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**Returns To Education During And After The Economic Crisis:  
Evidence From Latvia 2006–2012**

**Abstract**

*We employ EU-SILC micro data for Latvia to study how returns to education changed during the economic crisis of 2008–2009 and afterwards. We found that returns to education increased significantly during the crisis and decreased slightly during the subsequent economic recovery. The counter-cyclical effect was evident in nearly all population groups. After the crisis, education became more associated than before with a longer working week and a higher employment probability. Furthermore, we show that returns to education in Latvia are generally higher in the capital city and its suburbs than outside the capital city region, as well as for citizens of Latvia than for resident non-citizens and citizens of other countries, but lower for males and young people. Wage differential models reveal a relatively large wage premium for higher education and a rather small one for secondary education. Estimates obtained with instrumental variable (IV) models significantly exceed the OLS estimates.*

**Keywords:** *returns to education, Mincer coefficient, wage differentials model, higher education wage premium, instrumental variables*

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## 1. Introduction

During the last two decades Latvia has experienced the growing popularity of higher education. In 2014, people with higher education accounted for 34% of Latvian employment, compared to only 22% in 2002. However, despite its growing popularity, the media highlights anecdotal evidence that higher education does not guarantee a higher wage in Latvia. The issue addressed in this paper is whether education in Latvia indeed ceased to promote wages after the economic crisis.

Several papers have offered mixed results on whether there exists a trend in returns to education over time. For instance, Trostel, Walker and Woolley (Trostel, Walker and Woolley 2002, p. 15) do not find significant changes in returns to education for most countries. In turn, Montenegro and Patrinos (Montenegro and Patrinos 2014, p. 19) report a downward trend in returns to education, reflecting an increase in education attainment and therefore in the supply of the educated labour force. There is a gap in the literature, however, on how returns to education may change over the business cycle. Latvia may be considered as a unique case to study in this regard. The Latvian economy, being one of the most overheated in the world in 2007, lost one fifth of its output during the crisis, but recovered quickly afterwards. Before the crisis the real estate bubble promoted strong growth in employment and wages in the construction sector, where formal education is not a prerequisite. However during the economic crisis the demand decreased most for low-skilled employees, as evidenced by the skyrocketing unemployment rate and sharp drop in the vacancy rate. The structural changes in the labour market could, therefore, suggest that returns to education might have risen during the crisis.

Measuring returns to education has its roots in the mid-20th century, with Mincer's paper (Mincer 1974) being one of the most famous contributions. While during the following decades there was consensus that more educated people receive higher wages, both the methodology and results tended to differ. Despite its popularity, Mincer's model can be criticised (1) for its linearity assumption, stating that returns for each additional year of schooling are the same; and (2) for claiming that an individual's choice of years of schooling is exogenous. Other models should be used to account for these issues. The linearity assumption is relaxed in the wage differentials model, while the endogeneity issue is often addressed using the instrumental variables (IV) method.

Returns to education in Latvia have previously been estimated in several papers. Trostel et al. (Trostel 2002, p. 5) used data from the International Social Survey Programme (ISSP) and estimated the Mincer coefficient for hourly wages in Latvia as being 6.7% for males and 7.8% for females in 1995. Estimates for Latvia were higher than the 28 country sample average. However, caution should be taken

when comparing these results with those in other papers: in the case of Latvia, the dataset contained only 331 observations.

Hazans (Hazans 2003, pp. 515–523) used micro data from the Labour Force Survey (LFS) 2000 to estimate a wage differentials model for Latvia, Estonia, and Lithuania. He concluded that, by international standards, the Baltic States have a relatively large (monthly) wage premium for higher education, but rather small for secondary education. In all three countries returns to education are larger for females than for males. In Estonia, ethnic minorities gain less from higher education than ethnic Estonians, while in Latvia and Lithuania the ethnic gap is not statistically significant.

The Ministry of Welfare (Ministry of Welfare 2006, p. 41) used Latvia's LFS 2003–2004 micro data and included education as one of the factors affecting wage differences among individuals. It concluded that about a half of the wage premium reflects the direct impact of education on wages, while the other half mirrors a better access to higher paid jobs (the career component).

Flabbi, Paternostro and Tiongson (Flabbi, Paternostro and Tiongson 2007) used the ISSP data for eight Eastern European countries during the transition period. Latvia was placed in the "medium" returns group, with the Mincer coefficient increasing somewhat during the transition period (from 6.7% in 1995 to 7.8% in 2002). Returns to education (using monthly wages) in the private sector were higher than in the public sector during the early transition period, but later on this difference diminished to an insignificant level.

Romele (Romele 2014) used Latvia's LFS micro data to study returns to education (using annual wages). She found that in 2011 compared with 2010 the Mincer coefficient decreased both for males (from 7.9% to 7.1%) and females (from 8.1% to 6.8%).

Montenegro and Patrinos (Montenegro and Patrinos 2014, pp. 27–28) estimated the Mincer model in 139 economies all over the world. The results for Latvia show that the Mincer coefficient, after increasing by half in 2006, was broadly stable at 10%–12% in the next six years.

To sum up, previous papers measuring returns to education in Latvia either used data for the period prior to Latvia's EU accession, or were limited to the standard Mincer or wage differentials models only. Different dependent variables have been used in previous papers, e.g. hourly wages (Trostel et al. 2002), monthly wages (Hazans 2003; Flabbi et al. 2007) and annual wages (Romele 2014), however none tested the sensitivity of the results with respect to the choice of wage variable. Despite a possible endogeneity bias, all previous papers on Latvia, to the best of our knowledge, relied solely on OLS estimates.

The contribution of our paper is threefold. First, we focus on how returns to education have changed over the business cycle, particularly in the economic crisis. Second, we study how education affects wages in different population groups. Third, we estimate IV models using parental and spouse's education, as well as a binary variable indicating whether the most recent education level was obtained prior to the transition to the market economy. In addition, we include parents and spouse's education as additional factors to control for unobservable ability. We use the hourly wage in the base specification, and use monthly as well as annual wages as a robustness check.

