

# Does the Short Supply of College Education Bite?

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# Czech Returns to Schooling: Does the Short Supply of College Education Bite?

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## Abstract

Czech returns to education are estimated using 2002 data on hourly wages of salaried employees. The return to an additional year of schooling is close to 10% – that is relatively high given the level of economic development and average schooling level. Particularly large is the college/high-school wage gap: it is about 50% higher than in Germany or Austria, which have a similar education structure. This is likely caused by the short supply of tertiary education provided by the funds-starved Czech public colleges.

*JEL classification:* J31, P23.

*Keywords:* Czech Republic, Returns to Education.

Tento článek využívá dat o mzdách českých zaměstnanců z roku 2002 k odhadům mzdové výnosnosti vzdělání. Každý rok školní docházky zvyšuje hodinové mzdy o téměř 10 procent. Tato výnosnost vzdělání je v mezinárodním srovnání relativně vysoká, uvážíme-li průměrnou úroveň vzdělání a stupeň ekonomického rozvoje. Neobvykle velký je především rozdíl mezi platy pracovníků s úplným středoškolským vzděláním a platy vysokoškolsky vzdělaných zaměstnanců. Tento rozdíl je o asi 50 procent větší než v Německu nebo Rakousku, kde je podobně jako v ČR relativně menší podíl vysokoškolsky vzdělaných pracovních sil. Je pravděpodobné, že tyto rozdíly jsou zapříčiněny nedostatečnou nabídkou vysokoškolského vzdělání v podfinancovaných veřejných vysokých školách.

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## 1. Introduction

A large body of empirical literature documents the rise in returns to education occurring during early pro-market reforms in post-soviet economies. However, there is a dearth of descriptive evidence on late-transition pre-EU-accession returns to education. This paper fills the gap for the Czech Republic by estimating private wage returns to various education degrees using a large matched employer-employee data set covering salaried employment in the enterprise sector in 2002.

One dimension of the analysis is given particular attention: namely the quantification of the Czech college/high school wage gap. The size of the gap is important for the recent local policy debate on the limited supply of (and excess demand for) college education in the Czech Republic. The country has one of the highest secondary school completion rates in the OECD, but one of the lowest shares of college graduates in the labor force (OECD, 1997). I therefore ask whether the limited supply of college education leads to unusually high returns to having graduated from college.

I provide separate estimates not only for men and women, but also for different age groups. A separate focus on young employees is motivated by the potentially low substitutability of workers with a given level of education across age groups. (Recall that older Czech workers graduated from communist schools.) Furthermore, public-college enrollment in the Czech Republic increased by approximately 50% during the first transition decade, leading to an increase in the relative supply of college graduates among the labor market inflow. Such higher relative supply may lower the relative price of college degrees on the labor market. Yet, public colleges remain highly oversubscribed.<sup>1</sup> One interpretation of this fact is that the demand for education is “too” high because public colleges are tuition free. An alternative explanation is that the market reward to college degrees is very high. A quantification of the market value of a recent college degree, relative to a high school diploma, is

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<sup>1</sup>Every year, only about half of all applicants to Czech public colleges manage to get enrolled (UIV, 1998).

therefore important for shedding light on the binding nature of limited supply of college education in the Czech Republic.<sup>2</sup>

It is important to stress from the start that because I rely on employee data, the estimated returns to education are quite descriptive in their nature. I do not control for sample selection into work for women nor for the selection of both men and women into enterprise-sector salaried employment as opposed to public-sector employment or self-employment (entrepreneurship).

The paper is organized as follows. The next section provides a brief discussion of the existing empirical literature on returns to education in transition economies. It also includes some notes on the Czech educational system. In section 3, I describe the data set, while section 4 reviews the results. Section 5 concludes.

## 2. Background

The wage rewards of schooling – “returns to education” – are a central concern to both labor economics and econometrics.<sup>3</sup> The topic continues to generate voluminous empirical literature, recently evaluated by Heckman et al. (2003). It is therefore not surprising that wage rewards of education received much attention in post-soviet economies, where they are crucially tied to the growth potential.

