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Human Capital and International Competitiveness in Europe, with Special Reference to Transition Economies

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Abstract

This paper assesses the impact of human capital endowments on international competitiveness in Europe, with special reference to transition economies in Central and Eastern Europe (CEE). The analysis uses longitudinal data for 27 European economies over the period 1995-2010. In line with the orthodox theory, a positive relationship is found between the labor force's level of educational attainment and competitiveness. While in the European Economic Area (EEA17) tertiary education is the only significant education-based determinant of the export market share, in CEECs both the shares of the workforce with secondary and tertiary education are significant with the former having a greater impact. Some evidence is found for the hypothesized impact of the quality of education.

JEL Classification: F10, F14, I25

Key words: International competitiveness, export market share, educational attainment, quality of education, transition economies

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1. Introduction

In a globalized economy, maintaining and increasing international competitiveness is a major challenge, particularly for transition economies. The increased openness and integration, which began with the transformation from centrally planned to market economies, has been accompanied by improved international competitiveness in the majority of Central and Eastern European countries (CEECs). As a complex and multifaceted concept, international competitiveness has been elaborated quite extensively in the literature. The vast majority of studies investigating the concept of international competitiveness at the macro level have focused predominantly on constructing and developing competitiveness indicators and indices with the purpose of ranking and comparing trends across sectors or countries (Herciu, 2013, Startienė and Remeikien, 2014, Carraresi and Banterle, 2015). However, its definition and measurement remain contentious, with no agreement on the superiority of any single measure.

Despite the abundance of studies on the measurement of international competitiveness, potential determinants of international competitiveness have received little attention with human capital being particularly under-researched. Given the lack of evidence in the context of transition economies, particularly at aggregated levels of investigation, this paper fills the void by assessing empirically the impact of several human capital measures on international competitiveness using longitudinal data for the period 1995-2010. The key research questions addressed in this paper are: firstly, to what extent the improvements in the international competitiveness of the transition economies of Central and Eastern Europe (CEE)[1] can be explained by improvements in their human capital stock. Secondly, can the differences in competitiveness performance across these countries be explained by differences in the quality and quantity of their stock of human capital? Finally, does the relationship between human capital and competitiveness differ between the transition economies of CEE and those of the European Economic Area (EEA17)?

Whilst addressing these research questions, we make several contributions to the literature. Firstly, we address an issue that has not been well researched not only in the context of transition economies but also in terms of the role of human capital in international competitiveness. Since the ability to compete in international markets is regarded as an important indication of the economic performance of countries, we adopt an export-based approach to proxy international competitiveness. Our empirical approach is innovative in two ways: (i) we address the potential endogeneity of educational attainment as well as two of our control variables (patent applications and foreign direct investment) by applying a fixed effects instrumental variable approach, (ii) we estimate the effects of time-invariant and slowly changing explanatory variables by applying fixed effects vector decomposition and Hausman-Taylor estimators. In contrast to the common approach of approximating human capital with the level educational attainment only, this study also introduces the quality of education. To the authors' knowledge, this is the only study that highlights the importance of the quality of education in international competitiveness. Quality of education is proxied by three alternative cognitive skills measures obtained from Hanushek and Woesmann (2012) and Altinok et al. (2014). Finally, considering the overall performance differences within

[1] Given the restricted availability of data for certain indicators, the empirical assessment is limited to selected transition economies: Bulgaria, the Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, the Slovak Republic and Slovenia.

Europe, we provide a comparative assessment of the transition economies of Central and Eastern Europe (CEECs)[2] with the European Economic Area (EEA17). Having separate country group analysis allows an assessment of the heterogeneity between them and enables separate inferences to be drawn in regard to the hypothesized impact of human capital.

The rest of this paper is organized as follows: section 2 provides a discussion of the characteristics and evolution of international competitiveness and human capital in CEECs. The theoretical framework informing this empirical analysis, focusing on the underlying mechanism of labour productivity, innovation and technology adoption, is presented in section 3. This section also incorporates a review of previous related empirical research and derives the empirical specification adopted in the subsequent analysis. The following section outlines the empirical modelling strategy and assesses the merits of alternative estimation approaches, with a particular focus on addressing the issues of time invariant variables and potential endogeneity. Section 5 reports and interprets the empirical findings. Finally, section 6 summarizes the main findings and concludes.

2. Context of the investigation

Since the start of the transition process, the Central and Eastern European region has witnessed a rapid and significant growth of exports, which has been accompanied by increasing market shares in world markets. From 1995 to 2016, the exports of the CEECs increased by 554 percent, which has been associated with a significant expansion in the exports to GDP ratio (World Bank, 2018a). In 2016, the region's exports, on average, accounted for 60 percent of GDP, reaching the EU-18's level, as compared to about 35 percent in 1995 (World Bank, 2018b). This rapid export growth in CEECs has been accompanied by a re-orientation of their export flows towards Western Europe (UNCTAD, 2016). Amid growing global competition, many transition countries have managed to change their initial export structure and move towards more knowledge and technology-intensive goods and services, which in turn has increased their relative competitive positions within these industries.

The shift towards knowledge-based economies, greater participation in international markets and continued transition-related structural changes have also increased the demand for highly qualified

[2]Although the transition process has been declared to be complete by the World Bank (2008) for all the Central and Eastern European countries in the sample, these are still regarded in the literature as transition economies.

labor in the former socialist countries of Central and Eastern Europe (Murthi and Sondergaard, 2012, EBRD, 2013 Arias et al., 2014). Their transition towards market economies was accompanied by numerous changes in their educational systems. The pre-transition period was primarily associated with larger shares of resources being invested in heavy industries and agriculture (Brunello et al., 2010). Intellectual work was valued relatively less than physical work, the socialist period being associated with low wage differences between skilled and unskilled workers (Munich et al., 2005). This encouraged the overwhelming majority of students to pursue vocational studies and/or leave school after the completion of the secondary level of education (Brunello et al., 2010).[3] However, when the restructuring process started in early 1990s, the situation changed significantly, shifting the focus from vocational upper secondary towards general education. The expansion of the services and the contraction of the agriculture sector were associated with a profound change in the composition of skills demanded in the market. A shift in the demand towards highly educated employees has been prevalent in the majority of these countries. In particular, the structural changes were reflected in a reduction in the demand for agricultural and manual skills and a growing demand for services and professional skills (Murthi and Sondergaard, 2012). During transition the educational attainment of the population aged 15 and over has experienced a positive trend, particularly with regard to tertiary education. Although variations across the region are observed, the stock of population who have completed tertiary education increased by 109 percent from 1990 to 2010 converging towards the level in the EU-18, though slight differences remain (Barro and Lee, 2014).

