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ABSTRACT

Lost in Transition?
The Returns to Education Acquired under Communism
15 Years after the Fall of the Berlin Wall*

Using data for 22 economies in Eastern and Western Europe, we find evidence that having studied under communism is relatively penalized in the economies of the late 2000s. This evidence, however, is limited to males and to primary and secondary education, and holds for eight CEE economies but not for the East Germans who have studied in the former German Democratic Republic. We also find that post-secondary education acquired under communism yields higher, not lower, payoffs than similar education in Western Europe.

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Introduction

The fall of the Iron Curtain ushered in drastic changes in the economic and education systems of Eastern Europe. The transition from a centrally planned to a market economy affected the lifestyles and the living standards of millions of Eastern Europeans, who faced the transition process being endowed with education acquired under communism and having experienced a completely different economic system and incentive mechanisms. To what extent is this human capital valuable in the market economies of current Eastern Europe?

The existing empirical evidence on the returns to education and experience during the transition gives a mixed answer to this question: while education acquired under communism has not suffered, labour market experience has been seriously penalized, mainly because of the outdated technologies adopted by state industries. This evidence typically covers a single country and the transition years. The substantial economic turmoil, negative economic growth and large labour reallocations of these years have had temporary as well as permanent effects on the returns to human capital. Relatively little is known about the late transition years and especially the period of EU accession, which is characterized by the progressive implementation of a functioning free market economy in Central and Eastern European countries (CEE from now on).

In this paper, we ask whether education under communism is still valuable in the late 2000s, when most CEE countries have already entered (in 2004) or were entering (in 2007) the European Union. Our empirical strategy compares the returns to education earned by a treatment group with the returns of two control groups. The treatment group consists of the cohorts of employees aged between 25 and 38 in 1989, who have completed their education under communism and reside and work in Eastern Europe. The first control group consists of the same age cohorts, who have been educated, reside and work in Western Europe. The second group is composed instead of Eastern Europeans aged 6 to 13 in 1989, who have gone to school entirely or partly after the fall of the Berlin Wall, under new educational curricula and institutions. By comparing the treatment group with the first control group, we consider individuals operating in different labour markets but belonging

to the same age cohorts. The comparison of the treatment group with second control group considers instead individuals operating in the same labour market but belonging to different cohorts.

A key tenet of the large literature which estimates the (private) returns to schooling is that education is correlated with ability, which is typically unobserved. Failure to account for this correlation yields biased estimates (see Card, 1999). In this paper, we address this problem by following the strategy used by Card and Rothstein, 2007. For each gender, we group our data by country, year of birth and year of the survey. Next, we compare males and females within each cell. By so doing, we difference out the common components of average unobserved ability. We assume that the residual gender gap is a function of observables, which include parental education and labour market variables.

Using data for 22 economies in Eastern and Western Europe, we find some evidence that having studied under communism is penalized in the economies of the late 2000s. This evidence, however, is limited to males and to primary and secondary education, and holds for eight CEE economies but not for the East Germans who have studied in the former German Democratic Republic. We also find that post-secondary education under communism yields higher, not lower, payoffs than similar education in Western Europe. Therefore, not all who studied under communism are penalized by the radical transformation of Eastern European economies. Males are affected more than females. The primary/secondary versus post-secondary education as well as the males versus females divides mirror well the industry versus services divide. While the former has been heavily affected by the transition from communist to free market economies, the latter largely benefitted and rapidly expanded.

Finally, we find evidence that younger males in Eastern Europe, who have studied at least in part after communism, have higher payoffs to their education than their senior counterparts. This result does not square well with the view that school quality has declined in CEE countries after the fall of the Berlin Wall. We argue that evidence of declining school quality is mixed at best and suggest that the higher payoffs earned by the young are driven by increased demand for skilled labour in Eastern Europe.

The paper is organized as follows. Section 1 briefly describes the transition from

communism in CEE countries, and Section 2 reviews the relevant literature. The economic model which guides our empirical analysis is presented in Section 3, while Section 4 is devoted to the description of the empirical setup. The data are introduced in Section 5 and the results are presented in Sections 6 to 9. In the final Section 10 we summarize and discuss our findings. Conclusions follow.

1. Transition from Communism

Under communism, planned economies in Eastern Europe and the Soviet Union invested a large share of their resources in the development of heavy industry, to support a fast process of industrialization and modernization of a production structure traditionally dominated by agriculture. Workers of large metallurgical and mechanical factories were considered the elite of the proletarians and the vanguard of Marxism. To be able to balance the military power of the US, the focus on heavy industry continued for decades, sacrificing the production of consumption goods and the development of an advanced service sector. The fall of the communist regimes and the adoption of a market economy required a radical re-allocation of production factors away from the traditional industries. During the early stages of transition, CEE countries saw a dramatic fall of GDP and employment (Boeri and Terrell, 2002), followed by economic recovery (see Figure 1).

CEE countries lost 22.6 of their GDP in the initial phase of output decline, which lasted on average 3.8 consecutive years (only 2 years in Poland, 3-4 years in Hungary, Czech Republic and Slovak Republic and 5-6 years in the Baltic States) (The World Bank, 2002). In most countries unemployment stagnated at high levels for long time. The average unemployment rate was between 9 and 14 percent in the period between 1992 and 1999 and reached its peak at 14-16 percent 3-4 years after the beginning of the transition[1]. Real wages declined by about 20 percent during the initial two transition years and then remained stable or slightly increased since 1991.

Dramatic changes occurred in the structure of employment between 1989 and 1998.

[1] The Czech Republic was an exception, with initially low unemployment rates which peaked 9 years after the beginning of the transition at about 10 percent.

On average, employment in agriculture remained stable, the employment share in industry felt by 10 percentage points and employment in the service sector expanded (Boeri and Terrell, 2002). During the same period, the share of agriculture on GDP remained at 14 percent, industry dropped from 45 to 33 percent and services increased from 41 to 53 percent (The World Bank 2002). From almost non-existent before the fall of the Iron Curtain, the private sector reached rapidly 65 percent of all employment with a peak of 80 percent in Hungary by 1997 (Boeri and Terrell, 2002). In terms of GDP shares, CEE countries moved from 11 percent of GDP generated by the private sector in 1990 to 68 percent in 1999.

The downsizing of heavy industry caused a permanent reduction in the demand for unskilled labour. At the same time, the expansion of skill-intensive services (for example, finance, insurance and real estate, consulting, information services, tourism) dramatically increased the demand for more educated employees (Orazam and Vodopivec, 1997). Looking at the supply side, Lamo et al., 2010, suggest that the emphasis on vocational education in former communist countries slowed down worker mobility across sectors during the transition period, pushing many middle-age workers towards the exit strategy provided by early retirement programs put in place to facilitate the transformation of CEE economies. This pattern is still recognizable in the late 2000. Table 1 shows the percentage of individuals born between 1951 and 1964 who are retired, unemployed or disabled in Western and Eastern Europe during the years 2006 to 2008, more than 15 years since the fall of the Berlin Wall. The percentage is generally higher in CEE countries and close to 35 percent for those with less than upper secondary education.

In spite of the fact that education in CEE economies under communism was provided free of charge, and stipends were often granted to students, mental work was valued less than physical work and manufacturing was valued more than services. Under socialism, labour markets were characterized by complete job security and an egalitarian wage distribution. Wage grids were established, and differences between skilled and unskilled workers were kept small compared to Western standards (Munich et al. 2005). Wages were higher for blue collars, and workers in manufacturing were paid better than workers in services, in spite of lower average education.

Overall, the system encouraged students to select vocational curricula and to leave school after completing upper secondary education. This situation changed abruptly with the transition to a market economy, when the structure of incentives was progressively altered in favour of college and more general education[2]. Table 2 compares the educational attainment of two groups of individuals in 2006-2008, those born in Eastern Europe between 1951 and 1964 (seniors), who have completed their education under communism, and those born in the same area between 1976 and 1983 (juniors), who have spent at least some time in education after the fall of communism. As a benchmark, we also show the educational attainment of the same cohorts in the West[3].

When comparing seniors with juniors in the East, we find that average years of education are broadly similar for males (12.47 versus 12.52), but significantly higher for junior females (13.13 versus 12.39). We also find that the percentage of college graduates is higher in the younger cohorts, especially among females. Compared to Western Europe, the share of individuals with high school education in CEE economies is relatively high for both age groups (68/58 percent for junior males/females in the East against 50/43 percent in the West), and the share of college graduates is relatively low (18/30 percent for junior males/females in the East against 30/42 percent in the West).

2. Review of the literature

Two strands of literature are related to our study. The first examines the changes in the returns to schooling in CEE economies after the fall of the Berlin Wall. The second is broader and focuses on cohort effects in the returns to education. The latter strand investigates also the hypothesis that education under communism is less appropriate for a market economy and should receive a lower return than post-communist education.

