

Returns to the Market:

Valuing Human Capital in the Post-Transition Czech and Slovak Republics

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Abstract

An employer-based sample of over 660,000 Czech and 260,000 Slovak workers is used to estimate the benefits of education in 1995 to 1997. By 1997 education of all types had become substantially more highly rewarded in both countries than it was either under communism or in the early years of the transition. Education's value began increasing earlier and reached a higher level in the Czech Republic than in Slovakia. Findings suggest that returns to unmeasured human capital or productive characteristics have also increased. Only eight years after the fall of communism, returns to human capital were on average as large or larger than in comparable, developed market economies.

Abstract

Tento článek využívá informace o mzdách více než 660 tisíc českých a 260 tisíc slovenských zaměstnanců pocházejících z pravidelného firemního výběru k odhadům výnosnosti vzdělání v letech 1995 až 1997. V roce 1997 bylo vzdělání všech typů odměňováno nepoměrně lépe než za komunismu a výrazně lépe než v prvních letech ekonomické transformace. Hodnota vzdělání začala růst dříve a dosáhla vyšší úrovně v letech 1995 až 1997 na Slovensku. Výsledky dále naznačují, že hodnota neměřených lidských zdrojů a produktivních vlastností také vzrostla. Osm let po pádu komunismu hodnota vzdělání na trhu práce v letech 1995 až 1997 a na Slovensku dohnala a předešla úroveň obvyklou v srovnatelných vyspělých zemích.

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Introduction and Background

The collapse of communism in the late 1980s plunged the countries of Central and Eastern Europe into one of the most profound economic transformations of all time. Ten years later it is possible to begin assessing the impact of this process on basic economic phenomena. The current paper investigates levels of and changes in returns to human capital of various forms in the post-transition Czech and Slovak Republics.

Theoretically, the change from a planned to a market economy could involve either increases or decreases in measured returns to human capital. It is conventionally assumed that ideological considerations under communism overvalued the contributions of low-skilled proletarian workers while simultaneously devaluing the contributions of well-educated intellectuals, thereby producing lower rates of return to education than would typically be found in market economies.¹ This assumption suggests that the economic transformation of the past decade should result in increasing returns to education. On the other hand, it is possible that skills learned under communism may not be applicable in a market economy. Returns to experience may, therefore, fall during the transition, as may returns to schooling for those who completed their education prior to the economic transition.

Several studies have investigated changes in measured returns to education and other forms of human capital between the final years of communism system and the early years of market economies in various Central and Eastern European countries.² These studies are summarized in Svejnar (1998). In general, results have indicated that returns to education

¹Wage setting in planned economies was highly centralized. Czechoslovakia had a national matrix divided according to degree and experience with a base wage set for each cell. This base wage was adjusted up or down by a multiplier that reflected favored or disfavored regions or industries.

²See, for example, Jones and Ilayperuma (1994) for Bulgaria; Krueger and Pischke (1995) and Bird, Schwarze and Wagner (1994) for Eastern Germany; Halpern and Körosi (1997) for Hungary; Rutkowski (1997 and 1996) for Poland; and Orazem and Vodopivec (1997) for Slovenia.

increased during the transition, with a greater increase accruing to men, probably reflecting the fact that under communism returns to education were traditionally higher for women. Some studies also found evidence that returns to experience obtained under communism fell during the transition.

Two studies have investigated changes in returns to human capital between communist and post-communist eras in the Czech and Slovak Republics. Chase (1997) reports that returns to a year of education increased from 2.4 per cent for men and 4.2 per cent for women in 1984 to 5.2 per cent for men and 5.8 per cent for women in 1993 in the Czech Republic. In the Slovak Republic, returns to a year of education increased from 2.8 per cent to 4.9 per cent for men and from 4.4 per cent to 5.4 per cent for women during the same period. Examining specific types of education, Chase finds increases in returns to education were particularly large for male college graduates and female graduates from academic high schools. On the other hand, no increase in returns was observed for those with post-graduate education. Flanagan (1995) analyzes only the Czech Republic and reports similar increases from 3.4 per cent for men in 1988 to 4.4 per cent in 1993. Unlike Chase, however, he does not find any increase in annual returns to schooling for women during this period but finds a larger increase in returns to a high school degree than a university degree and reports a reduction in returns to experience.

The current research uses an extensive new data source to investigate returns to education in the Czech and Slovak Republics between 1995 and 1997 when the economic transition had progressed for a number of years. Returns to education are substantially larger by 1997 than those reported by either Chase or Flanagan for 1993. There is also evidence of modest increases in returns to experience in the Slovak Republic, in contrast to unchanged returns to experience in the Czech Republic, during the period under study. Unfortunately,

differences in data structure make it impossible to determine whether returns to experience in the sample are larger or smaller than those reported by Chase and Flanagan. In addition to the increases in returns to traditional measures of human capital, the unexplained variance of log wages increased substantially between 1995 and 1997, suggesting that returns to unmeasured human capital or productive characteristics have also increased. The overall pattern of the findings suggests that restructuring of the labor market proceeded more rapidly in the Czech Republic than in Slovakia and that reforms in wage structure to reflect individual differences in productivity were slower in the public sector than among private enterprises. By the end of the period under study, only seven to eight years after the fall of communism, returns to human capital were on average as large or larger than in comparable, developed market economies.

The Data

The data were obtained from surveys of employers conducted on behalf of the Czech and Slovak ministries of labor.³ The purpose of these surveys is to provide background information for use in tripartite negotiations on guidelines for increases in general wage levels involving the government, employer associations, and trade unions. Participating firms reported quarterly on wages and other characteristics for all workers they employed except top managers. Prior to 1998, no individual identifier was included so a panel data set could not be created from the individual quarterly data sets.⁴

³Both the Czech and Slovak republics also conduct quarterly labor force surveys of individuals. Unlike in the U.S. Current Population Survey, however, these surveys do not ask about wages. Thus, wage data reported by workers is only available from micro censuses conducted every five years, the last of which was undertaken in 1993 and was used by Chase for his analysis.

⁴Preliminary attempts to create a panel data set by matching individual records across years yielded too low a success rate to enable analysis.

