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Original citation & hyperlink:
Mulliqi, A, Adnett, N & Hisarciklilar, M 2019, 'Human Capital and Exports: A Micro-level Analysis of Transition Countries', The Journal of International Trade & Economic Development, vol. 28, no. 7, pp. 775-800.
https://dx.doi.org/10.1080/09638199.2019.1603319

DOI 10.1080/09638199.2019.1603319
ISSN 0963-8199
ESSN 1469-9559

Publisher: Taylor and Francis

This is an Accepted Manuscript of an article published by Taylor & Francis in The Journal of International Trade & Economic Development on 11/04/2018, available online: http://www.tandfonline.com/10.1080/09638199.2019.1603319

This is an accepted version of an article to be published by Taylor & Francis in The Journal of International Trade & Economic Development: https://doi.org/10.1080/09638199.2019.1603319

Human Capital and Exports: A Micro-level Analysis of Transition % Countries %

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Abstract

This paper investigates the impact of human capital endowments on export intensity employing firm level data for 29 transition economies. A particular focus is placed on comparing and contrasting Central and Eastern Europe countries (CEECs) with those from the former Soviet % Union, the Commonwealth of Independent States (CIS). The impact of the share of employees % with higher education, provision of on-the-job training, years of experience of the top manager and labour cost on export intensity is assessed. To test these relationships, Tobit and Fractional % Logit approaches are adopted. The estimation results suggest that, overall, having a more educated workforce exerts a positive impact on the export intensity of firms in transition economies, the % magnitude being larger for CEECs. Average labour cost, as an alternative measure, also turns out % to exert a positive but stronger impact. Insufficient evidence is found of a role for training programmes and years of experience of the top manager.

JEL Classification: F10, F14, I20, J24,

Key words: Export intensity, human capital, education, transition economies %

Acknowledgments: We thank the anonymous referees for their helpful comments and suggestions.

1. Introduction

The transformation of Central and Eastern Europe and the Former Soviet Union from centrally planned economic regimes to a market oriented system has been associated with a deeper integration of this region into the global economy. The overall export performance of these countries has increased significantly, reflecting their improving relative competitive positions. In 2016, exports of the Central Eastern European countries (CEECs[1]) accounted for approximately 1,112 billion and the Commonwealth of Independent States (CIS[2]) for approximately 645 billion (constant) US dollars, which represents, respectively, an increase of 404[3] and 134 percent since 1995 (World Bank, 2018a). The overall increase in exports over time has been accompanied by a significant expansion in the exports to GDP ratio in the CEECs. On average, the region's exports in 2016 accounted for 60 percent of their GDP, reaching the EU-18 average level, as compared to about 35 percent in 1995 (World Bank, 2018b). In contrast, having an initial ratio higher than the CEECs' average, the CIS has recorded a decrease of 9 percent in their export shares in GDP since 1995. The rapid export growth in many transition countries has been also accompanied by re-orientation of their export flows towards Western Europe (UNCTAD, 2016) and a growth in the exports of medium and high technology goods (World Bank, 2018c). However, despite the increased diversification, there are still significant differences between the CEECs and the CIS in terms of the destinations and level of sophistication of the goods and services exported. The key question addressed in this paper is to what extent the above indicators of the improved international competitiveness of transition countries, together with the differences in performance between these countries, can be explained by differences in their stock of human capital.

The transition process involved significant changes in the education and training systems in most of these transition economies. Switching to a market economy brought the need for a new set of skills that were not generally promoted and developed in the formerly planned economic system. An overview of schooling data by Barro and Lee (2014) shows that the process of transition was associated with decreases in the proportion of population with no completed schooling or with

[1] Albania, Bosnia and Herzegovina, Bulgaria, Czech Republic, Estonia, Croatia, Hungary, Kosovo, Lithuania Latvia, % FYR Macedonia, Montenegro, Poland, Romania, Serbia, Slovak Republic and Slovenia.

[2] Armenia, Belarus, Kazakhstan, Kyrgyz Republic, Moldova, Russian Federation, Ukraine and Uzbekistan. The % reported figure does not include Azerbaijan, Georgia, Tajikistan, and Turkmenistan due to missing data.

[3] Due to missing data for 1995, the rate of change calculation here does not include Bosnia and Herzegovina, % Montenegro, Kosovo and Albania. %

only primary education and an increase in the proportion of population who completed secondary education, the magnitude being significantly higher in the CEECs as compared to the CIS. The largest growth rate was recorded in tertiary education completions, albeit with considerable variations across the region. The growth in higher levels of education was also reflected in increases in the average years of total schooling. From 1990 to 2010, the transition region experienced an increase of 85.5 percent in the stock of population who had completed tertiary education, the rate being higher for the CEECs (Barro and Lee, 2014).

While the stock of educated individuals in transition economies has increased significantly over the last two decades, evidence on whether the quality of education has improved is less easy to establish. Hanushek and Woessmann (2012) constructed a quality measure by averaging international mathematics and science test scores over the period 1964-2003 for a sample of 50 countries. The cognitive skills indicator, measured by the average test scores from primary through to the end of secondary school, in the entire transition region was 4.71. The CEECs' average was 4.73 as compared to 4.88 in the EU-18, though Estonia, for instance, recorded higher test scores than many developed OECD countries, even outperforming Finland and other highly ranked performers. The average corresponding rate for the CIS was 4.62. Separate assessment of PISA[4], 2000-2009; TIMSS[5], 1995-2011 and PIRLS, 2001-2011 data shows a similar picture, with the gap between transition countries and the EU-18 narrowing for younger cohorts, implying improvements in the quality of primary education in the former countries.

Overall, a positive link between human capital and export intensity has been established in the empirical literature, though the measures used to capture the human capital dimension are often weak and little explicit reference has been made to transition countries. Van Dijk (2002) found that the share of skilled employees exerted a positive impact on export propensity of Indonesian firms, with the impact of the training dimension being relatively small. Average years of schooling, experience and tenure of employees were found to have a positive association with the probability of exporting in an analysis of Brazilian firms conducted by Arbache and De Negri (2005). Many

[4] Programme for International Student Assessment (PISA) is an international survey of the OECD that assesses the capabilities of 15-year-olds in reading, mathematics and science (see http://www.oecd.org/pisa for more information).
[5] Trends in International Mathematics and Science Study (TIMSS) and Progress in International Reading Literacy Study (PIRLS) are administered by the International Association for the Evaluation of Educational Achievement. TIMMS is conducted every four years at the fourth and eighth grades while PIRLS is conducted at the fourth grade every five years (see https://timssandpirls.bc.edu for more information).

studies have employed wage measures to proxy for the human capital of the workforce. A positive relationship between the average wage per employee and export propensity and intensity was found by Barrios et al. (2001) for a sample of Spanish firms. Bernard and Jensen (2001) and Wagner (2012) also found supporting evidence for the positive impact of average wages on the export propensity and intensity of American and German firms respectively. In addition, a positive association between the share of white collar, medium and highly qualified employees and export propensity and intensity was established in both research studies. Studies by Sousa et al. (2000), Ruane and Sutherland (2004), Arnold and Hussinger (2004), Alvarez (2007), Cassiman and Martínez-Ros (2007), and Eickelpasch and Vogel (2009), Dosi et al. (2013) and Falk and Hagsten (2015) all generated similar findings. Gashi et al. (2014) provide the only previous study of the impact of human capital and technology-related factors on the export behaviour in the transition region. The share of employees with higher education was found to exert a positive and significant impact on the export intensity of firms, but no evidence for the importance of on-the-job training, the share of skilled workforce and the education of the top managers was found.

By focusing on firms in transition economies, this paper makes several contributions to knowledge. The empirical analysis makes use of a large and very comprehensive firm level dataset that, in addition to the main variables of interest, allows the investigation of the role of other relevant competitiveness-enhancing factors. The measures of human capital that have been previously employed in empirical research are often weak and little reference has been made to transition countries. This study employs a comprehensive set of measures of human capital. In addition to the education level of the employees, the analysis below assesses the impact of on-the-job training programmes and the experience of the top manager. In an alternative model specification, the impact of average wages of the employees is also examined. Furthermore, the analysis splits the transition region into CEECs and CIS which enables a comparative assessment of the role of human capital in these two country groups and draw separate inferences in regard to the hypothesised impact of human capital. Another novelty of this paper is the assessment of the relative importance of human capital endowments for different industries, with particular focus on technologically-intensive goods. To assess the robustness of the empirical results, in addition to the Tobit approach which is commonly used in the literature, Fractional Logit is also employed.

The remaining parts of this paper are organized as follows: section 2 discusses data and variable specifications. The source of the dataset employed in this research paper, definitions of the explanatory variables, and their hypothesised influence on export intensity are summarized in this section. The subsequent section outlines the empirical modelling strategy and the advantages and disadvantages of each estimation approach; it explains the main rationale for using different estimation approaches. Section 4 reports and interprets the final estimates and marginal effects from the baseline model specification and also briefly summarizes the augmented model's outcomes. Finally, section 5 summarizes the main findings and examines their implications for policy-makers. The evidence obtained in this paper suggests the potential benefits of policy interventions that encourage and support higher education in these countries, in addition to complementary competiveness-enhancing actions.