Quality of education in CEECs, proxied by average student test scores in reading, mathematics and science (see Hanushek and Woessmann, 2012; PISA[4], 2000-2009; TIMSS[5], 1995-2011 and PIRLS[6], 2001-2011), appears to be slightly lower than that in the EU-18; with Hanushek and Woessmann's regional average index at 4.73 and 4.88 for the two groups, respectively. Although the t-test suggests that this difference is not statistically significant, it is important to note that significant differences within CEECs exist. While Estonia outperforms many developed countries

[3] This period was also associated with: an authoritarian administration of education institutions, a strictly centralized traditional curriculum with no emphasis on creative judgment and problem-solving skills and very limited monitoring of learning outcomes (OECD, 2011).
[4] PISA - Programme for International Student Assessment
[5] TIMSS - Trends in International Mathematics and Science Study
[6] PIRLS - Progress in International Reading Literacy Study

(including high performers such as Finland) and the Czech Republic, Slovakia and Hungary have internationally comparable scores, countries such as Albania and Macedonia are listed in the lower end of the distribution.

3. Theoretical framework and empirical specification

The importance of human capital accumulation for competitiveness and export performance is derived from its intrinsic relation with technological progress, innovation and labor productivity. According to Romer (1990), skilled individuals are more likely to innovate, adopt, and adapt to more sophisticated technologies, thus leading to higher productivity and economic growth. Similarly, Nelson and Phelps (1966) argue that better educated individuals make better innovators and are more likely to successfully adopt new technologies, hence accelerating technological diffusion. According to Wakelin (1998), there are two theoretical approaches that explain the link between innovation and exports. The "neo-endowment" approach, which initially focused on the factor endowments of labor and capital, has been augmented by including human capital and knowledge as determinants of trade, i.e. the Heckscher-Ohlin theory. The second approach, on the other hand, refers to the technological differences as the principal sources of trade, i.e. the technology gap theory (Posner, 1961) and the product cycle approach (Vernon, 1966). The new trade theory adds the possibility of increasing returns to scale and monopolistic competition to the traditional models (Krugman, 1979). The importance of productivity in this relationship is highlighted by Melitz (2003) who argues that only the most productive firms can overcome the additional export-related costs and engage in exporting activities. A similar contribution to the productivity-export nexus has been made by Bernard et al. (2003).

Most empirical studies treat human capital and technology as crucial drivers of international competitiveness. An increasing level of human capital has been argued to promote innovative activities, which in turn will impact international competitiveness by improving the quality of existing products and enabling the creation of new products that are of superior quality to those of competitors (Grossman and Helpman, 1991, Agénor, 1995). The importance of knowledge and skills for international competitiveness is also supported by the established link between productivity and knowledge-based activities. According to Porter (1990), human capital, as a key

determining factor of productivity, is an important source of the competitive advantage of countries.

Even though the link between human capital and international competitiveness has been empirically tested, the measures used to capture this relationship are often weak and little reference has been made to transition economies. At the macro level, a positive impact of human capital on trade/export-based indicators was found by Carlin et al. (2001), Chor (2010), Van der Marel (2012), and Johansson et al., (2014). Similarly, at micro level, a positive relationship has been found between the firm's human capital endowments and their export propensity and intensity (see Eickelpasch and Vogel, 2009, Wagner 2012, and Falk and Hagsten 2015). Gashi et al. (2014) is the only micro level study that investigates the role of human capital and technology on the export intensity of transition economies. However, a key limitation of these studies is that they measure human capital only by the education level of the workforce, ignoring the quality of education. International competitiveness also tends to be poorly measured; particularly in the micro level studies (e.g. export propensity and intensity do not capture the relative competitive position of firms in international markets). Another shortcoming of these studies is the lack of a critical debate regarding potential sources of endogeneity and ways to account for it. With the purpose of filling these gaps, this paper has considered various human capital and international competitiveness measures. In addition to education attainment, the effect of the quality of education is also assessed. Three measures of the quality of education are used in the estimations. Finally, an important element of this investigation is assessing and addressing potential endogeneity.

International competitiveness is a complex and ambiguous notion; this is reflected in many measurement approaches proposed in the literature. However, there has been a distinct tendency among researchers to rely on trade/export-based indicators since sustaining and gaining shares in international markets is an indication of a superior competitiveness position relative to other countries. Hence, given the widely accepted theoretical basis and data availability, international competitiveness in this empirical analysis is represented by the export market share *(emsh)*. This variable is defined as the ratio of a country's exports of goods to the total exports of goods of the EU-28 (measured as percentages). The rationale for using this particular specification of export market share is to be able to capture the degree of importance/competitiveness of a country within the total exports of a region (EU-28). That is to say, if exports of a country increase at a higher rate

than the total exports of the EU-28, it can be argued that the relative position of that country has improved compared to the EU-28, and vice-versa. This definition has been proposed by European Commission and it has been used to construct export market share indicators by Eurostat and OECD. Following Hoshi et al. (2007), an alternative measure has been considered to proxy international competitiveness: the exports of goods of country *i* over the total imports of goods of EU-28.[7] Whilst the latter is a good measure of the export share of a country in a particular market, in this investigation the interest is in measuring the competitiveness of a country in the global market, compared to the EU-28.[8]