Although collection of this data began in 1993, in the first two years small sample sizes and unrepresentative coverage may make conclusions drawn from it questionable. Analysis is therefore restricted to more recent years when coverage was generally representative of the entire economy and data collection methods were well established. The sample consists of all employees from responding firms for the first quarter of 1995, 1996, and 1997 for the Czech Republic and a randomly drawn one-in-three subsample of employees from responding firms for the third quarter of these years for the Slovak Republic. Since much of the analysis focuses on returns to education, observations that do not report education have been dropped from the sample. This criterion results in the exclusion of about 40 percent of the sample in the Czech Republic, and over 50 percent of the sample for 1995 in Slovakia, falling to about 16 percent in subsequent years.⁵ In the end, the sample analyzed ranges from 3.7 to 5.9 percent of the entire Czech labor force employed in 225 firms in 1995, 281 firms in 1996 and 497 firms in 1997. Comparable figures for Slovakia are 1.9 to 3.9 percent of the labor force employed in 205, 417 and 523 firms.

As can be seen from Table 1, the data set is reasonably representative of the full labor force with respect to gender, education, and age. It differs from the full labor force primarily with respect to industry. Observations have, therefore, been weighted by the ratio of the proportion of their industry in the each year's sample to the proportion of that industry in the economy as a whole in 1996, the middle year of the sample. Again as can be seen in Table 1, the weighted sample closely reflects the economy.⁶

⁵We examined the distribution of other variables for observations containing missing and reported values for education. In general there were no substantive differences except for a slightly higher propensity for education to be missing among women.

⁶Of course, given the enormous sample sizes involved, almost any difference will be statistically significant using conventional tests. Throughout this paper we rely, instead, on heuristic judgement as to when a difference appears economically meaningful.

As with most other data from transition economies, education is reported as the highest degree obtained rather than as years of schooling actually attended. The Czech and Slovak educational system provides several paths that students may follow. After eight years of primary education, students apply for various types of secondary school depending on their future career plans, with admission to over-subscribed programs rationed on the basis of exam performance. The lowest level of additional education available involves two years of vocational training. Four-year high school education is divided into three types: vocational education leading to a certification exam, specialized secondary education in professional fields such as nursing and engineering, and general secondary education in academic high schools known as *gymnázia*. Both specialized secondary school graduates and *gymnázium* graduates may continue on to university. In the Czech and Slovak Republics university education typically involves the study of a single field and lasts five years. Students desiring the most advanced degree typically continue for another three years of post-graduate study.⁷

As in other studies of returns to education in Central Europe, when treating education as a continuous variable, primary school graduates are assumed to have received 8 years of schooling, vocational graduates 10 years of schooling, secondary school graduates 12 years of schooling, university graduates 17 years of schooling, and those with post graduate degrees 20 years of schooling. These assumptions obviously introduce measurement error into the variable representing years of schooling.⁸ As will be seen below, the impact of inferring years

⁷Although the structure of the Czech and Slovak educational systems parallels those of other countries, they differ in that a smaller proportion of secondary school students typically enroll in general secondary education while a greater proportion follow a technical route. In 1995, 16 percent of Czech and 22 percent of Slovak secondary school students were in a general program, compared with 47 percent in a typical OECD country. As a consequence, enrollments in universities are correspondingly low as well. This suggests that, in the intermediate run, returns to general secondary and university education may be higher than in a typical OECD country.

⁸No data exist that would enable an estimation of the extent of this error, since neither any individual nor aggregate data source contains both degree and years of schooling. Under communism the educational

of schooling from degree obtained on estimates of the return to education may be substantial.

The data available do not contain reliable measures of actual work experience. Given that they also do not contain reliable measures of actual years of education, it seems to make little sense to calculate potential work experience. Indications of returns to experience are instead obtained by examining coefficients on age. This decision was reinforced by the fact that the Slovak data reported age only in discrete categories rather than in continuous years.

The dependent variable in all analyses is the logarithm of hourly wage. Each quarter, employers in the Czech and Slovak Republics are legally required to calculate for each worker an average hourly wage, defined as total cash compensation including bonuses and other special payments⁹ divided by total hours worked for that quarter. This calculated average wage is used for calculating sickness and unemployment benefits and is reported in the data set used for the current research.

Returns to Education

Results are taken from a basic Mincerian wage equation relating the log of wages to a set of dummy variables for the highest degree obtained (with primary school as the reference group). The control variables included the respondents' gender, age, industry of employment, region, a quadratic in firm size and the employer's ownership type.¹⁰ The first panel of Table 2

system was relatively rigid, so the error is likely to come mostly from those who repeat grades or change fields of study.

⁹It is common in the Czech and Slovak Republics for employers to pay 13th and 14th month salaries as bonuses in June and December. In calculating the average hourly wage these payments are spread over the following two quarters if the employer pays two extra salaries and over the following four quarters if the employer pays only one extra salary. The average hourly wage excludes sick pay, severance pay, profit sharing, and payments in kind or subsidies to commuting or to other consumption.

¹⁰In contrast to the primary variable of interest, education, observations where values of the control variables are missing are retained in the estimation, but a dummy variable is included in each regression and set equal to one when a given type of data is missing. The fraction of observations with missing values for

presents the coefficients on specific degrees in log wage equations compared with primary school graduates¹¹ in both the Czech and Slovak Republics for 1995, 1996, and 1997. We must emphasize that the conventional approximation suggesting that these coefficients be considered “returns” to education (an interpretation adopted by Chase and others examining transition economies) holds only for small values (coefficients less than about 0.25). For larger values the approximation breaks down. For example, a coefficient of 0.806 (the value for university graduates in the Czech Republic in 1997) implies an actual increase in earnings over primary school graduates of 124%.¹² In order to be consistent with previous work, we will in general report estimated coefficients, acknowledging where important that actual differences in returns are greater than those for coefficients.

Several results stand out in Table 2. First, returns to education are almost uniformly higher in the Czech than in the Slovak Republic. This conclusion is reinforced when it is recalled that the data for the Czech Republic were collected six months earlier than those for Slovakia. Second, returns to almost all types of education increased substantially between 1995 and 1997 as can be seen in the columns reporting the ratios of coefficients in 1995 and 1997. Third, the estimated returns to education for 1995 are substantially higher than those reported by Chase and Flanagan for two years earlier. This increase in the value of education

other variables was much lower than for education, typically 5 percent or less (except for ownership for the Czech Republic in 1996 which was about 25 percent). In addition, examination of the data strongly suggests that one firm in Slovakia misclassified the educational level of a number of its workers in 1995. Observations with this apparent coding error have been purged from results by including a dummy variable equal to one for these observations.

