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Returns to Education in European Emerging Markets: A Meta-Analytic Review*

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Abstract: In this paper, we perform a meta-analysis of 1599 estimates extracted from 69 previous studies to identify time-series changes in returns to education in 20 European emerging markets. We also examine possible difference in returns to education across the region. A meta-synthesis of collected estimates suggests a decreasing trend over time in returns to education in European emerging markets as a whole. Synthesis results also indicate that the western part of the region tends to have higher returns to education than the eastern part. Both the meta-regression analysis of literature heterogeneity and the test for publication selection bias produced findings that are highly consistent with the meta-synthesis results.

Keywords: return to education; wages; meta-analysis; publication selection bias; European emerging markets

JEL classification numbers: D31; I26; J31; P23; P36

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1 Introduction

At the beginning of the transition from the socialist planned system to a market economy, most firms in Central and Eastern Europe (CEE) and the former Soviet Union (FSU) encountered difficulties in recruiting talented and skilled workers who would adapt to the new economic environment. The so-called "red executives" in enterprises established during the socialist era in these European emerging markets also did not have the knowledge and skills required to survive the transition; in addition, there was no managerial labor market to encourage their turnover. Not only corporate executives and managers, but also white- and blue-collar workers who were accustomed to working in formerly socialist enterprises faced difficulties in adapting to newly introduced duties in the market economy. Many researchers regarded the shortage of highly skilled and talented workers in the labor market to be one of the major bottlenecks to economic transition (Jones et al., 1995; Muravyev, 2001, 2003; Crino, 2005; Eriksson, 2005; Ryan, 2006; Horie and Kumo, 2020). In the 1990s, many traditional vocational schools and colleges still continued to train youth for jobs that no longer existed and were no longer required in the labor market (Walker, 2006). In these circumstances, a dramatic increase in the corporate need for workers competent in the new economic environment considerably increased the returns to secondary and higher education.

During the socialist period, vocational schools and colleges had provided education and training to students in a tight relationship with state enterprises. The transfer of graduates from school to work was organized by the State, and graduates were mandatorily assigned to jobs in state enterprises institutionally linked to the schools and colleges (Horie, 2005). This was called the State Job-Assignment System (SJAS). Under the SJAS, state enterprises essentially had no decision-making power to recruit and select new graduates from schools and colleges but simply accepted the new employees assigned by the State. The transition to a market economy meant that these firms were suddenly faced with the challenges of recruiting and selecting new graduates they need on their own, and that new graduates were now valued based on their ability to fit their knowledge and skills to the firms' new strategies. Wages, which was quite rigid during the socialist period due to the salary systems fixed by narrowly classified occupations by the State, became more flexible in the newly established labor market. Soon after the transition to a market economy, a wage gap began to form between winners and losers: workers who were competitive in the labor market and those who did not adapt to the new economic environment. All of these institutional changes had a considerable impact on the relationship between education and wages.

The drastic changes described above have inspired many researchers to study the effect of education on wage levels in European emerging markets. Most of this work has focused on a considerable increase in the returns to education during the early stage of transition. However, many of these countries have already changed the institutions embedded during the socialist period into new ones during the last three decades, successfully doing away with socialist legacies. Therefore, we can expect that the returns to education, which skyrocketed immediately after the collapse of socialism, have gradually diminished over the years. Evidence regarding the time trend in the returns to education throughout the transition period, however, is quite limited; thus, the overall picture on this point is ambiguous.

In addition, studies that have examined the returns to education in European emerging markets have largely failed to provide empirical evidence by cross-country comparison. In fact, the literature empirically examining returns to education in transition economies is strongly constrained by datasets of differing quality levels and sample designs across countries (Flabbi et al., 2008). Educational systems are also diverse throughout the region. As a result, most researchers often end up focusing on a specific country or a few countries that have comparable datasets and sample designs.

Nevertheless, empirical analyses of a relatively large number of countries have been covered in a handful of studies, including those of Flabbi et al. (2008), who estimated the returns to education in seven CEE countries and Russia by using data derived from the International Social Survey Program; Hölscher et al. (2011), who used cross-sectional data regarding 10 CEE EU member states obtained from the European Union Statistics on Income and Living Conditions (EU-SILC) to compare these countries against West European EU member states; and Mysíková and Večerník (2019), who also used EU-SILC data to estimate the returns to education in EU member states, including 11 CEE countries. However, it is regrettable that, due to data limitations, Hölscher et al. (2011) and Mysíková and Večerník (2019) did not include any non-EU countries. In addition, these two studies cover a period in the recent 2000s; thus, they do not provide evidence regarding the longitudinal tendency in the returns to education throughout the transition period.

In this paper, we aim to overcome the above-mentioned research constraints and provide deeper insights into the returns to education in European emerging markets by conducting a large meta-analysis of the extant literature. The meta-analysis, which takes advantage of the heterogeneity across studies, is capable of answering questions that would be difficult to examine in standard empirical analyses (Stanley and Doucouliagos, 2012; Ma and Iwasaki, 2021). As shown later, the meta-analysis in this paper indeed enables us to explore longitudinal changes in returns to education and find diverse characteristics among European emerging markets, including many non-EU member states. Fleisher et al. (2005) present a pioneering meta-analysis on the returns to education in 10 CEE and FSU countries and China, using estimates reported in 25 previous studies. Our meta-analysis examines the literature uncovered by Fleisher et al. (2005) to estimate and compare the returns to education in 20 European emerging markets, consisting of East Germany, 11 EU member states (Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia), and 8 non-EU countries (Albania, Belarus, Kosovo, Macedonia, Moldova, the Russian Federation, Serbia, and Ukraine). We also examine the long-term time trend in the returns to education in the region. By achieving these two objectives, this paper considerably complements the findings of Fleisher et al. (2005).

Meta-synthesis of 1599 estimates extracted from 69 previous studies suggests a decreasing trend over time in the returns to education in European emerging markets as a whole. Synthesis results also indicate that the western part of the region tends to have higher returns to education than the eastern part. Both meta-regression analysis (MRA) and testing for publication selection bias produced findings that are highly consistent with the meta-synthesis results.

The remainder of the paper is organized as follows: Section 2 develops testable hypotheses for meta-analysis, taking account of the regional context of the educational systems and labor markets in European emerging markets. Section 3 describes the procedures used for searching and selecting the literature subject to the meta-analysis and overviews the selected studies. Section 4 performs a meta-synthesis of the collected estimates. Section 5 conducts MRA of heterogeneity among studies to assess the statistical robustness of the synthesis results presented in Section 4. Section 6 tests for publication selection bias. Finally, Section 7 summarizes the major findings and concludes the paper.

2 Returns to Education in European Emerging Markets: Hypothesis Development

The returns to education in European emerging markets at the very beginning of the transition period have attracted the attention of many researchers. This is because there was an argument that the transition to a market economy could cause a peculiar phenomenon in which CEE and FSU countries might experience a sharp upward trend in the returns to education. It was commonly asserted that returns to education in the socialist period were generally low in these countries because wages were determined by the centralized planning system, in which a rigid wage structure that gave equal pay for jobs was rarely affected by differences in educational background (Graeser, 1988).[1] Accordingly, researchers expected that the economic transition had reset the socialist wage system, making wages flexible in the labor market, and resulting in a stronger link between educational backgrounds and wages. As a consequence, there was a drastic rise in returns to education.

Several attempts have been made to ascertain the validity of this prediction. A variety of empirical studies have examined the returns to education during the early period of transition in European emerging markets. For example, Grogan (1997), Arabsheibani and Lau (1999), Lehmann and Wadsworth (2001), and Gerry et al. (2004) found a notable increase in returns to education in Russia, while Newell and Reilly (1996) and Deloach and Hoffman (2002) doubted the presence of an enhanced wage effect of schooling in Russia. Pastore and Verashchagina (2006) concluded that the returns to education in Belarus were generally low throughout the early stage of transition, which could be explained by the gradualist approach to structural reform of the Lukashenko administration. Ganguli and Terrell (2006) also suggested that the earnings differentials by education remained very low in transition in Ukraine. In the very early stage of transition (until 1994), Estonia experienced inverse returns to education (Noorkôiv et al. 1998). In Poland, wage premiums for skilled white-collar workers grew dramatically at the beginning of the transition, which brought a striking increase in the returns to education (Rutkowski 1996). Similar trends were observed in the Czech Republic. In fact, Flanagan (1995) demonstrated that, in the Czech Republic, the returns to secondary and higher education increased remarkably as compared to those for primary education. Münich et al. (2005) also found that the returns to education in the early stage of the transition significantly exceeded those under the old regime. In Romania, the education premium grew substantially in the 1990s (Andrén et al. 2005).

[1] According to Gregory and Kohlhase (1988), even under centralized wage setting in the Soviet Union, higher education enabled individuals to enter higher-paying occupations and, once in a given occupation, those more highly educated tended to earn more than others in the same occupation with lower educational attainment. However, the wage differences between those with higher and lower educational attainments in the Soviet Union were not comparable to those in Western capitalist countries.

As these previous studies show, most researchers share the belief that returns to education grew considerably during the early stage of economic transition in many European emerging markets.

However, studies that span a period extending into the 2000s and beyond often report a gradual decrease in returns to education over time. For instance, Strawinski et al. (2018) examined the returns to education in Poland from 1995 to 2013 and suggested that overeducation likely caused a decrease in the returns to higher education. Laporšek et al. (2021) revealed that the increasing supply of college graduates had the effect of lowering the relative earnings for college graduates as compared to high school graduates in the 2000s and later in Slovenia. Mysíková and Večerník (2019) used panel data covering the period from 2005 to 2014 to examine returns to higher education in East European countries in comparison with their Western counterparts and confirmed that no country displayed a constant upward or downward trend throughout the observation period. Magda et al. (2021) found that the decline in returns to tertiary education was an important factor associated with decreasing wage inequality in the CEE. Hölscher et al. (2011) also stated that there was a consensus that wage inequality rose in the early stage of transition, while empirical evidence in the later stages is more mixed and diverse.

The changing trend in the returns to education in European emerging markets is likely to be closely linked with the spread of higher education fueled by education reforms. Although former socialist countries in Europe generally offered good access to primary and secondary education, access to higher education was quite limited. The educational systems in CEE and FSU countries resembled each other institutionally because they originated in the Soviet system. Until the 1960s, the Moscow-approved system targeted full access to primary education, after which, the principal goal turned to universal secondary education, which was achieved in the most CEE countries by the 1980s (Roberts, 2001). On the other hand, these socialist states provided only limited opportunities in higher education, and admission to such schools was highly competitive (Gregory and Kohlhase, 1988; Gerber, 2000).

During the transition period, higher education institutions in most European emerging markets were transformed from budget-run institutions to organizations that voluntarily charge tuition, which compelled them to accept more students. This tendency was reinforced by the establishment of new colleges and universities after the collapse of socialism. As **Figure 1** shows, although the rates of higher education enrollment in all countries except Russia and Belarus were less than 20% in 1985, a rapid increase was observed through the 1990s and 2000s. In the 2010s, however, most of the countries experienced slight or drastic declines in their enrollment rates. It is logical to expect that returns to education may soar during the early stage of the transition when access to higher education was still very limited. Over the subsequent period of 30 years, however, the population with higher education gradually increased, which naturally resulted in a gradual decrease in the returns to higher education.

As shown in **Figure 2**, a consistent increase in the working-age (ages 15 to 64) population with higher educational attainment can be observed in all seven European emerging markets. The population with higher educational attainment in Poland, which joined the EU in 2004, was almost half that of the EU15 in 2000, but it reached almost 90% of that of the EU15 by 2019. Bulgaria, which became a member of the EU in 2007, had surpassed the EU15's 2007 record by 2014. In Latvia, the population by tertiary educational attainment has been above the EU15's level since 2015. The shortage of highly educated workers, which gave the initial large impact on their wage levels during the early stage of the economic transition, is considered to be largely eased today. The EU had promoted human resource development to enhance smart, sustainable, and inclusive growth; it also set a target of increasing the share of the population aged 30 to 34 to have completed tertiary education to 40% by 2020 (European Commission, 2010). Increasing the population of highly educated workers in EU member states in CEE is expected to change the trend in returns to education in the early stage of transition to a new trend after the enlargement of the EU. Based on these arguments, we predict that:

Hypothesis 1: *The returns to education in European emerging markets have gradually decreased over time* (decreasing trend hypothesis).

Even though a decreasing trend can be seen in the returns to education in European emerging markets as a whole, the differences between countries from this viewpoint should not be ignored. The EU accession of CEE countries has required each individual government and firm to reinforce their institutional convergence to EU standards in their governance and business. In this context, the returns to education would be affected by the institutional convergence in terms of the accession period and geographical adjacency to the EU core. In other words, the earlier they became a member of the EU, the deeper the convergence would be. The closer geographically to the old core members of the EU, the deeper the convergence would be. Therefore, it is probable that the wage effect of education in the western part of European emerging markets is relatively higher than that in the eastern part, including not only non-EU countries such as Russia but also countries like Romania, whose EU membership has been delayed.

In this regard, we raise two important factors in the divergent returns to education across European emerging markets. The first factor is the notable advancement in the Europeanization of the educational systems in CEE countries that joined the EU in 2004. The Europeanization of the educational system comes from the Bologna Process, an intergovernmental agreement incorporating a series of reforms in higher education. It aims to work toward setting up the European Higher Education Area, which encourages international cooperation, academic exchanges, and transition from school to work throughout the area. Through the Bologna Process, a series of institutional reforms were implemented to ensure comparable higher-education qualifications. The Bologna Process has been implemented in most European emerging markets, but to what extent its objectives have been realized across the region is questionable. In fact, the impacts of the Bologna Process on educational systems were significant in Hungary, the Czech Republic, and Poland, which became initial signatories in the Bologna Declaration, along with the EU15, in 1999. Although Romania also signed the declaration in 1999, the Europeanization of the educational system in this country practically began only after it joined the EU in 2007 (Deca, 2015). Russia joined the Bologna Process in 2003 but has retained its own system of higher education qualifications and, in practicality, lags far behind other CEE countries (Luchinskaya and Ovchynnikova, 2011). The Europeanization of the educational system ensures the quality of education and can eventually strengthen the signaling effect of an academic background in the labor market.