[2]The share of students enrolled in general education between 1989 and 1997 rose from 24 to 28 percent in Hungary, from 22.5 to 32.4 percent in Poland, from 17.8 to 22.1 percent in the Czech Republic and from 18.1 to 25 percent in the Slovak Republic.

[3] We select birth cohorts so as to have individuals aged at least 25 in 1989 for the older age group and at least 25 in 2006, 2007 and 2008 for the younger age group.

There is a large body of empirical evidence documenting the increase in the return to schooling in CEE countries during the transition period. Selected examples of this literature are reviewed below. Fleisher at al., 2005, consider several contributions in the field and conclude that returns to education increased markedly during the transition, both in CEE economies and in Russia. Orazem and Vodopivec, 1997, compare the wages of different skill groups in Slovenia before and after the transition, and find that returns to schooling increased sharply during the early phases of the transition. Similar results are obtained by Munich et al., 2005, who study the case of the Czech Republic. Andrén et al., 2005, estimate the impact of schooling on monthly earnings from 1950 to 2000 in Romania. Nearly constant at about 3 to 4% during the socialist period, this impact increased steadily during the 1990s and reached 8.5% in the year 2000. Finally, Flabbi et al., 2008, use data from the International Social Survey Programme (ISSP) covering the period 1991-2002 and show that the estimated returns to schooling have increased mainly during the early transition stage, with limited changes during the period of late transition.

Are these changes in the returns to education homogeneous or do they differ across different age cohorts? Card and Lamieux, 2001, suggest that cohort effects in the college wage gap arise when workers belonging to different cohorts are imperfect substitutes in production. On the supply side, and conditional on demand, large cohorts of labour market entrants with a given education level can command lower earnings at entry because of stronger competition, which is more intense when the degree of substitutability across neighbour cohorts is higher. On the demand side, the labour market conditions at the time of entry in the labour market matter, and tougher conditions prevailing at the beginning of a career may produce persistent negative consequences. For instance, Oreopoulos et al., 2008, estimate that young graduates entering the labour market during a recession suffer significant initial earnings losses which fade away only after 8 to 10 years. In CEE economies, cohort effects could have emerged both because of changes in labour supply by educational attainment and because of the differential exposure to the transition, which radically modified the structure of labour demand by sector and by skills.

Perhaps the most important determinant of cohort effects in the returns to education is skill-biased technical change. This type of progress increases the relative productivity of

skilled labour and generates a continuous upward shift in its demand (see Acemoglu and Author, 2010, for a recent discussion and an extension of the original model) [4]. The skill biased technical change hypothesis explains why the college wage premium has not declined over time in the US or the UK, in spite of the massive expansion of tertiary education observed earlier in the US and later in Western Europe (Machin and McNally, 2007)[5].

Only a few studies attempt to estimate cohort effects in the returns to education in CEE countries. Juraida, 2003, uses Czech data and finds that the returns to one year of education in 2002 are close to 10% for the young generation aged 24 to 44 and equal to 8.7% for the older generation aged 45 to 61. Since the young generation includes both those who have completed their studies under communism and those who have studied at least in part after 1989, it is difficult to use these results to understand whether education received under communism is less suitable to a modern market economy[6].

Compos and Jolliffe, 2007, study Hungary and argue that it is not formal education but experience acquired before the transition which is outdated. In the communist era, workers operated old technologies and followed procedures and regulations which disappeared in the subsequent market economy. They show that returns to general secondary, college and university education increased over time from 1986 to 2004, but were unchanged for vocational education. They also compare the returns to education earned by individuals aged less than or equal to 20 and more than 20 both in 1986 – before

[4] The by now classical work by Katz and Murphy, 1992, suggests that the long term dynamics in the college wage gap between 1963 and 1987 in the US are consistent with a linearly increasing relative demand for college graduates, with fluctuations largely explained by changes in the relative supply. Card and Lemieux, 2001, argue that the increase in college wage premium the US, Canada and the UK has been largely due to the slowdown in the rate of growth of educational attainment that began with cohorts born in the early 1950s.

[5] In a recent contribution, Walker and Zhu, 2008, examine the college wage premium in England and Wales for the cohorts who studied just before and just after the quick education expansion in tertiary education observed between 1987 and 1993 in England, and show that the college wage premium did not change significantly across cohorts for both genders. Green and Zhu, 2010, confirm that the college wage premium remained fairly stable for both men and women over the period 1994 to 2006, but find that wage dispersion has increased, especially for men (see also Acemoglu and Autor, 2010, for the US). Gebel and Pfeiffer, 2010, use data from the German Socio-Economic Panel spanning the period 1984 to 2006 and find that the cohorts of "baby boomers", who were born between 1958 and 1965 and massively participated to the education expansion in Germany, have the lowest average return to education at the beginning of their career (even compared to the more recent 1966-1973 cohort).

[6] Jurajda, 2003, finds that returns are similarly high for workers who were aged between 11 and 17 at the time of the breakdown of communism.

the fall of the Berlin Wall – and in 2004, and find that returns are higher for the older age cohorts. Since the younger age group in 2004 was born in 1984 or later, it is quite likely that this group has been entirely educated after the fall of communism. The older age group includes instead both those who have studied entirely under communism and those who have experienced both systems. The higher returns earned by the older age group suggest that pre-transition education is not obsolete in the modern market economy. A potential problem with this interpretation is that the younger age group excludes most college graduates, who typically graduate after age 20. Because of this, the lower returns found for the younger generation could be driven by self-selection out of education and into the labour market.

Munich et al., 2005, use Czech data for the period 1991 to 1996 to estimate the wage effects of the number of years of communist and post-communist education and find that years of post-communism education have a lower return than years of education under communism. They argue that this evidence strongly contradict the hypothesis that human capital acquired under communism is less appropriate for a market economy. Yet an alternative explanation is that the individuals with post-communist education have entered the Czech labour market in a phase of intense turmoil, suffering as a consequence earnings losses which typically fade away only after several years. To rule out this alternative explanation one would need to compare returns at the end of the transition period, for instance in the late 2000s.

Finally, Orlowski and Riphahn, 2009, compare East and West Germany and find that, whilst returns to education are comparable, returns to experience are much lower in Eastern Germany than in Western Germany almost twenty years after re-unification. They argue that socialist labour market experience is of little value in the new market economy, but that schooling acquired in the East could still be a useful signal of innate individual productivity[7]. Similar results have been found by Chase, 1998, for both the Czech Republic and Slovakia, and Flanagan, 1998, for the Czech Republic.

[7] Education in the former GDR was very selective, and only about 10 percent of all students attaining grade 10 were admitted to high school and could attend the advanced school exam (Abitur) required to be admitted to a University (Riphahn and Trübswetter, 2010).

In summary, the available empirical evidence does not support the hypothesis that the education accumulated under communism is obsolete in a market economy. Yet this evidence is based on single CEE economies and often covers the period of early transition from communism, when intense economic restructuring could have altered the structure of returns. As argued by Machin and McNally, 2007, there is a sharp contrast between the large body of empirical evidence documenting the rise in returns to education occurring during early pro-market reforms, and the paucity of studies that consider the late transition of the EU accession period.

3. The Model

Assume that firms in each economy produce output using following production function

$$Y_{ct} = \overline{N}_{ct} \qquad [1]$$

where Y is output, $\overline{N}$ total employment in efficiency units, c the country and t the time. Total employment depends on male ($\overline{N}_m$) and female labour ($\overline{N}_f$) in efficiency units, which are imperfect substitutes in production, and is given by

$$\overline{N}_{ct} = \left[e^{\theta fct} \left(\overline{N}_{fct}\right)^{\sigma} + e^{\theta mct} \left(\overline{N}_{mct}\right)^{\sigma} \right]^{\frac{1}{\sigma}} \qquad [2]$$

where θ is an efficiency parameter, which varies by gender (m for males and f for females), country and time, $-\infty \leq \sigma < 1$ and $\frac{1}{1-\sigma}$ is the elasticity of substitution. Both female and male employment in efficiency units consists of k groups of imperfectly substitutable workers, who differ in their age

$$\overline{N}_{fct} = \left\{ \sum_{a=1}^{k} e^{\mu fact} \left[N_{fact} \right]^{\rho f} \right\}^{\frac{1}{\rho_f}} \quad [3]$$

$$\overline{N}_{mct} = \left\{ \sum_{a=1}^{k} e^{\mu mact} \left[N_{mact} \right]^{\rho m} \right\}^{\frac{1}{\rho_m}} \quad [4]$$

where μ is an efficiency parameter, a is age, $-\infty \leq \rho_f, \rho_m < 1$, and N is employment.

