EQUILIBRIUM
Quarterly Journal of Economics and Economic Policy
Volume 13 Issue 2 June 2018
p-ISSN 1689-765X, e-ISSN 2353-3293
www.economic-policy.pl

ORIGINAL PAPER

Citation: Cieślik, A., & Michałek, J. J. (2018). Process and product innovations, multi-product status and export performance: firm-level evidence from V–4 countries. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, *13*(2), 233–250. doi: 10.24136/eq.2018.012

Contact to corresponding author: michalek@wne.uw.ed.pl, University of Warsaw, Faculty of Economic Sciences, Długa 44/50, Warszawa, Poland
Received: 26 May 2017; Revised: 11 February 2018; Accepted: 5 April 2018

Andrzej Cieślik
University of Warsaw, Poland

Jan Jakub Michałek
University of Warsaw, Poland

Process and product innovations, multi-product status and export performance: firm-level evidence from V–4 countries

JEL Classification: *F14; O32; P33*

Keywords: *export activity; firm heterogeneity; process and product innovations; multi-product status; Visegrad countries*

Abstract
Research background: In this paper, we study empirically the relationship between different forms of innovations, multi-product status and export performance of firms from four Visegrad countries. We treat innovations as the key element that can increase the level of firm productivity.
Purpose of the article: The main objective is to analyze the empirical relationship between different firms of innovation of firms from Visegrad countries and their export performance. In contrast to previous studies that use R&D spending as a measure of innovation, we rather relay on innovation outcomes. Our detailed hypotheses postulate the existence of positive relationships between firm export performance and different forms of innovation. We seek to determine which type of innovation activity is of the greatest importance for exporting and whether it depends on firm size, the level of internationalization, the use of human capital and its sector of activity. In addition, we control for the multi-product status of firms, i.e. whether they sell one or many products.
Methods: The measures of innovative activity of companies include both spending on R&D as well as its effects, such as product and process innovations. In addition, we control for the

multi-product status measured by the share of the main product in total sales of the firm, as well as for other firm-level characteristics. The empirical implementation of the theoretical framework is based on the probit models, applied to the fifth edition of BEEPS firm level data set covering the period 2011–2014.

Findings & Value added: Our results indicate that the probability of exporting is positively related to both product and process innovations but not to the multi-product status. In addition, we find that the probability of exporting is related to the set of control variables including labor productivity, firm size, the share of university graduates in productive employment, foreign capital participation and the use of foreign licenses.

Introduction

Innovation can be an important element of the modernization and export expansion of Visegrad–4 countries (V–4) and their convergence with more developed member states of the European Union (EU). The measures of innovative activity of firms typically include spending on R&D as well as its effects, such as patents and the share of new products in the total sales. One of the key elements of innovation activity is research and development (R&D), which is described as the process of systematic creative work that combines both basic and applied research aimed at extending the company's knowledge resources and their practical application. R&D activity may lead to product and process innovations, as well as the creation of intellectual property right related to patents and trademarks.

The main objective of this paper is to analyze empirically the relationship between innovation of firms in V–4 countries and their export competitiveness. In particular, we attempt to validate the main hypothesis concerning the positive relationship between innovation activities and exporting. In particular, in our paper we investigate the main hypothesis that various forms of innovations may differently affect efficiency of firms from V–4 countries and their ability to export. In contrast to the majority of previous studies that use R&D spending as a measure of innovation, we analyze innovation outcomes as well.

Our detailed hypotheses postulate the existence of a positive relationships between firm export performance and different types of innovation activities. In particular, we seek to determine which types of innovation are of the greatest importance for exporting, having controlled for firm size, the level of internationalization, the use of human capital and its sector of activity. In addition, we hypothesize that the number of varieties produced by the firm, i.e. the multi-product status of the firm, is positively related to the probability of exporting. Our study is based on the firm-level data for the period 2011–2014.

The results of our study can help in proposing a set of policy conclusions that can apply to firms from V–4 countries. The firms from those countries are lagging behind in terms of innovation activities, and their presence in foreign markets is still limited compared to the firms from the more developed EU member states. This is particularly important in the light of changes in the allocation of the EU funds in the current Financial Perspective, i.e. increasing expenditure for innovative firms, aimed at increasing their presence in the global markets. This study should also contribute to a better understanding of the mechanisms of cooperation between managers, engineers, scientists and research centers serving to create new processes, products and technological progress as well as social development of V–4 countries.