Pay differentiation was strictly regimented under central planning, as wages were set according

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<sup>2</sup>See e.g., Card and Lemieux (2000) for work stressing imperfect substitutability of workers across age groups and changing relative supply of college education across cohorts. Ideally, one would capture time and age effects together with cohort-specific effects. However, this approach is not feasible so far given the few available years of post-communist history.

<sup>3</sup>Many advances in applied microeconometrics occurred within the “returns” literature. Originally, the literature addressed two major issues: measurement error and ability bias. Currently, there are two competing strategies of estimating returns to education. The first is based on quasi experiments (e.g., Card, 2001). The second estimates more structural models of individual choice, which explicitly allow for human capital heterogeneity and variation in returns across individuals (e.g., Heckman and Vytlačil, 1998). While the first approach is statistically more robust, the second may be closer to estimating policy-relevant (treatment) effects.

to industry-specific wage grids varying only with the difficulty and “social importance” of the job and with the worker’s education and experience (Münich et al., 1999). Since returns to education provide a direct incentive for investment in human capital, it was desirable that pro-market reforms allow for an increase in the returns. Indeed, wage regulations were quickly abolished at the start of the 1990s and wage dispersion rose rapidly. A wealth of studies summarized by Svejnar (1999) documents this increase in wage differentiation and suggests that it was in part due to a swift increase in benefits of education.<sup>4</sup>

The Czech Republic was no exception in this regard. Three studies, which investigate changes in the returns to education between communist and post-communist eras in the Czech Republic, report significant increases in the returns. Chase (1997) finds that among men the added income for each year of education approximately doubled between 1984 and 1993 while Flanagan (1995) reports somewhat smaller increases from 3.4 percent for men in 1988 to 4.4 percent in 1993. Finally, Münich et al. (1999) estimate that male returns to a year of schooling increased from 2.7 percent in 1989 to 5.8 percent by the end of 1996. Skill-related wage differentials kept rising even in the mid to late 1990s, albeit at a slower pace (Filer et al., 1999). By 1997, male employee wages increased by up to 9 percent for each year of additional schooling.

There is also evidence comparing returns to specific education degrees across main sectors of the economy: Using 1998 data and focusing on a different issue, Jurařda (2003) reports a 10 percentage points higher college/high school wage gap in the enterprise sector than in the public sector comprising of education, health and public administration.<sup>5</sup>

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<sup>4</sup>The literature on early-transition returns to education includes Krueger and Pischke (1995) for East Germany, Rutkowski (1996) for Poland, Orazem and Vodopivec (1997) for Slovenia, Lubyová and Sabirianova (2001) for Slovakia and Russia.

<sup>5</sup>Put differently, the relative difference between the wages of high school graduates with a comprehensive school-leaving examination and the wages of workers with only an elementary education was higher in the enterprise sector than in the public sector. The relative wages of all other education groups, in comparison to wages of elementary

In this paper, I extend the existing evidence by covering the situation after the end of the first transition decade and two years before EU entry. As argued in the introductory section, the analysis is important for the ongoing debate about the reform of the tuition-free oversubscribed and under-funded tertiary education in the Czech Republic (World Bank, 2001). Although the structure of the Czech educational system parallels those of other European countries, there is a significant difference in the educational structure of the labor force: While the secondary school completion rate is very high, only a small proportion of Czech workers have completed college.<sup>6</sup> This fact is not surprising given that a major group of secondary-level students attends apprenticeship programs which offer only dismal prospects of continuing on to higher education degrees.

Given these imbalances, the focus of the present study is on the returns to specific education degrees. While Czech elementary (compulsory) and tertiary education is quite similar to those found in other countries, Czech secondary education deserves some explanation. Overall, there are three types of secondary schools in the Czech Republic: vocational, specialized and academic (“gymnasium” in Czech). At the end of all academic secondary schools, most specialized schools and some vocational programs, students pass school-leaving examinations (“maturita” in Czech). These exams approximately correspond to the U.K. General Certificate of Education (GCE) or the German “Abitur” exam. All graduates who pass these comprehensive exams may continue on to colleges, but about two thirds of those who do so typically come from gymnasia. Colleges are publicly funded and typically involve a single-field four to five year track of study.<sup>7</sup>

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education workers, were similar across the two sectors of the economy.

