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Determinants of Export Performance: Comparison of Central European and Baltic Firms*

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Abstract

Following the new strand in the new trade theory literature focusing on firm heterogeneity in this paper we investigate the determinants of firms' export performance in three Baltic states and four Central European countries (CECs). We start by estimating probit regressions for the pooled datasets that include these two groups of countries and then we disaggregate the samples into particular countries. The study covers Estonia, Latvia, Lithuania, the Czech Republic, Hungary, Poland and Slovakia and is based on BEEPS firm-level data collected for three years: 2002, 2005 and 2009. Our estimation results obtained for the Baltic and CECs indicate that the probability of exporting is positively related to the level of productivity, firm size, the share of university graduates in productive employment and the internationalization of firms. The results obtained for the two groups of countries are not statistically different, while results for particular countries reveal some degree of heterogeneity.

1. Introduction

In the late 1980s and early 1990s, several Central and Eastern European countries started their transition from non-market to market economies, radically liberalized multilateral and regional trade policies and integrated successfully with the European Union. Given the positive changes in the international institutional environment and deepening integration with the EU, firms from these countries gained access to foreign markets and became the leaders in export activity among the post-transition countries. The majority of previous studies on the effects of trade liberalization in these countries were based on aggregate trade-flow data and gravity models derived from either the neoclassical or new trade theory.

In recent years a new strand in the new trade theory literature, initiated by the Melitz (2003) model, has emerged. This strand stresses the link between export performance and firm heterogeneity expressed in terms of productivity. The empirical evidence shows that only a small fraction of the most productive firms accounts for the majority of exports and most firms do not export. Empirical studies based on firm-level data have been conducted mostly for developed countries and also for some developing economies. The empirical evidence for the post-transition

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economies of Central and Eastern Europe is much less abundant as firm-level data on export performance for the new EU member states are scarce.

The main goal of this paper is to use a multi-country firm-level dataset to compare the determinants of exporting in two groups of new EU member states: the Baltic states and the CECs that joined the European Union in 2004. The market reforms in the CECs started earlier than in the Baltic states. In particular, reforms in Hungary and Poland started in the late 1980s and in the Czech Republic and Slovakia in 1991, while the Baltic countries initiated reforms somewhat later, after regaining their independence from the former Soviet Union.[1] Therefore, our research hypothesis is that the relationship between productivity and exporting postulated by the Melitz (2003) model should be more pronounced in the CECs than in the Baltic states.

In addition to studying the relationship between labor productivity and exporting predicted by the new trade theory models with heterogeneous firms, we are also interested in investigating other firm characteristics that may affect firms' export performance. This allows us to verify whether the same firm characteristics affect export performance of individual firms in the two groups of countries as well as across particular countries. The study covers seven countries: Estonia, Latvia, Lithuania, the Czech Republic, Hungary, Poland and Slovakia. Our study is based on BEEPS firm-level data collected for three years: 2002, 2005 and 2009.

We start with estimating probit regressions using the pooled datasets separately for two country groups, and then we disaggregate each sample into particular countries. We analyze firm-level export determinants in each group and then formally test for differences between the two country groups.

The paper is organized as follows: In Section 2 we review the relevant literature. In Section 3 we discuss the analytical framework and the empirical methodology. In Section 4 we describe the properties of the dataset. Section 5 discusses the estimation results. Section 6 summarizes and concludes with policy recommendations and directions for further studies.

2. Literature Review

The theoretical model proposed by Melitz (2003) is regarded as the workhorse of modern international trade analysis. In particular, Melitz relaxed the key assumption of firm symmetry in the Krugman (1979, 1980) monopolistic competition model and introduced firm heterogeneity in terms of labor productivity. The Melitz model assumes that productivity differences among firms are exogenously given and each firm has to pay fixed costs of entry into domestic and foreign markets. In this model the relationship between the level of labor productivity and exporting has been placed at the center of analysis. The model predicts that only the most productive firms with the lowest marginal costs can cover the fixed cost of entry and self-select themselves into export markets.[2]

[1] A detailed analysis of the dynamics and the relationship between political and economic reforms in Central and Eastern European countries can be found in the recent study by Campos and Horvath (2012).

[2] Helpman *et al.* (2004) extended the original Melitz (2003) model to show that the internalization of firms can take place not only through exporting but also via horizontal foreign direct investment. In their model the most productive firms become multinationals, while firms with an intermediate level of productivity and firms with the lowest productivity operate only in the domestic market.

The majority of empirical studies find support for the theoretical prediction of the Melitz model, i.e. that more productive firms self-select into foreign markets. The number of empirical studies referring to firm heterogeneity in general, and the Melitz model in particular, have grown rapidly in recent years and summarizing this extensive literature is beyond the scope of this paper. The survey of early empirical evidence on the relationship between firm productivity and exporting was provided by Tybout (2003). The extensive summaries of more recent empirical evidence on this relationship in particular countries were offered by Wagner (2007, 2012).

According to the first survey by Wagner (2007), a large number of studies using data from different countries report results showing that exporters and importers are more productive that non-exporters and non-importers. In particular, his review provides clear-cut evidence in favor of the self-selection hypothesis. On the one hand, he argues that future exporters tend to be more productive than future non-exporters in the years before they enter the export market and often have higher *ex ante* productivity growth rates. On the other hand, Wagner (2007) shows that the evidence pertaining to the learning-by-exporting hypothesis, i.e. the possibility of reverse causality, is somewhat mixed. In particular, the empirical results for post-entry differences in performance between exporters and non-exporters point to faster productivity growth for the former group in only some studies. This picture was largely confirmed in the recent survey by Wagner (2012). It has also been pointed out that the empirical results ensuing from the learning-by-exporting hypothesis might not be robust with respect to the specific methodologies and datasets.

