Export Activity in Visegrad--4 Countries: Firm Level Investigation

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Key words: export activity, firm heterogeneity, Central Europe
JEL code:

1. Introduction*

In the recent years a new strand in the new trade theory literature has emerged. In contrast to older literature which assumed that firms are symmetric, new literature stresses firm heterogeneity in terms of productivity and export performance. It turns out that only a small fraction of the most productive companies account for the majority of exports and most firms do not export concentrating their activities instead on domestic markets only. The majority of empirical studies based on firm-level data are conducted for particular developed and some developing countries while empirical data for the post-transition economies of Central and Eastern Europe is virtually non-existent.

Therefore, the main goal of this paper is to study the relationship between labor productivity and exporting, having controlled for other firm characteristics in the four Visegrad (V-4) countries. Our study is based on the BEEPS firm level data for the 2002–2009 period. In the 1990s these countries faced transition from non-market to market economies and radically liberalized their multilateral and regional trade. We will start with estimating probit regressions for the pooled dataset that includes all V-4 countries and will then disaggregate the sample into particular countries. Our preliminary estimation results obtained for the whole V-4 sample indicate that the probability of exporting increases with higher productivity, having controlled for the share

* Opinions expressed by the authors in their paper reflect neither the positions of the Faculty of Economics of the University of Warsaw, nor that of the European Central Bank.

of university graduates in productive employment, spending on R&D projects, the use of foreign technology licenses, foreign ownership, and company size. The results obtained for particular V-4 countries reveal some degree of heterogeneity among those countries.

The structure of this paper is as follows. In Section 2 we will review the relevant literature. In Section 3 we will discuss the empirical methodology and the data, while Section 4 will be devoted to an analysis of the results of our empirical research. In Section 5 we will sum up our findings and present conclusions.

2. Literature Review

Firm heterogeneity has long been a major issue in economics. For example, according to the evolutionary theory, economic change occurs via interaction between heterogeneous agents in the presence of market selection [Winter, 1971; Nelson and Winter, 1982]. In particular, Nelson [1991] made a strong case for the economic significance of discretionary differences among firms. Similarly, elements of firm heterogeneity can be found in the equilibrium models of industrial dynamics [Jovanovic, 1982; Pakes and Ericsson, 1998]. Also, some macroeconomic models rejected the standard assumption of a representative agent [Stoker, 1993]. However, firm heterogeneity has been introduced into the theoretical models of international trade only recently under the growing pressure of empirical studies based on firm-level data [Bernard et al., 2003; Melitz, 2003]. The key prediction emerging from this new strand in the international trade literature is that firms will resort to distinct international activities depending on their productivity levels [Helpman et al., 2004].

By now empirical evidence on firm heterogeneity in economic literature has been very extensive. According to Castellani and Zanfei [2006], intra-industry variance in productivity, wages and profitability exceeds intersectoral variance. This, for example, has been demonstrated in the context of U.S. economy by Baily et al. [1992] for productivity, by Davis and Haltiwanger [1991] for wages and by Mueller and Raunig [1999] for profitability. In the context of international trade, a number of studies argue that more productive companies tend to self-select into export markets. This has been demonstrated by Bernard and Wagner [1997] for German firms, by Bernard and Jensen [1999] for U.S. firms, by Clerides et al. [1998] for Columbia, Mexico and Morocco, and by Castellani [2002] for Italy[1].

Following the recent developments in the empirical trade literature the relationship between the level of labor productivity and exporting has been placed in the center of analysis in the new trade theory models. In particular, Melitz [2003] relaxed the key assumption of firm symmetry in the Krugman

[1] The survey of early empirical evidence on firm heterogeneity and exporting has been provided by Tybout [2003].

[1980] monopolistic competition model and introduced firm heterogeneity in terms of labor productivity. In his model, productivity differences among firms are exogenously given and each firm has to pay fixed costs of entry into domestic and foreign markets. The model predicts that the most productive firms with lowest marginal costs can cover the fixed cost of entry and become exporters. The Melitz [2003] model can be used to study the whole range of various issues. In particular, it can be used to assess the effects of trade liberalization. On the one hand, the fall in the cost of importing will force the least productive firms to leave the domestic market and reallocate market shares from these firms to more productive companies. As a result, the average level of productivity within the sector increases. On the other hand, a reduction of the cost of exporting reduces the threshold level of productivity that firms need to export and consequently the highest productivity non-exporters can enter the export markets.

