Estimation of Private and Social Rates of Return to Investments in Education in Latvia

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The main aim of the paper is to evaluate the rates of return to investments in education at individual and society level as well. The task of the paper is to provide detailed analysis and estimation of the variables which impact the private and social rates of return. It is based on Professor Angel de la Fuente methodology complemented by Mincer earnings function and non-parametric DEA (Data Envelopment Analysis) method to estimate world technological frontier and the technological gap. For this purpose the authors build the matrix with respective years of schooling depending from level of schooling and birth of year taking into account the differences in schooling system since 1940ties. The authors have used the data of Labour Force Survey of Central Statistical Bureau of Latvia data 2010 for Mincer rate of return selecting the figures corresponding to the criteria of 6148 records, to estimate other variables the authors used mainly Eurostat data base and AMECO data base to obtain net capital stock to GDP at constant market prices. The methodology involves the estimation of several variables – net replacement ratio of unemployment benefits, employment levels of employees with secondary and tertiary education and increase of employment level from one additional year of schooling, average years of schooling based on R. Barro and J.W. Lee’s methodology, average retirement age based on D. Latulippe’s methodology, productivity growth from one additional year of schooling, taxes and unemployment level of youth.

The private rate of return in 2006 was equal to 16.76%, in 2008 it was 12.82% and in 2010 it was 13.91% which shows the benefits of tertiary education as higher income and employment probability after financial investments in education. The results show that private rate of return to tertiary education has decreased before crisis. It can be explained by inadequate high wage levels of the individuals with lower education. The rate of return is twice higher as rate of return from investments in education in secondary education. The results of the survey confirm the positive impact of education at individual and societal level even during the crisis and that approves thesis that education has important role in achieving better and faster European integration.

Keywords: Mincer rate of return, private and social rates of return, education, employment, economic growth.

Introduction

Nowadays education is becoming more and more important for faster growth of the economy and human well-being. Indeed, many studies reveal that investments in education, especially higher education, have a high rate of return. Although the private rate of return is higher than the social rate of return, it has wider impact and advantages, such as increased health and awareness about the importance of prophylactic measures, reduced crime rate, and greater participation of people in voting and social processes.

The aim of the paper is to analyze the private and social rates of return in Latvia in 2010. The private rate of return is the costs and benefits rate of investing time and financial resources in education and receiving higher income after the completion of studies. Moreover, with higher education the opportunity to become employed increases, and higher education is related to a higher employment rate.

The estimate of private and social rates of return is based on Professor Angel de la Fuente’s methodology, which is adapted to the situation in Latvia (Fuente 2003). The authors used DEA method to estimate the world technological frontier and the technological gap between Latvia and world technological frontier.

The importance of human capital has been investigated by Adam Smith, Ernst Engell, Karl Marx and others. Later the most influential work about the distribution of earnings was developed by Gary Becker (1962).

In 1974 Jacob Mincer published his work “Schooling, Experience and Earnings”, and nowadays his developed earnings function is used by many notable researchers, such as David Card (1995, 1999), Heckman, Lochner and Todd (2003, 2005).

The Mincer earnings function estimates the benefit from one additional year of schooling in terms of work salary at the individual level. The function includes variables such as number of schooling years, earnings, work experience and work experience squared. The function does not cover other benefits of education, such as better employment, lower unemployment rates and other quantitative variables. Because of an interest primarily to explain a country’s growth, initial research considered aggregate measures of human capital (Polacheck 2009). To understand such investments in education, a method was developed to estimate private and social rates of return. The goal was to compare investments in education at an individual level and/or societal level with benefits at
an individual and/or societal level. A private rate of return helps to explain why individuals invest their own resources in education. A well-known researcher who estimated private and social rates for many countries is the Greek economist and former World Bank education economist Professor Psacharopoulos (Psachropoulos, 1985). G. Psacharopoulos and H. Patrinos estimated that in countries with high incomes (USD 9,266 or more), the social rate of return for primary education was 13.4%, for secondary education – 10.3% and for higher education – 9.5% (Psacharopoulos, Patrinos, 2004). Similarly, the private rate of return was 25.6% for primary education, 12.2% for secondary education, and 12.4% for higher education. According to OECD, internal rate of return for an individual obtaining tertiary education as part of initial education are in the 6.1% to 24.8% range (OECD, 2012).