¹¹One caveat is in order. The data collection instrument asked for highest degree obtained. Thus, it omits some education for those who enrolled in, but did not complete, a higher degree. The one exception to this generalization is for the reference group with primary education. This group not only includes those who did not complete secondary school, but also those who did not complete primary school (there being no category for “none” with respect to highest degree). This is not likely to be an oversight but, instead, to reflect the very low proportion of Czech and Slovak workers who do not have at least a primary education (less than 0.5% according to recent labor force surveys).

¹²Evaluated as $\text{Inv}[e^{\text{coef}}] - 1$.

is especially notable for general secondary education, the type of schooling that was most likely to be undervalued when compared to vocational and technical education in the wage structure inherited from central planners at the beginning of the transition.¹³

Although it appears that the return to holding a university degree also increased substantially between 1995 and 1997, there may not have actually been any in the value of going to university for most graduates. To understand this point it is helpful to recall that most university graduates in the Czech and Slovak Republics first complete general secondary education¹⁴ where, as can be seen in Table 2, there have been particularly large increases in return. Thus, the greater earnings of university graduates when compared with primary school graduates can be decomposed into the difference between general secondary school graduates and primary school graduates, and the difference between university graduates and general secondary school graduates. Once these increases in the value of general secondary education are taken into account, there was no change in the apparent value of a university degree beyond that of an academic high school degree between 1995 and 1997 in either republic.

It is natural to ask how the returns to education during the latter part of the 1990's compare with those earlier in the transition. Unfortunately, reliable data from the source used for this paper do not exist prior to 1995. The current results can, however, be compared with those obtained by Chase for earlier years. In making this comparison, several caveats are in

¹³To simplify a long and generally arcane discussion, Marxist theory, following Adam Smith, divided labor into “productive” and “unproductive” categories. As a first approximation, productive labor was involved in direct production of physical commodities while unproductive labor was engaged in services and administration. Thus, communist national income accounts typically focused on “net material product” or the total value of physical commodities produced. Obviously, more highly educated workers and workers with a general rather than technical education were more likely to have been involved in unproductive and, therefore, undervalued labor.

¹⁴In 1992, for example, 61 percent of those who entered university came from a gymnázium and 32 percent from a special secondary (technical) school. The remaining 7 percent came from various other sources.

order. First, Chase estimates a somewhat different specification, using actual experience rather than age and omitting firm size. Second, he divides educational attainment into slightly different categories, thereby limiting the degrees for which direct comparisons can be made. Finally, in his published work Chase reports separate results for men and women. Since his estimated coefficients for the two sexes do not in general diverge substantially, results from the current estimation are compared in Table 3 to a weighted average of the male and female results reported by Chase for the three major educational groups where his study and the current research used roughly comparable definitions. In Table 3 we report the approximate returns to holding specific degrees rather than the raw coefficients from log wage equations. In both republics returns to education in 1995 and 1997 have clearly increased over the two years earlier reported by Chase. In addition, the rate of increase in returns to education appears to have accelerated, particularly in the Czech Republic. Given the necessary delay required for planning and implementing privatization of state-owned firms, most large firms in the Czech and Slovak Republics were not effectively in private hands until several years after the transition began.¹⁵ Thus, it is not surprising that labor market restructuring was also slow in getting under way.

Once restructuring began, it proceeded at a different pace in the two countries, a difference apparent in the results. Chase reports roughly equivalent increases in returns to various degrees between 1984 in 1993 in both the Czech and Slovak Republics, resulting in approximately equal returns to each level of education in the two republics in 1993.¹⁶ In the

¹⁵The most common form of creating private ownership in the Czech Republic involved voucher privatization. Shares from the first wave of this scheme were not distributed to their final owners until the middle of 1993, while those from the second wave were not distributed until early 1995. Slovakia participated in the first but not the second wave of voucher privatization and has generally been slower to privatize firms not included in the first wave.

¹⁶In this context it must be recalled that prior to 1993 the Czech Republic and Slovakia were joined in a single state with a single set of governmental policies. It is therefore likely that the early stages of the

years since 1993, however, rates of return to education increased substantially more rapidly in the Czech Republic than in Slovakia, resulting by 1997 in the generally higher value of human capital for the Czech Republic seen in Table 2.

The second panel of Table 2 reports estimated returns to each additional year of schooling when the respondent's years of schooling are inferred from his or her highest degree completed.¹⁷ Once again, the apparent returns to education of 6.5 to 9.0 percent per year are significantly greater than the 4.8 to 5.2 percent per year reported by either Chase or Flanagan for two years earlier. Returns to years of schooling measured in this way also apparently increased substantially between 1995 and 1997 in both the Czech and Slovak Republics.

As discussed above, however, estimates of returns to education measured using years of schooling inferred from highest degree achieved are likely to create measurement error problems, a factor not taken into consideration by previous studies of returns to education in post-communist countries. As an indication of the potential magnitude of this problem, the second panel of Table 2 also reports estimated returns to each year of schooling from an instrumental variables (IV) estimation where the first-stage equation includes one-digit occupational dummies as instruments for years of education.¹⁸ The effect of changing from OLS to IV estimates is to substantially increase apparent returns to education. Interestingly, the IV estimates no longer show an increase in returns to education between 1995 and 1997

transition from communism were more closely parallel across the two countries than developments since their split on January 1, 1993.

¹⁷Because these coefficients are considerably smaller, the approximation interpreting them as returns to each year of schooling is valid and will be used in the discussion that follows.

¹⁸These are not perfect instruments. While undoubtedly correlated with years of schooling, they may also be correlated with the extent of measurement error, particularly if students more often fail exams and have to repeat programs in fields of study, leading to certain occupations, or if certain occupations are more likely to attract students who switch fields of study partway through their education, thereby increasing the time to their degrees.

for the Czech Republic although an apparent increase in returns to education for Slovakia remains. It is not clear why the general pattern of increasing returns to education is not seen in the Czech Republic using this estimation technique, although the fact that the predictive power of the first-stage equation was substantially larger in 1997 than in 1995 may be reintroducing much of the measurement error.¹⁹ These results are reported primarily to introduce a cautionary note that previous studies attempting to estimate returns to education measured as a continuous variable for Central and Eastern European countries should be interpreted carefully unless the original data source contains an explicit measure of actual years of schooling. The remainder of this paper focuses on the more accurately measured returns to specific degrees completed.

