EDUCATION AND GROWTH IN TRANSITION COUNTRIES

by

Andrew Medvedev

A thesis submitted in partial fulfillment of
the requirements for the degree of

Master of Arts in Economics

National University "Kyiv-Mohyla Academy"
Economics Education and Research Consortium
Master's Program in Economics

2005

Approved by ____
Ms.Svitlana Budagovska (Head of the State Examination Committee)

____

____

____

Program Authorized
to Offer Degree Master's Program in Economics, NaUKMA

Date ____

National University "Kyiv-Mohyla Academy"

Abstract

EDUCATION AND GROWTH IN TRANSITION COUNTRIES

by Andrew Medvedev

Head of the State Examination Committee: Ms.Svitlana Budagovska,
Economist, World Bank of Ukraine

In this study we quantify the relationship between economic growth and the level of schooling in transition countries using Solow's aggregate production function augmented with human capital. We find that the relationship is negative and statistically significant and that 1% change in the level of schooling is associated with –0.67% change in GDP per worker. Explanations, such as signaling theory (Spence 1997), the hypothesis of rent seeking and low level of adoption of innovative technologies, are offered. To account for the level of adoption of new technologies we estimate the model, which includes FDI as a proxy for the former. The result obtained is both the level of schooling and FDI being statistically insignificant and we argue that the level of adoption of new technologies is not high enough to allow schooling to pay off in terms of economic growth.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

ACKNOWLEDGMENTS

I wish to thank my thesis advisor, Prof. Lilia Maliar, and Prof. Tom Coupe for their great support in writing this thesis.

Chapter 1

INTRODUCTION

Education has generally been considered to have positive effect on an economy's growth rates. "The claim that expanding education is good for economic growth seems intuitively obvious" (Pritchett 1996). But this belief is not always confirmed by empirical studies. A substantial amount of research has been done on the world data to determine the relationship between education and growth and the results have been different (Barro (1991), Sala-i-Martin (1997), Benhabib and Spiegel (1994), Spiegel (1994)). So far, no research has been done on the subject of education's influence on growth in transition countries. In this thesis we are going to estimate the effect that education may have on growth in transition countries. Transition countries are different from the rest of the world by having abnormally high levels of education for their per capita GDP (Spagat (2002)). Thus, the coefficients on human capital in aggregate production function estimated for transition countries may be relatively low, if positive. Education obtained before the beginning of transition may not be adequate to the market economy. In the process of transition the quality of education is improving but relatively slowly. For example, in 1990 Bulgaria adopted a new law on education introducing Western-style regulation of education and degree system but the process of awarding doctoral degrees remains very bureaucratic (Pleskovic et al (2002)). The faculty of the majority of educational institutions financed by state mainly consists of the same professors as in the socialist time, who do not have proper training. But education does not remain the sole prerogative of the government. Private educational institutions are appearing at a relatively fast pace in most transition countries. For example, no less than 279 institutions of higher education are registered in Georgia. Ukraine has 200 private educational institutions, in which only 1% of all students are enrolled, Belarus has 20. The only countries of the former Soviet that have almost no private educational institutions are Uzbekistan and Turkmenistan. Salaries of teachers in private institutions are up to 10 times higher than in public institutions (Pleskovic et al. (2002)).

Although the quality of education is improving with the development of private education, it remains rather low, thus, education may not be contributing positively to growth or even contribute negatively. The aim of this thesis is to find out, firstly, if education produces positive or negative impact on the rates of growth in real per capita GDP in these economies and, secondly, what the magnitude of this impact is. This question is important because it shows to what extent the growth in transition countries is driven by educational attainment.

Chapter 2

LITERATURE REVIEW

Since growth economists discovered that economic growth cannot be adequately explained by only two factors such as labor and physical capital human capital has become one of the central issues in growth studies (Griliches (1996)). The most challenging part of any research which deals with human capital is to determine how to actually measure it. Most frequently used approach to constructing a measure of human capital has been proxying it by some measure of education, which is considered to be the most important part of human capital. One can expect education to be positively related to growth rates because educated people are more productive workers and the more educated people in a given economy are the more this economy as a whole is adoptive to technological innovations that in turn increase productivity.

Several previous studies have shown that the level of education is positively correlated with per capita GDP growth across countries (Barro (1991), Mankiw, Romer and Weil (1992), Benhabib and Spiegel (1994)). Although these studies are related as they all quantify the relationship of education and growth, they do it using different poxies of human capital and different production function specifications.

Barro (1991) finds that initial level of human capital (proxied by 1960 enrollment rates) is positively related to growth in real per capita GDP in subsequent years (1960-1985). In this paper he regressed the growth in per capita GDP over the years 1960-1985 on several factors including 1960 enrollment rates. However, it was shown later by Barro and other researchers that enrollment rates cannot be considered good proxies for human capital.

Mankiw, Romer and Weil (1992) estimated the Solow model augmented with human capital. They assumed the production function for human capital to be the same as for physical capital, that is, human capital in a current period depends on human capital in the previous period, investment in human capital and the depreciation rate, which equals the depreciation rate of physical capital. They restricted the investment into human capital to the investment in education. So, in their paper the value of human capital was mainly determined by the investment in education, which was a very strong assumption. They found that the Solow model augmented with human capital explained the cross-country variation in income better than the original model, which accounted for only physical capital and labor. In this thesis we are going to estimate Solow aggregate production function with human capital as it is suggested by Mankiw, Romer and Weil (1992) but using a different proxy for human capital.

Benhabib and Spiegel (1994) run cross-country growth accounting regressions using Cobb-Douglas production function enhanced with human capital and found that human capital had a negative and insignificant effect on growth in real per capita GDP, which was a surprising result. They used Kyriacou's (1991) estimates of average years of schooling for the work force in 1965 and 1985, Summers and Heston's GDP and labor force data and a measure of physical capital derived from investment flow for the sample of 78 countries. They found that human capital did not contribute significantly to GDP growth as an input into aggregate production function. However, when they constructed a model of the human capital's effect on growth through faster adoption of technology human capital showed positive impact on growth (Benhabib and Spiegel (1994)).

