Effect of Education on Economic Growth in Transition Economies

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Abstract: *In this study, effect of education on economic growth is investigated for 24 transition economies for 1998-2005 periods. For this purpose some equations are estimated by dynamic panel regressions. When investigating effect of education on economic growth, human capital, education index, enrollment ratio and literacy rate data are used proxies for education. According to one step GMM estimation results while human capital, education and literacy rate positively affect economic growth, enrollment ratio has positive but statistically insignificant effect in transition economies in the short run. Even effect of human capital and literacy are bigger than physical capital. Effect of human development and literacy rate continue in the long run.*

Key words: *Education, Economic growth, Transition economies.*

JEL Classification: E60, H52, I21.

Introduction

Neo-classical growth models emphasized the role of capital accumulation. In the Solow–Swan Model, factors such as the growth rate of population, the structure of the labor force, and the rate of technological change were assumed to determine the long-run equilibrium growth rate. In the context of labor, neoclassical theory of economic growth had placed much emphasis on exogenous demographic factors that affect the growth rate of nations. The steady state growth is constrained by the rate of growth of the labor force. Exogenous technical progress is the main driving force of the model. However, a large part of the measured growth in output was left unexplained in the neoclassical model, the so-called Solow's residual (see Romer: 2005).

Endogenous growth theory was developed in the 1980s as a response to neo-classical growth model by relaxing the assumption of

diminishing returns to capital and by rendering technological progress endogenous to the model. This theory, motivated by the work of Paul Romer (1986) and Robert Lucas (1988), has identified a number of factors that determine the growth rate of an economy. Hence, factors such as increasing returns to scale, innovation, openness to trade, research and development, and human capital formation are considered key factors in explaining the growth process (see Turnovsky, 1999 for a detailed review). The rate of technological progress should not be taken as a given in these growth models. Appropriate government policies can permanently raise a country's growth rate particularly if they lead to a higher level of competition in markets and a higher rate of innovation. Investment in human capital (education and training of the workforce) is an essential part of economic growth. Indeed, since investment in human capital is taking place through training and education, there is a strong rationale in favor of government intervention. More specifically, government policies intended to affect publicly-provided education and training will, in effect, determine the process of growth of the whole economy (see Lucas, 1988; Shaw, 1992; Romer, 1994; Aghion and Howitt, 1998).

Mankiw, Romer and Weil (1992, hereafter MRW) augmented the aggregate production function with human capital by proxy of educational attainment. They found that the Solow model performs well in explaining cross-country differences in income levels and is even more successful when human capital is taken into account, and concluded that the model is consistent with the international evidence.

Lucas (1988) model claims that human capital has stronger effects on economic growth than MRW model. In MRW model human capital does not continuously affect growth, but affects it only transaction process through steady-state. In short, effect of human capital on economic growth is a "level effect" rather than a "growth effect". However human capital continuously affects growth in Lucas model.

1. A Brief Empirical Literature

Effect of human capital or educational attainment of the labor force on the output and the growth of an economy is a continuing debate.

Some recent empirical studies have found that economic growth do not affected by increases in educational attainment. Benhabib and Spiegel's paper (1994) was the first to point out this puzzle. Using cross-country estimates of physical and human capital stocks, the authors run the growth accounting regressions implied by a Cobb-Douglas aggregate production

function. Their results indicate that human capital enters insignificantly in explaining per capita growth rates. After this result, they next specify an alternative model in which the growth rate of total factor productivity depends on a nation's human capital stock level. Tests of this specification do indicate a positive role for human capital. In brief, Authors find that human capital growth has an insignificant and usually negative effect in explaining per capita income growth but level or stock of human capital is an important factor on growth. Similar results are obtained by Pritchett (2001).