We find that during 2006–2012, on average each additional year of schooling was associated with a higher wage of about 8%. This finding is similar to the result for OECD countries (7.5% on average; Hanushek, Schwerdt, Wiederhold and Woessmann 2015, p. 28) as well as to the results for Eastern European countries (7.4%; Montenegro and Patrinos 2014, p. 11). The wage differentials model shows that employees with higher education earned approximately 48% more than employees with secondary education; in turn, employees with lower than secondary education earned 9% less. Estimates of the higher education wage premium in Estonia range from 40% to 51%, while in Lithuania – between 59% and 74% (Badescu, D'Hombres and Villalba 2011, pp 21–32; Hazans 2003), therefore the estimates for Latvia lay somewhere in the middle. The estimates of a secondary education wage premium are broadly similar to the estimates for Lithuania (14% and 13%), but somewhat smaller than the estimates for Estonia (19% and 23% (Badescu et al. 2011; Hazans 2003). The results for the Baltic countries, however, are lower than for some other European countries, e.g. Poland (34%) and the UK (42%); (see Strauss and de la Maisonnette 2010, pp 11–12). Thus, our results are in line with Hazans (Hazans 2003), who showed that the wage premium for secondary education in the Baltics is relatively low. We also found that returns to education increased significantly during the crisis and decreased slightly during the subsequent economic recovery.

This paper is structured as follows. Section 2 reviews the methodology of the Mincer model, wage differentials model, and the IV model. Section 3 examines the EU-SILC micro data used in the study. In Section 4, we present the main empirical results. Section 5 provides an overview of the performed robustness checks, while Section 6 discusses the differences in returns to education for several population groups and regions. Finally, the last section offers conclusions.

## 2. Methodology

The Mincer model is often used as a starting point in measuring returns to education and as a benchmark for comparing the obtained results with those of other models. This model approximates the human capital accumulation of individual  $i$  with the linear function of years of schooling and quadratic function of job experience:

$$y_i = \alpha_0 + \beta_0 S_i + \tau_0 X_i + \tau_1 X_i^2 + \varepsilon_i \quad (1)$$

where  $y_i$  is the log wage of individual  $i$ ,  $S$  is years of schooling and  $X$  is job experience (years). The famous Mincer coefficient  $\beta_0$  implies a percentage wage increase for each additional year of formal education.

The wage differentials model relaxes the linearity assumption by allowing each educational level to have a different impact on wages:

$$y_i = \alpha_0 + \beta_1 S_{1i} + \beta_2 S_{2i} + \dots + \beta_j S_{ji} + \tau_0 X_i + \tau_1 X_i^2 + \varepsilon_i \quad (2)$$

where binary variable  $S_{ji}$  equals 1, if the highest level of education for person  $i$  is  $j$ . For instance, the wage premium for education level  $j$  (e.g. higher education), ceteris paribus, reflects the relative differences in wages for people with higher education and people in the control group (e.g. secondary education). It is calculated as follows:

$$\text{Wage premium of education level } j = (e^{\beta_j} - 1) * 100 \quad (3)$$

The Mincer and wage differentials models can be supplemented with vectors of other wage determinants, which may be both exogenous and endogenous to education level (denoted as  $C_i$  and  $F_i$  respectively):

$$y_i = \alpha_0 + \beta_0 S_i + \tau_0 X_i + \tau_1 X_i^2 + C_i \omega' + \varepsilon_i \quad (4)$$

$$y_i = \alpha_0 + \beta_0 S_i + \tau_0 X_i + \tau_1 X_i^2 + C_i \omega' + F_i \mu' + \varepsilon_i \quad (5)$$

When the Mincer model is supplemented only with variables that are exogenous to the education level (see equation (4)), e.g. gender and ethnicity, the interpretation of the Mincer coefficient remains the same. However, if the model includes variables that are endogenous to education (see equation (5)), e.g. occupation, sector, and position, the Mincer coefficient may be smaller, reflecting only the direct impact of education on wages, i.e. higher wages for

people working in the same occupation, sector, and position. The difference in the Mincer coefficient estimate in equations (4) and (5) reflects the indirect impact of education on wages (the career component), i.e. better education promotes employment in higher paid occupations, sectors, and positions.

There are, however, various reasons why estimates of returns to education may be biased: two of them relate to a possible endogeneity issue, and the last one – to a possible measurement error of the education variable.

An endogeneity issue may arise if individuals are different in their ability in a way not related to their formal education. Ability may be indeed correlated with educational attainment, because, for instance, individuals with higher ability may choose to obtain higher education levels in order to signal their potential employers about their skills. In this case, the Mincer coefficient may be biased upwards.

Another endogeneity issue may arise if returns to education differ among individuals ( $\beta_i$  instead of  $\beta_0$ ). Individuals with higher returns are likely to choose a higher education level (Blundell, Dearden & Sianesi 2005, p. 478), thus causing error term  $\varepsilon$  to be correlated with years of schooling. Considering the estimated model given in equation (1), the true model may be written as:

$$y_i = \alpha_0 + (a_i - a_0) + \beta_i S_i + \tau_0 X_i + \tau_1 X_i^2 + \varepsilon_i \quad (6)$$

where  $a_i$  reflects the ability of individual  $i$  (population average  $a_0$ ) and  $\beta_i$  represents returns to schooling for individual  $i$  (population average  $\beta_0$ ). Rearranging, we obtain:

$$y_i = \alpha_0 + \beta_0 S_i + \tau_0 X_i + \tau_1 X_i^2 + (a_i - a_0) + (\beta_i - \beta_0) S_i + \varepsilon_i \quad (7)$$

Neither  $a_i$  nor  $\beta_i$  are directly observable. Therefore error  $\varepsilon_i$  is correlated with education variable  $S_i$ , and the  $\beta_0$  estimate is likely to be biased:

$$\begin{cases} y_i = \alpha_0 + \beta_0 S_i + \tau_0 X_i + \tau_1 X_i^2 + \varepsilon_i \\ \varepsilon_i = (a_i - a_0) + (\beta_i - \beta_0) S_i + \vartheta_i \end{cases} \quad (8)$$

Besides, the education variable might be measured with error. The education variable is truncated, so people with a low-level education are more likely to overstate it, while people with a high-level education are more likely to understate it. Measurement error may compensate for the possible upward ability bias discussed above. For instance, Ashenfelter and Zimmerman (Ashenfelter and Zimmerman 1997, p. 8) claim that both biases are of a similar magnitude; hence reducing the total bias of the Mincer coefficient.