<sup>6</sup>According to OECD (1997), by 1995 about 88 percent of the Czech labor force aged 25 to 64 had completed at least higher secondary school. Only one OECD country had a greater rate of high school completion (the U.S. at 89 percent), while the average across OECD countries was only 65 percent. On the other hand, only 12 percent of the population 25 to 64 had a university degree in 1995, compared to an OECD average of 23 percent. Among OECD countries, only Turkey and Italy (8 percent) and Austria (9 percent) had a lower rate of university completion among the working-age population.

<sup>7</sup>Since 1995 a new type of tertiary school has emerged, partly in response to the excess demand for college education:

The preferred categorization of the different education degrees used in the subsequent analysis falls into four groups: (i) elementary education, (ii) apprenticeship without GCE, (iii) all types of secondary education with GCE combined, and (iv) college degrees and higher.<sup>8</sup> One may want to further differentiate types of GCE-awarding secondary schools; these results are available upon request.

### 3. Data

In the Czech Republic, there are two major worker-level data sets with wage information.<sup>9</sup> First, self-reported wage information is available in the Mikrocensus household survey for 1988, 1992, and 1996.<sup>10</sup> Second, there is a quarterly national employer survey, called the Information System on Average Earnings (ISAE), in which firms report hourly wages of their employees.<sup>11</sup> In this paper, I rely on the second data source from the first quarter of 2002.

The ISAE employer survey was started in the early 1990s based on informal sampling practices. Fortunately, recent data are based on two major updates (in 1998 and 2002) based on stratified random sampling conducted by the Czech Statistical Office in 1996 and 2000 within the Eurostat's Structure of Earnings Survey program. Only firms employing more than 10 workers are sampled. The data include over one third of the entire Czech enterprise employment and cover all firm size

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These so-called higher professional schools typically provide two years of education leading to various specialized diplomas in professional fields. Although these schools are considered tertiary, they operate in the framework of secondary schooling and cannot award Bachelor degrees.

<sup>8</sup>This grouping roughly corresponds to the OECD classification of education levels—the ISCED groups. Category (i) essentially consists of compulsory education and spans ISCED levels 1 and 2. Category (ii) corresponds to ISCED 2 and a small group of workers with ISCED 3C. Category (iii) is identical with ISCED 3A. Finally, the highest category (iv) covers ISCED levels 5 and 6.

<sup>9</sup>Unfortunately, the Czech Labor Force Survey does not ask about wages.

<sup>10</sup>This data has been used in analyses of earnings differentiation by Večerník (2001).

<sup>11</sup>The survey is collected by a private agency on behalf of the Czech Ministry of Labor and Social Affairs.

categories and industries, except the budgetary sector of health, education, and public administration.<sup>12</sup>

The data include not only the industry, region of operation and ownership type for each firm, but also hourly wages, gender, education, age, and a detailed occupational classification for all employees of the surveyed enterprises.<sup>13</sup> These wage records are drawn directly from companies' personnel databases using software developed by the data collection agency. Having available a measure of hourly wage rates is ideal for the purpose of estimating returns to education because of the potential differences in hours worked across levels of education. Furthermore, the definition of hourly wage is detailed and fully consistent across firms.<sup>14</sup> The uniformity of the wage definition and the use of personnel records minimizes the extent of reporting errors likely present in household survey data. As with most other data from transition economies, education is reported in ISAE as the highest degree obtained rather than as years of schooling actually attended. Unfortunately, education is missing for 8% of workers and this part of the data is therefore excluded from the analysis. Table 1 contains selected summary statistics and sample-size indicators for the analysis-ready data. There are over eight hundred thousand worker wage records available from over 2000 firms.