Further assume that product prices are given in the international market, and normalized to 1. Define g as gender (f: females; m: males). Profit maximization with respect to employment N_{gact} yields the following first order condition

$$e^{\left(\mu_{gact} + \theta_{gct}\right)} \left(\frac{N_{gact}}{\overline{N}_{gct}} \right)^{\rho g - 1} \left(\frac{\overline{N}_{gct}}{\overline{N}_{ct}} \right)^{\sigma - 1} = w_{gact} \quad [5]$$

where w is the real wage. By taking logs of [5] we obtain

$$\ln w_{gact} = \mu_{gact} + \overline{\theta}_{gct} + (\rho_g - 1) \ln \left(\frac{N_{gact}}{N_{gct}} \right) \quad [6]$$

where $\overline{\theta}_{gct} = \theta_{gct} + (\sigma - 1) \ln \left(\frac{\overline{N}_{gct}}{\overline{N}_{ct}} \right) + (\rho_g - 1) \ln \left(\frac{N_{gct}}{\overline{N}_{gct}} \right)$. Equation (6) is the demand for labour in the cell defined by gender, age, country and time. Labour market equilibrium requires that we characterize supply. Define relative supply as $\frac{P_{gact}}{P_{gct}}$, where P is the labour force. When the labour market is perfectly competitive, relative demand equals relative supply and we have that $\frac{N_{gact}}{N_{gct}} = \frac{P_{gact}}{P_{gct}}$. Using this into (6) yields

$$\ln w_{gact} = \mu_{gact} + \bar{\theta}_{gct} + (\rho_g - 1)\ln\left(\frac{P_{gact}}{P_{gct}}\right) \quad [7]$$

With imperfect substitutability, the real wage of each group of workers decreases when relative supply increases.

In the presence of frictions or wage bargaining, nonzero unemployment emerges and employment is equal to $N_{gact} = P_{gact} - U_{gact}$, where U is unemployment. Some rearrangement yields $\frac{N_{gact}}{N_{gct}} = \frac{P_{gct}}{N_{gct}}\left[\frac{P_{gact}}{P_{gct}}(1-u_{gact})\right]$, where u is the unemployment rate. Taking logs and defining $\hat{\theta}_{gct} = \bar{\theta}_{gct} + (\rho_g - 1)\ln\left(\frac{P_{gct}}{N_{gct}}\right)$, we obtain

$$\ln w_{gact} = \mu_{gact} + \hat{\theta}_{gct} + (\rho_g - 1)\ln\left(\frac{P_{gact}}{P_{gct}}\right) - (\rho_g - 1)u_{gact} \quad [8]$$

With wage bargaining or frictions, unemployment is positive and real wages are higher than in perfect competition.

We assume that the efficiency parameter μ depends on human capital H

$$\mu_{gact} = \psi_g H_{gact} + \omega_{gact} \quad [9]$$

Following Willis, 1986, we model human capital as a function of years of schooling S and potential experience X, defined as age A minus years of schooling minus age when school starts ζ

$$H_{gact} = \eta_{1g} S_{gact} + \eta_{2g} X_{gact} \quad [10]$$

$$X_{gact} = A_{gact} - S_{gact} - \zeta_{ct} \quad [11]$$

Using [10] and [11] into [9] and letting vector *Y* include age, the log of relative supply and the unemployment rate, we can write the wage equation more compactly as

$$\ln w_{gact} = \omega_{gact} + \hat{\theta}_{gct} + \beta_g Y_{gact} + \psi_g \alpha_g S_{gact} \qquad [12]$$

where $\alpha_g = (\eta_{1g} - \eta_{2g})$ and ζ is included in $\hat{\theta}_{gct}$.

The percentage increase in earnings associated to a one-year increase in years of schooling consists of two components: 1) the productivity of human capital ψ_g; 2) the effect of additional schooling on human capital α_g, or "school effectiveness". In this setup, returns to education can be low even when school effectiveness is high if the productivity of accumulated human capital is low.

4. The Empirical Setup

The empirical counterpart of equation [12] is

$$\ln w_{gact} = \beta_g Y_{gact} + \psi_g \alpha_g S_{gact} + \omega_{gact} + \hat{\theta}_{gct} + v_{gact} \qquad [13]$$

where *v* is an error term, which includes several components beside pure noise: measurement error, unmeasured group characteristics such as average ability and other factors which affect selection into employment. Since these components are likely to be correlated with measured schooling, standard ordinary least squares estimates of eq. (13) are bound to be biased (see for instance Card, 1999).

Selection into employment and positive wages is not random but varies by gender, age and country and with labour market conditions, which we proxy with the cell specific unemployment and relative labour force rates. To take selection into account, we model the error term v_{gact}, as follows

$$\nu_{gact} = \phi_{1g} u_{gact} + \phi_{2g} \frac{P_{gact}}{P_{gct}} + \xi_{gact} \quad [14]$$

Next, we model the error term ω_{gact} as a function of parental background FB_{gac} and the residual error term υ_{gact}

$$\omega_{gact} = \tau_g FB_{gac} + \upsilon_{gact} \quad [15]$$

Although some unobserved heterogeneity has been eliminated by aggregation, average unobserved abilities which are correlated with average education still remain. Following Card and Rothstein, 2007, we "difference out" the gender-invariant components of these unobserved effects by comparing males and females within the same cell (age by country by time). Using Δ as the "between – genders" difference operator (males minus females) and differencing by gender equation (13) yields

$$\Delta \ln w_{act} = \overline{\beta}_f \Delta Y_{act} + (\overline{\beta}_m - \overline{\beta}_f) Y_{mact} + \gamma_f \Delta S_{act} + (\gamma_m - \gamma_f) S_{mact} + \Delta \xi_{act} + \Delta \hat{\theta}_{ct} + \Delta \upsilon_{act} \quad [16]$$

where $\gamma = \alpha\psi$, the vector Y includes also parental background effects FB and $\overline{\beta}_g$ is a vector of parameters β_g, ϕ_{1g}, ϕ_{2g} and τ_g. Equation (16) associates the gender difference in log average wages to the difference in average years of schooling and to the years of schooling attained by males in the same cell. When the effect of schooling on earnings does not vary by gender, $(\gamma_m - \gamma_f)$ is equal to zero.

Although differencing removes common un-observables, gender specific un-observables still remain, and could be correlated with the change and level of average schooling, thereby biasing standard ordinary least squares estimates. We deal with this as follows: first, we capture $\Delta \hat{\theta}_{ct}$ in a flexible way by using country by year dummies κ_{ct}. The inclusion of these dummies implies that the relationship between human capital and earnings is identified by the variation provided by different cohorts within each country and

wave.

Second, we define $\Delta\upsilon_{act} = \chi_{ct} + \chi_{ac} + \chi_{act}$. Since the country by time effects are already captured by the set of country by time dummies, we only need to worry about the age by country effect, which we model as follows

$$\chi_{ac} = \kappa_c + \kappa_a + \pi_1 GDP_{ac} \qquad [17]$$

where κ_c and κ_a are country and age dummies and GDP is log real GDP per head at age 10, which is expected to capture the average economic environment faced by the age cohort at the time of education.

These assumptions imply that equation (16) becomes

$$\Delta \ln w_{act} = \kappa_c + \kappa_a + \kappa_{ct} + \overline{\beta}_f \Delta Y_{act} + (\overline{\beta}_m - \overline{\beta}_f) Y_{mact} + \gamma_f \Delta S_{act} + (\gamma_m - \gamma_f) S_{mact} + \varepsilon_{act} \qquad [18]$$

where $\varepsilon_{act} = \Delta\xi_{act} + \Delta\chi_{act}$ and Y_{act} includes also the log of GDP at age 10 in addition to relative supply, unemployment rates and parental background[8]. Under the maintained hypothesis

$$\begin{aligned} E[\Delta S_{act}, \varepsilon_{act}] &= 0 \\ E[S_{act}, \varepsilon_{act}] &= 0 \end{aligned} \qquad [19]$$

ordinary least squares yield consistent estimates of the relevant parameters γ_m and γ_f.

The use of country and country by year dummies allows us to control for country specific un-observables, both time variant and time invariant. By using age dummies we also control in a flexible way for differential effects of potential experience and time of entry in the labour market. In the empirical implementation, we estimate Eq. (18) separately by age group (seniors versus juniors) and by area (Eastern versus Western Europe). We

[8] Notice that the coefficient associated to the relative population rate reflect both the elasticity of substitution between cohorts and the effect on selection into employment.

measure relative supply with relative population and the activity rate. In order to alleviate concerns about reserve causality affecting these variables and the unemployment rate, we use first lags rather than current levels. Also, due to data availability, these labour market variables are defined by country, year of survey and 5-year age groups.

5. The Empirical Strategy and the Data

We compare the returns to education earned by the cohorts of individuals who completed their schooling in Eastern Europe before the fall of the Berlin Wall with the returns earned by two control groups: the same cohorts who completed their education in Western Europe, and the younger cohorts who went to school in CEE countries entirely or partially after 1989. The treatment group consists of individuals born between 1951 and 1964, who were at least 25 in 1989 and have been in employment during the period 2006 to 2008. By and large, these individuals had completed their education before the end of Communism in the East[9]. The younger control group consists instead of individuals born between 1976 and 1983, who were at most 13 in 1989 and at least 25 and employed during the years 2006-2008. This group has been exposed at least in part to post-communism education. First of all, compulsory education in the East ends typically at 14 or later. Therefore, even the oldest in this group has spent some time at school after 1989. Second, more than 80 percent of those born between 1976 and 1983 in the East have completed at least upper secondary education and have gone to school until age 18 or later. Even if we place the start of the transition period in 1991, as done for instance by Flabbi et al, 2008, these individuals have been exposed to some extent to new education curricula and systems.