In particular, the learning-by-exporting hypothesis was confirmed for some less developed countries in the early studies, such as Isgut (2001) for Colombia, Blalock and Gertler (2004) for Indonesia, and Alvarez and Lopez (2005) for Chile. However, more recent firm-level evidence for the EU member states does not support this hypothesis. In particular, a lack of evidence for the learning-by-exporting hypothesis has been reported by Arnold and Hussinger (2005) for Germany, Damijan and Kostevc (2006) for Slovenia, Pisu (2008) for Belgium, and Smets and Warzynski (2010) for Denmark.

Empirical evidence on the relationship between productivity and exporting based on multi-country firm-level datasets is still rather scarce. According to Wagner (2012, p. 261): "Any attempt to extract information on the size of the effects—the economic relevance, not the statistical significance—is hindered by the absence of a reasonably high degree of comparability across the studies. This lack of comparability is due to differences in the unit of analysis (establishment vs. enterprise), the sampling frame (all firms vs. firms with a number of employees above a certain threshold only), the specification of the empirical models estimated and the econometric methods applied."

To the best of our knowledge the only exception is the EFIGE (European Firms in the Global Economy) report (2010), which is the outcome of an international research project based on comparable firm-level data from several EU countries.[3] The results of this project confirmed the importance of firms' productivity

[3] An earlier multi-country study was carried out by the International Study Group on Exports and Productivity (2008). However, their analysis was focused on export premiums and did not study the role of individual firm characteristics other than productivity.

for exporting. In this report it was demonstrated that firms' export performance in seven EU countries (France, Spain, Germany, Italy, the UK, Hungary and Austria) is dependent on labor productivity as well as other firm characteristics. This study covered more than 14,000 firms in the 2008–2009 period. The study showed that in all countries exporting firms were on average more productive and bigger compared to non-exporters. Moreover, the study showed that the probability of exporting increased with firm age, the share of university graduates in total employment, R&D spending and foreign ownership.

The empirical evidence for particular new EU member states is rather scarce, while it is virtually nonexistent for the whole group of these countries. Separate studies for Hungary based on the EFIGE dataset were conducted by Muraközy (2012) and Békés *et al*. (2012). The results obtained for Hungary were similar to the results obtained for other countries covered by EFIGE (2010). Their studies showed that firm heterogeneity also matters in Hungary. In particular, a large difference between domestic and foreign-owned firms was reported. The foreign-owned firms were more export oriented and more exposed to in global demand. This might be due to the fact that foreign-owned firms were more integrated into global production chains and the collapse of these networks was more harmful to them.

Firm-level evidence on export performance for other CEE economies is also scarce and limited to country studies based on firm surveys. The notable exception is the recent study by Putniņš (2013), who employed an international business approach to studying the determinants of export competitiveness of Latvian firms. He finds that exporters are larger, younger, faster growing and pay higher wages compared to non-exporters. His findings regarding wages are consistent with the view that exporters have higher labor productivity or utilize more skilled labor. Especially direct exporters tend to be more innovative, proactive and willing to take risks and therefore have higher entrepreneurial orientation. Moreover, foreign-owned companies reveal a higher propensity to export compared to domestic-owned firms. His findings are generally in line with the results of other empirical studies that focus on the relationship between the level of labor productivity and exporting.

Our analysis is involves a subgroup of the new EU member states that radically liberalized their foreign trade policies in the 1990s and joined the EU in 2004. In particular, we empirically examine the nexus between firm-level productivity and exporting postulated by the Melitz (2003) model using the multi-country firm-level dataset for two groups of countries: the Baltic states and the CECs known as the Visegrad Group. We hypothesize that this nexus should be more pronounced in the CECs compared to the Baltic states and thus we formally test for differences between these two country groups.

This allows us to fill in the existing gap in the empirical literature on the relationship between exporting and firm characteristics by providing cross-group and multi-country comparisons. In particular, our analysis allows us to identify similarities and differences between particular groups of new EU member states. We also compare the results for the new EU member states with the EFIGE (2010) results for the old EU member states.

Our empirical approach is an equivalent of studying the firm-level determinants of extensive margin effects. This means a positive effect on trade through

an increase in the number of exporting firms or products exported. In addition to productivity, we also take into account other firm characteristics that may affect export performance, such as the age and the size of the given firm, the use of human capital proxied by R&D spending and the share of university graduates in total employment, and the degree of firm internationalization proxied by the use of foreign technology licenses and the role of foreign ownership. This allows us to investigate whether the same firm characteristics affect the export performance of individual firms in the new EU member countries.

3. Analytical Framework and Empirical Methodology

In this study we refer directly to the Melitz (2003) model, which is an extension of the Krugman (1979, 1980) model. Melitz replaced Krugman's assumption of a representative firm with the concept of heterogeneous firms. He assumed a reverse linear production function in the following form: $l_i = f + q_i / \varphi_i$; where l_i is the unit labor input of firm i, q_i is the volume of production, f is the fixed cost and φ_i a randomly determined level of productivity of firm i. The labor force, like in Krugman's model, is the only factor of production. Melitz (2003) assumed that market entry entails the same fixed costs. Export activity requires additional fixed costs associated with the specificity of the foreign market and additional transport costs.

