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Determinants of trade balance in Polish and Czech manufacturing sectors

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Abstract

Research background: A strong industrial base is essential for achieving long-term sustainable economic growth and export competitiveness. In that sense, manufacturing remains a significant contributor to exports in the CEE countries. However, its role and its influence vary between CEE economies and change over time.

Purpose of the article: The main objective of this paper is to compare the determinants of the international competitiveness, measured by the net exports of the manufacturing sectors in the Czech and Polish economies, by using the database of 13 manufacturing sub-sectors in 1995–2011. The authors research the question of how much foreign and domestic demand, the level of labour costs, the level of sector innovation intensity, the level of sector openness to foreign markets as well as sectoral labour productivity influence the changes in trade balance.

Methods: Our approach is based on employing an error correction model and SUR model to disaggregated sectoral manufacturing data.

Findings & Value added: The results of the analysis conducted show substantial differences in the roles particular variables play in explaining the net exports in individual sectors.

For the majority of Polish and Czech manufacturing sub-sectors, generation of positive trade balance is determined by relative demand growth. An increasing labour productivity influences heavily a positive trade balance of Polish goods in majority of sub-sectors, however, a key factor in Czech sub-sectors is decreasing unit labour costs. The results of the analysis indicate mostly a greater impact of the researched factors on net exports in long rather than short term and the better capacity of the Czech economy to correct deviations from the equilibrium.

Introduction

Growth models in CEE countries has based on a massive inflow of direct foreign investments, especially in manufacturing, from the onset of the transformation. This resulted in a substantial share of manufacturing goods in total exports and a high ranking of some CEE countries among the most industrialized economies in the world. Regarding the fact that CEE exports represent a major source of growth, positive net export is a sign of a high level of international competitiveness. Therefore, knowledge about the main determinants of net exports, especially at the level of individual sectors, seems to be crucial for creating an appropriate export-led growth strategy.

The studies identifying the determinants of manufacturing trade balance of CEE countries are scarce. The one which can be found is based on highly aggregated data and focuses on one chosen determinant, or concentrates on factors determining exchange with one chosen market. For this reason, the Authors want to fill the gap in the empirical literature on the determinants of CEE net exports. The Authors have decided to choose Poland and the Czech Republic, two leading economies among Central and East-European countries whose international competitiveness can be analysed in terms of their results in manufacturing. The empirical part of the article concentrates on 13 manufacturing sub-sectors and covers the period 1995–2011.

The structure of the paper is as follows. In the first part theoretical foundations of the relationship between the trade balance and its determinants have been presented. Next both data used in the analysis and the methodology of the research have been shown. In the subsequent part, the Authors present the results of the empirical analysis. The last part of the paper contains conclusions drawn from the conducted research.

Literature review

Domestic and foreign demand are the main determinants of net exports. The relationship between demand and trade balance can be found in the Porter's model of diamond (1990, p. 78) or in the Dixit–Stiglitz's model "love of diversity" (Dixit *et al*., 1977, pp. 297–308). The Authors' hypothesis is that high level of domestic demand does not help improve international competitiveness of manufacturing sectors, measured by trade balance, since it has a negative effect on the pace of exports growth and a positive effect on imports dynamics. Due to partial substitutability between sales on domestic and foreign markets, entrepreneurs want to compensate for the decrease of demand on the domestic market by selling abroad, and if the economic situation in their country is good, they focus on the domestic market, which is easier and they know it better. A negative relationship between the level of domestic demand and exports can be found is works of Sharma (2003, pp. 435–446). The relationship between exports and domestic demand can be positive. This can be due to the fact that some export-entrepreneurs do not limit their exports in times of high domestic demand on account of substantial prior investments they made to enter foreign markets. Due to a high level of import penetration ratio both in Polish and Czech manufacturing, we assume that the growth of domestic demand implies the import growth of manufacturing goods.

The Authors' hypothesis is that a high level of foreign demand fosters the positive trade balance. This hypothesis is based on the model of imperfect substitutes related to trade balance, put forward by Bahmani-Oskooee (1985, pp. 500–504). Additionally, Bahmani-Oskooee (1991, pp. 403–407) proposed substituting of trade balance measured as the difference between exports and imports with export-import quotient, which is also an approach taken by the Authors in this paper.

Price is an equally important determinant of international competitiveness. Literature overview made by Turner and Golub (1997, p. 7) indicates that in industrialized economies relative unit labour costs in industry (RULC) seem to be the best singular measure of cost/price competitiveness.

Relatively low labour mobility, in comparison with capital, and ongoing international fragmentation of production make the level of RULC become not only an important determinant of production localization but also of a trade balance (Deardorff, 1984, pp. 467–517). In Lewney's studies of manufacturing sector in 15 EU countries in 1998–2008 the decrease of RULC fostered the generation of positive trade balance in 10 countries, in 3 countries it negatively influenced this balance and in the remaining two RULC was a statistically unimportant variable (Lewney, 2011).