The second factor to make the returns to education divergent among European emerging markets is the uneven distribution of foreign direct investment (FDI) across the region. Bhandari (2007) and other empirical works repeatedly verified that FDI can widen wage disparities in emerging markets. After the fall of the Berlin Wall, the newly advanced foreign enterprise firms in host countries helped them navigate to freedom from the rigid wage system inherited from the socialist era. The human resource management they introduced in the host countries also acted as a powerful measure to create a close relationship between a human resource and its reward. These foreign firms tended to pay higher wages to skilled and educated workers than did their domestic counterparts, which contributed to the widening wage disparities in CEE countries (Alili and Adnett, 2018). As Iwasaki and Tokunaga (2020) revealed, the farther away geographically from the EU 15, the greater reduction in FDI per capita European emerging markets experienced. This means that foreign firms in the eastern part of European emerging markets are expected to exert less impact on the wage systems than in their western counterparts. This expectation coincides with the findings of Estrin (2017), who claimed that the variation in FDI spillover effects can be explained by differences in two main factors: integration with the global economy (e.g., EU membership) and the quality of institutions.

Taking the above discussions into consideration, concerning cross-country variations in the returns to education in European emerging markets, we hypothesize that:

Hypothesis 2: *Returns to education in European emerging markets are higher in the western area than the eastern are*a (west-high/east-low hypothesis).

In the following sections, we examine the above two hypotheses by conducting a meta-analysis of the existing literature. Although the major focus of this paper is on the returns to higher education in European emerging markets, our meta-analysis also involves the returns to secondary education, because it is important to identify whether a similar or diverse trend can be observed between higher and secondary education in terms of the wage effect of education with the aim of obtaining a more accurate picture of the returns to education in European emerging markets.

3 Literature Selection Procedure and Overview of Selected Studies

This section first describes how we searched for and identified research works to be included in the meta-analysis to test the decreasing trend hypothesis and the west-high/east-low hypothesis proposed in the previous section. It also provides an overview of the selected studies.[2]

As the first step in identifying studies that provide estimates of the returns to secondary and higher education in European emerging markets, we used the electronic academic literature databases of EconLit and Web of Science and accessed the websites of major academic publishers to find relevant articles.[3] The search covered a period from 1990 to the first quarter of 2021. We carried out an "AND" search using the term *wage* or *education* in combination with one of the terms *emerging markets*, *transition economies*, *Central Europe*, *Eastern Europe*, *former Soviet Union*, and the name of one

[2] The literature selection and meta-analysis in this paper were carried out in general conformity with the guidelines described in Havránek et al. (2020).

[3] We used the websites of the following academic publishers for our literature search: Emerald Insight, Oxford University Press, Sage Journals, ScienceDirect, Springer Link, Taylor & Francis Online, and Wiley Online Library. The final literature search was conducted in May 2021.

of the European emerging markets and obtained approximately 420 articles in either electronic form or hard copies. We then carefully examined each of the collected articles and narrowed the field to only those studies that provide estimates of returns to secondary and higher education in European emerging markets as outcomes from regression estimation of a Mincer-type wage function. As a result, we selected a total of 69 studies from Flanagan (1995) to Laporšek et al. (2021) that investigated one or more of 20 CEE and FSU countries.[4]

The 69 selected studies are informative for testing the decreasing trend hypothesis because they cover the 32-year period from 1986 to 2017 as a whole. In addition, only twelve of 69 studies used panel data, meaning that the overwhelming majority of estimates reported in the selected studies are empirical results of the returns to education in a particular year. This fact is also favorable for testing the decreasing trend hypothesis.

The selected studies satisfy the conditions for testing the west-high/east-low hypothesis by comparing the returns to education across 20 European emerging markets. A breakdown of these studies by publication year shows that ten (14.5% of the total) of the 69 articles were published in the 1990s, 23 (33.3%) in the 2000s, 28 (40.6%) in the 2010s, and eight (11.6%) in the 2020s. This clearly reflects the active attempt of econometrical analysis in studies of European emerging markets conducted in the 2000s onward. In other words, our meta-analysis is based mostly on the empirical results obtained in recent years when remarkable improvements have been made in the empirical methodology, which greatly increases our chances to identify the true effect size of returns to education throughout the region.

We collected a total of 1599 estimates from the above 69 studies. The mean (median) of the number of collected estimates per study is 23.2 (16). All of these are single-term estimates of either the dummy variable for the completion of secondary education or that for the completion of higher education, for which the group of compulsory education graduates was set as the reference category. A total of 775 estimates were collected for the former variable type and 824 for the latter.[5] Estimates of the secondary education

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[4] **Appendix Table A1** lists the 69 selected studies. Bibliographic information of these research works is provided in **Supplement**. A study by Flabbi et al. (2008), which we mentioned in the Introduction, was excluded from our meta-analysis due to some technical reasons related to the style of reporting empirical results.

[5] Estimates of the interaction terms of academic background dummy variables and other independent variables that were simultaneously estimated along with the single terms were excluded from our meta-analysis. Furthermore, although many previous studies use not only

completion dummy are collectively referred to as the "secondary education studies," and those of the higher education completion dummy as the "higher education studies" hereinafter.

We converted all 1599 collected estimates to partial correlation coefficients (PCCs) in order to adjust the difference in the units of estimation results and with or without logarithmic transformation of the wage variable. The PCC is a unitless statistic that measures the association of a dependent variable and the independent variable in question when other variables are held constant. When t_k and df_k denote the t value and the degree of freedom of the k-th estimate (k = 1, ..., K), respectively, the PCC (r_k) is calculated with the following equation:

$$r_k = \frac{t_k}{\sqrt{t_k^2 + df_k}} \quad (1)$$

The standard error (SE_k) of r_k is given by $\sqrt{(1 - r_k^2)/df_k}$.

As the evaluation criteria for correlation coefficients, Cohen (1988) suggested using the values of 0.10, 0.30, and 0.50 as cut-offs to distinguish a small effect, medium effect, and large effect, respectively. These criteria, however, are meant for zero-order correlations and are, therefore, somewhat unsuitable for evaluating empirical results in the field of economics, where a large number of control variables are usually employed. To address this issue, Doucouliagos (2011) proposed a new standard for labor economic research, setting 0.048, 0.112, and 0.234 as the lowest thresholds of small, medium, and large effects, respectively.[6] In the meta-analyses presented in the following sections, we evaluate returns to education in accordance with these criteria.

4 Meta-Synthesis

A meta-analysis conventionally consists of three steps: (1) meta-synthesis of collected estimates, (2) meta-regression analysis (MRA) of heterogeneity across studies, and (3)

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academic background dummy variables but also years-of-schooling variables in their empirical analyses, our analysis does not use estimates of years-of-schooling variables because it specifically focuses on returns to secondary and higher education.

[6] Doucouliagos (2011) provides a set of guidelines for interpreting the practical significance of partial correlation coefficients derived from the observed distribution of 22,141 estimates reported in economics papers. He recommends regarding the 25th, 50th, and 75th percentiles of these estimates as the lower thresholds of small, medium, and large effects, respectively. The effect size guideline for labor economics is presented in Table 3 (ibid., p. 11).

testing for publication selection bias (Iwasaki, 2020a). Our meta-analysis will follow this standard procedure.[7] Furthermore, to test the hypotheses proposed in Section 2, we use the average estimation year and the geographical remoteness from the core EU measured by the direct distance from Brussels to the capitals of European emerging market countries as the classification criteria.[8] With the aim of synthesizing the collected estimates and testing for publication selection bias, we divide them into three time periods, according to the average estimation year, with 1995 and 2005 as boundary years.[9] We also divide the collected estimates into five regional zones, based on the distance from Brussels, with 1000, 1400, 1600, and 1800 kilometers as geographic boundaries and refer to these five zones as Zones 1 through 5, respectively. Meanwhile, MRA directly utilizes the average estimation year and the distance from Brussels as meta-independent variables.

Table 1 shows how the 20 European emerging markets subject to the meta-analysis are classified into the above-defined five regional zones. In this table, the degree of progress in the Bologna process and the scale of FDI stock per capita by regional zone are also reported. From the table, we confirm that the geographic remoteness from the core EU, measured by the distance from Brussels, tends to be negatively related to both the progress in the Bologna process and the FDI stock per capita in 20 economies in line with the arguments in Section 2.

First, let us look at the distribution of the collected estimates. **Table 2** shows the descriptive statistics of the collected estimates, as well as results of a *t*-test of means and the Shapiro-Wilk normality test. **Figure 3** draws from the kernel density estimation results. In both **Table 2** and **Figure 3**, results are exhibited separately for secondary education and higher education studies. The results by period and regional zone are also displayed for each study type.

In both Panels (a) and (b) of **Table 2**, the mean and median of the estimates collected from all studies are positive, and Panels (a) and (b) of **Figure 3** show highly skewed distributions toward the positive side. These findings indicate that the overwhelming

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[7] The methodological description of the meta-analysis presented in this paper is kept to a minimum due to space limitations. For more details, see Borenstein et al. (2009), Stanley and Doucouliagos (2012), and Iwasaki (2020b, Chapter 1).

[8] For East Germany, we used the distance from Brussels to Berlin.

[9] By the mid-2000s, many CEE and FSU countries had dramatically reflected the Bologna Process in their educational systems (Kwiek, 2014). Therefore, the mid-2000s can be regarded as a turning point in terms of the Europeanization of the educational system in the region.

majority of selected studies report positive returns to education, as predicted by the human capital theory. In fact, the PCCs of 693 (89.4%) of the 775 estimates collected from secondary education studies are positive. Similarly, the PCCs of 804 (97.6%) of the 824 estimates reported in higher education studies also take a positive value. When the Doucouliagos standard is applied to the estimates showing positive effects of secondary education on wages, the effect sizes of 13 estimates (1.9% of the total) are rated as large, those of 85 estimates (12.3%) are rated as medium, those of 227 estimates (32.8%) are rated as small, and those of the remaining 355 estimates (51.2%) are rated as less than small. With regard to the estimates of higher education, the effect sizes of 55 estimates (6.8% of the total) are rated as large, those of 211 estimates (26.2%) are rated as medium, those of 209 estimates (26.0%) are rated as small, and those of the remaining 293 estimates (36.4%) are rated as less than small. This finding suggests that returns to both secondary and higher education have most likely reached an economically meaningful level in European emerging markets.

For both study types, the distributions of estimates displayed by period and regional zone in **Table 2** and **Figure 1** largely support both the decreasing trend hypothesis and the west-high/east-low hypothesis. Specifically, estimates covering the period to 2005 are more positively skewed than those covering the period of 2006 and later. Furthermore, estimates reported in studies of countries belonging to Zones 1 and 2 exhibit more positively skewed distributions than those in studies of countries in the other three zones.

Table 3 presents the meta-synthesis results. This table not only shows the results using the traditional fixed-effect model and random-effects model but also presents the results of new synthesis methods proposed by Stanley and Doucouliagos (2017) and Stanley et al. (2017): the unrestricted weighted least squares averaging method (UWA) and the UWA of estimates with statistical power of greater than 0.80 (weighted average of the adequately powered—WAAP), respectively.[10] As in **Table 2** and **Figure 1**, **Table**

[10] The synthesized effect size obtained with the UWA approach is a point estimate produced by the regression that takes the standardized effect size as the dependent variable and the estimation precision as the independent variable. Specifically, we estimate the following equation, in which there is no intercept term, and the coefficient α_1 is utilized as the synthesized value of the PCCs:

$$t_k = \alpha_1(1/SE_k) + \varepsilon_k,$$

where ε_k is a residual term. In theory, the coefficient α_1 is identical to the estimated value in a traditional fixed-effect model. Its standard error, however, is believed to be more robust to heterogeneity across studies. Furthermore, according to Stanley et al. (2017), WAAP is a

3 shows the results individually for secondary education studies and higher education studies and the results by period and regional zone.

In Column (2) of both Panels (a) and (b) of **Table 3**, the Cochran Q test of homogeneity consistently rejects the null hypothesis at the 1% significance level, and the I^2 and H^2 statistics also suggest the presence of heterogeneity across studies in all cases.[11] Therefore, we adopt the synthesized effect sizes of the random-effects model in Column (1) as the reference values. With respect to the results of UWA and WAAP estimations in Column (3), all of the synthesis values are based on a considerable number of estimates whose statistical power exceeds the threshold of 0.80. Accordingly, we adopt the WAAP synthesis values, which are more reliable than those of the UWA, as the reference values for comparison with those generated by the random-effects model.

As shown in the first row of Panel (a) of **Table 3**, the synthesized effect size for all secondary education studies is 0.051 with the random-effects model and 0.044 with the WAAP approach in terms of PCC. According to the Doucouliagos standard, the returns to secondary education in all of 20 European emerging markets can be rated as small according to the random-effects model and less than small when the WAAP approach is used. On the other hand, Panel (b) of **Table 3** shows that the synthesized effect size for all higher education studies is 0.096 with the random-effects model and 0.085 with the WAAP approach in terms of PCC. Thus, whichever approach is used, the returns to higher education in the region can be regarded as small. It deserves special mention that, as compared to secondary education, higher education doubles the effect of human capital on wages.

The synthesized effect sizes computed by period clearly support the decreasing trend hypothesis. In fact, synthesis values for the period of 2006 or later are consistently smaller than those for the period from 1996 to 2005, and those for the period from 1996 to 2005 are consistently smaller than those for the period of 1995 or before, regardless of study type or synthesis method.

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promising alternative to the estimate obtained from the estimation of a traditional random-effects model because the former is less affected by publication selection bias than the latter.

[11] The Cochran test of homogeneity examines the null hypothesis that the effect sizes are the same across the studies based on the Q statistic, which is defined as the ratio of the observed variation to the within-study error. The I^2 and H^2 statistics measure the degree of heterogeneity across the studies using the Q statistic and the degree of freedom (DF) using the formula: $I^2 = \{(Q - DF)/Q\} \times 100\%$ and $H^2 = Q/DF$, respectively. For more details, see Higgins and Thompson (2002) and Borenstein et al. (2009).

A comparison of the random-effects estimates by regional zone indicates that, while the synthesized effect sizes for Zones 1 and 2 are larger than that for the whole region, those of the other three zones are smaller, irrespective of the study type. The WAAP estimates have slightly different implications: The synthesis results for higher education studies show that Zone 3 exhibits the largest effect size among the five regional zones. In sum, almost all of the synthesized effect sizes estimated for geographic subgroups seem to support the west-high/east-low hypothesis, with the exception of those for higher education studies using the WAAP approach.