Table 4 contains estimated coefficients for various degrees for men and women separately.²⁰ While it appears that increases in the value of education were greater for men than for women in the Slovak Republic, unlike in previous studies, there is no evidence in the current data that increases in education's value differs significantly between the sexes in the Czech Republic. Indeed, where there are differences, they apparently favor, women especially with respect to vocational training followed by an examination.

Estimates of the value of education for various age groups are presented in Table 5. As is usually found, the difference in earnings between those with only a primary school education and those with higher levels of education increases as workers age. In addition, the coefficients on each type of degree generally increase for all age groups in both republics

¹⁹The R^2 for the first stage in the Czech Republic was 0.61 in 1997, up from 0.53 two years earlier. In Slovakia, where the IV estimates of returns to education increase over time parallel to the OLS estimates, the first stage R^2 always remains under 0.50 and does not increase over time

²⁰Unless otherwise stated all results discussed include controls for age, industry, region, firm size and firm ownership status.

between 1995 and 1997. This finding strongly suggests that skills learned in school during the communist period has not been significantly devalued by the shift to a market economy. In the Slovak Republic the increase for each type of degree is roughly equal for all age groups. Indeed, if there are substantial differences, they are in the direction of greater increases in rewards for older workers with vocational training or general secondary training. In the Czech Republic, however, younger workers with secondary school training are clearly benefitting most from the economic transition in the years between 1995 and 1997. One logical explanation for this difference would be if industrial restructuring has proceeded further in the Czech Republic than in Slovakia.

Examination of coefficients for various age groups in the Czech Republic helps to clarify one paradox evident in Table 2. Taken as a whole, returns to post-graduate education fell between 1995 and 1997. When examined for individual age groups, however, this overall decline masks a more divergent pattern. Returns to post-graduate education increased between 1995 and 1997 among the youngest age group 20 to 29 years old after dipping in 1996, while they fell uniformly among middle-aged workers between 30 to 49 years old. Middle-aged workers with advanced degrees are likely to be practitioners in areas such as medicine and education where salaries have been severely restricted by budgetary pressures in the state sector. Younger workers with post-graduate degrees are likely to have chosen fields of study after 1989 in response to the demands of a market economy.

Education coefficients for workers in firms with private, foreign and state ownership are shown in Table 6.²¹ Here a clear pattern emerges. In general, the largest increases in the

²¹Cooperatives and firms with mixed ownership structures are not analyzed independently since their behavioral incentives are unclear. Ownership structure is determined by holding 50 percent or more of a firm's equity. If no type of owner has a majority, then the firm is classified as having a mixed ownership structure. The only exception is in the case of formal joint ventures between local and foreign firms, which were classified as foreign by definition.

value of education between 1995 and 1997 occurred for private-sector workers in Slovakia, followed by state-sector workers in the Czech Republic and employees of foreign firms in Slovakia. In contrast, however, little if any increase occurred for many types of workers employed by private-sector Czech or state-owned Slovak firms, while increases for workers in these sectors who did have a greater return to their degree in 1997 than in 1995 were relatively modest.

This suggests that reform in the wage structure in these two economies followed a well-defined sequence. Wages apparently were adjusted most rapidly among private-sector Czech firms, so that by 1995 the structure of wages in these firms already reflected differences in market valuation of various workers' productivity. Thus, in the initial year under study, returns to every degree were highest among workers in private-sector firms in the Czech Republic. Given the Czech Republic's unusually low unemployment rate among transition (or, indeed, among all European) economies,²² there was strong pressure on state-owned firms to revise their wage structure to conform to the higher wages available to more skilled workers in the private sector. Thus, by 1997 state-owned firms had closed much of the gap between their employees' wages and those of workers in the private sector.

Reforms apparently proceeded at a much slower pace in Slovakia, however, so that even by 1997 the structure of wages among private or foreign firms there did not exhibit as large a return to human capital as among private-sector Czech firms.²³ Finally, given the

²²In 1996, except for primary school graduates, who had an unemployment rate of about 10 percent, unemployment rates for other educational groups in the Czech Republic year were less than 3.3 percent for all educational groups and fell to as low as 0.5 percent for university graduates.

²³Foreign firms in the Czech Republic present a somewhat mixed pattern. We do not know how to interpret these results given that firms with foreign ownership tended to be highly bimodal, either being well-performing green-field investments or among the worst formerly state owned firms which were privatized to foreign buyers because they needed large injections of capital for restructuring. In Slovakia, which made less extensive use of voucher privatization, foreign ownership is not only more common, it spreads across a wider divergence of firms.

relative lack of reform and higher unemployment rates in Slovakia,²⁴ there appears to have been little upward pressure on wages for more skilled workers in state-sector firms in recent years and, consequently, little change in returns to education for these workers between 1995 and 1997.²⁵

Returns to Experience

Table 7 shows the earnings of workers of various ages relative to those less than 20 years old. Given that labor force participation rates for both men and women were extremely high in communist Czechoslovakia prior to 1989, the pattern of increases in earnings with age should provide a reasonable approximation of the value of experience. Here, there is a strong difference in the pattern of results between the Czech and Slovak Republics. In 1995, coefficients on age were higher in the Czech Republic than those in Slovakia for every age category except the oldest. By 1997 this gap had closed and returns to age were slightly higher for most age groups in Slovakia.

Even more striking is the fact that while the returns to every age category increased substantially in Slovakia, returns to age fell slightly for all but the youngest age group in the Czech Republic. This difference suggests that experience-related human capital acquired under communism lost some of its value in the Czech Republic but increased in value in

²⁴Slovak unemployment rates for 1996 were as high as 28 percent for primary school graduates and ranged from 11.2 to 13.6 percent for all other workers except those with specialized secondary and university education where they were 7.9 and 3.0 percent respectively

²⁵This sequencing of labor market restructuring can also be seen by comparing the returns to education between each country's capital city and elsewhere, results which are available on request. Once again, little evidence of increase in returns to education between 1995 and 1997 exists in Prague, where it is reasonable to speculate that rapid restructuring and extremely low unemployment rates (1.4 percent for all workers in 1996) may have resulted in wages having a market-driven structure by 1995. In other regions in the Czech Republic and in all of Slovakia, where restructuring may be presumed to have been slower, returns to education increased throughout this period.

Slovakia. Once again this pattern is likely to be due to more rapid and extensive restructuring in the Czech Republic, as well as perhaps to a greater persistence of administrative wage structures in Slovakia.