The level of innovation is yet another determinant of international competitiveness. In works by Vernon (1966, pp. 190–207) and Young (1991, pp. 369–405) innovations have a decisive influence on competitive advantage of a country on foreign markets. Also, in competitiveness models some economists posit a positive relationship between innovation and largely defined competitiveness of economy/sector (Porter, 1990, p. 75). In the light of the above, the Authors suspect that innovative sectors are net exporters rather than net importers and posit a claim that there is a positive relationship between innovation level and trade balance in manufacturing sub-sectors.

Another factor which influences the competitiveness of manufacturing sectors is their openness. In endogenous growth theories attention is paid to long-term advantages from trade openness i.e. more intensive technological transmission (Goldberg *et al*., 2008, pp. 24–31), faster implementation of new technologies and ideas (Rivera-Batiz *et al*., 1991, pp. 971–1001) and the specialization increase, via learning by doing (Young, 1991, pp. 369–405). In the light of the above, we posit a hypothesis that the openness of manufacturing sector fosters competitiveness measured by trade balance.

Labour productivity is another factor whose influence on trade balance the Authors aim to verify. Theoretical positive impact of productivity on export growth is found in new trade theories (Melitz, 2003, pp. 1695–1725; Melitz & Ottawiano, 2008, pp. 295–316). Both of the models assume that only companies with the highest productivity are capable of entering and competing on export markets and their activity on foreign markets leads to their expansion. Empirical verification of this relationship based on Melitz model can be found in works of Wagner (2008, pp. 169–180) and Bustos's analysis (2011, pp. 304–40).

Summin up, the Authors aim to analyse to what extent the size of foreign demand, the size of domestic demand, the level of relative unit labour costs, the level of innovation intensity, sector openness to foreign markets and labour productivity in a sector influence the international competitiveness of Polish and Czech manufacturing sectors measured by foreign trade balance.

Research methodology and data description

Before evaluating the international competitiveness of the manufacturing sector in the Czech Republic and Poland, we assess the stationarity of the variables used in the analysis and the co-integration between them. To evaluate the stationarity of panel data, we employ three panel unit root tests: the Breitung test (Breitung, 2000, pp. 161–177) and the Im-Pesaran-Shin test (Im *et al*., 2003, pp. 53–74) — which are based on the assumption of sectional independency; and the test proposed by Pesaran (2007, pp. 265–312), which allows for cross-sectional correlation.

When the non-stationarity of the variables is confirmed, then the co-integration procedure can be applied to test for a long-run relationship between the exports to imports ratio and its determinants. For this purpose, we use the Engle–Granger (1987, pp. 251–276) procedure. To assess panel co-integration, two Pedroni test statistics — panel-t statistic and group-t statistic (Pedroni, 1999, pp. 653–670) are used.[1] When we confirm co-integration between variables then, according to Granger's representation theorem, analysed regressions can be presented as an error correction model (ECM).

In the light of the current research on estimators which are appropriate for non-stationary panel data and in the context of our sample size, in the first step co-integration vector parameters are obtained with a DOLS estimator (Kao & Chiang, 2000, pp. 179–222). The starting point in Kao and Chiang's approach is a fixed effects model:

$$y_{it} = \alpha_i + x'_{it}\beta + \varepsilon_{it}\,, \tag{1}$$

where x_{it} is integrated of order one:

$$x_{it} = x_{i,t-1} + \xi_{it}\,. \tag{2}$$

If all Kao and Chiang's additional assumptions are met, then ε_{it} is expressed as follows:

$$\varepsilon_{it} = \sum_{-\infty}^{\infty} c_{ij}\xi_{i,t+j} + \nu_{it}\,. \tag{3}$$

The error terms ξ_{it} and ν_{it} are not correlated simultaneously and are not correlated for all lags and leads either. The lags and leads are usually lim-

[1] In comparision to Pedroni's tests, tests developed by Westerlund (2007) perform better both in power and size. The discrepancies are caused by the absence of common-factor restriction in Westerlund's test. In the case of our sample size the use of Westerlund's tests is strongly hampered.

ited to $\langle -q,q \rangle$ due to the assumption of c_{ij} being absolutely summable. Combining (1), (2) and (3), we obtain the DOLS regression, which allows endogeneity to be removed by using the lag and lead values of Δx_{it} as additional regressors of y:

$$y_{it} = \alpha_i + x'_{it}\beta + \sum_{j=-q}^{q} c_{ij}\Delta x_{i,t+j} + v_{it} . \tag{4}$$

In the next step, DOLS residuals are used to estimate error correction models.

From the point of view of this analysis, SUR estimation seems to be an interesting approach. It allows heterogeneous coefficients for each subsector to be obtained. In the case of non-stationary data, Mark *et al*. (2005, pp. 797–820) propose a DSUR estimator. Its construction is similar to the DOLS estimator with endogeneity controlled by introducing the lags and leads of Δx_{it}, which come from the whole system. Starting with regression (1) and x_{it} described as (2) we assume that:

$$z'_{qit} = \left(\Delta x'_{i,t-q},\ldots,\Delta x'_{i,t+q}\right), \qquad z'_{qt} = (z'_{q1t},\ldots,z'_{qNt}) . \tag{5}$$

Then, the DSUR regression looks as follows:

$$y_{it} = x'_{it}\beta_i + z'_{qt}\delta_{qi} + v_{it} . \tag{6}$$

Introducing additional factors into the equation substantially reduces the degrees of freedom, which is why the DSUR estimator is recommended for panels with large T. Our sample size forces us to abandon DSUR and to focus on the ordinary SUR approach, remembering that in such a case standard errors are biased.