2. Data and model specification

This paper uses micro level data obtained from the Business Environment and Enterprise Performance Survey (BEEPS) conducted by the European Bank for Reconstruction and Development (EBRD) and the World Bank. The dataset covers 14,539 enterprises in 29 countries[6] (17 CEECs and 12 CIS) surveyed in 2011-2014, making it the largest and most comprehensive firm-level dataset available for European and Central Asian transition countries. Although the main interest lies in the human capital dimension, given the large set of available indicators, this empirical investigation will also be able to account for other relevant competitiveness-enhancing factors. Export intensity is measured by the share of exports in firm's total sales.

The anticipated positive impact of human capital on export intensity is mainly explained through the mechanism of labour productivity. More skilled and competent employees are more likely to perform better at work, hence, enhancing the productivity level of the firm. Furthermore, a highly qualified labour force tends to be better endowed with specific skills, such as foreign languages or intercultural competence, which would facilitate the process of exporting through creating and maintaining contacts with clients in international markets (Van Dijk, 2002; Eickelpasch and Vogel, 2009). A similar explanation can be adopted for the role of the top manager on firm's exporting

[6] CEECs: Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Kosovo, Latvia, Lithuania, FYR Macedonia, Montenegro, Poland, Romania, Serbia, Slovak Republic, Slovenia; CIS: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Mongolia, Russia, Tajikistan, Ukraine, Uzbekistan.

activities. Even though, according to Syverson (2011), the impact of managers on firms' productivity has not been very much explored, a significant positive result is expected to be observed. Syverson (p.336) argues that managers are 'conductors of an input orchestra', as they organize the application of labour, capital and inputs. Similar to a conductor, poor managerial skills could cause 'discordant' production processes. Moreover, as Nazarov and Akhmedjonov (2011) argue, better managers are more likely to adopt new technologies, employ more educated workforce and offer more on-the-job trainings for their workers.

The productivity – export intensity nexus is then explained using Melitz's (2003) theoretical framework: more productive firms self-select themselves into international markets. A similar contribution has been made by Bernard et al. (2003). Their theoretical approach has been further extended by including other firm characteristics (such as, size, age, innovation and location) that are likely to influence export behaviour. This extension forms the basis of the eclectic model utilised below.

We use several proxies to measure human capital at firm level: the level of completed education of the workforce, the extent of on-the-job training, the share of skilled workers, top manager's experience, and average labour cost. The first measure is defined as the percentage of full-time employees who have completed a university degree. The importance of on-the-job training is captured by a dummy variable, which takes the value of one if the firm has provided formal training programmes for its employees and zero otherwise. The third proxy measure is defined as the percentage of skilled full-time production workers in a firm's total full-time workforce, while the final dimension represents years of experience of the top manager in the sector that the establishment operates in. Average labour cost in the establishment aims to capture the effect of human capital intensity and is included in the alternative model specification replacing the former set of human capital variables. This measure is calculated by dividing the total cost of labour - including wages, salaries and benefits - by the total number of employees. A justification for the use of this measure is that, in competitive markets, the level of compensation proxied by the average wage tends to be highly correlated with the skill structure of the labour force (Wagner,

2012). In line with the theoretical framework, all these measures are expected to exert significant positive effects on the export intensity of the surveyed firms.[7]

A significant body of literature has argued that engaging in innovative activities tends to boost firm's labour productivity, which in turn is reflected in more productive firms entering international markets (Cassiman et al., 2010; Calder, 2010; Aw et al., 2011; Cassiman and Golovko, 2011; Becker and Egger, 2013; Movahedi et al., 2017). This hypothesis will be tested by employing two distinct sets of innovation-related measures in alternative model specifications: an input measure represented by R&D spending and several output proxies: introduction of new products/services, new production/supply methods and new organisational/management practices or structures. Any potential endogeneity issue is precluded given that these measures refer to the preceding three-year periods and there is no reason to hypothesize that the current values of export intensity could have influenced previous years' innovation activities. In line with previous empirical studies, both innovation output and innovation inputs are expected to exert positive impact on the export intensity of firms. A relative measure of technology, firm's self-assessment of technological progress in comparison to its main competitor, is also used, though due to the high share of missing values this measure is only included in an alternative model specification which uses multiple imputation for missing observations. For practical reasons, this categorical variable is transformed into a binary dummy variable; it takes value one for firms that report to have a similar or more advanced technology compared to the main competitor and zero for those that report to have a less advanced technology.

The model is augmented by a set of control variables which are derived from various strands of previous research. Firm size is one of the most investigated characteristics in the firm internationalization literature. According to Wagner (1995, 2001, 2012), the positive impact of a firm's size on its exporting activities comes from the ability of larger firms to absorb the fixed costs associated with exporting and efficiency gains from economies of scale in production. Furthermore, larger firms tend to benefit from more specialized management and marketing

[7] One may argue that the direction of causality between education and a firm's engagement in exporting activities might not only be from the former to the latter and that it is more likely for the exporting firms to employ highly educated workforce. However, we argue that even if such a feedback mechanism is likely to exist, it would take time for firms to adjust the skill level of their workforce in response to changes in their exports. Furthermore, the summary statistics reveal that exporting firms in our sample have, on average, lower shares of educated individuals than non-exporters, which suggests that reverse causation is not likely to be present in our model.

practices, have higher risk-taking capacities due to their greater diversification, face fewer constraints in accessing finance and have advantages in competing for more qualified workers. However, there may be limits to these advantages. After some threshold point, expansion may become no longer profitable because of increased organization costs due to increased operation scale (Wagner, 2012). Furthermore, large firms might have no incentives to penetrate international markets if they exert monopoly power in their domestic markets (Wakelin, 1998). In our empirical investigation, firm size (number of employees) is included in quadratic form, and to avoid potential endogeneity, its three year lagged values are used.[8]

The age of the establishment, capturing the experience of the firm, is another characteristic that is expected to have a positive impact on the firm's export intensity (Roberts and Tybot, 1997; Barrios et al., 2001; Van Dijk, 2002; Arnold and Hussinger, 2004; Gashi et al. 2014; Wagner, 2014). Wagner (2014), for example, found empirical evidence supporting the positive link between the age of the firm and export propensity and intensity. In addition, the number of exporting destinations and products exported appeared to be positively affected by age. However, the expectation of a positive link between the firm's age and its exporting behavior has been queried by Van Dijk (2002), who argues that although older firms, given their business experience, might be more likely to engage in international markets, younger firms may be more likely to use new advanced technologies which enhance productivity and product quality. Arnold and Hussinger (2004), on the other hand, argue that age might be more important for relatively newer firms and experience gains are likely to be significant only until a certain threshold point. Hence, in this analysis, firm's number of years of experience is included in quadratic form. A logarithmic transformation has been applied to both the firm size and age given their skewed distributions.

Foreign ownership is considered as another important determinant of firm's engagement in exporting activities (Roberts and Tybout, 1997, Aitken et al., 1997, Bernard and Jensen, 1999, 2001, 2004, Greenaway et al., 2005, Alvarez and Lopez, 2005, Greenaway and Kneller, 2007, Roper et al. 2006). Foreign-owned firms are more likely to engage in international markets through exporting as they are generally more integrated into international business networks. Having more access to new and more advanced technologies, human capital, management know-how, and

[8] BEEPS data has two variables related to firm size: number of employees in the last fiscal year and three years prior to the survey. 4 percent of firms in the sample had not been in business three years prior to the survey; in order not to lose observations, these 'missing' values are replaced by the number of employees in the last fiscal year.

marketing expertise allows them to produce more efficiently (Van Dijk, 2002, Greenaway et al., 2004, Cassiman and Martínez-Ros, 2007). Foreign ownership is represented by a dummy variable, which takes the value of one if more than 50 percent of a firm's assets are foreign owned and zero otherwise. Given the major firm ownership transformations carried out during the process of transition in these countries, the presence of state-owned firms is also controlled for. A firm is considered to be state-owned if more than 50 percent of its assets belong to the state. Although the percentage of these firms in the dataset is fairly low, in line with theory and previous empirical studies, it is expected that the impact of the state ownership dummy will be negative. As argued in an EBRD Transition Report (2005), state-owned firms in transition economies perform less efficiently and are more likely to focus on domestic markets than foreign-owned and private firms.

To consider the influence of access to external finance on export intensity, a dummy variable for firms that have a line of credit or a loan from a financial institution has been included in the model specification. As summarized in Manova (2013), financial constraints tend to have a greater negative impact on export-related activities compared to domestic production due to the extra fixed and variable costs related to exporting, greater risks and the larger working capital required. In line with the existing empirical evidence, a positive coefficient is expected for the access to finance proxy (Muûls, 2008, Bellone et al., 2010, Bernard et al., 2010, Berman and Hericourt, 2010, Minetti and Zhu, 2011, Feenstra et al., 2011, Eck et al., 2012, Alvarez and Lopez, 2013, and Gashi et al., 2014).

Location of the establishment is expected to exert a positive impact on the firm's engagement in international markets if it captures the potential economies of agglomeration. Aitken et al. (1997), Becchetti and Rossi (2000) and Koenig (2009) reveal that co-location, i.e. firms operating close to each other, has a positive and significant impact on a firm's propensity to export. Due to the lack of more comprehensive measures in BEEPS, following Gashi et al. (2014), being located in the capital city is used as a proxy measure for agglomeration. In the same vein, the potential impact of a firm's membership in a business association on its exporting activities is tested in the model. Bennett (1998) and Gashi et al. (2014), referring to SMEs, argue that being a member of a business association is crucial for networking and benchmarking and as a consequence it is likely to have a positive influence on export intensity.