Many empirical growth studies have shown that education has a positive effect on economic growth. This has been shown in the early growth regression studies of Barro (1991), Barro and Sala-i-Martin (1992, 1995), and others that followed them. The main explanation for this finding has been the human capital theory which argues educated workers have higher human capital and thus higher productivity. Hence if a country has more educated workers, it has higher productivity (Zeira, 2009). Wolff (2001) finds a positive relationship between schooling ratio, average education level of labor and economic growth.

Papageorgiou's (2003) study gives some aspects about the issue. The results of obtained using the whole sample of 80 countries confirm the results obtained by Benhabib and Spiegel (1994). But when the sample of countries is divided into three subsamples based on per capita income, estimates suggest that for the wealthiest group of countries the role of human capital is only as a facilitator of innovation and imitation of technology. In contrast, for the poorest group of countries the role of human capital is as an input of final output production and as a facilitator of imitation. In addition, regression estimates suggest that the relative contribution of human capital to technology adoption increases with country wealth.

Tallman and Wang (1994) argue that qualitative improvement of human capital is more effective rather than a quantitative improvement of it on economic development process of Taiwan. Similar results hold by Lin (2003) for same country.

McMahon (1998) analyses relations between economic development and human capital for East Asia Countries. The author finds that since most countries had universal primary education early, the rate at which secondary education expanded was crucial in achieving high rates of high per capita growth. Secondary and higher education expenditures are more significant after primary enrollments are universal.

Agiomirgianakis et.al. (2002) use a large panel of data including 93 countries. Following a dynamic panel data approach, the results indicate that

education has a significant and positive long-run effect on economic growth. Moreover, the size of this effect is stronger as the level of education (primary, secondary, and tertiary) increases.

In their empirical study about educational growth effect of education, Petrakis and Stamatakis (2002) consider income differences between countries. The findings suggest that as the level of development increases, the contribution to growth of higher educational levels increase. Educational investment relates to growth differs between OECD and less developed countries. This finding is supported by some empirical studies (Barro and Sala-i-Martin, 1995; Cohn and Addison, 1998).

2. An Empirical Test for Transition Economies

In this section, model estimations for 24 transition economies (see appendix) for 1998-2005 periods are applied. Firstly, methodology and data sets are introduced. After the introduction, dynamic panel estimations and their results are given.

Methodology

The last few years several important advances have seen in the empirical literature on growth. There is increasing use of panel data methods. In this study, dynamic panel data methods-first differenced generalized method of moments (hereafter GMM) is used for investigating effects education on economic growth.

A dynamic panel model can be written as follows;

$$Y_{it}= Y_{i(t-1)}+ x_{it}\beta+n_i+u_{it}$$

and

$$E (u_{it}|x_{i1}, \ldots\ldots\ldots\ldots..,x_{iT}\ n_i=0\ (t=1\ldots\ldots\ldots T) \qquad (1)$$

In this model, x is an exogenous variable and it is only related to n individual effect (Arellano, 2003).

There are some differences between dynamic panel data models and fix effect -random effect models (Greene, 2000). In the dynamic panel data models, when taking first difference equations, between groups variability can be eliminated from fix and random effect models. But in this situation, the model will become as following form;

$$Y_{it} - Y_{it-1} = \beta(x_{it} - x_{it-1}) + \delta(Y_{i,t-1} - Y_{i,t-2}) + (\varepsilon_{it} - \varepsilon_{it-1}) \qquad (2)$$

Here, serial correlation problems appear between (Yi, t-1- Yi, t-2) lagged dependent variables and (εit- εit-1). To eliminate this problem, Anderson and Hsiao (1981) recommend for using some instrumental variables. In this context, the authors suggest that for (Yi, t-1- Yi, t-2) either (Yi, t-2- Yi, t-3) or Yi, t-2 and Yi, t-3 different lagged variables can be used as instrumental variables. These lagged variables may be correlated with independent variables but they will not be related to error term.