There are several options for how to solve the endogeneity issue. One option is to include a proxy variable for an individual's ability in the Mincer model. For instance, Harmon, Oosterbeek and Walker (Harmon, Oosterbeek and Walker 2000, pp. 20–21) included individuals' test scores obtained before they started to acquire a formal education (at the age of 7). Badescu, D'Hombres and Villalba (Badescu et al. 2011, pp 21–27) included parental education as a control variable. Both papers, however, showed that the inclusion of an ability variable does not significantly change the estimate of returns to education.

Another option is to use IV models, finding an instrument which is correlated with the education variable but is not correlated with the Mincer model's error term. Some examples used in papers are parental education and/or spouse's education (Trostel et al. 2002, pp. 11–14) and education system reforms (Card 2001, pp. 1137–1144; Leigh & Ryan 2008).

IV models can be empirically estimated with the 2SLS method:

$$\begin{aligned}\hat{S}_i &= \alpha_2 + \pi_0 Z_i + n_i \\ y_i &= \alpha_0 + \beta_0 \hat{S}_i + v_i\end{aligned}\tag{9}$$

The first step calculates expected education  $S_i$  by employing a strong correlation between the instrument and education variable (the relevance condition). The second step expresses the log wage as a function of the expected education estimate. If the instrument impacts wages only through education and does not have any direct impact on it (exclusion restriction),  $\beta_0$  reflects the true coefficient of returns to education.

Inappropriate instruments may substantially bias the results, especially if the instruments are weak. As the relevance condition can be tested with ease, weak instrumental factors should be avoided. Unfortunately, the exclusion restriction cannot be tested directly as it involves an unobservable residual. This is why researchers pay extra attention to convincing the reader that the chosen variable fits the exclusion restriction. Some papers argue that one of the most widely used variables (related to family education) is not an appropriate instrument. It is possible that both parental and spouse's education is correlated with household income, which may in turn affect an individual's employment choice and hence also the wage. Moreover, parental education may be correlated with unobservable ability, and, therefore, also with the Mincer model error. The same issue may be present when using the spouse's education, as individuals with a high ability level may try to find a spouse with a similarly high ability. Furthermore, parents with higher education may use their professional relations to help their children obtain better paid jobs. Besides, the education level of

family members may be subject to a larger measurement error than the education level of the respondent him/herself. However, as the EU-SILC data set includes education attainment of household members, in this paper we try the parental (and spouse) education variable as both an instrument and as a control variable.

In most cases, estimates of returns to education are larger when using IV models (Card 2001, p. 1155). It is possible that instruments explain only part of the education variable variance. For instance, using changes of the compulsory education level as an instrument, one estimates the variation of years of schooling only for those individuals who abandon studies as soon as possible. Therefore, the estimated returns to schooling are not attributable to each year of formal schooling, but rather to those years that are affected by the instrument (Card 2001, pp. 1155–1157). As reform variables proved to be reliable instruments, we will use the transition to a market economy as an instrument possibly influencing the education choice.

### **3. Data**

We used anonymised micro data from the EU-SILC survey, obtained from the Central Statistical Bureau of Latvia (CSB). The EU-SILC survey is carried out annually and focuses on income and living conditions of households. It is a rich set of data that includes information about individuals' gender, age, education, and earnings. Importantly, contrary to the LFS, earnings and age are given as precise numbers rather than intervals. Therefore, it is often used in estimating returns to education for other countries (for instance, Badescu et al. 2011). The choice of the research period (from 2006 to 2012) was determined by the availability of data. The seven-year period allows us to measure how returns to education have changed during and after the period of the economic crisis.

The survey sample was narrowed to the working age population (15–64). Observations with a missing education level, wage, average hours worked per week or months worked per year were excluded. The resulting sample consists of a total of 29,499 observations for the period of 2006–2012, and from 3,690 to 4,433 observations per year. Since the hourly wage is not directly observable in the data set, it was calculated from the annual wage, taking into account average hours worked per week and the number of months worked in the year.

The years of schooling variable is not directly observable. It was calculated from the highest level of education (ISCED) attained.



## 4. Empirical results

First, we present the estimates of the Mincer model, followed by the wage differentials model and IV model.

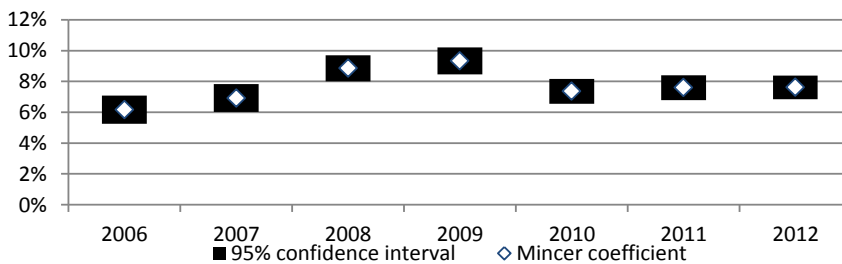
Our results show that in Latvia education is positively and statistically significantly correlated with higher wages. The standard Mincer model reveals that, on average, each additional year of education is associated with a higher wage (by 7.7%; see Table 1A). This finding is similar to the result for OECD countries (7.5% on average; Hanushek et al. 2015, p. 28), as well as to results for Eastern European countries (7.4%; Montenegro and Patrinos 2014, p. 11). It is also similar to the previous estimates of the Mincer coefficient for Latvia: 7.8% (Flabbi et al. 2007); 6.8%–8.1%, (Romele 2014); and 6.5%–11.9%, (Montenegro and Patrinos 2014, pp. 27–28).

The negative coefficient of the quadratic experience term suggests that marginal returns to job experience decrease with each additional year of experience. These findings are in line with the previous research (Ministry of Welfare 2006, p. 180).

Contrary to the previous research, we do not find any evidence of increasing education returns over time; possibly because we do not include the early transition period (the last decade of 20<sup>th</sup> century).