Another potential determinant investigated is the percentage share of imported input materials in all material inputs. It has been established in previous research that importing foreign intermediate inputs is likely to enhance a firm's productivity. Among the studies that have found supporting evidence for this nexus are Kasahara and Rodrigue (2008), Halpern, Koren and Szeidl (2009), Smeets and Warzynski (2010), Bas and Strauss-Kahn (2014). As argued by Feng et al. (2012), the impact of importing intermediate inputs can be even stronger if domestic and foreign input materials complement each other or if the latter are more technologically advanced. Limited number of studies focus on the relationship between foreign inputs and firm exporting. Due to the issue of missing data, this and the membership in a business association will be included only in the imputed model.

In order to account for the industry characteristics, the empirical model is augmented by a set of industry dummies. Manufacturing sector is disaggregated into three categories of technology intensity - low and medium-low, medium-high, and high-technology intensive goods - using ISIC rev. 3, while services and primary goods are grouped into one category.[9] Interaction terms between human capital and industry/technological intensity dummies have also been included to differentiate the impact of different dimensions of human capital on the export intensity of firms engaged in different technology-intensive activities.

Country-specific characteristics (time invariant economic, political, cultural and institutional factors) are controlled for by including country dummies. It is important to note that even though these countries have progressed considerably during the course of transition, there are evident discrepancies between them in terms of their institutional development and other structural reforms. In general countries from the SEE region and Central Asia are still lagging behind compared to other countries from the region, i.e. countries from the central Europe and the Baltic States (EBRD, 2017)

Variable descriptions are presented in Table 1. Summary statistics are reported in Table 2.

Insert Table 1 around here

[9] The low and medium-low technology intensive goods have been grouped into a single category given the similarities in the estimated coefficients, whereas, the latter two technology categories (medium-high and high) have been included separately.

Descriptive statistics in Table 2 reveal that the average share of exports in total sales of firms is 5 percent. Note that this result is mainly driven by the large number of non-exporting firms in the sample. Data show that only 14 percent of firms have been engaged in exporting activities, with an average export share of approximately 38 percent. Regarding the key variables of interest, on average, 36 percent of employees are with a university degree; top managers have an average of 16 years of experience; and around 38 percent of firms have offered formal training programmes to their employees. In terms of firm size, data show that over 90 percent of the surveyed firms are categorized as SMEs. The vast majority of firms in the sample are privately owned with a negligible number of multinationals (around 4 percent). In terms of the innovation input and output indicators, the descriptive statistics show that only 10 percent of firms in the sample have been engaged in R&D activities. On average, 26, 21, and 22 percent of firms have introduced new products/services, production/supply methods and new organisational/management practices or structures over the previous three years, respectively. The average age/experience of firms in the sample was revealed to be approximately 14 years. Data on location as a proxy measure of agglomeration show that only 22 percent of firms have operated in the capital city. In terms of access to external finance, 34 percent of firms have had a line of credit or a loan from a financial institution. Around 36 percent of firms have been engaged in manufacturing with the majority of them producing low and medium-low tech goods. The country group statistics are also presented in Table 2.

Insert Table 2 around here

3. Estimation methodology

Guided by the theoretical framework outlined above, an eclectic empirical model assessing the impact of human capital endowments on a firm's engagement in international markets through exporting is developed and estimated for a large cross section of firms from 29 European and Euro-Asian transition economies. Robustness of results is confirmed by using two alternative estimation approaches, which have their own specific advantages for the type of data used in this study.[10] Export intensity, defined as the share of exports in total sales of a firm, is zero for a large majority

[10] The empirical analysis is implemented using Stata (Version 12.0). To facilitate replication Stata commands are available on request.

of firms in the sample and positive for the others. As it has been discussed in Section 2 above, more productive firms are more likely to self-select to exporting. Hence estimation of export intensity based on a sub-sample of exporting firms only is likely to create a selection bias in our results. In addition, our interest lies not only in examining the intensity for a small group of firms that have already been exporting but on the overall international competitiveness of the firms in European and Euro-Asian transition economies. We therefore include all exporting and non-exporting firms in the sample and employ a corner solution model. We use Tobit modelling as our first estimation approach as it has been widely done in this literature. Previous studies using a Tobit approach when examining the determinants of export propensity/intensity include: Wagner, (1995), Wagner (1996), Van Dijk (2002), Barrios et al. (2001), and Gashi et al. (2014).

The Tobit estimation, however, relies on strong assumptions of normality and homoskedasticity; any departure from these results in inconsistent estimates. Despite its widespread use in this literature, the Tobit has been criticized for not being an appropriate estimation approach when the dependent variable is by definition bounded by zero and one (Maddala, 1991, Wagner, 2001).[11] While, in this sample, the upper bound is not highly represented, there is high number of observations in the lower bound (non-exporters). To address these criticisms and as a robustness check, we additionally implement fractional logit model, one of the fractional response models (FRM) that Papke and Wooldridge (1996) developed to account for the bounded nature of the data. FRM extends the generalized linear model (GLM) and uses quasi-maximum likelihood estimation method that, under GLM conditions, produce "fully robust and relatively efficient estimates" (Gallani and Krishnan, 2017, p.6). Gallani and Krishnan (2017) explain that this approach produces a better fit by capturing the non-linear structure of the data. One of its strengths, unlike the Tobit model, is its non-reliance on the assumption of normality, which is likely to be violated in practice. FRM, however, remains under-utilized in economic research, especially in the field of international competitiveness (exceptions include Wagner, 2001, 2012, Van Dijk, 2002, and Eickelpasch and Vogel, 2009).[12]

[11] Referring to Maddala (1991), Wagner (2001, p.231) states that Tobit "is appropriate when the value of the variable % can be less than a lower limit but observations with such values of the variable are not observed because of censoring". % This is not the case for variables that are bounded by definition.

[12] The estimations have been also replicated by Poisson modelling and the results are generally consistent with those % from the other approaches. The results are available on request from the authors. %

A prevalent issue when conducting survey-based analyses is missing data, which mainly occur when no responses are given to the survey questions. For the majority of variables in the dataset, the fraction of missing information is fairly low, however, there are some explanatory variables[13] that have higher rates of missing data and that were hence excluded from the baseline model specification. Although the rate of missingness in the baseline model (without these variables) is fairly low, in order to mitigate the risk of making incorrect inferences from incomplete data and as a robustness check, the baseline model is re-estimated through multiple imputation. In addition, an augmented regression model has been developed, in order to be able to examine the impact of the variables with higher rates of missingness on a firm's export intensity.

According to Rubin (1987), multiple imputation involves replacing each missing observation with a set of *m* plausible values. Each set of imputed values is used to create a complete dataset, resulting in *m* complete datasets, which are then analysed using any standard estimation technique. The required number of imputations (*m*) is determined by the rate of missingness, with 2-10 values being sufficient when there are not many missing values (Rubin, 1987). However, when the rate of missingness is relatively higher, a larger set of imputed values might be required to produce more reliable results.[14] Once the datasets are analysed, the results are combined in order to produce the final estimates and standard errors. The ultimate aim of multiple imputation, according to Rubin (1996), is not to generate information through simulated values but to address incomplete data in a way that leads to valid statistical inference.

4. Empirical evidence

Interpretation of results in both the Tobit and Fractional Logit approaches are commonly undertaken by calculating the partial effects. In Wooldridge (2009, p. 541), two types of partial effects for Tobit model are presented: the 'conditional partial effects' for the expected values of the dependent variable (y) when y is greater than 0, and the 'unconditional marginal effect'. In the

[13] These variables are: the share of skilled production employees, a relative measure of technology, participation in a % business association and, the share of foreign material inputs.

[14] The set of plausible values for the missing observations is generated through an imputation model. This model is % specified with a set of predictive variables that might contain potential information about missing observations. % Schafer and Graham (2002) used 20 imputations for a share of nearly 80% of incomplete data. On the other hand, % White et al. (2011) argue that number of imputations should be even higher, e.g. equal to the fraction of missing data. %

estimation strategy, the latter approach is adopted for interpretation given the interest in examining the effects of variables on the whole population of firms.

We conducted several checks to assess the validity of the estimations and the goodness-of-fit of the Tobit and Fractional Logit models. Initially the observed values were compared with model predictions. For Fractional Logit, the mean difference between observed values and predictions is very close to zero, -1.057×10^{-10}. The t-statistic for the significance of this mean difference is calculated to be -7.485×10^{-8}. Hence the null hypothesis of the zero mean difference is not rejected. A similar outcome is also produced by the Tobit model. The mean difference between actual and predicted values is -0.001; the calculated t-statistic is -0.708. In a similar approach, the 95% confidence interval for the mean difference is -0.00277 and 0.00277 for Fractional Logit, and -0.00383 and 0.00178 for Tobit, confirming that both model predictions are not too far away from the observed values.

The 'hit ratio', i.e. percentage of correct predictions in the data, is a widely used goodness-of-fit measure, though it is applicable for categorical response models. Since the dependent variable is continuous, for both observed values and predictions, the [0,1] range was split into 10 equal-width categories. The ratio of predicted values that fall in the correct category were then considered.[15] The hit ratio for Fractional Logit model is 82%, whereas it is 80.39% for Tobit. Overall, the results from the two approaches are broadly similar, though Fractional Logit performs slightly better than Tobit.