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

Firm heterogeneity and internationalization can be interpreted as a two-way link. On the one hand, differences in firm productivity related to the level of technology and innovativeness should be reflected in various advantages which make international operations possible. That is to say, the use of firms' distinctive competencies in foreign markets requires some retention of the knowledge capital within firm boundaries (through internal networks of subsidiaries). The operations in foreign markets may also require some interactions with external parties, including local suppliers and users (via an external network of linkages).

On the other hand, exporting and FDI can generate new technological advantages and contribute to productivity improvements. These improvements can result from the expansion of foreign networks that allow for a better exploitation of economies of scale and a faster movement along their learning curves. In addition, the internationalization of firms can create new channels of technology transfers. In particular, productive knowledge can move within the multinational firm or it can be purchased from external suppliers. Therefore, the internationalization can increase firm productivity through learning by exporting or through FDI generating further heterogeneity.

The majority of empirical studies support the theoretical prediction of the Melitz [2003] model, i.e. that more productive firms self-select into foreign markets, while only a few studies argue that learning by exporting significantly affects firm productivity. An extensive summary of empirical evidence on the relationship between productivity and export performance is provided by Wagner [2005]. Therefore, in our study we will focus on the impact of productivity differences on the probability of exporting. Furthermore, we

will try to take into account other firm characteristics that may affect export performance such as R&D spending, foreign technology licenses and firm ownership.

3. Empirical methodology and data description

3.1 Empirical methodology

We use the probit model to study the relationship between labor productivity and exporting, having controlled for other firm characteristics. Building on the previous theoretical literature we develop an empirical model to investigate the effects of various firm characteristics on their export performance. Our variable follows $Y^{i*} = X_i\theta + \varepsilon_i$, where X_i is the vector of firm characteristics affecting profits, θ is the vector of parameters of these characteristics that needs to be estimated, while ε_i is an error term which is assumed to be normally distributed with the zero mean.

Instead of observing the volume of exports we observe only a binary variable indicated the sign of Y^{i*}.

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

The probability that a firm exports as a function of firm, industry and country characteristics can be demonstrated as:

$$\Pr\left(Y_i = 1 | X_i\right) = \Phi\left(X_i\theta\right)$$

3.2. Data description

Our analysis 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 in Europe and Central Asia (ECA) and Turkey. The main objective of the BEEPS survey 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 as determined by a wide range of interactions between companies and the state. The surveys covered manufacturing and services sectors and are representative of the variety of firms according to sector and location within each country. The data was collected for the years 2002, 2005, and 2009.

Our study focuses on four Visegrad (V-4) countries: the Czech Republic, Hungary, Poland and Slovakia. These countries were leaders in multilateral and regional trade liberalization in the early 1990s. Already in December 1991 these countries signed the Europe Agreements creating free trade agreements with the European Union. According to these agreements bilateral trade in manufactured products between V-4 countries and the EU was gradually liberalized by the end of 1990s. Trade liberalization of V-4 countries with Western Europe was

complemented by the bilateral agreements with the EFTA countries signed in 1992. By the end of 1992 the V-4 countries also signed the agreement establishing the Central European Free Trade Area (CEFTA) that liberalized trade in manufactured products among themselves. Given the positive changes in the international institutional environment one can expect that V-4 countries firms are also leaders in export activity.

Therefore, it is worth comparing the propensity to export of firms in the V-4 countries with other countries covered by the BEEPS. The export activity is defined as a situation where at least one percent of sales revenue comes from the sales made abroad. In Table 1 we present the export propensity of the V-4 countries firms and selected countries of the former communist countries with Turkey as a benchmark—a market economy representing a region free of the experience of communism.

Table 1.

Comparison of the propensity to export: V-4 countries, other post-communist countries, and Turkey

Export (national sales less than or equal to 99% of establishment's sales)		
Country	Mean	Freq.
Turkey	0.57896874	2463
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 Rep.	*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

Export (national sales less than or equal to 99% of establishment's sales)		
Country	Mean	Freq.
Russia	0.18341232	2110
Kyrgyz Rep.	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
Total	0.28795883	29341

Source: authors' own calculations based on BEEPS data.