Instead, we found that returns to education in Latvia were counter-cyclical. They rose significantly during the period of the economic crisis (from 6.9% in 2007 to 8.9% and 9.3% in 2008 and 2009 respectively), and decreased afterwards (to 7.4% in 2010; see Figure 1). This means that during the economic crisis returns to education were higher than in the other phases of the business cycle.

**Figure 1. Mincer coefficient and its 95% confidence interval (2006–2012)**



Source: Authors' own calculations using EU-SILC micro data for Latvia.

The extension of the Mincer model with exogenous variables did not significantly change the returns to education estimate (8.0%), however additional wage determinants were obtained. For instance, with all other factors remaining constant, males earned 31% more on average than females. The wages of married persons were almost 5% higher than wages for singles or divorced persons. Latvian citizens earned 11% more than Latvian resident non-citizens and citizens of other countries, which may reflect the impact of state language proficiency on wages. Employees currently engaged in formal education earned 10% more, while long-term illness decreased wages by about 8%, which may reflect the negative impact of poor health on labour productivity and wages.

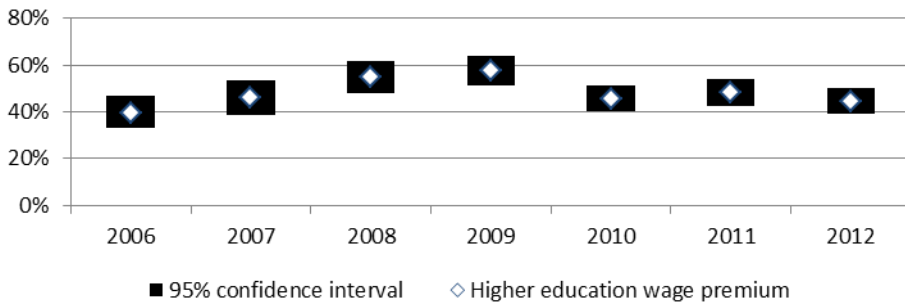
Furthermore, there is a positive link between wages and company size. The hourly wage for the self-employed and for those employed in small companies was respectively by 31% and 4% smaller than in medium-sized companies. In large companies, in turn, employees earned 13% more. This may reflect higher labour productivity in large companies, due to greater specialisation opportunities or a higher capital to labour ratio, which may stem from a better access to external financing (Fadejeva & Krasnopjorovs 2015, p. 16). Alternatively, this may reflect a higher labour income share in large companies, possibly owing to wider collective bargaining coverage. Firms with collective agreements generally pay higher wages (Ministry of Welfare 2006). Also, we found that employees earn 3% less if they changed employers during the past year. This result is in line with the evidence that the wage of a newly hired worker tends to be smaller than the wages of incumbent workers, even after controlling for experience and task assignment (Fadejeva & Krasnopjorovs 2015, p. 22). Also, the region of residence proved to be a significant wage determinant, with the highest wages posted in Riga and the lowest in Latgale.

Extending the Mincer model with factors endogenous to years of schooling reveals that about half of the impact of education on wages in Latvia comes from a career component, i.e. better access to higher paid occupations, and sectors. The other half reflects a direct wage premium: each additional year of schooling increases the wage on average by 3.8% for employees working in the same occupation, sector, and position. The share of the career component in the Mincer coefficient remained roughly constant over time. Employees in managerial positions earn 6% more on average than others. Occupation proved to be a significant wage determinant, with the highest wages (all other factors being constant) received by managers (ISCO 1) and the lowest by agricultural, forestry, and fishery workers (ISCO 6). With respect to sectors, the highest wages (all other factors being constant) are found in financial intermediation, and the lowest in agriculture and industry (A–E) as well as in trade (G).

The wage differentials model results show that employees with higher education earn significantly more than those with secondary education (see Table 2A). Moreover, employees with lower than secondary education earn significantly less. The higher education wage premium was 48%, and the secondary education wage premium was 9% on average during 2006 to 2012, which is broadly in line with previous studies.

The wage premium for higher education changed counter-cyclically. It rose from 40% in 2006 to 58% in 2009, and decreased towards the 2007 level afterwards (see Figure 2).

**Figure 2. Higher education wage premium and its 95% confidence interval (2006–2012)**



Source: Authors' own calculations using EU-SILC micro data for Latvia.

Extending the wage differentials model with exogenous control factors does not statistically significantly change wage premiums for higher and secondary education. Also, the impact of other control variables on wages is similar to that estimated in the Mincer model. Consequently, the choice of education variable does not change the estimated impact of other factors on wages in a statistically significant way.

The addition of occupation, sector, and manager dummies reveals that about half of wage premiums for higher and secondary education are attributed to the career component, while the other half (23% and 4%) reflects higher wages for employees within the same occupation, sector, and position. The share of the career component in wage premiums remained roughly constant over time. Therefore, during the period of economic crisis, education became an even more significant determinant of access to better paid sectors, occupations, and positions. In this respect, the result of the wage differentials model is similar to that of the Mincer model.

Next, we employed the IV model using the transition to an open market economy as an instrument. When Latvia regained its independence, the transition to a market economy may have increased returns to education, therefore possibly

affecting the individuals' choices of education. The highly significant F-test value in the first stage regression indicates that the dummy variable satisfies the relevance condition. There is no motivation, however, to assume that the ability (or any other characteristic that may impact wages) of those who finished their education in the Soviet times was different from the ability of those who did so after 1990. Therefore, the variable indicating when the highest level of education was obtained should satisfy the exclusion restriction and may be used as an instrumental factor.<sup>1</sup>

We define IV to be a binary variable that is equal to 1, if an individual finished education before 1990. The IV model estimate (15.1% in standard and 14.3% in extended model) is twice as large as the Mincer coefficient (Table 1).

**Table 1. Returns to education: binary variable = 1 if individual finished education before 1990 as IV (2006–2012)**

Model	Standard model	Extended model (with ex. factors)
Mincer model	0.077*** (0.002)	0.080*** (0.002)
IV model	0.151*** (0.005)	0.143*** (0.005)

Notes: \*\*\*, \*\*, \*: statistically significant with 99%, 95% and 90% confidence level respectively. Standard errors in parentheses.