Returns to experience also differed across sectors. In all years they were higher at every age and grew more rapidly with age in the state sector than the private sector in both republics, not a surprising result if administrative wage systems using experience as an input were more likely to be retained in state enterprises.²⁶ Between 1995 and 1997 returns to experience rose among private-sector firms while falling in state-sector firms in the Czech Republic. They remained relatively constant in private-sector firms but increased slightly in state firms in Slovakia.

Returns to Unmeasured Human Capital

Overall, the variance of log wages increased substantially in both countries between 1995 and 1997. In addition, the variance in log wages was higher in the Czech Republic than in Slovakia for each year, suggesting a more flexible wage structure in the economy where transition had progressed further. This result can be seen in Table 8, which also shows the percentage of the variance in log wages that can be explained by the estimated wage equation. Several results stand out in this table in addition to the increase in overall dispersion of wages. In neither country does the ability to explain the variation in wages increase over time. Indeed, for the Czech Republic, the explanatory power of the Mincerian wage regression actually falls between 1995 and 1997.

The increasing importance of education as a determinant of wages discussed above can be seen clearly in the third row of Table 8, which shows the percentage of the variance in log

²⁶These results are not reported but are available from the authors on request.

wages explained by a regression that includes only the highest educational degree completed. In both countries, even though the full regression does not explain a greater proportion of the variance in log wages over time, education alone has substantially more predictive power in 1997 than it did in 1995.

The fact that the full equation is not able to explain more of the variance in log wages in 1997 than in 1995, coupled with the large overall increase in that variance means that a significant increase in the unexplained variance in log wages also exists between these two years, as shown in the final row of Table 8. The logical conclusion is that in addition to the increase in returns to measured human capital, especially schooling, there has also been an increase in returns to unmeasured individual characteristics, most probably unmeasured human capital and innate ability.²⁷

Summary and Conclusions

Overall there has been a substantial increase in returns to human capital during the transition from communism to a market economy in the Czech and Slovak Republics. The difference between the earnings of those with a primary school education and those with most types of education generally increased substantially between 1995 and 1997. By 1997 the earnings advantage accruing to most degrees was from two to three times larger than it had been in 1984 under communism. There is evidence that the rate of growth in returns to education accelerated as the transition progressed, but that by 1997 it may have slowed or even halted in areas where restructuring began earlier and had progressed further, such as

²⁷The alternative possibility is that there was an increase in the variance of unmeasured non-individual characteristics that influence wages (such as local unemployment rates). Economic conditions in the Czech and Slovak Republics were very stable in the period under study, however, making this possible explanation unlikely.

private-sector or Prague-based firms in the Czech Republic.

If true, this finding suggests that a similar slowdown in the rate of increase in returns to education should soon occur in the remaining sectors. This does not imply that no further increases in returns education will occur. Instead, it suggests that the process of revaluing human capital acquired under communism may be nearing its completion. Further increases in returns to education can be expected as new cohorts enter the labor market having made decisions during school to acquire human capital more in line with the demands of the market economy than was acquired by their elders who made educational choices distorted by the perverse incentives and admission quotas for specific programs established under central planning. Indeed, the potential of the decisions made by current students to further increase returns to education is indicated by very large increases in returns to education between 1995 and 1997 in the Czech Republic for workers 29 or younger.

Indeed, it is not surprising that increases in returns to education in the Czech and Slovak Republics have slowed in recent years since by 1997 these returns were generally similar to those found in other market economies. Recall that in 1997 the coefficient for college education as compared to primary school education for workers of each sex was about 0.80 percent in the Czech Republic and 0.70 percent more in Slovakia. Roughly comparable figures for other countries include 0.64 for the U.K., 0.73 for Western Germany, 0.56 for Italy 0.42, for Sweden, and 0.63 percent for Korea.²⁸

Increases in returns to education have occurred for almost every subgroup analyzed, although they have generally been greater in the Czech Republic than in Slovakia, in the private sector than in the public sector, and among younger workers. Rates of increase have

²⁸U.K. figures are for men with 20 years of experience, all others are for all males except Germany where women are also included. Results calculated from country studies by various authors in Freeman and Katz (1995).

been approximately equal for men and women.

Findings suggest that there have also been significant increases in the returns to unmeasured productive characteristics although not in returns to experience, at least as proxied by age. This latter result implies that, although experience acquired under communism has not lost value as potentially indicated in some previous research, in contrast to education it has not become significantly more valuable either.

Perhaps the most striking finding is the rapidity with which returns to education have adapted to the structure of a market economy. By 1997, a mere seven years after the fall of communism and six years after the start of economic reforms in the Czech and Slovak Republics, changes in the wage structure have been so massive that human capital acquired in school, even under central planning, was far more richly rewarded than previously. Indeed, in much less than a decade, labor market restructuring provided workers with returns on human capital that were at least as great as in long-established market economies.

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Table 1
Sample Characteristics

Variable	Czech Republic			Slovak Republic		
	Unweighted	Weighted	Labor Force Survey	Unweighted	Weighted	Labor Force Survey
Means						
Hourly Wage ^a	53.383	50.512	---	43.367	41.26	---
Primary School	0.1554	0.1479	0.1121	0.1522	0.1438	0.1058
Vocational School	0.4492	0.4289	0.4565	0.3899	0.3651	0.3921
Vocational w/ Exam	0.0542	0.0475	0.0122	0.0932	0.0816	0.0352
General Secondary	0.0389	0.0472	0.0400	0.0552	0.0645	0.0479
Special Secondary	0.2025	0.1911	0.2692	0.2172	0.2224	0.2920
University	0.0894	1264	0.1102	854	0.1116	0.1265
Post-graduate	0.0106	0.0110	A	69	0.0109	A
Years of Schooling	11.0118	112708	---	11.0936	11.3396	---
Age 19 or Less	0.0164	0.0175	0.0407	0.0154	0.0173	0.0273
Age 20-29	0.1921	0.1877	0.2248	2029	0.1920	0.2545
Age 30-39	0.2214	0.2175	0.2402	0.2813	0.2748	0.2939
Age 40-49	0.3028	0.3061	0.2973	0.3239	0.3266	0.2892
Age 50-59	0.2060	0.2156	0.1622	0.1580	0.1653	0.1243
Age 60 or More	0.0252	0.0434	0.0348	0.0152	0.0213	0.0108
Male	0.6200	0.5587	0.5627	0.5746	0.5229	0.5409
Prague / Bratislava	0.1376	0.2232	0.1251	0.2063	0.2167	0.0904
Industry						
Agriculture & Forestry	0.0210	0.0621	0.0601	0.0597	0.0869	0.0862
Banking & Insurance	0.0436	0.0132	0.0176	0.0067	0.0146	0.0178
Real Estate & Business Services	0.0113	0.0782	0.0758	0.0085	0.0669	0.0663
Public Administration	0.0334	0.0249	0.0333	0.0018	0.0333	0.0407
Education	0.0006	0.0478	0.0638	0.0537	0.0842	0.0835
Health & Social Work	0.0515	0.0549	0.0532	0.0836	0.0581	0.0576
Other Services	0.0153	0.0311	0.0301	0.0066	0.0415	0.0412
Mining	0.0783	0.0177	0.0171	0.0423	0.0112	0.0111
Manufacturing	0.6001	0.2949	0.2856	0.3859	0.2578	0.2555
Utilities	0.0539	0.0179	0.0174	0.0494	0.0241	0.0238
Construction	0.0249	0.0924	0.0895	0.0515	0.0692	0.0686
Trade & Repairs	0.0068	0.1587	0.1537	0.0193	0.1578	0.1564
Hotel & Restaurant	0.0023	0.0318	0.0308	0.0058	0.0182	0.0181
Transport & Communications	0.0571	0.0743	0.0720	0.2230	0.0739	0.0732
Firm Ownership						
Foreign	0.0116	0.0078		0.0447	0.0505	
Private	0.3897	0.4360		0.2202	0.2415	
Cooperative	0.0366	0.0427		0.0230	0.0518	
State	0.4583	0.3863		0.6472	0.5922	
Mixed Ownership	0.0150	0.0060		0.0559	0.0574	
N	662073	662073	4978400 ^b	221970	221970	2276800 ^b