The structure of this paper is as follows. In Section 1, we provide the literature review of previous empirical studies on the innovation-exports nexus. In Section 2, we describe the analytical framework. In Section 3, we describe the dataset. In Section 4, we present our empirical results. The last section summarizes and concludes.

Literature review

The recent strand in the international trade literature has placed the relationship between firm productivity and exporting in the center of analysis. This strand was initiated by empirical studies for the United States by Bernard and Jensen (1995), and for Columbia, Mexico and Morocco by Clerides *et al.* (1998). Subsequently, a large number of empirical studies for other countries followed. Frequently cited examples include studies by Bernard and Wagner (1997) and Wagner (2002) for Germany, Delgado *et al.* (2002) for Spain, Castellani (2002) for Italy, Girma *et al.* (2003, 2004) for the UK; Baldwin and Gu (2003) for Canada, Hansson and Lundin (2004) for Sweden.

These empirical studies served as a basis for the list of micro-level stylized facts concerning the export activity at the firm-level. In particular, it turned out that only a fraction of all firms export, while the majority of them concentrate their activity on the domestic market only. Moreover, the exporters were found to be more productive and bigger than non-exporters. Following the developments in the empirical literature the theoretical modeling of the role of firm heterogeneity in the context of export performance was initiated by Melitz (2003). His original model was extended by a number of scholars including Melitz and Ottaviano (2008), Jung (2012), Demi-

dova and Rodríguez-Clare (2013).[1] However, Melitz-type models typically assume that firm productivity is exogenously given, while in reality productivity can be related to innovation activities.[2]

The majority of existing empirical work on the relationship between innovation activities and exporting concentrates on developed countries. In one of the earliest studies, Wakelin (1998) employed British firm-level data to report a positive impact of innovation activity on exports. Similar findings were reported in the majority of studies for other developed countries: Bernard and Jensen (1999) for the US, Roper and Love (2002) for the UK and Germany, Ebling and Janz (1999), Lachenmaier and Wößmann (2006) and Becker and Egger (2013) for Germany, Caldera (2010), Van Beveren and Vandenbussche (2010) for Belgium, Damjan *et al.* (2010) for Slovenia, Cassiman *et al.* (2010) and Filipescu *et al.* (2013) for Spain and Gkypali *et al.* (2015) for Greece.

The empirical evidence on the relationship between innovation activities and exporting for firms from less developed members of the European Union is less abundant. The existing studies which use firm-level data focus mainly on the relationship between productivity and export performance, having controlled for other firm characteristics in the context of CEE countries was studied by Hagemejer and Kolasa (2013), Békés *el al.* (2011), Békés and Muraközy (2012), Cieślik *et al.* (2012; 2013a, b; 2014; 2015).

In studying the relationship between productivity and export, R&D spending was often included as one of control variables. For example, Cieślik *et al.* (2012a, b; 2014; 2015) confirmed the positive relationship between R&D expenditure and the probability of exporting in the number of Central and East European countries using the BEEPS data. In more recent studies for selected CEE countries, the role of different forms of innovations was studied. The examples for Poland include studies by Cieślik and Michałek (2016), Cieślik *et al.* (2016), Brodzicki (2016, 2017), Brodzicki and Ciołek (2016).

The most recent studies by Cieślik and Michałek (2017a, b) have studied the relationship between different forms of innovations and exporting using the multi-country firm-level dataset for two groups of countries: the new EU member states and the European and Central Asian (ECA) countries, respectively. These studies have demonstrated the significant role of both product and process innovations for export performance of firms in

[1] The development of this literature has been summarized by Redding and Melitz (2014).

[2] Some theoretical studies attempt to endogenize productivity. Examples include Atkeson and Burstein (2007) and Constantini and Melitz (2008).

analyzed countries. However, the empirical evidence for the group of V–4 countries is still missing.