In accordance with the conventional human capital theory (see Schultz, 1961, Becker, 1964), education is regarded as the key component of human capital development, assessed primarily through its role in boosting labor productivity. Given the lack of more detailed information on the skills and competences of the potential labor force, the empirical analysis relies on the attainment of formal education provided by Barro and Lee (2014) and students' performance in various international assessments. Using UNESCO, Eurostat, and national sources survey and census data, Barro and Lee (2014) constructed measures of educational attainment for a large number of countries at 5-year intervals for the period 1950 - 2010. The indicators used in the analysis are: the percentage of population aged 15 and over who have attained secondary education, the percentage of population aged 15 and over who have attained tertiary education and the average number of years of schooling for the population aged 15 and over. The first two variables refer not only to the total stock of population who have completed the entire cycle of studies, but also to those who have completed some secondary/tertiary education. That is to say, the first measure reflects the share of population who have completed secondary education as their highest level attained as well as those who have attained part of secondary education, whereas, the share of population who have continued to higher education are reflected in the (total) tertiary education measure. Henceforth, these variables will be referred as the share of population 15 and over who have attained secondary/tertiary education as their highest level. Since these indicators are constructed at 5-year intervals, we have filled the gaps for the periods in between using interpolation in order to make

[7]As a robustness check, an alternative regression analysis employing this measure was conducted, these results are available on request. The results for the variables of interest were very similar.

[8] In addition to the export market share, a modified version of Balassa's (1965) revealed comparative advantage index (RCA) was considered. However, given the various criticisms of its inability to fully capture the theoretical concept of competitiveness, as well as its questionable statistical features, it was not used in the estimations.

use of the highest possible number of observations. According to Rizvanolli (2012), interpolation is preferred to multiple imputation since the missing values are more likely to be linked to the existing data values rather than to other variables. By arguing that the education stock changes slowly over time with a possible increasing trend, linear interpolation based on the time variable is applied (see also Seck, 2012). It is pertinent to note that the choice of stock rather than flow measures stems from their relative superiority in capturing the actual human capital of the current labor force. School enrolment rates, despite being frequently employed in the literature, represent the level of schooling and human capital of the future, rather than the current, workforce.

In order to overcome some of the drawbacks of focusing entirely on the quantity of educational achievement, three proxies for education quality have been introduced into the investigation. Given the lack of more direct information on the quality of education, Hanushek and Woessmann's (2012) cognitive skills measure which is based on students' achievements in internationally comparable tests is used. Hanushek and Woessmann construct this indicator by standardizing primary/secondary students' test scores in mathematics and science and averaging them across time (period 1964–2003).[9] According to Hanushek and Woessmann, the key rationale for averaging the data over a period of 40 years is to capture the education quality of the labor force rather than that of students.[10]

Altinok et al. (2014) constructed a similar measure of education quality which covers a longer period of time (1965-2010) and a larger group of countries. In order to assess the robustness of the results, this measure covering test scores in primary and secondary education (averaged across time) is used in an alternative model specification. In addition to the averaged indicator, Altinok et al. (2014) provided a panel dataset on students' performance for the period 1965-2010.[11] The adjusted mean scores of students of secondary education in different assessments are also used to proxy the quality of education in the estimations. Since data is available at intervals rather than

[9] The following tests were used by Hanushek and Woessmann's (2012) in the calculation of the indicator: First International Mathematics Study (FIMS); First International Science Study (FISS); Second International Mathematics Study (SIMS); Second International Science Study (SISS); Third International Mathematics and Science Study (TIMSS) and Programme for International Student Assessment (PISA).

[10] Even though the quality of the human capital of the adult labour force has started to become part of various International Adult Literacy surveys, their time span and country coverage are still very limited, making it unsuitable for this analysis.

[11] Education quality dataset v2.2 available at https://sites.google.com/site/nadiraltinok/home/datasets.

annually, linear interpolation has been used to fill the gaps in between. Due to data missing for some years/countries, the impact of this indicator was assessed in a separate analysis covering a smaller sample. [12]

Another important aspect to be accounted for in this investigation is the degree of the skills mismatch, which in turn may limit the contribution of more educated employees to enhancing productivity and competitiveness. In the absence of a better proxy for skills mismatch (e.g. employees' responses on whether their skills and qualification match their job requirements) the long-term unemployment rate is employed as a broader mismatch proxy.

A related dimension, of special interest to this analysis is the degree of innovation. The extent of innovation and technology diffusion are among the major underlying forces determining international competitiveness (Roper and Love, 2002, European Commission, 2008). Numerous empirical studies have found positive correlation between innovation activities and export share, though the causation direction has not been clearly established (Damijan et al., 2008, Cassiman et al., 2010). In this investigation data on patent applications provided by World Bank's World Development Indicators (WDI) database is utilized.[13]

The choice of control variables is derived from the theoretical framework and literature review presented above. Transnational corporations play an important role in promoting the export market share of host countries by providing extra capital, technology and managerial practices, better access to their home markets as well as to other new international markets (UNCTAD, 2002). Accordingly, numerous studies have found supporting evidence for the positive and significant impact of inward FDI on the export performance of countries (for example: Wang et al., 2007, Kutan and Vukšic, 2007). This dimension is represented by the percentage share of inward FDI stock in GDP.

The level of real GDP per capita is introduced to capture the development level of countries. Richer countries typically have high-quality institutions and a supportive business environment which leads to increased productivity and greater international competitiveness. The new trade theory

[12] Data for some of the countries in the sample is missing for some years/intervals thus making interpolation inappropriate.
[13] Research and development expenditure (% GDP) and patent grants could not be used in the estimations due to the large amount of missing data.

highlights the importance of the market size. By exploiting economies of scale, larger countries are able to produce greater output and a wider range of products which in turn influence exports (Krugman, 1979, Helpman and Krugman, 1985). The size of the economy is measured by its population size.

