Watson (1993), extends the traditional (static) OLS regression by employing lags, leads and contemporaneous values of the explanatory variable in first difference. DOLS is employed to estimate long-run equilibria that is corrected for potential simultaneity bias among explanatory variables. FMOLS, as developed by Phillips and Hansen (1990), has certain advantages, such as correcting for endogeneity and serial correlation effects (Narayan and Narayan, 2010).

The suitability of proposed methods to estimate cointegrating coefficients was discussed, by, among others, McCoskey and Kao (1998) and Kao and Chiang (2001). Scholars have confirmed that the FMOLS and DOLS techniques are preferable methods, suggesting that the DOLS estimator outperforms other asymptotically efficient panel cointegration estimators. Therefore, this DOLS estimator is our preferred estimator.

4. Empirical Results

The results of the Pesaran CD and Breusch-Pagan LM statistics confirm cross-sectional dependencies in all variables in the panel. Therefore, the paper focuses on the CIPS stationarity test that considers cross-sectional dependencies. Also, the IPS stationarity test is used to compare the results when not considering the previous dependence.

The results confirm non-stationary data on the levels and stationary data in the first differences. Therefore, the analysis of the paper is based exclusively on the data of the order $I(1)$, or $I(0)$ respectively, so that the presence of undesired $I(2)$ variables is eliminated. The Westerlund panel cointegration test for aggregate functions is also performed, and we assume that the results for disaggregated analysis would not be significantly different from the aggre gate results. Due to space constrictions, the detailed results of the tests are not reported here. Like any other results, they are available upon request from the author.

4.1. Aggregate Export and Import Functions

We start with an estimation of aggregate export and import functions. From the estimated dynamic panel ARDL model, we calculate long-term and short--term coefficients and the coefficient of the speed of adjustment as well. The analysis was initially performed for all available observations. However, our the results indicate a significant impact of the global financial and economic crisis on our estimates, which is why we have split the analysed period into the pre--crisis period, that is, the period beginning in 1995Q4 and ending in 2008Q4, and the post-crisis period, that is, the period beginning in 2010Q1 and ending in 2016Q4. The year 2009 was excluded from the reference period. According to some authors (Gouher, Anwar and Tariq, 2017) the world trade in 2009 dramatically declined (that is not the case of subsequent years) due to the shock originated from the economic crisis. This is also the reason why we have decided to split the whole examined period into two sub-periods (pre-crisis and post-crisis). This approach enables us to analyse estimated results for the pre-crisis and post--crisis periods and examine changes in export and import functions determination together with changes in mutual relationship between export and import components followed by the recent economic crisis. We suggest that fundamental changes in economies during the crisis period (European Commission, 2009a/b; United Nations, 2010) affected contribution of individual export and import determinants in our results.

Tables 2 and 3 present estimates of the aggregate export function for the pre--crisis and post-crisis periods that are based on two estimation methods: PMG and MG (due to constricted space, the results of the robustness check based on the DOLS and FMOLS estimates of the aggregate export function for the pre--crisis and post-crisis periods are available upon request from the authors).

Table 2 shows the results of the estimation of the aggregate export function for the pre-crisis period. Based on the Hausman test, we lean towards the results from the PMG estimation method. Our estimates also indicate that the results are sensitive to the method used in terms of magnitude and significance of the coefficients. The long-term coefficients of both REER indicators confirm the assumption of the positive effect of REER on export dynamics, as both coefficients are negative. However, estimates of short-term coefficients indicate insignificance of ULC based REER and a significant, though positive (volume effect in the short-term period is smaller than the price effect), effect of CPI-based REER on export. It seems that the long-term coefficients are more significant and larger compared to the short-term estimates. Our result is consistent with most studies that argue that price competitiveness matters in the Euro Area and the EU (see, e.g., Comunale and Hessel, 2014; Bayoumi, Harmsen and Turunen, 2011; Mirdala,

2015). The findings also confirm a significant positive long-term effect of foreign demand on export (although the short-term coefficient is negative). Similarly, our results indicate strong positive effects of imports on export performance, which reveals a significant mutual relationship between exports and imports in both the short-term and long-term period. Finally, the ECT has an expected negative sign, indicating a return of the variables to the long-term equilibrium (after the initial positive shock).