It is likely, however, that the above synthesis results are produced by roughly dividing the estimation period into three time frames and the country location into five regional zones. For further clarification, in Panels (a) and (b) of **Figure 4**, we broke down the collected estimates into shorter time frames based on the average estimation period and examined changes in effect sizes over time by study type. In both panels, the slope of the approximate line (*yr*) is estimated to be negative and statistically significant at the 1% level, implying that, as the average estimation period draws closer to the present, the returns to secondary education and higher education drop yearly by 0.0017 and 0.0021, respectively. In other words, even when the study period is divided into units of years, the decreasing trend hypothesis is strongly supported.

Panels (c) and (d) of **Figure 4** display the detailed geographic order of collected estimates. Again, in these panels, the approximate line is estimated with a significant and negative coefficient of the distance variable (*ds*), indicating that the returns to both secondary and higher education decline by 0.00003 for each additional kilometer of distance from Brussels. This result also backs up the west-high/east-low hypothesis.

5 Meta-Regression Analysis

While the meta-synthesis presented in the previous section enables explicit hypothesis testing by providing point estimates as synthesized effect sizes, it fails to give sufficient consideration to the possible influence of heterogeneity across the selected studies on their reported estimates. This section verifies the reliability of synthesis results by estimating a multivariate meta-regression model in which differences in study conditions and quality levels of the selected works are simultaneously controlled for. Specifically, we estimate a regression equation in the form of:

$$y_k = \beta_0 + \sum_{n=1}^{N-1} \beta_n x_{kn} + \beta_N se_k + e_k\,, \;\; k = 1, \cdots, K, \;\; (2)$$

where y_k is the PCC of the k-th estimate, β_0 is the intercept, β_n denotes the meta-regression coefficient to be estimated (n = 1, 2, ..., N), x_{kn} denotes a meta-independent variable that captures the various study-related factors that can potentially affect the estimate, se_k is the standard error of the PCC of the k-th estimate, and e_k is the residual term.

Although the most important aspect in the estimation of Eq. (2) is its effectiveness in controlling for literature heterogeneity, there is currently no consensus among meta-analysts regarding the best estimator for this purpose (Iwasaki et al., 2020, 2022). Hence, following the precedent of Stanley and Doucouliagos (2012), Iwasaki (2022), Kočenda and Iwasaki (2022), and other previous meta-studies, we perform an MRA using the seven estimators to check the statistical robustness of coefficient β_n: (1) the cluster-robust ordinary least squares (OLS) estimator, which clusters the collected estimates by study and computes robust standard errors; the cluster-robust weighted least squares (WLS) estimator, which uses (2) the inverse of the standard error (1/*SE*), (3) the degree of freedom (*df*), or (4) the inverse of the number of estimates reported per study (1/*EST*) as an analytical weight; (5) the multi-level mixed effects restricted maximum likelihood (RML) estimator; (6) the cluster-robust random-effects panel generalized least squares (GLS) estimator; and (7) the cluster-robust fixed-effects panel least squares dummy variable (LSDV) estimator.[12]

As meta-independent variable x_{kn}, a series of variables are employed to capture differences in estimation periods and geographic remoteness from the core EU that are keys to hypothesis testing. It is also used for target region, target gender, target cohort, target firm ownership, data type, survey data used, estimator, wage type, presence of control for selection bias and endogeneity, selection of control variables with potentially significant impact on estimates, and the quality level of the study. All of these variables are simultaneously estimated along with the standard errors of the PCCs. The names, definitions, and descriptive statistics of the meta-independent variables are provided in **Table 4**.

As pointed out by Bayesian meta-analysts, MRA faces the so-called "model

[12] We report either a random-effects model or a fixed-effects model based on the Hausman test of model specification.

uncertainty" problem, which means that the true model cannot be identified in advance (Polák, 2019; Havranek and Sokolova, 2020; Sokolova and Sorensen, 2021). Furthermore, it is probable that the simultaneous estimation of a large number of meta-independent variables can give rise to multicollinearity. To address these issues, following the approach adopted in Brada et al. (2021), we conducted Bayesian model averaging (BMA) by taking the average estimation period, distance from Brussels, and the standard errors of the PCCs as focus regressors and the remaining 24 independent variables as auxiliary regressors to extract posterior inclusion probabilities (PIPs) of the latter 24 variables. We then estimated a meta-regression model that introduces only those auxiliary regressors with 0.80 or more PIP (i.e., selected moderators) with focus regressors on the right-hand side.[13] The estimation results with the selected moderators are presented in **Table 5**.[14] Here, we interpret the results based on the assumption that estimates that not only are statistically significant but also have the same sign in at least four of six models constitute statistically robust estimates.

In both Panels (a) and (b) of **Table 5**, the variable of the average estimation year is repeatedly given robust and negative coefficients; therefore, it strongly supports the decreasing trend hypothesis in agreement with the results of meta-synthesis reported in **Table 3**. In fact, the estimation results in these panels indicate that, as the estimation period draws closer to the present, the returns to secondary (higher) education tend to drop yearly in a range between 0.0011 (0.0019) and 0.0046 (0.0074). This finding also corresponds well with the results obtained from the regression analysis in **Figure 4**.[15]

Estimates of the distance from Brussels also support the west-high/east-low hypothesis. Actually, we confirm that there exists a tendency that the returns to secondary (higher) education decline in a range between 0.0033 (0.0025) and 0.0044 (0.0066) as the distance from Brussels to the capital of European emerging market

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[13] The BMA estimation results are provided in **Appendix Table A2**.

[14] Estimation results of a model with all meta-independent variables are reported in **Appendix Table A3**. As shown in this table, the combination of statistically significant meta-independent variables is different from that in **Table 5**, implying that the MRA without the selection of moderators is likely to be strongly affected by the problems of model uncertainly and multicollinearity in the case of this study.

[15] Refinement of the econometric method over time may produce the observed decline in the returns to education. To examine this possibility, we have checked the correlation of the average estimation year with the quality level of the study and the publication of studies that include control for selection bias and/or endogeneity; as a result, we found no strong relationship between them.

countries increases by 100 kilometers.

Summing up, MRA in this section that takes model uncertainty and multicollinearity into account produces coefficients that plausibly support both the decreasing trend hypothesis and the west-high/east-low hypothesis, thus, corroborating the findings obtained from meta-synthesis performed in the previous section.

6 Testing for Publication Selection Bias

As described in the preceding sections, both the meta-synthesis of collected estimates and the MRA of literature heterogeneity produced findings that are consistent with our expectations. However, in order to establish the reliability of our hypothesis testing, we need to rule out the possibility that the selected studies might not contain genuine evidence due to the effect of publication selection bias. Hence, as the final stage of the meta-analysis, we test for publication selection bias and, if it does exist, examine the extent of its impact and verify the presence of genuine evidence. To this end, we not only utilize a funnel plot but also conduct a funnel-asymmetry test (FAT), precision-effect test (PET), and precision-effect estimate with standard error (PEESE). This FAT-PET-PEESE procedure was proposed by Stanley and Doucouliagos (2012) and has been used widely in recent meta-studies (Iwasaki, 2020a).

The FAT can be performed by regressing the t value of the k-th estimate on the inverse of the standard error ($1/SE$) using Eq. (3), thereby testing the null hypothesis that the intercept term γ_0 is equal to zero:

$$t_k = \gamma_0 + \gamma_1(1/SE_k) + v_k, \quad (3)$$

where v_k is the error term. When the intercept term γ_0 is statistically significantly different from zero, we can assume that the distribution of the effect sizes is asymmetric. Even when FAT detects publication selection bias, genuine evidence can still exist in the selected studies. Stanley and Doucouliagos (2012) proposed examining this possibility by testing the null hypothesis that the coefficient γ_1 is equal to zero in Eq. (3). The rejection of the null hypothesis $\gamma_1 = 0$ implies the presence of genuine evidence. This null hypothesis is tested using the so-called "precision-effect test" (PET), precisely because the coefficient γ_1 is the coefficient of precision. Moreover, Stanley and Doucouliagos (2012) also stated that an estimate of the effect size adjusted for publication selection bias (i.e., coefficient γ_1) can be obtained by estimating Eq. (4), which has no intercept. If the null hypothesis $\gamma_1 = 0$ is rejected, then the non-zero true effect does actually exist in the selected studies, and the coefficient γ_1 can be regarded as the estimate of the non-zero effect.

$$t_k = \gamma_0 SE_k + \gamma_1 (1/SE_k) + v_k \quad (4)$$

The use of Eq. (4) to estimate a publication-selection-adjusted effect size is called "the PEESE approach." To test the robustness of the regression coefficients obtained from this FAT-PET-PEESE procedure, we estimate Eqs. (3) and (4) using not only the unrestricted WLS estimator but also four additional estimators that are capable of addressing heterogeneity across studies.

Figure 5 presents the funnel plots. As Panels (a) and (b) of the figure show, estimates collected from both secondary education studies and higher education studies are strongly skewed to the positive side. If the true effect is assumed to be zero, as the dotted line in **Figure 5** demonstrates, the ratio of positive to negative estimates is 693:82 for secondary education studies; therefore, the null hypothesis that the number of positive estimates equals that of negative estimates is strongly rejected by a goodness-of-fit test (z = 21.947, p = 0.000). The same ratio for higher education studies is 804:20, which reflects a highly positively skewed distribution that rejects the null hypothesis (z = 27.311, p = 0.000). If the WAAP synthesis value reported in **Table 3** is assumed to be the approximate value of the true effect, as depicted by the solid line in **Figure 5**, the estimates collected from secondary education studies have a ratio of 411:364, with a value of 0.044 being the threshold; therefore, the null hypothesis that the ratio of estimates below the WAAP value versus those over it is 50:50 is again rejected, but only at a 10% significance level (z = -1.688, p = 0.091). On the other hand, estimates reported in higher education studies have a ratio of 448 to 376 when the WAAP synthesis value of 0.085 is set as the threshold. In this case, the distribution of estimates is strongly skewed to the left side, rejecting the null hypothesis (z = -2.508, p = 0.012). In sum, while it is highly likely that publication selection bias is at work in higher education studies, the assessment of funnel symmetry for secondary education studies considerably varies on the assumption of the true effect.

Therefore, we leave the final judgment to the FAT-PET-PEESE procedure, which is methodologically more rigorous than a visual examination by funnel plot. The test results for secondary education studies are reported in **Table 6**. Panel (a) of the table shows that the FAT rejects the null hypothesis that the intercept γ_0 is zero only in one of five models. This implies that the collected estimates likely have funnel symmetry; accordingly, the presence of publication selection bias is not suspected in the secondary education studies. However, even when funnel symmetry is present, the selected studies may not contain evidence of the true effect. The PET is used to test for the presence of genuine evidence. As reported in Panel (a) of **Table 6**, the PET rejects the null hypothesis that the coefficient of the inverse of the standard errors (γ_1) is zero in all five models, meaning that the collected estimates do contain genuine evidence. Furthermore, the PEESE approach in Panel (b) of the table shows that the coefficient (γ_1) is statistically significantly different from zero across all five models, therefore implying that the true effect size of returns to secondary education should be in a range from 0.0344 to 0.0565 in terms of PCC.

Table 7 shows the test results for the higher education studies. The results in this table resemble those for the secondary education studies in that, although the FAT suggests a high likelihood of publication selection bias in this study type, the PET confirms the presence of genuine empirical evidence, and the PEESE generated statistically robust coefficients showing that the true effect size lies in a range from 0.0651 to 0.0844.

For both types of studies, the estimates derived from the PEESE approach well correspond with the synthesis results that are close to the WAAP synthesis values reported in **Table 3**. In sum, according to the Doucouliagos standard, the returns to secondary education in European emerging markets are likely to be around the threshold of a small effect size, whereas the returns to higher education are well above the threshold of a small effect size but fall short of the medium threshold.[16]

We also applied the FAT-PET-PEESE procedure to the selected studies by period and by regional zone, which, along with the results for all studies described above, are summarized in **Table 8**. In both types of studies, although publication selection bias was detected in the collected estimates from 1995 or before, the presence of empirical evidence regarding a non-zero true effect was confirmed for all periods. The effect sizes by period corrected for publication selection bias clearly indicate decreases in returns to both secondary and higher education over time; these findings are highly in line with those of the meta-synthesis and MRA that also strongly support the decreasing trend hypothesis.

When we look at the findings of the FAT-PET-PEESE procedure based on the regional classification, we note that the FAT did not reject the null hypothesis for any of

[16] According to the guidelines provided by Havránek (2015) and Havranek and Sokolova (2020), we also conducted the instrumental variable (IV) estimation of Eq. (3) by using the inverse of the square root of an observed value as the instrumental variable, and found that the null hypothesis was rejected by both FAT and PET.

the regional zones, with the exception of higher education studies in Zones 1 and 3. Thus, the effect of publication selection bias at the regional level seems to be minor at best. Furthermore, in eight of ten cases, the PET rejected the null hypothesis, and the PEESE generated a non-zero publication-selection-adjusted effect size that is highly compatible with the corresponding WAAP synthesis value reported in **Table 2**. Hence, we judge that these results mostly back up the west-high/east-low hypothesis.

7 Conclusions

A drastic increase in returns to education was a peculiar and characteristic phenomenon noted during the early phase of the transition from a planned system to a market economy in European emerging markets. Therefore, many researchers have attempted to empirically examine changes in returns to education in the region during this period. More than three decades have passed since these countries began their economic transition, during which time there have been many developments that could have greatly affected returns to education, including drastic education reforms, the remarkable expansion of higher education, the Europeanization of educational systems, followed by economic integration with the EU and accumulation of FDIs. These developments have significantly altered the social and economic environments in this region.

In view of the above fact, we set out to answer two questions in the present study: first, whether returns to education in European emerging markets have gradually decreased over time and, second, whether differences in the progress of Europeanization have resulted in regional gaps in returns to education.[17] To address these issues, we conducted a meta-analysis of a total of 1599 estimates extracted from 69 studies to identify time-series changes in returns to education in 20 European emerging markets and to examine possible differences across the region from this viewpoint.