The progress of economic research on the relationship of growth and human capital can be followed if one considers the quality of the proxies of measures of human capital that researchers used in their studies. In his early research Barro (1991) used enrollment rates as a proxy for human capital but the implications of this study are limited, as these data "do not adequately measure the aggregate stock of human capital available contemporaneously as an input to production" (Barro 2000). Using only enrollment rates in previous periods it is impossible to determine the years of schooling of the labor force in a given period and, thus, it is impossible to quantify the share of educational capital in aggregate production. Later studies (Barro and Lee (1996)) used estimates of educational attainment as a proxy for human capital. However, educational attainment as a proxy for human capital also has a number of shortcomings: first, it does not take into account the quality of education and, second, it is only one part of the stock of human capital that an individual possesses – the other part is the experience gained after formal education, and that was not taken into consideration in Barro and Lee (1996).

Other approaches to explain the relations of education and growth more accurately were used by a number of researchers. To study how the quality of education relates to growth Hanushek and Klimko (2000) conducted a cross-country analysis using international test scores in science and mathematics and found that test scores were positively related to growth rates of per capita real GDP. Barro (2000) got the same result using a different data set. Two important facts that can be pointed out from these two studies suggest that the test scores are useful for explaining per capita growth in real GDP: the correlation of average years of schooling with the test scores in 1995 in Barro-Lee data set is as low as 0.38 and both the test scores and the average years of schooling are significant when included in growth regression (Hanushek and Klimko (2000)). This suggests that test scores provide additional information and test scores and average years of schooling can explain GDP growth better than average years of schooling alone.

A different approach to constructing a reasonable measure of human capital is measuring the human capital by the outcomes of labor market as, for example, done by Pritchett (1996). In his paper he used market value of human capital and showed that enrollment rates are not a good proxy for human capital stock because they appear to be uncorrelated with human capital growth rates. He constructed human capital stock using wage differentials of population groups with different numbers of years of schooling. To make sure that his results are robust to the choice of sample he conducted his research using both Barro-Lee and Nehru-Swanson-Dubey data sets, which are the most comprehensive data sets for the levels of educational attainment, that were available at that time and also today. The main finding of this paper is that the correlation of growth rates of educational stock with growth rates of real per capita GDP is negative. This finding contradicts the widely accepted idea of the positive economic effect of education but is consistent with previous studies (Benhabib and Spiegel (1994)).

Human capital is a very complex economic variable and it is hard to measure it precisely. The stock of formal education is a proxy for it but it is only one part of human capital. It is possible to include other necessary components into the constructed measure of human capital stock by specifying a production function of human capital, as it was done by Bils and Klenow (2000). The main idea of their research was to find the causal effect of schooling on growth. They first computed the correlation of 1960 enrollment rates with growth rates in real GDP in subsequent years using a sample of 93 countries. After that, they reduced this correlation coefficient to the correlation coefficient of combined growth rates in technology and human capital by assuming a certain share of physical capital in total output. To construct a measure of human capital stock they specified a human capital production function consistent with Mincer's equations that had been estimated by labor economists in many countries. In this their approach is different from that of Mankiw et al. (1992) who assumed that "the same production function applies to human capital, physical capital and consumption" (Mankiw, Romer and Weil (1992)). Having estimated growth rates of human capital stock they regressed them on 1960 enrollment rates and found that the growth in human capital caused by growth in schooling can only account for no more that one-third of the correlation of enrollment rates with growth. Further in their work they expanded the schooling's influence on growth by including the effect of schooling on technology adoption. But even after that the channel from schooling to growth was not able to explain a significant part of the empirical relation of 1960 enrollment rates with growth. After finding that, they constructed a model explaining the effect of expected growth on schooling and after calibrating it concluded that it was capable to generate much of the empirical coefficient. The results of this study provide scientific evidence on the fact that enrollment rates are not good proxies of human capital.

After quantifying the effect of education on growth in transition countries in this thesis we will compare the results to the findings of microeconomic studies done for this region. Those include Herasym (2004), Nesterova and Sabirianova (1998), Clark (2000), Orazem and Vodopivec (1994), Chase (1997). All these studies report positive returns to schooling in transition countries on micro level in a number of years.

C h a p t e r 3

DATA DESCRIPTION

For our analysis we will use the yearly data on GDP, the stock of physical capital and the stock of educational capital for 12 transition countries for the period 1990 – 2000. The data set we have is an unbalanced panel as observations of educational capital are not available for every country in every year. The data on GDP is taken from Worldbank's World Development Indicators Online and is measured in 1995 US$. To get per worker quantities it is divided by total labor force, which is taken from the same database. The data for physical capital stock was provided by Oleg Badunenko. For his analysis of the causes of growth in the world and changes in world income distribution during 90's (Badunenko (2003)) he estimated the stock of physical capital for 23 transition countries for years 1950 – 2000 using perpetual inventory method and methodology of Penn World Tables (Summers and Heston (1991)) and methodology of Nehru and Dhareshwar (1993). He estimated the initial level of capital stock using the following formula:

$$K_0 = I_0 /(g + \varphi) \ ,$$

where g is computed as the average growth rate of the investment series, and I_0 is the value of the first observed investment level (Badunenko (2003)). He assumed φ equal to 0.06 for all countries. The stock of physical capital in each period is then computed using the following rule:

$$K_T = (1 - \varphi) \cdot K_0 + \sum_{t=0}^{T-1} I_t (1 - \varphi)^t$$

To get per worker quantities we divided the data by employment.

The stock of human capital is proxied by average years of education of labor force. It is calculated using the data on educational attainment of labor force from World Development Indicators Online, namely labor force with primary education (% of total), labor force with secondary education (% of total) and labor force with tertiary education (% of total). Then, we collected the data on the duration of primary and secondary school in the countries on our list; it can be found in Table 1.