In 2010 Barro and Lee published a detailed study – “A New Data Set of Educational Attainment in the World, 1950 – 2010” – in which estimated rates of return are based on a regression model of 962 observations at 5-year intervals during the period from 1970 to 2005 in 127 countries. They found that rates of return vary from 5.5% to 12.1%, which is close to typical Mincer rates of return found in labour literature (Barro, Lee 2010).

Another aspect concerns a wider definition of human capital. Ben-Porath emphasized the importance of human capital invested in families, friends and firms (Ben-Porath 1980). According to Ben-Porath, “The family plays a major role in the allocation and distribution of resources” (Ben-Porath 1980:1). Rates of return are estimated according to different education levels; in most cases, rates of return are higher from higher education rather secondary education. However, it is still an open question as to when investments in human capital are the most “profitable”. According to J.J. Heckman and B. Jacobs, “Investments in the human capital of children have higher returns than investments in the human capital of older workers.” (Heckman, Jacobs 2010:2). Thus, human capital should be maintained over the life cycle to earn a sufficiently high return. Work place training helps to maintain human capital over the life cycle, whereas early retirement schemes reduce the time in which the maximum benefits from investments in human capital can be harvested. In the human capital theory, researchers spent a lot of time investigating the model of signaling. According to the model, an individual’s productivity is unknown to the firm prior to hiring, but education can serve as a signal about unobserved skills. If the quality of education is used as a screen, it’s effect on earnings should be less for self-employed persons since they cannot transmit a false signal or self-employed “were more certain of their future employment path, and therefore less likely to purchase schooling” (Wolpin 1977:956). P. Arcidiacono, A. Hizmo and P. Bayer state that when employers gather information about a worker’s ability in order to determine wages, they rely less on education and more on newly obtained information (Arcidiacono, Bayer, Hizmo 2009).

A challenging question is how to measure human capital. One of the most useful approaches is to use the average number of years of schooling as a measure of human capital.
The most challenging task is to estimate the direct private cost of education. This variable is estimated as the private cost of education per one pupil and student as a percentage of GDP per capita. Estimates show that the private costs of education per one student/pupil as a percentage of GDP per capita without state subsidies stayed the same during the crisis (in 2006 it was 8.6%, in 2008 it was 7.31% and in 2010 it was 9.01%). However, private expenditures on higher education have decreased every year (in 2006 it was 53.6 million, in 2008 it was LVL 64.3 million and in 2010 it was LVL 54.9 million). That can be explained by the fact that in 2010 the GDP per capita decreased significantly. After the estimation, the private cost of education per pupil/student as a percentage of GDP per capita is multiplied by the ratio between average work salary of an worker with tertiary education and GDP per capita (in 2006 it was 1.070, in 2008 it was 0.992 and in 2010 it was 0.907). That explains the education cost per student in relation to average GDP per capital from average work salary.

The next variable is the Mincer rate of return, which estimates the rate of return from one additional year of schooling. The estimate is based on the Mincer earnings function and takes into account factors such as earnings (the author's estimate is based on net work salary), education level and work experience which is estimated as age minus years spent in education and preschool age (6 years). The Mincer earnings function is the sum of the linear function of number of years of schooling and quadratic function of work experience, and it is based on a regression model in which an employee’s earnings depend on his or her education and work experience. J. Mincer declares that “Experience on the job is often the most essential part of the learning process.” (Jacob Mincer 1958: 287).

The Mincer earnings function looks as follows: 
\[
\ln Y_x = \ln Y_0 + rs + \beta_1 x + \beta_2 x^2,
\]
where
- \(r\) – rate of return
- \(s\) – years of schooling
- \(x\) – years of work experience
- \(Y_x\) – annual earnings after schooling according to \(x\) years work experience after schooling

Extended earnings function looks as follows: 
\[
\ln Y_x = \beta_0 + \beta_1 D_p + \beta_2 D_s + \beta_3 D_t + \beta_4 x + \beta_5 x^2 + \epsilon,
\]
where \(D_p, D_s, D_t\) – dummies equal to 0 or 1 for primary education, secondary education and tertiary education

Rate of return for tertiary education is equal \(e^{\beta_3 - \beta_2}\).