The demand side is taken directly from the Krugman model. Products are horizontally differentiated and the demand function is derived from the standard Dixit-Stiglitz "love for variety" utility function. The Melitz model predicts the process of self-selection. The firms with the lowest productivity, below a certain threshold level φ_{co} , cannot generate positive operating profits (equal to $\pi_i = p_i q_i - w l_i$) and do not enter the domestic market. Intermediately productive firms serve only the domestic market, while the most productive ones produce for both the export and domestic markets. In contrast to Krugman (1979, 1980), the model predicts that only a fraction of firms become exporters. Thus, the causality in the Melitz model is well determined by the self-selection process and only the most productive firms become exporters.

In the context of the Melitz (2003) model, the empirical analysis is switched from aggregate to micro-economic firm-level, based on firm characteristics, affecting the efficiency of firms and their probability of exporting. Therefore, following the earlier studies discussed in the previous section, we use the simple probit model to empirically investigate the relationship between exporting and productivity, having controlled for other firm characteristics. Building on the previous empirical literature, we develop an econometric model to investigate how various firm characteristics affect the probability of exporting. This probability is modeled as a function of firm characteristics.

Our dependent variable indicating the export status of firm i is denoted by Y_i*. Instead of observing the volume of exports, we observe only a binary variable Y_i indicating the sign of Y_i^*. Moreover, we assume that the variable Y_i^* follows $Y_i^* = \mathbf{X_i}\theta + \varepsilon_i$, where the error term ε_i is independent of $\mathbf{X_i}$ which is a vector containing explanatory variables that affect exports with the first term equal to unity for all i, θ is the vector of parameters on these variables that needs to be estimated and ε_i is assumed to be normally distributed with a zero mean.

Our dependent variable follows a binary distribution and takes the value 1 when the firm exports and 0 otherwise:

$$Y_i = \begin{cases} 1 & \text{if } Y_i^* > 0 \\ 0 & \text{if } Y_i^* = 0 \end{cases} \tag{1}$$

We can obtain the distribution of Y_i given $\mathbf{X_i}$. Hence, the probability that a firm exports can be written as:

$$P(Y_i = 1 | \mathbf{X_i}) = \Phi(\mathbf{X_i}\boldsymbol{\theta}) \tag{2}$$

where $\Phi(\cdot)$ denotes the standard normal cumulative distribution function (cdf).

To be able to successfully employ the probit model, it is important to know how to interpret the vector of estimated parameters on the explanatory variables $\boldsymbol{\theta}$. Consider a specific explanatory variable $x_{ij,}$ which is an element of vector $\mathbf{X_i}$. The partial effect of x_{ij} on the probability of exporting can be written as:

$$\partial P(Y_i = 1|\mathbf{X_i})/\partial x_{ij} = \partial p(\mathbf{X_i})/\partial x_{ij} \tag{3}$$

When multiplied by Δx_{ij} equation (3) gives the approximate change in $P(Y_i = 1|\mathbf{X_i})$ when x_{ij} increases by Δx_{ij}, holding all other variables constant.

4. Data Description

Our study is based on "EBRD-World Bank Business Environment and Enterprise Performance Survey" (BEEPS) data collected by the World Bank and the European Bank for Reconstruction and Development in the post-communist countries located mainly in Europe and Central Asia (ECA). The main objective of BEEPS was to obtain feedback from enterprises in the aforementioned countries on the state of the private sector. The survey examined the quality of the business environment. The survey questions concerned firm identification, sector of activity, legal and economic status, characteristics of managers and firm size, the infrastructure of services in the analyzed country, economic performance and key characteristics of the reviewed firms, as well as stakeholders, e.g. employers' organizations, employees' organizations, local government, central government, the ICT industry, SMEs, academics, etc.

In all countries where a reliable sample frame was available, the sample was selected using stratified random sampling.[4] However, only a small proportion of the same firms was sampled every year. This means that the application of panel data analysis is not possible. Therefore, we used the standard probit procedure on the pooled cross-section dataset without controlling for individual firm effects, though we control for time-specific and industry-specific effects.

Our sample includes only three years for which data was collected: 2002, 2005 and 2009. The sample period covers different phases of the business cycle such as the global economic crisis of 2008–2009 and important changes in the institutional environment such as accession to the European Union in 2004. Therefore, we include time effects in order to control for policy changes and business cycles.

[4] The only exception was Albania. The details concerning the sampling methodology are explained in the Sampling Manual available at http://www.enterprisesurveys.org/Methodology/.

The surveys covered both the manufacturing and services sectors and are representative of the variety of firms according to sector and location within each country. The number of firms operating in the service sector was relatively small compared to the manufacturing sector. Therefore, it was not possible to perform estimations separately for the manufacturing and service sectors. Moreover, particular industries within each sector can differ with respect to their capital intensity and export performance. Therefore, to control for heterogeneity across industries we used industry-specific effects in addition to individual firm characteristics in our estimating equations.

Our study focuses on two groups of Central and Eastern European countries: three Baltic states and four CECs. The CECs include the Czech Republic, Hungary, Poland and Slovakia. These countries were the leaders in multilateral and regional trade liberalization in the 1990s. In December 1991 the CECs signed the Europe Agreements creating free trade agreements with the European Union and the Interim Agreement, which regulated trade-related aspects of relations, was adopted in 1992.[5] The Baltic states include Estonia, Latvia and Lithuania. The economic transition in the Baltic states started a few years later, as these countries were part of the former Soviet Union until the early 1990s. In the mid-1990s the Baltic states signed association agreements with the EU that that came into effect in 1998.