Source: Authors' own calculations using EU-SILC micro data.

These results are broadly in line with papers on other countries' findings that the IV model estimates significantly exceed the OLS Mincer coefficient; however in the case of Latvia this difference seems to be particularly large.

It is possible that this IV estimate is not attributable to the whole population. Secondary education was compulsory in Soviet times as it is nowadays; therefore, a change of political and economic system may have influenced educational choices only with respect to higher education. Thus, the obtained IV estimate may reflect only the percentage change in wages due to each additional year spent in higher education.

We check this using the wage differentials model by allowing each education level to have a different impact on wages. Each additional year of schooling in ISCED 5 (higher education) increases the wage by about 12%, which exceeds the estimates for other education levels (see Table 2).

<sup>1</sup> We could have used more than one instrumental factor and test for over-identification; however, as education of parents and spouse is unlikely to be a valid instrument, testing would not give us any insight on the validity of the reform variable.

**Table 2. Returns for each additional year of schooling by ISCED levels (2006–2012)**

Model	ISCED 3	ISCED 4	ISCED 5
Standard model	0.030	0.006	0.129
Extended with exogenous variables	0.037	0.041	0.121
Extended with exogenous and endogenous variables	0.015	–0.004	0.070

Source: Authors' own calculations using EU-SILC micro data.

This is broadly similar to the IV model estimate, which may imply that the transition to a market economy increased incentives to acquire higher education without markedly promoting secondary education acquisition.

Next we employed parental and spouse education, first as control variable to account for unobserved ability, and then as an instrument. Inclusion of the parents' years of schooling variable as a control factor decreases the value of the Mincer coefficient by about 10% (see Table 3). This decrease, however, is not statistically significant. The results herein are in line with Badescu et al. (Badescu et al. 2011, p. 27), who found that the inclusion of a parental education control variable does not alter the estimate of returns to education. In turn, the inclusion of a spouse's years of schooling in the Mincer model decreases the Mincer coefficient by 10%–20%. Moreover, this decrease of the Mincer coefficient is statistically significant. In Latvia, parental and spouses' education is highly correlated with an individual's education, thus fulfilling the relevance condition of IV. IV estimates of returns to education, ranging from 12% to 19%, are 2–3 times higher than the Mincer coefficient. Note that information on parental education was available only for those individuals who lived in one household with their parents (23% of the sample). In turn, the inclusion of a spouse's education narrowed the sample to married individuals only (62% of the sample). This is another reason why IV model results should not be attributed to the whole population. Moreover, as noted before education of parents (and a spouse) is likely to have a direct impact on an individual's wages, thus not meeting the exclusion restriction and not being a valid instrument.

**Table 3. Returns to education: family education as instrumental and control variables (2006–2012)**

Model	Parents' education		Spouse's education	
	Standard model	Extended model (w.ex. factors)	Standard model	Extended model (w. ex. factors)
Mincer model	0.059*** (0.003)	0.064*** (0.003)	0.079*** (0.002)	0.084*** (0.002)
Mincer with family controls	0.051*** (0.003)	0.059*** (0.003)	0.064*** (0.002)	0.074*** (0.002)
IV model	0.144*** (0.011)	0.121*** (0.011)	0.192*** (0.006)	0.148*** (0.006)

Source: Authors' calculations using EU-SILC micro data.

To sum up, IV estimates significantly exceed the Mincer coefficient, which is in line with the literature. This, however, lacks intuition, since it was expected that an unobservable ability might overestimate the Mincer coefficient. Though a transition to a market economy probably fits the definition of a valid instrument, IV models estimates may reflect only the impact of years spent in higher education. Besides, family background may not be valid instruments and IV models could be employed only in samples that do not represent the whole population. Therefore, we conclude that the IV models in the case of Latvia are supplementary to, but not a substitute for, the Mincer and wage differentials model's estimates.

## 5. Robustness check

In order to check whether the results are robust with respect to the wage variable, we followed Card (Card 1999, pp. 1808–1809) and decomposed the impact of education on annual wages into three parts: its impact on hourly wage, impact on hours worked per week, and impact on months worked per year.

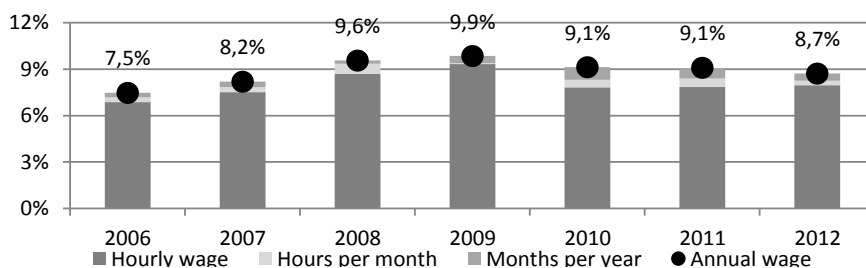
The Mincer coefficient appeared to be higher (8.4%) using the annual wage than using the monthly wage (7.9%) or hourly wage (7.7%; see Table 4).

**Table 4. Mincer coefficient on annual wage decomposition (2006–2012)**

Dependent variable	Hourly wage (1)	Hours worked per month (2)	Monthly wage (3)=(1)+(2)	Months worked per year (4)	Annual wage (5)=(3)+(4)
Mincer model	0.077*** (0.002)	0.002*** (0.001)	0.079*** (0.002)	0.005*** (0.001)	0.084*** (0.002)
Mincer(with ex. factors)	0.080*** (0.002)	0.004*** (0.001)	0.084*** (0.002)	0.005*** (0.001)	0.089*** (0.002)

Source: Authors' own calculations using EU-SILC micro data.