^aReal wages in 1995 Czech and Slovak crowns (approximately 30 crowns to the U.S. dollar).

^bEstimate of total labor force. Characteristics based on an approximate 1 percent sample.

Table 2
Coefficients on Education Measures

Level of Education	Czech Republic				Slovak Republic			
	95	96	97	97/95	95	96	97	97/95
Vocational	0.108 (54.06)	0.094 (43.77)	0.135 (59.84)	1.250	0.128 (31.40)	0.122 (37.34)	0.110 (30.46)	0.859
Vocational w/Exam	0.227 (52.84)	0.233 (50.35)	0.315 (97.43)	1.388	0.139 (21.71)	0.168 (36.88)	0.197 (39.13)	1.417
General Secondary	0.302 (81.37)	0.336 (87.36)	0.418 (117.16)	1.384	0.198 -26.73	0.270 (55.07)	0.317 (59.20)	1.601
Special Secondary	0.370 (158.43)	0.375 (149.32)	0.445 (178.32)	1.203	0.314 (72.05)	0.322 (91.44)	0.355 (92.03)	1.131
University	0.645 (216.00)	0.676 (226.39)	0.806 (290.92)	1.250	0.576 (105.81)	0.626 (147.54)	0.682 (148.08)	1.184
Post-graduate	0.880 (88.20)	0.823 (115.58)	0.715 (110.61)	0.813	0.804 (62.50)	0.835 (79.34)	0.866 (74.20)	1.077
Years of Schooling	0.076 (245.70)	0.078 (254.49)	0.090 (345.79)	1.179	0.065 (118.00)	0.070 (165.77)	0.078 (168.43)	1.203
Years of Schooling (IV)	0.138 (246.00)	0.136 (259.69)	0.132 (345.45)	0.957	0.101 (103.58)	0.108 (144.73)	0.123 (158.22)	1.218
N	181780	187270	293020		42125	91076	88769	

T-Statistics in parentheses.

Table 3
Increased Earnings Compared to Primary School Graduates Over Time

Level of Education	Czech Republic				Slovak Republic			
	1984	1993	1995	1997	1984	1993	1995	1997
General Secondary	15%	27%	35%	52%	9%	30%	22%	38%
Specialized Secondary	20%	28%	45%	57%	16%	23%	36%	43%
University	40%	60%	92%	125%	40%	58%	79%	97%

Figures for 1984 and 1993 calculated from Chase (1998)

Table 4
Coefficients on Education by Sex

Male	Czech Republic				Slovak Republic			
	95	96	97	97/95	95	96	97	97/95
Vocational	0.112 (41.85)	0.109 (36.58)	0.132 (39.48)	1.179	0.096 (17.27)	0.119 (26.78)	0.100 (19.66)	1.037 *
Vocational w/Exam	0.198 (36.02)	0.196 (34.06)	0.233 (49.42)	1.177	0.101 (11.85)	0.129 (20.60)	0.176 (25.60)	1.743
General Secondary	0.258 (46.47)	0.284 (48.74)	0.36 (64.09)	1.395	0.160 (15.12)	0.215 (28.70)	0.256 (29.52)	1.600
Special Secondary	0.337 (101.15)	0.343 (93.42)	0.401 (104.41)	1.190	0.257 (38.74)	0.307 (60.01)	0.301 (51.31)	1.171
University	0.648 (173.41)	0.696 (176.52)	0.795 (201.62)	1.227	0.553 (73.89)	0.633 (110.68)	0.685 (105.21)	1.239
Post-graduate	0.916 (86.13)	0.897 (103.47)	0.756 (100.23)	0.825	0.838 (52.35)	0.911 (68.61)	0.900 (59.99)	1.074
N	117698	122191	170825		23849	53717	49984	

Female	Czech Republic				Slovak Republic			
	95	96	97	97/95	95	96	97	97/95
Vocational	0.095 (29.99)	0.073 (22.37)	0.113 (37.28)	1.192	0.158 (25.67)	0.115 (24.35)	0.113 (21.41)	0.715
Vocational w/Exam	0.249 (36.30)	0.297 (38.18)	0.365 (82.78)	1.466	0.199 (20.77)	0.253 (36.83)	0.239 (29.57)	1.201
General Secondary	0.336 (65.32)	0.345 (65.44)	0.445 (99.95)	1.324	0.259 (25.37)	0.325 (49.95)	0.384 (56.11)	1.483
Special Secondary	0.390 (116.53)	0.397 (113.21)	0.462 (144.52)	1.185	0.376 (64.53)	0.358 (75.43)	0.411 (79.71)	1.093
University	0.666 (130.38)	0.678 (143.38)	0.801 (201.94)	1.203	0.627 (78.75)	0.623 (100.02)	0.710 (107.71)	1.132
Post-graduate	0.711 (24.19)	0.748 (59.55)	0.669 (43.52)	0.941 *	0.829 (33.75)	0.808 (47.14)	0.901 (46.59)	1.087 *
N	64090	65079	122195		16804	35732	36521	

T-Statistics in parentheses.