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<sup>12</sup>The sample is not perfectly representative of the population of firms. Thus, to recover population statistics as closely as possible, weights reflecting the sampling procedure were calculated by dividing the population frequency of firms within strata cells by the corresponding sample frequency. The population distribution is based on end-of-year firm register, which is compiled by the Czech Statistical Office and which is used as a sampling frame for the survey. The re-weighted data form the basis for the analysis.

<sup>13</sup>Wage records of top management are excluded from the data.

<sup>14</sup>Each quarter, employers in the Czech Republic are legally required to calculate for each worker an average hourly wage, defined as total cash compensation including bonuses and other special payments divided by total hours worked for that quarter. This average wage is then used for calculating sickness and unemployment benefits.

## 4. Results

### 4.1. Education Structure of Employment and Relative Wages

The structure of enrollment by school type and level has changed significantly since the breakdown of the communist regime; in particular, enrollment in tertiary education has increased by over 50% (UIV, 1998). A simple view of the extent to which this recent development has affected the educational structure of the employee workforce is presented in the top two panels of Table 2. Relative supply of education, which one would expect to be linked to relative wage rewards of education, is presented for each gender and age group separately; this is motivated by the concern that workers with similar education but different age (experience) are not close substitutes.

Several facts stand out in Table 2:<sup>15</sup> (i) Czech employees over 45 have a lower overall level of education, (ii) the educational structure of enterprise employment is stable for workers between 31 and 44 years of age, who are most likely to hold an apprenticeship degree with no GCE, (iii) there has been an overall increase in the level of education for younger female employees, (iv) while the fraction of female employees with at least a college degree has increased for the younger cohorts, young men with tertiary education are relatively less likely to become employees in firms with over 10 workers, which are covered in the ISAE sample. The last finding corroborates earlier evidence from transition economies suggesting that young, well-educated men are most likely to move into the *de novo* sector consisting of self-employed and small newly started private firms (see e.g., Jurařda and Terrell, 2003).

The middle two panels of Table 2 show relative average wages of workers across education levels, conditional only on age and gender. The displayed statistic gives wage levels relative to the average wage of employees with a secondary degree with GCE within each gender and age group. Starting

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<sup>15</sup>Note that it is rare for one to attain a college degree before 23 years of age in the Czech Republic. Hence, the low fraction of college graduates in the youngest age group.

with women in the bottom panel, average wages appear similar for apprentices and employees with only primary education—both groups make on average only about 67% of the hourly wage level of workers with a GCE. This gap is surprisingly stable for all age groups above 24. Even for male workers, the benefits of an apprenticeship degree, relative to only primary education, appear small at about 5 percentage points.

While not having a GCE lowers hourly wages by about 30 percent, obtaining a college degree leads to wage rates that are nearly two times higher than wages of workers with a secondary education with GCE. The college/high school gap is “only” about 50% for workers aged 24-30, but this is likely driven by differences in experience, as high school graduates have accumulated more productive practice than college graduates of the same age. Finally, it is interesting to note that college/high school wage gaps are remarkably similar across gender.

The bottom two panels of Table 2 present an alternative comparison of relative wages based on medians as opposed to means. This alternative summary statistic is not sensitive to outliers and represents more closely the situation for “typical” workers. As expected, wage differences based on medians are somewhat smaller, but remain substantial. For example, a college educated male worker aged 31-37 whose wage is at least as high as that of half of all other similar workers faces hourly wage rates that are 65% higher than those of a typical worker in the same age category with only a GCE.

How does the Czech college/high school unconditional mean wage gap compare to those found in other countries? Brunello et al. (2000) document the size of the college/high school male wage gap in 10 European economies in the mid to late 1990s using data on workers who are approximately in the 45-51 age group. Their base group of high-school graduates covers upper secondary education (ISCED 3 and 4) and therefore closely corresponds to the definition of secondary education with GCE used in this paper. Furthermore, their sample of countries covers Austria and West Germany, two neighbors of the Czech Republic with a similarly low supply of tertiary education and a strong

tradition of vocational education. Brunello et al. (2000) define the college/high school gap as the log of the ratio of average hourly wages and find that this unconditional wage gap varies from a low of 0.28 in Italy to a high of 0.57 in Portugal. It equals 0.41 in West Germany and 0.37 in Austria.