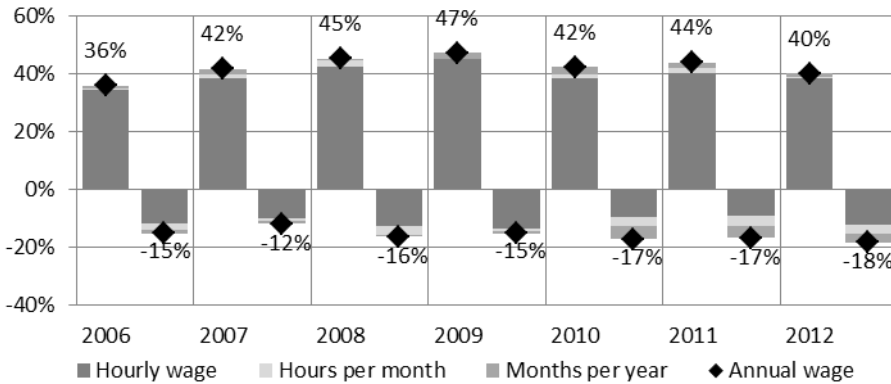
This implies that an additional year of schooling is associated with longer working hours (by 0.2%) and more months worked per year (by 0.5%). The impact of education on hours worked per week during and after the crisis was larger than before the crisis (see Figure 3). Employees with a low level of education experienced a steeper decline in working hours. Also, the impact of education on months worked per year increased during the crisis, reflecting growing employment probability differentials among employees with different levels of education.

**Figure 3. Decomposition of the Mincer coefficient on annual wage (extended Mincer model; 2006–2012)**

Source: Authors' own calculations using EU-SILC micro data for Latvia.

The results of wage premium decomposition reveal that the impact of higher education on hourly wages was counter-cyclical, while it had a broadly constant impact on hours worked per week and months worked per year (see Figure 4).

**Figure 4. Decomposition of wage premium for higher education (left) and penalty for not obtaining secondary education (right) (extended wage differentials model; 2006–2012)**



Source: Authors' own calculations using EU-SILC micro data for Latvia.

Meanwhile, the impact of secondary education on hourly wages was broadly similar over time, while its impact on hours worked per week and months worked per year increased substantially after the crisis. This may reflect a situation whereby employees with a lower than secondary education level were laid off or involuntary transferred to part-time jobs during the crisis.

Further, we decomposed wage premiums from the model extended by sector, occupation, and position variables to check whether increased hours worked per week and months worked per year can be associated with the career component. The results show that there is no direct impact of higher education or secondary education on the number of months worked per year. This implies that education promotes employment security through the career component. It seems that one advantage of education is the opportunity to work in more stable sectors, occupations, and positions.

To sum up, we found that returns to education are slightly, but statistically significantly, higher when the dependent variable switches from hourly wage to monthly or annual wage. This implies that better educated workers not only earn higher wages, but also have a higher probability of employment and longer working hours.



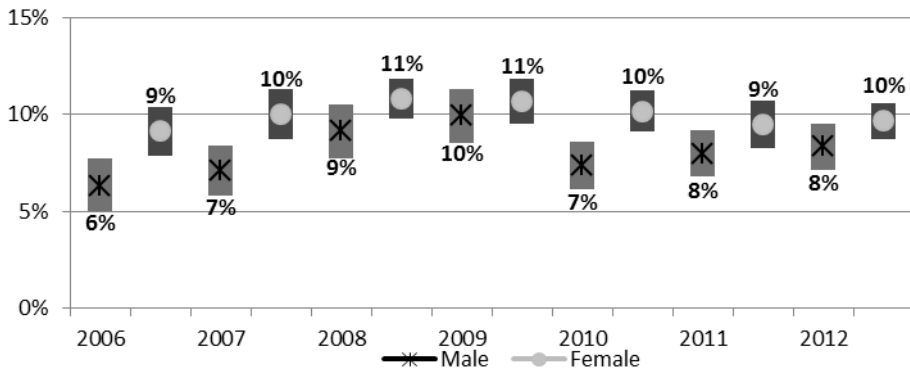
## 6. How education affects wages in different population groups, sectors, and regions?

Next, we check whether returns to education differ with respect to gender, age, sector of employment, region, citizenship, and country of birth. In particular, we investigate the sources of counter-cyclicality of the Mincer coefficient. For instance, it may be driven either by increases in the Mincer coefficient during the crisis in separate sectors, or by structural changes in the labour market (e.g. with layoffs concentrated more in sectors with a low Mincer coefficient).

Our results imply that gender differences in the Mincer coefficient are statistically significant, with returns to education being higher for females than for males (see Figure 5; the 2006–2012 average Mincer coefficient is 10.0% for females and 8.0% for males). These results are broadly in line with the previous findings in the literature for Latvia and other countries, which imply higher returns to education for females (Montenegro & Patrinos 2014, p. 7).

Before the economic crisis, returns to education for females were significantly higher than for males, but during the crisis the differences became insignificant.

**Figure 5. Mincer coefficients and 95% confidence intervals by gender (2006–2012)**



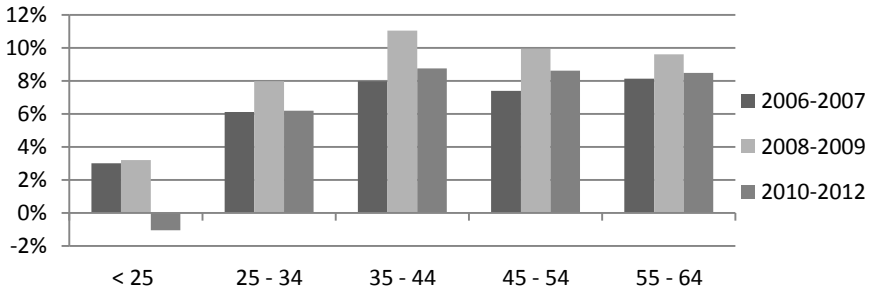
Source: Authors' own calculations using EU-SILC micro data for Latvia.

Changes in the Mincer coefficient over time for males are statistically significant and exhibit larger counter-cyclicality.

Regression analysis shows that returns to education for young people are lower (albeit highly statistically significant) than in other age groups. The Mincer coefficient for the age group 15–24 was 1.7%, against 6.7% in the age group 25–34 and about 9% in subsequent age groups. It is possible that either education is not instantaneously reflected in labour productivity, or that productivity is not instantaneously reflected in wages. During the economic

crisis, returns to education increased in all age groups except for youth. Furthermore, the Mincer coefficient estimate for the age group 15–24 was not significant after the crisis period (see Figure 6).