Table 1: Duration of primary and secondary school by countries

Country	**Primary School**	**Secondary School**
Bulgaria	8	4
Croatia	8	4
Czech Republic	9	3
Estonia	9	3
Hungary	7	5
Latvia	9	3
Lithuania	9	4
Poland	9	3
Romania	8	4
Russian Federation	9	3
Slovakia	9	4
Slovenia	8	4

The sources for these data are the web sites of the ministries of education and World Education News and Review (http://www.wes.org/ewenr/).

It is difficult to determine the number of years a person with tertiary education possesses because she can hold a bachelor's, a master's or a Ph.D. degree and we do not know which one. Therefore, we decided to ignore master's and Ph.D. degrees and to assumed a person with tertiary education has a only a bachelor's degree, which, of course, makes the estimates of average years of education less accurate but, intuitively, the extent of such error is small. For example, in 2000 3091 Bulgarian nationals were trained as doctorands in Bulgarian universities, which is 0.074% of the labor force of Bulgaria in that year. We can expect the number of people holding a doctor's degree be of the same order and it suggests that ignoring it will not seriously influence the results of our analysis.

To get average years of schooling we weight the durations of primary, secondary and tertiary education by the percentages of labor force having corresponding levels of education and sum them. The shortcoming of measuring average years of schooling in this way is that a worker with a certain level of education may have incomplete education of higher level and, thus more years of schooling. Another drawback is that average years of schooling is not a perfect proxy for human capital stock because it only measures a part of it. It does not measure the quality of education and does not account for the experience gained on the workplace and in other ways. Better health system can increase the productivity of the labor force. There are formal and informal occupation specific training programs, firms' internal training programs for employees, wage increments to seniority that can be called a part of human capital (Pritchett (1996)). Unfortunately, data on international test scores for students from transition countries, which can be a good proxy for the quality of education, and data on work experience and on-the-job and informal education of labor force are not available.

Another problem is that our estimates are average years of schooling of the labor force whereas we need estimates of average years of schooling of employment. This approximation also makes the results less reliable.

Descriptive statistics of the variables (before taking logarithms) are presented in Table 2.

Table 2: Descriptive statistics of variables

Variable	**gdp** (GDP in constant USD)	**pc** (stock of physical capital in constant USD)	**sch** (average years of schooling)	**fdi** (FDI in constant USD)
Number of observations	129	132	73	107
Mean	7913.627	11895.73	11.58622	97.60195
Std. Dev.	4433.843	5863.809	.7813804	101.3004

Correlation between stock of physical capital and average years of schooling is 0.2058.

Average years of schooling by country can be found in the Table 3.

We also use the variable of FDI in our alternative regression to proxy for the level of adoption new technologies. The data on FDI is taken from World Development Indicators Online. The series of FDI is incomplete and there are missing observations. But for most years for which average years of schooling is available FDI is also available. Only 4 observations of average years of schooling are not matched by FDI.

Table 3: Average years of schooling by country

Country	**Average years of schooling**
Bulgaria	11.292
Croatia	10.327
Czech Republic	11.266
Estonia	12.566
Hungary	11.216
Latvia	11.511
Lithuania	12.814
Poland	11.269
Romania	10.721
Russian Federation	12.139
Slovakia	12.596
Slovenia	11.265

C h a p t e r 4

METHODOLOGY

3.1 Specification of the model

We will estimate the logarithmic form of Solow aggregate production function represented in per worker quantities and enhanced with human capital. The model represented in levels is described by the equation:

$$Y_t = A(t) * K_t^{\alpha} * L_t^{\gamma} * H_t^{\beta}$$

To convert it into per worker quantities we divide it by labor force and get:

$$y_t = a(t) * k_t^{\alpha} * h_t^{\beta} ,$$

where lower case represents per worker quantities.

Then, if we take logs of both sides we get:

$$\log(y_t) = \log(a(t)) + \alpha * \log(k_t) + \beta * \log(h_t)$$

So, we have to estimate the following regression:

$$\log(y_t) = \hat{\delta} + \hat{\alpha} * \log(k_t) + \hat{\beta} * \log(h_t) + \nu_t$$

The dependant variable is log of GDP per worker and the explanatory variables are stock of physical capital per worker and stock of human capital per worker.

3.2 Method of estimation

To determine the appropriate method of estimation we run a number of statistical tests: F-test to choose between pooled and fixed-effects regression, F-test to choose between pooled and random-effects regression and Hausman test to test whether random-effects estimates are consistent. The results are presented in Table 4. We choose fixed-effects as preferred method of estimation.

Table 4: Statistical tests

Test	**P-value**	**Result**
Pooled vs. Fixed	0.0000	Fixed-effects is chosen
Pooled vs. Random	0.0000	Random-effects is chosen
Random-effects estimates are consistent	0.0221	Fixed-effects is chosen
Heteroscedasticity	0.0293	Heteroscedasticity is present

To detect heteroscedasticity we first run least squares dummy variables regression (LSDV) and then run Breusch-Pagan/Cook-Weisberg test for heteroscedasticity and reject the hypothesis of constant variance at 5% level of confidence. Although this is an unpleasant result, we know that heteroscedasticity is a very common phenomenon and fixed effects partially solve the problem: in fixed effects model we can use the same procedure to estimate the variance of the fixed effects with or without heteroscedasticity (Greene (2000), p. 579).

However, fixed-effects do not fully solve the problem and we also run LSDV and report the results of both methods.

Due to the fact that all our explanatory variables are stock variables, theoretically, endogeneity between them and GDP is unlikely. On the one hand, stocks of physical capital and human capital affect GDP in a given year because they are inputs into aggregate production function. On the other hand, theoretically, it is unlikely that the level of GDP in a given year affects stocks of physical capital and human capital in that year because the latter are the outcomes of the previous long accumulation processes and, thus, are not sensitive to contemporaneous GDP variations.