Moreover, the CECs established the Central European Free Trade Area (CEFTA) covering mostly non-agricultural products, while the Baltic countries established the Baltic Free Trade Area (BAFTA), which liberalized all trade among themselves. In addition, the Baltic countries signed a number of bilateral free trade agreements with the CECs. Despite its later start, the pace of trade liberalization in the Baltic states was faster compared to that in the CECs. On 1 May 2004, all of the Baltic states and the CECs joined the European Union.

Export activity is defined as the situation when at least 1% of sales revenue comes from sales made abroad. In *Table 1* we present the export propensity of firms from the Baltic states and the CECs as well as other former communist countries.

Table 1 reveals a great degree of heterogeneity across firms in the whole region. On the one hand, the large share of exporting firms is typical for the countries that emerged from the former Yugoslavia. Those countries were more market-oriented and had more liberal trade regimes in the past compared to the other former communist countries. On the other hand, the share of exporting firms from the former Soviet Union is the lowest, with the exception of the Baltic states, which are comparable to the CECs and located in the upper-middle part of the group. The largest share of exporting firms is reported in Slovakia, Estonia, Lithuania, Hungary, and the Czech Republic, with Latvia in the middle, and Poland at the bottom. This is in line with the traditional observation that firms from bigger countries usually sell their products in the domestic markets. However, a great deal of heterogeneity in export performance across firms from different countries cannot be explained only by the country characteristics whose importance is stressed by the traditional trade theory. Therefore, it is necessary to study also the role of firm characteristics in determining export performance in line with the recent trend in the new trade theory.

[5] While the original Europe Agreement for the former Czechoslovakia was signed in 1991, the agreement had to be renegotiated because of the split of the country. The actual Agreements between the EU and the Czech Republic and the EU and Slovakia were signed in 1993 and came into effect in 1995.

Table 1 Propensity to Export among Firms from the Baltic States and Central European Countries and Other ECA Countries

Export (national sales less than or equal 99% of establishment's sales)		
Country	**Mean**	**Freq.**
Slovenia	0.55167394	687
Croatia	0.41551724	1160
Serbia	0.37222222	900
Slovakia	0.36555891	662
FYR Macedonia	0.36005435	736
Estonia	0.35454545	660
Lithuania	0.35441176	680
Hungary	0.35099913	1151
Czech Republic	0.34458673	859
Bosnia	0.34366577	742
Bulgaria	0.31840259	1853
Latvia	0.28527607	652
Albania	0.27459016	732
Poland	0.27253886	1930
Belarus	0.25825472	848
Moldova	0.2356257	887
Ukraine	0.21819138	1902
Romania	0.21345876	1382
Armenia	0.18994413	895
Russia	0.18341232	2110
Kyrgyz Republic	0.1704918	610
Georgia	0.1689008	746
Montenegro	0.13636364	154
Uzbekistan	0.12526998	926
Tajikistan	0.11836735	735
Azerbaijan	0.11	900
Kazakhstan	0.10079768	1379

Source: The authors' own calculations based on BEEPS data.

The probability of exporting of firms from the analyzed country groups can be related to the explanatory variables on firm characteristics. The key explanatory variable—labor productivity—is expressed as the total amount of annual sales per full-time employee (*prod*). The choice of this measure of productivity is supported by the original Melitz (2003) model. While previous studies of other countries used alternative measures of productivity, such as TFP or value added per employee, calculation of these alternative measures was not possible due to the data constraint. In particular, the BEEPS dataset is not sufficiently rich and does not include information on firms' capital, intermediate inputs or value added.

Table 2 Description of Variables Used in The Empirical Study

Variables	BEEP input Name	Description
Export	d_d3a	binary variables, that takes the value 1 if the establishment is exporting and zero if not
Prod	prod=d2/l1	logarithm of productivity expressed as total amount of annual sales per full time employee
Firm_size	l1	logarithm of no. permanent, full-time employees of this firm at end of last fiscal year
Firm_age		number of years since start of operations
Firm_age2		number of years since start of operations squared
Foreign_tech	e6	binary variable, that takes the value 1 if the establishment uses technology licensed from a foreign-owned company and 0 otherwise
Foregin_cap	b2a	binary variable, that takes the value 1 if shares owned by private foreign individuals, companies or organizations.
R&D	R&D = (ECAo4/d2)*100	% of total annual sales spent on research and development
Univ	lECAq69	% employees at end of fiscal year with a university degree

Other firm-level characteristics that may affect export activity, analyzed in our empirical study, include the level of innovation proxied by R&D spending (*R&D*) and the stock of human capital proxied by the percentage of employees with university degrees (*univ*). In addition, we control for foreign ownership (*foreign_cap*), the use of foreign technology (*foreign_tech*), the size of the firm (*firm_size*), the age of the firm (*firm_age*) and its squared value (*firm_age2*) to account for potential nonlinearities between age and the probability of exporting. All these firm-level characteristics come from the BEEPS dataset.

The exact definitions of the variables used in our empirical study are presented in *Table 2*.

Our sample used in the econometric analysis includes pooled cross-section data for firms located in two groups of countries—the Baltic states and the CECs—for which explanatory variables were available in all of the analyzed years. The size of the firm sample in each country is given in *Table 3*.

5. Estimation Results

In this section we present two sets of estimation results. First, we discuss the results for the CECs and Baltic countries obtained using the clustered standard errors at the country level. Then we formally test for differences between these two country groups. Finally, we discuss the results obtained for individual countries.