**Figure 6. Mincer coefficients by age group and business cycle period**

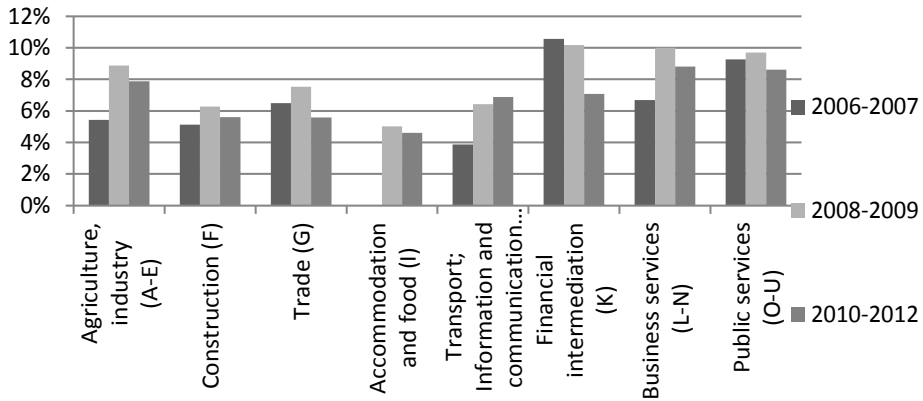


Source: Authors' own calculations using EU-SILC micro data for Latvia.

Education has a statistically significant impact on wages in each sector of the economy. The highest Mincer coefficient is found in public administration, education, and healthcare (8.9%), followed by real estate, science and administrative services (8.8%) and financial intermediation (8.8%). Meanwhile, the lowest Mincer coefficients were recorded in accommodation and food services (3.4%) as well as construction (5.4%).

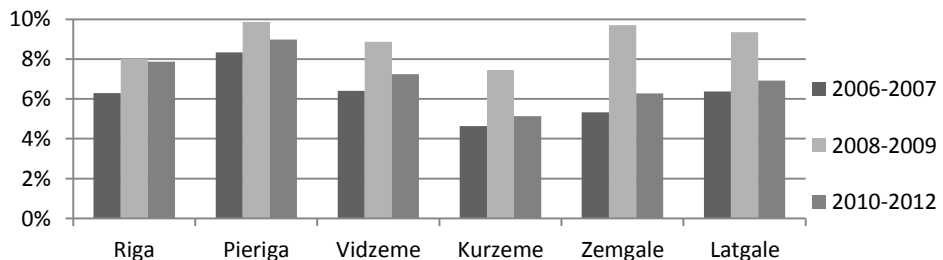
Differences in the Mincer coefficient across sectors may reveal why returns to education are lower for males than for females. According to the CSB data, about of 90% employees in construction were males (2008–2013). In financial intermediation (the sector with the highest Mincer coefficient), on the other hand, only 32% of employees were males.

During the economic crisis, returns to education increased in every sector of the economy except financial intermediation (see Figure 7). After the crisis, the Mincer coefficient decreased in all sectors except transport and information and communication. As a result, the counter-cyclicality of the Mincer coefficient is evident not only in aggregate data, but is also present in the majority of sectors.

**Figure 7. Mincer coefficients by sector and business cycle period**

Source: Authors' own calculations using EU-SILC micro data for Latvia.

Given that returns to education may differ across regions and that there is no empirical evidence for Latvia as yet, we estimated the Mincer coefficient separately for Latvia's NUTS-3 regions. During 2006–2012, on average the highest average Mincer coefficient was recorded in Pierīga (suburbs of Riga; 9.0%) and the lowest in Kurzeme (5.2%). During the crisis, the Mincer coefficient increased in all regions, however the increase was smaller in Riga and Pierīga (see Figure 8). Therefore, the counter-cyclicality of returns to education was particularly present outside the capital city region.

**Figure 8. Mincer coefficients by region and business cycle period**

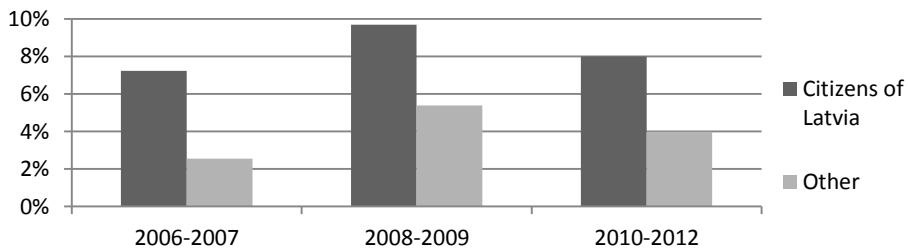
Source: Authors' own calculations using EU-SILC micro data for Latvia.

Among citizens of Latvia returns to education are more than two times higher than among Latvia's resident non-citizens and citizens of other countries (8.1% and 3.8% respectively). These results are broadly in line with the results for other countries, which generally suggest that the ethnicity with the largest

share in population has higher returns to education (see, e.g. Hanushek et al. 2015, p. 17). In the papers so far, Latvia's Mincer coefficient differences were estimated by ethnicity, not by citizenship.

During the period of economic crisis, the Mincer coefficient increased for both Latvia's citizens as well as for resident non-citizens and citizens of other countries (see Figure 9). Accordingly, returns to education behaved counter-cyclically, irrespective of citizenship.

**Figure 9. Mincer coefficients by citizenship and business cycle period**



Source: Authors' own calculations using EU-SILC micro data for Latvia.

## 7. Conclusions

We employed EU-SILC micro data for Latvia to study how returns to education changed during and after the economic crisis of 2008–2009. We found that returns to education increased significantly during the crisis, and decreased slightly during the subsequent economic recovery. The counter-cyclical effect was particularly strong for males; it was evident in the majority of sectors, for all age groups (except youth), and in all regions of the country, particularly outside the capital city region.