As a rough check of the appropriateness of the Tobit model, following Wooldridge (2002), the adjusted Tobit estimates were compared with those of Probit.[16] Wooldridge explains that a significant difference between the estimates produced by the two estimators suggests that the model is not well specified. The outcome of our check reveals no significant difference between the two estimation methods, suggesting that the Tobit estimates are consistent (see Appendix Table A1). A conditional moment test (in particular ***tobcm***, a user written command in Stata) is

[15] Because of converting a continuous variable into a categorical one, this approach causes loss of information. It also is sensitive to the number of groups defined. However, it still provides a satisfactory indication of goodness-of-fit in the absence of alternative diagnostic checks for these two estimation approaches in literature.

[16] During this comparison, the Tobit estimates have been adjusted by dividing the coefficient estimates by the standard error of the regression, σ (i.e. $\beta j/\sigma$). The Probit model treats *exp_int* as a binary variable: one for exporters and zero otherwise.

commonly used to check for potential non-normality in Tobit models however, it seems to be applicable only for models with zero lower bounds, and no upper limits. In the estimations both lower and upper limits were utilised which makes the test unsuitable. In order to assess any potential collinearity between the predictors in the baseline regression model, the variance inflation factors and the correlation matrix have been computed. The outcomes from both approaches appear to show no warning signs of potential multicollinearity in the data. Collinearity diagnostics are presented in Table A2 in the appendix.

The estimation results based on the full sample of firms show that, overall, in line with expectations and consistent with previous research for non-transition economies, a higher share of employees with higher education has a positive and significant impact on firm's export intensity, although the magnitude of this effect is not large (see results in Table 3). According to the Tobit's 'unconditional' marginal effects, holding everything else constant, an increase of 10 percentage points in the share of employees with a university degree (*emp_edu*) increases the share of international sales in a firm's total sales (*exp_int*) by 0.251 percentage points (Table 3, column 1). If this effect is interpreted at the mean value, an increase of 10 percentage points on *emp_edu*, i.e. from 36 percent to 46 percent increases the mean value of share of exports (*exp_int*) from 5.31 percent to 5.561 percent. The marginal effect of education in Fractional Logit is smaller in magnitude (0.112 percentage points), and its level of significance has fallen to 10 percent (Table 3, column 2). No supporting evidence is found for the impact of on-the-job training (*emp_trng*) and top manager's years of experience (*manager_exp*) on a firm's extent of exporting. A possible explanation for this insignificant impact might be that SMEs, which dominate this sample, are less inclined to offer training programmes compared to larger firms. The summary statistics of this sample of firms reveal that 36 percent of SMEs are offering training programmes compared to 67 percent of large firms and amongst the latter, provision of training has a significant positive effect on firms' extent of exporting.[17] The statistical insignificance of the manager's experience (*manager_exp*) might be attributed to higher values of this variable implying either more elderly managers (pre-transition)[18] or to lower educational attainment levels, which may both weaken the expected positive effect if these managers lack the ability to quickly adjust to the changes in a

[17] This result is obtained from estimations on a sub-sample of large firms. Estimation results are available on request.
[18] The more experienced managers may have been managers before the start of transition and that experience may not be relevant to the current environment.

dynamic business environment. Inclusion of this variable in its quadratic form did not make a difference in its statistical significance. In an alternative specification where a firm's average labour cost (*lnavrg_tlc*) is used as a proxy measure for human capital endowments (see Table 3), human capital is found to exert a positive and highly significant impact on firm's export intensity in both the Tobit and Fractional Logit approaches.

Insert Table 3 around here

The industry dummies reveal that operating in the manufacturing sector influences positively a firm's share of international sales, with its impact becoming stronger in magnitude for firms producing and exporting medium-high and high-tech goods. Marginal effects from Specification 2 in both estimation approaches suggest that a highly educated workforce has a lower or insignificant impact on export intensity of manufacturing firms compared to those operating in services and primary goods sectors (see columns 1 and 4 of Table 4). The average marginal effect of *emp_edu* in services and primary goods is positive and significant while it is negative in low and medium-low-tech manufacturing. The effects are insignificant in the medium-high and high-tech manufacturing. The pairwise comparisons between these industry groups reveal statistically significant differences in the effects of *emp_edu* between *low_mlow_tech*, *mhigh_tech* and primary goods and services. The marginsplot is presented in the appendix section (see Figures A3).[19] An explanation for the seemingly counterintuitive results is that the manufacturing firms in this sample are mainly engaged in exporting low and medium-low technology goods[20], where the qualification of the workforce might not be of primary importance. The statistics also show that, on average, manufacturing firms in this sample have lower shares of employees with higher education (30%) compared to their counterparts in services and primary goods (39%). There seem to be insignificant differences between the sectors when it comes to offering formal training programmes to employees. Similarly, insufficient evidence is found for the importance of top manager's years of experience when technology-intensive goods are compared and contrasted to services and primary goods (see columns 2, 3, 5, and 6 of Table 4).

[19] The marginsplots presented in the appendix for this and other variables of interest refer to the Tobit model. The % corresponding plots for Fractional Logit are similar, hence are available on request.

[20] According to their technology intensity level, the majority of exporting (manufacturing) firms seem to export low % and medium low - tech goods (70.8%), followed by medium-high (23.3%), with only a very small proportion (5.9%) % exporting high tech goods. %

A firm's expenditure on R&D (*RD_exp*) appears to have a positive impact on firm's export intensity. The coefficient of new organisational/management practices or structures introduced over the three previous years (*new_org_str*) is positive and significant in the Tobit model only, as did the introduction of new products and/or services (*new_prod_serv*). The new methods introduced over the three previous years (*new_methods*), on the other hand, does not exert any statistically significant impact on the export intensity of firms in any of the models (see results in Table 3). A potential explanation for its insignificance might be the low share of firms that introduced new methods in the sample (i.e. only 21%), with only 22.5 % of those firms having been engaged in exporting activities.

Insert Table 4 around here

From the set of control variables, location in the capital city (*location*) is found to have a negative impact on firm's export intensity. Although this result is contrary to expectations, it should be noted that this is a weak measure of potential agglomeration. Furthermore, the data show very low concentration of firms in the capital cities. Firm size (*lnsize*) is estimated to have a positive impact; as expected its effect appears to be increasing with a decreasing rate, although the differences across its values are not statistically significant (see Appendix Figure A4). The marginal effect of firm's business experience (*lnage*) on its export intensity is insignificant up to a certain point, and after that it becomes negative (sees Appendix Figure A5). In line with expectations, foreign ownership appears to play an important role in determining a firm's participation in international markets via exporting. Being a foreign-owned firm (*foreign_dummy*) tends to positively influence its export intensity, whereas, the estimated parameter for state ownership (*state_dummy*) is overall significant and negative. The results suggest that having a line of credit or a loan from a financial institution (*credit*) has a positive and strong impact on a firm's export intensity (Table 3). Country-specific conditions, as captured by country dummies (*dcountry*), are generally found to be statistically significant; implying that economic, institutional, cultural and other country-specific factors partly explain a firm's extent of exporting.

Following the discussion presented in the previous section on the issue of missing values, as a robustness check, the models have been re-estimated on a full sample of observations through the

use of multiple imputation.[21] The estimated results from the imputed baseline model – Specification 1 are generally consistent with those of non-imputed model (see imputed results[22] in columns 1 & 2, Table A6 in the appendix). In order to be able to examine the impact of variables with higher fraction of missing data, an augmented regression model has been additionally developed (columns 3 & 4 in Table A6). In addition to the baseline model regressors, this augmented model includes: the share of skilled production employees, a relative measure of technology, participation in a business association and the share of foreign material inputs.[23] This set of results reveals no supporting evidence for the hypothesised role of the share of skilled employees, technological level and participation in a business association on export intensity. The parameter estimate of the share of imported input materials on the other hand, turned out to be highly significant and with the expected sign.