Our data are drawn from the European Union Statistics on Income and Living Conditions (EU-SILC), a survey of living conditions in European countries which covers both Western and Eastern European countries. The EU-SILC is a survey of households based on nationally representative samples, which collects comparable cross sectional and

[9] In our data, more than 96 percent of the individuals in the selected age cohorts declare to have attained their highest education before 1989.

longitudinal micro data on income poverty and social exclusion and contains information on income, housing, material deprivation, labour, health, demography and education. We use data from three waves (2006-2007-2008) and 22 countries: Bulgaria, The Czech Republic, Estonia, Hungary, Poland, Romania, Slovenia and Slovakia in Eastern Europe and Austria, Belgium, Denmark, Cyprus, Spain, France, Finland, Greece, Italy, Netherlands, Norway, Portugal, Sweden and the United Kingdom in Western Europe.

For each country in the sample, we only consider the sub-sample of individuals who reside in the country of birth (about 92 percent of the total in 2008). By so doing, we minimize the risk of assigning to individuals the wrong education system. This would happen if we were to assume that a person living in France but born and educated in Poland completed her education in the former country rather than in the latter[10]. Since the exclusion from the sample of individuals born and educated in a country and living in another is impossible for Germany using EU-SILC data, we turn for this country to an alternative dataset, the German Socio-Economic Panel Study (SOEP), which allows us to clearly identify whether the received education was completed in previous East rather than West Germany.

We compute years of schooling as the difference between the age when the highest level of education was attained and country specific information on the age when school typically starts. Real hourly earnings in Euro (CPI deflated) are obtained as the ratio of gross employee cash earnings to the number of hours worked[11]. Individual data on schooling and earnings are aggregated into cells defined by year of birth, country, gender and wave. We only retain those cells that include at least 30 observations. When collapsing the data, we use cross sectional EU-SILC weights[12]. We end up with a sample of 877 cells for senior males and females in both Eastern and Western Europe and 138 cells for junior Eastern Europeans.

[10] If we exclude Germany and consider the 2008 wave of EU-SILC, only 3 percent of the individuals in the relevant age cohorts have been born in a European country different from the country of residence.
[11] We only consider individuals with at least 15 and at most 80 hours worked per week. For most countries we use data on gross personal income. For a few countries (Greece, Portugal and Italy), we use instead gross monthly earnings when data on gross personal income are missing.
[12] This restriction forces us to exclude Ireland from the sample, because almost half of the original cells are dropped.

Average years of schooling by area, gender and group of cohorts (seniors and juniors) are shown in Table 2. Table 3 shows instead the average real hourly gross wage by area, cohort and gender for the year 2006. As expected, wages are higher for males than for females, especially among the older cohorts, and the ratio between hourly wages in the West and in the East ranges from about 3.5 for the junior age group to about 4.3 for the older cohorts.

Unfortunately, the EU-SILC dataset does not contain information on parental background. We retrieve this information for the relevant cohorts and countries and waves using data drawn from the European Social Survey (ESS), and measure parental background with the percentage of parents in the cell who have attained less than upper secondary education[13].

The data for Germany are drawn from waves 2000 to 2009 of the German Socio-Economic Panel. We retain only individuals born in Germany who have studied either in previous West or in previous East Germany, and measure the quantity of education with the years required to attain the current education level. Due to the limited number of available observations, our sample includes only senior individuals, who were born between 1945 and 1964, and therefore were at most 55 in the selected sample period. We divide these individuals in two groups, those who have completed their education in the West and those who have studied in the East, independently of whether they are currently living and working in other parts of Germany[14]. Table 4 shows the average years of schooling and the real average hourly wage for each group and gender in 2006. We find that senior East Germans have on average a slightly higher level of education than senior West Germans. On the other hand, the latter have higher real hourly wages.

We also use data from the International Adult Literacy Survey (IALS), which contains information both on educational attainment and on adult literacy. Literacy is assessed in three domains: prose literacy, or the skills needed to understand and use information from texts; document literacy, or the skills required to locate and use information contained in various formats, including payroll forms, maps, transportation

[13] Since this information is not available for Lithuania, we drop this country from our sample.
[14] This information is contained in the variables "psbilo" and "pbbilo" in the SOEP dataset. See Haisken De New and Frick, 2005, for details.

schedules; quantitative literacy, or the skills required to apply arithmetic operations, such as balancing a check-book or determining the amount of interest on a loan. Since literacy test scores – which range in IALS from zero to 500 - are affected by adult learning and school quality, they can be interpreted as a broader proxy of individual (cognitive) human capital than the number of years of attained education (see Hanushek and Wossmann, 2009).

The IALS survey was conducted from 1994 to 1998 and involved several European countries from previous Western and Eastern Europe. We restrict out attention to the countries which are also included in our sample drawn from EU-SILC: Belgium, Denmark, the Czech Republic, Finland, Hungary, Italy, the Netherlands, Norway, Poland, Sweden, Slovenia and the UK, and collapse data into cells identified by year of birth, country and gender. Due to the relatively few observations, we only retain cells with at least 10 individuals. Since this restriction excludes an important number of cells for the younger age group, we only use literacy data for the senior age group, who in these data is defined as individuals born between 1940 and 1965. The average test score by gender and area displayed in Table 5 below shows that average literacy is higher among those educated in Western Europe and slightly higher among males.

Finally, the data on country, age and gender specific unemployment rates and activity rates are drawn from the Eurostat database. Since these data are only available by age group, we select five age groups – 25-29, 30-34, 45-49, 50-54 and 55-59 and match these groups to the relevant cells defined by age, country and gender in the EU-SILC dataset.

6. Senior Employees in Western and Eastern Europe

We pool the 22 countries in the sample into two groups, one for Eastern and the other for Western Europe and compare the returns to schooling earned by the age cohorts who have studied under communism in the East to the returns earned by the same age cohorts who have studied in the West by estimating Eq. (18) separately for the two groups of countries. Given that we use grouped data, we weight our estimates with the square root of the number of individuals in each cell, and cluster standard errors by country and year of

birth to take into account the possibility that the error term is correlated across the three available waves – 2006, 2007 and 2008 - because of common year of birth by country effects.

Table 6 Panel A presents our results[15]. We find that the estimated returns to schooling are slightly higher for Eastern European females who have studied under communism than for equally aged Western European females: one additional year of schooling is expected to raise wages by 6.6% in the East and by 5.3% in the West. In the case of males, additional schooling raises wages by 5.4% in the West and by 5.3% in the East. When we test whether these differences are statistically significant, we fail to reject the null hypothesis of no significant difference.

These findings rely on the assumption that the relationship between log hourly earnings and years of schooling is linear. This is equivalent to assuming – at the individual level – that the returns to an additional year of post-secondary education are equal to the returns to primary and secondary education[16]. We relax this assumption by replacing Eq. (18) with

$$\Delta \ln w_{act} = \kappa_c + \kappa_a + \kappa_{ct} + \overline{\beta}_f \Delta Y_{act} + (\overline{\beta}_m - \overline{\beta}_f) Y_{mact} + \gamma_f^H \Delta S_{act}^H + (\gamma_m^H - \gamma_f^H) S_{mact}^H + \gamma_f^C \Delta S_{act}^C + (\gamma_m^C - \gamma_f^C) S_{mact}^C + \varepsilon_{act} \quad [20]$$

where S^H and S^C are average years of schooling in primary and secondary education and post-secondary education respectively.

We compute cell specific S^H and S^C from individual data as follows: for the individuals who have completed at most upper secondary education (ISCED=3), S^H is equal to the number of years of schooling required to attain the highest degree and S^C is equal to zero. For the individuals who instead have completed post-secondary education, S^H is the country specific modal number of years of schooling required to attain upper

[15] The full estimates are reported in Table A1 in the Appendix.
[16] In this paper, primary and secondary education corresponds to ISCED levels 0 to 3 and post-secondary education to ISCED levels 4 to 6.

secondary education (ISCED 3; 12 years for most countries in the sample), and post-secondary schooling is the difference between total years of schooling and this modal number. Cell averages are then obtained by averaging individual data over gender, country, wave and year of birth.

As shown in Panel A of Table 7, we find that the point estimates of the returns to schooling are generally higher for post-secondary education than for primary or secondary education, with the exception of senior males in Western Europe, for whom these returns are rather similar. In Eastern Europe, the returns earned by senior females are equal to 8.6% per year of schooling in post-secondary education and to 4.1% per year spent in primary and secondary schools. Turning to senior Eastern European males, while post-secondary education yields a rather high 9.8% return per year, primary and secondary education earns a small and negative return.