The meta-synthesis of the collected estimates strongly supports our prediction that the returns to education in European emerging markets decreased over time. The synthesis results also verify the west-high/east-low hypothesis that the western part of the region tends to have higher returns to both secondary and higher education than the

[17] The trend of diminishing returns to education was confirmed to be monotonic over time by the fact that, in the estimation results obtained by adding the squared term of the average estimation year to the regression equation in **Figure 4** and **Table 5**, the single term of the variable was estimated to be significant and negative, while its squared term showed an insignificant estimate.

eastern part. The estimation results of a multivariate meta-regression model and the test results for publication selection bias are also consistent with the meta-synthesis results.

The findings of meta-analysis in this paper strongly suggest that severe supply constraint of highly educated human resources as a legacy of socialism has been significantly resolved by the financial independence of secondary and higher education institutions and the increase in enrollment that accompanied the transition process to a market economy. Our results also highlight the problem that remarkable differences in the progress of the Bologna Process, in the scale of FDI, and expansion of multinational enterprises have created large regional disparities in the returns to education in European emerging markets. The latter issue presents an important policy challenge, especially for countries in the eastern part of the region.

Appendix. Method for Evaluating a Study's Quality Level

This appendix describes how we evaluated the quality levels of studies included in our meta-analysis.

As the basic source of information for evaluating the quality levels of journal articles, we used the rankings of economic journals published on February 1, 2018 by IDEAS (http://ideas.repec.org/), a bibliographic database dedicated to economics and available freely on the Internet. IDEAS provided the most comprehensive rankings of 2159 economic journals as of February 2018. We conducted a cluster analysis by using the comprehensive evaluation scores provided by IDEAS to divide the 2159 journals into 20 clusters and then graded (weight) each journal on a scale from 20 (a group of journals belonging to the highest cluster) to 1 (a group of journals belonging to the lowest cluster).

For journals not indexed by IDEAS, we referred to impact factors (Thomson Reuters) and other journal rankings that allowed us to compare them against the journals indexed by IDEAS, and then graded them according to the scores given to the equivalent journals listed in IDEAS.

For academic books or book chapters, we gave an initial score of 1 and upgraded them to a median score of 10 when any of the following conditions were satisfied: (1) it is clearly specified that the book or article in question has been peer-reviewed; (2) the book or article in question has been published by a major academic publisher that receives assessment by outside experts; and, (3) the quality level of the research in question is clearly high.

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Supplement

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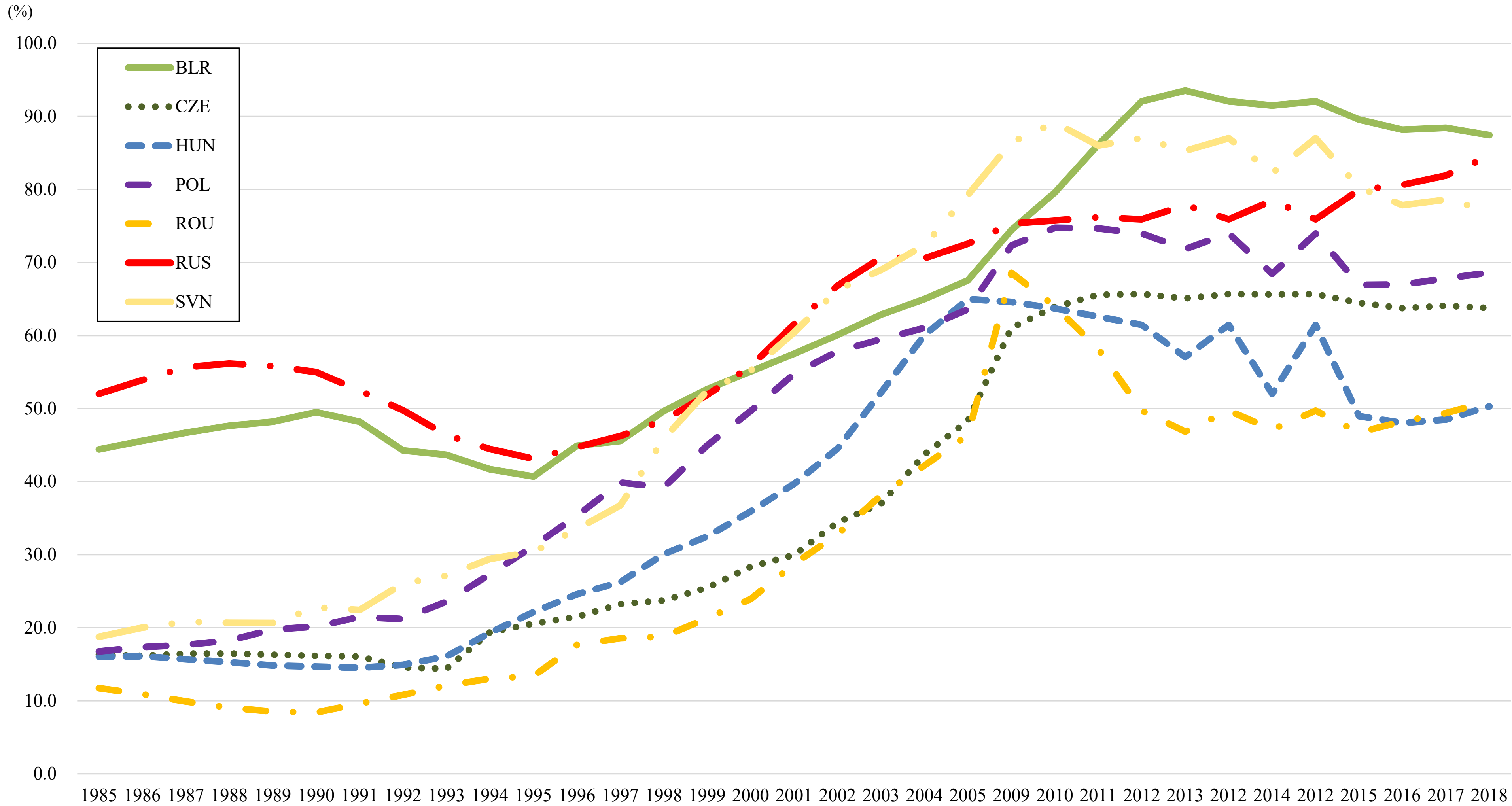


Figure 1. Higher education enrollment rates in 7 European emerging markets: 1985–2018

Source: UNESCO Institute for Statistics (http://uis.unesco.org/en/home)

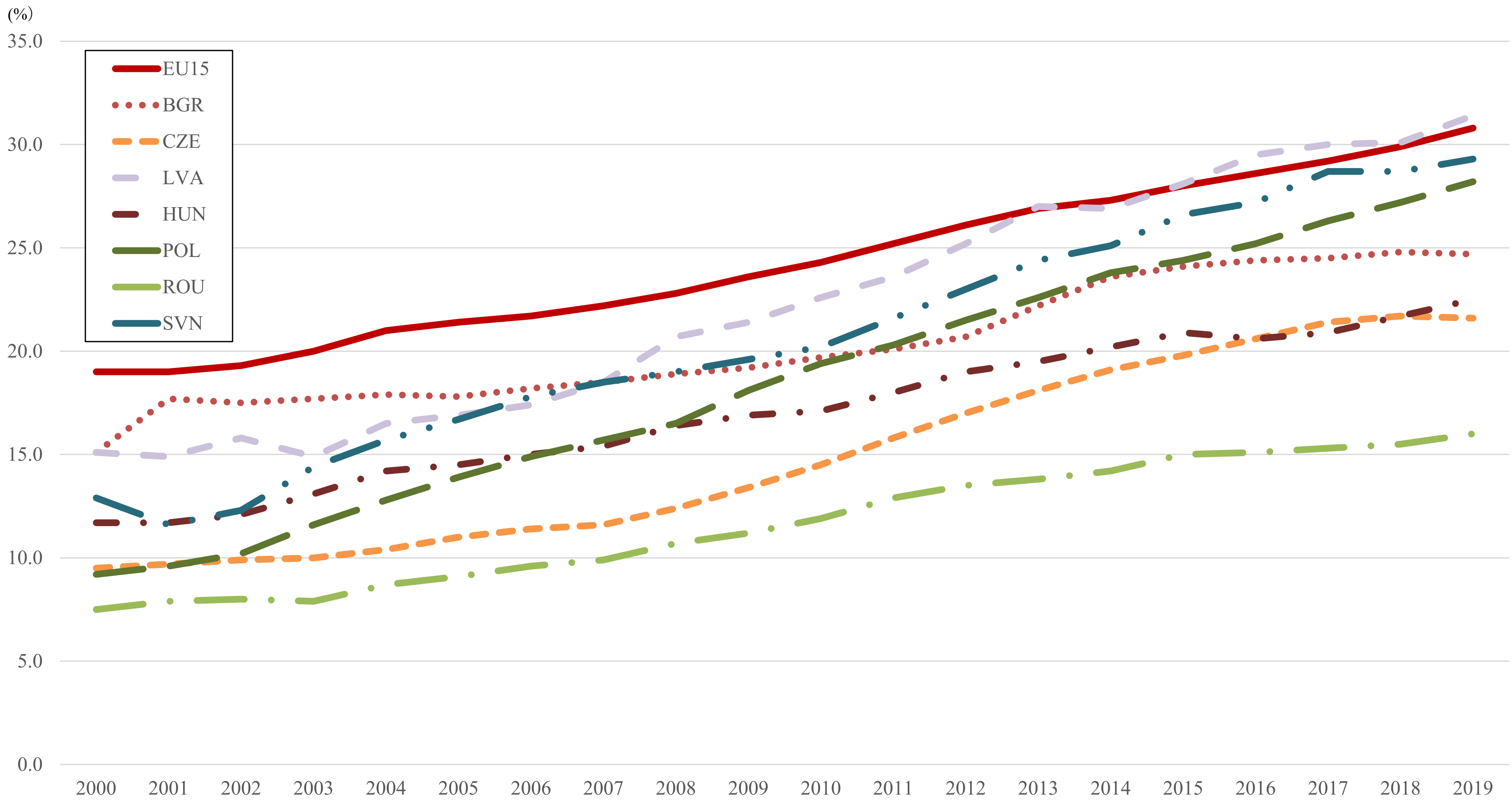


Figure 2. Ratio of higher education graduates to the working population in EU15 and 7 European emerging markets: 2000–2019

Source: EUROSTAT (https://ec.europa.eu/eurostat)

Table 1. Relationship between geographic remoteness from the core EU, progress in the Bologna process, and FDI stock per capita in European emerging markets

Regional zone	Geographic remoteness from the core EU [a]	Progress in the Bologna process in 2018/19 [b]	FDI stock per capita in 2018 [c]	Countries belonging to [d]
Zone 1	Less than 1000 km	44.25	11,619	East Germany, Czech Republic, Slovakia, Slovenia
Zone 2	From 1000 to 1399 km	45.50	6,979	Croatia, Hungary, Poland, Serbia
Zone 3	From 1400 to 1599 km	42.25	7,892	Albania, Estonia, Latvia, Lithuania
Zone 4	From 1600 to 1799 km	38.00	4,764	Belarus, Bulgaria, Kosovo, Romania
Zone 5	1800 km or more	39.00	3,223	Moldova, Russian Federation, Ukraine

Notes:

[a] Measured by distance from Brussels

[b] Denotes the country average of a total of 13 scorecard indicators reported in the Bologna Process Implementation Report (European Commission, 2020); Kosovo is not accounted for due to the lack of membership.

[c] Authors' calculation based on the data of FDI stock and total population in 2018 available in the UNCTAD database (https://unctadstat.unctad.org); East Germany and Kosovo are not accounted for due to data unavailability.

Table 2. Descriptive statistics of partial correlation coefficients, *t*-test, and Shapiro–Wilk normality test of collected estimates

(a) Secondary education studies

Study type	Number of estimates (K)	Mean	Median	S.D.	Max.	Min.	Kurtosis	Skewness	*t*-test [a]	Shapiro–Wilk normality test (z) [b]
All studies	775	0.054	0.040	0.063	0.453	-0.112	7.409	1.523	24.038 ***	9.635 †††
By period										
1995 or before	165	0.061	0.047	0.062	0.349	-0.020	6.502	1.631	12.727 ***	6.428 †††
1996–2005	413	0.062	0.047	0.067	0.453	-0.095	6.152	1.197	18.935 ***	7.024 †††
2006 or later	197	0.032	0.023	0.048	0.380	-0.112	18.883	2.650	9.226 ***	7.024 †††
By regional zone										
Zone 1	92	0.073	0.049	0.099	0.453	-0.095	4.757	1.177	7.129 ***	4.313 †††
Zone 2	215	0.076	0.064	0.062	0.258	-0.050	2.799	0.637	17.975 ***	4.374 †††
Zone 3	38	0.048	0.043	0.040	0.212	-0.018	8.884	1.840	7.431 ***	3.518 †††
Zone 4	172	0.050	0.041	0.056	0.305	-0.112	5.444	0.895	11.655 ***	4.342 †††
Zone 5	258	0.033	0.028	0.043	0.380	-0.069	20.054	2.789	12.192 ***	8.191 †††

(b) Higher education studies

Study type	Number of estimates (K)	Mean	Median	S.D.	Max.	Min.	Kurtosis	Skewness	*t*-test [a]	Shapiro–Wilk normality test (z) [b]
All studies	824	0.097	0.076	0.084	0.475	-0.077	5.647	1.435	33.221 ***	10.115 †††
By period										
1995 or before	133	0.108	0.075	0.096	0.475	-0.037	4.982	1.404	13.031 ***	5.755 †††
1996–2005	404	0.110	0.099	0.086	0.462	-0.045	4.954	1.182	25.686 ***	7.406 †††
2006 or later	287	0.074	0.043	0.070	0.415	-0.077	7.984	1.868	18.090 ***	8.407 †††
By regional zone										
Zone 1	112	0.123	0.052	0.131	0.475	-0.023	3.419	1.343	9.903 ***	7.015 †††
Zone 2	307	0.112	0.109	0.074	0.439	-0.010	3.885	0.807	26.375 ***	5.857 †††
Zone 3	60	0.082	0.038	0.075	0.392	0.006	7.692	2.106	8.404 ***	5.891 †††
Zone 4	171	0.082	0.073	0.067	0.344	-0.077	3.953	0.839	15.954 ***	4.604 †††
Zone 5	174	0.076	0.056	0.070	0.296	-0.037	3.221	0.929	14.306 ***	5.388 †††

Notes:

[a] ***: Null hypothesis that the mean is zero is rejected at the 1% level.