5.1 Results for the CECs and Baltic Countries

In columns (1)–(6) of *Table 4* we report the results obtained for two separate groups of countries—the CECs and Baltic countries, respectively—having controlled for the standard factors mentioned in other firm-level studies. We focus on the relationship between labor productivity and export performance predicted by the Melitz (2003) model. In addition, we control for other factors that may affect export activity

Table 3 The Size of the Sample in Each Country

Export (national sales less than or equal 99% of establishment's sales)		
Country	**Freq.**	**Percent**
Total CECs-4	4602	100.00
Non exporters	3134	68.10
Exporters	1468	31.90
Czech Republic	859	100.00
Non exporters	563	65.54
Exporters	296	34.46
Slovakia	662	100.00
Non exporters	420	63.44
Exporters	242	36.56
Hungary	1151	100.00
Non exporters	747	64.90
Exporters	404	35.10
Poland	1930	100.00
Non exporters	1404	72.75
Exporters	526	27.25
Total Baltics-3	1991	100.00
Non exporters	1330	66.80
Exporters	661	33.20
Estonia		
Non exporters	426	64.55
Exporters	234	35.45
Latvia		
Non exporters	465	71.43
Exporters	186	28.57
Lithuania		
Non exporters	439	64.56
Exporters	241	35.44

Source: The authors' own calculations based on BEEPS data.

identified in the firm-level empirical literature. These factors include the level of innovations proxied by R&D spending (*R&D*), the stock of human capital proxied by the percentage of employees with university degrees (*univ*), foreign ownership of the firm (*foregin_cap*), the use of foreign technology (*foreign_tech*), the size of the firm (*firm_size*), the age of the firm (*firm_age*) and its squared value (*firm_age2*).

In columns (1) and (4) we report the baseline estimation results obtained for the CECs and Baltic countries, respectively, without controlling for time and industry effects. Our estimation results reveal that the estimated coefficients on the productivity variables display positive signs and are of a similar magnitude.[6] The estimated parameter for the CECs is statistically significant already at the 1% level, while for

Table 4 Estimation Results for the CECs and Baltic Country Groups

Variables	CECs			Baltics		
	(1)	(2)	(3)	(4)	(5)	(6)
Prod	0.0446***	0.0450***	0.0454***	0.0448*	0.0363	0.0359
	(0.00614)	(0.00516)	(0.00478)	(0.0251)	(0.0263)	(0.0245)
Firm_size	0.257***	0.233***	0.231***	0.363***	0.326***	0.324***
	(0.0268)	(0.0294)	(0.0301)	(0.0619)	(0.0695)	(0.0701)
Age	0.00270	0.00509	0.00469	-0.0258	-0.0176	-0.0175
	(0.00459)	(0.00417)	(0.00406)	(0.0194)	(0.0208)	(0.0201)
Age_sqr	-2.76e-05	-3.59e-05	-3.27e-05	0.000186	0.000112	0.000113
	(3.51e-05)	(3.22e-05)	(3.02e-05)	(0.000186)	(0.000191)	(0.000195)
Foreign_cap	0.00930***	0.00981***	0.00983***	0.00846***	0.00838***	0.00842***
	(0.000559)	(0.000615)	(0.000651)	(0.00277)	(0.00319)	(0.00314)
Foreign_tech	0.711	0.202	0.222	0.530**	-0.0898	-0.0686
	(0.456)	(0.579)	(0.578)	(0.266)	(0.396)	(0.371)
R&D	0.106***	0.0738***	0.0806***	0.0466***	0.0353*	0.0362*
	(0.0277)	(0.0229)	(0.0227)	(0.0170)	(0.0210)	(0.0190)
Univ	0.00463*	0.00533*	0.00523*	0.00488***	0.00572***	0.00570***
	(0.00276)	(0.00297)	(0.00299)	(0.000880)	(0.000940)	(0.000996)
Constant	-2.202***	-0.836***	-1.414***	-1.901***	-1.049***	-1.036*
	(0.147)	(0.0766)	(0.498)	(0.187)	(0.0643)	(0.531)
Time effects	no	yes	yes	no	yes	yes
Industry effects	no	no	yes	no	no	yes
Observations	1,496	1,496	1,483	419	419	415
Log likelihood	-774.8	-751.2	-748.2	-219.2	-214.3	-213.7
Pseudo R^2	0.175	0.200	0.190	0.222	0.240	0.231

Notes: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

the Baltic countries it is statistically significant only at the 10% level. The majority of other variables are also statistically significant, albeit at different levels of statistical significance.

In particular, the estimated parameters on the firm size variable are positive and statistically significant already at the 1% level in both groups of countries. The magnitude of the estimated parameter on the firm size variable is slightly higher for the Baltic countries. These results are generally in line with the Melitz (2003) model (economies of scale) and other empirical studies. The estimated coefficient on the firm age variable and its squared value are not statistically significant either

[6] We can note that the number of observations in our estimations reported in *Table 4* is smaller in comparison with the number of observations in *Table 3*. This is due to the fact that some of the firm characteristics used in our study were not available for all firms.

in the case of the CECs or in the case of the Baltic countries. This result is different from the results obtained for the old EU countries reported in EFIGE (2010).

Moreover, the empirical results confirm the importance of internationalization of firms for their export performance. This relationship is clearly visible is the case of the foreign capital variable, which is positive and statistically significant already at the 1% level in both groups of countries, though the magnitude of the estimated coefficient is slightly lower for the Baltic countries. However, the estimated parameter on the foreign technology variable is positive and statistically significant at the 5% level only for the Baltic states.