As we mentioned in introduction, we choose Poland and the Czech Republic as leading economies among CEE countries according to their large shares of manufacturing goods in total exports (exceeding 3/4) and a high ranking positions among the most industrialized economies in the world.

The data are taken from the STAN OECD database and the WIOD database (Timmer *et al.*, 2015, pp. 575–605). We divide the whole manufacturing sector into subsectors according to NACE 1.1. Due to lack of available data for all 14 subsectors, we combine subsector DB (manufacture of textiles and textile products) and subsector DC (manufacture of leather and leather products). Finally, we examine 13 manufacturing subsectors using balanced panel data for the period 1995–2011.[2] The details of the dataset are presented in Table 1.

Empirical results

According to the methodology described in the previous section, our empirical analysis begins with assessment of the panel unit root.[3]

For the Czech Republic results indicate that all the variables are stationary in first differences. The unit root tests applied to the Polish manufacturing sector indicate that the first differences of L_NEX, L_FD, L_FDDD are stationary. For the selected variables (logarithms of DD, RULC, OPEN, LPRO and INNO) the additional Fisher tests are computed. The results confirm non-stationarity of all the variables apart from R&D expenditure (INNO).

The next step in our analysis is devoted to co-integration analysis. The regressions contain non-stationary variables only. We use two kinds of model for both of the countries. The first model takes the logarithm of DD and the logarithm of FD separately into account, whereas the second uses a demand variable constructed as the relation of FD to DD (L_FDDD).

All the tests reject the null of no co-integration, for both countries and both types of model.[4] According to Granger's representation theorem, this means that all the regressions can be presented as an ECM.

In order to estimate ECM, we apply a two-step Engle-Granger procedure. In the first step, we use the DOLS estimator. The number of leads and lags is chosen on the basis of SIC. All the regressions contain individual effects and a deterministic trend. In the second step, DOLS residuals are used to estimate ECM. In the case of Poland, the level of L_INNO which is not taken into account in the long-run regressions due to its stationarity is added to the estimated regressions.

The results of estimated share models for the Czech Republic and Poland are reported in Table 2.

[2] A new complete WIOD database release 2016 (WIOD Tables and Socio-Economic Accounts), has been available since February 2018, however because it covers the period 2000-2014 (T=15) and divides manufacturing sector C into 19 sub-sectors (N=19) the SUR approach cannot be employed. The SUR system requires N<T, that is why we decided to use the previous version of WIOD database.

[3] The results are obtainable upon request.

[4] The results are obtainable upon request.

In the short term, few variables are statistically important in accounting for the trade balance of the manufacturing sector of the chosen economies. We consider that this is due to the specificity of the trade balance, which is a transaction system in foreign trade. In the short term, this implies a lack of influence of both demand factors. Only at the 0.1 significance level and exclusively for Polish manufacturing is a negative effect of domestic demand observed. This is probably due to a high level of the import penetration ratio in Polish manufacturing, in which a substantial part of growing domestic demand is satisfied by commodity imports rather that domestic production. In addition, the non-significance of investment in R&D (L_INNO) in the short term for the trade balance in Polish and Czech manufacturing is probably due to the specificity of the implementation process of each innovation type, i.e. a long time between the R&D investment stage and the export growth stage. On the other hand, labour productivity and trade openness turn out to be significant and have a positive influence on phenomenon both in Polish and Czech manufacturing. A decrease in RULC in the short term also fosters generation of a positive trade balance.

In the long term, the vast majority of the determinants significantly account for the level of the trade balance, and the force of their impact is much stronger in the long rather than the short term, especially for Poland. The growth of domestic demand positively influences the manufacturing trade balance of both economies. This may be due to the fact that there is a large number of specialized exporters among the exporters of manufacturing goods and the intensity of their exports does not rely so heavily on changes in domestic demand, as is the case for non-specialized exporters.[5] Growing foreign demand supports generate a positive trade balance, yet the power of its impact is greater for the Polish than for the Czech industry.

The key element which determines the positive trade balance is a decrease in RULC. Its influence on the trade balance is substantially greater in Poland than in the Czech Republic. This may indicate a domination of a price competition strategy in export markets among Polish and Czech manufacturing exporters. Similarly, a growth in trade openness strongly and positively influences the phenomenon. Moreover, R&D investment in the Czech economy, which is insignificant in the short term, helps generate a positive trade balance for the Czech manufacturing in the long term. Another important variable which substantially influences the generation of a positive trade balance is a productivity increase. The results of the estimations for Polish manufacturing help to confirm the thesis positing a positive

[5] In 2008, 74.3 % of all Polish specialized exporters were in the manufacturing sector (MG, 2010).

influence of a productivity increase on export intensification, and by the same token on net exports. However, in the model estimated for the Czech economy, productivity is statistically insignificant. For this reason, we decide to make some changes. Because of the explanatory variable, which is the export and import quotient, relative demand is included in the model. This is the relationship between foreign demand mainly influencing exports and domestic demand influencing imports. The results for the new model are presented in Table 3.