In accordance with Ricardo's theory of comparative advantage and previous research (Carlin et al., 2001, Laursen and Meliciani, 2010), production cost (in particular labor cost/unit labor cost) is another potential influential determinant of export engagement. In these estimations this dimension is proxied by a real unit labor cost index.

A transition indicator has also been included in the estimations. It represents a country's progress in transition and is defined as an average measure of a set of indicators (large scale privatization, small scale privatization, governance and enterprise restructuring, price liberalization, trade and foreign exchange system, and competition policy) provided by the EBRD (2014). Following Eicher and Schreiber (2007, p.4), this averaged indicator is normalized to a range from zero to one. Zero denotes the "complete absence of market based economic institutions", whereas one refers to "institutional standard similar to OECD economies.

The potential link between the level of economic freedom of a country and its export market share is also assessed in this investigation. Higher economic freedom is expected to be associated with greater competition, enhanced entrepreneurship, less regulation, more efficient allocation of resources, and more/cheaper access to imported inputs (Miller and Kim, 2017). This investigation uses the Heritage Foundation's economic freedom index which is based on a set of 10 different aspects of economic freedom, including property rights, freedom from corruption, fiscal freedom, government spending, business freedom, labor freedom, and monetary freedom.[14]

Finally, the potential impact of the size of the non-tradable sector on the exports share of a country is investigated. The chosen measure represents the value added in wholesale and retail trade, transport, and government, financial, professional, personal services (such as education, health

[14] Whilst there is a correlation of 0.72 between the economic freedom index and the transition indicator in the CEECs sample, this did not affect the final estimation results. As Wooldridge (2009) points out, if the degree of correlation between any control variables does not affect, i.e. is not correlated with the variables of interest, the partial effects of the latter can be determined without any difficulties.

care) and real estate services (as a % of GDP).[15] A higher share of services in a country, holding other factors constant, is likely to reduce its propensity to export; hence, a negative coefficient is expected to be found for this variable.

Variable names, descriptions, their expected signs and data sources are summarized in Table 1.

INSERT Table 1. Variable descriptions

4. Estimation methodology

Following the data and variable specification presented in the previous section, and guided by the theoretical framework outlined in section 3, an eclectic empirical model assessing the impact of human capital endowments on international competitiveness is developed and estimated for the CEECs[16] over the period 1995-2010. For comparison, the same model is also estimated separately for the European Economic Area (EEA17).

$$Y_{it} = \beta X'_{it} + \alpha_i + \delta Yrd + \varepsilon_{it},$$

$$i = 1, \ldots, 27, \quad t = 1, \ldots, 16$$

Where Y_{it} represents the natural logarithm of export market share of country i in year t, X_{it} is a vector of explanatory variables, α_i is the unobserved country specific effects and ε_{it} is the error term. The models are augmented by including set of time dummies (*Yrd1996-2010)*. Two specifications are estimated using alternative measures of educational achievement: Specification 1 focuses on the impact of the share of population aged 15 and over who have attained secondary and tertiary education, respectively while, Specification 2 assesses the effect of the average years of schooling.

[15] It also covers the imputed bank service charges, import duties, and any statistical discrepancies noted by national compilers as well as discrepancies arising from rescaling (WDI – World Bank, 2014).

[16] Albania, Croatia, Bosnia and Herzegovina, Kosovo, Macedonia, Montenegro and Serbia are excluded from the investigation due to lack of data.

Specification 1[17]**:**

$lnemsh_{it} = \beta_1 lnsedut_{it} + \beta_2 lntedut_{it} + \beta_3 educq_{it} + \beta_4 lnpatappr_{it} + \beta_5 lnfdi_{it} + \beta_6 lngdpc_{it} + \beta_7 lnpop_{it} + \beta_8 unem_{it} + \beta_9 lnecofree_{it} + \beta_{10} lnrulc_{it} + \beta_{11} transindN_{it} + \beta_{12} serv_{it} + \alpha_i + Yrd1996\text{-}2010 + \varepsilon_{it}$

Specification 2:

$lnemsh_{it} = \beta_1 avyrs_{it} + \beta_2 sqravyrs_{it} + \beta_3 educq_{it} + \beta_4 lnpatappr_{it} + \beta_5 lnfdi_{it} + \beta_6 lngdpc_{it} + \beta_7 lnpop_{it} + \beta_8 unem_{it} + \beta_9 lnecofree_{it} + \beta_{10} lnrulc_{it} + \beta_{11} transindN_{it} + \beta_{12} serv_{it} + \alpha_i + Yrd1996\text{-}2010 + \varepsilon_{it}$

The summary statistics show very large standard deviations for *patappr*, *fdi*, *gdpc*, and *pop*, implying that data for these variables are spread widely around the mean (see Table 2). Since we are dealing with countries of different sizes and economic development levels, this level of dispersion is expected. In addition, the means of these variables are larger than their medians, indicating a positively skewed distribution; hence, a logarithmic transformation has been applied to make their distribution more symmetrical. The statistics from Table 2 below also show that we are using an unbalanced panel due to missing data for some variables in some years. There is no indication of data missing for a specific reason rather than randomly, therefore this is not expected to influence the reliability of the results. To assess if there are any significant differences between the two groups of countries, the t-test and Kruskal-Wallis test have been computed. The p-values reported in the table show that, for the majority of the variables, the null hypothesis has been rejected, suggesting that there are differences in the mean values between these countries (these countries do not come from the same population). From the variables of interest, *cskills* makes an exception, whilst the null hypothesis of *studperf* is rejected only at 10 percent. Furthermore, Chow tests are applied to test for the equality of the effects of these explanatory variables for the two groups of countries. The null of equal coefficients is rejected in both model specifications with $F_{10, 288}$ statistics of 17.04 (p-value: 0.000) and 21.07 (p-value: 0.000), respectively.[18] Hence models are estimated separately for the two groups of countries.

INSERT Table 2. Descriptive statistics

[17] The impact of the quality of education proxied by three different measures is assessed in alternative model specifications.