T a b l e 2

Estimated Results of the Aggregate Export Function for the Pre-Crisis Period

Variable	PMG		MG	
	Estimated long-term elasticities			
Lreer_CPI	**–0.328*** (0.024)**		–0.107 (0.056)	
lreer_ULC		**–0.298*** (0.022)**		–0.154 (0.023)
lfd	**0.372*** (0.022)**	**0.502*** (0.037)**	0.475* (0.070)	0.389** (0.046)
lm	**0.710*** (0.057)**	**0.785*** (0.061)**	0.805*** (0.126)	0.827*** (0.155)
	Estimated short-term elasticities			
ECT	**–0.166*** (0.012)**	**–0.171*** (0.014)**	–0.415*** (0.057)	–0.431*** (0.062)
lreer_CPI D1	**0.149*** (0.048)**		0.140 (0.022)	
lreer_ULC D1		**0.056 (0.341)**		0.027 (0.718)
lfd D1	**–0.345*** (0.039)**	**–0.375*** (0.018)**	–0.351* (0.060)	–0.389** (0.016)
lm D1	**0.656*** (0.049)**	**0.636*** (0.025)**	0.452*** (0.041)	0.421*** (0.022)
constant	**0.207*** (0.013)**	**–0.107*** (0.055)**	–0.203* (0.060)	0.231 (0.033)
R-squared	0.62	0.66	0.60	0.55

Note: Standard errors in parentheses. For calculations, 1 lag is considered (suggested by AIC). ECT (error correction term) represents the speed of adjustment. The index D1 indicates the first differences of the variable. The variables are in log form (index "l" before the variable). *Lfd* is foreign demand, *lm* is import, *lreer_cpi* is a REER vis-à-vis 37 partners deflated by CPI, *lreer_ulc* is a REER vis-à-vis 37 partners deflated by ULC; *** indicates a rejection of insignificance at the 1% level, ** at the 5% level, and * at the 10% level.

Source: Authors' calculations.

Table 3 shows the results of the export determinants in the post-crisis period, with PMG results as the preferred estimation method based on the Hausman test. Coefficients on both types of REER are still negative, though slightly smaller (in the long-term), which indicates a reduced role of price competitiveness in determining export performance. Similarly small and negative (though insignificant) are both CPI and ULC-based REER in the short-term estimates. The crisis period changed the expected effect of foreign demand on export performance. Coefficients in both

the long term and the short term (insignificant) are positive and smaller in comparison with the model for the crisis period. However, mutual dependence between exports and imports during the crisis period increased, as the estimated long-term coefficients for imports are slightly higher. As a result, imports remained the most crucial determinant of export performance (especially in the long-term estimates) in our group of countries, even during the crisis period (see the results from disaggregated export function estimates in Table 6 for a more detailed explanation). The ECT coefficient has an expected negative sign, indicating a return of the variables to the long-term equilibrium (after the initial positive shock).

T a b l e 3

Estimated Results of the Aggregate Export Function in the Post-Crisis Period

Variable	PMG		MG	
	Estimated long-term elasticities			
lreer_CPI	**–0.193*** (0.012)**		–0.452** (0.042)	
lreer_ULC		**–0.087* (0.008)**		–0.279* (0.071)
lfd	**0.276*** (0.019)**	**0.125*** (0.010)**	0.220 (0.016)	0.280 (0.033)
lm	**0.883*** (0.065)**	**0.822*** (0.072)**	0.691*** (0.047)	0.663*** (0.066)
	Estimated short-term elasticities			
ECT	**–0.350*** (0.023)**	**–0.399*** (0.028)**	–0.640*** (0.042)	–0.669*** (0.050)
lreer_CPI D1	**–0.121 (0.017)**		0.037 (0.007)	
lreer_ULC D1		**–0.075 (0.005)**		0.020 (0.009)
lfd D1	**0.132 (0.043)**	**0.142 (0.038)**	0.100 (0.012)	0.102 (0.033)
lm D1	**0.421*** (0.038)**	**0.270*** (0.019)**	0.283*** (0.015)	0.159*** (0.022)
constant	**1.482*** (0.132)**	**1.219*** (0.099)**	1.332*** (0.359)	1.369*** (0.287)
R-squared	0.68	0.65	0.57	0.53

Note: Standard errors in parentheses. For calculations, 1 lag is considered (suggested by AIC). ECT (error correction term) represents the speed of adjustment. The index D1 indicates the first differences of the variable. The variables are in log form (index "l" before the variable). *Lfd* is foreign demand, *lm* is import, *lreer_cpi* is a REER vis-à-vis 37 partners deflated by CPI, *lreer_ulc* is a REER vis-à-vis 37 partners deflated by ULC; *** indicates a rejection of insignificance at the 1% level, ** at the 5% level, and * at the 10% level.

Source: Authors' calculations.

Tables 4 and 5 present estimates of the aggregate import function for the pre-crisis and post-crisis periods that are based on two estimation methods: PMG and MG (due to constricted space, the results of the robustness check based on the DOLS and the FMOLS estimates of the aggregate import function for the pre-crisis and post-crisis periods are available upon request from the authors).