Chapter 5

RESULTS

5.1 General results

Regression results are presented in Table 5. In LSDV regression both coefficients are statistically significant at 10% level of confidence, the coefficient on physical capital is positive, which is intuitive, and the coefficient on average years of schooling is negative, which is counter-intuitive. The results of other estimation methods – fixed-effects and OLS with robust standard errors – are also included in the table to show that the sign of the coefficient on average years of schooling is also negative for other methods. P-value is 0.091, therefore, schooling is statistically significant only at 10% level of confidence.

Scatterplot of GDP and average years of schooling for all countries in the sample is displayed in Figure 1. On the scatterplot we see that Slovenia has per worker levels of GDP much higher that the other eleven countries. To test if it affects the regression results we excluded Slovenia from the sample. Regression resulted, as before, in the coefficient on average years of schooling being statistically significant and negative. Also, Croatia in 1991 has very low level of schooling in comparison with other observations and, hypothetically can drive the result. However, if we exclude it from the sample the result does not change.

The coefficients obtained with fixed-effects and LSDV are exactly the same. However, the standard errors are different. In fixed-effects average years of schooling is significant at 5% level of confidence while in LSDV it is only significant at 10% level of confidence.

Table 5: Estimation results

Variable	Coefficient	St. Error	P-value
LSDV regression with robust standard errors			
Physical capital per worker	1.287604	.2031523	0.000
Average years of schooling	-.6722843	.3916439	0.091
R^2 = 0.9853			
Fixed-effects regression			
Physical capital per worker	1.287604	.2383606	0.000
Average years of schooling	-.6722843	.3348655	0.049
R^2: within = 0.3489; between = 0.3856; overall = 0.4851			
Pooled OLS regression with robust standard errors			
Physical capital per worker	.6607936	.0770124	0.000
Average years of schooling	-1.724847	.6933565	0.015
R^2 = 0.5395			

Having obtained the coefficients we can quantify the schooling's relationship with growth:

Ln(GDP) = 1.29 * ln(physical capital) – 0.67 * ln (average years of schooling) + e

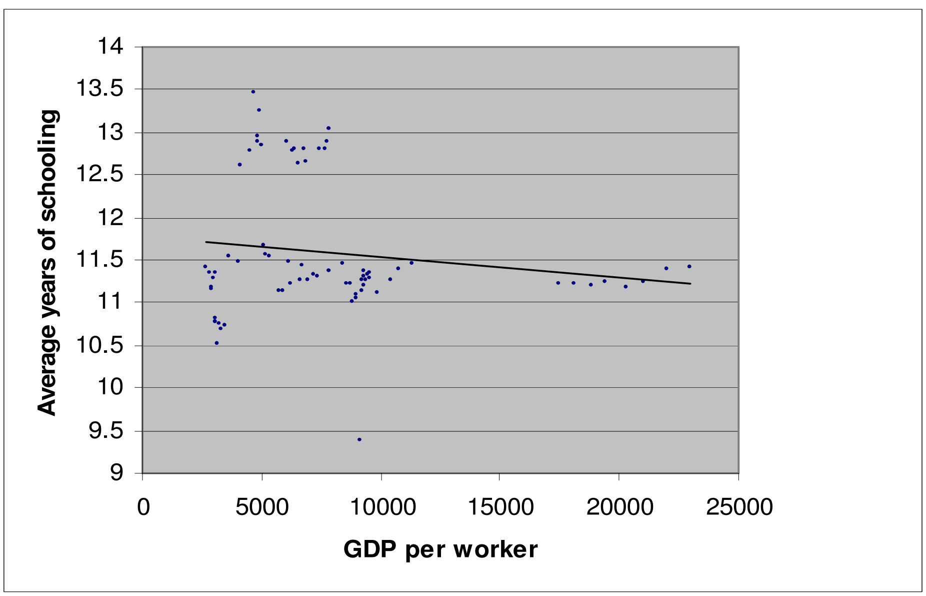
Taking the total differential:

$$\frac{\partial(\ln GDP)}{\partial GDP} * \Delta GDP = 1.29 * \frac{\partial \ln(PC)}{\partial PC} * \Delta PC - 0.67 * \frac{\partial \ln SCH}{\partial SCH} * \Delta SCH + e,$$

$$\frac{\Delta GDP}{GDP} = 1.29 * \frac{\Delta PC}{PC} - 0.67 * \frac{\Delta SCH}{SCH} + e$$

According to the above expression, 1% change in average years of schooling is associated with –0.67% change in GDP per worker.

Figure 1: Scatterplot of GDP per worker and average years of schooling



These results appear to be in line with what other researchers found: for example, Benhabib and Spiegel (1994) and Spiegel (1994) based on estimates of human capital created by Kyriacou (1991) and Pritchett (1996) based on Barro-Lee and

Nehru-Swanson-Dubey data sets. Kyriacou's data set includes estimates of average years of schooling of labor force in 68 countires; Barro-Lee data set includes estimates of average years of schooling of the population aged 25 and over in 98 countries. Spiegel (1994) showed that result negative relation of education and growth was robust to the choice of sample and to the inclusion of auxiliary variables (dummies for SSA and Latin America, size of the middle class, political instability, share of machinery investment) (Pritchett (1996)).

Pritchett offers the following explanations for his findings:

- schooling does not raise cognitive skills, although it raises personal wages;
- the demand for educated labor is low in the countries where the adoption of new technologies is low, and the returns of education are falling rapidly
- institutional environment in some countries created incentives for educated labor to flow to economic activities that can reduce economic growth, for example, excessive bureaucracy or overmanned state-owned enterprises.

These three explanations provide reasoning to why education may have no effect on growth, but they do not answer the question, why education may have a strong and negative effect on growth.