In the new model, all the explanatory variables are statistically important in explaining the variation of the net exports of the manufacturing sector in both economies, both for the short term (except for FDDD in the Czech Republic) and the long term. The impact of the variables used is substantially greater for the long term. The influence of demand factors measured by relative demand is similar in both economies for the long term. The key elements which are decisive in generating a positive trade balance in the Polish and the Czech industry are: trade openness, unit labour costs and labour productivity. The estimated size of the parameter λ, which determines the pace of adaptation of the variables to long-term equilibrium, indicates that the Czech economy has a better capacity to correct those deviations.

It may be interesting to see how the trade balance, divided into different manufacturing sub-sectors, reacts to its determinants. To see this, we propose a model which allows heterogeneous parameters for each sub-sectors to be obtained. On account of the fact that R&D investment turns out to be insignificant in the joint model for Poland, and because of its low level of variation, it is omitted in the sector model for Poland. The results of estimation are shown in Table 4 for Poland and in Table 5 for the Czech Republic. In these tables, the sectors are sorted in diminishing order, according to sector's share of the entire exports of manufacturing commodities in 2011.

Labour productivity is an equally crucial factor in explaining net exports of particular sub-sectors of Polish manufacturing. In a vast majority of the sub-sectors, an increase in this factor fosters the generation of an export/import surplus. The increase in productivity has the biggest impact on the trade balance in the following sub-sectors: machinery, metal, paper, wood, electro-optics, and transport.

In two sub-sectors (textiles and chemicals) a decrease in labour productivity fosters the generation of a positive trade balance, which is an unexpected result. It must be remembered, however, that labour productivity is only a part of productivity as a whole, and the chemical industry is at the same time very capital intensive and not so labour-intensive. In the model analysed, only 31% of the variation in net exports can be explained.[6] This may indicate the existence of important determinants for this sub-sector which are not included in the model.

The importance of cost factors is much smaller than the importance of demand and labour productivity. This is because in three sub-sectors which have the biggest shares of total manufacturing net exports the RULC are statistically unimportant. In only four sub-sectors in the short term and in six sub-sectors in the long term does a decrease in unit labour costs foster the generation of a positive trade balance. The decrease in RULC influences the increase in net exports the most in the paper, minerals and furniture sub-sectors. On the other hand, the chemical sub-sector is the only sector in which an increase in RULC fosters the growth in net exports both in the short and long term. This may be due to increasing quality of the goods exported connected with higher costs, and the large gap which still exists between the levels of unit labour costs in Poland and Germany (the reference country) not having a negative effect on export intensity, or by the same token on the trade balance for chemical products.

Growing trade openness substantially influences generation of a positive trade balance in as many as 8 of the 13 sub-sectors in the long term and in 7 of the 13 sub-sectors in the short term. This influence is the strongest in the minerals, chemical, gum, paper, food, and transport sub-sectors. For two sub-sectors (textiles and metals), increasing trade openness is a key factor negatively influencing the value of net exports.

In our model, in majority of the sub-sectors, three or more explanatory variables are statistically important, which is believed to be a satisfactory result. Similarly, the values of the coefficients of determination for the particular sub-sectors (except for electro-optics and textiles) indicate a satisfactory matching of the model, and negative λ indicators ranging from -0.19 to -1.02 show the stability of the model.

Analysing the net exports for the Czech sub-sectors (Table 5) in only four of them in both the short and long term does an increase in relative demand foster the growth of net exports. However, in food, coke and oil refinement, chemicals, and — crucially because of their share of total exports — transport and machinery in the long term positive net exports are generated when the relative demand decreases. This indicates a strong independence of these sub-sectors from the economic situation in foreign markets, because an export/import surplus in these sub-sectors can be achieved even in a situation when foreign demand is weaker than domestic demand.

[6] The results are obtainable upon request.

Relative unit labour costs heavily determine the trade balance in Czech manufacturing sub-sectors. This may indicate a domination of a price strategy as a competition tool in foreign markets among the Czech exporters of manufacturing goods, a strategy which, given the positive trade balance in Czech manufacturing from 2002, turns out to be effective. The strongest influence of RULC can be seen in the long term in the Czech chemical and transport industries.

An increase in trade openness, as in Poland, supports net exports. Importantly, in the electro-optics, transport and machinery sub-sectors — the sectors with the biggest share of the Czech trade balance — the importance of this variable is much more visible than is the case in the Polish sub-sectors dominating the export of manufacturing goods. Interestingly, both in Czech and Polish manufacturing of textiles and metal, an increase in trade openness has a negative influence on the generation of positive net exports.