*Difference in returns between 1995 and 1997 is NOT significant at the 1 percent confidence level.

Table 5
Coefficients on Education by Age

Age 20-29	Czech Republic				Slovak Republic			
	95	96	97	97/95	95	96	97	97/95
Vocational	0.058 (11.91)	0.042 (8.52)	0.098 (14.25)	1.695	0.068 (6.80)	0.080 (8.79)	0.056 (5.40)	0.830 *
Vocational w/Exam	0.138 (19.43)	0.152 (20.79)	0.237 (30.27)	1.717	0.092 (7.68)	0.133 (12.92)	0.125 (10.77)	1.353 *
General Secondary	0.170 (22.65)	0.193 (24.05)	0.333 (38.63)	1.959	0.179 (11.92)	0.157 (12.99)	0.217 (16.27)	1.212 *
Special Secondary	0.249 (44.51)	0.216 (37.83)	0.319 (43.81)	1.281	0.187 (16.84)	0.220 (22.18)	0.212 (19.07)	1.134 *
University	0.433 (60.04)	0.433 (61.68)	0.533 (66.58)	1.231	0.352 (26.37)	0.434 (37.50)	0.433 (33.75)	1.230
Post-graduate	0.268 (1.67)	0.160 (1.78)	0.378 (19.40)	1.410 *	0.341 (3.35)	0.185 (3.03)	0.337 (3.50)	0.988 *
N	34881	36926	55357		8841	18123	18024	

Age 30-39	Czech Republic				Slovak Republic			
	95	96	97	97/95	95	96	97	97/95
Vocational	0.094 (21.24)	0.064 (13.64)	0.131 (24.26)	1.399	0.096 (12.48)	0.082 (12.83)	0.070 (9.84)	0.736 *
Vocational w/Exam	0.207 (25.75)	0.190 (23.76)	0.313 (45.01)	1.512	0.116 (10.20)	0.122 (14.96)	0.158 (17.31)	1.362
General Secondary	0.305 (37.29)	0.273 (31.49)	0.418 (53.65)	1.370	0.176 (12.51)	0.220 (24.46)	0.244 (24.18)	1.386
Special Secondary	0.329 (65.54)	0.293 (54.22)	0.447 (77.08)	1.359	0.274 (34.15)	0.273 (39.48)	0.307 (40.13)	1.120
University	0.639 (111.93)	0.617 (103.85)	0.777 (127.82)	1.216	0.497 (52.90)	0.541 (69.47)	0.620 (72.33)	1.247
Post-graduate	0.924 (62.18)	0.690 (49.52)	0.592 (46.10)	0.641	0.726 (26.01)	0.655 (26.49)	0.490 (16.43)	0.675
N	41042	42162	63363		12264	25743	24437	

Age 40-49	Czech Republic				Slovak Republic			
	95	96	97	97/95	95	96	97	97/95
Vocational	0.094 (27.84)	0.086 (23.72)	0.126 (32.87)	1.335	0.125 (17.85)	0.117 (21.52)	0.106 (18.76)	0.848 *
Vocational w/Exam	0.280 (31.62)	0.240 (21.97)	0.310 (48.96)	1.107	0.129 (9.74)	0.159 (17.68)	0.198 (20.19)	1.535
General Secondary	0.357 (53.35)	0.400 (60.05)	0.468 (68.72)	1.311	0.190 (14.39)	0.300 (35.90)	0.352 (39.99)	1.853
Special Secondary	0.395 (99.77)	0.429 (99.12)	0.474 (109.46)	1.200	0.356 (48.28)	0.336 (57.93)	0.393 (65.48)	1.104
University	0.731 (135.37)	0.720 (135.50)	0.867 (175.76)	1.186	0.656 (68.37)	0.691 (96.01)	0.738 (97.86)	1.125
Post-graduate	0.786 (39.37)	0.721 (57.29)	0.689 (57.45)	0.877	0.733 (34.40)	0.836 (46.21)	0.875 (42.73)	1.194
N	58122	58432	83933		13062	29460	29375	

Table 5
(Continued)

Age 50-59	Czech Republic				Slovak Republic			
	95	96	97	97/95	95	96	97	97/95
Vocational	0.135 (30.79)	0.109 (23.46)	0.106 (23.18)	0.785	0.165 (16.26)	0.119 (16.51)	0.115 (13.82)	0.697
Vocational w/Exam	0.233 (16.50)	0.260 (16.35)	0.308 (39.47)	1.322	0.115 (5.73)	0.127 (9.48)	0.188 (12.92)	1.635
General Secondary	0.387 (45.59)	0.418 (52.72)	0.408 (52.16)	1.054 *	0.216 (11.41)	0.346 (27.78)	0.355 (26.83)	1.644
Special Secondary	0.432 (86.35)	0.421 (78.42)	0.460 (88.18)	1.065	0.394 (35.99)	0.390 (49.71)	0.414 (46.11)	1.051 *
University	0.696 (99.80)	0.776 (116.78)	0.860 (143.80)	1.236	0.718 (50.89)	0.711 (70.90)	0.799 (72.44)	1.113
Post-graduate	0.872 (35.71)	1.099 (72.73)	0.882 (61.01)	1.011 *	0.908 (33.78)	0.865 (44.88)	0.956 (44.48)	1.053 *
N	36746	40260	59371		6140	14535	14394	

Age 60 Plus	Czech Republic				Slovak Republic			
	95	96	97	97/95	95	96	97	97/95
Vocational	0.183 (12.26)	0.137 (9.40)	0.214 (16.84)	1.169 *	0.226 (5.05)	0.145 (5.75)	0.134 (3.58)	0.593 *
Vocational w/Exam	0.383 (6.82)	0.079 (1.12)	0.358 (16.72)	0.935 *	0.123 (1.73)	0.120 (3.05)	0.016 (0.24)	0.127 *
General Secondary	0.175 (6.04)	0.229 (8.18)	0.268 (10.34)	1.531 *	-0.027 (-0.33)	0.094 (1.45)	0.405 (5.17)	-14.934
Special Secondary	0.516 (25.23)	0.439 (23.44)	0.456 (28.61)	0.884 *	0.271 (5.92)	0.414 (13.88)	0.433 (10.19)	1.598
University	0.660 (30.44)	0.711 (40.12)	0.882 (54.42)	1.336	0.748 (13.40)	0.693 (23.90)	0.773 (18.65)	1.033 *
Post-graduate	1.052 (17.91)	0.918 (32.25)	1.022 (33.25)	0.971 *	1.057 (15.92)	1.009 (23.49)	1.019 (19.04)	0.964 *
N	3783	4542	8366		670	1615	1092	

T-Statistics in parentheses.