Important discrepancies in the speed and degree of integration and export restructuring between countries in Central and Eastern Europe (CEECs) and Former Soviet Union (CIS) were noted in the Introduction section. To what extent human capital endowments contribute to these differences is now addressed by re-estimating the models on sub-samples of countries. Chow tests were used to test for the equality of the effects of the explanatory variables for the two country groups. The null hypothesis of equal coefficients is rejected in both Tobit and Fractional Logit with $F_{17,\ 12857}$ statistics of 4.29 (p-value: 0.000) and $chi2_{17}$ of 53.33 (p-value: 0.000), respectively. [24]

Based on the estimated results produced by the Tobit model, the share of employees with higher education appears to exert a positive and highly significant impact on the export intensity of firms in both groups of countries. The unconditional marginal effects reveal that, holding everything else constant, an increase of 10 percentage points in a firm's share of workforce with higher education (*emp_edu*), increases its export intensity by 0.394 percentage points if operating in CEECs and 0.147 percentage points in CIS (Table 5). It is important to note that these marginal effects, in economic terms, are not very large. Applying these figures to the mean values of the variables, a

[21] Given the relatively low share of missing data in the baseline model, 22 imputations are used for each missing observation. %

[22] The marginal effects could not be produced for the imputed models hence these results refer to parameter estimates. %

[23] The number of imputations used in this model is 45. %

[24] The Chow tests were run on a full sample of countries including explanatory variables as well as their interactions % with the country-group dummy. The joint significance of the interaction terms was then tested by an F-test and Chi2 % test. %

10 percentage point increase in the mean value of *emp_edu* in the CEECs (from 19.7 percent to 29.7 percent) increases the export intensity (*exp_int*) from 10 percent to 10.394 percent. The economic impact is slightly smaller in the CIS[25], i.e. a 10 percentage point increase in the mean value of *emp_edu* (from 45.9 percent to 55.9 percent) raises the export intensity *(exp_int)* from 2.43 percent to 2.577 percent at the mean. A potential explanation for the weaker impact of human capital on the export engagement of firms in CIS, despite their relatively higher shares of educated employees, might be the quality of education and mismatches between the education provided and that required to raise productivity and innovation. According to the cognitive skill index introduced earlier in this paper, transition economies from the Former Soviet Union block have recorded lower average test scores as compared to their counterparts from CEE. Note that, the significance level of this variable disappears when the Fractional Logit approach is adopted. The training dummy, i.e. if a firm has introduced formal training programmes for its employees (*emp_trng*), and the years of experience of the top manager in a particular sector (*manager_exp*) were again statistically insignificant when the two subsamples were assessed separately. When average labour cost (*lnavrg_tlc*) is used to proxy human capital, its estimated coefficient is positive and highly significant for the CIS subsample in both estimators, whereas its impact in the CEECs is less significant. The empirical results (marginal effects) for both sets of countries are reported in Table 5.

Insert Table 5 around here

As in the full sample estimations, three interaction terms between human capital measures and technology intensity industries have been included in model specification 2 (Table 6). The average marginal effects show that, in both subsamples, increased shares of educated workforce are found to have a higher impact on the export share of total sales of the firms in primary industries and services in comparison to the low and medium-low technology manufacturing firms (See columns 1 and 4 of Table 6). The evidence is weaker for the high and medium-high technology manufacturing firms. The marginal effect of *emp_edu* in the medium-high tech sector is positive and significant only in the CIS subsample, whereas the corresponding effect in the high tech sector is statistically significant in Fractional Logit for the CEECs only. The corresponding plots are

[25] The equality of these coefficients is rejected at 10% significance level: the 90% confidence interval for the CEECs is [0.00017, 0.00053] while it is [0.00005, 0.00015] for the CIS.

presented in the appendix section (see Figures A7 & A8). On the hypothesis as to whether offering formal training programmes is of more use for manufacturing firms' export intensity, across the two country groups, evidence is mixed and relatively weak. The marginal effects of Tobit suggest that on average, the impact of training programmes on exporting is stronger for firms operating in medium-high tech industries (CEECs only) compared to non-manufacturing industries. The same effect is not supported by Fractional Logit. The only significant effect of *emp_trng* found in the CIS subsample is in the sector of *low_mlow_tech*. No evidence of an impact of top manager's experience on a firm's extent of exporting across industries is found.

Insert Table 6 around here

5. Conclusion

The aim of this paper was to examine the impact of human capital endowments on export intensity and contribute to filling a research gap in the context of transition economies. The empirical investigation made use of various human capital measures which allowed the drawing of more comprehensive inferences. In addition to the education level of the workforce, the human capital dimension was further expanded by including on-the-job training programmes, years of experience of the top manager and in an alternative specification, a labour cost measure. Given their diverse competitiveness performances during the course of transition, a comparative analysis of CEECs with CIS was conducted, allowing us to investigate the hypothesized differences between each set of countries. Furthermore, the relative importance of human capital endowments for different industries was empirically examined. To check the robustness of the results, two estimation techniques were employed, ensuring that the findings are consistent and unbiased and hence the inference drawn is more reliable. The issue of missing values was addressed through multiple imputation analysis.

In line with the theoretical underpinnings, the full sample estimated results suggest that having a more qualified workforce exerts a positive and statistically significant impact on the export intensity of firms in transition economies. The effect of average labour cost, assessed in an alternative model, was stronger, whereas no supporting evidence is found for the role of on-the-job training programmes and years of experience of the top manager. Once industry groups are distinguished, the share of workforce with higher education is revealed to have a lower or

insignificant marginal effect on the export engagement of firms in manufacturing industries compared to those operating in services and primary goods sectors.

Country group differentiation suggests that, according to the Tobit's final estimates, the share of workforce with higher education has a positive impact on firm's share of international sales in both European (CEECs) and Euro-Asian (CIS) transition economies, though the magnitude is slightly larger for the former group. This link is not statistically supported by Fractional Logit estimations. No supporting evidence, on the other hand, is found for the role of formal training programmes and a top manager's years of experience when these countries are assessed separately. While firms from CIS appear to have on average a larger share of employees with higher education compared to CEECs, its impact on export intensity is lower in magnitude. As previously argued, this might be potentially attributed to the lower quality of education or greater skill mismatch in this set of countries. The estimated parameter of average labour cost was found to be more significant in the CIS subsample.

These findings imply that firms' investment in enhancing labour productivity through attracting and hiring more skilled and qualified employees can be further supported and facilitated by suitable policy interventions. Designing and implementing policies that encourage and support higher education can have positive implications for firms that aim to enter, remain and increase their export share in international markets. Not only would exporting firms become more productive by hiring more skilled and competent workers, but also raising the supply of tertiary educated individuals would, other things being equal, lower their relative costs and in turn improve the international competitiveness of firms. An increased focus on tertiary education would assist them in the process of catching-up with their non-transition counterparts. The quality of education is another key dimension of human capital that requires further consideration, especially in countries that are struggling to achieve higher quality schooling. According to Murthi and Sondergaard (2012), many transition countries are still focused on the measurement of inputs into education rather than on the outputs; hence, policy agendas should try to switch that focus into paying more attention to how much students are learning and if their acquired knowledge and skills are meeting the needs of the labour market.

However, given that the overall economic impact of human capital endowments assessed in this investigation is not very large in magnitude, policies focusing merely on this source of

competitiveness are not sufficient, hence, those policies should be complemented by additional complementary competiveness-enhancing interventions. The latter would include improving the business climate, encouraging entrepreneurship, business start-up, attracting foreign investors, promoting R&D and innovation, facilitating technological diffusion, targeting return migrants, and exploiting links with the diaspora.

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Table 1. Variable descriptions %

Variable description	**Variable name**	**Expected sign**
Direct exports as a percent of total annual sales	exp_int	Dep. variable
Percentage of full time employees who completed a university degree	emp_edu	+
Formal training programs for permanent employees (dummy)	emp_trng	+
The share of skilled production workers in a firm's total full-time workforce	skilled_emp	+
Top manager's number of years of experience working in this sector	manager_exp	+
Average annual wage (converted to euros)	avrg_tlc	+
Spending on R&D (dummy)	RD_exp	+
New products/services introduced over last 3 years (dummy)	new_prod_serv	+
New production/supply methods introduced over last 3 years (dummy)	new_methods	+
New organisational/management practices or structures introduced over last 3 years (dummy)	new_org_str	+
Technology compared to the technology of establishment's main competitor (dummy)	tech_dummy	+
Number of permanent, full-time individuals working 3 fiscal years ago	size	+
Establishment's business experience	age	+
Foreign ownership (dummy)	foreign_dummy	+
State ownership (dummy)	state_dummy	-
Access to finance (dummy)	credit	+
Location (dummy)	location	+
Participation in a business association (dummy)	bus_assoc	+
Foreign material inputs or supplies	f_inputs	+
Manufacturing /Tech intensity (dummies):		
Low and medium-low tech goods	low_mlow_tech	

Medium-high tech goods	mhigh_tech	+
High tech goods	high_tech	
Non- technologically classified activities (primary goods and services)	nonclass_tech	
Country dummies	dcountry1-dcountry29	

Table 2. Descriptive statistics %

	Full sample			**CEECs**			**CIS**		
Variables	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
exp_int	12919	.0526658	.1820658	4836	.0999752	.2452062	8083	.024361	.1219512
emp_edu	12919	36.12029	31.58829	4836	19.72767	24.76423	8083	45.92787	31.16099
emp_trng	12919	.3843177	.4864524	4836	.4044665	.4908392	8083	.3722628	.4834378
skilled_emp	4788	58.58081	24.08008	1714	59.03798	24.60368	3074	58.3259	23.78335
manager_exp	12919	16.2148	9.744193	4836	18.7957	9.696193	8083	14.67067	9.441869
lnavrg_tlc	10210	8.014848	1.250247	3706	8.48261	1.23766	6504	7.748315	1.177054
RD_exp	12950	.1051737	.306789	4855	.130793	.3372086	8095	.0898085	.2859249
new_prod_serv	12919	.2586113	.4378885	4836	.3190653	.4661626	8083	.2224422	.4159123
new_methods	12919	.2101556	.4074347	4836	.2289082	.4201735	8083	.198936	.3992245
new_org_str	12919	.2239337	.4168943	4836	.2541356	.4354193	8083	.2058642	.4043567
tech_dummy	1171	.8983775	.3022804	423	.8699764	.3367277	748	.9144385	.2799026
lnsize	12919	2.898776	1.242769	4836	2.800271	1.236359	8083	2.95771	1.242937
lnsize_sqr	12919	9.947256	8.836092	4836	9.369788	8.644583	8083	10.29275	8.931405
lnage	12919	2.395253	.7150127	4836	2.635384	.6313137	8083	2.251584	.7235836
lnage_sqr	12919	6.248439	3.322376	4836	7.343723	3.159352	8083	5.593137	3.244133
foreign_dummy	12919	.0443533	.2058867	4836	.0715467	.2577626	8083	.0280836	.165222
state_dummy	12919	.0103723	.1013189	4836	.0031017	.0556126	8083	.0147223	.1204463
credit	12919	.3466987	.4759372	4836	.4671216	.4989694	8083	.2746505	.4463656
location	12919	.2189798	.4135709	4836	.2512407	.4337715	8083	.1996783	.3997833
bus_assoc	138	.6014493	.4913835	0			138	.6014493	.4913835
f_inputs	4952	33.17225	36.43173	1772	42.77427	38.57931	3180	27.8217	34.02816
low_mlow_tech	12919	.2764146	.4472416	4836	.2746071	.4463622	8083	.277496	.447791
mhigh_tech	12919	.0650979	.2467081	4836	.0556245	.2292188	8083	.0707658	.2564491
high_tech	12919	.0184999	.1347555	4836	.0144748	.1194496	8083	.0209081	.1430855
nonclass_tech*	12919	.6399876	.4800222	4836	.6552936	.4753216	8083	.6308301	.4826099

* This refers non-technologically classified activities, i.e. primary goods and services and it provides the base group for the tech dummies in the estimations.