T a b l e 4

Estimated Results of the Aggregate Import Function in the Pre-Crisis Period

Variable	PMG		MG	
	Estimated long-term elasticities			
lreer_CPI	0.147* (0.095)		**0.190** **(0.046)**	
lreer_ULC		0.583 (0.041)		**0.616** **(0.043)**
ldd	0.804*** (0.039)	0.811*** (0.076)	**0.857***** **(0.063)**	**0.856*** **(0.079)**
lx	0.861*** (0.027)	0.862*** (0.061)	**0.682***** **(0.063)**	**0.434** **(0.021)**
	Estimated short-term elasticities			
ECT	–0.114*** (0.009)	–0.123*** (0.013)	**–0.394***** **(0.028)**	**–0.366***** **(0.035)**
lreer_CPI D1	–0.388** (0.036)		**–0.310***** **(0.029)**	
lreer_ULC D1		–0.406*** (0.035)		**–0.305***** **(0.028)**
ldd D1	0.923*** (0.078)	0.950*** (0.083)	**0.712***** **(0.066)**	**0.784***** **(0.058)**
lx D1	0.531*** (0.042)	0.519*** (0.037)	**0.359***** **(0.025)**	**0.368***** **(0.042)**
Constant	–0.934*** (0.052)	–0.967*** (0.069)	**–1.256***** **(0.117)**	**–1.157***** **(0.094)**
R-squared	0.63	0.69	0.66	0.64

Note: Standard errors in parentheses. For calculations, 1 lag is considered (suggested by AIC). ECT (error correction term) represents the speed of adjustment. The index D1 indicates the first difference of the variable. The variables are in log form (index "l" before the variable). *Ldd* is domestic demand, *lx* is export, *lreer_cpi* is a REER vis-à-vis 37 partners deflated by CPI, *lreer_ulc* is a REER vis-à-vis 37 partners deflated by ULC; *** indicates a rejection of insignificance at the 1% level, ** at the 5% level, and * at the 10% level.

Source: Authors' calculations.

Table 4 presents the estimates of the long-term and short-term coefficients of the aggregate import function in the model with pre-crisis data. The results of the Hausman test favour the results of the MG method. REER appreciation has a positive effect on import, as indicated by our long-term estimates. It seems that import is more sensitive to the associated cost than price-related changes in competitiveness, as the REER coefficients for the model with ULC based REER are significantly higher. However, short-term estimates indicate a negative effect of REER appreciation on import, which is similar to our results for export function (Tables 2 and 3) and favours price effect to volume effect. An increase in REER reduces import prices and decreases imports in the short term (Christodoulopoulou and Tkačevs, 2014). Our results also reveal a significant and positive effect of both domestic demand and import on export dynamics for both short-term and long-term estimates. ECT has an expected negative sign, indicating a return of the variables to the long-term equilibrium (after the initial positive shock).

T a b l e 5

Estimated Results of the Aggregate Import Function in the Post-Crisis Period

Variable	PMG		MG	
	Estimated long-term elasticities			
lreer_CPI	**0.078** **(0.006)**		0.134 (0.036)	
lreer_ULC		**0.550***** **(0.049)**		0.206 (0.023)
ldd	**0.498***** **(0.038)**	**0.689***** **(0.055)**	0.296 (0.025)	0.352* (0.075)
lx	**0.117** **(0.022)**	**0.215***** **(0.004)**	0.545 (0.038)	0.664*** (0.028)
	Estimated short-term elasticities			
ECT	**–0.129***** **(0.056)**	**–0.142***** **(0.062)**	–0.387*** (0.078)	–0.491*** (0.065)
lreer_CPI D1	**0.076** **(0.003)**		0.056 (0.005)	
lreer_ULC D1		**0.151** **(0.008)**		0.072** (0.003)
ldd D1	**0.959***** **(0.041)**	**0.925***** **(0.068)**	0.830*** (0.091)	0.749*** (0.103)
lx D1	**0.624***** **(0.056)**	**0.613***** **(0.099)**	0.378*** (0.119)	0.297*** (0.093)
constant	**0.470***** **(0.065)**	**0.403***** **(0.041)**	–0.833 (0.068)	–0.868 (0.057)
R-squared	0.62	0.61	0.52	0.50

Note: Standard errors in parentheses. For calculations, 1 lag is considered (suggested by AIC). ECT (error correction term) represents the speed of adjustment. The index D1 indicates the first difference of the variable. The variables are in log form (index "l" before the variable). *Ldd* is domestic demand, *lx* is export, *lreer_cpi* is a REER vis-à-vis 37 partners deflated by CPI, *lreer_ulc* is a REER vis-à-vis 37 partners deflated by ULC; *** indicates a rejection of insignificance at the 1% level, ** at the 5% level, and * at the 10% level.