[18] The Chow tests were based on fixed-effects estimations. Models were run on a pooled sample of countries including the explanatory variable set as well as their interactions with the transition dummy. The joint significance of the interaction terms is then tested by an F-test.

The analysis uses a fixed effects estimator. The Hausman test suggests that the unobserved effect and explanatory variables in the model are correlated, hence random effects estimates would be inconsistent and biased (Hausman, 1978). However, a main shortcoming of the fixed effects approach is the inability to estimate the coefficients of time-invariant variables (Wooldridge, 2009). Given that two of our measures of education quality (the cognitive skills and student mean scores) are time invariant, we use Fixed Effects Vector Decomposition (FEVD) and Hausman-Taylor (HT) estimators to identify the effects of these variables.

The FEVD is a three step procedure that allows for time invariant and slowly changing explanatory variables in models with unobserved time invariant effects (Plumper and Troeger, 2007, 2011). First, a standard fixed effects model, excluding time invariant variables, is estimated. In stage two, the unit effects, which are extracted from the first stage regression, are regressed on time invariant and/or slowly changing variables. This step decomposes the unit effects into unexplained and explained parts. The third stage involves a pooled OLS estimation of the unexplained part extracted from step two on the time varying, time invariant and/or slowly changing variables. Estimations are performed using a user-written command in Stata, *xtfevd* (Plumper and Troeger, 2007). By conducting a series of Monte Carlo simulations, Plumper and Troeger (2007, 2011) have suggested that their estimator outperforms pooled OLS, random effects and Hausman and Taylor in estimating models with time invariant and/or slowly changing variables. They argue that FEVD has got better finite sample properties and thus, produces more accurate estimates when both time invariant and time varying variables are assumed to be correlated with the unobserved effect. Moreover, they argue that FEVD is more efficient than FE, given that its estimates are based on within as well as between variance.[19]

The HT estimator is a mixture of fixed effects and random effects models which allows for a subset of explanatory variables to be correlated with unobserved effects while others are uncorrelated

[19]Although this approach has been used in many empirical analyses, it has also been criticized. Greene (2011) argues that the new method is the same as the LSDV estimator and that there are no apparent efficiency gains. Moreover, he has strongly criticized step 3 of the procedure by arguing that it produces very small standard errors, and therefore, it should not be carried out. However, the authors of FEVD have addressed the issue of very small standard errors in their updated Stata ado file. According to Breusch et al. (2011), if there is an indication of potential endogeneity, i.e. time invariant variables being correlated with the unobserved effects, the FEVD estimator will be inconsistent.

(Hausman and Taylor, 1981). Variables that are specified as exogenous, both time varying and time invariant, are used to instrument the endogenous variables. Despite its widespread popularity among researchers, Cameron and Trivedi (2005) and Breusch et al. (2011) argue that identifying the endogeneity or exogeneity of every explanatory variable is not an easy task. Similarly, Plumper and Troeger (2007) claim that this method yields reliable estimates only if the instrumental variables are strongly correlated with the endogenous variables and uncorrelated with the unobserved specific effects and error term. Acknowledging the potential limitations stemming from the assumptions of each method, we will interpret only the coefficients of the time invariant variables.

The presence of endogenous variables in the model due to simultaneity represents a source of potential estimation inconsistency. Educational attainment, patent applications and foreign direct investment are suspected to be subject to simultaneous causality. A potential feedback effect from exports to educational attainment is likely to be observed if higher demand for more educated workers, as a result of rising exports, increases the rate of return from investing in additional schooling, hence raising levels of educational attainment in the workforce. In a similar manner, a feedback effect may also occur from exports to innovation. Several studies have found supporting evidence for this hypothesis, even though this reverse causation tends to be limited to specific firms, countries and/or innovation categories (Damijan et. al., 2008, Van Beveren and Vandenbussche, 2010). FDI is also likely to be influenced by a country's exporting. For instance, a higher degree of openness, commonly measured by export ratios, has been suggested to encourage foreign investment, though the empirical evidence is mixed (Charkrabarti, 2001). While most of these relationships are highly unlikely to occur simultaneously, as it usually takes some time for the feedback effects to take place, a conservative approach is taken and Schaffer's (2010) instrumental variable estimation approach is applied to account for potential endogeneity in the models. Since finding suitable and valid instruments is very difficult, the lagged values (one period) of the potential endogenous variables are used as internal instruments. The key rationale for using lags is that these values were produced at an earlier point in time and hence are unlikely to be influenced by current changes.

5. Results

The results presented here are based on the instrumental variable fixed effects estimator for time varying variables and on fixed effects vector decomposition and Hausman and Taylor for the time invariant variables.[20] Overall, the results suggest that the impact of educational attainment on export market share is subject to the level of education investigated, thus highlighting the importance of distinguishing between different levels. Although both measures of educational attainment seem to have a positive impact on the export market share of CEECs, the share of population who have attained secondary education exerts a relatively stronger impact. Namely, it is estimated that, on average holding other factors constant, an increase of 1 percent in the share of the population aged 15 and over who have attained secondary education increases the export market share by 1.164 percent (see Table 3). When expressing these effects in terms of the sample means, a rise of 10 percent in *sedut* from 70.73 to 77.8 increases the mean value of export market share from 0.79 to 0.88. On the other hand, an increase of 1 percent in the share of population with tertiary education increases the share of exports by 0.515 percent (significant at 10 percent), ceteris paribus. For illustration, at the sample means, an increase of 10 percent in *tedut* from 15.9 to 17.49 is estimated to increase export market share from 0.79 to 0.83. When the EEA17 is investigated separately, empirical evidence also appears to support the importance of tertiary education in enhancing international competitiveness (see Table 3). Despite the expected positive sign, the magnitude of the coefficient is not large. It requires an increase of 10 percent in *tedut*, i.e. from 20.71 to 22.78, to increase export market share by 2.90 percent, which at the mean value of *emsh*, is an increase from 6.81 to 7.0. No supporting evidence is found for the impact of secondary education on the international competitiveness of these countries. Given their stage of development and their potentially higher level of export sophistication, this empirical finding is in accordance with a priori expectations. The average years of schooling variable was expected to have a non-linear impact on competitiveness, hence both the level and squared terms of *avyrs* were included in Specification 2. However, results of the estimations do not seem to support this expectation in either group of countries.