Applying the same scale and focusing on the comparable group of (about 30 thousand available) male employees aged 45-51, the Czech data imply a college/high school wage gap of 0.60, much higher than most EU figures and even somewhat above the high level of Portugal. In particular, the Czech gap is about 50% higher than those of both Germany and Austria. Given that the gap is even higher for Czech workers aged 31-44, I therefore conclude that the returns to college degrees on the Czech labor market are extremely high in the West European context.

## 4.2. Mincerian Returns to Education

In this section, I estimate extended Mincerian log-wage regressions. First, I condition on education together with worker potential experience and its square.<sup>16</sup> Second, I additionally control for an extended set of firm characteristics including region of location, two digit industry, ownership type and a quadratic in firm size. The purpose of this exercise is twofold: (i) to estimate the widely used and comparable return to an additional year of schooling, often referred to as “benefits of education”,<sup>17</sup> and (ii) to check for the sensitivity of the benefits of education to the potential education-related differences in worker employment patterns across firm types.

Table 3 reports these results, namely the coefficients on education variables in log-wage regression equations.<sup>18</sup> The top panel of the table reports the returns to an additional year of schooling

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<sup>16</sup>Potential experience equals age minus 6 minus imputed years of schooling. For women, this measure overestimates the actual years of experience depending on the number of children and length of maternity leaves.

<sup>17</sup>Technically, they represent only the private economic benefits to education, while private returns would also reflect the private costs of education. Social returns to education would then incorporate various education externalities.

<sup>18</sup>The reported standard errors are robust to unconditional heteroscedasticity as well as to interdependence of error terms across workers of the same firm. See Jurajda (2003) for details.

based on years of schooling data imputed from the education degree using typical years of study.<sup>19</sup> The bottom panel shows the results of a separate estimation conditioning on a set of dummy variables for the highest degree obtained, with secondary education with GCE serving as the reference group.

The first two columns of Table 3 show parameter estimates from regressions where the only additional control variable is worker experience and its square. The results imply that wages of male (female) employees in the Czech Republic increase by about 11 (9) percent with each additional year of schooling. Comparing these estimates to those in the last two columns of Table 3, where I additionally control for many firm characteristics, suggests that these returns to schooling are not very sensitive to conditioning on employment patterns. Put differently, workers with relatively many years of schooling are only somewhat more likely to work in firms, industries and regions where wages are higher for all types of workers.

Examining the impact of specific degrees in the bottom panel of Table 3, it is clear that educational structure is a major determinant of wages even after controlling for other explanatory characteristics. Education degrees alone explain over 30 percent of the variation in raw wages. The estimated coefficients do not move by more than 4 percentage points when additional firm characteristics are accounted for, with the exception of the female dummy for apprenticeship degree.<sup>20</sup> The benefits of specific degrees are also quite similar across gender, even after conditioning on other explanatory variables.

Next, Table 4 lists the estimated returns to education for each age group, combining male and female workers and conditioning on the extended set of regressors. The returns to years of schooling

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<sup>19</sup>These estimates are subject to measurement error to the extent that students switch programs, repeat years of study or, alternatively, take unusually few years to complete a given degree. Münich et al. (1999) are able to compare estimates based on imputed years of schooling to those calculated off reported years in school. They find that the imputation-based Czech returns to education in 1996 are 0.8 percentage points higher than the correct estimates.

<sup>20</sup>The estimated returns are not overly sensitive to the weighting scheme either.

vary relatively little over age categories. The age trends in the estimated conditional returns to specific degrees (as compared to secondary education) are similar to those in the unconditional gaps in Table 2. Note that after imposing the same returns to experience for workers of all types of education, the returns to college are relatively higher for the young age group in Table 3.