Next consider Western Europeans: on the one hand, we find that years of primary and secondary education yield a 3.9 percent return for senior females and a 5.5 percent return for senior males. On the other hand, the returns to years of post secondary education are equal to 6.8 and 5.0 percent respectively. When we test whether the point estimates of the returns to S^H and S^C are statistically different, or whether returns earned by senior workers in the East are statistically different from the returns earned by senior workers in the West, we find that this is the case for males but not for females.

Our findings suggest that the answer to the question whether education under communism is less appropriate for a market economy than education completed in the West depends on the level of attained education: when we consider primary or secondary education, there is evidence that male employees who have studied under communism earn significantly lower returns in the late 2000s than employees in the same age groups who have studied in the West. No such evidence exists for female labour. When we turn instead to post-secondary education, the evidence is that returns are higher, not lower, for the relatively few who went to college under communism, especially if they are males.

In the model of Section 3, returns to schooling reflect both the productivity of human capital and school effectiveness. Eventual evidence that the education acquired under communism is less appropriate for a modern market economy than the education

acquired in the West or after communism can be explained by our model either with the former type of education being less valuable for the production of human capital, or with the fact that the skills learnt under communism were based on and applied to vastly outdated technologies, and therefore cannot be as valuable when applied to the modern technologies adopted more than 15 years after the fall of the Berlin Wall.

Human capital has many dimensions, cognitive, non-cognitive and technical. In line with the relevant literature – see for instance Hanushek and Wossmann, 2009 – we measure the cognitive dimension with adult literacy test scores, which are standardized measures of prose, quantitative and document literacy. As discussed in the previous section, the IALS survey provides comparative data on these scores for a sub-sample of countries in Eastern and Western Europe. We use these data to run the following regression

$$\Delta \ln TS_{ac} = \kappa_c + \kappa_a + \pi_f \Delta S_{ac} + (\pi_{mac} - \pi_{fac}) S_{mac} + \tau_{1f} \Delta FB_{ac} + (\tau_{1m} - \tau_{1f}) FB_{mac} + \pi_1 GDP_{ac} + \eta_{TSac} \quad [21]$$

where *TS* is for test scores and we only consider the senior age groups in Eastern and Western Europe[17]. Notice that, since the IALS survey was carried out between 1994 and 1998, the adult literacy scores refer to the initial stages of the transition process in CEE countries rather than to the late 2000s.

Table 8 reports our results. We find no support for the view that an additional year of schooling under communism in the East has had a smaller effect on the development of cognitive skills in adult age than a similar year spent in the West. Quite the contrary, there is evidence that school effectiveness has been higher for females in the East than in the West. Under the assumption that the estimates in Table 8 hold also for the broader sample of countries in Table 6, we can use them to compute the productivity component of the returns to schooling - parameters ψ in Eq. (13). As shown in Table 9, this component is lower in the East than in the West. The difference in the estimated productivity parameter is sizeable for females and small for males, and statistically significant only for females.

[17] We omit country by time dummies in this specification because there is only one wave for each country.

7. Senior Employees in Western and Eastern Germany

We estimate the returns to schooling in post-unification Germany by using 10 waves of SOEP (from 2000 to 2009) and by focusing exclusively on senior workers, who have completed their studies either in the previous German Democratic republic (GDR) or in the previous Federal Republic of Germany (FRG). We pool data from the Eastern and Western Lander and retain only the cells with at least 5 observations. The estimated model is

$$\begin{aligned}\Delta \ln w_{art} &= \kappa_r + \kappa_a + \kappa_{rt} + \varsigma\kappa_r GDR + \overline{\beta}_f \Delta Y_{art} + (\overline{\beta}_m - \overline{\beta}_f) Y_{art} + {\gamma_f}^H \Delta {S^H}_{art} + ({\gamma_m}^H - {\gamma_f}^H) {S^H}_{mart} \\ &+ {\delta_f}^H \Delta {S^H}_{art} * GDR + ({\delta_m}^H - {\delta_f}^H) {S^H}_{mart} * GDR + {\gamma_f}^C \Delta {S^C}_{art} + ({\gamma_m}^C - {\gamma_f}^C) {S^C}_{mart} \\ &+ {\delta_f}^C \Delta {S^C}_{art} * GDR + ({\delta_m}^C - {\delta_f}^C) {S^C}_{mart} * GDR + \tau_f \Delta FB_{ar} + (\tau_m - \tau_f) FB_{ar} + \eta_{art}\end{aligned} \quad [22]$$

where hourly wages are monthly gross earnings divided by average monthly hours of work, *r* is the region of Germany (previous West and East) and GDR is a dummy equal to 1 if the individuals in the cell have completed their education in the previous GDR rather than in the Federal Republic (FRG). Our results are reported in Table 10.

In contrast to our findings in Table 7, we find that the returns to S^H In Germany are generally higher than the returns to S^C. Notice that more than 50 percent of the individuals in the relevant age cohorts who have attained lower or upper secondary education have done so by completing an apprenticeship, both in the West and in the East. This subscribes to the view that, at least for East Germans, even vocational education attained under communism is not penalized by the transition to a market economy. Furthermore, there is little statistical evidence that returns to schooling are lower for those who have studied under communism. Quite the contrary, we find that males with post-secondary education in the East have significantly higher payoffs to their years of schooling than males who have completed a similar level of education in the West.

8. Senior and Junior Employees in Western and Eastern Europe

In this section, we compare the returns to schooling earned by two groups of Eastern Europeans, the seniors born between 1951 and 1964 and the juniors born between 1976 and 1983. While the first group has completed education under communism, the second group has spent at least some time at school after the fall of the Iron Curtain. Panels B of Table 6 and 7 show the results of this comparison. When we restrict the relationship between log earnings and schooling to be linear and the marginal returns to schooling to be constant, we find that the estimated returns to schooling vary considerably by gender: in the case of females, junior workers earn 5.6% more for each year of education, a return close to the 6.6% payoff obtained by senior employed females. The difference of returns is not statistically significant. For males, the average hourly wage of junior employees increases by 11.6% for each additional year of schooling, a return more than twice as big as the one earned by senior employees (5.3%). In this case, the difference of returns is statistically significant at the 5 percent level of confidence.

When we allow returns to schooling to vary according to whether education is post-secondary or lower, we find that the returns earned by junior female employees are not statistically different from the returns earned by senior females. On the other hand, junior male employees in the East have systematically higher returns than senior males in the same area. The difference is small and not statistically significant for post-secondary education, and large and statistically significant for primary and secondary education.

9. Robustness checks

We have compared the returns to education of junior and senior workers educated in Eastern and Western Europe by assuming that these returns are homogeneous within each area. Yet this restriction may not hold. We ask whether our qualitative findings still hold when we restrict the comparison to two groups of countries in the East and the West of Europe which share the same returns to education within each group. To identify these two groups, we estimate an augmented version of Eq. (18), which includes among the

regressors the interactions of country dummies with the level and the "between-genders" difference in years of schooling, and select the sub-sample of countries for which the hypothesis of no joint statistical significance of these interactions cannot be rejected. It turns out that we need to exclude from the sample the following countries: Cyprus, Austria and Sweden in the West and Romania, Estonia and Slovakia in the East. Table 11 presents the estimates when these countries are omitted from the comparison. We confirm the findings reported in Table 6 that the returns earned by senior workers in Eastern and Western Europe are not statistically different. We also find that the returns accruing to junior male workers in the East are higher than those earned by senior workers in the same area. We also confirm the finding that junior males educated in the East have substantially higher returns to education than senior males.

In our definition of senior workers we have also included employed individuals who are aged between 51 and 55 at the time of the survey (2006-2008). A potential concern with this choice is that selection into retirement may affect average earnings and education in the oldest cells of the sample. To illustrate, the percentage of retired individuals is as low as 1 percent in the cells of individuals aged below 50, and equal to 7.9 and 4.1 percent respectively in the cells of Eastern and Western Europeans aged 51 to 55. In our estimates, we control for self-selection into employment and the labour force using the country by age by gender values of the unemployment rate and the activity rate. As a further control, we replicate our estimates of Eq. (18) by considering only the year of birth cohorts between 1956 and 1964. As shown in Table 12, we cannot reject the null hypothesis that the estimated returns to education earned by senior employees are not significantly different between Eastern and Western Europe. We also confirm that these returns are significantly higher for junior than for senior males in Eastern Europe. Therefore, we conclude that restricting our sample to a younger group of seniors does not alter in a significant way our empirical results.

We also ask whether our estimates are affected by adding labour market experience, which in the EU-SILC data is defined as the number of years since the first regular job was started. In results available from the authors upon request, we show that adding the level and difference of experience to Eq. (18) does not alter our findings in a

qualitative way. Moreover, when we test whether the level and difference of labour market experience is statistically significant, we cannot reject the null hypothesis of no significance[18].