Labour productivity plays a key role in explaining net exports in a much smaller number of Czech manufacturing sub-sectors than is the case in the Polish economy. However, in transport and machinery which have the biggest share in Czech manufacturing exports — productivity growth positively influences net exports. Nonetheless, the influence of labour productivity on net exports in the most important export sub-sectors is much stronger in the Polish than in the Czech economy.

Innovation is only introduced in the model for the Czech economy because of its degree of integration. It has the biggest influence on net exports in chemicals, textiles, transport and coke and oil refinement both in the short and long term. These results are not surprising because in the majority of EU countries (including the Czech Republic) every year the biggest domestic and foreign investors in R&D are companies in the chemical, pharmaceutical and car industries. On the other hand, in the textile sub-sector high prices and the income elasticity of textile products is an incentive for enterprises to increase investment in R&D to vary their product range.

Discussion

This study has examined the role of selected determinants in net export growth of the Polish and Czech manufacturing. Our study, which focuses on trade balance as the narrow competiveness measure is rather unique, but its results can be related to other analyses of CEE exports or CEE trade competitiveness.

This analysis shows that Czech and Polish positive trade balance in manufacturing sector is strongy detremined by the relative demand growth. These conclustion is in line with the results of other CEE export determiants analysis (Golik *et al*., 2014, p. 25), which confirmes that the growing demand from the CEE trading partners boosts activity in the industrial sector and accelerates exports growth in this sector. This is probably connected with the inclusion of the CEE countries in the European and global value chains. CEE exports are dominated by intra-GVC demand, which implies strong position of the CEE conutries in the GVCs as the supplier of machinery and transport equipment. However, in our additional analysis based on sub-sectors data we found that a positive trade balance in some Polish and Czech manufacturing sectors was achived even when a relative demand decreased. So, we recommend some further in-depth analyses of the role of the demand in generating a positive trade balance with the use of highly disaggregated data.

We also have found a confirmation of the prominent role of labour productivity in determining positive trade balance in CEE coutries, especially in Polish manufacturing sectors. Our results are consistent with Cieślik *et al*. (2018, pp. 4–22) micro analysis for CEE economies, indicating that the probability of exporting in CEE countries is strongly and positively related to the level of labour productivity.

Except for the productivity gap between CEE countries and their trade partners, labor costs are also still competitive (especially to the developed countries), in CEE economies. However, at the same time wages are growing quickly and CEE government policies are raising minimum wages faster than an averaged labour productivity. All of this can diminish the importance of cost factors in generating a positive trade balance of the CEE countries analyzed. Our analysis shows that price/cost competitiveness was much more important for a trade balance growth in the Czech manufacturing sectors comapared to the Polish economy. A study by Bierut and Kuziemska-Pawlak (2017, pp. 522–542) also comfimed that the CEE growth of exports could be even irrespective of ULC movements. We state that gains in non-price competitiveness should be considered vital for the CEE region to compete successfully in international markets in the long run.

In our study, we also try to assess the impact of innovative inputs (R&D spending) on trade balance performance in Polish and Czech manufacturing sectors. In developed OECD countries R&D spending has shown positive effects on trade competitiveness of the manufacturing sector (Guarascio *et al*., 2016, pp. 869–905). For a sample of selected CEE countries in our and in other study (Vrh, 2018, pp. 645–663) these results are not confirmed.

This probably results from the 'time-lag' issue beetwen investement in R&D and effects (Rivera Leon *et al*., 2011, p. 93), still an unsatisfactory innovation performance of CEE countries (EC 2017) and low capabilites of CEE contries to convert its excelent improvement in scholary outputs into higher capacities in innovations (Karo & Kattel, 2015, pp. 172–187). It could be also the problem of a low variability of R&D spending on sectoral level, because in the newest analysis of CEE export determinants (Cieślik & Michałek, 2018, pp. 982–996), based on firm data a R&D spending become one of the most important factors supporing direct and indirect exports of CEE countries.

To sum up, our research shows the need for further, more detailed research that would be based on highly disaggregated data from the manufacturing sectors.

Conclusions

For many CEE countries export represents a major source of growth, so positive net exports could be a measure of their level of international competitiveness. Therefore, knowledge about the main determinants of net exports, especially at the level of individual sectors, seems to be crucial for creating an appropriate export-led growth strategy.

The aim of this study has been to fill the gap in the empirical literature on the determinants of CEE's net exports. This paper has added to the few existing empirical works by specifying the net export performance equation not only as a function of foreign demand and price or cost factors, as is done traditionally, but also of the size of domestic demand, the level of innovation intensity, the level of openness to foreign markets and labour productivity. Our new approach is also based on employing an error correction model to disaggregated sectoral manufacturing data.

The results of the estimation help confirm an influence of increasing relative demand, increasing productivity and trade openness on the generation of a positive trade balance both in the Polish and Czech manufacturing. Moreover, in both countries positive net exports are vulnerable to unit labour cost decreases. They also contribute to the better capacity of the Czech economy to correct deviations from the equilibrium in one period of time.