Another important aspect of firm export performance relates to their multi-product status. Some recent theoretical studies aim at studying the relationships between the number of product produced and firm export performance. The examples of theoretical modeling of multi-product firms include Feenstra and Ma (2008), Eckel and Neary (2010), Bernard *et al.* (2011), Arkolakis and Muendler (2013) and Mayer *et al.* (2014).[3] Bernard *et al.* (2010), argue that product switching for the US firms is correlated with both firm- and firm-product attributes, and that product adding and dropping induce large changes in firm scope. Eckel and Neary (2010) study how globalization affects the scale and scope of multi-product firms, and show that productivity increases as firms concentrate on their core competence. Finally, Mayer *et al.* (2014) show theoretically and empirically for French firms that tougher competition in an export market induces a firm to skew its export sales toward its best performing products.

The contribution of our paper to the literature is empirical one. In particular, in this paper we study which forms of innovations can improve efficiency of firms from V–4 countries and whether they can increase their exports. There are serveral differences between our paper and the previous studies. First, in contrast to earlier literature for more developed EU members, our research is based on a comparable multi-country firm-level data collected by the World Bank. This allows us to study the relationship between various forms of innovations and exporting for firms from V–4 countries, depending on their multi-product status and ownership.

Secondly, on the one hand, we study various sources of innovations such as domestic R&D, the use of foreign technologies, while on the other hand — the innovation outcomes. We proxy the use of foreign technology by the purchase of foreign licenses, as well as the involvement of foreign companies in the host country. Moreover, we investigate the relative importance of various types of innovation outcomes for export performance such as: product, process, as well as marketing and managerial innovations, having controlled for the multi-product status of the firm. This allows identifying the relative importance of various types of innovation activities for exporting of firms from V–4 countries, which are still less innovative when compared to their counterparts from the more developed EU members.

[3] Some of the aforementioned models are extensions of the framework proposed by Allanson and Montagna (2005) for a closed economy.

In addition, our study will allow for formulating specific recommendations for economic policy for firms from V–4 countries, especially for policies to encourage innovation in these countries.

Analytical framework

Following a majority of empirical studies on European firms surveyed in the literature review section, such as recent studies by Cieślik and Michałek (2017a,b), we refer to the Melitz (2003) self-selection hypothesis showing the positive impact of firm productivity on export performance.[4] In addition to firm productivity in our empirical approach we analyze other firm-level variables which might affect export performance and were used in previous studies.

The dependent variable used in our empirical model showing the export status of firm i is denoted by Y_i*. We observe only the binary variable Y_i indicating the sign of Y_i^*, instead of observing the volume of exports, i.e. whether the firm sells its output in only the domestic market or it exports. Furthermore, it is assumed that the variable Y_i^* follows $Y_i^* = \mathbf{X_i\Theta} + \varepsilon_i$, where the error term ε_i is assumed to satisfy the standard properties, $\mathbf{X_i}$ is a vector of explanatory variables that affect exports, and $\mathbf{\Theta}$ is the parameter vector on these variables that needs to be estimated.

The export status binary variable takes the value 1 when the firm exports and 0 otherwise:

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

Therefore, the probability that a firm exports can be written as follows:

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

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

[4] The previous empirical evidence favoring the self-selection hypothesis is summarized by Wagner (2007, 2012).

The interpretation of the estimated coefficients on the explanatory variables Θ obtained from the probit model can be explained as follows. For 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:

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

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

Data description

Our study is based on "EBRD-World Bank Business Environment and Enterprise Performance Survey" (BEEPS) data compiled by the World Bank and the EBRD in the post-communist countries in Europe and Central Asia (ECA). The main goal of the BEEPS data base was to provide firm level information from in the aforementioned countries.

Our sample covers the period 2011–2014 for which the BEEPS V data was collected[5]. The BEEPS data base includes information on both the manufacturing and services sectors. Particular industries within each sector may differ with respect to their capital intensity and export performance. However, the number of enterprises operating in each sector was small, and it was impossible to run estimations separately for each sector. Therefore, to control for heterogeneity within each sector we include industry-specific effects in addition to individual firm characteristics.

Unfortunately, only a small proportion of firms was sampled every year and, therefore, the application of panel data analysis is impossible. Thus, we used the standard probit procedure on the pooled cross-section dataset without controlling for individual firm effects, but we control for country-specific and industry-specific effects. In three cases the data includes about 250–300 observations per country, with the exception of Poland (542 firms).[6]

The dependent variable in our regression indicates the export status of the firm. This variable takes the zero value if the firm sells its output only

[5] Almost 60% of surveys in all countries were made in year 2013. The numbers of observations (surveys) per year were as follows: 2884 in 2011, 1833 in 2012, 13435 in 2013 and 4287 in 2014.