[b] †††: Null hypothesis of normal distribution is rejected at the 1% level.

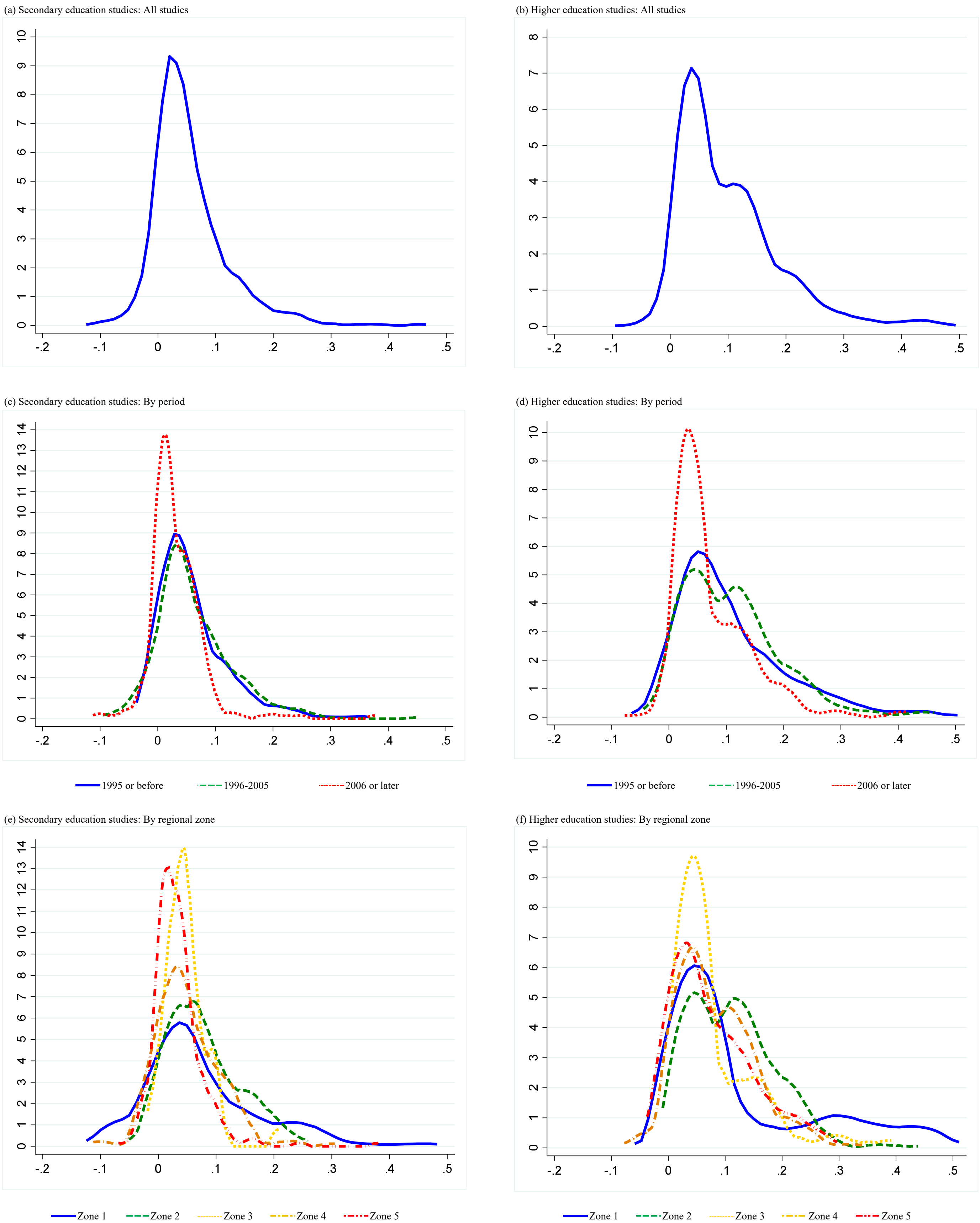


Figure 3. Kernel density estimation of collected estimates

Note: The vertical axis is the kernel density. The horizontal axis is the partial correlation coefficient of collected estimates. See Table 2 for the descriptive statistics of collected estimates.

Table 3. Synthesis of estimates

(a) Secondary education studies

Study type	Number of estimates (K)	(1) Traditional synthesis: Fixed-effect model (z value)[a]	(1) Traditional synthesis: Random-effects model (z value)[a]	(2) Heterogeneity test and measures: Cochran Q test of homogeneity (p value)[b]	(2) I^2 statistic[c]	(2) H^2 statistic[d]	(3) Unrestricted weighted least squares average (UWA): UWA of all estimates (t value)[a,e]	(3) Number of the adequately powered estimates[f]	(3) WAAP (weighted average of the adequately powered estimates) (t value)[a]	(3) Median S.E. of estimates	(3) Median statistical power
All studies	775	0.044*** (314.00)	0.051*** (23.84)	300000.00*** (0.00)	99.51	202.79	0.044*** (16.01)	350	0.044*** (10.69)	0.017	0.715
By period											
1995 or before	165	0.110*** (150.25)	0.060*** (13.00)	9863.58*** (0.00)	97.05	33.95	0.110*** (19.37)	159	0.109*** (19.02)	0.019	1.000
1996–2005	413	0.088*** (328.87)	0.059*** (18.47)	220000.00*** (0.00)	99.15	117.93	0.088*** (14.22)	339	0.088*** (12.89)	0.019	0.997
2006 or later	197	0.023*** (134.99)	0.031*** (9.32)	17480.86*** (0.00)	99.70	335.76	0.023*** (14.29)	99	0.023*** (10.17)	0.008	0.861
By regional zone											
Zone 1	92	0.044*** (239.91)	0.072*** (6.90)	240000.00*** (0.00)	99.97	2923.84	0.044*** (4.64)	51	0.044*** (3.43)	0.006	1.000
Zone 2	215	0.046*** (192.09)	0.067*** (18.09)	45909.82*** (0.00)	99.51	202.76	0.046*** (13.11)	115	0.045*** (9.53)	0.015	0.856
Zone 3	38	0.036*** (39.48)	0.044*** (8.55)	525.58*** (0.00)	95.21	20.90	0.036*** (10.48)	12	0.035*** (6.05)	0.013	0.764
Zone 4	172	0.031*** (32.69)	0.049*** (12.60)	2125.01*** (0.00)	93.41	15.16	0.031*** (9.27)	56	0.017*** (3.99)	0.016	0.472
Zone 5	258	0.036*** (43.97)	0.033*** (11.49)	5636.61*** (0.00)	90.61	10.65	0.036*** (9.39)	56	0.038*** (4.06)	0.020	0.445

(b) Higher education studies

Study type	Number of estimates (K)	(1) Traditional synthesis: Fixed-effect model (z value)[a]	(1) Traditional synthesis: Random-effects model (z value)[a]	(2) Heterogeneity test and measures: Cochran Q test of homogeneity (p value)[b]	(2) I^2 statistic[c]	(2) H^2 statistic[d]	(3) Unrestricted weighted least squares average (UWA): UWA of all estimates (t value)[a,e]	(3) Number of the adequately powered estimates[f]	(3) WAAP (weighted average of the adequately powered estimates) (t value)[a]	(3) Median S.E. of estimates	(3) Median statistical power
All studies	824	0.085*** (612.22)	0.096*** (32.72)	430000.00*** (0.00)	99.76	414.25	0.085*** (26.73)	688	0.085*** (24.41)	0.018	0.998
By period											
1995 or before	133	0.189*** (259.05)	0.108*** (13.17)	27477.54*** (0.00)	99.13	115.51	0.189*** (17.96)	133	0.189*** (17.96)	0.017	1.000
1996–2005	404	0.151*** (581.08)	0.110*** (24.92)	230000.00*** (0.00)	99.61	258.34	0.151*** (24.11)	381	0.151*** (23.41)	0.018	1.000
2006 or later	287	0.052*** (307.00)	0.072*** (18.30)	45839.75*** (0.00)	99.79	483.16	0.052*** (24.25)	187	0.051*** (19.59)	0.017	0.860
By regional zone											
Zone 1	112	0.089*** (509.40)	0.123*** (9.87)	330000.00*** (0.00)	99.98	4823.44	0.089*** (9.31)	102	0.089*** (8.89)	0.014	1.000
Zone 2	307	0.076*** (303.85)	0.111*** (25.23)	80718.04*** (0.00)	99.63	271.67	0.076*** (18.71)	239	0.076*** (16.47)	0.018	0.989
Zone 3	60	0.130*** (147.29)	0.076*** (9.37)	5558.49*** (0.00)	98.47	65.35	0.130*** (15.17)	57	0.130*** (14.79)	0.018	1.000
Zone 4	171	0.055*** (60.22)	0.080*** (16.44)	3491.08*** (0.00)	96.17	26.12	0.055*** (13.29)	126	0.054*** (11.38)	0.015	0.949
Zone 5	174	0.065*** (58.89)	0.076*** (14.08)	4144.96*** (0.00)	95.50	22.22	0.065*** (12.03)	82	0.064*** (8.07)	0.023	0.788

Notes: *** denotes statistical significance at the 1% level.

[a] Null hypothesis: The synthesized effect size is zero.

[b] Null hypothesis: Effect sizes are homogeneous.

[c] Ranges between 0 and 100% with larger scores indicating heterogeneity

[d] Takes zero in the case of homogeneity

[e] Synthesis method advocated by Stanley and Doucouliagos (2017) and Stanley et al. (2017)

[f] Denotes number of estimates with statistical power of 0.80 or more, which is computed by referring to the UWA of all collected estimates

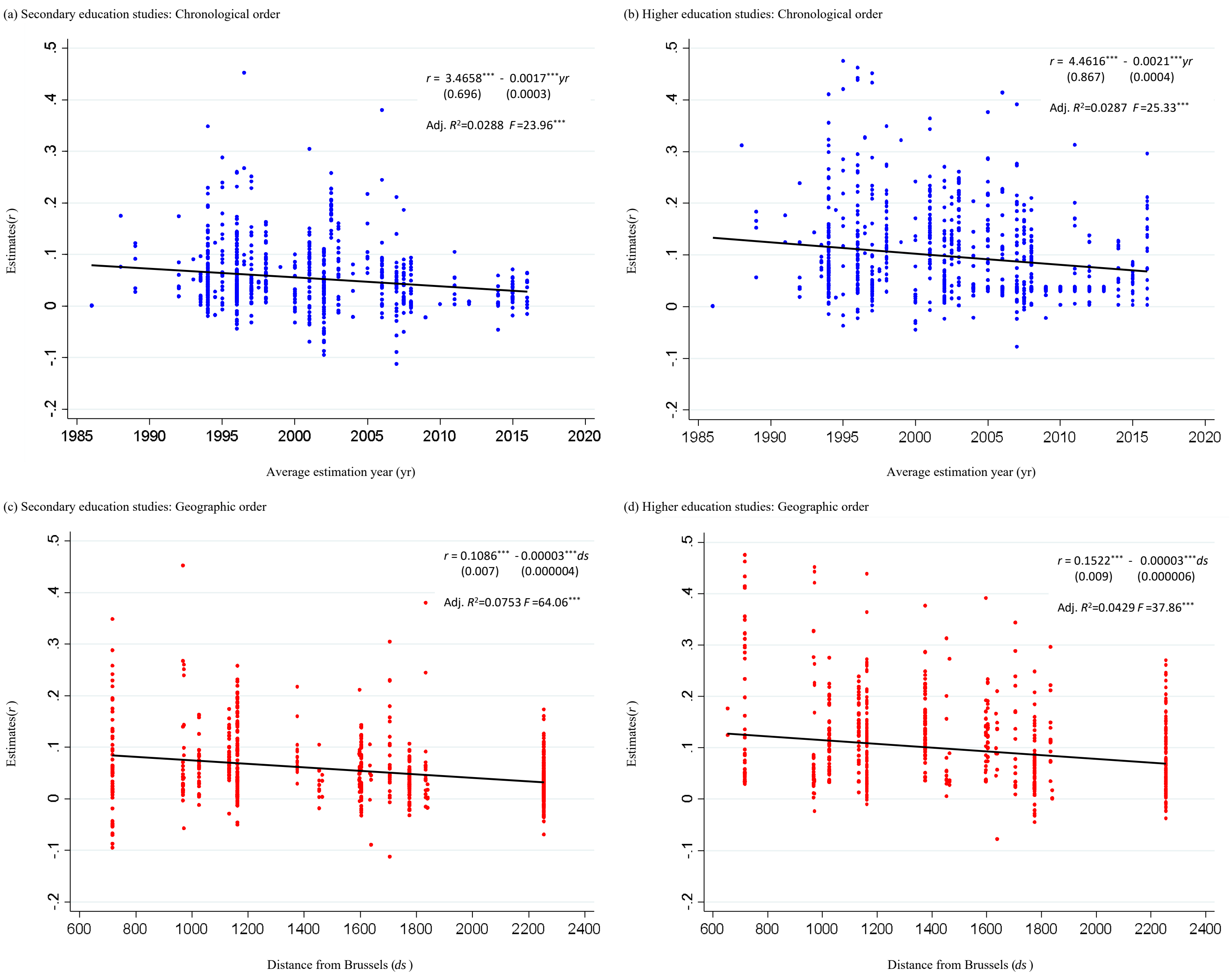


Figure 4. Chronological and geographic order of partial correlation coefficients

Notes: The values in parentheses below the coefficients in the equation are robustness standard errors. *** denotes statistical significance at the 1% level.