Finally, we compare simple specifications of the returns to education degrees across 1998, 2000 and 2002. The structure and size of the 2000 data is similar to that of the 2002 sample. The 1998 data is described in Jurařda (2003); in comparison with the most recent data, the enterprise sector sample from 1998 contains only about one half of the 2002 firms and is less representative of the entire economy. The results presented in Table 5 imply that the education-related wage differentials have been constant over the 2000-2002 period. The 1998-2002 comparison suggests a large increase in the college/high school wage gap as well as a reduction in the penalty for not having any secondary education. However, given the low comparability of the data over time, I hesitate to draw strong conclusions.

## **5. Conclusions**

In this paper, Czech returns to years of schooling and to specific education degrees are estimated using 2002 data on hourly wages of salaried employees. The return to education is close to 10%, which is relatively high. Furthermore, the college/high school wage gap is much higher than those found in the EU economies. In particular, it is about 50% higher than comparable gaps in Austria or Germany, both of which have relatively similar educational systems and enrollment patterns. There is also some evidence that the gap has increased between 1998 and 2002. These findings are consistent with the interpretation that the continuing dramatic oversubscription of Czech public colleges is due to insufficient supply (lack of funding) and not to low cost (tuition-free). The short supply of college education apparently ‘bites’ on the Czech labor market.

Earlier estimates of returns to education (Filer et al., 1999) based on mid-transition data already

implied that the Czech returns to education have increased to a high level relative to the level of development (Psacharopoulos, 1994). One explanation for this fact is that one year of communist schooling supplies relatively less human capital. However, the analysis presented in this paper shows that returns are similarly high even for workers who were 11 to 17 at the time of the breakdown of communism. These findings are consistent with the presence of high demand for educated workers, driven perhaps by skill-biased technological change (Katz and Autor, 1999), combined with the traditionally limited supply of tertiary education.<sup>21</sup>

The economic costs of having relatively few college-educated workers are potentially large and diverse. Today, the country is less likely to attract high-value-added foreign direct investment that requires an abundant college-educated labor force. Tomorrow, the gains from technological innovations will be smaller. Finally, EU accession will open EU universities to Czech students on an equal-access basis. Those who are unable to get enrolled in local tertiary education are likely to do so abroad. To the extent that these future EU-based students will be unlikely to return to the Czech Republic upon graduation, the insufficient supply of college education may result in a brain drain.

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<sup>21</sup>One would expect that in the long run a country's technology reflects its relative endowment abundance, including the educational structure of the labor force. It would therefore be natural to expect the Czech economy to operate more vocational education-intensive blue-collar technology. Still, the emergence of IT and other "skill-biased" technologies may reinforce the relative lack of a highly educated labor force on the Czech labor market.

## Bibliography

- Brunello, G., Comi, S., and C. Lucifora (2000) "The College Wage Gap in 10 European Countries: Evidence from Two Cohorts," IZA Discussion Paper No. 228.
- Card, D. (2001) "Estimating the return to schooling: Progress on some persistent econometric problems," *Econometrica*, 69 (5), 1127-1160.
- Card, D., and T. Lemieux (2000) "Can Falling Supply Explain the Rising Return to College for Younger Men? A Cohort-Based Analysis," NBER Working Paper No.7655.
- Chase, R.S. (1998) "Markets for Communist Human Capital: Returns to Education and Experience in Post-Communist Czech Republic and Slovakia," *Industrial and Labor Relations Review*, 51 (3), 401-423.
- Filer, R., Jurajda, Š., and J. Plánovský (1999) "Education and Wages in the Czech and Slovak Republics during Transition." *Labour Economics* 6 (4), 581-593.
- Flanagan, R.J. (1995) "Wage Structure in the Transition of the Czech Economy," IMF Working Paper 95/36.
- Heckman, J.J., Lochner, L.J., and P.E. Todd (2003) "Fifty Years of Mincer Earnings Regressions," IZA Discussion Paper no. 775.
- Heckman J.J., and E. Vytlačil (1998) "Instrumental variables methods for the correlated random coefficient model - Estimating the average rate of return to schooling when the return is correlated with schooling," *Journal of Human Resources*, 33 (4), 974-987.
- Jurajda, Š. (2003) "Gender Wage Gap and Segregation in Enterprises and the Public Sector in Late Transition Countries," *Journal of Comparative Economics*, 31 (2), 199-222.
- Jurajda, Š, and K. Terrell (2003) "Job Growth in Early Transition: Comparing Two Paths," *Economics of Transition*, forthcoming.
- Katz, L.F., and D.H. Autor (1999) "Changes in the Wage Structure and Earnings Inequality," in Ashenfelter, Orley, and Card, David, Eds., *Handbook of Labor Economics*, Vol. 3, pp. 1463-1555. Amsterdam: North Holland.
- Krueger, A.B., and J.S. Pischke (1995) A Comparative Analysis of East and West German Labor Markets: Before and After Unification. In Freeman, R.B., and F. Katz, eds., *Differences and Changes in Wage Structures*, Chicago: The University of Chicago Press.
- Lubyová, M., and K.Z. Sabirianova (2001) "Returns to human capital under economic transformation: The cases of Russia and Slovakia," *Ekonomický časopis*. 49 (4), 630-662.