The significance of the human capital factors for firms' export performance is differentiated between these two groups of countries. The level of R&D expenditure is statistically significant already at the 1% level in the case of both groups of countries, though the magnitude of the estimated coefficient is visibly higher in the case of the CECs. The importance of tertiary education is also confirmed in both groups of countries. However, the estimated parameter on the university variable is statistically significant for the CECs only at the 10% level, while for the Baltic states it is significant at the 1% level. This means that the human capital factors in the smaller Baltic countries are more important than in the CECs. In particular, R&D efforts may not translate into higher export performance of the Baltic firms. This is in line with the observation that the structure of exports of the Baltic states is more traditional in comparison with the CECs (Benkovskis and Rimgailaite, 2011).

In columns (2)–(3) and (5)–(6) we investigate the robustness of our baseline results for the CECs and the Baltic states by controlling for time and industry effects. In the case of the CECs, the inclusion of time and industry dummies slightly affected the magnitudes of the estimated parameters on particular explanatory variables but did not affect their statistical significance. However, in the case of the Baltic countries, the inclusion of time and industry dummies had a more pronounced impact on both the magnitudes and statistical significance of explanatory variables. In particular, the productivity and the use of foreign technology variables lost their previous statistical significance. In addition, the R&D variable became statistically significant only at the 10% level.

The descriptive analysis of the differences and similarities in the level and statistical significance of particular parameter estimates for the two groups of countries does not allow drawing clear-cut conclusions. Therefore, we complement our descriptive analysis with a series of formal Wald tests. The null hypothesis of the tests asserts that the estimated parameters in the regressions for the Baltic states and the CECs are not statistically different. The test results are reported in *Table 5*. The Wald statistics used for testing this hypothesis are based on a variance matrix unadjusted for heteroscedasticity. This is because the number of clusters (minus 2) used in calculating the robust variance matrix is smaller than the number of restrictions that we are jointly testing and in this specific case a robustified version of the Wald statistics cannot be calculated.

In column (1) we compare the estimated baseline specifications for the CECs and the Baltic states reported in columns (1) and (4) of *Table 4*. The Chi2 value of the test for the productivity variable is very close to 0 and the corresponding *p*-value equals 0.995. The value of the test of the joint hypothesis of no significant dif-

Table 5 Wald Test Results for the CECs and Baltic Country Groups (Chi2)

Variables	Specifications (1)&(4)	Specifications (2)&(5)	Specifications (3)&(6)
	(1)	(2)	(3)
Prod	0.00 (0.995)	0.09 (0.759)	0.11 (0.738)
Firm_size	3.23 (0.073)	2.39 (0.123)	2.30 (0.129)
Age	3.26 (0.071)	1.97 (0.161)	1.87 (0.171)
Age_sqr	1.93 (0.165)	0.87 (0.352)	0.83 (0.362)
Foreign_cap	0.09 (0.770)	0.25 (0.620)	0.23 (0.628)
Foreign_tech	0.20 (0.657)	0.37 (0.542)	0.34 (0.559)
R&D	3.92 (0.048)	1.52 (0.217)	1.98 (0.159)
Univ	0.01 (0.934)	0.02 (0.896)	0.02 (0.875)
Overall	9.37 (0.312)	10.33 (0.323)	6.27 (0.617)

Notes: The *p*-values are reported in parentheses. The reported Wald test statistics are not robust in terms of heteroscedasticity.

ferences between coefficients for all variables equals 9.37 and the corresponding *p*-value equals 0.312. In column (2) we compare the parameters reported in columns (2) and (5) of *Table 4* obtained from the specifications controlling for time effects. The value of the test for the productivity variable equals 0.09 and the corresponding *p*-value equals 0.759. The value of the test of the joint hypothesis equals 10.33 and the corresponding *p*-value equals 0.323. Finally, in column (3) we compare the parameters reported in columns (3) and (6) of *Table 4* obtained from the specifications controlling for both time and sectoral effects. The value of the test for the productivity variable equals 0.11 and the corresponding *p*-value equals 0.738. The value of the test for the joint hypothesis equals 6.27 and the corresponding *p*-value equals 0.617.

This means that the null hypothesis asserting that there are no statistically significant differences in the estimated parameter on the productivity variable for the two groups of countries cannot be rejected in any of the specifications. Therefore, we cannot positively validate our research hypothesis that the relationship between productivity and exporting is more pronounced in the CECs compared to the Baltic states. Moreover, we find that the hypothesis that there are no jointly statistically significant differences in the estimated parameters for the two groups of countries cannot be rejected in any of the specifications. This means that despite the fact that the reforms in the Baltic countries started later than in the CECs, they managed to catch up with the CECs in terms of export performance.

In addition to the coefficient estimates in *Table 6,* we also provide estimates of the marginal effects describing the effect of a particular explanatory variable on the probability of exporting. The particular columns of *Table 6* are direct counter-

Table 6 Estimation Results for the CECs and Baltic Country Groups (Marginal Effects)