Table 1 reveals a great degree of heterogeneity across the firms in the V-4 countries as well as across the whole region. It can be noted that on average Turkish companies are the most export-oriented among firms in the region. A high share of exporting firms is typical for the countries that emerged from the former Yugoslavia which had been traditionally more market-oriented and had more liberal trade regimes in the past compared to other communist countries. In contrast to the aforementioned countries, the share of exporting firms from the former Soviet Union is the lowest, with the exception of the Baltic states. Finally, the V-4 countries are located in the upper-middle sector of the group. The largest share of the exporting firms has been reported in Slovakia, Hungary and the Czech Republic being in the middle, and Poland at the bottom. This is in line with the frequent observation that firms from bigger countries usually sell their products in domestic markets. However, a great degree of heterogeneity in export performance even among the V-4 countries cannot be explained by the country characteristics only 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.

Our sample used in the econometric analysis includes a cross-section for 4602 Central European firms based in the four Visegrad (V-4) countries: the Czech Republic, Hungary, Poland and Slovakia in the years analyzed. The size of firm sample in each country is given in Table 2[2]. The yearly distribution of firms is presented in Table A.1 in the Annex.

[2] Minor differences in the total number of firms are related to unidentified firms in the global database.

Table 2.

Sample sizes in V-4 countries

Export (national sales less than or equal to 99% of establishment's sales)	Freq.	Percent
Total	4602	100.00
Non exporters	3134	68.10
Exporters	1468	31.90
Poland	1930	100.00
Non exporters	1404	72.75
Exporters	526	27.25
Czech Republic	859	100.00
Non exporters	563	65.54
Exporters	296	34.46
Hungary	1151	100.00
Non exporters	747	64.90
Exporters	404	35.10
Slovakia	662	100.00
Non exporters	420	63.44
Exporters	242	36.56

Source: authors' own calculations based on BEEPS data[3].

The probability of exporting in V-4 firms is related to the explanatory variables on firm and sector characteristics. These variables are based on survey questions regarding identification of firm, sector of activity, legal and economic status, characteristics of managers and size of the firm are assembled, the infrastructure of services in analyzed country, economic performance and key characteristics of reviewed firms, as well as stakeholders, e.g. employers organizations, employees organizations, local government, central government, ICT industry, SMEs, academics, etc.

Table 3.

Description of variables used in empirical study

Variable name	BEEP input name	Description
Export	*d_d3a*	binary variables, that takes the value 1 if the establishment is exporting and zero if not

[3] As demonstrated in Table A.1, it is almost impossible to create a panel data set for a large number of the same firms in all years covered by the survey. Therefore, we have analyzed the probability of exports of all firms included in the data base, independently from the year of the analysis or country.

Variable name	BEEP input name	Description
	Labour productivity	
lprod	*lprod* = log(*lprod*) *prod* = *d*2/l1	logarithm of productivity expressed as total amount of annual sales per full time employee
lprod_cost	*prod_cost* = (*d*2 – *n*2*a* – *n*2e)/l1 *lprod_cost* = log(*prod_cost*)	logarithm of productivity expressed as total amount of annual sales net of raw materials and labour cost, per full time employee
	Human capital	
lUniv	IECAq69	logarithm of % employees at end of fiscal year with a university degree
Lsk_prod	*sk_prod* = (*l*4*a*/*l*3*a*)*100	logarithm of % of skilled production workers
R&D spending	R&D = (ECAo4/*d*2)*100	logarithm of % of total annual sales spent on research and development
size	*l*1	Size of firm
small	*l*1	dummy variable for small size establishments. Takes the value one if the establishment hires <20 employees, and zero otherwise.
medium	*l*1	dummy variable for medium size establishments. Takes the value 1 if the establishment hires between 20–99 employees, and zero otherwise.
large	*l*1	dummy variable for large size establishments. Takes the value one if the establishment hires 100 employees, and zero otherwise.
	Internationalization of firm	
foreign	e6	binary variable, that takes the value 1 if the establishment uses technology licensed from a foreign-owned company, and 0 otherwise
ownerf	*b*2*a*	binary variable, that takes the value 1 if shares owned by private foreign individuals, companies or organizations.

4. Estimation results

In this section we will present three sets of the estimation results. First, we will discuss the benchmark results obtained for the whole V-4 group. Then, we will show the sensitivity tests. Finally, we will discuss the results for the individual countries.

4.1 Benchmark results for the whole V-4 group

In columns (1)–(2) of Table 4 we report baseline results that come form the specification that includes various measures of productivity, having controlled for standard factors mentioned in other studies. In the first case, productivity is expressed as the total amount of annual sales per full time employee (*lprod*), while in the second productivity is expressed as total amount

of annual sales net of raw materials and labour cost, per full time employee (*lprod_cost*). Other factors that may affect export activity include the level of innovations proxied by the R&D spending (*R&D*), the stock of human capital proxied by the percentage of employees with university degrees (*univ*) and the share of skilled workers in total full-time employment (*lsk_prod*). In addition, we control for the foreign ownership of the firm (*ownerf*), and the size of the firm (*medium* and *large*).