Finally, we check the robustness of our finding to two additional variations: first, we remove agriculture from the data; second, we exclude those individuals who have completed their schooling after 1987 in the senior age group and before 1990 in the junior age group. In both cases, results available from the authors show no qualitative changes with respect to the baseline results presented above.

10. Summary and discussion

We have compared the returns to education of senior Eastern European workers with those of coetaneous Westerners and younger Easterners. Considering the former comparison, we have found that the pattern of returns to education changes significantly depending on whether we assume constant or variable returns across degrees. If we assume that the returns to years of schooling do not vary with the attained degree, we find that estimated returns in the late 2000s for those who have been educated under communism, both males and females, are not significantly different from the returns earned by those who have studied in Western Europe. There is also no evidence that education under communism is less effective in developing cognitive skills and literacy in adult life than education attained elsewhere in Europe. Quite the opposite, the former is more effective when we consider senior females.

With the notable exception of Germany, when we allow for the effects of years of schooling on earnings to differ depending on the attained degree, we find that the returns to years of primary and secondary education are significantly lower than the returns to post-secondary education, independently of where this education was received. Moreover, the returns to primary and secondary education are particularly low for senior males educated under communism, who enjoy instead a relatively high return from their post-secondary

[18] Notice that in all our regressions we control for year of birth dummies and for education in the cell. This is equivalent to controlling for potential experience.

education. Germany differs from the European countries considered in this study because returns to primary / secondary education are generally higher than returns to post-secondary education. Overall, since upper secondary (vocational) education was the bulk of education in the communist regimes, our evidence supports the view that the primary and secondary education acquired by males under communism is currently penalized in most East European labour markets. No evidence of such a penalty exists for females.

When we compare seniors and juniors in CEE countries, we observe that younger males earn considerably higher returns to education than more senior males. There is no significant difference in returns between younger and older females. Furthermore, the higher returns to education experienced by younger males are driven by the returns to primary and secondary education, which is still by and large vocational[19].

It is useful to contrast our results with those found in the relevant empirical literature. As reviewed in Section 2, this literature – and especially the contributions by Compos and Jolliffe, 2007, for Hungary and Munich et al., 2005, for the Czech Republic – does not find convincing evidence that education under communism is less valuable or appropriate for a market economy than education after communism. We contribute to this literature by using data for nine Eastern European countries – including previous East Germany - rather than from a single country and by examining returns more than 15 years after the fall of the Iron Curtain.

We have shown that there is empirical support for the view that male primary and secondary education under communism is generally less valuable than the same level of education acquired either during the same period of time in the West or after the fall of the Berlin Wall in the East. We have also shown that post-communist education yields higher returns for males than education under communism. Pre-college education under communism is penalized, but only for males. Why are females educated under communism not affected?

One reason is that the radical transformation of the economy in CEE countries after

[19] The share of students in vocational education declined from 82.2 to 77.9% from 1989 to 1996 in the Czech Republic, from 76.1 to 72.9 percent in Hungary, from 77.5 to 68.9 percent in Poland, from 81.9 to 75.9 percent in the Slovak Republic and from 87.2 to 70 percent in Romania (World Bank, 2000).

the fall of the Berlin Wall affected mainly the industrial sector, where male employment with less than college education was heavily concentrated. If we consider senior and junior employees in the East and the West, we find that in the East the percentage of male employees working in industry during 2006-2008 was 55% and 49% respectively. This percentage falls to 26 and 23 percent for female employees. In the West, the share of male employment in industry has been much lower, at 39% for seniors and 40% for juniors. Senior male employees with primary and secondary education, who entered the labour market or were already in the market when the transition to market economies begun in the East, took the brunt of the recession either in terms of unemployment or in terms of lower wages. On the one hand, this negative cohort effect has been quite persistent and lasted until the end of the transition. On the other hand, and with the exception of East Germany, the industrial skills developed before the end of communism have become increasingly less suitable to the new market economies. Female labour was partly spared because it was mainly employed in the expanding service economies of the East.

The relatively low appropriateness of primary and secondary education attained under communism does not extend to college education. Quite the contrary, this type of education yields higher or as high returns as the education obtained in the West or after the fall of the Berlin Wall. To interpret these findings, it is useful to look at demand and supply by education. As shown in Table 2, the percentage of individuals who have obtained a college degree under communism is much lower than the percentage of equally aged college graduates in the West, especially for males. When we compare different cohorts within the same area, it is clear that college education has substantially expanded, both in the East and in the West. This expansion has been relevant for females but moderate for males in Eastern Europe. In the late 2000s, the overall stock of college graduates in the East was still substantially below that of the West.

On the demand side, we have mentioned in Section 2 that the service sector expanded significantly in CEE countries between 1989 and 1998 both in terms of employment and of its share of GDP. This process continued afterwards, although at a slower pace. According to the World Bank (WDI indicators), the value added generated by services in 2008 was between 58 and 66 percent of GDP in the major CEE economies, with

an important expansion of the financial sector and other skill-intensive services, following progressive liberalization. Most likely, the increased demand for college graduates in the area generated by the expansion of skill-intensive services exceeded the growth in the stock of graduates, which could expand mainly via higher education of the younger cohorts, thereby contributing to the relatively high returns to post-secondary education for senior and junior employees of both genders.

Compos and Jolliffe, 2007, find that returns for those who received their education post-1989 in Hungary have fallen since 1995, which they interpret as evidence of falling school quality. We find instead that returns for those who have studied post-1989 in eight Eastern European countries (including Hungary) have increased with respect to the returns earned by older workers, especially for men. We reconcile our findings with declining school quality in CEE countries by arguing that the evidence of such decline is mixed at best. We propose three pieces of evidence in support of our view. First, as shown in Table 13, the share of public education expenditure on GDP has fallen during the transition in some countries (Hungary, Bulgaria and Slovakia) but risen in others (Poland, Romania and Slovenia). If we look instead at the growth of public expenditure in education during the 1990s, we find that it has been negative only in Bulgaria (see World Bank, 2000).

Second, the pupil – teacher ratio in basic education has declined in all countries, with the exception of Estonia (see Table 14). Last but not least, the average maths test scores of students enrolled in the eight grade in 1999, who have spent all their time in school after the fall of the Berlin Wall, is above the international average in all the CEE countries considered in this study, with the exception of Romania (see Mullis et al, 2000). When compared to average maths test scores in 1995, scores in 1999 are higher in Hungary, more or less unchanged in Romania, Slovak Republic and Slovenia, and lower in Bulgaria and the Czech Republic.

Conclusions

We have used multi-country data to investigate whether education under communism is less valuable in the free market economies prevailing in Eastern Europe

around or after the accession to the European Union. We have compared the cohorts of individuals who have studied under communism with post-communist cohorts and with older cohorts who have studied in the West. We have found evidence that having studied under communism is penalized in the economies of the late 2000s. This evidence, however, is limited to males and to primary and secondary education, and holds for eight CEE economies but not for the East Germans who have studied in the former German Democratic Republic.

We have also found evidence that post-secondary education under communism yields higher, not lower, payoffs than similar education in Western Europe. Therefore, not all those who studied under communism are penalized by the radical transformation of Eastern European economies. The primary/secondary versus post-secondary divide mirrors well the industry versus services divide. It is the former that has been heavily affected by the transition from communist to free market economies.

Interestingly, the relative fortunes of education under communism vary with gender, as we find no evidence that females who studied under communism are penalized in the returns to their education today. Again, a plausible explanation is that since females worked and work mainly in the service sector, they have been spared relatively to males the costs of industrial transformation and restructuring.