The authors used Labour Force Survey data (survey was carried out by Central Statistical Bureau of Latvia) on 6148 respondents in 2010.

By applying the Mincer earnings function, the authors estimated that the rate of return of higher education was equal to 43.62% – which means that on average higher education increase earnings by 43.62% (for one year of tertiary education it is equal around 9.69 – divided 43.62% by 4.5 years. Authors estimated that average length of tertiary education in Latvia during 1996 and 2010 was 4.5 years). Authors would like to point out that in 2008 the rate of return was much lower as consequence of high unreasonable increase in earnings of employees with secondary education.

The next variable is average labour taxes (\(t_o\)). Using Labour Force Survey 2010 authors estimated average tax of employees with tertiary education and it was equal to 30.93% significantly higher as in 2008 when it was equal to 28.39%. The maximum average earnings tax in 2010 was 35%.
Table 1. Results of regression and variables of Mincer earnings function

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std.error</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>lnY</td>
<td>5,291</td>
<td>0,024</td>
<td>217,257</td>
</tr>
<tr>
<td>β₁</td>
<td>0,012</td>
<td>0,002</td>
<td>5,645</td>
</tr>
<tr>
<td>β₂</td>
<td>-0,00032</td>
<td>0,000046</td>
<td>-6,950</td>
</tr>
<tr>
<td>D₁ higher education</td>
<td>0,405</td>
<td>0,016</td>
<td>24,801</td>
</tr>
<tr>
<td>D₂ secondary education</td>
<td>0,043</td>
<td>0,010</td>
<td>4,244</td>
</tr>
</tbody>
</table>

R Square 0,130
Adjusted R Square 0,129
Std.Error of the Estimate 3,7943
F 229,384
Sig. 0,000

Source: estimated by authors, OLS.

The authors used Labour Force Survey data 2010 and estimated that the average net work salary of part-time employees aged 20 – 24 was LVL 131.92 ($\tau_s$). The estimate was based on the following conditions: the individual is an employee (not self-employed), she/he has a permanent part-time job for an unspecified period, she/he is 20 – 24 years of age, and she/he has a specific level of education – primary education, general secondary education, general secondary education after vocational basic education and training, vocational basic education and training after basic education, vocational secondary education after basic education and training after basic education, vocational continuing or in-service training programmes after general secondary education). To receive a net work salary of LVL 131.92, the employee should pay labour taxes of 27.67% from a gross work salary of LVL 182.44.

The next variable is unemployment benefit in relation to net work salary. This variable shows the net earnings of unemployed persons in relation to net earnings of employed individuals which are equal to 100% of average production worker earnings who is single and without children. The net earnings of an average production worker in 2010 were LVL 4,029 per year, or LVL 335.75 per month. By estimating the unemployment benefit from net earnings of LVL 335.75, we get a net earnings replacement ratio of 48% (the average net replacement rate in Europe in 2010 was equal to 56.65%, The World Bank, 2013). The same rate is applicable to the individuals with tertiary education.

The next variable is average retirement age. According to Mincer’s theory, the number of years spent in education has a direct relationship to length of work experience – the more years one spends in education, the later one retires and thus contributes a higher social benefit to the economy and state welfare (Mincer 1974). The authors estimated the average retirement age according to Denis Latulippe’s methodology (Latulippe 1996). First, the average retirement age in the group 40 – 44 and the number of people in age group x, x+n who will retire is estimated according to D.Latulippe.

\[
E(y) = \frac{\beta_1 + \beta_2 x}{z} + \frac{\beta_3 + \beta_4 x}{z} + \frac{\beta_5 + \beta_6 x}{z} + \frac{\beta_7 + \beta_8 x}{z} + \frac{\beta_9 + \beta_{10} x}{z} = 47
\]

\[y \text{ – age} \]
\[x \text{ – age on last birthday} \]

\[
R_{x+x+4}^z = (A_{x+x+4}^z - A_{x+5+x+9}^z) * P_{x+x+4}^z
\]

where

\[A_{x+x+n}^z \text{ – average active population in age group from x to x + n in year z} \]
\[P_{x+x+4}^z \text{ – number of population in age group x to x + n in year z z – 2010} \]

The average retirement age is equal to

\[
R_4 = \frac{0.5 * R_{4-40}^{4-40} + 47 + \sum_{x=41}^{x=49} R_{x-40}^{4-40} * (x + 5)}{0.5 * R_{4-40}^{4-40} + \sum_{x=41}^{x=49} R_{x-40}^{4-40}} = 61.13
\]

where

\[R_{x,x+4}^z \text{ – number of people in age group x, x+n who will retire in the next five years} \]
\[R_{x,x+4}^z \text{ – number of people in age group 40 – 44 who will retire at age 45 – 49} \]
\[x, x+4 \text{ – age group} \]

According to the State Social Insurance Agency, the average retirement age in Latvia in 2010 was 60.93 years. Eurostat provides activity rates of employees only till age 74 however small but there is a number of employees who continue to work in age 75 – 79. For this reason the authors estimated activity rates in age group 75 – 79 using the multivariate regression but number of population in age group 75 – 79 by trend (data are not recalculated according to the results of 2011 Population Census carried out by Central Statistical Bureau of Latvia to be comparative with other variables). The authors estimated average retirement age of people with secondary education and tertiary education.

Table 2. Average retirement rates

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2008</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average retirement age*</td>
<td>61.31</td>
<td>61.7</td>
<td>61.13</td>
</tr>
<tr>
<td>Average retirement age of employees with tertiary education*</td>
<td>61.94</td>
<td>62.92</td>
<td>61.36</td>
</tr>
<tr>
<td>Average retirement age of employees with secondary education*</td>
<td>61.18</td>
<td>61.31</td>
<td>60.44</td>
</tr>
<tr>
<td>Average retirement age in according to The State Social Insurance Agency data</td>
<td>60.76</td>
<td>59.24</td>
<td>60.93</td>
</tr>
</tbody>
</table>

Source: The State Social Insurance Agency, estimated by authors.

The next variable is length of working life (H). Taking into account the estimated average retirement age of employees with tertiary education and the average number of years of
schooling, the average length of working life is equal to 42.96 years (61.36 – (6+12.40)). The longer one’s working life, the higher the private rate of return.

The next variable is employment in age group 35 – 44 (pₙ). From Eurostat data, the authors estimated that the unemployment rate in 2010 in age group 35 – 44 years was 16.72%. As an employment indicator, the authors estimated the employed population in relation to the economically active population in age group 35 – 44. In contrast, we see that during the economic crisis, the employment rate decreased significantly by 10 percentage points.

One of the benefits of education is higher employment rates of those who have better education. For this reason, authors compared the employment rates between employees with different levels of education – primary, secondary and higher education.

The average increase in employment from one additional year of education will be estimated in accordance with following method (Fuente, 2003):

\[ d(n) = \frac{p(n + 1) - p(n)}{S(n + 1) - S(n)}, \]

where

\[ p(n) \] – employment rates by education levels (70.65%; 81.94%; 89.69% in case of employment to active population; 52.59%; 73.48%; 85.29% in case of employment to total population)

\[ S(n) \] – years of education in each level (8, 11, 15.5)

\[ p'(S) \] – increase of employment rate from one additional year of education

\[ p(S) \] – average employment rate in age group 35 – 44 = 89.69% and 85.29%

\[ p'(S) \] – weighted average from d(1) and d(2) in case of secondary education

\[ e = \frac{p'(S)}{p(S)} = 1.92\% \] (in relation to employment from active population, private rate of return)

\[ e = \frac{p'(S)}{p(S)} = 3.07\% \] (in relation to employment from total population, social rate of return)

In Latvia the difference between different levels of education comparatively is very high – as we can see in Table 4 the difference in employment with primary education and secondary education reaches more than 20.89 percentage points (employment levels in relation to the employment from total population).

In estimating private return, we should take into account highest proportion 2/3 from the ratio of increase from one additional year of education in relation to employment from active population and it is equal to 2.47(1.28 in case of tertiary education). In estimating social return, we should take into account 1/3 from the ratio of increase from one additional year of education in relation to employment from total population and it is equal to 2.46% (2.05 in case of tertiary education). In the case of private rate of return, a higher rate is usually applied because the return from an additional year of schooling usually is higher at an individual than at a societal level.

The next variable pertains the relationship between those who study and those who do not in age group 20–24 (η). This variable is estimated as the relation between those in the active population who study and those do not.

Table 3. Employment rates in age group 35–44 in 2006, 2008 and 2010

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2008</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment in age group 35 – 39, thousands</td>
<td>131.6</td>
<td>136.9</td>
<td>118.9</td>
</tr>
<tr>
<td>Employment in age group 40 – 44, thousands</td>
<td>140.8</td>
<td>133.5</td>
<td>114.0</td>
</tr>
<tr>
<td>Employment in age group 35 – 39 with tertiary education, thousands</td>
<td>30.7</td>
<td>37.6</td>
<td>37.4</td>
</tr>
<tr>
<td>Employment in age group 40 – 44 with tertiary education, thousands</td>
<td>35.5</td>
<td>39.1</td>
<td>32.2</td>
</tr>
<tr>
<td>Active population in age group 35 – 39, thousands</td>
<td>138.8</td>
<td>147.1</td>
<td>144.1</td>
</tr>
<tr>
<td>Active population in age group 40 – 44, thousands</td>
<td>149.9</td>
<td>143.1</td>
<td>135.4</td>
</tr>
<tr>
<td>Active population in age group 35 – 39 with tertiary education, thousands</td>
<td>31.0</td>
<td>38.8</td>
<td>42.3</td>
</tr>
<tr>
<td>Active population in age group 40 – 44 with tertiary education, thousands</td>
<td>36.8</td>
<td>40.2</td>
<td>35.3</td>
</tr>
<tr>
<td>Total employment rates in age group 35 – 44, %</td>
<td>94.35</td>
<td>93.18</td>
<td>83.33</td>
</tr>
<tr>
<td>Total employment rates in age group 35 – 44 with tertiary education, %</td>
<td>97.64</td>
<td>97.09</td>
<td>89.69</td>
</tr>
<tr>
<td>Population in age group 35 – 44 with tertiary education, thousands</td>
<td>70.8</td>
<td>81.2</td>
<td>81.6</td>
</tr>
<tr>
<td>Employment rates from population in age group 35 – 44 with tertiary education, %</td>
<td>93.50</td>
<td>94.46</td>
<td>85.29</td>
</tr>
</tbody>
</table>

Source: Employment by sex, age group and nationality (1 000), Eurostat.
Active population by sex, age and nationality (1 000), Eurostat.
Estimated by authors.

Table 4. Employment rates in age group 35–44 by education level in 2010

<table>
<thead>
<tr>
<th></th>
<th>Primary (ISCED 1, 2 levels)</th>
<th>Secondary (ISCED 3, 4 levels)</th>
<th>Tertiary (ISCED 5, 6 levels)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment rates from active population p(n)</td>
<td>70.65%</td>
<td>81.94%</td>
<td>89.69%</td>
<td>83.28%</td>
</tr>
<tr>
<td>Employment rates from total population</td>
<td>52.59%</td>
<td>73.48%</td>
<td>85.29%</td>
<td>74.77%</td>
</tr>
</tbody>
</table>

Source: Active population by sex, age group and highest level of education attained (1 000), Eurostat.
Employment by sex, age group and highest level of education attained (1 000), Eurostat.
Population, aged 15 to 74 years, by sex, age and highest level of education attained (1 000), Eurostat.
The employment of young people in the active population who do not study and work in relation to those who both study and work shows a relation between people who study and work and people who only work. The rate will decrease if the share of employment of those who only work increases or if the employment of those who study and work decreases. However, the decision of students to work during studies is influenced by several socio-economic factors which are difficult to evaluate; therefore, the authors limit estimation only to quantitative factors. Estimation is based on example of students distribution by OECD (see OECD 2000:280).

Table 5. Relation between people who study and work and those who only work aged 20–24

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2008</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of employees who study and work from all students who study</td>
<td>40.74</td>
<td>48.86</td>
<td>30.32</td>
</tr>
<tr>
<td>Share of students who study and work from active students</td>
<td>92.18</td>
<td>87.35</td>
<td>74.01</td>
</tr>
<tr>
<td>Share of people who work and do not study from all people who are not in education</td>
<td>75.46</td>
<td>73.31</td>
<td>55.11</td>
</tr>
<tr>
<td>Share of people who work and do not study from all active people who do not study</td>
<td>89.62</td>
<td>88.03</td>
<td>66.60</td>
</tr>
<tr>
<td>Share of people who do not study to those who study (from all people, social rate of return)</td>
<td>0.54</td>
<td>0.67</td>
<td>0.55</td>
</tr>
<tr>
<td>Share of people who do not study to those who study (from all active people, private rate of return)</td>
<td>0.881</td>
<td>0.931</td>
<td>0.683</td>
</tr>
</tbody>
</table>

Source: Participation of young people in education and training by employment status, age and sex (from 2004), Eurostat Young people not in employment and not in any education and training, by age and sex (NEET rates), Eurostat Population on 1 January by five years age groups and sex, Eurostat Estimation by authors

The last variable is share of youth in age group 15–19 who only study (1 – ϕ). This variable is estimated from the entire population in age group 15–19 years minus those who worked or were unemployed. The authors estimated potential labour supply in age group 15–19 from one minus share of youth in age group 15–19 years who was working or was unemployed. The authors estimated that the potential youth supply while in school in age group 15–19 in 2010 was equal to 0.901. This variable reflects the current situation – the workforce supply during school time. However, the variable does not reflect the possible supply of labour force that excludes those who would like to work while studying (in case of tertiary education authors estimated share of youth in age group 20 – 24, in 2006 it was 40.5%, in 2008 – 43.8% and in 2010 43.2%).

When benefits are divided by costs, we get a private rate of return which in 2010 was 13.94% and it is private ratio of benefits from tertiary education. Expressed private ratio from increasing function of R in expression

$$R_p = \frac{R}{1 - e^{-RH}}$$

we gets private ratio which is equal to 13.91% where denominator appears that the working life of individual is finite. If education costs increase, the private rate of return decreases. We can modeling if all tertiary education costs would be covered from private sources in this case the private ratio of benefits would be only 9.58%. Direct costs of education in Latvia are characterized by low state subsidies in higher education and high private investments in higher education. In 2009 in EU-27 there were only three countries (Cyprus, Latvia and Romania) where state and private expenditures compared to GDP per capita in secondary education exceed expenditures in higher education. Although the increase is not significant, an increase in employment leads to a higher private rate of return from education. The Mincer rate of return plays a more significant role – increasing by 1% point (i.e., increasing work salary by 1% from one additional year of schooling) would increase the private rate of return by 1.36 percentage points at a given model. Labour taxes do not have a significant impact on the private rate of return from investments in education.

Finally, we get this model with estimated variables (Fuente 2003).

\[
\text{Benefits} = 0 + \left( \frac{(1 - \alpha_p) p_0}{p_0 + (1 - p_0)x} \right) e = 11.32 \\
\text{Costs} = \left( \frac{1 - \tau_g (1 - \psi) p_0}{1 - \tau_g p_0 + (1 - p_0)x} \right) + \left( \frac{\mu_2}{1 - \tau_g p_0 + (1 - p_0)x} \right) = 0.74
\]

The authors estimated that private rate of return to investments in tertiary education in 2008 was 12.82% which is lower than estimated private rate of return after the crisis – 16.76% in 2010. The author estimated that private rate of return is almost twice higher as private rate of return to investments in secondary education (4.01% in 2006, 6.12% in 2008 and 6.18% in 2010).

Estimation of social rate of return

The social rate of return is the costs and benefits ratio from investments in education by individual and public resources. The authors exclude consideration of the fact that graduates do not always work in the field for which their education prepared them. This could increase the social rate of return

\[
\text{Social rate of return} = \frac{\text{Benefits}}{\text{Costs}}
\]

56
because graduates mostly choose to work in more profitable professions.

Basically, the authors used E. de la Fuente’s methodology and non-parametric DEA method to estimate world technological frontier and gap between Latvia and world technological gap.

A new variable is total education costs. In 2010 state expenditures for one student in tertiary education without expenditures for science as percentage of GDP per capita was 12.59%. It should be taken into account that the state budget allocated for tertiary education was dramatically decreased (68.7 million in 2010 and 111.9 million in 2008 without expenditures for science). Total expenditures per student as a percentage of GDP per capita in 2010 were higher than in 2008 and 2006 mainly because of investments by EU Structural Funds (2006 – 28.55%, 2008 – 30.22%, 2010 – 39.42%). Finally, total expenditure is multiplied by the employment rate from the total population to show the amount of expenditure in education for one student/pupil as a percentage of GDP per capita at the current employment rate.

In 2010 it was 31.996%.

A new variable is the macroeconomic Mincer rate of return (\(\rho, \rho_{\text{mcan}}\)), which shows the rate of return per capita from one additional year of schooling. Zvi Griliches suggests that “possibly, the only approach to testing the productivity of schooling directly is to include it as a separate variable in an estimated production function” (Griliches, 1996: 5).

Authors used simple production function; as a result we get elasticity of human capital \(\alpha_s\). Elasticity shows the percentage of increase if human capital increases by 1% and if others factors of production function remain unchanged.

To estimate elasticity of human capital, the authors used production function, which combines all production factors (labour, capital, land and human factor) and transforms them into finished products and services. The factors of production function are the main factors of economic growth. The quality of the labour force is connected with the average number of years of schooling.

To estimate elasticity of human capital, the authors included it as a separate variable in an estimated production function “(Griliches, 1996: 5).”

\[ Y_t = A_t K_t^{\alpha_k} S_t^{\alpha_s} L_t^{\alpha_l}, \]

where

\( Y_t \) is GDP (chain-linked reference year 2000),
\( A_t \) is technology progress
\( K_t \) is physical capital
\( L_t \) is employment
\( S_t \) is human capital indicator measured as average number of years of schooling
\( \alpha_s \) is human capital elasticity
\( \alpha_l \) is employment elasticity
\( \alpha_k \) is physical capital elasticity

Rewriting the production function and dividing both sides by employment the function is following

\[ \frac{Y_t}{L_t} = A_t K_t^{\alpha_k} S_t^{\alpha_s} L_t^{\alpha_l}, \]

where

\[ K_t \] is physical capital at period \( t \)
\( L_t \) is gross fixed capital formation \( \varphi = 1 - \delta \), where \( \delta \) is deprecation ratio (authors assumed 10% on the basis of previous research results in Latvia)

Since 2000 the average number of years of schooling increased almost by one year however changes is not significant to include in production function therefore authors used another measure of human capital as number of men at age 25–64 with tertiary education and multiplied with average years of schooling (\( H_t \)) extracted from the formula by Jones (Jones, 2002).

\[ H_t = \frac{Y_t}{L_t} = A_t K_t^{\alpha_k} S_t^{\alpha_s} L_t^{\alpha_l}, \]

Finally, we get the following production function

\[ \ln\left( \frac{Y_t}{L_t} \right) = 3.673 + 0.743 \left( \frac{\ln K_t}{L_t} \right) - 0.237 \ln H_t, \]

We can see that during the crisis the model is not suitable as education has rather negative impact and it is linked to decrease of labour productivity which is caused mainly by other external factors.

<table>
<thead>
<tr>
<th>Year</th>
<th>( \frac{Y_t}{L_t} ) million Lats</th>
<th>4Kt ( \text{million Lats} )</th>
<th>Human capital, th. Hu</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>5783.01</td>
<td>8059.19</td>
<td>1263.05</td>
</tr>
<tr>
<td>2001</td>
<td>6090.01</td>
<td>9457.61</td>
<td>1207.88</td>
</tr>
<tr>
<td>2002</td>
<td>6298.14</td>
<td>9352.49</td>
<td>1292.25</td>
</tr>
<tr>
<td>2003</td>
<td>6752.51</td>
<td>9719.08</td>
<td>1292.25</td>
</tr>
<tr>
<td>2004</td>
<td>7213.83</td>
<td>10308.04</td>
<td>1328.98</td>
</tr>
<tr>
<td>2005</td>
<td>7910.88</td>
<td>11445.52</td>
<td>1328.98</td>
</tr>
<tr>
<td>2006</td>
<td>8477.22</td>
<td>12433.68</td>
<td>1328.98</td>
</tr>
<tr>
<td>2007</td>
<td>9098.81</td>
<td>13572.53</td>
<td>1483.96</td>
</tr>
<tr>
<td>2008</td>
<td>8733.71</td>
<td>14176.02</td>
<td>1580.00</td>
</tr>
<tr>
<td>2009</td>
<td>7925.21</td>
<td>15110.93</td>
<td>1580.00</td>
</tr>
<tr>
<td>2010</td>
<td>8076.91</td>
<td>14725.19</td>
<td>1580.00</td>
</tr>
</tbody>
</table>

Source: IKG08. Expenditure of gross domestic product (ths Lats), Central Statistical Bureau
The authors used DEA method to estimate the gap between world technological frontier and Latvia. For this reason the authors obtained the data about net capital stock in 2000 from AMECO database (Net capital stock per unit of gross domestic product at constant market prices) and using the same methodology as in case of production function estimated physical capital for years 2001 – 2010.

The authors estimated the technological gap between Latvia and world technological frontier during 2000 – 2010 using simple formula \( a/(a+b) \), where a is output per working hour in case of Latvia and b difference between world technological frontier and rate of Latvia. Authors estimated that efficiency rate of Latvia during 2000 – 2010 was 78.8% which is close to estimated efficiency rate by Senior economist of the Bank of Latvia O.Krasnopjorovs (he estimated that average efficiency rate of Latvia during 2000 – 2010 was equal to 70.8%, O.Krasnopjorovs, 2012).

Finally, the authors used the ln of estimated efficiency rate, the R&D expenditures as percentage of GDP, factor of human capital (see above the production function) in simple technical progress function and estimated that one additional year of schooling is negative and equal to around -6% (variable \( \lambda \)) which can be explained by economic recession during the crisis opposite to increase of tertiary education attainment and average years of schooling. The R&D expenditures have positive impact and are equal to 0.57 (variable \( \gamma \)).

Finally, we get this model with estimated variables (Fuente 2003, authors add efficiency rate from one additional year of schooling). The social rate of returns model excludes the taxes and benefit parameters.

The numerator reflects the benefits of education.

The Costs is \( (1 - (1 - \phi)\eta) + \mu \frac{1}{\rho_0} = 1.30 \)

From this equation we find that in 2010 the social rate of return \( r \) for education was 0.38%, which is equal to marginal effect from one additional year of schooling. The authors would like to stress out that the effect is comparatively low however education has a positive return at the societal level after the crisis. The model is very sensitive and it is simple to estimate marginal effect from changes in the level of variables.

Conclusion

During the economic crisis, the employment rates decreased more rapidly, particularly in employee groups with secondary and primary education. In 2008 the difference between employment rates of the active population with higher education and secondary education was 4.57 percentage points while in 2011 it was 9.44 percentage points. The difference between employment rates of the active population with secondary and primary education was 8.01 percentage points while in 2011 it was 10.47 percentage points. It means that a higher level of education increases employment probability.

During the crisis, the share of youth in age group 20 – 24 who do not study and are unemployed in 2010 in comparison with 2006 has increased by 10.5 percentage points or by three times while the student share that studies and works at the same time has decreased by only 3.4 percentage points. The share of youth who study and do not work has increased from 40.5% in 2006 to 43.2% in 2010; this fact confirms that the recession has not been an obstacle to studying. More youths are engaged in formal education or training than before the crisis; that is, the share of students in 2011 has increased by 5.5 percentage points in comparison with 2008 regardless of whether they work or not.

The authors assumes that work salary has a higher impact on the rate of return from education than does employment because the difference in employment rate between the active population with secondary education and higher education in 2010 was equal to 7.75 percentage points while the average work salary of employees with higher education in 2010 in sectors B – N (Eurostat) was 40% higher than the work salary of employees with secondary education in the same sectors.

The results of research show that Latvia has a high private rate of return from tertiary education; therefore, institutions in Latvia which are responsible for education policy should speak more actively about the high added value of education and the high rate of return – primarily about increases in wage and employment probability.

The results of the research shows that private rate of return to investments in education decreased in 2008 which could be explained by lower wage inequality before the crisis and higher incomes in group of individuals with secondary education. The results can be explained also by high state investments in tertiary education before crisis. The results reveal that tertiary education has high impact on welfare of individuals and society and education will be the main driver to achieve faster economic growth and better European integration.

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References


Figure 4. World Technology Frontier, 2010
Source: Eurostat, AMECO database, estimated by authors


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