5.2 Comparing macro level results with micro level results

From research studies on micro level we can see that education has positive effect on personal earnings (the results of some studies are presented in Table 6). This fact supports the idea that schooling is a productive resource because employers are willing to pay more to more educated people. Then, it remains counter-intuitive that schooling does not positively influence aggregate output. However, it could, to some extent, be explained by signaling model (Spence 1997), which suggests that level of schooling itself does not mean productive skills but is a signal to an employer that a person possesses high innate abilities. It is impossible for us to test if schooling is a signal in our sample of countries because we cannot obtain data on measure of innate ability. The studies aimed to test the model mainly found that there was little evidence of schooling being just a signal, for example, Knight and Sabot (1990) for Kenya and Tanzania, Glewwe (1991) for Ghana, Alderman, Behrman, Ross and Sabot (1996) for Pakistan (Pritchett (1996)). If we assume that the signaling theory is true, we can explain the absence of schooling's influence on growth and, also, statistically significant negative effect, which we obtained: if schooling is just a signal then there is an excessive amount of resources spent on this signal in the form of education and this signal could be created by cheaper means, so, the resources spent on education, which is not productive, reduce growth.

Table 6: Rates of Return to Schooling in Transition Economies (Selected Studies)

Authors	Country	Pre-transition			During transition			Data
		Males	*Females*	*M and F*	*Males*	*Females*	*M and F*	
Flanagan (1994) (as cited in Svejnar, 1999)	Czech R.	0.034	0.054	0.044	0.044	0.053	0.049	1988 and 1991 surveys
Orazem and Vodopivec (1994)	Slovenia	*Vocat School* *Middle School* *University*		0.163 0.319 0.715	*Vocat School* *Middle School* *University*		0.201 0.406 0.943	1987 and 1991 data
Chase (1997) (from Svejnar, 1999)	Czech R. Slovak R.	0.024 0.028	0.042 0.044		0.052 0.049	0.058 0.054		1984 and 1993 micro data
Rutkowski (1997) (from Svejnar, 1999)	Poland			0.05			0.07-0.078	1987, 1992 and 1995-96 micro data
Campos and Jolliffe (2004)	Hungary			0.064			0.112	1986 and 1998 micro data

Source: Herasym (2004)

5.3 Omitted variables

One possible reason for the years of schooling being negatively correlated with GDP is omitted variables.

The first candidate for an omitted variable is the quality of schooling. In his paper Pritchett (1996) discusses the consequences of not accounting for the quality of schooling. He argues that accounting for it can only make the coefficient on schooling more negative because excluding the quality of education from the analysis would bias the estimates upwards due to "general underlying positive covariance between quantity and quality of schooling" (Schultz (1988)). This suggests that, if we include some measure of the quality of schooling in the model, it would make the estimates of the coefficients on schooling even more negative. But we only can predict it theoretically and do not know if this prediction would be supported by the data. To do it we would need the data on some measure of the quality of schooling, such as international test scores, which we do not have.

Another candidate for an omitted variable is the level of adoption of new technologies. The findings of this thesis could be explained by the fact that if there is low level of adoption of new technologies in an economy schooling will not pay off in aggregate output because there will be some level of education above which the education will become not productive because the level of technology of aggregate production will not allow a person with more years of education to be more productive than a person with some lower level of education. Again, this can only explain no effect of schooling on growth, but not negative effect.

To assess the level of adoption of new technologies in transition countries we can look at levels of FDI. Borensztein et al. (1996) studied the effect of FDI on economic growth in developing countries using the sample of 69 countries over the period 1970 – 1989 and found that FDI was an important means of transfer of new technologies, contributing relatively more to growth than domestic investment.

In the table below there are the figures of per capita FDI for the countries in our sample for year 1996.

Country	**Per capita FDI in 1996, USD**
Bulgaria	16.44
Croatia	107.37
Czech Republic	124.15
Estonia	77.83
Hungary	231.98
Latvia	152.03
Lithuania	42.24
Poland	115.10
Romania	11.63
Russian Federation	11.22
Slovakia	56.41
Slovenia	83.60

With Hungary being the country with the highest per capita FDI, the figures for other countries are very different – from the lowest of 11.22 to the highest of 152.03. Thus, if, indeed, FDI is a proxy for adoption of new technologies there is a possibility that in some countries with low levels of FDI (and adoption of new technology) some years of schooling of labor force can be not productive.

To determine the hypothetical influence of FDI we included the variable fdi into the model. Regression results are presented in Table 6.

Table 6. Estimation results (model with FDI)

Variable	Coefficient	St. Error	P-value
LSDV regression with robust standard errors			
Physical capital per worker	1.389042	.1704103	0.000
Average years of schooling	-.1394065	.2876945	0.630
FDI	-.0012155	.0144841	0.933
R^2 = 0.9901			
Fixed-effects regression			
Physical capital per worker	1.389042	.2151954	0.000
Average years of schooling	-.1394065	.3291627	0.674
FDI	-.0012155	.0118502	0.919
R^2: within = 0.5025; between = 0.3594; overall = 0.4990			
Pooled OLS regression with robust standard errors			
Physical capital per worker	.6172929	.0810451	0.000
Average years of schooling	-1.627438	.7354856	0.030
FDI	.0907263	.0405707	0.029
R^2 = 0.5626			

OLS regression with robust standard errors results in all variables being statistically significant and the sign of the coefficient on average years of schooling being negative. However, F-statistic in fixed-effects regression and Wald chi2 statistic in random-effects regression suggest that either fixed-effects or random-effects regression should be chosen over OLS as the method of estimation. Running LSDV and then Breusch-Pagan/Cook-Weisberg test for heteroscedasticity results in heteroscedasticity being present and LSDV with robust standard errors as the appropriate method of estimation. In both LSDV and fixed-effects coefficients on average years of schooling and FDI are not statistically different from zero.

This result means that if we account for the level of adoption of new technologies average years of schooling have insignificant influence on GDP, thus, we can conclude that the level of adoption of new technologies is not high enough to allow schooling to pay off in terms of economic growth.