Table 3. Estimation results (marginal effects) for the share of exports in firm's total sales %

Baseline model – Specification 1		
Variables	**Tobit**	**Fractional Logit**
emp_edu†	0.000251***	0.000112*
	(5.03e-05)	(6.62e-05)
emp_trng†	0.000523	-0.00235
	(0.00270)	(0.00326)
manager_exp†	7.11e-05	7.25e-07
	(0.000124)	(0.000148)
new_org_str	0.00695**	0.00579
	(0.00328)	(0.00396)
new_prod_serv	0.00663**	-0.00396
	(0.00297)	(0.00342)
new_methods	0.00374	0.00534
	(0.00333)	(0.00410)
location	-0.00503*	-0.0116***
	(0.00302)	(0.00338)
lnsize‡	0.0179***	0.0183***
	(0.00114)	(0.00136)
lnage‡	-0.00530***	-0.00894***
	(0.00198)	(0.00231)
foreign_dummy	0.0637***	0.0601***
	(0.00832)	(0.00871)
state_dummy	-0.0133	-0.0261***
	(0.00899)	(0.00817)
credit	0.0148***	0.00871***
	(0.00265)	(0.00311)
low_mlow_tech	0.0543***	0.0600***
	(0.00342)	(0.00402)
mhigh_tech	0.103***	0.108***
	(0.00768)	(0.00969)
high_tech	0.106***	0.125***
	(0.0146)	(0.0190)
RD_exp	0.0236***	0.0166***
	(0.00410)	(0.00461)
lnavrg_tlc	0.00667***	0.00408**
	(0.00162)	(0.00193)
Pseudo R square	0.2305	
No. Observations	12,919	12,919

*** p<0.01, ** p<0.05, * p<0.1

† Variables are interacted with industry groups. Marginal effects at average values are reported here. See Table 4 for marginal effects calculated for each industry group.

‡ Variables are included in quadratic form. Marginal effects at average values are reported here. See Appendix Figure A4 & A5 for marginal effects calculated over differing values of the variable.

Notes: (1) Country dummies included but not reported

(2) To avoid potential correlation, effects of RD_exp and lnavrg_tlc are estimated separately (in different models) from other innovation and human capital measures, respectively

(3) Standard errors are reported in parentheses

Table 4. Marginal effects of human capital variables interacted with industry groups %

Baseline model - Specification 2						
	Tobit			Fractional Logit		
Variables	**emp_edu**	**emp_trng**	**manager_exp**	**emp_edu**	**emp_trng**	**manager_exp**
nonclass_tech	0.000321***	-0.00182	-0.000158	0.000269***	-0.00441	-0.000195
	(4.19e-05)	(0.00254)	(0.000130)	(5.42e-05)	(0.00324)	(0.000166)
low_mlow_tech	-0.000403***	0.00773	0.000381	-0.000745***	0.000897	0.000145
	(0.000114)	(0.00548)	(0.000252)	(0.000154)	(0.00619)	(0.000292)
mhigh_tech	0.000258	0.00690	0.000459	0.000154	0.0114	0.000312
	(0.000218)	(0.0119)	(0.000538)	(0.000273)	(0.0139)	(0.000638)
high_tech	0.000135	-0.0198	0.00120	0.000262	-0.0259	0.00104
	(0.000382)	(0.0231)	(0.00104)	(0.000448)	(0.0272)	(0.00139)
No. of observ.	12,921	12,921	12,921	12,921	12,921	12,921

*** p<0.01, ** p<0.05, * p<0.1 %

Notes: (1) Marginal effects presented in this table are for interacted variables in models reported in Table 3. %
(2) Nonclass_tech refers to primary goods and services.
(3) Standard errors are reported in parentheses.

Table 5. Estimation results (marginal effects) for the share of exports in firm's total sales, by country group

Baseline model – Specification 1				
	Tobit		Fractional Logit	
Variables	**CEECs**	**CIS**	**CEECs**	**CIS**
emp_edu†	0.000394***	0.000147***	0.000136	7.99e-05
	(0.000127)	(3.97e-05)	(0.000165)	(4.98e-05)
emp_trng†	-0.00727	0.00369	-0.0111	0.00321
	(0.00590)	(0.00249)	(0.00694)	(0.00319)
manager_exp†	0.000137	-8.72e-06	-1.88e-05	-3.17e-05
	(0.000280)	(0.000112)	(0.000324)	(0.000137)
new_org_str	0.0202***	0.00125	0.0146*	0.00132
	(0.00756)	(0.00281)	(0.00885)	(0.00329)
new_prod_serv	0.00697	0.00575**	-0.00824	-0.00172
	(0.00661)	(0.00278)	(0.00757)	(0.00307)
new_methods	0.0151*	-0.00198	0.0125	0.000294
	(0.00782)	(0.00276)	(0.00918)	(0.00332)
location	-0.00126	-0.00506*	-0.0149**	-0.00824***
	(0.00656)	(0.00291)	(0.00739)	(0.00312)
lnsize‡	0.0302***	0.0110***	0.0328***	0.00994***
	(0.00258)	(0.00100)	(0.00296)	(0.00124)
lnage‡	-0.0134***	-0.00126	-0.0203***	-0.00187
	(0.00466)	(0.00163)	(0.00522)	(0.00193)
foreign_dummy	0.105***	0.0396***	0.102***	0.0354***
	(0.0154)	(0.0102)	(0.0165)	(0.0107)
state_dummy	-0.0495*	-0.00835	-0.0891***	-0.0129***
	(0.0279)	(0.00535)	(0.00647)	(0.00449)
credit	0.0222***	0.00981***	0.0126*	0.00597**
	(0.00575)	(0.00253)	(0.00673)	(0.00292)
low_mlow_tech	0.120***	0.0186***	0.125***	0.0176***
	(0.00769)	(0.00302)	(0.00857)	(0.00351)
mhigh_tech	0.184***	0.0528***	0.194***	0.0444***
	(0.0163)	(0.00713)	(0.0196)	(0.00828)
high_tech	0.196***	0.0544***	0.252***	0.0364***
	(0.0376)	(0.0119)	(0.0413)	(0.0128)
RD_exp	0.0386***	0.0149***	0.0282***	0.00948**
	(0.00851)	(0.00420)	(0.00945)	(0.00477)
lnavrg_tlc	0.00610*	0.00622***	0.00312	0.00450***
	(0.00363)	(0.00132)	(0.00400)	(0.00134)
Pseudo R square	0.1891	0.1647		
No. of observations	4,836	8,083	4,836	8,083

*** p<0.01, ** p<0.05, * p<0.1

† Variables are interacted with industry groups. Marginal effects at average values are reported here. See Table 6 for marginal effects calculated for each industry group.

‡ Variables are included in quadratic form. Marginal effects at average values are reported here.

Notes: (1) Country dummies included but not reported.
(2) To avoid potential correlation with other innovation and human capital variables, effects of RD_exp and lnavrg_tlc are estimated separately (in different models).
(3) Standard errors are reported in parentheses.