Source: Authors' calculations.

Table 5 shows the results of the import determinants in the post-crisis period. According to the Hausman test, we favour the results of the PMG model. Estimated coefficients for both REER variables have a significant and positive effect on import in the long run and short run (contrary to our calculations for the pre--crisis period), as well.

However, the responsiveness of import to both CPI and ULC based REER slightly decreased (coefficients and slightly lower). A similar scenario (positive but lower coefficients) was observed for domestic demand and export estimates in the long run. However, short-term estimates revealed positive but higher (in comparison with a pre-crisis model) responsiveness of import to shocks in domestic demand and export. ECT has an expected negative sign, indicating a return of the variables to the long-term equilibrium (after the initial positive shock).

While a positive role of foreign demand in determining export (in the long--term) and domestic demand (in both long-run and short-run) in determining

import was generally expected, high sensitivity of export dynamics to shocks in import, and import dynamics to shocks in export, emphasizes the role of the mutual relationship between export and import in shaping the external equilibrium in our group of countries (Barrell and Dées, 2005). Moreover, demand determinants dominate to price- and cost-related competitiveness indicators (both REER indicators) in determining both export and import favouring demand-driven origins of export-import mismatch and thus external imbalances for our sample of countries.

We suggest that import intensity of exports and export intensity of imports represents not only generally expected result of deeper integration among countries on the common EU market but also the idea of increasing involvement of countries in the international fragmentation of production that makes individual sectors (segments) in particular countries even more interdependent. Post-crisis development even increased short-term export intensity of exports and long-term import intensity of exports. As a result, participation in the global value chains intensifies competition not only on the country level but also on sector level. Increasing international competition among sectors involved in the international fragmentation of production may even deepen economic differences (performance, competitiveness) among domestic participants (sectors) in international and domestic production chains further fuelling divergences in domestic sectors and regions.

4.2. Disaggregated Export and Import Functions

The estimation of disaggregated export and import functions is also based on the dynamic panel ARDL model for non-stationary heterogeneous panels. Both exports and imports are split into smaller parts from the territorial and commodity point of view. From the territorial point of view, our disaggregated dataset is split into export and import within and outside the EU. The motivation for this is based on the idea of determining which trade flow destination is more relevant to the development of the explanatory variables. At the same time, export and import are divided by the BEC classification into three groups: capital goods, intermediate products and consumption goods.

Table 6 present estimates of the disaggregated export function for the pre--crisis and post-crisis periods that are based on two estimation methods: PMG and MG (due to constricted space, the results of the robustness check based on the DOLS and the FMOLS estimates of the disaggregated export function for the pre-crisis and post-crisis periods are available upon request from the authors).