*Difference in returns between 1995 and 1997 is NOT significant at the 1 percent confidence level.

Table 6
Coefficients on Education by Firm Ownership Type

Private	Czech Republic				Slovak Republic			
	95	96	97	97/95	95	96	97	97/95
Vocational	0.152 (44.08)	0.128 (32.58)	0.135 (43.82)	0.888	0.091 (10.34)	0.105 (14.00)	0.129 (18.82)	1.416
Vocational w/Exam	0.278 (35.30)	0.298 (34.99)	0.248 (52.77)	0.892	0.110 (7.36)	0.130 (11.72)	0.228 (22.54)	2.073
General Secondary	0.338 (47.64)	0.338 (41.74)	0.419 (85.78)	1.240	0.200 (10.83)	0.205 (17.51)	0.289 (27.14)	1.445
Special Secondary	0.393 (91.53)	0.366 (74.87)	0.434 (124.60)	1.104	0.210 (21.11)	0.277 (33.42)	0.321 (41.02)	1.529
University	0.853 (141.43)	0.809 (120.94)	0.841 (207.92)	0.986 *	0.583 (45.93)	0.639 (63.10)	0.708 (69.57)	1.214
Post-graduate	0.750 (25.34)	0.850 (26.78)	0.926 (50.66)	1.235	0.826 (6.58)	0.973 (31.32)	0.942 (31.12)	1.140 *
N	51946	46820	159219		7763	18883	22228	

State	Czech Republic				Slovak Republic			
	95	96	97	97/95	95	96	97	97/95
Vocational	0.106 (41.22)	0.107 (31.55)	0.146 (46.80)	1.377	0.153 (30.79)	0.120 (33.61)	0.116 (26.77)	0.758
Vocational w/Exam	0.195 (34.82)	0.205 (28.06)	0.378 (91.06)	1.938	0.171 (24.22)	0.161 (33.42)	0.158 (27.52)	0.924 *
General Secondary	0.282 (64.29)	0.289 (51.29)	0.363 (73.93)	1.287	0.228 (28.31)	0.292 (56.75)	0.308 (51.45)	1.351
Special Secondary	0.337 (117.92)	0.368 (100.91)	0.424 (126.60)	1.258	0.359 (71.55)	0.335 (88.61)	0.371 (84.73)	1.033 *
University	0.538 (151.23)	0.607 (140.87)	0.741 (210.01)	1.377	0.569 (93.09)	0.591 (131.10)	0.638 (126.50)	1.121
Post-graduate	0.857 (83.99)	0.804 (110.63)	0.744 (119.08)	0.868	0.829 (66.09)	0.791 (78.80)	0.833 (70.81)	1.005 *
N	110901	75307	117220		28085	63396	52174	

Foreign	Czech Republic				Slovak Republic			
	95	96	97	97/95	95	96	97	97/95
Vocational	0.077 (2.58)	0.110 (3.37)	0.206 (10.46)	2.691	0.081 (6.36)	0.061 (2.74)	0.009 (0.60)	0.115
Vocational w/Exam	0.265 (6.05)	0.277 (6.14)	0.365 (11.03)	1.375 *	0.145 (5.17)	0.174 (5.47)	0.163 (7.59)	1.123 *
General Secondary	0.519 (11.47)	0.310 (6.98)	0.393 (13.26)	0.756 *	0.165 (4.92)	0.143 (3.90)	0.236 (9.33)	1.427 *
Special Secondary	0.342 (10.73)	0.373 (11.65)	0.398 (19.99)	1.162 *	0.220 (13.07)	0.232 (8.63)	0.289 (16.32)	1.314
University	0.610 (17.15)	0.615 (18.48)	0.776 (36.76)	1.272	0.642 (25.72)	0.709 (22.88)	0.781 (36.34)	1.218
Post-graduate ^a	0.904 (22.80)	0.667 (9.58)	0.776 (10.40)	0.858 *	0.463 (1.88)	0.984 (3.19)	0.198 (1.77)	0.428 *
N	1035	2188	4450		2276	2161	5490	

T-Statistics in parentheses.

*Difference in returns between 1995 and 1997 is NOT significant at the 1 percent confidence level.

^aNumber of observations is less than 10, making the coefficients unreliable.

Table 7
Coefficients on Experience (Age)

Age Group	Czech Republic				Slovak Republic			
	95	96	97	97/95	95	96	97	97/95
20-29	0.199 (44.14)	0.161 (26.79)	0.206 (36.77)	1.035 *	0.180 (17.22)	0.223 (28.08)	0.220 (25.36)	1.222
30-39	0.331 (74.12)	0.293 (48.87)	0.322 (57.62)	0.973 *	0.275 (26.59)	0.330 (42.10)	0.330 (38.40)	1.200
40-49	0.393 (89.37)	0.352 (59.51)	0.378 (68.24)	0.962 *	0.326 (31.64)	0.393 (50.32)	0.389 (45.47)	1.193
50-59	0.390 (86.61)	0.360 (60.08)	0.373 (66.81)	0.956 *	0.337 (31.80)	0.409 (50.95)	0.404 (46.04)	1.199
60+	0.107 (19.66)	0.098 (14.50)	0.089 (14.33)	0.830 *	0.129 (9.56)	0.199 (19.39)	0.220 (19.21)	1.705
N	181780	187270	293020		42125	91076	88769	

T-Statistics in parentheses.

*Difference in returns between 1995 and 1997 is NOT significant at the 1 percent confidence level.

Table 8
Explained and Unexplained Variation in Wages

Variance analysis	CR			SR		
	95	96	97	95	96	97
Variance of ln(w)	0.1561	0.213	0.2171	0.1254	0.1663	0.1891
% of variance ln(w) explained						
- using full specification	51.5	53.4	48.1	45.9	45.0	45.1
- using highest degree only	21.7	27.7	28.2	16.2	17.9	19.6
Unexplained variation using full specification	0.07585	0.0993	0.1127	0.06796	0.0916	0.1044