Table 6. Marginal effects of human capital variables interacted with industry groups, by country group

Baseline model - Specification 2						
Tobit						
		CEECs			**CIS**	
Variables	**emp_edu**	**emp_trng**	**manager_exp**	**emp_edu**	**emp_trng**	**manager_exp**
nonclass_tech	0.000472***	-0.00784	-7.22e-05	0.000182***	0.00131	-0.000161
	(0.000101)	(0.00549)	(0.000277)	(3.86e-05)	(0.00238)	(0.000130)
low_mlow_tech	-0.000891**	-0.00605	0.000728	-9.84e-05	0.0107**	7.62e-05
	(0.000353)	(0.0133)	(0.000636)	(7.80e-05)	(0.00446)	(0.000198)
mhigh_tech	-9.88e-05	0.0480*	0.000372	0.000358*	-0.00696	0.000281
	(0.000628)	(0.0279)	(0.00138)	(0.000193)	(0.0107)	(0.000461)
high_tech	0.00150	-0.101	-3.17e-05	-6.04e-05	0.00943	0.00119*
	(0.00109)	(0.0651)	(0.00327)	(0.000308)	(0.0176)	(0.000724)
No. of observ.	4,836	4,836	4,836	8,085	8,085	8,085
Fractional Logit						
		CEECs			**CIS**	
Variables	**emp_edu**	**emp_trng**	**manager_exp**	**emp_edu**	**emp_trng**	**manager_exp**
nonclass_tech	0.000368***	-0.0125*	-0.000278	0.000170***	0.00133	-0.000121
	(0.000125)	(0.00682)	(0.000339)	(5.31e-05)	(0.00333)	(0.000179)
low_mlow_tech	-0.00151***	-0.0135	0.000483	-0.000265***	0.00768	-8.79e-05
	(0.000430)	(0.0142)	(0.000697)	(0.000101)	(0.00509)	(0.000225)
mhigh_tech	-0.000611	0.0506	2.33e-05	0.000381*	-0.00767	0.000371
	(0.000837)	(0.0326)	(0.00163)	(0.000204)	(0.0114)	(0.000465)
high_tech	0.00230**	-0.101	0.000140	-9.65e-05	0.0126	0.000736
	(0.00102)	(0.0669)	(0.00345)	(0.000263)	(0.0171)	(0.000850)
No. of observ.	4,836	4,836	4,836	8,085	8,085	8,085

*** p<0.01, ** p<0.05, * p<0.1 %

Notes: (1) Marginal effects presented in this table are for interacted variables in models reported in Table 5.

(2) Nonclass_tech refers to primary goods and services.

(3) Standard errors are reported in parentheses.

Appendix

Table A1. Adjusted Tobit vs Probit estimates

Variables	Tobit	Probit	Adjusted Tobit (βj/σ)
emp_edu	0.00201***	0.00410***	0.00311***
emp_trng	0.00419	0.0299	0.00649
manager_exp	0.000569	0.00127	0.000881
new_org_str	0.0543**	0.0996**	0.0841**
new_prod_serv	0.0521**	0.175***	0.0807**
new_methods	0.0296	0.0470	0.0458
location	-0.0411	-0.00822	-0.0637
lnsize	0.204***	0.326***	0.316***
lnsize_sqr	-0.00877**	-0.0139*	-0.01358**
lnage	0.0341	0.00144	0.0528
lnage_sqr	-0.0148	-0.00522	-0.0229
foreign_dummy	0.376***	0.560***	0.582***
state_dummy	-0.119	-0.116	-0.184
credit	0.116***	0.245***	0.180***
low_mlow_tech	0.382***	0.620***	0.592***
mhigh_tech	0.545***	0.956***	0.844***
high_tech	0.542***	0.861***	0.839***
Sigma (σ)	0.6457		
No. of Observations	12,919	12,919	12,919

*** p<0.01, ** p<0.05, * p<0.1 %

Table A2. Collinearity diagnostics %

Variable	VIF	Sqrt VIF	Tolerance	R-Squared	Eigenval	Cond Index
emp_edu	1.12	1.06	0.8940	0.1060	7.9595	1.0000
emp_trng	1.18	1.09	0.8493	0.1507	1.4474	2.3450
manager_exp	1.19	1.09	0.8385	0.1615	1.0292	2.7810
lnavrg_tlc	1.06	1.03	0.9416	0.0584	1.0088	2.8089
RD_exp	1.28	1.13	0.7842	0.2158	1.0025	2.8177
new_org_str	1.44	1.20	0.6967	0.3033	0.9434	2.9047
new_prod_serv	1.44	1.20	0.6954	0.3046	0.7729	3.2091
new_methods	1.57	1.25	0.6350	0.3650	0.6705	3.4454
location	1.03	1.02	0.9681	0.0319	0.6132	3.6029
lnsize	1.29	1.14	0.7756	0.2244	0.5843	3.6910
lnage	1.31	1.14	0.7661	0.2339	0.4545	4.1846
foreign_dummy	1.06	1.03	0.9424	0.0576	0.4455	4.2271
state_dummy	1.03	1.02	0.9696	0.0304	0.3782	4.5876
credit	1.08	1.04	0.9223	0.0777	0.3631	4.6819
low_mlow_tech	1.15	1.07	0.8689	0.1311	0.1766	6.7144
mhigh_tech	1.09	1.04	0.9178	0.0822	0.0927	9.2645
high_tech	1.04	1.02	0.9617	0.0383	0.0472	12.9845
Mean VIF	1.20					
Condition Number						27.5120
Eigenvalues & Cond Index computed from scaled raw sscp (w/ intercept)						
Det(correlation matrix)			0.1857			