Table 4. Name, definition, and descriptive statistics of meta-independent variables

Variable name	Definition	Descriptive statistics					
		Secondary education studies			Higher education studies		
		Mean	Median	S.D.	Mean	Median	S.D.
Average estimation year	Average estimation year	2000.615	2000	6.386	2002.430	2002	6.677
Distance from Brussels	Direct distance from Brussels to the capital of target country (100 km)	15.995	16.03702	5.108	14.810	13.7517	4.774
Urban region	1 = if the target region is urban, 0 = otherwise	0.116	0	0.321	0.045	0	0.207
Rural region	1 = if the target region is rural, 0 = otherwise	0.008	0	0.088	0.004	0	0.060
Male	1 = if the sample is limited to male workers, 0 = otherwise	0.356	0	0.479	0.322	0	0.467
Female	1 = if the sample is limited to female workers, 0 = otherwise	0.310	0	0.463	0.268	0	0.443
Young age	1 = if the sample is limited to young-age workers, 0 = otherwise	0.006	0	0.080	0.006	0	0.078
Middle age	1 = if the sample is limited to middle-age workers, 0 = otherwise	0.014	0	0.118	0.013	0	0.115
Elder age	1 = if the sample is limited to elder-age workers, 0 = otherwise	0.012	0	0.107	0.011	0	0.104
State enterprise	1 = if the target firm is state enterprise, 0 = otherwise	0.071	0	0.257	0.055	0	0.227
Private firms	1 = if the target firm is private firm, 0 = otherwise	0.085	0	0.279	0.063	0	0.243
Panel data	1 = if panel data is employed for empirical analysis, 0 = otherwise	0.114	0	0.317	0.081	0	0.273
Original household survey	1 = if the results of an original household survey are used as the data source, 0 = otherwise	0.529	1	0.499	0.339	0	0.474
Non-OLS	1 = if an estimator rather than OLS is used for estimation, 0 = otherwise	0.206	0	0.405	0.308	0	0.462
IV/2SLS/3SLS	1 = if IV, 2SLS, or 3SLS estimator is used for estimation, 0 = otherwise	0.025	0	0.155	0.027	0	0.161
Regular wage	1 = if regular wage/income is used for empirical analysis, 0 = otherwise	0.557	1	0.497	0.540	1	0.499
Control for selection bias	1 = if the sample selection bias of employment is controlled for, 0 = otherwise	0.089	0	0.285	0.189	0	0.392
Control for endogeneity	1 = if the endogeneity between education and wage level is controlled for, 0 = otherwise	0.005	0	0.072	0.012	0	0.110
Occupation	1 = if the estimation simultaneously controls for occupation, 0 = otherwise	0.434	0	0.496	0.523	1	0.500
Age/age group	1 = if the estimation simultaneously controls for age or age group, 0 = otherwise	0.533	1	0.499	0.567	1	0.496
Health condition	1 = if the estimation simultaneously controls for the health condition of workers, 0 = otherwise	0.036	0	0.187	0.066	0	0.248
Firm size	1 = if the estimation simultaneously controls for the size of firms to which workers belong, 0 = otherwise	0.252	0	0.434	0.369	0	0.483
Location fixed effects	1 = if the estimation simultaneously controls for location fixed effects, 0 = otherwise	0.652	1	0.477	0.595	1	0.491
Industry fixed effects	1 = if the estimation simultaneously controls for industry fixed effects, 0 = otherwise	0.400	0	0.490	0.368	0	0.482
Time fixed effects	1 = if the estimation simultaneously controls for time fixed effects, 0 = otherwise	0.101	0	0.301	0.064	0	0.245
Quality level	20-point scale of the quality level of the study	15.262	18	5.079	15.108	16	4.208
SE	Standard error of partial correlation coefficient	0.021	0.0174	0.019	0.020	0.0176	0.018

Note: See Appendix for details of quality level.

Table 5. Meta-regression analysis of literature heterogeneity

(a) Secondary education studies

Estimator	Cluster-robust OLS	Cluster-robust WLS [1/*SE*]	Cluster-robust WLS [*d.f.*]	Cluster-robust WLS [1/*EST*]	Multi-level mixed effects RML	Cluster-robust fixed-effects panel LSDV
Meta-independent variable (default category)/model	[1]	[2]	[3]	[4]	[5]	[6] [a]
Estimation period						
Average estimation year	-0.0029 ***	-0.0045 ***	-0.0046 **	-0.0029 ***	-0.0016 **	-0.0011 *
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Geographic remoteness from the core EU						
Distance from Brussels	-0.0034 ***	-0.0026	-0.0020	-0.0044 **	-0.0033 **	-0.0033 *
	(0.001)	(0.002)	(0.005)	(0.002)	(0.001)	(0.002)
Selected moderators						
Middle age	-0.0579	-0.0226	-0.0022	-0.0943 **	-0.0146 **	-0.0102
	(0.035)	(0.019)	(0.009)	(0.045)	(0.006)	(0.015)
Original household survey	-0.0274 **	-0.0287	0.0135	-0.0172	-0.0140	
	(0.013)	(0.019)	(0.038)	(0.017)	(0.015)	
IV/2SLS/3SLS	0.0832 ***	0.1019 ***	0.1279	0.1005 ***	0.0258 ***	0.0155
	(0.018)	(0.026)	(0.078)	(0.017)	(0.008)	(0.016)
Control for endogeneity	-0.1388 ***	-0.1399 ***	-0.1095 ***	-0.1528 ***	-0.0920 ***	-0.0822 **
	(0.009)	(0.015)	(0.033)	(0.012)	(0.004)	(0.034)
Industry fixed effects	-0.0252 **	-0.0208	-0.0072	-0.0194	-0.0128 **	-0.0118
	(0.010)	(0.016)	(0.029)	(0.013)	(0.006)	(0.009)
SE	0.4503 *	-0.1068	-2.1375	0.2940	0.4516 ***	0.4090 ***
	(0.232)	(0.592)	(2.287)	(0.369)	(0.093)	(0.127)
Intercept	6.0104 ***	9.0252 ***	9.3607 **	5.8646 ***	3.4092 **	2.3810 **
	(1.375)	(2.571)	(4.333)	(1.996)	(1.410)	(1.196)
K	775	775	775	775	775	775
R^2	0.307	0.230	0.234	0.277	-	0.245

(b) Higher education studies

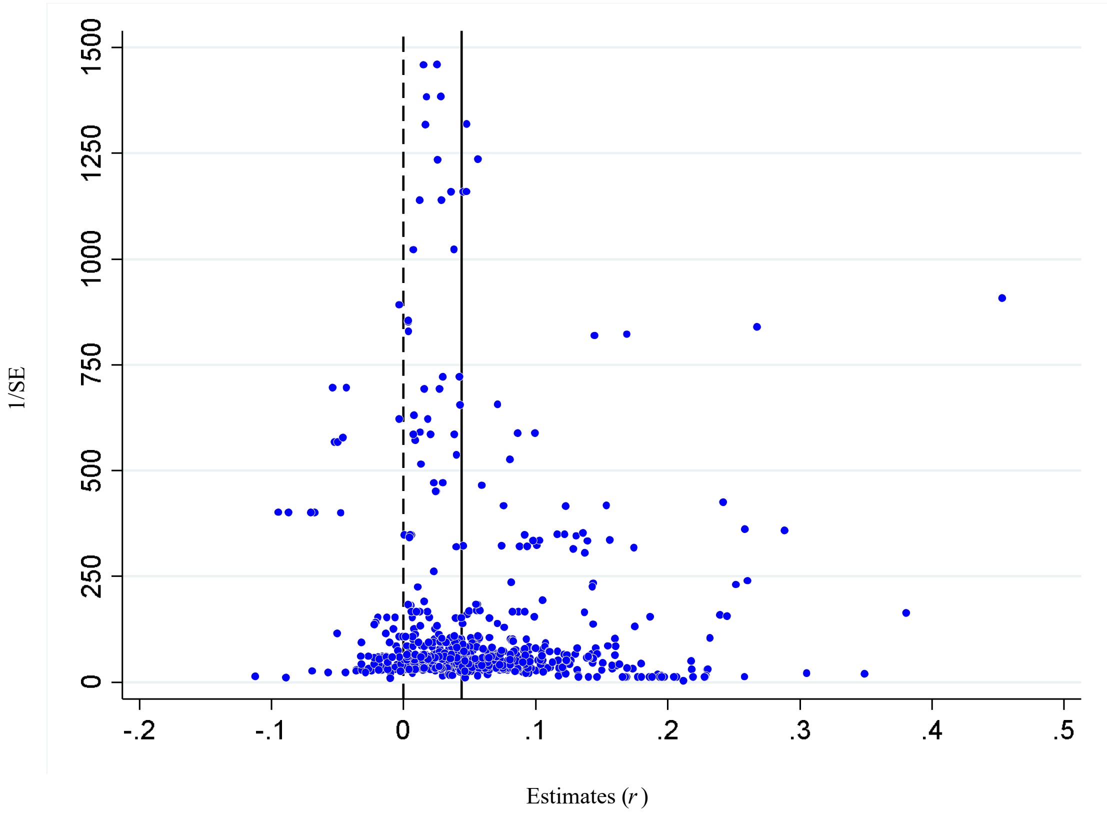
Estimator	Cluster-robust OLS	Cluster-robust WLS [1/*SE*]	Cluster-robust WLS [*d.f.*]	Cluster-robust WLS [1/*EST*]	Multi-level mixed effects RML	Cluster-robust random-effects panel GLS
Meta-independent variable (default category)/model	[7]	[8]	[9]	[10]	[11]	[12] [b]
Estimation period						
Average estimation year	-0.0019	-0.0044 ***	-0.0074 ***	-0.0013	-0.0018 *	-0.0019 ***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Geographic remoteness from the core EU						
Distance from Brussels	-0.0048 ***	-0.0066 **	-0.0060	-0.0058 ***	-0.0026 *	-0.0025 **
	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)
Selected moderators						
IV/2SLS/3SLS	-0.1109 ***	-0.0908 ***	-0.0718	-0.1280 ***	-0.0607 ***	-0.0599 ***
	(0.016)	(0.026)	(0.080)	(0.018)	(0.007)	(0.020)
Occupation	-0.0311 **	-0.0141	0.0098	-0.0429 ***	-0.0365 **	-0.0366 **
	(0.014)	(0.019)	(0.026)	(0.016)	(0.017)	(0.015)
Location fixed effects	0.0264 *	0.0185	-0.0159	0.0351 *	0.0119	0.0119
	(0.016)	(0.022)	(0.030)	(0.018)	(0.018)	(0.020)
SE	1.0181 ***	0.5546	-0.0654	0.8111	0.8414 ***	0.8418 ***
	(0.300)	(0.651)	(2.753)	(0.515)	(0.173)	(0.171)
Intercept	3.8740 *	9.0327 ***	14.9449 ***	2.7541	3.8379 *	3.8560 ***
	(2.306)	(2.742)	(4.592)	(2.250)	(2.280)	(1.390)
K	824	824	824	824	824	824
R^2	0.196	0.252	0.323	0.209	-	0.170

Notes: Figures in parentheses beneath the regression coefficients are robust standard errors. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Selected moderators denote the meta-independent variables having a PIP of 0.80 or more in the Bayesian model averaging estimation reported in Appendix Table A2. See Table 4 for the definitions and descriptive statistics of meta-independent variables.

[a] Hausman test: χ^2 = 12.34, p = 0.089

[b] Hausman test: χ^2 = 6.17, p = 0.290

(a) Secondary education studies



(b) Higher education studies

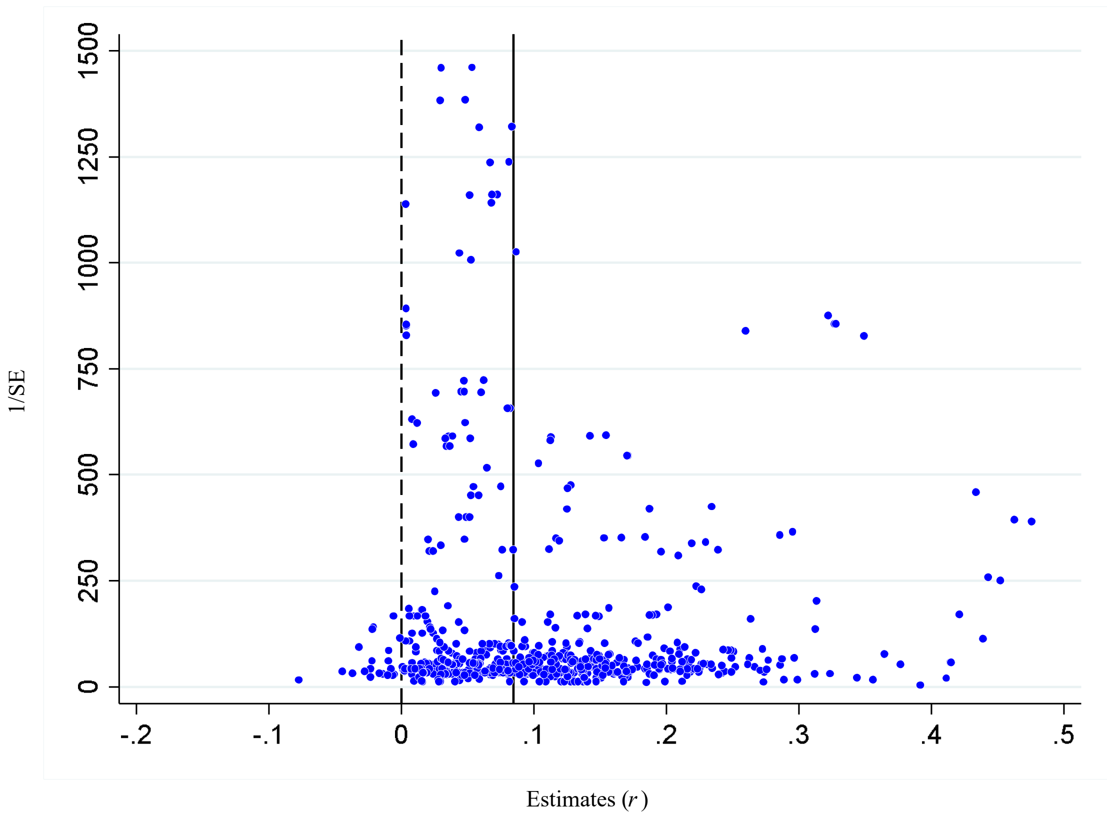


Figure 5. Funnel plot of partial correlation coefficients

Note: The solid line indicates the synthesized effect size by WAAP estimation as reported in Table 3.