T a b l e 6

Estimated Results of the Disaggregated Export Function

	Pre-crisis period				**Post-crisis period**			
Variable	PMG		MG		PMG		MG	
	Estimated long-term elasticities							
lreer_cpi	–0.348 (0.017)		**–0.199 (0.033)**		**–0.328 (0.051)**		–0.347 (0.041)	
lreer_ulc		**–0.205** (0.028)**		–0.209 (0.036)		**–0.370* (0.050)**		–0.447 (0.056)
lfd	0.504 (0.021)	**0.506*** (0.057)**	**0.298* (0.089)**	0.301 (0.077)	**0.279*** (0.061)**	**0.242*** (0.072)**	0.344 (0.027)	0.217 (0.025)
lm_cap$_{extra}$	–0.093 (0.010)	**0.112*** (0.018)**	**0.076 (0.008)**	–0.019 (0.004)	**–0.615*** (0.048)**	**–0.607*** (0.072)**	–0.714 (0.043)	–0.631 (0.069)
lm_inter$_{extra}$	0.242 (0.019)	**0.256*** (0.039)**	**0.174 (0.037)**	0.191 (0.049)	**0.221*** (0.043)**	**0.202*** (0.034)**	0.395 (0.034)	0.245 (0.043)
lm_con$_{extra}$	–0.255 (0.075)	**–0.298*** (0.080)**	**–0.132 (0.037)**	–0.144 (0.048)	**–0.069 (0.004)**	**–0.033 (0.008)**	–0.183 (0.030)	–0.103 (0.047)
lm_cap$_{intra}$	0.355 (0.029)	**0.360*** (0.048)**	**0.127*** (0.037)**	0.129 (0.042)	**0.105 (0.029)**	**0.176* (0.056)**	0.179 (0.042)	0.093 (0.009)
lm_inter$_{intra}$	0.337 (0.071)	**0.319*** (0.013)**	**0.494*** (0.039)**	0.482 (0.088)	**0.328** (0.050)**	**0.242* (0.063)**	0.287 (0.047)	0.352 (0.045)
lm_con$_{intra}$	0.369 (0.077)	**0.405*** (0.108)**	**0.113 (0.068)**	0.119 (0.047)	**0.550*** (0.118)**	**0.556*** (0.142)**	0.665 (0.136)	0.512 (0.134)
	Estimated short-term elasticities							
ECT	–0.130 (0.045)	**–0.127*** (0.056)**	**–0.612*** (0.038)**	–0.609 (0.042)	**–0.367*** (0.018)**	**–0.385*** (0.028)**	–0.827 (0.104)	–0.802 (0.117)
lreer_cpi D1	0.144 (0.029)		**0.150 (0.042)**		**0.113** (0.043)**		0.092 (0.011)	
lreer_ulc D1		**0.121 (0.055)**		0.110 (0.042)		**0.097** (0.015)**		0.038 (0.006)
lfd D1	–0.111 (0.058)	**–0.050 (0.012)**	**–0.135** (0.047)**	–0.116 (0.055)	**0.264 (0.065)**	**0.318 (0.063)**	0.201 (0.086)	0.033 (0.009)
lm_cap$_{extra}$ D1	0.020 (0.012)	**0.019** (0.009)**	**0.014 (0.009)**	0.010 (0.006)	**0.171*** (0.041)**	**0.168*** (0.031)**	0.053 (0.017)	0.016 (0.007)
lm_inter$_{extra}$ D1	0.095 (0.022)	**0.094*** (0.031)**	**0.047** (0.014)**	0.040 (0.018)	**0.003 (0.001)**	**0.021 (0.005)**	0.075 (0.027)	0.077 (0.039)
lm_con$_{extra}$ D1	0.070 (0.080)	**0.069* (0.099)**	**0.051 (0.249)**	0.051 (0.229)	**0.075 (0.317)**	**0.093 (0.177)**	0.165 (0.060)	0.149 (0.044)
lm_cap$_{intra}$ D1	0.050 (0.012)	**0.049* (0.009)**	**0.030 (0.018)**	0.029 (0.013)	**0.066 (0.023)**	**0.070 (0.031)**	0.056 (0.026)	0.119 (0.029)
lm_inter$_{intra}$ D1	0.380 (0.000)	**0.380*** (0.000)**	**0.130* (0.065)**	0.131 (0.039)	**0.199* (0.066)**	**0.240** (0.020)**	0.032 (0.008)	0.028 (0.007)
lm_con$_{intra}$ D1	0.047 (0.009)	**0.040 (0.008)**	**0.029 (0.006)**	0.017 (0.007)	**0.121 (0.037)**	**0.159 (0.029)**	0.653 (0.065)	0.641 (0.060)
constant	0.369 (0.066)	**0.262*** (0.088)**	**0.343 (0.096)**	0.421 (0.148)	**1.575*** (0.229)**	**1.272*** (0.307)**	1.335 (0.082)	1.181 (0.074)
R-squared	0.78	**0.81**	**0.83**	0.79	**0.86**	**0.85**	0.77	0.73

Note: Standard errors in parentheses. For calculations, 1 lag is considered (suggested by AIC). ECT (error correction term) represents the speed of adjustment. The index D1 indicates the first difference of the variable. The variables are in log form (index "l" before the variable). *Lfd* is foreign demand, *lm* is import, *lreer_cpi* is a REER vis-à-vis 37 partners deflated by CPI, *lreer_ulc* is a REER vis-à-vis 37 partners deflated by ULC, *lm_cap* is import of capital goods, *lm_inter* is import of intermediate goods, *lm_con* is import of consumption goods. Index *extra* represents flows from countries outside EU while index *intra* represents flows from countries within EU; *** indicates a rejection of insignificance at the 1% level, ** at the 5% level, and * at the 10% level.

Source: Authors' calculations.

Table 6 presents the results of the disaggregated export function estimates for both the pre-crisis and post-crisis periods. According to the Hausman test, estimates based on the PMG model with ULC based REER and the MG model with CPI-based REER are selected as the appropriate models for the pre-crisis period, while the PMG model for both exchange rate variables is more appropriate for a model with post-crisis data. Coefficients for exchange rates and foreign demand correspond to our estimates from aggregate export function (Tables 2 and 3), which is why we focus on the analysis of decomposed import components in the short term and long term only.

All estimates of import components for a short-term period indicate a positive effect on export. However, export in our sample of countries seems to be the most responsive to the shocks in imports of intermediate goods from countries within the EU (both pre-crisis and post-crisis periods), indicating an effect of international fragmentation of production that makes export and import mutually dependent.