The returns to education, measured by standard and extended Mincer and wage differentials models, as well as by IV models, are statistically significant. The Mincer model reveals that during 2006–2012, on average each additional year of schooling was associated with a higher wage by about 8%, which is similar to the estimates for Eastern European countries. The wage differentials model shows that employees with higher education earned 48% more than employees with secondary education; in turn, employees with lower than secondary education earned 9% less. Estimates of higher education wage premiums are broadly similar to those found in other Baltic states, while the estimates of a secondary education wage premium are somewhat smaller than those found for Estonia, but do not

differ from the estimates for Lithuania. Half of the impact came via the career component, i.e. better access to higher paid occupations, sectors, and positions, and the share of the career component in the Mincer coefficient remained broadly constant over time.

After the economic crisis, education became even more associated with a longer working week and better employment prospects, and the impact of education is higher on annual and monthly wages than on hourly wages.

Furthermore, we find that returns to education in Latvia are generally higher in the capital city and its suburbs than outside the capital city region, for citizens of Latvia than for non-citizens and citizens of other countries, albeit being lower for males and young people.

In line with the previous findings for other countries, IV models give higher estimates of returns to education than the standard and extended Mincer models. However, none of the IV estimates leads to convincing results. We conclude that in the case of Latvia the Mincer and wage differentials models provide more relevant results than IV models.

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## Appendices

**Table 1A. Mincer model results (average 2006–2012)**

	Standard	Extended with exogenous variables	Extended with exogenous and endogenous variables
Experience	0.008*** (0.0012)	0.012*** (0.001)	0.010*** (0.001)
Experience <sup>2</sup> (/10)	-0.003*** (0.000)	-0.003*** (0.000)	-0.003*** (0.000)
<b>Years of schooling</b>	<b>0.077*** (0.002)</b>	<b>0.080*** (0.002)</b>	<b>0.038*** (0.002)</b>
Male	-	0.267*** (0.007)	0.217*** (0.008)
Married	-	0.047*** (0.007)	0.029*** (0.007)
Latvian citizen	-	0.108*** (0.010)	0.079*** (0.009)
Studying	-	0.096*** (0.016)	0.029* (0.015)
Long-term illness	-	-0.082*** (0.009)	-0.068*** (0.008)
Self-employed	-	-0.373*** (0.021)	-0.360*** (0.021)
Employees <10	-	-0.040*** (0.008)	-0.031*** (0.008)
Employees >50	-	0.123*** (0.008)	0.099*** (0.007)
Job change	-	-0.027** (0.014)	-0.011 (0.014)
Region	-	Included	Included
Sector	-	-	Included
Occupation	-	-	Included
Manager	-	-	0.057*** (0.011)
Year	Included	Included	Included
Constant	-0.537*** (0.027)	-0.787*** (0.031)	0.119** (0.051)
R <sup>2</sup>	0.160	0.280	0.357
Observations	29 499	29 470	29 470

Source: Authors' own calculations using EU-SILC micro data.

**Table 2A. Wage differential model results (average 2006–2012)**

	Standard	Extended with exogenous variables	Extended with exogenous and endogenous variables
Experience	0.010*** (0.001)	0.014*** (0.001)	0.011*** (0.001)
Experience <sup>2</sup> (/10)	-0.003*** (0.000)	-0.003*** (0.000)	-0.003*** (0.000)
<b>Years of schooling</b>	-	-	-
<b>Higher education</b>	<b>0.393*** (0.008)</b>	<b>0.398*** (0.008)</b>	<b>0.210*** (0.010)</b>
<b>Lower than secondary</b>	<b>-0.090*** (0.012)</b>	<b>-0.112*** (0.012)</b>	<b>-0.044*** (0.011)</b>
Male	-	0.264*** (0.007)	0.216*** (0.008)
Married	-	0.050*** (0.007)	0.031*** (0.0069)
Latvian citizen	-	0.0961*** (0.010)	0.075*** (0.009)
Studying	-	0.113*** (0.016)	0.042*** (0.015)
Long-term illness	-	-0.083*** (0.009)	-0.068*** (0.008)
Self-employed	-	-0.371*** (0.021)	-0.358*** (0.021)
Employees <10	-	-0.037*** (0.008)	-0.03*** (0.008)
Employees >50	-	0.1216*** (0.008)	0.098*** (0.007)
Job change	-	-0.030** (0.014)	-0.013 (0.014)
Region	-	Included	Included
Sector	-	-	Included
Occupation	-	-	Included
Manager	-	-	0.056*** (0.011)
Year	Included	Included	Included
Constant	0.485*** (0.015)	0.291*** (0.021)	0.616*** (0.042)
R <sup>2</sup>	0.170	0.288	0.360
Observations	29 499	29 470	29 470

Source: Authors' own calculations using EU-SILC micro data.

## Streszczenie

### ZWROTY Z EDUKACJI W TRAKCIE I PO KRYZYSIE GOSPODARCZYM: DANE DLA ŁOTWY 2006–2012

*W artykule wykorzystano dane dla Łotwy, pochodzące z europejskiego badania warunków życia ludności (EU-SILC), celem zbadania jak kształtowały się zwroty z edukacji w czasie kryzysu ekonomicznego 2008–2009 i w latach następnym. Stwierdzono, że zwroty z edukacji znacznie wzrosły w czasie kryzysu a następnie nieznacznie spadły*



w trakcie późniejszego ożywienia gospodarczego. Efekt antycykliczny był widoczny w niemal wszystkich grupach ludności. Po zakończeniu kryzysu edukacja bardziej niż dotychczas związana była z wydłużeniem tygodnia pracy i większym prawdopodobieństwem zatrudnienia. Ponadto wykazano, że zwroty z edukacji na Łotwie są generalnie wyższe w stolicy i w jej okolicach niż poza tym regionem, jak również są one wyższe dla obywateli Łotwy niż dla rezydentów niebędących obywatelami i dla obywateli innych krajów, ale niższa w przypadku mężczyzn i młodzieży. Modele zróżnicowania płac wskazują na stosunkowo wysoką premię płacową za wyższe wykształcenie i raczej niską premię za średnie wykształcenie. Oszacowania uzyskane przy zastosowaniu modeli zmiennych instrumentalnych znacznie przekraczają szacunki uzyskane za pomocą zwykłej metody najmniejszych kwadratów.

**Słowa kluczowe:** zwroty z edukacji, współczynnik Mincera, modele zróżnicowania płac, premia płacowa z wykształcenia wyższego, zmienne instrumentalne