Variables	CECs (marginal effects)			Baltics (marginal effetcs)		
	(1)	(2)	(3)	(4)	(5)	(6)
Prod	0.0154***	0.0157***	0.0156***	0.0171*	0.0139	0.0136
	(0.00206)	(0.00171)	(0.00154)	(0.00981)	(0.0102)	(0.00950)
Firm_size	0.0889***	0.0810***	0.0797***	0.138***	0.125***	0.123***
	(0.00971)	(0.0104)	(0.0105)	(0.0256)	(0.0288)	(0.0288)
Firm_age	0.000936	0.00177	0.00162	-0.00983	-0.00671	-0.00667
	(0.00159)	(0.00145)	(0.00140)	(0.00757)	(0.00808)	(0.00777)
Firm_age2	-9.55e-06	-1.25e-05	-1.12e-05	7.11e-05	4.27e-05	4.30e-05
	(1.22e-05)	(1.12e-05)	(1.04e-05)	(7.18e-05)	(7.36e-05)	(7.46e-05)
Foreign_cap	0.00322***	0.00342***	0.00338***	0.00323***	0.00320**	0.00320**
	(0.000173)	(0.000223)	(0.000235)	(0.00112)	(0.00129)	(0.00126)
Foreign_tech	0.273	0.0735	0.0806	0.208**	-0.0339	-0.0258
	(0.179)	(0.219)	(0.219)	(0.103)	(0.148)	(0.138)
R&D	0.0365***	0.0257***	0.0278***	0.0178***	0.0135*	0.0138*
	(0.00949)	(0.00790)	(0.00774)	(0.00629)	(0.00787)	(0.00703)
Univ	0.00160*	0.00185*	0.00180*	0.00186***	0.00218***	0.00217***
	(0.000959)	(0.00103)	(0.00102)	(0.000309)	(0.000320)	(0.000341)
Time effects	no	yes	yes	no	yes	yes
Industry effects	no	no	yes	no	no	yes
Observations	1,496	1,496	1,483	419	419	415

Notes: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

parts of the columns in *Table 4*. These estimation results are very similar to the estimation results reported in *Table 4* in terms of the signs and statistical significance of particular parameters.

5.2 Results for Individual CECs and Baltic Countries

In *Table 7* we show the estimation results obtained for the individual CECs and Baltic countries, having controlled for time-specific effects.[7] These results reveal some degree of heterogeneity among particular countries.

In column (1) we display the estimation results for the Czech Republic. These results are similar to those obtained for the whole sample of the CECs in terms of the signs and statistical significance of particular explanatory variables. In particular, the estimated coefficient on the productivity variable displays a positive sign and it is statistically significant at the 1% level. Also, foreign ownership and firm size are positively related to the probability of exporting at the 1% level. The measures

[7] We were not able to control for industry-specific effects due to the small number of observations for particular countries.

Table 7 Estimation Results for Individual Countries

Variables	Czech Rep.	Slovakia	Hungary	Poland	Estonia	Latvia	Lithuania
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Prod	0.390**	0.118	0.206**	-0.00907	-0.0647	0.0897	0.504***
	(0.160)	(0.211)	(0.0993)	(0.0858)	(0.194)	(0.210)	(0.179)
Firm_size	0.155***	0.425***	0.290***	0.216***	0.234**	0.266**	0.425***
	(0.0576)	(0.119)	(0.0503)	(0.0399)	(0.111)	(0.112)	(0.0953)
Firm_age	-0.0258	-0.0220	-0.00104	0.00850	0.0354	0.0811	-0.0452
	(0.0324)	(0.0344)	(0.0122)	(0.00872)	(0.0363)	(0.0551)	(0.0356)
Firm_age2	0.000461	0.000110	1.06e-05	-7.14e-05	-0.000209	-0.00127	0.000399
	(0.000422)	(0.000328)	(9.33e-05)	(7.69e-05)	(0.000314)	(0.000792)	(0.000440)
Foreign_cap	0.00903***	0.00375	0.00920***	0.0113***	0.00461	0.00418	0.0185***
	(0.00328)	(0.00608)	(0.00257)	(0.00285)	(0.00396)	(0.00608)	(0.00548)
Foreign_tech		-0.832	-1.151	1.144**	0.0942	-0.514	-1.302
		(0.900)	(0.856)	(0.515)	(0.765)	(0.927)	(0.854)
R&D	0.224***	0.0445	-0.0614	0.0757**	0.763*	-0.159	0.0327
	(0.0752)	(0.0520)	(0.100)	(0.0296)	(0.452)	(0.136)	(0.0320)
Univ	0.0151***	0.00920*	0.00390	0.00179	0.00565	0.00887*	0.00184
	(0.00379)	(0.00541)	(0.00291)	(0.00224)	(0.00585)	(0.00467)	(0.00444)
Constant	-5.839**	-2.163	-4.278*	0.0809	-0.326	-2.071	-5.948**
	(2.726)	(3.059)	(2.217)	(1.168)	(3.091)	(2.161)	(2.327)
Time effects	yes	Yes	yes	yes	yes	yes	yes
Observations	299	112	397	681	124	127	168
Log likelihood	-129.3	-55.98	-222.7	-317.5	-57.18	-59.00	-75.56
Pseudo R^2	0.302	0.254	0.174	0.173	0.330	0.221	0.346

Notes: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

of human capital (R&D spending and university education) are also positively related to the probability of exporting and statistically significant at the 1% level, which is higher compared to the whole sample of the CECs.

In column (2) we report the estimation results for Slovakia. In contrast to the estimation results obtained for the Czech Republic, the majority of the estimated parameters are not statistically significant. The only exceptions are firm size, which is statistically significant at the 1% level, and university education, which is statistically significant only at the 10% level. However, these results might be due to the smaller sample size of firms compared to the Czech Republic.

In column (3) we show the estimation results for Hungary. In contrast to the results obtained for Slovakia, the level of productivity is positively related to the probability of exporting at the 5% level of statistical significance. Moreover, the probability of exporting increases with firm size and foreign ownership, which

are statistically significant at the 1% level. The measures of human capital (R&D spending and university education) are not statistically significant.