A considerable increase in a positive effect on export was identified in the case of import of capital goods from countries outside the EU in the post-crisis period, which corresponds to the rebirth of growth dynamics in our sample of countries fuelled by inflows of capital goods from faster-growing regions (U.S.A. and China). The responsiveness of export to import of consumption goods from countries within the EU in the post-crisis period notably increased as well; however, the estimated coefficients are insignificant.

The results for a long-term period differ slightly in comparison to our short--term estimates. Our estimates indicate a decrease in export after an unexpected shock in import of capital (the negative response of export to this shock is even higher in the post-crisis period) and consumption goods from countries outside the EU. It seems that these types of foreign trade inflows between EU and non-EU countries do not strengthen mutual links between exports and imports in our sample of countries in the long run.

On the other hand, the import of intermediate goods (from both EU and non--EU countries) positively affects export, although the effect slightly decreased during the crisis period. All three types of imports from EU countries have a positive impact on export in the long run. While the effects of imported capital and intermediate goods on export slightly decreased due to reduced export performance (lower foreign demand) of countries during the crisis period, the effect of imported consumption goods on export raised (shock in this segment of import crowded out domestic production abroad). ECT has an expected negative sign, indicating a return of the variables to the long-term equilibrium (after the initial positive shock).

T a b l e 7

Estimated Results of the Disaggregated Import Function

	Pre-crisis period				**Post-crisis period**			
Variable	PMG		MG		PMG		MG	
	Estimated long-term elasticities							
lreer_cpi	–0.102 (0.052)		**–0.183 (0.052)**		**–0.206 (0.092)**		0.872 (0.093)	
lreer_ulc		**–0.108 (0.031)**		–0.222 (0.023)		**–0.267** (0.020)**		–0.025 (0.009)
ldd	0.197 (0.055)	**0.231** (0.020)**	**0.405 (0.086)**	0.474 (0.071)	**0.584*** (0.076)**	**0.742*** (0.099)**	0.567 (0.089)	0.632 (0.069)
lx_cap_extra	0.061 (0.005)	**0.061*** (0.017)**	**0.102*** (0.037)**	0.104 (0.021)	**0.701*** (0.089)**	**0.682*** (0101)**	0.548 (0.071)	0.563 (0.088)
lx_inter_extra	0.205 (0.088)	**0.237*** (0.074)**	**0.183** (0.018)**	0.164 (0.051)	**0.568*** (0.069)**	**0.500*** (0.063)**	0.502 (0.091)	0.526 (0.102)
lx_con_extra	–0.063 (0.009)	**–0.066*** (0.008)**	**–0.046 (0.008)**	–0.038 (0.006)	**–0.153*** (0.048)**	**–0.139*** (0.061)**	–0.085 (0.027)	–0.171 (0.106)
lx_cap_intra	0.060 (0.018)	**0.050*** (0.029)**	**0.060 (0.015)**	0.089 (0.017)	**0.052 (0.009)**	**0.040 (0.017)**	0.111 (0.027)	0.090 (0.024)
lx_inter_intra	0.667 (0.089)	**0.608*** (0.117)**	**0.361*** (0.147)**	0.298 (0.065)	**0.286*** (0.031)**	**0.163** (0.030)**	0.391 (0.056)	0.359 (0.090)
lx_con_intra	0.118 (0.032)	**0.139*** (0.022)**	**0.102 (0.035)**	0.143 (0.040)	**0.604*** (0.092)**	**0.630*** (0.103)**	0.408 (0.031)	0.453 (0.026)
	Estimated short-term elasticities							
ECT	–0.199 (0.038)	**–0.199*** (0.041)**	**–0.623 (0.022)**	0.631 (0.047)	**–0.432*** (0.063)**	**–0.417*** (0.067)**	–0.391 (0.088)	–0.384 (0.092)
lreer_CPI D1	–0.214 (0.054)		**–0.132 (0.041)**		**0.153*** (0.065)**		0.181 (0.054)	
lreer_ULC D1		**–0.317*** (0.085)**		–0.327 (0.020)		**0.198*** (0.074)**		0.207 (0.075)
ldd D1	0.395 (0.104)	**0.405*** (0.094)**	**0.160 (0.175)**	0.154 (0.046)	**0.681** (0.125)**	**0.627** (0.137)**	0.326 (0.051)	0.383 (0.086)
lx_cap_extra D1	0.039 (0.011)	**0.036*** (0.009)**	**0.010 (0.004)**	0.011 (0.004)	**0.245*** (0.069)**	**0.248*** (0.081)**	–0.035 (0.007)	–0.037 (0.008)
lx_inter_extra D1	0.051 (0.033)	**0.040 (0.007)**	**0.034 (0.006)**	0.046 (0.017)	**0.064 (0.016)**	**0.059 (0.006)**	0.175 (0.032)	0.187 (0.049)
lx_con_extra D1	0.004 (0.002)	**–0.000 (0.003)**	**0.001 (0.002)**	–0.005 (0.003)	**0.020 (0.007)**	**–0.026 (0.007)**	0.084 (0.013)	0.146 (0.067)
lx_cap_intra D1	0.026 (0.009)	**0.025 (0.011)**	**0.000 (0.004)**	0.009 (0.005)	**0.026 (0.015)**	**0.020 (0.007)**	0.011 (0.05)	0.040 (0.006)
lx_inter_intra D1	0.282 (0.1140)	**0.292*** (0.128)**	**0.188*** (0.096)**	0.193 (0.087)	**0.178** (0.049)**	**0.162* (0.084)**	0.193 (0.044)	0.150 (0.081)
lx_con_intra D1	0.051 (0.008)	**0.056 (0.009)**	**0.036 (0.009)**	0.031 (0.005)	**0.105 (0.068)**	**0.057 (0.026)**	0.079 (0.037)	0.190 (0.086)
constant	–0.924 (0.226)	**–0.951** (0.213)**	**–0.946 (0.301)**	–1.159 (0.197)	**–0.817*** (0.227)**	**–0.707*** (0.301)**	–0.884 (0.244)	–0.682 (0.189)
R-squared	0.72	**0.85**	**0.86**	0.81	**0.83**	**0.86**	0.80	0.79