Despite many similarities between the potentials of Polish and Czech manufacturing, different sub-sectors have different shares in the trade balance or in value added generation, and there is also a different network of relationships between them. This led us to estimate a model which allows the importance of each determinant for each sub-sector to be evaluated. The results show substantial differences in the roles particular variables play in explaining the net exports. In both economies and in a majority of sub-sectors generation of a positive trade balance is determined by an increase in relative demand. However, some sub-sectors are capable of positive net export generation when relative demand is decreasing. Increasing productivity strongly influences a positive trade balance in a majority of the Polish sub-sectors, while in the Czech sub-sectors the key role is played by decreasing unit labour costs. Trade openness significantly helps the generation of positive net exports in a large number of both Polish and Czech sub-sectors, but in the key export sectors its influence is stronger in the Czech Republic. Investment in R&D turns out to be important both in the short and long term in sectors with high levels of investment in R&D (chemical and transport) only in the model used for the Czech economy.

The results of this research should be regarded as a basis for subsequent studies and should undergo further verification. We hope, however, that the results of the estimations will contribute to the discussion on the instruments which can help enhance the competitiveness of particular sub-sectors of manufacturing. The analysis conducted has shown that the influence of particular factors is different in each sub-sector, and, more importantly, that there are different key factors fostering the generation of a positive trade balance. The fact that positive trade balance generation in manufacturing is a key priority in the Czech strategy for export growth for 2012–2020 shows its importance.

The current study has two main shortcomings which should be addressed. First, because of time limit in the project, this research was conducted for two CEE countries (Poland and the Czech Republic). Therefore, to generalize the results for a whole group of CEE economies (which is interesting), the study should have involved more CEE countries in the sample. Second, the analyses have been conducted on the basis of gross trade data (not in value added terms). The large importance of global value chains in CEE's manufacturing export might affect to the final results.

For further research, due to our a priori knowledge of how the relationships between the phenomenon investigated and the determining factors chosen are formed, together with the sample size, the use of Bayesian estimation for the analysis is worth considering. Once the data is available, further estimation of the models for a longer time series would be desirable.

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Annex

Table 1. Details of the dataset

Variable Name	Variable Description	Source of the Data
L_NEX	logarithm of ratio of export goods value (million USD) to import goods value (million USD)	STAN OECD
L_FD	logarithm of unweighted sum of the final consumption expenditure of households, non-profit organizations serving households and government, fixed capital formation and changes in inventories and valuables from 39 countries* (million USD)	WIOD
L_DD	logarithm of sum of the final consumption expenditure of households, non-profit organizations serving households and government, fixed capital formation and changes in inventories and valuables (million USD)	WIOD
L_RULC	logarithm of ratio of national unit labour cost to unit labour cost in Germany – unit labour cost is the ratio of the sum of wages and salaries (million USD) to gross value added (USD)	WIOD
L_OPEN	logarithm of ratio of export goods value (million USD) to gross value added (million USD)	STAN OECD WIOD
L_INNO	logarithm of R&D expenditure (million USD)	STAN OECD
L_LPRO	logarithm of ratio of production (million USD) to total hours worked	WIOD

Note: to calculate FD for Poland date from 40 WIOD countries excluding Poland are taken. To calculate FD for the Czech Republic we take the same group of countries excluding the Czech Republic.

Table 2. Czech and Polish shared model – ECM results

	short-run elasticities			long-run elasticities	
	Czech Republic	Poland		Czech Republic	Poland
Δ L_DD	-0.005	-0.058*	L_DD	0.045**	0.086**
	(0.017)	(0.033)		(0.022)	(0.035)
Δ L_FD39	-0.061	-0.172	L_FD39	0.089*	0.392***
	(0.076)	(0.107)		(0.053)	(0.117)
Δ L_RULC	-0.110***	-0.053*	L_RULC	-0.146***	-0.958***
	(0.024)	(0.032)		(0.030)	(0.083)
Δ L_OPEN	0.298***	0.324***	L_OPEN	0.198***	0.496***
	(0.048)	(0.064)		(0.052)	(0.074)
Δ L_INNO	0.003	0.006[1)]	L_INNO	0.044***	-
	(0.012)	(0.015)		(0.014)	-

Table 2. Continued

	short-run elasticities			long-run elasticities	
	Czech Republic	Poland		Czech Republic	Poland
Δ L_LPRO	0.183***	0.123**	L_LPRO	0.009	0.529***
	(0.048)	(0.059)		(0.055)	(0.080)
λ	-0.790***	-0.479**			
	(0.121)	(0.215)			
R^2_{ECM}	0.517	0.363			

Note: Standard errors in parenthesis; 1) in the ECM for Poland the logarithm of R&D expenditure (L_INNO) is considered as the I(0) variable.
* - significant at the 0.1 level, **- significant at the 0.05 level, ***- significant at the 0.01 level.