Arellano and Bond (1991) argue that dynamic panel methods using these instrument variables may be consistent but estimators will be ineffective. The cause of ineffectiveness of estimators is arise from falling out of use all possible instrument variables. If lagged observations like as Yi, t-2 , Yi, t-3 or Yi, t-4 are not related to εit- εit-1, these variables are valid lagged variables. Consequently, they propose that all valid lagged variables must be used as instrument variables. Thus GMM estimators which eliminate the differences in unobserved individual effects use all possible lags of dependent and independent variables (Arellano and Bond, 1991).

Arellano and Bond (1991) indicate a dynamic panel data model estimated by GMM estimator as follows,

$$Y_{it} = a_1 Y_{it-1} + a_p Y_{it-p} + b_1 x_{it} + b_2 w_{it} + v_i + e_{it}$$

and,

$i=[1,\ldots\ldots..N]$, $t=[1,\ldots\ldots..T]$ (3)

The use of instruments potentially allows consistent estimation even in the presence of measurement error.

Model and Data

For investigating the effect of education on economic growth for 24 transition economies, following models are estimated:

$$\ln Y_{i,t} = \propto_1 \ln Y_{i,t-1} + \propto_2 \ln Y_{i,t-2} + \beta(L)\, X_{i,t} + \lambda_t + \eta_i + \upsilon_{i,t}$$

where $X_{i,t} = (L_{it}, K_{it}, H_{it}, EDU_{it}, ENR_{it}, LIT_{it})$ (4)

Variables and data description are given in Table 1.

Table 1. Variables and data descriptions (1998-2005)

Variables	Data Description	Source
Y	GDP per capita, (PPP US$)	WDI
L	Country Population	WDI
K	Gross Capital Formation (% of GDP)	WDI
HDI	Human Development Index Value	HDR
EDU	Education Index	HDR
ENR	Combined gross enrollment ratio for primary, secondary and tertiary education (%)	HDR
LIT	Adult Literacy Rate (aged 15 and above)	HDR

Estimation results

Panel unit root test results are indicated in Table 2. While Levin, Lin & Chu (LLC) values give common unit root process, Im, Pesaran and Shin (IPS) test indicates individual unit root process of variables.

Table 2. Panel Unit Root Tests

	Δ lnY	Δ lnL	Δ lnK	Δ lnHDI	Δ lnEDU	Δ lnENR	Δ lnLIT
LLC *t*	-63.1108***	-31.0297***	-254.696***	-78.3245***	-61.3189***	-36.1614***	-18.2743***
IPS *W-stat*	-11.5242***	-5.6751***	-78.3082***	-8.3441***	-17.9454***	-2.9124***	-28.1933***

Probabilities assume asymptotic normality. (***) indicates .01 significance level.

As indicated Table 2, all variables are stationary. After investigating unit root process, one step GMM estimation is applied.

Estimated models and results are given in Table 3. The standard errors and tests are based on the robust variance matrix. AR (1) and AR (2) test autocorrelation problem in the models. The AR (2) test is listed as m2 in Arellano and Bond (1991). Sargan Test is used whether or not instrument variables are valid in GMM estimation. Wald test is used for investigating entire significance of independent variables. Wald (joint) tests the significance on all regressors except the dummies, Wald (dummy) tests the significance of all dummies, and Wald (time) the significance of the time dummies and the constant.