[20] The estimation results for the time varying variables are generally consistent across the estimators, with the exception of FEVD estimates being statistically insignificant.

INSERT Table 3. IV estimation results

The quality of education, proxied by the cognitive skills index provided by Hanushek and Woessmann (2012) and student test scores of Altinok et al. (2014) are positive and statistically significant only for the EEA17 sample in the HT estimator (see Table 4). An increase of one standard deviation in cognitive skills index (*cskills*), ceteris paribus, increases the export market share (*emsh*) by 315.1 percent (Specification 1) and 316.8 percent (Specification 2). When interpreted in economic terms, at the mean value, it translates into an increase of *emsh* from 6.9 percent to around 29 percent. When *meanscores* is used in an alternative assessment, on average, holding everything else constant, an increase of 1 point in the average test score, increases the export market share by 2.97 percent. When applied to the mean, this reflects in an increase of *emsh* from 6.9 to 7.1.[21] One explanation for the differences in the results between the two groups of countries could be that, the greater importance of a rise in the level of those with intermediate levels of educational attainment, which represent a relatively large share of the labor force in CEECs, may be reflecting their focus on the production of relatively low-skill and low-technology products. As Gemmell (1996) and Sianesi and Van Reenan (2003) also suggest, tertiary education is more likely to impact on growth in more developed countries, whereas increases in the lower levels of education are more important for growth in developing countries.

INSERT Table 4. FEVD and HT estimation results

Similarly, when the quality of education was proxied by the time varying measure of students' performance provided by Altinok et al. (2014), its effect turned out significant only in the EEA17. It is estimated that, on average, holding other factors constant, an increase of 1 percent in the mean test score of secondary education students increases the export market share by 1.87 percent (see Table 5). In economic terms, this implies that at the mean values of the variables, a rise of 10 percent in *studperf* from 565.77 to 622.35 is expected to increase export market share from 6.5 to 7.71. Its impact is lower and marginally significant at 10 percent in Specification 2, i.e. 1.21.

[21] While the magnitude of the effects of the two variables seems quite different, it should be noted that these are measured differently. *Cskills* is a standardized index with the minimum of 4.54 and maximum of 5.19, whereas *meanscores* reflects mean test scores in the range of 507 to 608.

INSERT Table 5 IV Estimation results (including the new education quality measure)

From the set of control variables reported in Table 3, coefficients on GDP per capita *(gdpc)*, population *(pop),* economic freedom *(ecofree)* and unit labor cost *(rulc)* are significant in the CEECs sample, while the rest are not statistically different from zero, though they have, in general, the expected signs. The empirical results suggest that GDP per capita *(gdpc)* has a positive impact on the export market share of CEECs. When its impact is investigated for the EEA17, the coefficient of this variable turns out statistically insignificant. The coefficient of population *(pop)* is found to be positive in the CEECs sample supporting the hypothesis that country size does exert a positive impact on the share of exports, as bigger countries are expected to produce more output, and thus are more likely to export more. The effect of this variable is not statistically different from zero when assessed in the EEA17 sample. The coefficient of the mismatch proxy is also insignificant in the two sub-groups of countries. Finally, the results suggest that, in the line with theory, real unit labor cost *(rulc)* exerts a negative impact on the export market share in both sample estimations.

The coefficients on the effect of inward FDI stock *(fdi),* patent applications *(patappr)* and the share of services *(serv)* are generally significant and with expected signs for EEA17. The effect of economic freedom *(ecofree)* is negative and significant in the CEECs sample only. The transition indicator index *(transindN)* is found to be statistically insignificant, suggesting that the speed of the progress of countries during transition did not contribute much to their international competitiveness. This might be a reflection of the low variation of this variable due to the transition process being completed by 2004 in the majority of countries included in this sample.

6. Conclusions

In addressing the under-researched link between human capital endowments and international competitiveness, with particular focus on selected transition economies of Central and Eastern Europe, this paper fills a gap in the literature. Longitudinal data is used to assess the impact of human capital on international competitiveness of the 10 CEECs and 17 EEA17 for the period 1995-2010. In addition to human capital endowments that measure the quantity of education, three measures of the quality of education, which have not previously been considered in the international competitiveness literature, were also included in the regression analysis. The

empirical investigation further controlled for a range of potential competitiveness-enhancing factors derived from different strands of previous research. A variety of estimation methods have been employed, and the issue of potential endogeneity has been accounted for by following an instrumental variable approach.

In line with theoretical underpinnings, the empirical findings suggest that human capital endowments exert a significant effect on the international competitiveness of the countries under investigation. Both the level of secondary and tertiary educational attainment was found to exert a positive impact in the CEEC sample, while the share of population who have attained tertiary education appeared to be the only education-based determinant of the export share of EEA17. These empirical findings are in line with a priori expectations, considering the stage of development and the tendency of the latter group of countries to export more skill and technology intensive goods.

The evidence obtained in this paper suggests that increasing the stock of highly educated individuals has important implications for the enhancement of international competitiveness of these countries. Although the impact of tertiary education is significant in both CEECs and EEA17, its effect in the former set of countries is surpassed by that of secondary education. However, given the high and rising share of the population who have attained secondary education in transition countries, a focus on promoting post-secondary attainment seems more appropriate at this stage, which would assist them in upgrading the skill and technology intensity of their exports. The quality of education proxied by students' test scores averaged across time was found to have a positive and significant impact on the international competitiveness of the EEA17. Similar results were found when panel data on students' performance were used in an alternative assessment.

Future research on the topic would benefit from expanding the coverage of transition economies and the time span of the study, as well as improvements in human capital measurement, in particular in terms of capturing the effects of quality of education and other sources of human capital development such as formal and informal training.