Tables and Figures

Figure 1. Real GDP growth in Eastern and Western Europe. Source: Eurostat

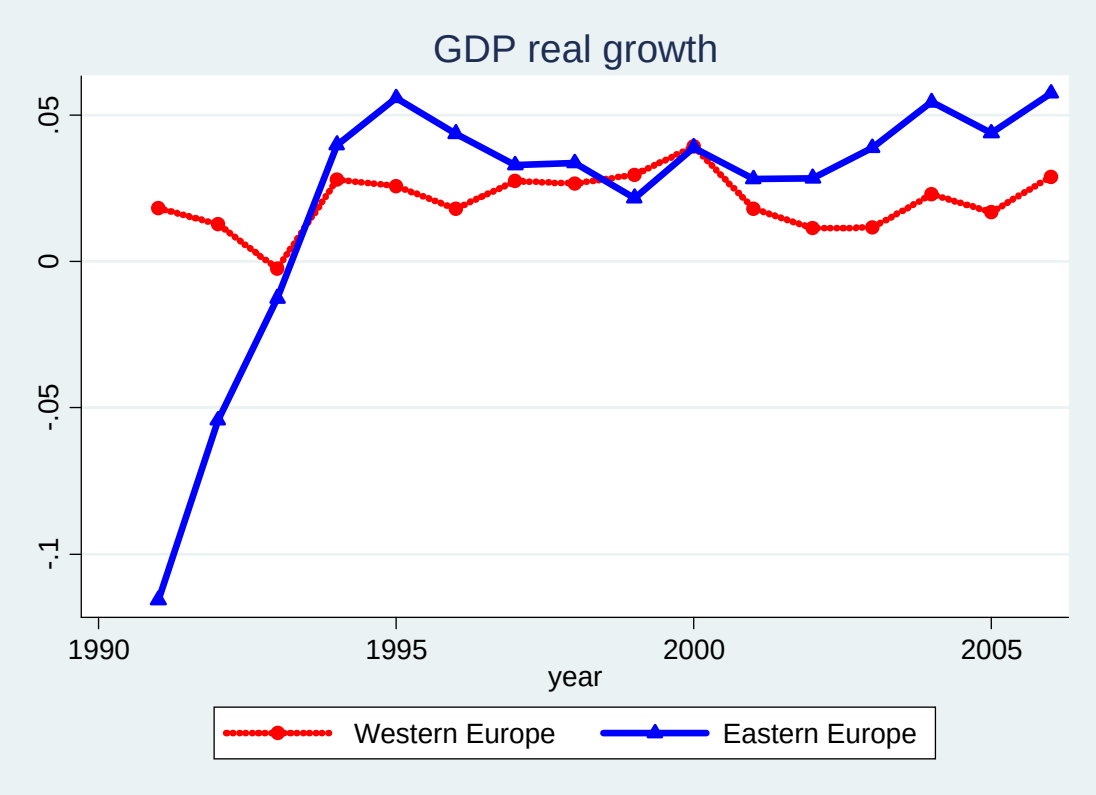

Table 1. Percentage retired, unemployed or disabled, by educational attainment. Cohorts born between 1951 and 1964. By area, cohort and gender. Eastern and Western Europe. 2006-2008.

		Males	Females
Western Europe			
	Less than high school	16.4	13.6
	High school	10.6	10.5
	College	5.5	5.6
Eastern Europe			
	Less than high school	36.9	37.4
	High school	21.5	24.0
	College	7.5	9.6

Source: our computations on EU-SILC data

Table 2. Educational attainment: by area, cohort and gender. Eastern and Western Europe. 2006-2008.

		Males		*Females*	
		Seniors	Juniors	Seniors	Juniors
Western Europe					
	Years of schooling	12.96	13.77	12.47	14.41
	% with high school	0.45	0.51	0.42	0.44
	% with college	0.22	0.28	0.23	0.40
Eastern Europe					
	Years of schooling	12.52	12.47	12.39	13.13
	% with high school	0.72	0.69	0.63	0.60
	% with college	0.14	0.16	0.17	0.28

Source: see Table 1

Table 3. Real hourly gross wage: by area, cohort and gender (in euros). Eastern and Western Europe. 2006.

		Males		*Females*	
		Seniors	Juniors	Seniors	Juniors
Western Europe	Real hourly wage	18.41	13.12	15.49	12.42
Eastern Europe	Real hourly wage	4.23	3.66	3.67	3.28

Source: see Table 1

Table 4. Educational attainment: by area, cohort and gender. Germany 2006. Source: SOEP

		Seniors	
		Males	Females
Studied in West Germany			
	Years of schooling	12.41	12.81
	Real hourly wage	21.21	17.23
Studied in East Germany			
	Years of schooling	12.62	13.16
	Real hourly wages	13.13	11.89

Source: our computations based on SOEP data

Table 5. Literacy test scores: by area and gender

		Seniors	
		Males	Females
Western Europe	Test score	287.87	280.54
Eastern Europe	Test score	250.05	246.13

Source: our computations based on IALS data

Table 6. Estimated returns to education. Dependent variable: Δlog hourly wage.

Panel A: senior workers in the West and East

	Females Eastern Europe	Females Western Europe	Males Eastern Europe	Males Western Europe
Years of schooling	0.066 (0.020) [0.001]	0.053 (0.009) [0.000]	0.053 (0.016) [0.002]	0.054 (0.010) [0.000]
Test of difference between East and West (p-value)	[0.555]		[0.974]	
Observations	258	519	258	519

Panel B: seniors and juniors in Eastern Europe

	Senior Females	Junior Females	Senior Males	Junior Males
Years of schooling	0.066 (0.020) [0.001]	0.056 (0.015) [0.000]	0.053 (0.016) [0.002]	0.116 (0.018) [0.000]
Test of difference between seniors and juniors (p-value)	[0.647]		[0.004]	
	258	138	258	138

Notes: each regression includes the level and gender difference of lagged relative population, unemployment rate and activity rates, country dummies, age dummies and country by year dummies. Clustered country by year of birth standard errors within parentheses and p-values within brackets.

Table 7. Estimated returns to years of schooling S_H and S_C. Dependent variable: Δlog hourly wage.

Panel A: senior workers in the West and East

	Females Eastern Europe	Females Western Europe	Males Eastern Europe	Males Western Europe
Years of schooling S_H	0.041	0.039	-0.022	0.055
	(0.030)	(0.014)	(0.026)	(0.015)
	[0.174]	[0.006]	[0.390]	[0.000]
Test of difference between East and West (p-value)	[0.936]		[0.010]	
Years of schooling S_C	0.086	0.068	0.098	0.050
	(0.022)	(0.013)	(0.021)	(0.013)
	[0.000]	[0.000]	[0.000]	[0.000]
Test of difference between East and West (p-value)	[0.454]		[0.021]	
Test of difference between S_H and S_C (p-value)	[0.171	[0.173]	[0.000]	[0.795]
Observations	258	519	258	519

Panel B: senior and junior workers in the East

	Senior Females	Junior Females	Senior Males	Junior Males
Years of schooling S_H	0.041	0.009	-0.022	0.105
	(0.030)	(0.040)	(0.026)	(0.041)
	[0.174]	[0.821]	[0.390]	[0.013]
Test of difference between East and West (p-value)	[0.465]		[0.010]	
Years of schooling S_C	0.086	0.063	0.098	0.119
	(0.022)	(0.015)	(0.021)	(0.024)
	[0.000]	[0.000]	[0.000]	[0.000]
Test of difference between East and West (p-value)	[0.328]		[0.460]	
Test of difference between S_H and S_C (p-value)	[0.171]	[0.176]	[0.000]	[0.784]
Observations	258	138	258	138

Notes: see Table 6

Table 8. The Effect of Years of Schooling on log Human Capital. Senior workers

	Females Eastern Europe	Females Western Europe	Males Eastern Europe	Males Western Europe
Years of Schooling	0.066	0.027	0.027	0.026
	(0.012)	(0.005)	(0.010)	(0.007)
	[0.000]	[0.000]	[0.008]	[0.000]
Test of difference between East and West (p-value)	[0.000]		[0.975]	
Observations	90	172	90	172

Notes: each regression includes country and age dummies. Clustered country by year of birth standard errors within parentheses and p-values within brackets.

Table 9. The productivity of human capital: by area and gender. Senior workers only.

	Females Eastern Europe	Females Western Europe	Males Eastern Europe	Males Western Europe
ψ^H	0.993	1.973	1.991	2.038
	(0.337)	(0.391)	(0.758)	(0.525)
	[0.003]	[0.000]	[0.009]	[0.000]
Test of difference between East and West	[0.061]		[0.959]	

Table 10. Estimated returns to years of schooling S_H and S_C for Germany. Dependent variable: Δlog hourly wage. Senior workers only

	Females who studied in Eastern Germany	Females who studied in Western Germany	Males who studied in Eastern Germany	Males who studied in Western Germany
Years of schooling S_H	0.107	0.110	0.141	0.170
	(0.019)	(0.064)	(0.045)	(0.057)
	[0.011]	[0.093]	[0.003]	[0.005]
Test of difference between East and West (p-value)	[0.011]		[0.651]	
Years of schooling S_C	0.048	0.070	0.169	0.016
	(0.021)	(0.025)	(0.032)	(0.031)
	[0.029]	[0.008]	[0.000]	[0.604]
Test of difference between East and West (p-value)	[0.011]		[0.001]	
Observations	398	398	398	398

Notes: each regression includes the level and gender difference of the lagged employment rate and relative population rate, a region of residence (West) dummy and age dummies**.** Clustered country by year of birth standard errors within parentheses and p-values within brackets.

Table 11. Estimated returns to education. Only countries with the same returns to schooling within each area. Dependent variable: Δlog hourly wage.

Panel A: senior workers in the West and East

	Females Eastern Europe	Females Western Europe	Males Eastern Europe	Males Western Europe
Years of schooling	0.051	0.057	0.075	0.053
	(0.026)	(0.009)	(0.024)	(0.011)
	[0.054]	[0.000]	[0.001]	[0.000]
Test of difference between East and West (p-value)	[0.842]		[0.369]	
Observations	168	389	168	389

Panel B: seniors and juniors in Eastern Europe

	Senior Females	Junior Females	Senior Males	Junior Males
Years of schooling	0.051	0.069	0.075	0.132
	(0.026)	(0.023)	(0.024	(0.022)
	[0.054]	[0.003]	[0.002	[0.000]
Test of difference between East and West (p-value)	[0.923]		[0.036]	
	168	90	168	90

Notes: see Table 6

Table 12. Estimated returns to education. Senior workers born between 1956 and 1964. Dependent variable: Δlog hourly wage.