- Münich, D., Svejnar, J., and K. Terrell (1999) "Returns to human capital under the communist wage grid and during the transition to a market economy." Discussion Paper No. 29. Prague: CERGE-EI.
- OECD (1997) *Education at a Glance: OECD Indicators*, Paris: OECD.
- Orazem, P.F., and M. Vodopivec (1997) "Unemployment in Eastern Europe, Value of Human Capital in Transition to Market: Evidence from Slovenia," *European Economic Review*, 41, 893-903.
- Psacharopoulos, G. (1994) "Returns to Investment in Education: A Global Update," *World Development*, 22 (9), 1325-1343.
- Rutkowski, J. (1996) "High Skills Pay off: The Changing Wage Structure During Economic Transition in Poland," *Economics of Transition*, 4 (1), 89-112.
- Svejnar, J. (1999) "Labor Markets in the Transitional Central and East European Economies," in Ashenfelter, O., and D. Card, eds. *Handbook of Labor Economics*, Elsevier Science B.V., pp. 2810-2857.
- UIV (Ústav pro informace ve vzdělávání – Institute for information on education) (1998) *Školství na křižovatce* (Education at a Crossroad).
- Večerník, J. (2001) "Earnings disparities in the CR: Evidence from the nineties and a cross-national comparison," *Czech Journal of Economics and Finance (Finance a úvěr)* 51 (9), 450-471.
- World Bank (2001) *Czech Republic: Enhancing the Prospects for Growth with Fiscal Stability*, A World Bank Public Expenditure Review, Washington D.C.

**Table 1: Weighted Data Means**

Variable	Women	Men
Hourly wage (CZK)	74.6	102.4
Age	41.0	41.2
Firm employment	2,325	1,599
Number of workers	321,641	484,126
Number of firms	2,223	2,196