Table 6. Meta-regression analysis of publication selection bias: Secondary education studies

(a) FAT-PET test (Equation: $t = \gamma_0 + \gamma_1(1/SE) + v$)

Estimator	Unrestricted WLS	Cluster-robust unrestricted WLS	Multi-level mixed-effects RML	Cluster-robust random-effects panel GLS	Cluster-robust fixed-effects panel LSDV
Model	[1]	[2]	[3]	[4] [a]	[5] [b]
Intercept (FAT: H_0: $\gamma_0 = 0$)	0.8432	0.8432	7.3866	7.3336	2.3759 *
	(0.732)	(1.288)	(4.504)	(4.470)	(1.396)
$1/SE$ (PET: H_0: $\gamma_1 = 0$)	0.0423 ***	0.0423 **	0.0339 ***	0.0342 ***	0.0309 ***
	(0.010)	(0.017)	(0.012)	(0.012)	(0.010)
K	775	775	775	775	775
R^2	0.182	0.182	-	0.182	0.182

(b) PEESE approach (Equation: $t = \gamma_0 SE + \gamma_1(1/SE) + v$)

Estimator	Unrestricted WLS	Cluster-robust unrestricted WLS	Multi-level mixed-effects RML	Random-effects panel ML	Population-averaged panel GEE
Model	[6]	[7]	[8]	[9]	[10]
SE	13.3406	13.3406	-15.3916	-15.3916	3.0242
	(10.499)	(18.315)	(15.192)	(25.063)	(10.799)
$1/SE$ (H_0: γ_1=0)	0.0439 ***	0.0439 ***	0.0344 ***	0.0344 ***	0.0565 **
	(0.009)	(0.015)	(0.012)	(0.004)	(0.024)
K	775	775	775	775	775
R^2	0.249	0.249	-	-	-

Notes: Figures in parentheses beneath the regression coefficients are standard errors. Except for Model [9], robust standard errors are estimated. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

[a] Breusch–Pagan test: χ^2 = 177.59, p = 0.0000

[b] Hausman test: χ^2 = 10.57, p = 0.0011

Table 7. Meta-regression analysis of publication selection bias: Higher education studies

(a) FAT-PET test (Equation: $t = \gamma_0 + \gamma_1(1/SE) + v$)

Estimator	Unrestricted WLS	Cluster-robust unrestricted WLS	Multi-level mixed-effects RML	Cluster-robust random-effects panel GLS	Cluster-robust fixed-effects panel LSDV
Model	[1]	[2]	[3]	[4] [a]	[5] [b]
Intercept (FAT: H_0: $\gamma_0 = 0$)	1.7365 **	1.7365	12.2730 **	12.1231 **	4.3810 **
	(0.779)	(1.827)	(5.203)	(5.129)	(1.927)
$1/SE$ (PET: H_0: $\gamma_1 = 0$)	0.0812 ***	0.0812 ***	0.0646 ***	0.0653 ***	0.0606 ***
	(0.011)	(0.022)	(0.016)	(0.016)	(0.015)
K	824	824	824	824	824
R^2	0.372	0.372	-	0.372	0.372

(b) PEESE approach (Equation: $t = \gamma_0 SE + \gamma_1(1/SE) + v$)

Estimator	Unrestricted WLS	Cluster-robust unrestricted WLS	Multi-level mixed-effects RML	Random-effects panel ML	Population-averaged panel GEE
Model	[6]	[7]	[8]	[9]	[10]
SE	17.8662	17.8662	-32.5065 *	-32.5065	12.4419
	(12.482)	(27.574)	(18.880)	(30.766)	(16.259)
$1/SE$ (H_0: γ_1=0)	0.0844 ***	0.0844 ***	0.0651 ***	0.0651 ***	0.0772 ***
	(0.010)	(0.020)	(0.016)	(0.005)	(0.025)
K	824	824	824	824	824
R^2	0.465	0.465	-	-	-

Notes: Figures in parentheses beneath the regression coefficients are standard errors. Except for Model [9], robust standard errors are estimated. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

[a] Breusch–Pagan test: $\chi^2 = 284.64$, $p = 0.0000$

[b] Hausman test: $\chi^2 = 22.32$, $p = 0.0000$

Table 8. Summary of publication selection bias test

(a) Secondary education studies

Study type	Number of estimates (K)	Test results[a]		
		Funnel asymmetry test (FAT) (H$_0$: γ_0=0)	Precision-effect test (PET) (H$_0$: γ_1=0)	Precision-effect estimate with standard error (PEESE) (H$_0$: γ_1=0) [b]
All studies	775	Not rejected	**Rejected**	**Rejected (0.0344/0.0565)**
By period				
1995 or before	165	**Rejected**	**Rejected**	**Rejected (0.1179/0.1238)**
1996–2005	413	Not rejected	**Rejected**	**Rejected (0.0801/0.1048)**
2006 or later	197	Not rejected	**Rejected**	**Rejected (0.0199/0.0228)**
By regional zone				
Zone 1	92	Not rejected	**Rejected**	**Rejected (0.0349/0.0442)**
Zone 2	215	Not rejected	**Rejected**	**Rejected (0.0452/0.0515)**
Zone 3	38	Not rejected	**Rejected**	**Rejected (0.0356/0.0357)**
Zone 4	172	Not rejected	Not rejected	**Rejected (0.0218/0.0244)**
Zone 5	258	Not rejected	Not rejected	**Rejected (0.0370/0.0571)**

(b) Higher education studies

Study type	Number of estimates (K)	Test results[a]		
		Funnel asymmetry test (FAT) (H$_0$: γ_0=0)	Precision-effect test (PET) (H$_0$: γ_1=0)	Precision-effect estimate with standard error (PEESE) (H$_0$: γ_1=0) [b]
All studies	824	**Rejected**	**Rejected**	**Rejected (0.0651/0.0844)**
By period				
1995 or before	133	**Rejected**	**Rejected**	**Rejected (0.2021/0.2211)**
1996–2005	404	Not rejected	**Rejected**	**Rejected (0.1382/0.1521)**
2006 or later	287	Not rejected	**Rejected**	**Rejected (0.0458/0.0512)**
By regional zone				
Zone 1	112	**Rejected**	**Rejected**	**Rejected (0.0884/0.0912)**
Zone 2	307	Not rejected	**Rejected**	**Rejected (0.0731/0.0768)**
Zone 3	60	**Rejected**	**Rejected**	**Rejected (0.1313/0.1360)**
Zone 4	171	Not rejected	**Rejected**	**Rejected (0.0460/0.0568)**
Zone 5	174	Not rejected	**Rejected**	**Rejected (0.0584/0.0653)**

Notes:

[a] The null hypothesis is rejected when more than three of five models show a statistically significant estimate. Otherwise not rejected.

[b] Figures in parentheses are PSB-adjusted estimates. If two estimates are reported, the left and right figures denote the minimum and maximum estimates, respectively.

Appendix Table A1. List of selected studies on returns to schooling in European emerging markets for meta-analysis

Author(s) (Publication year)	Target country	Estimation period	Number of collected estimates	
			Secondary education studies	Higher education studies
Flanagan (1995)	Czech	1988 - 1994	12	6
Steiner and Bellmann (1995)	East Germany	1990 - 1992		2
Grogan (1997)	Russia	1994 - 1994	6	6
Bedi (1998)	Poland	1996 - 1996	4	4
Newell and Socha (1998)	Poland	1992 - 1996	20	20
Noorkôiv et al. (1998)	Estonia	1989 - 1995	10	5
Arabsheibani and nLau (1999)	Russia	1994 - 1994	9	9
Filer et al. (1999)	Czech and Slovakia	1995 - 1997	12	12
Paternostro and Sahn (1999)	Romania	1994 - 1994	8	4
Reilly (1999)	Russia	1992 - 1996	8	8
Lehmann and Wadsworth (2001)	Russia	1994 - 1998	6	6
Deloach andn Hoffman (2002)	Russia	1994 - 1996		6
Jolliffe (2002)	Bulgaria	1995 - 1995	3	
Puhani (2002)	Poland	1994 - 1998	6	6
Adamchik et al. (2003)	Poland	1994 - 2001	24	24
Guariglia and Kim (2003)	Russia	1994 - 1998	2	2
Skoufias (2003)	Romania	1994 - 1994	32	32
Delteil et al. (2004)	Hungary	1989 - 1998	14	14
Falaris (2004)	Bulgaria	1995 - 1995	12	4
Gerry et al. (2004)	Russia	1994 - 1998	36	12
Hansberry (2004)	Russia	1996 - 2002	36	12
Jurajda (2005)	Czech	2002 - 2002	9	9
Münich et al. (2005)	Czech	1991 - 1996	24	12
Ogloblin and Brock (2005)	Russia	2000 - 2002	4	2
Ganguli and Terrell (2006)	Ukraine	1986 - 2003	18	6
Ogloblin and Brock (2006)	Russia	2002 - 2004	2	1
Pastore and Verashchagina (2006)	Belarus	1996 - 2001	24	36
Earle and Telegdy (2007)	Hungary	1992 - 2003	3	3
Kazakova (2007)	Russia	1996 - 2002	24	12
Myck et al. (2007)	Poland	1996 - 1996	2	1
Cattaneo (2008)	Albania	2002 - 2002	3	2
Csengödi et al. (2008)	Hungary	1992 - 2001	5	5
Dohmen et al. (2008)	Russia	1997 - 2002	52	52
Krillo and Masso (2010)	Estonia	1997 - 2007	4	4
Nestić (2010)	Croatia	1998 - 2008	32	48
Bouton et al. (2011)	Moldova	2006 - 2006	12	5
Eriksson and Pytlikova (2011)	Czech	2006 - 2006		4
Hölscher et al. (2011)	CEE10	2007 - 2007	29	29
Hoti (2011)	Kosovo	2002 - 2002	4	4
Kecmanovic and Barrett (2011)	Serbia	2001 - 2005	16	48
Kovacheva (2011)	Bulgaria	1997 - 2003	6	6
Pastore and Verashchagina (2011)	Belarus	1996 - 2006	36	12
Andrén (2012)	Romania	1994 - 2000	16	20
Kecmanovic (2012)	Serbia	2001 - 2005	4	12
Voinea and Mihaescu (2012)	Romania	2004 - 2009	8	8
Eriksson et al. (2013)	Czech	1998 - 1999		2
Vodopivec (2014)	Slovenia	1992 - 2001	2	2
Zulfiu-Alili (2014)	Macedonia	2008 - 2008		4
Andrén and Andrén (2015)	Romania	1994 - 2000	14	16
Dustmann et al. (2015)	Poland	1998 - 2007	22	22
Gustafsson et al. (2015)	Russia	2003 - 2003	4	4
Tiwari et al. (2015)	Russia	2006 - 2010	4	2
Bezeredi and Urban (2016)	Croatia	2012 - 2012		16
Cukrowska-Torzewska and Lovasz (2016)	Hungary and Poland	2006 - 2009	20	20
Magda et al. (2016)	Czech, Hungary, Poland	2002 - 2006	12	12
Grotkowska et al. (2018)	Poland	2012 - 2012	8	4
Kupets (2018)	Moldova	2016 - 2016	8	8
Vilerts (2018)	Latvia	2015 - 2015	8	8
Mysíková and Večerník (2019)	CEE11	2004 - 2013		97
Vahter and Masso (2019)	Estonia	2011 - 2011	4	4
Vasilescu and Begu (2019)	Romania	2016 - 2016		1
Grabowski and Korczak (2020)	Poland	2010 - 2016	4	4
Kossova et al. (2020)	Russia	2016 - 2016	3	3
Lehmann et al. (2020)	Latvia	2007 - 2015	4	4
Liwiński (2020)	Poland	2001 - 2005	6	6
Rudakov and Prakhov (2020)	Russia	2015 - 2017		6
Karabchuk et al. (2021)	Russia	2000 - 2015	24	12
Laporšek et al. (2021)	Slovenia	2015 - 2015	20	20
Madga and Sałach (2021)	Poland	2014 - 2014	11	12

Note: See Supplement for bibliographic information on the listed articles.

Appendix Table A2. Bayesian model averaging analysis of model uncertainty

Target study area	Secondary education studies				Higher education studies			
Meta-independent variable/model	[1]				[2]			
	Coef.	S.E.	*t*	PIP	Coef.	S.E.	*t*	PIP
Focus regressors								
Average estimation year	-0.00281	0.00037	-7.59	1.00	-0.00138	0.00049	-2.83	1.00
Distance from EU	-0.00003	0.00001	-6.10	1.00	-0.00005	0.00001	-5.87	1.00
SE	0.45599	0.11367	4.01	1.00	0.92204	0.16768	5.50	1.00
Auxiliary regressors								
Urban region	-0.00097	0.00379	-0.26	0.09	0.00222	0.00864	0.26	0.10
Rural region	0.00087	0.00632	0.14	0.05	0.03563	0.05534	0.64	0.35
Male	-0.00039	0.00177	-0.22	0.07	0.00002	0.00113	0.02	0.03
Female	0.00000	0.00087	0.00	0.04	0.00021	0.00166	0.13	0.05
Young age	-0.01355	0.02594	-0.52	0.26	-0.00898	0.02580	-0.35	0.14
Middle age	-0.04949	0.02375	-2.08	0.89	-0.01442	0.02732	-0.53	0.27
Elder age	-0.00300	0.01080	-0.28	0.10	-0.00247	0.01202	-0.21	0.07
State enterprise	0.00066	0.00321	0.21	0.07	0.00020	0.00263	0.07	0.04
Private firms	-0.00127	0.00436	-0.29	0.11	-0.00377	0.00938	-0.40	0.18
Panel data	0.00012	0.00156	0.08	0.04	-0.01145	0.01678	-0.68	0.38
Original household survey	-0.02589	0.00563	-4.60	1.00	-0.00002	0.00173	-0.01	0.04
Non-OLS	-0.00019	0.00206	-0.09	0.06	-0.01296	0.01655	-0.78	0.44
IV/2SLS/3SLS	0.07449	0.01456	5.11	1.00	-0.10265	0.02021	-5.08	1.00
Regular wage	-0.00802	0.00659	-1.22	0.67	-0.01334	0.01218	-1.10	0.62
Control for selection bias	-0.01016	0.01066	-0.95	0.55	-0.03514	0.02271	-1.55	0.77
Control for endogeneity	-0.13258	0.02730	-4.86	1.00	0.00048	0.00637	0.08	0.04
Occupation	-0.00423	0.00570	-0.74	0.41	-0.02848	0.00906	-3.14	0.98
Age/age group	-0.00041	0.00196	-0.21	0.07	-0.00924	0.01009	-0.92	0.53
Health condition	0.01010	0.01452	0.70	0.38	-0.01268	0.01744	-0.73	0.41
Firm size	-0.00024	0.00175	-0.14	0.05	0.00493	0.00881	0.56	0.29
Location fixed effects	0.00002	0.00089	0.02	0.04	0.02313	0.01051	2.20	0.91
Industry fixed effects	-0.02592	0.00490	-5.29	1.00	-0.00707	0.00996	-0.71	0.39
Time fixed effects	0.00130	0.00480	0.27	0.10	0.00209	0.00855	0.24	0.09
Quality level	0.00013	0.00036	0.35	0.15	0.00004	0.00029	0.15	0.06
K	775				824			
Model space	16,777,216				16,777,216			

Notes: S.E. and PIP denote standard errors and posterior inclusion probability, respectively. See Table 4 for the definitions and descriptive statistics of independent variables. The variables of target countries, average estimation year, and standard errors of partial correlation coefficients are included in estimations as focus regressors. Therefore, the PIP of these key variables is 1.00.