Note: Standard errors in parentheses. For calculations, 1 lag is considered (suggested by AIC). ECT (error correction term) represents the speed of adjustment. The index D1 indicates the first differences of the variable. The variables are in log form (index "l" before the variable). *Lfd* is foreign demand, *lx* is export, *lreer_cpi* is a REER vis-à-vis 37 partners deflated by CPI, *lreer_ulc* is a REER vis-à-vis 37 partners deflated by ULC, *lx_cap* is export of capital goods, *lx_inter* is export of intermediate goods, *lx_con* is export of consumption goods. Index *extra* represents flows to countries outside EU while index *intra* represents flows to countries within EU; *** indicates a rejection of insignificance at the 1% level, ** at the 5% level, and * at the 10% level.

Source: Authors' calculations.

Table 7 present estimates of the disaggregated import function for the pre--crisis and post-crisis periods that are based on two estimation methods – PMG and MG (due to constricted space, the results of the robustness check based on the DOLS and the FMOLS estimates of the disaggregated import function for the pre-crisis and post-crisis periods are available upon request from the authors).

Table 7 presents the results of the estimation of the disaggregated import function in the pre-crisis and post-crisis periods, with the same labels as the export function above. According to the Hausman test, estimates based on the PMG model with ULC based REER and the MG model with CPI based REER are selected as the appropriate models for the pre-crisis period, while the PMG model for both exchange rate variables is more appropriate for a model with post-crisis data. Coefficients for exchange rates and domestic demand correspond to our estimates from aggregate import function (Tables 4 and 5), which is why we focus on the analysis of decomposed export components in the short--term and long term only.

Short-term estimates indicate a generally positive, albeit small, effect of export components to both EU and non-EU countries on import. However, the export of intermediate goods to EU countries has a slightly higher positive effect on import than other components in both pre-crisis and post-crisis periods. Moreover, a higher, positive and statistically significant effect was also examined in the case of the export of capital goods to non-EU countries during the post-crisis period. In line with our results for disaggregated export function, we suggest that flows of intermediate goods within EU countries is playing an important role (albeit smaller during the post-crisis period) in strengthening the mutual relationship between dynamics of exports and imports.

Almost all estimated long-term coefficients are significant. Individual export components have a positive effect on import, except for export of consumption goods to non-EU countries (its negative effect slightly increased during the post--crisis period). Outflows of intermediate production to EU countries represented the most contributive determinant of the import dynamics during the pre-crisis period (its effect during the post-crisis period decreased), highlighting an importance of production chain fragmentation in strengthening mutual links between export and import. Moreover, the effect of intermediate production exported to non-EU countries on import significantly increased during the post-crisis period, possibly substituting a reduced effect of intermediate goods export to EU countries on import. A significant increase in the positive effect on import during the post-crisis period was examined in the case of exports of capital goods to non--EU countries (foreign investment demand driver from faster recovered economies outside the EU during the post-crisis period) and export of consumption

goods to EU countries (foreign consumption demand driver from faster recovered economies within EU during the post-crisis period). ECT has an expected negative sign, indicating a return of the variables to the long-term equilibrium (after the initial positive shock).