Table 4.

Baseline Results

VARIABLES	(1)	(2)	(3)	(4)
lprod	0.0990***		0.105***	
	(0.0183)		(0.0196)	
univ	0.00586***	0.00563***	0.00571***	0.00558***
	(0.00158)	(0.00169)	(0.00169)	(0.00170)
lsk_prod	0.0488**	0.0384*	0.0400*	0.0373
	(0.0222)	(0.0228)	(0.0229)	(0.0228)
R&D spending	0.0443***	0.0550***	0.0529***	0.0536***
	(0.00509)	(0.00624)	(0.00628)	(0.00630)
foreign			0.565*	0.513
			(0.332)	(0.338)
ownerf	0.00828***	0.0104***	0.0102***	0.0103***
	(0.00141)	(0.00171)	(0.00171)	(0.00171)
medium	0.514***	0.476***	0.473***	0.472***
	(0.0877)	(0.0944)	(0.0940)	(0.0945)
large	0.701***	0.619***	0.611***	0.622***
	(0.104)	(0.118)	(0.118)	(0.119)
lprod_cost		0.0954***		0.0941***
		(0.0188)		(0.0189)
Constant	–1.908***	–1.547***	–1.805***	–1.548***
	(0.284)	(0.282)	(0.309)	(0.282)
Observations	1,544	1,335	1,345	1,335
Log likelihood	–808.3	–671.5	–676.7	–670.3
Pseudo R2	0.200	0.202	0.205	0.204

Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Our estimation results reveal that all variables are statistically significant at the 1 per cent level with the exception of the share of skilled workers in to-

tal full-time employment which is statistically significant at the 5 per cent level. The estimated signs of parameters on our explanatory variables are in line with the expectations and results of other studies. Both measures of productivity are statistically significant at the 1 per cent level and display expected positive signs. This means that the higher level of productivity is positively related to the probability of exporting. Therefore, in the further analysis we will use the first measure of productivity. Moreover, all measures of human capital: the level of R&D, the share of skilled workers in employment and workers with university degrees are positively related to the probability of exporting. Finally, the probability of exporting increases with firm size and foreign ownership.

In columns (3)–(4) we control for the relative openness of the firm to the foreign technology licensed from a foreign-owned company (foreign). The inclusion of this variable does not change much our previous conclusions as it is statistically significant at the 10 per cent level only when productivity is measured as the total amount of annual sales per full time employee, and not statistically significant when productivity is expressed as the total amount of annual sales net of raw materials and the labour cost. In both cases the estimated parameters on the productivity variables remain statistically significant at the 1 per cent levels. However, the inclusion of the foreign technology variable affects the statistical significance of the skilled labor variable. In the first case, the skilled labour variable becomes statistically significant at the 10 per cent level only while in the second it completely loses its statistical significance.

4.2. Sensitivity tests for the whole V-4 group

In Table 5 we study the sensitivity of our benchmark results reported in column (1) of Table 4.

Table 5.

Sensitivity tests

VARIABLES	(1)	(2)	(3)	(4)
lprod	0.0914***	0.0916***	0.0941***	0.0972*
	(0.0185)	(0.0186)	(0.0203)	(0.0502)
lsk_prod	0.0514**	0.0517**	0.0339	0.0479**
	(0.0223)	(0.0223)	(0.0238)	(0.0222)
lRaD	0.0405***	0.0407***	0.0363***	0.0437***
	(0.00653)	(0.00654)	(0.00567)	(0.00515)
univ	0.00659***	0.00655***	0.00532***	0.00575***
	(0.00158)	(0.00158)	(0.00178)	(0.00160)
ownerf	0.00884***	0.00882***	0.00813***	0.00829***
	(0.00143)	(0.00143)	(0.00150)	(0.00142)

medium	0.512***	0.515***	0.452***	0.518***
	(0.0882)	(0.0884)	(0.0979)	(0.0880)
large	0.699***	0.693***	0.596***	0.705***
	(0.105)	(0.106)	(0.115)	(0.105)
lnonprod_workers			0.0337***	
			(0.0131)	
Constant	–2.011***	–2.011***	–1.987***	–1.897**
	(0.292)	(0.292)	(0.325)	(0.824)
Time dummies	YES	YES	YES	YES
Sector dummies	NO	YES	YES	YES
Country dummies	NO	NO	NO	YES
Observations	1,544	1,534	1,294	1,544
Log likelihood	–793.2	–790.7	–670.0	–808.0
Pseudo R2	0.215	0.209	0.216	0.200

Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

In column (1) we include time dummies for individual years of our sample. However, it turns out that our results in qualitative terms remain the same. All variables are statistically significant at the previous levels and the values of the estimated coefficients are very similar. In column (2) we add dummy variables for specific sectors. However, our results remain almost unchanged as jointly those sectoral dummies were not statistically significant[4].

In column (3) we included an additional variable reflecting the share of the non-productive workers in total employment. This variables was statistically significant at the 1 per cent level and displayed a positive sign. The estimation results did not change much with the exception of the skilled workers variable which became statistically not significant. Finally, in column (4) we added country dummies for particular V-4 countries. However, our results did not change much as none of the country-specific variables was statistically significant. The only impact of the inclusion of these variables was the fall in the level of statistical significance of the productivity variable from the 1 to 10 per cent level. This result may suggest that the average productivity of firms differs across the V-4 countries, and the country dummies might have overtaken the information included in the productivity variable (see Table A.3 in Annex for ANOVA analysis). However, the relationship between the level of productivity and the probability of exporting should be investigated separately for each country.

[4] The only sectoral dummy variable that was statistically significant was the dummy variable for the food sector. This variables was statistically significant only at the 10 per cent level and displayed a negative sign.

4.3. Results for individual V-4 countries

In Table 6 we show the estimation results obtained form the benchmark specification for the individual V-4 countries.

Table 6.

Results for individual V-4 countries

		(1)	(2)	(3)	(4)
EQUATION	VARIABLES	CZ	HU	PL	SK
	univ	0.0197***	0.00917**	0.00218	0.000199
		(0.00459)	(0.00426)	(0.00236)	(0.00618)
	lsk_prod	0.0899*	0.0525	0.00161	0.110
		(0.0534)	(0.0335)	(0.0473)	(0.190)
	lR&D	0.0850***	0.0285**	0.0567***	0.0752***
		(0.0148)	(0.0134)	(0.00944)	(0.0261)
	foreign		–0.245	0.985*	–0.556
			(0.872)	(0.535)	(0.704)
	ownerf	0.00893**	0.0127***	0.0107***	0.00600
		(0.00390)	(0.00304)	(0.00297)	(0.00584)
	lprod	0.397**	0.166	–0.103	0.140
		(0.188)	(0.107)	(0.0891)	(0.215)
	medium	0.521*	0.673***	0.372***	–0.155
		(0.277)	(0.166)	(0.141)	(0.414)
	large	0.417	0.966***	0.476**	1.092**
		(0.257)	(0.235)	(0.189)	(0.441)
	Constant	–5.894**	–3.346*	0.952	–2.035
		(2.636)	(1.752)	(1.091)	(3.096)
	Observations	233	356	652	99
	Log likelihood	–98.46	–19 4.8	–31 0.9	–48.29
	Pseudo R2	0.331	0.199	0.157	0.284

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

In column (1) we display the estimation results for the Czech Republic. These results are very similar to those obtained for the whole sample of the V-4 countries although the level of statistical significance for particular variables is slightly lower. In particular, the estimated coefficient on the labour productivity displays a positive sign but it is statistically significant only at

the 5 per cent level. The measures of human capital (R&D spending, skilled labour and university education) are all positively related to the probability of exporting although at different levels of statistical significance. The foreign ownership is also positively related to the probability of exporting at the 5 per cent level. Firm size is significant at the 10 per cent level but only for the medium sized firms.

In column (2) we show the estimation results for Hungary. In contrast to the results obtained for the Czech Republic, the level of labour productivity does not seem to be related to the probability of exporting. Only two measures of human capital—R&D spending and the share of university graduates—are statistically significant at the 5 per cent level, while the share of skilled labour is not statistically significant. Finally, the probability of exporting increases with firm size and foreign ownership.

In column (3) we report estimation results for Poland. These results are quite similar to those obtained for Hungary, although two important differences exist. In particular, the share of university graduates in firms is not statistically significant while the imported foreign technology variable is statistically significant at the 10 per cent level.