Appendix Table A3. Meta-regression analysis of literature heterogeneity: Estimation using all moderators

(a) Secondary education studies

Estimator	Cluster-robust OLS	Cluster-robust WLS [1/*SE*]	Cluster-robust WLS [*d.f.*]	Cluster-robust WLS [1/*EST*]	Multi-level mixed effects RML	Cluster-robust random-effects panel GLS
Meta-independent variable (default category)/model	[1]	[2]	[3]	[4]	[5]	[6] [a]
Estimation period						
Average estimation year	-0.0024 ***	-0.0040 ***	-0.0061 ***	-0.0025 **	-0.0015 **	-0.0015 **
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Geographic remoteness from the core EU						
Distance from Brussels	-0.0036 **	-0.0035	0.0007	-0.0046 **	-0.0034 **	-0.0032 *
	(0.002)	(0.003)	(0.005)	(0.002)	(0.002)	(0.002)
Target region (region unspecified)						
Urban region	-0.0058	-0.0087	-0.0316	0.0050	-0.0252 *	-0.0276 **
	(0.023)	(0.034)	(0.063)	(0.032)	(0.014)	(0.013)
Rural region	0.0250	0.0004	0.0027	0.0264	-0.0130	-0.0165
	(0.024)	(0.033)	(0.067)	(0.031)	(0.014)	(0.013)
Target gender (gender unspecified)						
Male	-0.0050	0.0035	-0.0137	-0.0099	-0.0080	-0.0078
	(0.012)	(0.019)	(0.031)	(0.014)	(0.008)	(0.008)
Female	-0.0016	0.0039	-0.0036	-0.0067	-0.0013	-0.0009
	(0.011)	(0.015)	(0.029)	(0.013)	(0.007)	(0.007)
Target cohort (cohort unspecified)						
Young age	-0.0580 **	-0.0041	0.0613	-0.0482	-0.0479 ***	-0.0461 ***
	(0.026)	(0.037)	(0.055)	(0.041)	(0.008)	(0.008)
Middle age	-0.0642 *	0.0036	0.0732	-0.0666	-0.0457 ***	-0.0439 ***
	(0.037)	(0.039)	(0.057)	(0.054)	(0.008)	(0.007)
Elder age	-0.0339	0.0223	0.0856	-0.0227	-0.0340 ***	-0.0324 ***
	(0.030)	(0.038)	(0.056)	(0.049)	(0.011)	(0.010)
Target firm ownership (ownership unspecified)						
State enterprise	0.0069	0.0015	-0.0206	0.0109	0.0027	0.0022
	(0.012)	(0.015)	(0.021)	(0.020)	(0.010)	(0.010)
Private firm	-0.0095	-0.0103	-0.0222	-0.0076	-0.0123 *	-0.0127 *
	(0.010)	(0.013)	(0.015)	(0.015)	(0.007)	(0.007)
Data type (cross-sectional data)						
Panel data	-0.0038	0.0080	0.0119	-0.0218	-0.0410 ***	-0.0425 ***
	(0.019)	(0.024)	(0.051)	(0.023)	(0.008)	(0.007)
Survey data used (government statistics)						
Original household survey	-0.0239 *	-0.0340	-0.0190	-0.0239	-0.0110	-0.0105
	(0.014)	(0.025)	(0.047)	(0.018)	(0.015)	(0.016)
Estimator						
Non-OLS (OLS)	0.0035	0.0357	0.0509 *	0.0384	0.0247	0.0248
	(0.015)	(0.024)	(0.030)	(0.025)	(0.019)	(0.020)
IV/2SLS/3SLS	0.0656 ***	0.0697 **	0.1198	0.0702 ***	0.0217 ***	0.0204 ***
	(0.024)	(0.031)	(0.076)	(0.024)	(0.006)	(0.005)
Wage type (total wage)						
Regular wage	-0.0073	-0.0185	0.0055	-0.0184	0.0027	0.0061
	(0.010)	(0.018)	(0.028)	(0.014)	(0.014)	(0.014)
Control for selection bias and endogeneity						
Control for selection bias	-0.0234	-0.0415 *	-0.0439	-0.0629 **	-0.0597 ***	-0.0607 ***
	(0.015)	(0.023)	(0.044)	(0.027)	(0.021)	(0.022)
Control for endogeneity	-0.1275 ***	-0.1348 ***	-0.1405 **	-0.1440 ***	-0.0892 ***	-0.0876 ***
	(0.018)	(0.032)	(0.064)	(0.022)	(0.004)	(0.003)
Selection of control variable						
Occupation	-0.0049	0.0014	0.0028	-0.0223	-0.0102	-0.0091
	(0.011)	(0.021)	(0.038)	(0.015)	(0.008)	(0.008)
Age/age group	-0.0060	0.0335	0.0829 **	0.0150	0.0005	0.0004
	(0.013)	(0.027)	(0.037)	(0.016)	(0.007)	(0.007)
Health condition	0.0195	0.0504 *	0.1187 **	0.0084	-0.0012	-0.0016
	(0.015)	(0.029)	(0.051)	(0.026)	(0.029)	(0.030)
Firm size	-0.0055	-0.0149	-0.0479	-0.0202	0.0055	0.0073
	(0.018)	(0.029)	(0.039)	(0.019)	(0.009)	(0.008)
Location fixed effects	-0.0009	-0.0085	-0.0505	-0.0074	0.0137	0.0149
	(0.013)	(0.025)	(0.043)	(0.014)	(0.013)	(0.014)
Industry fixed effects	-0.0226	-0.0006	0.0668	0.0047	-0.0139 *	-0.0144 *
	(0.014)	(0.035)	(0.057)	(0.024)	(0.008)	(0.008)
Time fixed effects	0.0118	0.0123	0.0489	0.0361	0.0679 *	0.0718 **
	(0.030)	(0.049)	(0.071)	(0.046)	(0.035)	(0.036)
Quality level						
Quality level	0.0002	-0.0002	0.0026	-0.0013	-0.0002	-0.0001
	(0.002)	(0.003)	(0.004)	(0.002)	(0.002)	(0.002)
SE	0.4468 **	0.4808	-1.0943	0.6256 *	0.4706 ***	0.4614 ***
	(0.207)	(0.498)	(2.055)	(0.336)	(0.104)	(0.102)
Intercept	4.8649 ***	8.0199 ***	12.1638 ***	5.2595 ***	3.1434 **	3.0281 **
	(1.620)	(1.894)	(4.420)	(1.978)	(1.407)	(1.484)
K	775	775	775	775	775	775
R^2	0.346	0.316	0.499	0.384	-	0.249

(Continued)

(b) Higher education studies

Estimator	Cluster-robust OLS	Cluster-robust WLS [1/*SE*]	Cluster-robust WLS [*d.f.*]	Cluster-robust WLS [1/*EST*]	Multi-level mixed effects RML	Cluster-robust random-effects panel GLS
Meta-independent variable (default category)/model	[7]	[8]	[9]	[10]	[11]	[12] [b]
Estimation period						
Average estimation year	-0.0006	-0.0037 **	-0.0080 ***	-0.0015	-0.0017	-0.0017
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Geographic remoteness from the core EU						
Distance from Brussels	-0.0053 **	-0.0079 **	-0.0068	-0.0081 ***	-0.0025	-0.0024
	(0.002)	(0.003)	(0.005)	(0.002)	(0.002)	(0.002)
Taget region (region unspecified)						
Urban region	0.0084	0.0093	0.0916	0.0258	0.0019	0.0014
	(0.034)	(0.051)	(0.075)	(0.045)	(0.020)	(0.020)
Rural region	0.1056 ***	0.0852 *	0.1598 **	0.1007 **	0.0852 ***	0.0839 ***
	(0.039)	(0.045)	(0.074)	(0.041)	(0.024)	(0.024)
Target gender (gender unspecified)						
Male	0.0063	0.0040	-0.0506	-0.0087	-0.0061	-0.0059
	(0.019)	(0.031)	(0.037)	(0.020)	(0.010)	(0.010)
Female	0.0112	0.0102	-0.0262	-0.0025	0.0074	0.0077
	(0.017)	(0.025)	(0.034)	(0.018)	(0.010)	(0.010)
Target cohort (cohort unspecified)						
Young age	-0.0805 ***	-0.0288	0.0277	-0.0966 **	-0.0297 *	-0.0264 *
	(0.027)	(0.027)	(0.050)	(0.039)	(0.016)	(0.016)
Middle age	-0.0698 **	-0.0109	0.0495	-0.0940 **	-0.0141	-0.0108
	(0.028)	(0.027)	(0.050)	(0.044)	(0.014)	(0.014)
Elder age	-0.0518 *	0.0005	0.0563	-0.0602	-0.0070	-0.0037
	(0.028)	(0.027)	(0.049)	(0.038)	(0.013)	(0.013)
Target firm ownership (ownership unspecified)						
State enterprise	0.00002	0.0117	-0.0011	-0.0044	-0.0037	-0.0039
	(0.0181)	(0.023)	(0.036)	(0.030)	(0.011)	(0.011)
Private firm	-0.0224 *	-0.0161	-0.0210	-0.0348 **	-0.0296 **	-0.0298 **
	(0.012)	(0.015)	(0.023)	(0.016)	(0.012)	(0.012)
Data type (cross-sectional data)						
Panel data	-0.0303	0.0168	0.0843	-0.0206	-0.0629 **	-0.0654 **
	(0.035)	(0.041)	(0.057)	(0.039)	(0.027)	(0.026)
Survey data used (government statistics)						
Original household survey	0.0058	-0.0291	-0.1067 **	-0.0017	-0.0171	-0.0181
	(0.024)	(0.035)	(0.048)	(0.022)	(0.022)	(0.023)
Estimator						
Non-OLS (OLS)	-0.0240 *	-0.0484 **	-0.0201	-0.0451 *	-0.0071	-0.0069
	(0.013)	(0.021)	(0.026)	(0.024)	(0.014)	(0.014)
IV/2SLS/3SLS	-0.1111 ***	-0.1950 ***	-0.1380	-0.1253 ***	-0.0616 ***	-0.0610 ***
	(0.032)	(0.064)	(0.155)	(0.047)	(0.004)	(0.003)
Wage type (total wage)						
Regular wage	-0.0144	-0.0146	0.0203	-0.0012	0.0056	0.0066
	(0.017)	(0.023)	(0.040)	(0.020)	(0.011)	(0.011)
Control for selection bias and endogeneity						
Control for selection bias	-0.0360 **	-0.0346	-0.0634 *	-0.0166	-0.0740 ***	-0.0752 ***
	(0.016)	(0.023)	(0.035)	(0.026)	(0.022)	(0.022)
Control for endogeneity	0.0156	0.0461	-0.0059	0.0186	0.0261 *	0.0289 **
	(0.036)	(0.070)	(0.125)	(0.056)	(0.014)	(0.013)
Selection of control variable						
Occupation	-0.0234	-0.0098	-0.0133	-0.0267	-0.0304	-0.0305
	(0.016)	(0.020)	(0.037)	(0.018)	(0.019)	(0.020)
Age/age group	-0.0180	0.0474 *	0.1080 ***	0.0164	-0.0216 **	-0.0232 **
	(0.022)	(0.027)	(0.033)	(0.021)	(0.010)	(0.010)
Health condition	-0.0299	-0.0368	-0.0040	-0.0489 **	-0.0640 **	-0.0657 **
	(0.018)	(0.026)	(0.054)	(0.021)	(0.030)	(0.031)
Firm size	0.0148	0.0172	-0.0220	0.0137	0.0035	0.0014
	(0.024)	(0.027)	(0.035)	(0.020)	(0.016)	(0.017)
Location fixed effects	0.0291	0.0585 **	0.0115	0.0487 **	0.0282	0.0286
	(0.021)	(0.023)	(0.037)	(0.020)	(0.021)	(0.021)
Industry fixed effects	-0.0206	-0.0586 **	-0.0354	-0.0254	-0.0169 *	-0.0167 *
	(0.017)	(0.025)	(0.046)	(0.022)	(0.010)	(0.010)
Time fixed effects	0.0145	-0.0025	-0.0855	0.0187	0.0696	0.0731 *
	(0.044)	(0.056)	(0.077)	(0.048)	(0.043)	(0.043)
Quality level						
Quality level	0.0016	0.0040	0.0076	0.0006	0.0008	0.0008
	(0.002)	(0.003)	(0.005)	(0.002)	(0.002)	(0.002)
SE	0.9079 ***	1.5882 **	1.8600	0.9996 *	0.8675 ***	0.8651 ***
	(0.280)	(0.753)	(2.249)	(0.569)	(0.177)	(0.180)
Intercept	1.4163	7.5383 **	16.1593 ***	3.1386	3.5269	3.5536
	(2.472)	(2.910)	(4.570)	(2.736)	(2.527)	(2.619)
K	824	824	824	824	824	824
R^2	0.290	0.382	0.595	0.323		0.199

Notes: Figures in parentheses beneath the regression coefficients are robust standard errors. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. See Table 4 for the definitions and descriptive statistics of meta-independent variables.

[a] Hausman test: $\chi^2 = 15.39$, p = 0.8448

[b] Hausman test: $\chi^2 = 27.12$, p = 0.1668