[6] The exact number of observation for each country, for all firms and those for which labor productivitry were calculated, is displayed in Table A.1 in Annex.

domestically, and one otherwise, if it exports some of its output. Based on previous empirical studies discussed in the literature review, we employ a number of explanatory variables, which reflect the firm characteristics and their innovation efforts. The variable description is presented in the Table 1, while their summary statistics are reported in Table 2.

The correlations between the explanatory variables are reported in Table 3.

The results presented in Table 3 show a high level of correlation between process and process innovations. The other forms of innovations are also weakly positively correlated. Therefore, one should interpret estimated coefficients on these variables with caution.

Estimation results

In this section, we report our estimation results in Table 4 obtained from specifications, in which we included the majority of independent variables which were used in previous empirical studies on firm level determinants of exports discussed in the literature review section.

First, in column (1) we show our benchmark results obtained from the specification, in which we controlled for a number of individual firm characteristics, but did not control for individual sectoral or country effects. In column (2) we added controls for individual sectoral or country effects. In subsequent columns we gradually eliminated the variables which were statistically not significant, keeping the variables used in empirical studies of Melitz (2003) model as long as possible. Thus, in column (3) we dropped the variables describing the age of firms and management and marketing innovations. Subsequently, in column (4) dropped all other non-significant variables, with the exception of key (in terms of Melitz (2013) model) labour productivity variable. Finally, in column (5) we showed the results of estimations including only statistically significant variables.

In column (1) of Table 4 we show the baseline results. The estimation is based on cross section analysis and covers the period 2011–2014. The independent variables describe various forms of innovations and firm R&D spending. The control variables include firm productivity, firm size, firm age, government and foreign ownerships, the stock of human capital measured by the percentage of workers with the tertiary degrees, and the use of foreign licenses. In addition, we control for the product mix of analyzed firm.

The estimated parameter on the productivity variable (*lprod*) is positive but statistically not significant. This result contradicts the Melitz (2003)

model. Out of four different forms of innovation outcomes, only one of them is statistically significant and displays expected positive sign — process innovations at 1 percent level of statistical significance. All other forms of innovations are statistically insignificant. This result is somehow unexpected, since in other empirical studies analyzing probability of exporting for post-communist economies, the product innovations are statistically significant and more important than process innovations (Cieslik & Michalek, 2017). On the other hand, the estimated parameter on the R&D spending (*R_D*), reflecting firm's efforts to increase innovativeness, is statistically significant at the 1 per cent level and displays expected positive sign, while the value of the estimator is high.

Moreover, some of our control variables are statistically significant and display expected signs. In particular, the variables describing firm size (*lsize*) and foreign ownership (*fo*) are statistically significant and display a positive sign. The variable reflecting the government ownership (*Share_gov*) is also statistically significant at 5 percent level, and displays the negative sign, which is also in line with other empirical studies, suggesting that state owned firms are usually less export oriented.

However, some other variables are statistically not significant in our estimation. In particular, the variable (*lage*), describing the experience of firm, does not affect export performance in V–4 countries. The variable describing the usage of foreign technology (*folicenses*) and the use of human capital (share of workers with tertiary degrees (*uni*)) are also statistically not significant, despite the fact that in other empirical studies these variables are usually positively affecting the probability of exports. Finaly, the variable describing product differentiation (*multi*) is also unimportant, in contrast to our preliminary hypothesis.

In column (2), we report estimation results obtained from the specification in which we control for both country and sector specific effects. These results are different in terms of statistical significance in the case of two variables, in comparison to benchmark results presented in the column (1). The estimator of the labor productivity variable (*lprod*) became positive and statistically significant, although at 10 percent level only. This result is in line with the prediction of Meltz (2003) model. The estimator describing the share of workers with tertiary degrees in total employment (*uni*) also became positive and statistically significant at 5 percent level, in line with other empirical studies. The signs and statistical significance of other variables did not change, while the value of the parameter on the R&D spending decreased significantly and that of process innovations increased slightly. The variables describing other forms of innovations remained statistically not significant.