FDI also have insignificant effect on growth although we would expect it to be positive like in Borensztein et al. (1996). However, the result of FDI not significantly influencing growth in transition countries has already been obtained by Mykytiv (2000). He suggested that legislative chaos and other factors may be the reason for FDI not improving economic growth.

5.4 Rent seeking

Another possible explanation of our result can be educational capital being used in personally renumerative but socially unproductive activities. Murphy, Shleifer and Vishny (1991) built a theoretical model explaining how slower growth can be a result of inefficient allocation of talent in the economy. Their model is based on Lucas (1978). In the model they assume increasing return to ability, which means that when people with high ability become entrepreneurs and hire people with low ability they increase overall productivity of the economy and growth. In the two-sector model the social optimum is when the ablest person becomes an entrepreneur in one sector and the next ablest one becomes an entrepreneur in the other one. In this way the externality of both entrepreneurs is maximized. However, each person is rent-seeking and both become entrepreneurs in the sector with the least rapidly diminishing returns, and there is non-zero externality only from the ablest person. As a result, the other sector grows slower than in the optimum. Also, they found empirical evidence that countries with higher proportion of engineers in labor force with tertiary education grow faster than countries with higher proportion of lawyers.

In this way, the reason for education not contributing positively to growth in the countries in the sample may be that education is attracted away from socially productive activities and into socially unproductive ones due to bad institutional environment.

Chapter 6

CONCLUSION

This analysis has shown that in transition economies educational capital, represented by average years of schooling is negatively associated with levels of GDP. It was estimated that 1% change in average years of schooling is associated with –0.67% change in per worker GDP. This is a counter-intuitive result and several possible explanations are offered within the thesis. Unfortunately only one of the explanations offered – low level pf adoption of new technologies – can be empirically tested on the basis of the available data.

First, if we assume that the true coefficient on average years of schooling has the same sign with the estimate obtained by us – negative – we can offer the following explanations for that:

- the level of schooling itself is not a measure of the level of productive skills of a person but is just a signal to employer that the person possesses high natural abilities. If schooling is just a signal then there is an unnecessary amount of resources spent on this signal in the form of education and it could be produced in a less expansive way. So, this spending of resources on education, which is not productive, can reduce GDP.
- inefficient allocation of talent in the economy. Highly educated labor force may be attracted away from socially productive activities and into socially unproductive ones due to bad institutional environment.

Second, if we assume that our estimate is incorrect, the result can be explained by misspecification of the model and, particularly, by omitted variables. We explore two possibilities to augment the model with additional variables: quality of schooling and level of adoption of new technologies. The data on the quality of schooling for the countries in our sample is not attainable, so, we cannot test the model with this variable included. The level of adoption of new technologies was proxied by FDI. The result of the model augmented with FDI was the effect of schooling being statistically insignificant, which suggests that the level of adoption of new technologies is not high enough to allow schooling to contribute positively to aggregate output.

BIBLIOGRAPHY

Alderman, H., J. Behrman, D. Ross and R. Sabot (1996), "The Returns to Endogenous Human Capital in Pakistan's Rural Labor Market", Oxford Bulletin of Economics and Statistics, vol. 58, p. 29-55

Badunenko, O. (2003), "Technological Change, Technological Catch-up, And Capital Deepening: Relative Contributions To Growth And Convergence During 90'S", EERC Master's Thesis

Barro, R. (1991), "Economic Growth in a Cross Section of Countries", The Quarterly Journal of Economics, vol. 106, nr. 2, p. 407-443.

Barro, R. and Lee J.-W. (1996), "International Measures of Schooling Years and Schooling Quality", The American Economic Review, vol. 86, no.2, p. 218-223.

Barro, R. (2000), "Education and Economic Growth", Harvard University, working paper.

Benhabib, J. and M. Spiegel (1994), "The Role of Human Capital in Economic Development: Evidence from Aggregate Cross-Country Data", Journal of Monetary Economics, vol. 34(2), p. 143-74.

Bils, M. and P. J. Klenow (2000), "Does Schooling Cause Growth?", The American Economic Review, vol. 90, nr. 5, p. 1160-1183.

Borensztein, E., J. De Gregorio and J-W. Lee (1996), "How Does Foreign Direct Investment Affect Economic Growth", Journal of International Economics, 45 (1998), p.115-135

Chase, R. (1997), "Markets for Communist Human Capital: Returns to Education and Experience in Post-communist Czech Republic and Slovakia", Economic Growth Center Discussion Paper No 770, Yale University.

Clark, A. (2000), "The Returns and Implication of Human Capital Investment in a Transition Economy: an Empirical Analysis of Russia", Edinburgh: Centre for Economic Reform and Transformation, discussion paper.

Glewwe P. (1991), "Schooling, Skills and the Returns to Government Investment in Education", Living Standards Measurement Survey Working Paper 76

Greene, W. (2000), "Econometric Analysis", 4th edition, Prentice Hall

Griliches, Z. (1996), "Education, Human Capital and Growth: a Personal Perspective", NBER working paper No 5426

Hanushek, E. and Klimko, D. (2000), "Schooling, Labor Force Quality and the Growth of Nations", Rochester Center for Economic Research, working paper.

Herasym, H. (2004), "Private Investment in Human Capital: Effect on Earnings in Ukraine", EERC Master's Thesis.

Knight, J.B. and Sabot R. (1990), "Education, Skills and Inequality: The East African Natural Experimant", Oxford for Worldbank

Kyriacou, G. (1991), "Level and Growth Effects of Human Capital", working paper, C. V. Starr Center, New York University

Mankiw, G., D. Romer, and D. Weil (1992), "A contribution to the Empirics of Economic Growth", Quarterly Journal of Economics, vol. 107(2), p. 407-437.

Mincer, J. (1974), "Schooling, Earnings and Experience", New York: Columbia University Press.