Figure A3. Marginal effects of *emp_edu* interacted with industry groups

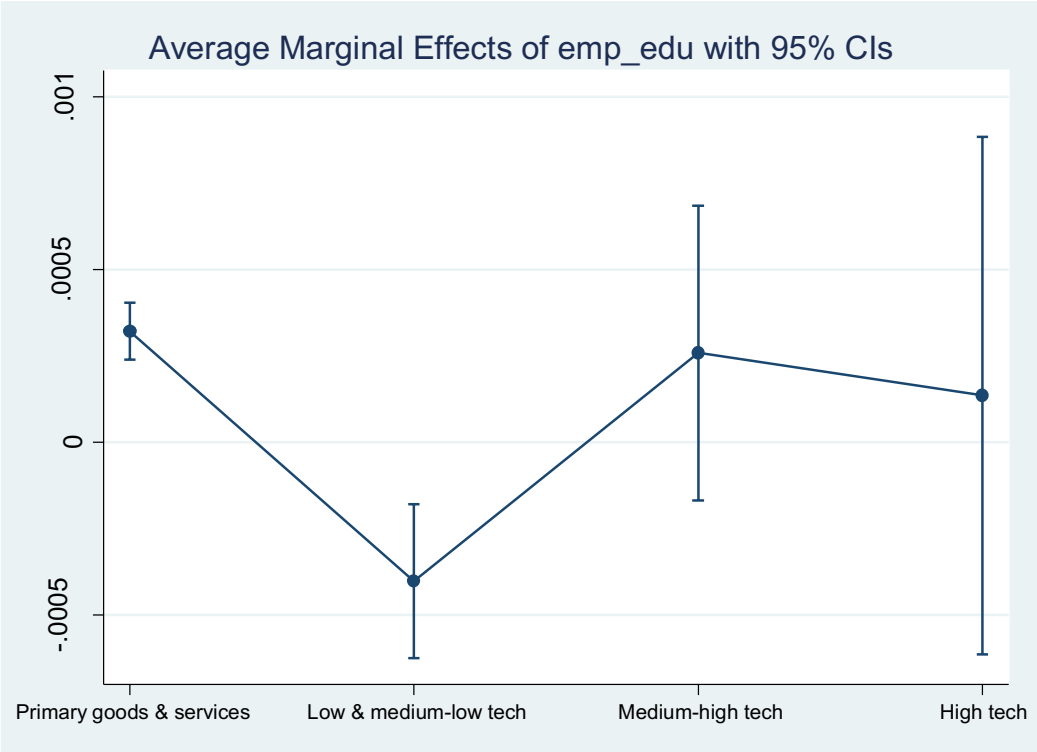

Figure A4. Marginal effects of *lnsize* at different values of size %

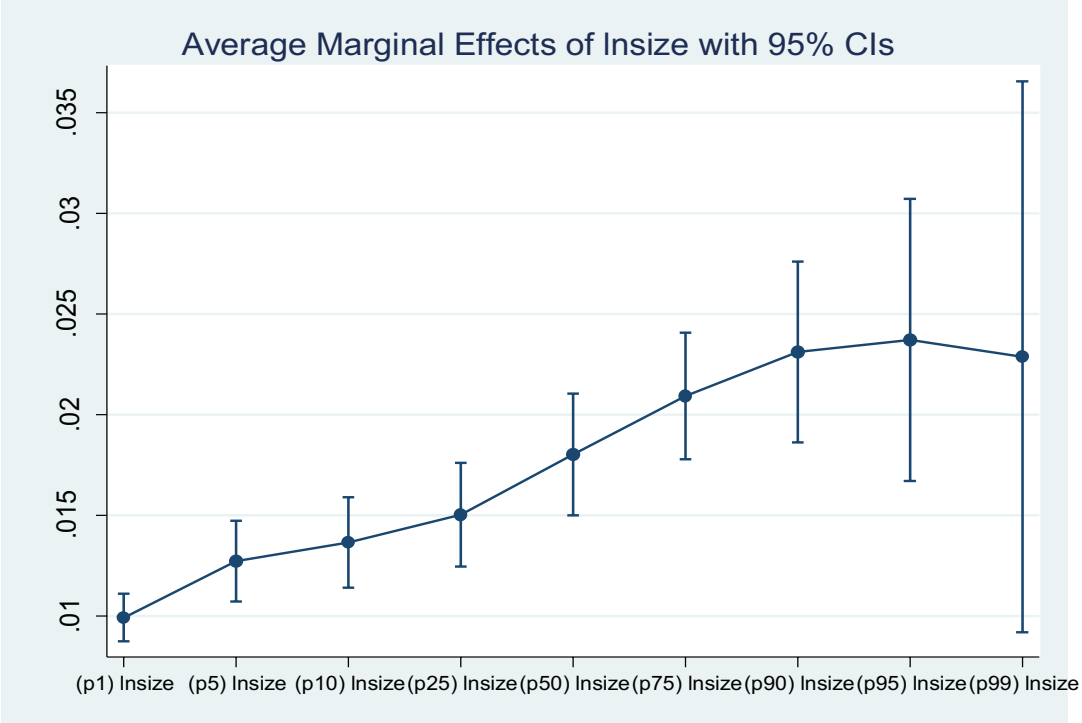

Figure A5 Marginal effects of *lnage* at different values of age

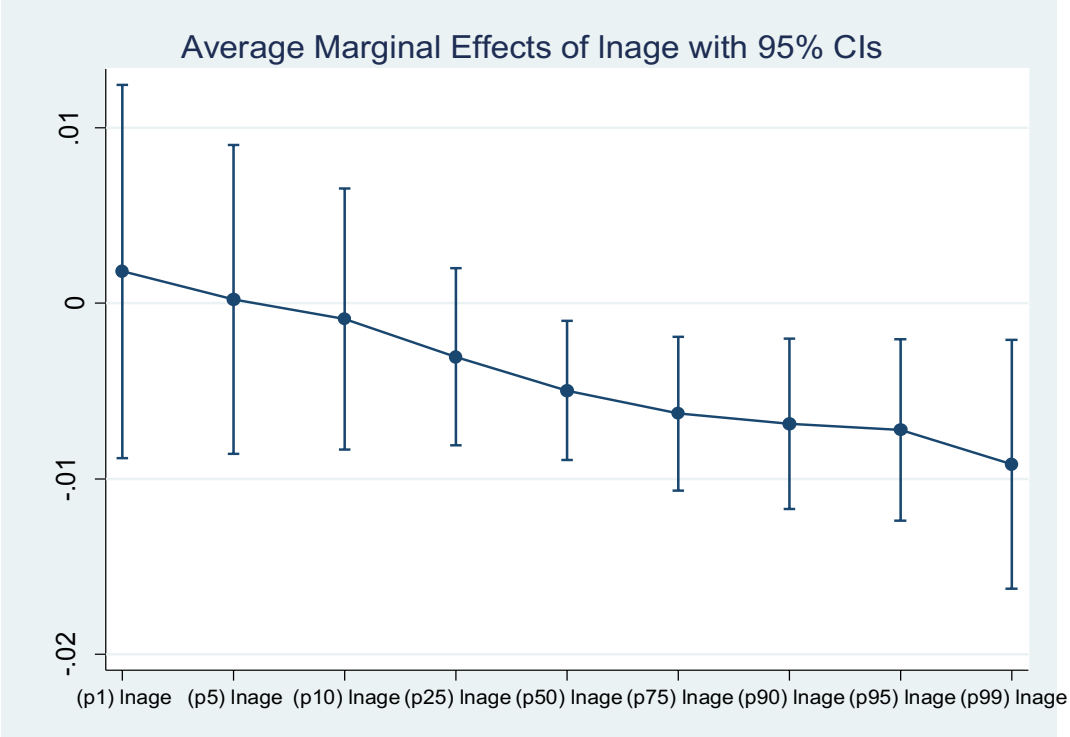

Table A6. Full sample imputed estimation results %

	Baseline Model		Augmented Model	
	Tobit	Fractional Logit	Tobit	Fractional Logit
Variables	**Specification 1**		**Specification 1**	
emp_edu	0.00187***	0.00247*	0.00166***	0.0019
	(0.00039)	(0.0015)	(0.0004)	(0.00152)
emp_trng	0.01672	-0.02326	0.01424	-0.02526
	(0.02062)	(0.07203)	(0.02092)	(0.07437)
manager_exp	0.00028	-0.00056	0.00012	-0.00159
	(0.00097)	(0.00333)	(0.001)	(0.00348)
skilled_emp			7.59e-06	0.00175
			(0.00054)	(0.00188)
new_org_str	0.04548*	0.1128	0.03784	0.09334
	(0.02419)	(0.08393)	(0.025)	(0.08871)
new_prod_serv	0. 05422**	-0.10385	0.0409*	-0.14917*
	(0.02199)	(0.07663)	(0.02284)	(0.08097)
new_methods	0.022003	0.12577	0.01461	0.09415
	(0.02492)	(0.08624)	(0.02525)	(0.0892)
location	-0.03172	-0.27237***	-0.0616**	-0.37527***
	(0.02386)	(0.08181)	(0.02475)	(0.08593)
lnsize	0.19291***	0.56567***	0.18673***	0.5399***
	(0.0312)	(0.10997)	(0.03201)	(0.11599)
lnsize_sqr	-0.00853**	-0.0248*	-0.0079**	-0.02228
	(0.00388)	(0.01296)	(0.00398)	(0.01375)
lnage	0.0401	0.16401	0.03037	0.11388
	(0.05388)	(0.18636)	(0.05435)	(0.19114)
lnage_sqr	-0.01404	-0.06346*	-0.01151	-0.0505
	(0.01052)	(0.03624)	(0.01058)	(0.037)
foreign_dummy	0.39093***	1.04032***	0.34847***	0.91631***
	(0.03651)	(0.10485)	(0.03707)	(0.11163)
state_dummy	-0.1198	-0.61488*	-0.10851	-0.59147*
	(0.08679)	(0.31532)	(0.0879)	(0.31797)
credit	0.11755***	0.18956***	0.11755***	0.20538***
	(0.01968)	(0.06734)	(0.02002)	(0.07023)
f_inputs			0.00246***	0.00886***
			(0.00037)	(0.00122)
tech_dummy			0.07873	0.3177
			(0.06476)	(0.26595)
bus_assoc			-0.00969	-0.02077
			(0.06178)	(0.24151)
low_mlow_tech	0.39142***	1.214301***	0.38597***	1.20739***
	(0.02089)	(0.07036)	(0.02295)	(0.08026)
mhigh_tech	0.54998***	1.56065***	0.53507***	1.52535***
	(0.02965)	(0.09934)	(0.03182)	(0.11105)
high_tech	0.53927***	1.63245***	0.49684***	1.48332***

	(0.05195)	(0.16842)	(0.0534)	(0.1807)
Imputations	22	22	45	45
No. of observations	14,539	14,539	14,539	14,539

*** p<0.01, ** p<0.05, * p<0.1

Notes:
(1) Country dummies included but not reported
(2) Standard errors are reported in parentheses

Figure A7 Marginal effects of *emp_edu* interacted with industry groups (CEECs)

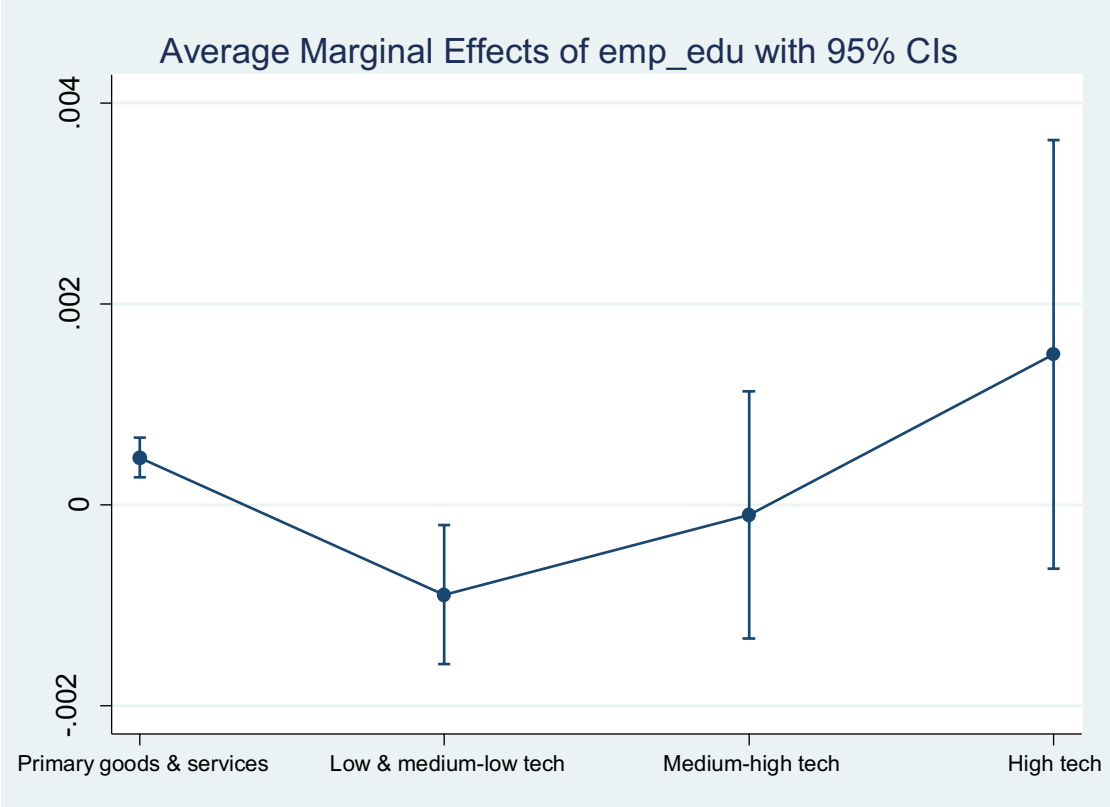

Figure A8 Marginal effects of *emp_edu* interacted with industry groups (CIS)