In column (3), we report estimation results obtained from the specification in which we eliminated some statistically not significant variables used in the column (2). First, we eliminated both marketing and management innovations which are correlated and the variable describing the age of the firms. However, this elimination of the estimated equation did not change statistical significance of the remaining explanatory variables and modified only very moderately the estimated values of parameters on these variables. In particular, product innovations and variable *multi* remained statistically not significant.

In column (4), we eliminated all the remaining statistically not significant variables, i.e. that one describing mulit-product status (*multi*), product innovations and foreign licenses. The values of other estimators and their statistical significance did not change significantly. The main important exception is that the labor productivity (*lprod*) estimator, which was previously significant at only 10 percent level, lost its statistical significance in this specification. This result is not in line with the prediction of Melitz (2003) model. Moreover, the government share variable remained negative, but its statistical significance decreased from 5 to 10 percent.

Thus, in column (5) we report the results of estimation obtained from the specification in which we dropped the productivity variable. In consequence, the number of observations increased from 945 to 1316, since the amount of sales was not available for many firms. All other estimators did not change their signs and statistical significance. We can treat these results as final ones.

Conclusions

In this paper, we studied the relationship between various forms of innovations, multi-product status and export performance of V–4 firms. Our empirical analysis referred to the new strand in the trade literature that stresses the importance of firm productivity in entering the export markets. We treated innovations as the key element that can increase the level of productivity, and focused our analysis on different forms of innovations as well as spending on research and development. In addition, we analyzed the role of the multi-product status of the firm in determining its export performance. We also controlled for the stocks of human capital proxied by the percentage of employees with tertiary education, the experience of company in terms of years of activity, ownership status (state or foreign) and the usage of foreign technology (licenses). The empirical implementation of the theo-

retical framework was based on the probit model and the unique BEEPS V firm level data set for V–4 countries covering the period 2011–2014.

Our estimation results indicate that the probability of exporting is positively related to labor productivity, but this relationship is not always significant. At the same time, process innovations, spending on R&D, firm size, the share of university graduates in productive employment and foreign capital participation are always positively related to the probability of exporting, while the state ownership significantly decreases this probability. The significance of process innovations and spending on R&D for exporting is in line with majority of other empirical studies for other countries. However, we were not able to positively verify the hypothesis that multi-product firms exhibit different export performance in comparison to those that produce only a limited number of products.

The empirical results suggest that product innovations, frequently treated as the main source of firms' competitive advantage in other countries, are non-significant in the case of firms from V–4 countries. Management and marketing innovations and the use of foreign licenses turned out not to be statistically significant as well. These results suggest that firms from V–4 are efficient in implementing technological improvements increasing productivity, but less successful in inventing new products or implementing foreign technologies. On the other hand, the large inflow of foreign direct investment (FDI), mostly form other EU countries, is increasing export performance of firms located in V–4 countries. In addition, the multi-product status, contrary to our preliminary hypothesis, turned out not to be statistically significant for exporting as well.

Our results suggest that from the perspective of policy, the financial support for the development of new processes as well as R&D activities should have a positive impact of export performance of firms from the V–4 countries. The lack of statistical significance of the product innovation variable should be treated with caution, as previous empirical studies for other more developed countries indicate that product innovations are more important for export performance compared to process innovations. This result suggests that the firms in V–4 countries currently may not have sufficient capacity to develop entirely new products. However, it does not mean that they will not be able to develop such products in future. Therefore, the economic policy in V–4 countries should consider providing more support to product innovations. Future studies should focus on the various forms of support for innovations and R&D activities in these countries.

References

Allanson, P., & Montagna C. (2005). Multiproduct firms and market structure: an explorative application to the product life cycle. *International Journal of Industrial Organization*, *23*(7–8).

Atkeson, A, & Burstein A. (2007). Innovation, firm dynamics, and international trade. *NBER Working Paper, 13326*.

Becker, S. O. & Egger, P. H. (2013). Endogenous product versus process innovation and a firm's propensity to export. *Empirical Economics*, *44*(1).

Békés, G., Muraközy, B., & Harasztosi, P. (2011). Firms and products in international trade: evidence from Hungary. *Economic Systems*, *35*(1).

Békés, G., & Muraközy, B. (2012). Temporary trade and heterogeneous firms. *Journal of International Economics*, *87*(2).