Murphy, K., A. Shleifer and R. Vishny (1991), "The allocation of Talent: Implications for Growth", The Quarterly Journal of Economics, vol. 106, No.2, p. 503-530

Mykytiv, A. (2000), "Does Foreign Direct Investment Have Positive Impact on Economic Growth in Transition Economies? A Cross-Country Study", materials of international conference "Crossboarder Capital Flows in Transition Economies", unpublished paper

Nesterova, D. and K. Sabirianova (1998), "Investment in Human Capital under Economic Transformation in Russia", EERC working paper 99/04.

Orazem, P. and M. Vodopivec (1994), "Winners and Losers in Transition. Returns to Education, Experience and Gender in Slovenia", World Bank Policy Research Working Paper.

Pleskovic, B., A. Aslund, W. Bader, R. Campbell (2002), "Capacity Building in Economics: Education and Research in Transition Economies", World Bank Policy Research Working Paper 2763

Pritchett, L. (1996), "Where Has All the Education Gone?", World Bank Policy Research Working Paper.

Psacharopoulos, G. (2002), "Returns to Investment in Education: A Further Update", World Bank Policy Research Working Paper 2881.

Sala-i-Martin, X. (1997), "I Just Ran Four Million Regressions", NBER working paper No 6252

Schultz, T. (1988), "Education Investments and Returns", Handbook of Development Economics, vol. 1

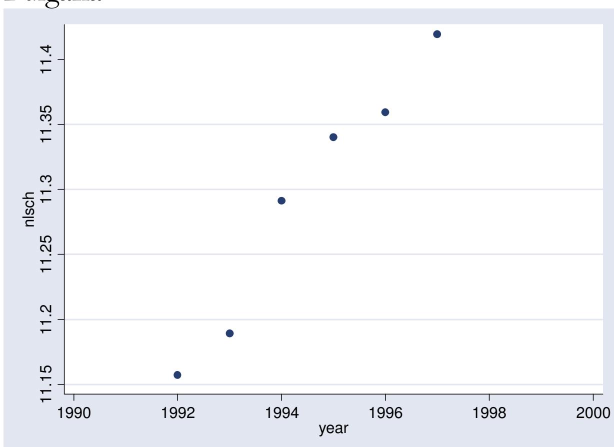
Spagat, M. (2002), "Human Capital, Growth and Inequality in Transition Economies", William Davidson Working Paper No 499

Spence M. (1997), "Competition in Salaries, Credentials and Signaling Prerequisites for Jobs", Quarterly Journal of Economics, 90(1), pp. 51-74