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Table 1. Variable descriptions

Variable name	Description	Expected sign	Data source
emsh	Exports of goods of country *i* over total exports of goods of EU-28 (in percentages)	Dep. variable	Own calculations based on UNCTAD database (2013)
sedut	The percentage of population aged 15 and over who have attained secondary education	+	
tedut	The percentage of population aged 15 and over who have attained tertiary education	+	Barro and Lee (2014)
avyrs	The average number of years of schooling of the population aged 15 and over	+	
cskills	Average test score in mathematics and science, primary through end of secondary school, all years (scaled to the PISA scale divided by 100) (averaged across time)	+	Hanushek and Woessmann (2009)
meanscores	Mean scores of students at international assessments (primary and secondary education) (averaged across time)	+	Altinok et al. (2014)
studperf	Adjusted mean scores of students of secondary education in various assessments (1965-2010)	+	Altinok et al. (2014)
patappr	Number of patent applications by residents	+	WDI – World Bank (2014)
fdi	Inward foreign direct investment stock (% GDP)	+	UNCTAD (2014)
gdpc	GDP per capita (constant 2005 US$)	+	WDI – World Bank (2014)
pop	Total population (in thousands)	+	Penn World Table 7.1 (Heston et al., 2012)
rulc	Real unit labour cost index (2005=100)	-	Eurostat (2014)
transindN	Transition indicator (average of a set of single indicators - normalized from 0 to 1)	+	EBRD (2014)
ecofree	Index of Economic Freedom (overall score based on a set of 10 factors)	+	The Heritage Foundation (2014)
unem	Skills mismatch: Long-term unemployment (% of total unemployment)	-	WDI – World Bank (2014)
serv	Services, etc. , value added (% of GDP)	-	WDI – World Bank (2014)

Table 2. Descriptive statistics

	CEECs			EEA17			t-test	K. Wallis
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	p-value	p. values
emsh	134	.7916021	.7617393	215	6.816349	8.240806	0.0000	0.0001
sedut	134	70.73351	10.51806	215	53.21805	10.92474	0.0000	0.0001
tedut	134	15.89873	5.333638	215	20.71307	5.294638	0.0000	0.0001
avyrs	134	11.11112	.9684657	215	10.19423	1.199015	0.0000	0.0001
sqravyrs	134	124.3879	21.46285	215	105.3533	23.40039	0.0000	0.0001
patappr	134	526.5746	598.8432	215	6915.116	12452.54	0.0000	0.0001
cskills	140	4.929907	.1911162	226	4.916854	.1796002	0.5101	0.3147
meanscores	140	566.0786	20.14482	226	574.8496	20.0868	0.0001	0.0001
studperf	123	561.4645	22.43789	199	565.772	22.28011	0.0937	0.0514
fdi	134	40.00946	21.98783	215	50.62089	51.14798	0.0236	0.9393
gdpc	134	8997.269	4175.677	215	38962.33	14453.93	0.0000	0.0001
pop	134	9106.06	9274.889	215	22956.18	26202.81	0.0000	0.0001
unem	134	46.4403	13.02313	215	31.97395	13.67586	0.0000	0.0001
ecofree	134	63.22015	7.539927	215	69.90419	5.87904	0.0000	0.0001
serv	134	62.11145	6.210989	215	70.61646	5.981306	0.0000	0.0001
rulc	134	102.2284	5.823399	215	101.846	3.904008	0.4635	0.7050
transindN	134	.8220978	.0879235	NA	NA	NA	NA	NA

Notes:

(1) The null hypothesis for the t-test is that there is no difference in the mean values between CEECs and EEA17.

(2) The null hypothesis for Kruskal-Wallis test is that the two groups of countries (i.e. CEECs and EEA17) come from the same population.

Table 3. IV estimation results

	Specification 1		Specification 2	
	CEECs	**EEA17**	**CEECs**	**EEA17**
VARIABLES	lnemsh	lnemsh	lnemsh	lnemsh
lnsedut	1.164***	0.0542		
	(0.43)	(0.177)		
lntedut	0.515*	0.290*		
	(0.283)	(0.154)		
avyrs			-0.305	-0.208
			(0.885)	(0.177)
sqravyrs			0.0346	0.0095
			(0.0353)	(0.00871)
lnpatappr	0.16	0.146**	0.0713	0.133**
	(0.105)	(0.0565)	(0.144)	(0.0547)
lnfdi	0.0553	0.0065	0.0395	0.0108**
	(0.0831)	(0.0047)	(0.073)	(0.00444)
lngdpc	0.940***	0.0498	0.645**	0.0974
	(0.284)	(0.244)	(0.252)	(0.237)
lnpop	5.427***	-0.115	5.147*	0.26
	(1.67)	(0.419)	(2.783)	(0.37)
unem	-0.00303	0.000703	-0.003	0.000764
	(0.00205)	(0.00083)	(0.002)	(0.0008)
lnecofree	-0.964***	-0.139	-0.958**	-0.21
	(0.352)	(0.225)	(0.38)	(0.23)
lnrulc	-0.735*	-0.556*	-0.863**	-0.583**
	(0.407)	(0.289)	(0.432)	(0.281)
serv	0.0167	-0.0364***	0.0157	-0.0365***
	(0.0114)	(0.00508)	(0.0113)	(0.005)
transindN	0.274		0.653	
	(0.47)		(0.51)	
No. of obs.	134	215	134	215
R-squared	0.899	0.639	0.910	0.643
No. of countries	10	17	10	17

Notes: (1) Year dummies are included in the estimations but are not reported in the table

(2) ***p<0.01, **p<0.05, *p<0.1; Robust standard errors in parentheses;