Bernard, A., & Jensen, J. B. (1999). Exceptional export performance: cause, effect, or both?. *Journal of International Economics*, *47*(1).

Bernard, A. B., Redding, S. J., & Schott, P. K. (2010). Multiple-product firms and product switching. *American Economic Review*, *100*(1).

Brodzicki, T. (2016). Innovation intensity as a driver of firm's internationalization intensity. Evidence for Poland. *Ekonomia, Rynek, Gospodarka, Społeczeństwo, 46*.

Brodzicki, T., (2017). Internationalisation and innovation intensities of Polish manufacturing firms: a close nexus? *Entrepreneurial Business and Economics Review, 5*(1). doi: 10.15678/EBER.2017.050106.

Brodzicki, T., & Ciołek, D. (2016). Determinanty działalności eksportowej polskich firm produkcyjnych. *Gospodarka Narodowa*, *86/87*(2).

Caldera, A. (2010). Innovation and exporting: evidence from Spanish manufacturing firms. *Review of World Economy*, *146*(4).

Cassiman, B., Golovko, E., & Martínez-Ros, E. (2010). Innovation, exports and productivity. *International Journal of Industrial Organization*, *28*(4).

Cieślik, A., Michałek, J., & Michałek, A. (2012a). Determinanty działalności eksportowej polskich przedsiębiorstw. *Gospodarka Narodowa*, *80/81*(7-8).

Cieślik, A., Michałek, J., & Szczygielski, K. (2016). Innovations and export performance: firm-level evidence from Poland. *Entrepreneurial Business and Economics Review*, *4*(4). doi: 10.15678/EBER.2017.050205.

Cieślik, A., & Michałek, J. (2016). Innowacje a działalność eksportowa polskich przedsiębiorstw. *International Business and Global Economy*, *2*(2). Doi: 10.4467/23539496IB.16.067.5648.

Cieślik, A., & Michałek, J. (2017a). Innovations and export performance of new EU member states. *Ekonomista, 5*.

Cieślik, A., & Michałek, J. (2017b). Innovation forms and firm export performance: empirical evidence from ECA countries. *Entrepreneurial Business and Economics Review*, *5*(2). doi: 10.15678/EBER.2017.050205.

Cieślik, A., Michałek J., & Michałek, A. (2012b). Export activity in Visegrad 4 countries: firm level investigation. *Ekonomia, Rynek, Gospodarka, Społeczeństwo*, *30*.

Cieślik, A., Michałek, J., & Michałek, A. (2014). The influence of firm characteristics and export performance in Central and Eastern Europe: comparisons of Visegrad, Baltic and Caucasus States. *Entrepreneurial Business and Economics Review*, *2*(1). doi: 10.15678/EBER.2014.020102.

Cieślik, A., Michałek, J., Michałek, A., & Mycielski, J. (2015). Determinants of export performance: comparison of Central European and Baltic firms. *Finance a Uver*, *65*(3).

Cieślik, A., Michałek, J., & Szczygielski, K. (2016). Innovations and export performance: firm-level evidence from Poland. *Entrepreneurial Business and Economics Review*, *4*(4). doi: 10.15678/EBER.2016.040402.

Constantini, J. A., & Melitz, M. J. (2008). The dynamics of firm-level adjustment to trade liberalization. In E. Helpman, D. Marin, & T. Verdier (Eds.). *The organization of firms in a global economy*. Cambridge, MA: Harvard University Press.

Costas, A., & Muendler, M. A. (2013). Exporters and their products: a collection of empirical regularities. *CESifo Economic Studies*, *59*(2).

Damijan, J. P., Kostevc, C., & Polanec, S. (2010). From innovation to exporting or vice versa? *World Economy*, *33*(3). doi: 10.1111/j.1467-9701.2010.01260.x.

Demidova, S., & Rodríguez-Clare, A. (2013). The simple analytics of the Melitz model in a small economy. *Journal of International Economics*, *90*(2). doi: 10.1016/j.jinteco.2013.02.006.

Ebling, G., & Janz, N. (1999). Export and innovation activities in the German service sector. Empirical evidence at the firm level. *Zentrum fur Europäische Wirtschaftsforschung. ZEW discussion paper.*

Gkypali, A., Rafailidis, A., & Tsekouras, K. (2015). Innovation and export performance: do young and mature innovative firms differ?. *Eurasian Business Review*, *5*(2). doi: 10.1007/s40821-015-0030-4.