Table 3. Czech and Polish shared model (with relative demand variable) – ECM results

	short-run elasticities			long-run elasticities	
	Czech Republic	Poland		Czech Republic	Poland
Δ L_FDDD	0.001	0.089***	L_FDDD	0.073***	0.109***
	(0.018)	(0.032)		(0.020)	(0.039)
Δ L_RULC	-0.103***	-0.059*	L_RULC	-0.123***	-0.261**
	(0.026)	(0.031)		(0.016)	(0.104)
Δ L_OPEN	0.284***	0.355***	L_OPEN	0.177***	0.337***
	(0.054)	(0.060)		(0.025)	(0.061)
Δ L_INNO	0.001	0.009[1)]	L_INNO	0.021**	-
	(0.013)	(0.016)		(0.008)	
Δ L_LPRO	0.170***	0.141**	L_LPRO	0.089***	0.207**
	(0.048)	(0.054)		(0.026)	(0.103)
λ	-0.771***	-0.548***			
	(0.221)	(0.078)			
R^2_{ECM}	0.44	0.44			

Note: Standard errors in parenthesis; 1) in the ECM for Poland the logarithm of R&D expenditure (L_INNO) is considered as the I(0) variable.
* - significant at the 0.1 level, **- significant at the 0.05 level, ***- significant at the 0.01 level.

Table 4. ECM results for Polish net exports decomposed by manufacturing sectors

	short-run elasticities					long-run elasticities			
	Δ L_FDDD	**Δ L_RULC**	**Δ L_OPEN**	**Δ L_LPRO**	**λ**	**L_FDDD**	**L_RULC**	**L_OPEN**	**L_LPRO**
DM	0.098**	0.154	0.715***	-0.169	-0.762***	0.086*	0.196	0.355***	0.272**
	(0.042)	(0.133)	(0.149)	(0.266)	(0.126)	(0.049)	(0.181)	(0.117)	(0.126)
DL	0.139***	-0.080	0.173**	0.237**	-0.189	0.132**	0.018	0.238***	0.292**
	(0.043)	(0.083)	(0.071)	(0.109)	(0.201)	(0.066)	(0.082)	(0.080)	(0.145)
DJ	0.352***	-0.061	-0.226***	0.315***	-0.997***	0.683***	0.092	-0.582***	0.514***
	(0.051)	(0.077)	(0.082)	(0.073)	(0.099)	(0.099)	(0.092)	(0.116)	(0.098)
DA	0.036	0.249**	0.556***	-0.074	-0.901***	-0.230***	-0.096*	0.384***	-0.025
	(0.050)	(0.099)	(0.057)	(0.085)	(0.126)	(0.051)	(0.058)	(0.050)	(0.041)
DG	0.555***	0.252***	0.735***	0.144***	-1.020***	0.644***	0.465***	0.683***	-0.096***
	(0.032)	(0.042)	(0.034)	(0.045)	(0.106)	(0.026)	(0.046)	(0.041)	(0.036)
DK	0.209***	-0.149	-0.052	0.486***	-0.933***	0.169***	-0.172**	0.076	0.597***
	(0.063)	(0.097)	(0.146)	(0.135)	(0.174)	(0.052)	(0.080)	(0.094)	(0.081)
DH	0.179***	-0.010	0.515***	0.197**	-0.720***	0.120***	-0.060	0.585***	0.297***
	(0.018)	(0.062)	(0.052)	(0.076)	(0.124)	(0.012)	(0.040)	(0.029)	(0.030)
DN	-0.047	-0.446***	0.164	-0.107	-0.654***	0.082	-0.257*	0.163	-0.037
	(0.055)	(0.130)	(0.122)	(0.085)	(0.137)	(0.085)	(0.137)	(0.117)	(0.082)
DF	-0.222	-0.055	0.247**	0.258***	-0.916***	-0.644***	-0.103**	-0.178	-0.026
	(0.174)	(0.043)	(0.107)	(0.080)	(0.105)	(0.210)	(0.052)	(0.159)	(0.070)
DB.DC	0.064**	-0.014	-0.156	-0.151*	-0.563***	0.090***	-0.017	-0.710***	-0.342***
	(0.027)	(0.059)	(0.106)	(0.080)	(0.141)	(0.027)	(0.062)	(0.079)	(0.024)
DE	0.458***	-0.213***	0.296***	0.502***	-0.533***	0.197**	-0.323***	0.442***	0.533***
	(0.096)	(0.076)	(0.090)	(0.114)	(0.135)	(0.079)	(0.077)	(0.057)	(0.087)

Table 4. Continued

	short-run elasticities					long-run elasticities			
	Δ L_FDDD	Δ L_RULC	Δ L_OPEN	Δ L_LPRO	λ	L_FDDD	L_RULC	L_OPEN	L_LPRO
DI	0.204***	-0.412***	0.743***	0.437**	-0.964***	0.189***	-0.315***	1.062***	0.191**
	(0.050)	(0.134)	(0.103)	(0.193)	(0.195)	(0.046)	(0.083)	(0.095)	(0.081)
DD	0.417***	-0.250***	0.171	0.395***	-0.691***	0.649***	0.133	-0.153	0.396***
	(0.055)	(0.071)	(0.116)	(0.082)	(0.120)	(0.090)	(0.127)	(0.142)	(0.127)

Note: Standard errors in parenthesis, * - significant at the 0.1 level, **- significant at the 0.05 level, ***- significant at the 0.01 level.