In column (4) we report the estimation results for Poland. These results are quite similar to those obtained for Hungary, though important differences exist. On the one hand, the estimated coefficients on the foreign capital and firm size variable are positive and statistically significant. On the other hand, the productivity and university variables are not statistically significant. Moreover, the foreign technology and R&D variables are statistically significant at the 5% level.

In column (5) we show the estimation results for Estonia. The majority of variables are not statistically significant, with the exception of firm size, which is statistically significant at the 1% level, and the R&D variable, which is statistically significant at the 10% level.

In column (6) we report the estimation results for Latvia. As in the case of Estonia, the majority of variables are not statistically significant. The only two exceptions include firm size, which is significant at the 5% level, and the share of university graduates in total employment, which is statistically significant at the 10% level. However, the results for Latvia and Estonia should be treated with caution due to the small sample of firms.

Finally, in column (7) we present the estimation results for Lithuania. These results confirm the main prediction of the Melitz (2003) model concerning the positive relationship between productivity, firm size and export performance. The other statistically significant variables is foreign ownership, which displays an expected positive sign.

Moreover, in addition to the coefficient estimates in *Table 8* we provide estimates of the marginal effects describing the effect of a particular explanatory variable on the probability of exporting. The particular columns of *Table 8* are direct counterparts of the columns in *Table 7*. These estimation results are quite similar to the estimation results reported in *Table 7* in terms of the signs and statistical significance of particular parameters.

6. Conclusions

In this paper we investigated the determinants of export activity of firms in the Baltic states and CECs. The study was based on firm-level data for three years: 2002, 2005 and 2009. First, we started with estimating probit regressions for two groups of countries—the Baltic states and the CECs—and then formally tested for differences between the two country groups. Finally, we disaggregated the samples into particular countries.

Our pooled estimation results obtained for the CECs were generally in line with the earlier results obtained for the old EU member states. In particular, firms' export performance was positively related to the level of productivity, firm size, the share of university graduates in productive employment, spending on R&D activities and the internalization of firms measured by foreign ownership. Despite some differences in the estimated parameters between the Baltic states and the CECs, the formal tests indicated that the results obtained for these two groups of countries were not statistically different.

Table 8 Estimation Results for Individual Countries (Marginal Effects)

Variables	Czech Rep.	Slovakia	Hungary	Poland	Estonia	Latvia	Lithuania
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Prod	0.132**	0.0449	0.0802**	-0.00275	-0.0250	0.0271	0.200***
	(0.0540)	(0.0798)	(0.0387)	(0.0260)	(0.0751)	(0.0635)	(0.0709)
Firm_size	0.0526***	0.161***	0.113***	0.0656***	0.0905**	0.0804**	0.169***
	(0.0193)	(0.0453)	(0.0196)	(0.0120)	(0.0452)	(0.0328)	(0.0377)
Firm_age	-0.00877	-0.00834	-0.000404	0.00258	0.0137	0.0245	-0.0179
	(0.0110)	(0.0131)	(0.00475)	(0.00264)	(0.0141)	(0.0156)	(0.0141)
Firm_age2	0.000157	4.18e-05	4.13e-06	-2.16e-05	-8.09e-05	-0.000382*	0.000158
	(0.000144)	(0.000125)	(3.63e-05)	(2.33e-05)	(0.000122)	(0.000221)	(0.000175)
Foreign_cap	0.00307***	0.00142	0.00358***	0.00342***	0.00178	0.00126	0.00733***
	(0.00112)	(0.00231)	(0.00101)	(0.000874)	(0.00156)	(0.00187)	(0.00220)
Foreign_tech		-0.257	-0.332**	0.426**	0.0360	-0.127	-0.402**
		(0.205)	(0.140)	(0.190)	(0.289)	(0.177)	(0.163)
R&D	0.0760***	0.0169	-0.0239	0.0229**	0.295*	-0.0479	0.0130
	(0.0261)	(0.0198)	(0.0390)	(0.00902)	(0.155)	(0.0408)	(0.0127)
Univ	0.00513***	0.00349*	0.00152	0.000543	0.00218	0.00268*	0.000729
	(0.00129)	(0.00205)	(0.00113)	(0.000680)	(0.00227)	(0.00141)	(0.00176)
Time effects	yes	yes	yes	yes	yes	yes	yes
Observations	299	112	397	681	124	127	168

Notes: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The results obtained separately for particular Baltic and Central European countries revealed some degree of heterogeneity among them with respect to the determinants of export performance. In particular, the productivity variable was significantly significant only in the Czech Republic, Hungary and Lithuania. Similarly, the use of foreign technology, foreign ownership, R&D expenditure and the share of university graduates in productive employment were statistically significant in only some countries. Firm size was the only variable that was statistically significant for all countries.

Our empirical results allow us to formulate a number of policy recommendations for development of export promotion strategies for the authorities of Baltic countries and CECs. In particular, the export performance of these countries can be improved by attracting export-oriented FDI, which can generate positive spillovers to domestic firms. Moreover, the export competitiveness of indigenous firms in these countries can be improved through the development of modern education systems allowing them to accelerate the accumulation of human capital. Financial support for research and development and innovation activities should also have a positive impact on the export performance of firms in some countries. Finally, our study confirmed the positive role of economies of scale in exporting. Therefore, competition policy in those countries should not discourage mergers among indigenous firms.

Further studies should extend our empirical analysis using other measures of productivity such as TFP or value added per employee, which were not available in our dataset. Moreover, it would also be useful to test for the direction of causality and the learning-by exporting-hypothesis mentioned in the literature. However, these extensions require a detailed firm-level, multi-country panel dataset.

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