Jung, B. (2012). Optimal fixed cost subsidies in Melitz-type models. *Empirica*, *39*(1). doi: 10.1007/s10663-010-9165-9.

Lachenmaier, S., & Wößmann, L. W. (2006). Does innovation cause exports? Evidence from exogenous innovation impulses and obstacles using German micro data. *Oxford Economic Papers*, *58*(2).

Mairesse, J., & Mohnen, P. (2010). Using innovation surveys for econometric analysis. In B. H. Hall & N. Rosenberg (Eds.). *Economics of innovations, Vol. 2*. Amsterdam: North-Holland.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica*, *71*(6). doi: 10.1111/1468-0262.0046.

Melitz, M. J., & Ottaviano, G. (2008). Market size, trade, and productivity. *Review of Economic Studies*, *75*(1).

Redding, S. J., & Melitz, M. J. (2014). Heterogeneous firms and trade. *Handbook of International Economics*, *4*.

Roper, S., & Love, J. H. (2002). Innovation and export performance: evidence from the UK and German manufacturing plants. *Research Policy*, *31*(7).

Van Beveren, I., & Vandenbussche, H. (2010). Product and process innovation and firms' decision to export. *Journal of Economic Policy Reform*, *13*(1).

Wagner, J. (2007). Exports and productivity: a survey of the evidence from firm-level data. *World Economy*, *30*(1).
Wagner, J. (2012). International trade and firm performance: a survey of empirical studies since 2006. *Review of World Economy*, *148*(2).
Wakelin, K. (1998). Innovation and export behaviour at the firm level. *Research Policy*, *26*(7–8).

Acknowledgements

The article came into being within the project no. 2015/17/B/HS4/01077 entitled "Innovation activity and export competitiveness in the new EU member countries" financed by the National Science Center (NCN).

Annex

Table 1. Variables' definitions

Variable	Definition
Export	binary variables, that takes the value 1 if the establishment is exporting and zero if not
Lprod	logarithm of productivity expressed as total amount of annual sales per full time employee
Age	The number of years since the establishment of the company
Lprod	logarithm of productivity expressed as total amount of annual sales per full time employee
Share_gov	Percentage of capital owed by Government/State
Multi	100 minus the share of main product in total sales. This variable measures whether the firm is producing many (multiple) products (zero means that the main product represents 100% of supply)
Size	Logarithm of no. permanent, full-time employees of this firm at end of last fiscal year
Uni	Percentage of full time employees who completed a university degree
Fo	Binary variable indicating whether the percentage owned by private foreign individuals is larger than none
Innov-product	Binary variable describing whether new products/services were introduced over last 3 years
Innov_process	Binary variable describing whether new production/supply methods were introduced over last 3 yrs
Innov_management	Binary variable describing whether new organizational/ management practices were introduced over last 3 yrs
Innov_marketing	Binary variable describing whether new marketing methods were introduced over last 3 yrs
R_D	Binary variable describing whether there was a spending on R&D over last 3 years
Folicences	Binary variable describing whether the firm used technology licensed from foreign-owned company

Table 2. The summary statistics for all CEE countries in the BEEPS sample

Variable	Obs	Mean	Std. Dev	Min	Max
lprod	970	13.43721	2.548728	4.222626	25.79845
lage	1.354	2.755795	0.541417	0	5.087596
share_gov	1.350	0.544444	6.514671	0	99
multi	1.340	13.63731	19.6094	0	100
R_D	1.364	0.115836	0.320145	0	1
uni	1.374	27.39156	32.8869	0	100
lsize	1.355	3.000468	1.306228	0	9.195227
multi	1.340	13.63731	19.6094	0	100
fo	1.374	0.122999	0.328555	0	1
folicenses	1.362	0.162261	0.368826	0	1
innov_product	1.365	0.314286	0.464401	0	1
innov_process	1.367	0.225311	0.41794	0	1
innov_managamenet	1.369	0.195033	0.396371	0	1
innov_markketing	1.365	0.235165	0.424257	0	1