Panel A: senior workers born between 1956 and 1964 in the West and East

	Females Eastern Europe	Females Western Europe	Males Eastern Europe	Males Western Europe
Years of schooling	0.088	0.039	0.065	0.045
	(0.028)	(0.012)	(0.022)	(0.015)
	[0.002]	[0.002]	[0.004]	[0.004]
Test of difference between East and West (p-value)	[0.077]		[0.404]	
Observations	158	339	158	339

Panel B: seniors born between 1956 and 1964 and juniors in Eastern Europe

	Senior Females	Junior Females	Senior Males	Junior Males
Years of schooling	0.088	0.056	0.065	0.116
	(0.028)	(0.015)	(0.022)	(0.018)
	[0.002]	[0.000]	[0.004]	[0.000]
Test of difference between East and West (p-value)	[0.220]		[0.035]	
	158	138	158	138

Notes: see Table 6

Table 13. Public educational expenditure as share of GDP. Eastern Europe. 1990 and 2005

		1990	2005
Countries			
	Poland	4.8	5.5
	Hungary	5.8	5.5
	Czech Republic	4.1	4.3
	Slovak Republic	5.1	3.9
	Bulgaria	5	4.5
	Romania	2.8	3.5
	Slovenia	4.8	4.9

Source: World Bank, 2004 and Unesco Statistics

Table 14. Pupil teacher ratio in basic education. Eastern Europe. 1989 and 1997

		1989	1997
Countries			
	Poland	18.6	15.4
	Hungary	13.1	12.2
	Czech Republic	20.8	14.5
	Slovak Republic	20	17.1
	Bulgaria	15.6	13.9
	Romania	20	14.8
	Slovenia	15.5	13.5
	Estonia	10.7	11.7

Note: World Bank, 2004

Appendix

Table A1. "Between genders" estimation of Table 6.

VARIABLES	(1) Seniors East	(2) Seniors West	(3) Juniors East
S	-0.012	0.000	0.061***
	(0.025)	(0.012)	(0.019)
ΔS	0.066***	0.053***	0.056***
	(0.020)	(0.009)	(0.015)
Unemployment rate	1.162	1.313	4.342***
	(1.872)	(1.446)	(1.467)
Δ Unemployment rate	-0.627	1.039	-2.633***
	(1.069)	(0.973)	(0.705)
Log activity rate	0.610	-0.327	-0.440
	(0.538)	(0.327)	(1.438)
Δ Log activity rate	-0.031	-0.139	0.452
	(0.354)	(0.338)	(0.729)
Log relative population	-0.084	-0.050	-0.782***
	(0.126)	(0.177)	(0.266)
Δ log relative population	0.515	1.297*	0.936**
	(0.414)	(0.666)	(0.439)
Low parental education	-0.421**	-0.047	0.008
	(0.168)	(0.182)	(0.143)
Δ Low parental education	0.134	-0.049	-0.097
	(0.118)	(0.168)	(0.106)
Log GDP per head at age 10	0.100	0.073	-0.155
	(0.147)	(0.152)	(0.110)
Observations	258	519	138
R-squared	0.619	0.481	0.705

Notes: each regression includes the country dummies, age dummies and country by year dummies. Clustered country by year of birth standard errors within parentheses and p-values within brackets.

References

Acemoglu, D and Autor D. 2010, Skills, tasks and technologies: Implications for employment and earnings. Working Paper 16082, National Bureau of Economic Research.

Andren, D, Earle, J. and Sapatoru, D, 2005, The wage effects of schooling under socialism and in transition: Evidence from Romania, 1950-2000, *Journal of Comparative Economics*, Elsevier, vol. 33(2), pages 300-323.

Boeri, Tito and Katherine Terrell. 2002 . Institutional determinants of labor reallocation in transition. *Journal of Economic Perspectives*, 16(1):51-76.

Campos, N and Jolliffe A. 2007, Earnings, Schooling and Economic Reform: Econometric Evidence from Hungary (1986-2004), IZA Discussion Papers 2678, Institute for the Study of Labor (IZA).

Card, D. 1999. The Causal Effect of Education on Earnings, in: O. Ashenfelter and D. Card (eds), Handbook of Labor Economics, Vol. 3A, Amsterdam, North Hollan

Card, D and Lemieux T. 2001, "Can Falling Supply Explain The Rising Return To College For Younger Men? A Cohort-Based Analysis," *The Quarterly Journal of Economics*, MIT Press, vol. 116(2), pages 705-746.

Card, D and Rothstein J. 2007, Racial segregation and the black-white test score gap, *Journal of Public Economics*, Elsevier, vol. 91(11-12), pages 2158-2184.

Chase, R.S. 1998. Markets for communist human capital: returns to education and expe rience in the Czech Republic and Slovakia. *Industrial and Labor Relations Review*, 51(3):401-423, 1998.

Flabbi, L. Paternostro, S. and E.R Tiongson. 2008. Returns to education in the economic transition: A systematic assessment using comparable data. *Economics of Education Review*, 27(6):724-740.

Flanagan, R. 1998, Were communists good human capitalists? The case of the Czech Republic. *Labour Economics*, 5(3):295 -312.

Fleisher, B, Sabirianova, K and Xiaojun W. 2005, Returns to skills and the speed of reforms: Evidence from central and eastern Europe, China, and Russia, *Journal of Comparative Economics*, 33(2):351-370.

Gebel, M and Pfeiffer F. 2007, Educational expansion and its heterogeneous returns for wage workers. SOEPpapers 13, DIW Berlin.

Green, F. and Y. Zhu, 2010, Qverqualification, job dissatisfaction, and increasing dispersion in the returns to graduate education, *Oxford Economic Papers*, forthcoming

Haisken-DeNew, JP. and Frick J.2005, The Desktop Companion to the German Socio-Economic Panel Study", DIW Berlin, Germany

Hanushek, E and Woessmann, L, 2009, Do Better Schools Lead to More Growth? Cognitive Skills, Economic Outcomes, and Causation,NBER Working Papers 14633, National Bureau of Economic Research, Inc.

Jurajda, S. 2003, Gender wage gap and segregation in enterprises and the public sector in late transition countries. *Journal of Comparative Economics*, 31(2): 199-222.

Katz, L.F. ,and K.M. Murphy, 1992, Changes in Relative Wages, 1963-1987: Supply and Demand Factors , *The Quarterly Journal of Economics*, Vol. 107, No. 1 (Feb., 1992), pp. 35-78

Lamo, A., Messina, J. and E. Wasmer 2010, Are Specific Skills an Obstacle to Labor Market Adjustment? IZA DP No. 5250

Machin, S. and McNally, S. 2006, Tertiary Education Systems and Labour Markets, OECD, Paris

Mullis, I.V., Martin, M.O., Gonzalez, E.J., Gregory, K.D., Garden, R.A., O'Connor K.M., Chrostowski, S.J. and T.A. Smith, 2000, TIMSS 1999. Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade, The International Association for the Evaluation of Educational Achievement, Boston MA

Munich, D, Svejnar, J, and Terrell K. 2005, Returns to human capital under the communist wage grid and during the transition to a market economy. The *Review of Economics and Statistics*, 87(1):100-123.

Orazem, P, Vodopivec M. 1997, Value of human capital in transition market: Evidence from Slovenia. Staff General Research Papers 5126, Iowa State University, Department of Economics.

Oreopoulos, P, Wachter, T and Heisz A. 2008, The Short- and Long-Term Career Effects of Graduating in a Recession: Hysteresis and Heterogeneity in the Market for College Graduates, IZA Discussion Papers 3578, Institute for the Study of Labor (IZA).

Orlowski, R and Riphahn R. 2009, The East German Wage Structure after Transition, *Economics of Transition* 17(4), 629-659

Riphahn, R.T. and P. Trübswetter, 2010, The Intergenerational Transmission of Educational Attainment In East and West Germany, mimeo

Walker, I and Zhu Y. 2008, The college wage premium and the expansion of higher education in the Uk. *Scandinavian Journal of Economics*, 110(4):695-709.

Willis, R. 1986, Wage Determinants: A Survey and Reinterpretation of Human Capital Earnings Functions', in O. Ashenfelter and R. Layard (eds.), *Handbook of LaborEconomics*, North Holland: Amsterdam and New York.

The World Bank 2000, Hidden Challenges to Education Systems in Transition Economies, The World Bank - Europe and Central Asia Region Human Development Sector, Washington DC

The World Bank 2002, Transition. The First Ten Years. Analysis and Lessons for Eastern Europe and the Former Soviet Union, The World Bank, Washington DC