Finally, in column (4) we report estimation results for Slovakia. In this case, a majority of the estimated parameters are not statistically significant. Exceptions include the estimator for large firms and the level of R&D spending. This results might be due to the small sample size.

The poor results for the variable proxing labour productivity in the model estimated separately for each of V-4 country, might result from the fact that labour productivity is less diversified within each country than between the countries. This could explain the statistical significance of the variable in the pooled regression and a weaker significance in the models estimated separately for each country.

5. Conclusions

In this paper we have investigated the determinants of export activity of firms based in the Visegrad-4 countries. The study covers the Czech Republic, Hungary, Poland and Slovakia and was based on firm level data for the 2002–2009 period. First, we started with estimating probit regressions for the pooled dataset that included all V-4 countries. We then disaggregated the sample into particular countries. Our preliminary estimation results obtained for the whole V-4 sample indicated that the probability of exporting increases with the higher level of labour productivity and the measures of human capital, including the share of university graduates in productive employment, R&D spending, and skilled labour. The results obtained separately for the specific Visegrad-4 countries revealed a similar pattern although a smaller number of explanatory variables were statistically significant for most countries. In particular, the spending on research and development activities was statistically significant in all analyzed countries. This may be due

to the fact the R&D spending in those countries is on average relatively low compared to the old EU-15 countries. The other two variables that were statistically significant in three out of four countries were foreign ownership and firm size. This is in line with the results of previous studies.

Moreover, the internationalization of the firms proxied by the use of foreign technology licenses and the foreign ownership was positively related to the probability of exporting. Finally, firm size was also a significant variable for the probability of exporting.

The results obtained for particular V-4 countries revealed some degree of heterogeneity among those countries. In particular, the productivity of labour and measures of human capital were statistically significant in the case of the Czech Republic and less so for the other V-4 countries. The size of the firm and foreign ownership were statistically significant for all V-4 countries except for Slovakia.

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Annex

Table A.1.

The yearly distribution of firms in V-4 countries

Summary of Exports (national sales than or equal to 99% of establishment's sales)	2002		2005		2009		Total
Country	Mean	Freq.	Mean	Freq.	Mean	Freq.	Freq.
Poland	0.31	500	0.25	975	0.28	455	1930
Czech Rep.	0.34	268	0.26	343	0.46	248	859
Hungary	0.32	250	0.36	610	0.35	291	1151
Slovakia	0.45	170	0.35	220	0.33	272	662

Source: authors' own calculations based on BEEPS data.

Table A.2.

Correlation matrix for the variable *lsk_prod* and *lnonprod_workers*

	lnonpr~k	*lsk_prod*
lnonprod_w~k	1.0000	
lsk_prod	–0.0154	1.0000

Table A.3.

ANOVA analysis for the productivity proxy in V-4 countries

a.1 Country Code	Summary of lprod				
	Mean	Std. Dev.	Freq.		
Poland	11.726316	.90374249	1380		
Czech Rep.	13.817131	1.1514695	640		
Hungary	16.236382	.99636648	957		
Slovakia	13.974055	.94278639	483		
Total	13.674267	2.0772929	3460		
Analysis of Variance					
Source	*SS*	*df*	*MS*	*F*	*Prob > F*
Between groups	11575.0627	3	3858.35423	3979.22	0.0000
Within groups	3351.02672	3456	.969625787		
Total	14926.0894	3459	4.31514582		
Bartlett's test for equal variances: chi2(3) = 56.0137 Probchi2 = 0.000					

Note: According to results obtained for Bartlett's test, we reject the hypothesis of equal variances across the analyzed V-4 countries for the *lprod* variable.

Abstract **Export Activity in Visegrad-4 Countries: Firm Level Investigation**

Following the new strand in the new trade theory literature that focuses on firm heterogeneity initiated by the Melitz [2003] model, in this paper we investigate the determinants of export activity of firms in the Visegrad-4 countries. The study covers the Czech Republic, Hungary, Poland and Slovakia and is based on firm level data for the 2002–2009 period. We will start with estimating probit regressions for the pooled dataset that includes all V-4 countries and will then disaggregate the sample into particular countries. Our preliminary estimation results obtained for the whole V-4 sample indicate that the probability of exporting increases with the higher share of university graduates in productive employment, larger spending on R&D projects, the use of foreign technology licenses, foreign ownership, higher productivity and company size. The results obtained for particular V-4 countries reveal some degree of heterogeneity among those countries.

Key words: export activity, firm heterogeneity, Central Europe
JEL code: