# Private Rate of Return on Human Capital Investment in the Czech Republic: Differences by Study Fields[1]

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## Abstract

The paper is focused on approaches to the measurement of the returns of private investments on human capital in the Czech Republic. In the last ten years, there is observed a significant increase in number of students at Higher Education Institutions (HEIs) and an increasing number of HEIs graduates is also expected in the Czech Republic in forthcoming years. Using data from the research project "REFLEX", from the Czech Statistical Office and from EUROSTUDENT IV survey, the paper provides the methodology and the experimental computations of the rates of return on private investment in the tertiary education broken down by study fields.

## INTRODUCTION

It is very popular to analyse the returns on human capital. Investments in the human capital can be assessed from different points of view. We can see these investments from the point of view of an individual: he has some opportunity costs (due to the postponing of starting his entrance to the labour market as well as the direct costs of the education such as tuitions, living costs in the university town, transport charges and so on). On the other hand, more educated person have higher wages, lower risk of unemployment,

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higher retire pension, longer life expectancy etc. These costs and benefits could be divided to two main groups — economic and non-economic.

From the point of view of the society, we can consider at the cost side public expenditures on education, opportunity costs such as lower tax revenues, and at the benefit side higher tax revenues in future, lower unemployment, higher gross value added, gross domestic product and so on.

## 1  DATA AND METODOLOGY

We use three different data sources: data from REFLEX survey, data on wages from the Czech Statistical Office (CSO) and finally the data from survey EUROSTUDENT IV. CSO data provide us information on level of wages depending on age, attained education and study field. REFLEX survey collected data on tertiary-educated persons after finishing their studies (from year 2000 till 2003) and then after 5 years (mainly 2005–2006). Most of graduates finished their studies in 2001 and 2002 and therefore we consider years 2001 and 2006 as basic years for our research. In total, REFLEX survey collected 6 794 responses, which means about 23% response rate. 17% of the sample are bachelor graduates and 82% master graduates, 57% are women and 43% men. The structure of graduates by study field is following: 27% economic, law and human sciences, 23% technical, 19% pedagogical. 90% of graduates studied in full-time study programs. Introduction and methodology of REFLEX survey has also information about age structure and regional structure of the Czech HEIs.

The third data source is the EUROSTUDENT survey, which has been realized during year 2009 and contains 8 386 responses (60% response rate). Only 7 166 observations related to full-time students are analyzed. 6 885 students studied at public HEIs, 281 students at private ones. According to the study cycle, the structure is following: 64.6% bachelor students, 17.9% long master students, 17.1% short master students and 0.3% Ph.D. students. The EEUROSTUDENT survey is a part of the international and periodic project, which includes all developed European countries (EU, EEA, Croatia and Turkey).[5]

For our experimental computations, we consider the differences between the net wages of the tertiary-educated person and the net wages of the upper-secondary-educated person with the General Certificate of Education (GCE) at the side of benefits and the EUROSTUDENT estimation of costs of studies at the tertiary stage as costs. We do not consider the risk of unemployment and the consequent losses at the side of benefits (construction of a probabilistic model is a complicated task due to the necessity of solving the problem of different wages and the probability of unemployment among the different age groups), but we consider the differences at the level of the retirement pensions; it is necessary to say that the regressive model is used in the process of computation of retirement pensions. The pensions from the Czech pension scheme (the Pay-as-You-Go model is currently used) depend on the number of years of the productive activity and on the amount of wages paid, but the amount of wages paid is reduced for the highest levels. We used the model for computing of the internal rate of return after 50 years of working. We do not consider the non-economic cost and benefits of the tertiary education (such as a better health, lower rate of criminality, etc.).

We compare wage development of two hypothetical individuals, who decided about their future in 1996. They have completed their upper secondary studies and one of them attends the 5-year tertiary education level and the second one joins the labour market. We use the data from the Czech Statistical Office on the distribution of the wages by age and by the highest level of education (two-dimensional cross table), published for years 2001 and 2006 as well. From these tables, we can use the levels of wages for an upper-secondary-educated person after 5-year-practice (he finished his secondary studies in 1996 and has 5 years of practice in 2001) and the starting wages for tertiary-educated person in 2001. We can

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[5]  More information about Eurostudent survey at: <http://www.eurostudent.eu>.

also estimate future development of the wages of both individuals using the longitudinal analysis of the wages, which depend on the age and on the education level as well. This estimation was recomputed by the newer data from the Czech Statistical Office about level of wages in years 2005 and 2010. All previous computations (Finardi, Fischer, Mazouch, 2008a) were recounted due to the financial and economic crisis, which affected the Czech economy and led to a lower level of wages in comparison with assumptions made in 2007.

The data on development of wages (with respect to age and educational profile as well) are shown in Tables 1, 2 and 3. Table 1 shows data from REFLEX survey, which includes data on wages of HEIs graduates. These data have been used for the first six-year prognosis of graduates' nominal wages (2001–2006). The average annual growth differs across different study fields.

**Table 1** Wage Development Between 2001 and 2006, tertiary-educated (REFLEX survey data)

| Study Fields | Monthly Wage (CZK) | | Average Annual Growth (2001–2006) |
|---|---|---|---|
| | **2006** | **2001** | |
| Natural Sciences | 29 790 | 14 812 | 1.1500 |
| Technical | 29 898 | 14 932 | 1.1490 |
| Agricultural | 21 755 | 11 715 | 1.1318 |
| Medical | 28 072 | 12 007 | 1.1851 |
| Economic | 32 530 | 15 854 | 1.1546 |
| Human Sciences | 25 234 | 13 492 | 1.1334 |
| Pedagogical | 21 855 | 11 572 | 1.1356 |

**Source:** REFLEX survey, own calculation

Table 2 shows the development of wages of upper-secondary-educated persons in the Czech Republic in the previous years. Average growth between years 2005 and 2010 has slowed down compared to years 2001 and 2006 and there is a change in wages of employees in the highest age categories: the age group of 65 and more has lower monthly wage than age group 60–64 years. Table 3 includes data on wage development of tertiary-educated persons between the same time periods as in Table 2. In both tables, we can observe that at the beginning of career the index of average annual growth being higher than

**Table 2** Wages Development Between 2010 and 2005, upper-secondary-educated

| 2010 | | 2005 | | Average Annual Growth (2005–2010) |
|---|---|---|---|---|
| **Age Group** | **Monthly Wage (CZK)** | **Age Group** | **Monthly Wage (CZK)** | **Nominal Wages** |
| 25–29 | 25 657 | 20–24 | 17 026 | 1.08547 |
| 30–34 | 29 551 | 25–29 | 21 804 | 1.06269 |
| 35–39 | 30 405 | 30–34 | 23 885 | 1.04946 |
| 40–44 | 28 876 | 35–39 | 22 888 | 1.04758 |
| 45–49 | 28 579 | 40–44 | 22 771 | 1.04648 |
| 50–54 | 28 208 | 45–49 | 22 859 | 1.04295 |
| 55–59 | 28 825 | 50–54 | 23 408 | 1.04251 |
| 60–64 | 30 973 | 55–59 | 24 137 | 1.05114 |
| 65 and more | 26 466 | 60–64 | 25 211 | 1.00976 |

**Source:** Czech Statistical Office, own calculation

**Table 3** Wages Development Between 2010 and 2005, tertiary-educated

| 2010 | | 2005 | | Average Annual Growth (2005–2010) |
|---|---|---|---|---|
| Age Group | Monthly Wage (CZK) | Age Group | Monthly Wage (CZK) | Nominal Wages |
| 30–34 | 46 119 | 25–29 | 27 774 | 1.10675 |
| 35–39 | 56 749 | 30–34 | 39 690 | 1.07413 |
| 40–44 | 56 853 | 35–39 | 42 170 | 1.06157 |
| 45–49 | 52 646 | 40–44 | 39 608 | 1.05856 |
| 50–54 | 49 969 | 45–49 | 39 234 | 1.04956 |
| 55–59 | 48 722 | 50–54 | 39 401 | 1.04338 |
| 60–64 | 50 966 | 55–59 | 39 384 | 1.05291 |
| 65 and more | 46 824 | 60–64 | 40 403 | 1.02994 |

**Source:** Czech Statistical Office, own calculation

in the forthcoming years. This feature is the same for upper-secondary-educated and form tertiary-educated employees. This is caused by the starting position in the labour market. During the first years after graduation the nominal growth of wages is quicker than after 10 and more years of working experiences.

**Table 4** Rate of Inflation (in %)

| 2010 | 1.5 | 2007 | 2.8 |
|---|---|---|---|
| 2009 | 1.0 | 2006 | 2.5 |
| 2008 | 6.3 | 2005 | 1.9 |

**Source:** Czech Statistical Office

**Table 5** Real Growth of Wages Between 2005–2010, upper-secondary-educated

| Age Group | Index of Average Growth in Nominal Wages | Average Inflation Rate (6 years) | Average Risk-Free Interest Rate Index (6 years) | Real Growth of Wages RI (2005–2010) | Real Growth of Wages RFIR (2005–2010) |
|---|---|---|---|---|---|
| 25–29 | 1.08547 | 1.022381 | 1.040597 | 1.061707 | 1.043122 |
| 30–34 | 1.06269 | 1.022381 | 1.040597 | 1.039426 | 1.021231 |
| 35–39 | 1.04946 | 1.022381 | 1.040597 | 1.026486 | 1.008517 |
| 40–44 | 1.04758 | 1.022381 | 1.040597 | 1.024647 | 1.006710 |
| 45–49 | 1.04648 | 1.022381 | 1.040597 | 1.023571 | 1.005653 |
| 50–54 | 1.04295 | 1.022381 | 1.040597 | 1.020118 | 1.002261 |
| 55–59 | 1.04251 | 1.022381 | 1.040597 | 1.019688 | 1.001838 |
| 60–64 | 1.05114 | 1.022381 | 1.040597 | 1.028129 | 1.010131 |
| 65 and more | 1.00976 | 1.022381 | 1.040597 | 0.987655 | 0.970366 |

**Note:** RI — Inflation Rate, RFIR — Risk-Free Interest Rate.
**Source:** Czech Statistical Office, Ministry of Finance of the Czech Republic, own calculation

We can compare the index of average growth of wages from 2005 till 2010 with the index of average rate of inflation measured by the CPI (Consumer Price Index); the index of average rate of inflation is 1.022381 (see Table 4). The index of average rate of inflation (1.022381) is significantly lower than the index of average risk-free interest rate from 2005 till 2010 (1.040597). The real growth in wages of upper-secondary-educated persons is showed in table 5 and for tertiary-educated persons in Table 6. The indices of average nominal growth of wages divided into age groups were compared with inflation rate (CPI) and with risk-free interest rate index. Both indices mentioned above are computed as a geometric mean from 2005 till 2010.

**Table 6** Real Growth of Wages Between 2005–2010, tertiary-educated

| Age Group | Index of Average Growth in Nominal Wages | Average Inflation Rate (6 years) | Average Risk-Free Interest Rate Index (6 years) | Real Growth of Wages RI (2005–2010) | Real Growth of Wages RFIR (2005–2010) |
|---|---|---|---|---|---|
| 30–34 | 1.10675 | 1.022381 | 1.040597 | 1.082518 | 1.063569 |
| 35–39 | 1.07413 | 1.022381 | 1.040597 | 1.050612 | 1.032221 |
| 40–44 | 1.06157 | 1.022381 | 1.040597 | 1.038334 | 1.020157 |
| 45–49 | 1.05856 | 1.022381 | 1.040597 | 1.035389 | 1.017264 |
| 50–54 | 1.04956 | 1.022381 | 1.040597 | 1.026584 | 1.008614 |
| 55–59 | 1.04338 | 1.022381 | 1.040597 | 1.020541 | 1.002676 |
| 60–64 | 1.05291 | 1.022381 | 1.040597 | 1.02986 | 1.011834 |
| 65 and more | 1.02994 | 1.022381 | 1.040597 | 1.007391 | 0.989756 |

**Note:** RI – Rate of Inflation, RFIR – Risk-Free Interest Rate.
**Source:** Czech Statistical Office, Ministry of Finance of the Czech Republic, own calculation

**Table 7** Risk-free Interest Rate (in %)

| | | | |
|---|---|---|---|
| **2011** | 4.00 | **2006** | 3.78 |
| **2010** | 3.71 | **2005** | 3.51 |
| **2009** | 4.67 | **2004** | 4.75 |
| **2008** | 4.55 | **2003** | 4.12 |
| **2007** | 4.28 | **2002** | 4.94 |

**Source:** Ministry of Finance of the Czech Republic,
Czech National Bank

**Table 8** Average Costs and Incomes of Public HEISs Students

| Year | Average Costs of Public HEISs Students (CZK / per month) | Average Incomes of Public HEIs Students (CZK / per month) |
|---|---|---|
| 2009 | 8 448 | 6 748 |
| 2008 | 7 947 | 6 348 |
| 2007 | 8 170 | 6 175 |
| 2006 | 7 971 | 6 025 |
| 2005 | 7 312 | 5 527 |
| 2004 | 7 113 | 5 377 |
| 2003 | 7 106 | 5 371 |
| 2002 | 6 580 | 4 973 |
| 2001 | 6 284 | 4 750 |
| 2000 | 6 049 | 4 572 |
| 1999 | 5 924 | 4 478 |
| 1998 | 5 352 | 4 045 |
| 1997 | 4 932 | 3 728 |
| 1996 | 4 533 | 3 427 |

**Source:** Eurostudent IV, Czech Statistical Office, own calculation

All the computations are in nominal values, but if we want to express the nominal wages in real value, we will use the risk-free interest rate.[6] Table 7 includes interest rates of middle-term and long-term bonds issued by the Czech National Bank. The annual average risk-free interest rate is 1.042056. Also the risk-free interest rate is lower than 5 years before — 1.05869 (Finardi, Fischer, Mazouch, 2008a).

For all the estimations and computations we consider tax conditions of year 2011: flat tax rate 15%, concept of so-called super-gross wage, social insurance rate paid by employer 34% and paid by employee 11%, tax credit for tax payer 1 970 CZK per month (23 640 CZK per year). Also the tax credit was discounted by the index of average growth of wages between years 1996 and 2010. The monthly average wage in year 1996 was 11 069 CZK and monthly average wage in year 2010 was 26 881 CZK; the final index of the growth of wages is 1.040295.

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[6]  Risk-free interest rate is mainly used for computations, which are connected with the public sector. Rate of inflation is mostly used for computations of purchasing power of consumers.

From EUROSTUDENT survey, we consider incomes and costs of public HEIs students only. The monthly average income of these students was 6 748 CZK in 2009. We discount the average income by the CPI from 1996 till 2009, because we estimated private rate of return for students of public HEIs, which began their studies mostly in year 1996 and finished studies in year 2000. The same method was used for costs of public HEIs students. Table 8 shows average incomes and costs of students per month. Total average costs from 1996 till 2000 reaches 321 478 CZK and total average incomes 242 988 CZK.

For the estimation of private returns on human capital we use the method of discount factor (Maříková, Mařík, 2007). In the first step we compute a Wage Premium (WP) for the HEIs graduates. In the second step we could finally estimate the discount factor:

$$WP = \sum \frac{W_{te} - W_{se} - C_{he}}{(1 + DF)^i},$$
(1)

where:
  WP is Wage Premium,
  $\Sigma W_{te}$ is a sum of nominal wages of tertiary-educated graduates for their working cycle,
  $\Sigma W_{se}$ is a sum of nominal wages of secondary-educated graduates for their working cycle,
  $\Sigma C_{he}$ is a sum of costs on studies of tertiary-educated graduates,
  DF is discount factor,
  i is a duration of cycle.
The equation (1) is solved for unknown DF, when $WP = 0$.

## 2  RESULTS AND INTERNATIONAL COMPARISON

Figure 1 shows the private rate of return on human capital broken down by study fields. The lowest rate of return is for agricultural studies graduates and the highest rate is for economic studies graduates. This is not surprising, because the labour market is still very "hungry" for economists.

Figure 2 describes private rate of return computed by OECD experts on education in the annual report called Education at a Glance 2011. The rates were computed on the data from year 2007. It is obvious that the Czech Republic is above the OECD average and this is mainly caused by the fact that there are no tuition fees. The private rate of return is mainly depends on the level of wages and wage premium for

**Figure 1** Private Rate of Return on Human Capital in the Czech Republic according to Study Fields
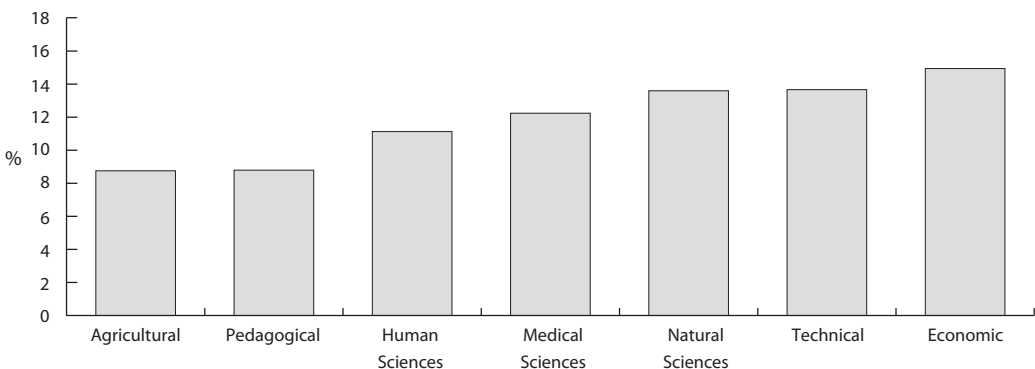


**Source:** Own calculation

**Figure 2** Private Rate of Return on Human Capital in the OECD Countries (tertiary education)
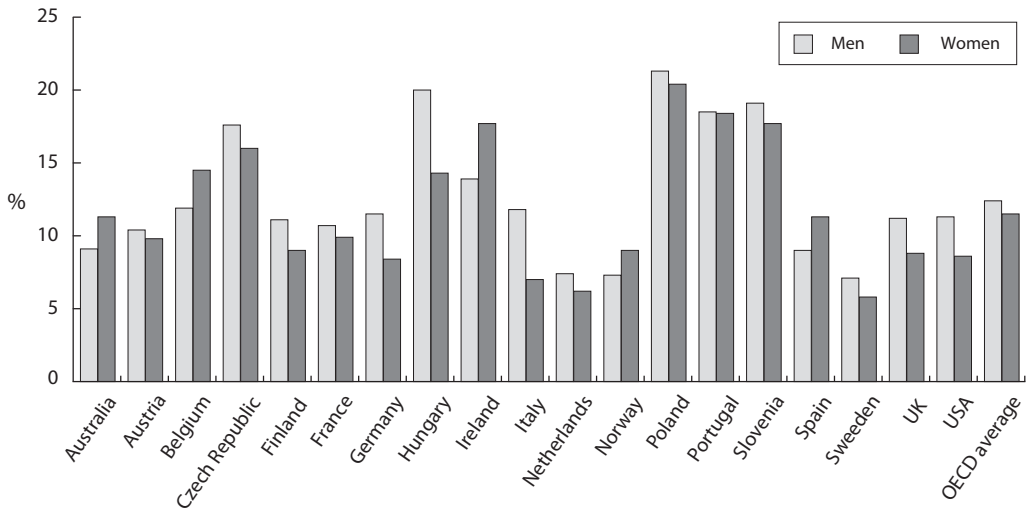


**Source:** Education at a Glance 2011 (OECD)

tertiary-educated persons and secondly on the tuition fees (if collected), see Figure 2. Only in 5 countries (Australia, Belgium, Ireland, Norway and Spain) are rates of return higher for women than for men. In Australia and Belgium taxes for men are higher than for women.  Belgium and Spain have progressive tax rates of personal income tax. In Ireland special tax deductions are applied for married couples, because it is a country with a high share of religious residents.

## CONCLUSION

Computing and estimating private and also public rates of return is very important for a future discussion about proposals of tuition fees in the Czech Republic. In our further research, we plan to include in our model tuition fees, progressive personal income taxes and estimate the rates of return for men, women and different regions of the Czech Republic. Estimations would help to set optimal rates of tuition fees for different faculties, study programmes or study fields.

The Ministry of Education, Youth and Sports of the Czech Republic presented a reform of a tertiary education system including tuition fees; therefore it is necessary to have detailed information about future incomes of HEIs graduates. So far, no research made an estimation of wage premium for different study fields in the Czech Republic.

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