Table 3: Estimation results, dependent variable: $\Delta \ln Y_t$

	(1)	(2)	(3)	(4)
Constant	.00407776	.00928797	.0187497	.0203032
	(.199)	(.538)	(1.02)	(1.14)
$\Delta \ln Y_{t-1}$	.108512	.168996***	.156599*	.187824*
	(1.61)	(2.96)	(1.87)	(1.93)
$\Delta \ln Y_{t-2}$	.112916**	.0606697	.0373975	.0496579
	(2.50)	(.913)	(.496)	(.67)
$\Delta \ln L_t$	1.75541	3.46668	3.33302	3.37785
	(.94)	(1.39)	(1.25)	(1.20)
$\Delta \ln L_{t-1}$	-4.53607**	-5.45663***	-5.33684***	-4.98773***
	(-2.45)	(-3.09)	(-3.28)	(-3.02)
$\Delta \ln L_{t-2}$	.517863	-.638706	-.787806	-1.04349
	(.21)	(-.278)	(-.334)	(-.391)
$\Delta \ln K_t$	-0.0237118	-.0104915	-.0513638	-.0425372
	(-.26)	(-.118)	(-.563)	(-.443)
$\Delta \ln K_{t-1}$	.0857222	.0671927	.0987034	.0637406
	(1.50)	(.855)	(1.30)	(.896)
$\Delta \ln K_{t-2}$	.0130636	.0420978	.0771944	.0670883
	(.304)	(.684)	(1.22)	(1.20)
$\Delta \ln HDI_t$	4.61021***			
	(4.64)			
$\Delta \ln HDI_{t-1}$	-2.03195***			
	(-3.64)			
$\Delta \ln EDU_t$		1.91309***		
		(0.855)		
$\Delta \ln EDU_{t-1}$		-0.579850		
		(-0.553)		
$\Delta \ln ENR_t$			.210880	
			(1.19)	
$\Delta \ln ENR_{t-1}$			-.0874183	
			(-.205)	
$\Delta \ln LIT_t$				1.44118***
				(3.00)
$\Delta \ln LIT_{t-1}$				-.937576**
				(-2.14)
Wald (joint) $Chi^2(10)$	151.2***	226.3***	57.9***	131.4***
Wald (dummy) $Chi^2(5)$	73.54***	90.66***	56.72***	184.8***
Wald (time) Chi^2(5)	73.54***	90.66***	56.72***	184.8***
Sargan test Chi^2(20)	29.12*	40.00***	40.75***	45.55***
AR(1) test N(0,1)	-1.915*	-2.333*	-2.003*	-1.870*
AR(2) test N(0,1)	-5828	-.3673	-.9229	-.9598

Numbers in the parentheses are t-statistics. (*), (**), (***) indicate .10, .05 and .01 significance levels, respectively.

Sargan and Wald tests results are significant. While AR(1) test results are negative and significant, AR(2) test results are negative and insignificant as expected.

According to one step GMM results, human capital, education and literacy rate positively affect economic growth in the short run. Effect of enrollment on growth is positive but statistically insignificant.

Long run effects can be computed by taking into account lagged coefficients. For human development it can be computed as 4.61021+ (-2.03195) / 1-(.108512+ .112916) = 3.3115 and for literacy rate 1.44118-.937576 / 1-(.187824+.0496579) = .6604. According to these results, both human development and literacy rate have positive effects on economic growth in the long run. Since lagged terms of enrollment and education insignificant, they are not computed for long term relationship.

Conclusions

In this study, effect of education on economic growth is investigating for 24 transition economies. For this purpose some equations are estimated by dynamic panel regressions. When investigating effect of education on economic growth, human capital, education index, enrollment ratio and literacy rate data are used proxies for education.

According to one step GMM estimation results while human capital, education and literacy rate positively affect economic growth, enrollment ratio has positive but statistically insignificant effect on it in transition economies in the short run. Even effect of human capital and literacy are bigger than physical capital. In the long run human development and literacy rate have continuing positive effects on growth.

Transition economies have to be more invest on their educational system. But since effect of education on growth is bigger than physical capital- at least in some situations-, the physical capital must be raised for enhancing marginal product of labor. It can be said that optimum human capital or educated labor and physical capital composition will help rising economic growth rates of these economies.

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Appendix

List of Countries: Albania, Armenia, Azerbaijan, Belarus, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Macedonia, Moldova, Uzbekistan, Poland, Romania, Russian Federation, Slovakia, Slovenia, Tajikistan, Ukraine.