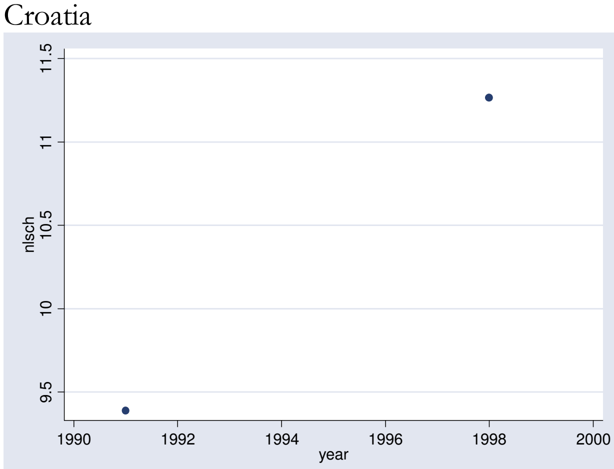
APPENDIX

Figure 2: Variation of average years of schooling across time

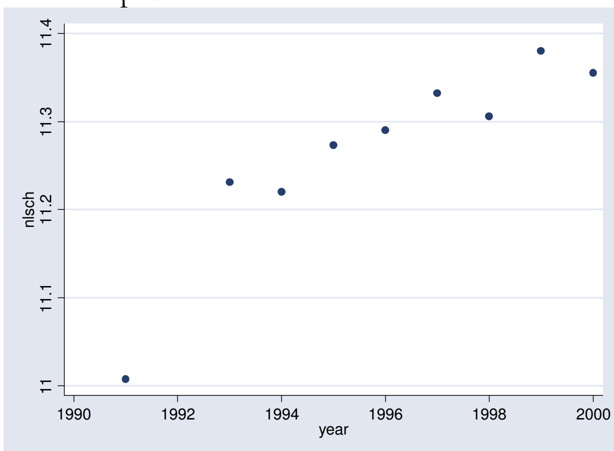
Bulgaria



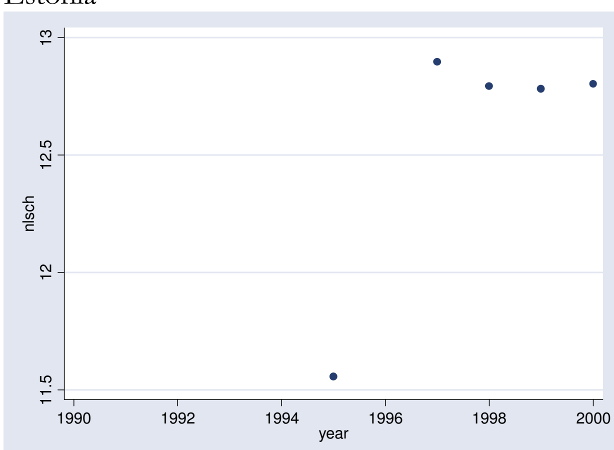
Croatia



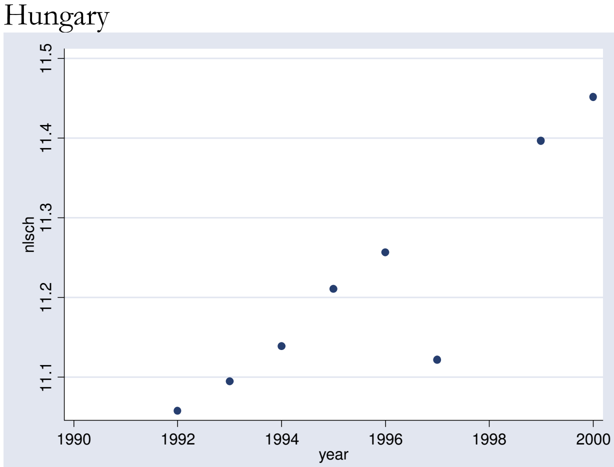
Czech Republic



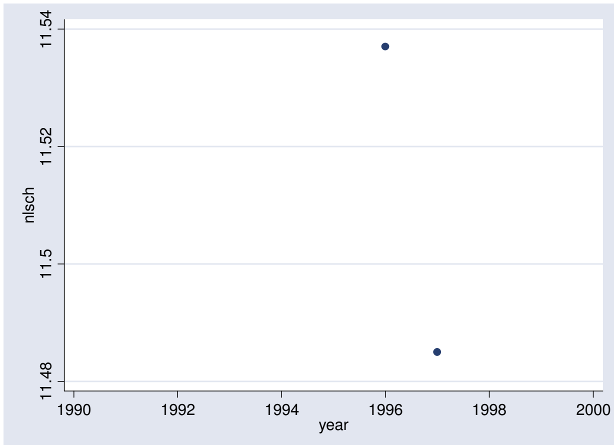
Estonia



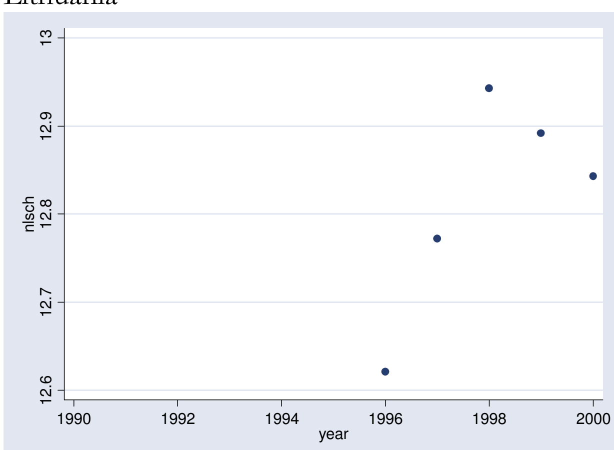
Hungary



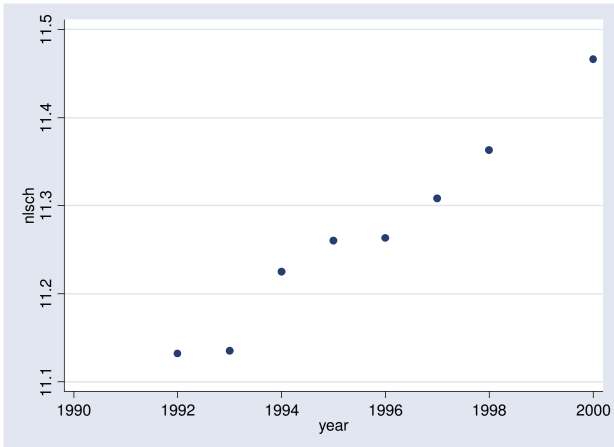
Latvia



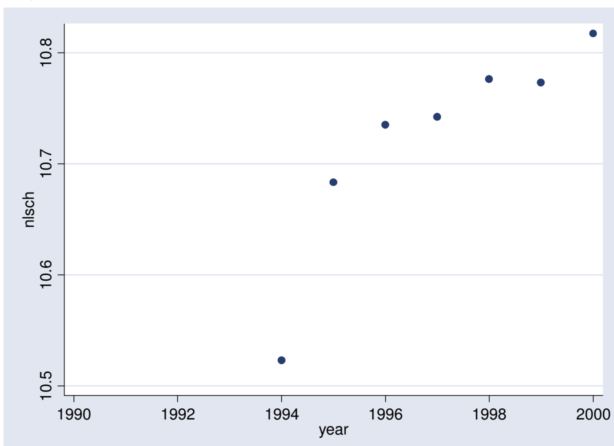
Lithuania



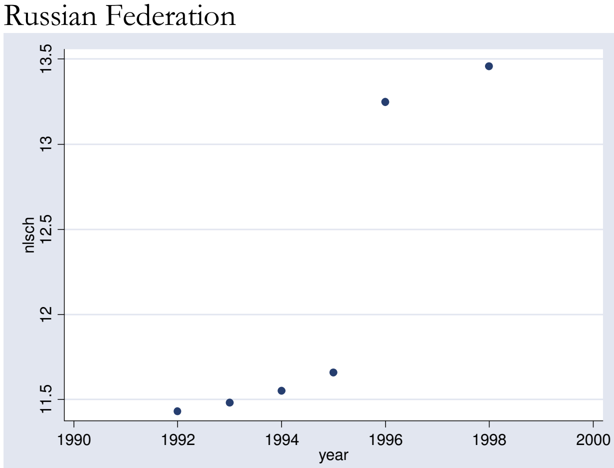
Poland



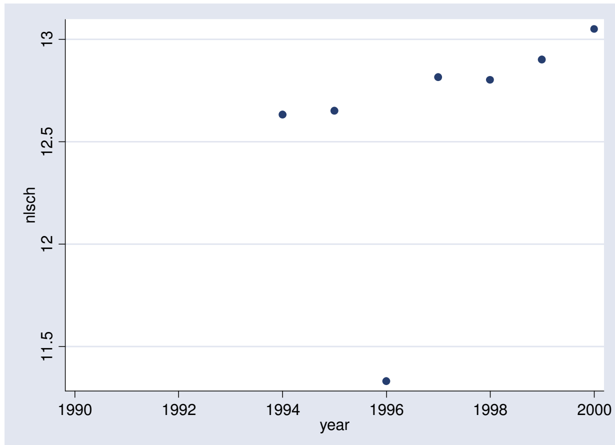
Romania



Russian Federation



Slovakia



Slovenia