Table 4. FEVD and HT estimation results

	Specification 1				Specification 2			
	CEECs	EEA17	CEECs	EEA17	CEECs	EEA17	CEECs	EEA17
	FEVD	**FEVD**	**HT**	**HT**	**FEVD**	**FEVD**	**HT**	**HT**
VARIABLES	lnemsh	lnemsh	lnemsh	lnemsh	lnemsh	lnemsh	lnemsh	lnemsh
cskills	**12.32**	**3.226**	**8.654**	**3.151*** **	**12.14**	**3.000**	**7.363**	**3.168*** **
	(21.94)	**(3.895)**	**(8.281)**	**(1.202)**	**(28.27)**	**(11.07)**	**(9.167)**	**(0.987)**
meanscores	**0.136**	**0.0282**	**0.101**	**0.0297*** **	**0.139**	**0.0281**	**0.0916**	**0.0296*** **
	(0.278)	**(0.0728)**	**(0.0771)**	**(0.00942)**	**(0.421)**	**(0.428)**	**(0.0857)**	**(0.00739)**
lnsedut	1.094	0.00503	0.884***	0.0247				
	(10.34)	(4.714)	(0.258)	(0.0912)				
lntedut	0.347	0.109	0.381*	0.0517				
	(16.94)	(1.732)	(0.208)	(0.0860)				
avyrs					-0.119	-0.233	-0.644	-0.229*
					(22.65)	(6.610)	(0.448)	(0.127)
sqravyrs					0.0257	0.0101	0.0463**	0.00984*
					(0.955)	(0.319)	(0.0200)	(0.00585)
lnpatappr	0.168	0.0889	0.115*	0.0883***	0.128	0.0856	0.0650	0.0893***
	(3.686)	(0.887)	(0.0597)	(0.0183)	(3.857)	(0.806)	(0.0556)	(0.0184)
lnfdi	-0.0211	0.00579	-0.0209	0.00525*	-0.0146	0.00750	-0.0169	0.00625**
	(5.258)	(0.0532)	(0.0569)	(0.00289)	(4.118)	(0.133)	(0.0519)	(0.00274)
lngdpc	1.004	0.114	0.917***	0.162	0.695	0.122	0.703***	0.198
	(16.09)	(4.863)	(0.212)	(0.163)	(14.96)	(9.565)	(0.207)	(0.159)
lnpop	5.620	0.176	4.056***	0.540***	5.959	0.361	3.939***	0.585***
	(6.916)	(0.813)	(0.886)	(0.141)	(4.805)	(0.305)	(1.054)	(0.118)
unem	-0.00251	0.00128	-0.00211	0.00145*	-0.00260	0.00117	-0.00261*	0.00138
	(0.0708)	(0.0155)	(0.00146)	(0.000850)	(0.0725)	(0.0149)	(0.00142)	(0.000853)
lnecofree	-0.682	-0.237	-0.619**	-0.227	-0.728	-0.298	-0.646***	-0.291*
	(12.44)	(3.116)	(0.273)	(0.156)	(10.76)	(1.990)	(0.249)	(0.154)
lnrulc	-0.723	-0.580	-0.614**	-0.578***	-0.857	-0.628	-0.785***	-0.623***
	(9.883)	(4.647)	(0.255)	(0.215)	(13.66)	(7.294)	(0.242)	(0.215)
serv	0.0197	-0.0356	0.0155**	-0.0368***	0.0191	-0.0347	0.018***	-0.0358***
	(0.162)	(0.112)	(0.00658)	(0.00361)	(0.158)	(0.0786)	(0.00587)	(0.00361)
transindN	0.169		-0.0203		0.540		0.391	
	(24.48)		(0.407)		(23.35)		(0.398)	
No. of Obs.	140	226	140	226	140	226	140	226
No. of countries	10	17	10	17	10	17	10	17

Notes: (1) Although the full set of results is reported in this table, the main focus is on the coefficients of the time-invariant variables

(2) Year dummies are included in the estimations but are not reported in the table

(3) ***p<0.01, **p<0.05, *p<0.1; Standard errors in parentheses;

(4) To avoid collinearity the **meanscores** variable is included in an alternative model specification.

Table 5. IV Estimation results (including the new education quality measure)

	Specification 1		Specification 2	
	CEECs	**EEA17**	**CEECs**	**EEA17**
VARIABLES	lnemsh	lnemsh	lnemsh	lnemsh
lnsedut	0.914**	-0.113		
	(0.434)	(0.195)		
lntedut	0.667*	0.184*		
	(0.369)	(0.106)		
avyrs			-0.0610	-0.197
			(1.431)	(0.154)
sqravyrs			0.0236	0.00930
			(0.0570)	(0.00722)
lnstudperf	**-1.066**	**1.870****	**-1.045**	**1.212***
	(1.444)	**(0.937)**	**(1.175)**	**(0.651)**
lnpatappr	0.0546	-0.0655	0.0279	-0.0333
	(0.127)	(0.0652)	(0.151)	(0.0639)
lnfdi	0.0569	-0.0179	0.0267	-0.00802
	(0.0771)	(0.0122)	(0.0787)	(0.00862)
lngdpc	1.014**	0.165	0.745***	0.152
	(0.411)	(0.275)	(0.263)	(0.228)
lnpop	2.453	-0.0614	3.412	0.236
	(1.771)	(0.349)	(4.334)	(0.287)
unem	-0.00196	0.00118	-0.00202	0.00108
	(0.00217)	(0.000775)	(0.00220)	(0.000722)
lnecofree	-0.928**	-0.737***	-0.980**	-0.662***
	(0.356)	(0.262)	(0.404)	(0.220)
serv	0.0131	-0.0320***	0.0140	-0.0295***
	(0.0157)	(0.00531)	(0.0152)	(0.00458)
lnrulc	-0.663	-0.475	-0.891**	-0.586*
	(0.422)	(0.356)	(0.430)	(0.308)
transindN	0.552		1.027**	
	(0.505)		(0.457)	
No. of obs.	123	199	123	199
R-squared	0.897	0.647	0.913	0.683
No. of countries	10	17	10	17

Notes: (1) Year dummies are included in the estimations but are not reported in the table

(2) ***p<0.01, **p<0.05, *p<0.1; Robust standard errors in parentheses;