Our results confirm that deeper economic integration among EU member countries makes intra-EU imports more important in determining export performance of our sample of countries in comparison with extra-EU imports especially in the long term. Moreover, imports of intermediate production fuels exports more intensively than imports of consumption and capital goods confirming the idea of increasing role of international fragmentation of production inside EU. Intra-EU (as well as extra-EU) intermediate production imports intensity of exports during the post-crisis period remained relatively stable in comparison with remaining import components. Import-export links based on international production chains seems to be more resistant to the changes in the international trade (higher volatility in dynamics of foreign demand and remaining import components) in the post-crisis period. We suggest that deeper international fragmentation of production based on import-export links may have stabilising effect on intra-EU trade flows as well as domestic aggregate demand.

Similar stabilising effect was revealed in analysing intra-EU export-import links. Significantly higher extra-EU intermediate production exports intensity of imports during the post-crisis period indicates crucial role of a territorial diversification of international production chains to non-EU countries that reduces exposure of export-import links to sudden changes in business cycle on the common market of EU. Moreover, higher stability of international production chains reduces risks of excessive fluctuations in trade balances of EU member countries.

Conclusion

Examination of the key determinants of export and import dynamics, together with identification of the patterns and sources of the mutual relationship between export and import in 21 EU countries from aggregate and disaggregated export and import functions, revealed interesting implications of deeper economic integration in the EU and international fragmentation of production chains. While our results confirmed relative importance of price (cost) and foreign/domestic demand-driven determinants in stimulating export and import, commodity and territorial decomposition of import and export components provide vital information on the relative importance of mutual links and relationships between export and import, and vice versa.

Emergence of the global value chains and participation of the EU member countries in the international fragmentation of production brought a new dimension to the analysis of mutual relationship between export and import. Deeper integration among EU member countries is associated not only with higher intensity of international trade flows with the final products but also with increasing role of the cross-country intermediate production flows. As a result, higher specialization of individual countries strengthens dependence of export industries on imports of intermediate products (and vice versa) that increases mutual interdependence among individual sectors (segments) in particular countries even more. This trend is even more obvious during the post-crisis period for the external trade within as well as outside European Union from both territorial and commodity aspects. On the other hand, resulting structural dependences that strengthens mutual links between exports and imports may have stabilising effect on intra-EU trade flows as well as domestic aggregate demand. Moreover, significantly higher extra-EU intermediate production exports intensity of imports during the post-crisis period indicates crucial role of a territorial diversification of international production chains to non-EU countries that reduces exposure of export-import links to sudden changes in business cycle on the common market of EU. Moreover, higher stability of international production chains reduces risks of excessive fluctuations in trade balances of EU member countries.

Relative position of individual country in the process of international fragmentation of production not only affects net gains that result from participation in the process of international division of labour but related mutual links between exports and imports (and associated shares of intermediate goods in the cross-country trade flows) substantially shapes external position (trade balance, current account) of the country. Deeper are the links between exports and imports, the more emphasis should policy makers put on long-term shaping of a structure of domestic internationalized industries to preserve long-term sustainability of a trade balance.

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Appendix

Table 8

Geographical and Integration Groups of Countries Considered in the Export Demand Index

Commonwealth of Independent States (CIS)	Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan
Emerging and Developing Asia (EDA)	Brunei Darussalam, Cambodia, China (Hong Kong + Macau + Mainland), Fiji, India, Indonesia, Lao P.D.R., Malaysia, Maldives, Mongolia, Myanmar, Nepal, Papua New Guinea, Philippines, Samoa, Solomon Islands, Sri Lanka, Thailand, Tonga, Vanuatu, Vietnam
European Union (EU)	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom
Latin America and the Caribbean (LAC)	Argentina, The Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela
Middle East and North Africa (MENA)	Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Tunisia, United Arab Emirates, Yemen
Sub-Saharan Africa (SUBA)	Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cabo Verde, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Republic of Congo, Côte d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Nigeria, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe
The Rest	Afghanistan, Albania, Aruba, Australia, Bermuda, Bosnia and Herzegovina, Canada, Cuba, Faroe Islands, New Caledonia (French territory), Greenland, Guadeloupe, French Guiana, Island, Israel, The Democratic People's Republic of Korea, Republic of Korea, Macedonia, Martinique, Montenegro, Netherlands Antilles, New Zealand, Norway, Pakistan, Réunion, Serbia and Montenegro, Serbia, Singapore, Somalia, Switzerland, Syria, Turkey

Source: Authors' processing.