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Working Paper

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Institute of Economic Research Working Papers, No. 46/2017

Provided in Cooperation with:

Institute of Economic Research (IER), Toruń (Poland)

Suggested Citation: Olczyk, Magdalena; Kordalska, Aleksandra (2017) : Determinants of Net Exports in Polish and Czech Manufacturing: A Sectoral Approach with Error Correction Model, Institute of Economic Research Working Papers, No. 46/2017, Institute of Economic Research (IER), Toruń

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Institute of Economic Research Working Papers

No. 46/2017

**DETERMINANTS OF NET EXPORTS IN POLISH
AND CZECH MANUFACTURING:
A SECTORAL APPROACH WITH ERROR
CORRECTION MODEL**

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Article prepared and submitted for:

9th International Conference on Applied Economics Contemporary Issues in Economy, Institute of Economic Research, Polish Economic Society Branch in Toruń, Faculty of Economic Sciences and Management, Nicolaus Copernicus University, Toruń, Poland, 22-23 June 2017

Toruń, Poland 2017

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Determinants of Net Exports in Polish and Czech Manufacturing: A Sectoral Approach with Error Correction Model

JEL Classification: *F40; C23; F14; O14; L60*

Keywords: *CEE economies; net exports; international competitiveness; manufacturing; error correction mode*

Abstract

Research background: Growth model 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 position of some CEE countries among the most industrialized economies in the world.

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.

Methodology/methods: Our approach is based on employing an error correction model and SURE 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

CEE exports represent a major source of growth, so positive net exports 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 researches identifying the determinants of manufacturing trade balance of CEE countries are scarce. For this reason authors want to fill the gap in the empirical literature on the determinants of CEE net exports, based on Poland and the Czech Republic, two leading economies among Central and East-European. 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. The next section presents both data used in the analysis and the methodology of the research. 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.

Research Methodology and Data Description

Before evaluating the international competitiveness of the manufacturing sector in the Czech Republic and Poland, first we test non-stationarity of the variables using the Breitung test (Breitung, 2000), the Im-Pesaran-Shin test (Im et al., 2003) and Pesaran test (2007). Second, we verify the cointegration between variables by using two Pedroni test statistics – panel-t statistic and group-t statistic (Pedroni, 1999).

If the cointegration between variables is confirmed, according to Granger's representation theorem, analysed regressions can be presented as an error correction model (ECM).

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

$$y_{it} = \alpha_i + x_{it}'\beta + \varepsilon_{it}, \quad (1)$$

where x_{it} is integrated of order one:

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

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

$$\varepsilon_{it} = \sum_{-\infty}^{\infty} c_{ij} \xi_{i,t+j} + v_{it} . \quad (3)$$

The error terms ξ_{it} and v_{it} are not correlated simultaneously and are not correlated for all lags and leads either. The lags and leads are usually limited 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 :

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

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) 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:

$$z'_{qit} = (\Delta x'_{i,t-q}, \dots, \Delta x'_{i,t+q}), \quad z'_{qt} = (z'_{q1t}, \dots, z'_{qN_t}) . \quad (5)$$

Then, the DSUR regression looks as follows:

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

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.

The data are taken from the STAN OECD database and the WIOD database (Timmer, 2015). 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. The details of the dataset are presented in Table 1.

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.

Source: own elaboration.

Empirical results

According to the methodology described in the previous section, our empirical analysis begins with assessment of the panel unit root for all the variables and the cointegration analysis.¹ All the results allow us 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.

The results of estimated shared models for the Czech Republic and Poland are reported in Table 2. Because of the explanatory variable, which is the export and import quotient, relative demand (FDDD) is included in the model. This is the relationship between foreign demand mainly influencing exports and domestic demand influencing imports.

¹ The results are obtainable upon request. The results confirm non-stationarity of all the variables apart from R&D expenditure (INNO) and cointegration between variables.

Table 2. Czech and Polish shared model (with relative demand variable) – ECM results

	short-run elasticities			long-run elasticities	
	Czech Republic	Poland		Czech Republic	Poland
ΔL_FDDD	0.001	0.089***	L_FDDD	0.073***	0.109***
	(0.018)	(0.032)		(0.020)	(0.039)
ΔL_RULC	-0.103***	-0.059*	L_RULC	-0.123***	-0.261**
	(0.026)	(0.031)		(0.016)	(0.104)
ΔL_OPEN	0.284***	0.355***	L_OPEN	0.177***	0.337***
	(0.054)	(0.060)		(0.025)	(0.061)
ΔL_INNO	0.001	0.009 ¹⁾	L_INNO	0.021**	-
	(0.013)	(0.016)		(0.008)	
ΔL_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.

Source: own calculations.

In the 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 Polish and 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 these deviations.

Table 3 ECM results for Polish net exports decomposed by manufacturing sectors

	short-run elasticities				λ	long-run elasticities			
	ΔL_FDDD	ΔL_RULC	ΔL_OPEN	ΔL_LPRO		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)
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.

Source: own calculations.

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 3 for Poland and in Table 4 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.

The results in Table 3 and Table 4 show substantial differences in the roles particular variables play in explaining the net exports. In both economies and in 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 the majority of the Polish sub-sectors, while in the Czech sub-sectors a 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.

Table 4 ECM results for Czech net exports decomposed by manufacturing sectors

	short-run elasticities					λ	long-run elasticities				
	ΔL_FDDD	ΔL_RULC	ΔL_OPEN	ΔL_LPRO	ΔL_INNO		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**	-0.212***	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)
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.

Source: own calculations.

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 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. The results show also substantial differences in the roles particular variables play in explaining the net exports in majority of sub-sectors generation of a positive trade balance.

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 discussion of 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.

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 esti-

mation for the analysis is worth considering. Once the data is available, further estimation of the models for a longer time series would be desirable.

This work was supported by the National Bank of Poland within the framework of National Bank of Poland Research Grant Competition for year 2014 and fully financed by the NBP

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