**Table 2: Educational Structure of Employment and Wages by Education, Gender and Age**

Education \ Age in	15-23	24-30	31-37	38-44	45-51	52-61	15-61
Men: % Share of Each Education Category on Age Group							
Primary	9	6	6	6	10	11	8
Apprenticeship, no GCE	60	58	56	56	59	55	57
Secondary with GCE	30	28	26	24	19	23	24
University and higher	1	9	13	14	12	11	11
Women: % Share of Each Education Category on Age Group							
Primary	11	7	9	15	28	26	18
Apprenticeship, no GCE	35	41	44	44	41	37	41
Secondary with GCE	50	43	39	35	27	33	35
University and higher	3	10	8	7	5	4	6
Men: Average Hourly Wage Relative to Secondary Education with GCE							
Primary	0.76	0.69	0.66	0.65	0.59	0.58	0.63
Apprenticeship, no GCE	0.83	0.75	0.71	0.70	0.66	0.65	0.70
Secondary with GCE	1.00	1.00	1.00	1.00	1.00	1.00	1.00
University and higher	1.09	1.51	1.94	1.91	1.81	1.77	1.85
Women: Average Hourly Wage Relative to Secondary Education with GCE							
Primary	0.76	0.66	0.67	0.65	0.63	0.61	0.66
Apprenticeship, no GCE	0.77	0.67	0.69	0.68	0.65	0.64	0.68
Secondary with GCE	1.00	1.00	1.00	1.00	1.00	1.00	1.00
University and higher	1.05	1.57	2.07	1.75	1.83	1.70	1.78
Men: Median Hourly Wage Relative to Secondary Education with GCE							
Primary	0.78	0.74	0.69	0.67	0.65	0.64	0.68
Apprenticeship, no GCE	0.87	0.80	0.77	0.74	0.72	0.71	0.76
Secondary with GCE	1.00	1.00	1.00	1.00	1.00	1.00	1.00
University and higher	1.14	1.34	1.65	1.59	1.58	1.54	1.58
Women: Median Hourly Wage Relative to Secondary Education with GCE							
Primary	0.76	0.71	0.69	0.67	0.67	0.63	0.69
Apprenticeship, no GCE	0.79	0.71	0.72	0.70	0.68	0.67	0.71
Secondary with GCE	1.00	1.00	1.00	1.00	1.00	1.00	1.00
University and higher	1.00	1.46	1.71	1.56	1.60	1.67	1.59

**Table 3: Estimated Mincerian Returns to Education in 2002**

	Gender	Men	Women	Men	Women
	Age group	15-61	15-61	15-61	15-61
<i>Years of schooling</i>		0.111	0.089	0.103	0.077
		(0.003)	(0.003)	(0.002)	(0.003)
<i>Returns relative to secondary education with GCE</i>					
Primary education		-0.407	-0.393	-0.378	-0.351
		(0.017)	(0.014)	(0.013)	(0.012)
Apprenticeship, no GCE		-0.302	-0.357	-0.263	-0.284
		(0.010)	(0.012)	(0.007)	(0.010)
University education		0.500	0.498	0.494	0.454
		(0.016)	(0.026)	(0.015)	(0.022)
<i>Control variables</i>					
Experience and its square		Yes	Yes	Yes	Yes
Firm controls		No	No	Yes	Yes

Note: All OLS coefficient estimates are highly statistically significant based on standard errors (in parentheses) allowing for clustering of unobservables within firms. Firm control variables are total employment and its square, industry, ownership and regional dummies.

**Table 4: Estimated Mincerian Returns to Education by Age**

	Gender	Both	Both	Both	Both	Both
	Age Group	24-30	31-37	38-44	45-51	52-61
<i>Years of Schooling</i>		0.090	0.105	0.100	0.087	0.087
		(0.004)	(0.004)	(0.003)	(0.002)	(0.002)
<i>Returns relative to secondary education with GCE</i>						
Primary education		-0.316	-0.362	-0.395	-0.405	-0.407
		(0.020)	(0.022)	(0.016)	(0.012)	(0.012)
Apprenticeship, no GCE		-0.210	-0.243	-0.282	-0.315	-0.343
		(0.011)	(0.009)	(0.010)	(0.009)	(0.009)
University education		0.448	0.535	0.511	0.468	0.431
		(0.026)	(0.027)	(0.025)	(0.024)	(0.021)

Note: All firm and worker control variables are included. See Table 3 for more notes.

**Table 5: Estimated Returns to Education over Time**

	Year	1998	2000	2002
<i>Returns Relative to Secondary Education with GCE</i>				
Primary education		-0.427	-0.370	-0.360
		(0.015)	(0.009)	(0.010)
Apprenticeship, no GCE		-0.271	-0.279	-0.272
		(0.013)	(0.008)	(0.006)
University education		0.409	0.481	0.482
		(0.030)	(0.020)	(0.014)

Note: The estimates are based on all workers and condition on all controls and the female dummy. For more notes see Table 3.



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