Table 3. The correlations between explanatory variables for all CEE countries in the BEEPS sample

	lprod	lage	share_~v	multi	R_D	uni	lsize	multi	Fo	folice~s	in~prod	inn~procs	inn~mgm	inn~mkt
lprod	1													
lage	-0.0801	1												
share_gov	0.0235	0.0549	1											
multi	-0.0144	0.0265	0.0107	1										
R_D	0.0376	0.0219	0.0067	0.1173	1									
uni	-0.0879	0.0119	-0.0369	0.0201	0.0155	1								
lsize	-0.0285	0.1857	0.1901	0.0424	0.1876	-0.0729	1							
multi	-0.0144	0.0265	0.0107	1	0.1173	0.0201	0.0424	1						
fo	0.0509	-0.0375	-0.0143	0.0461	0.0997	0.0228	0.2598	0.0461	1					
folicenses	-0.1151	-0.059	-0.0274	0.0858	0.0788	0.0567	0.1922	0.0858	0.1751	1				
innov_productt	0.0181	0.0238	-0.0665	0.1091	0.2874	-0.0099	0.0813	0.1091	0.0902	0.1465	1			
innov_process	0.051	0.0436	0.0179	0.0966	0.2649	-0.0601	0.1458	0.0966	0.125	0.1427	0.5174	1		
innov_managemnt	-0.0357	0.0756	-0.0098	0.0441	0.2459	0.0449	0.1502	0.0441	0.1256	0.1327	0.3203	0.4033	1	
innov_marketing	0.0159	0.063	0.0047	0.0557	0.0785	0.0429	0.0804	0.0557	0.0708	0.0933	0.3008	0.3078	0.4487	1

Table 4. Probality of exports: estimation results for V–4 countries over the 2011–2014 period

Variables	(1)	(2)	(3)	(4)	(5)
lprod	0.0192	0.0531*	0.0491*	0.0443	
	(0.0183)	(0.0299)	(0.0296)	(0.0290)	
lage	0.0860	0.0728			
	(0.0974)	(0.105)			
share_gov	-0.0275**	-0.0337**	-0.0338**	-0.0330*	-0.0314*
	(0.0129)	(0.0168)	(0.0170)	(0.0170)	(0.0168)
multi	0.00285	0.00316	0.00307		
	(0.00226)	(0.00241)	(0.00240)		
innov_product	0.0389	-0.104	-0.104		
	(0.115)	(0.125)	(0.122)		
innov_process	0.345***	0.370***	0.399***	0.336***	0.239**
	(0.128)	(0.136)	(0.130)	(0.112)	(0.0959)
innov_managem	0.0689	0.0991			
	(0.131)	(0.138)			
innov_marketing	-0.102	-0.0181			
	(0.120)	(0.128)			
R_D	0.610***	0.444***	0.453***	0.455***	0.478***
	(0.138)	(0.148)	(0.145)	(0.140)	(0.127)
uni	6.90e-06	0.00356**	0.00373**	0.00342**	0.00297**
	(0.00150)	(0.00169)	(0.00167)	(0.00162)	(0.00132)
lsize	0.216***	0.212***	0.219***	0.221***	0.215***
	(0.0388)	(0.0421)	(0.0411)	(0.0398)	(0.0323)
fo	0.483***	0.480***	0.482***	0.493***	0.427***
	(0.143)	(0.152)	(0.152)	(0.150)	(0.128)
folicenses	0.152	0.0672	0.0742		
	(0.124)	(0.135)	(0.133)		
Constant	-1.871***	-1.981***	-1.748***	-1.670***	-1.012***
	(0.394)	(0.475)	(0.384)	(0.378)	(0.151)
Country effects	No	Yes	Yes	Yes	Yes
Sectoral effects	No	Yes	Yes	Yes	Yes
Observations	914	914	924	945	1,316
Log likelihood	-514.1	-453.5	-459.0	-474.1	-663.9
Pseudo R2	0.126	0.229	0.227	0.220	0.199

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 5. The list of analyzed countries and the number of observations on labor productivity

Country	All observations	Summary of lprod		
		Mean	Std. Dev.	Frequency
Poland	542	12,53481	1,886507	390
Czech Rep.	254	14,34824	1,445675	215
Hungary	310	16,63346	1,384401	193
Slovak Rep.	268	10,75806	1,515367	172
total	1374			970