Table 5. ECM results for Czech net exports decomposed by manufacturing sectors

	short-run elasticities						long-run elasticities				
	Δ L_FDDD	Δ L_RULC	Δ L_OPEN	Δ L_LPRO	Δ L_INNO	λ	L_FDDD	L_RULC	L_OPEN	L_LPRO	L_INNO
DL	0.044**	-0.050	0.561***	0.334***	-0.089***	-0.439***	-0.058	-0.040	0.705***	0.019	-0.073
	(0.021)	(0.082)	(0.061)	(0.083)	(0.031)	(0.077)	(0.035)	(0.157)	(0.055)	(0.072)	(0.057)
DM	0.005	-0.262***	0.595***	-0.0003	0.067*	-0.703***	-0.137***	-0.250***	0.503***	0.070***	0.154***
	(0.054)	(0.037)	(0.062)	(0.051)	(0.040)	(0.169)	(0.036)	(0.042)	(0.058)	(0.026)	(0.041)
DK	-0.143***	-0.406***	0.749***	-0.030	0.033	-1.061***	-0.143***	-0.156*	0.728***	0.146**	0.040
	(0.033)	(0.109)	(0.128)	(0.129)	(0.048)	(0.169)	(0.031)	(0.090)	(0.098)	(0.072)	(0.050)
DJ	0.161***	-0.146***	-0.341***	-0.089	0.160***	-1.220***	0.108***	-0.169***	-0.243***	-0.024	0.075
	(0.128)	(0.041)	(0.067)	(0.063)	(0.037)	(0.169)	(0.038)	(0.062)	(0.056)	(0.080)	(0.049)
DG	-0.073***	-0.214**	0.353***	-0.153	0.145*	-0.753***	-0.050*	-0.373***	0.336***	-0.145	0.330***
	(0.016)	(0.097)	(0.108)	(0.095)	(0.075)	(0.158)	(0.027)	(0.056)	(0.109)	(0.107)	(0.103)
DH	0.032**	-0212***	0.200***	0.188***	-0.001	-1.066***	-0.020	-0.187***	0.181***	0.211***	0.018
	(0.015)	(0.048)	(0.066)	(0.062)	(0.012)	(0.118)	(0.023)	(0.050)	(0.064)	(0.030)	(0.016)
DN	-0.037*	-0.018	-0.110*	-0.052	-0.106***	-0.916***	-0.027	-0.140**	0.249***	-0.036	-0.100***
	(0.021)	(0.038)	(0.060)	(0.064)	(0.009)	(0.082)	(0.036)	(0.064)	(0.046)	(0.036)	(0.017)

Table 5. Continued

	short-run elasticities						long-run elasticities				
	Δ L_FDDD	Δ L_RULC	Δ L_OPEN	Δ L_LPRO	Δ L_INNO	λ	L_FDDD	L_RULC	L_OPEN	L_LPRO	L_INNO
DB,DC	-0.028	-0.435***	0.055	0.208*	0.158***	-0.900***	0.071*	-0.143	-0.664***	-0.245***	0.175***
	(0.035)	(0.103)	(0.175)	(0.122)	(0.024)	(0.142)	(0.040)	(0.093)	(0.104)	(0.041)	(0.035)
DA	-0.178**	-0.152***	0.116	-0.118	0.076***	-1.323***	-0.219***	-0.082	0.218***	-0.258***	0.031
	(0.069)	(0.053)	(0.089)	(0.110)	(0.022)	(0.218)	(0.074)	(0.052)	(0.075)	(0.042)	(0.024)
DE	0.148***	0.085	0.149	-0.024	0.023***	-1.111***	0.208***	0.130***	0.210***	0.216***	0.029***
	(0.050)	(0.052)	(0.093)	(0.072)	(0.008)	(0.176)	(0.042)	(0.045)	(0.054)	(0.033)	(0.006)
DI	-0.007	-0.124	0.574***	0.070	-0.036	-0.280	0.050*	0.015	0.486***	-0.075	-0.095***
	(0.022)	(0.108)	(0.129)	(0.122)	(0.028)	(0.190)	(0.028)	(0.107)	(0.138)	(0.060)	(0.033)
DF	-0.789***	-0.197***	0.245***	0.200***	0.195***	-1.194***	-0.774***	-0.190***	0.051*	0.030	0.118**
	(0.073)	(0.016)	(0.061)	(0.050)	(0.043)	(0.146)	(0.127)	(0.024)	(0.031)	(0.045)	(0.057)
DD	-0.009	-0.113**	0.422***	0.197**	-0.031***	-0.433***	-0.063	-0.067	0.188	-0.187	-0.0005
	(0.013)	(0.047)	(0.098)	(0.083)	(0.010)	(0.069)	(0.046)	(0.120)	(0.230)	(0.117)	(0.036)

Note: Standard errors in parenthesis, * - significant at the 0.1 level, **- significant at the 0.05 level, ***- significant at the 0.01 level.