The Role of Education for the Economic Growth of Bulgaria

Neycheva, Mariya

Burgas Free University

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ABSTRACT: The paper presents results of a study which estimates the impact of human capital on growth in Bulgaria over the period 2000-12. The empirical models are based on the extended Cobb-Douglas production with three inputs ─ labor, physical capital and human capital. Export and Foreign Direct Investments (FDI) are included as well. The quantity of human capital is measured by the share of people in the labor force aged 25-64 having completed at least upper secondary education.

The outcome suggests that the share of people with upper secondary education enters insignificantly the regression model. Moreover, its short-run accumulation is related negatively to real output per capita. When tertiary education is considered, the result is positive and statistically significant. In general, the study cannot fully support the hypothesis that education fosters growth because people with upper secondary education twice outnumber those with tertiary education. The results also imply that the upward trend of real output is attributed mainly to FDI, physical capital accumulation and export.

A reasonable explanation of the non-significant role of secondary education is that the quality of human capital is a crucial factor for growth especially in countries where the average educational level is relatively high. According to the results of a partial correlation analysis foreign language proficiency explains a large part of the variation in output per capita across Europe.

1. Introduction[1]

For almost a decade before the beginning of the recent crisis Bulgaria had been experiencing one of the highest rates of growth in Europe. The question which this study poses is about the contribution of human capital to the economic development. I estimate the link between educational attainment of the labor force and the rate of real GDP changes on the basis of the production function approach.

The basic empirical specification is based on the extended Cobb-Douglas production function with three inputs: labor, physical capital and human capital. The model includes additional growth determinants such as export and FDI. Educational attainment of the labor force aged 25 to 64 years measures the human capital stock. Such an approach solves the problem of endogeneity because the educational level of the population in a given period reflects the growth trend in the past only. The quantity of human capital is measured by the share of people in the labor force having completed at least upper secondary education. Foreign language knowledge measures of the quality of human resources, specifically: 1). the average number of foreign languages learnt per pupil at secondary school; 2). the share of people who speak English. This is an adequate measure for a small open economy such as Bulgaria because knowledge of most popular foreign languages facilitates the adoption of advanced production technologies and models of management, international trade and FDI.

2. Human Capital in the Models of Growth: A Brief Review of the Theoretical Literature

In the theoretical literature two main strands of *models* try to explain the link between human capital and long-run economic growth: endogenous growth models and the extended neoclassical model. In the models of endogenous growth human capital is a key determinant of the long-lasting growth trend. Romer (1986) focuses on the role of human capital (or "knowledge") for the development of new capital goods and productivity improvements. The rationale behind the devotion of

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[1] The full research on the impact of education on growth in Bulgaria could be found in Neycheva(2013).

resources to the development of knowledge is the existence of a patent system. Both the limitless process of generation of knowledge and the presence of externalities determine the increasing returns to human capital, which are crucial for growth in the long run.

In the model of Lucas (1988), individuals allocate their time between production and schooling. The assumption that human capital involves constant returns to the existing stock of human capital produces a positive growth rate of output per capita. In both models the growth trend depends on the initial stock of human capital. Nelson and Phelps (1966) propose an alternative explanation. The existence of qualified labor resources enhances the capacity of the country for innovation as well as for adoption and implementation of new and better products, new methods of production as well as new technologies from abroad.

An important feature of the endogenous growth theory is that although the individual firm faces diminishing returns, the returns to capital at the aggregate level could be constant or even increasing. This rising marginal productivity in the economy driven by human capital is essential for the growth process. The long-term rate of growth per capita is determined within the model.

The followers of the neoclassical theory introduce human capital in the Solow-Swan model (Mankiw, Romer and Weil, 1992). Both physical and human capital may accumulate over time. However, investments in human capital lead only to transitional growth; no long-run growth of GDP per capita is observed because of the decreasing marginal returns to both types of capital and a lack of externalities. The neoclassical framework is rather more successful in explanation of the international differences in income than the growth path per se.

3. Methodology and Empirical Results

The study utilizes the extended Cobb-Douglas production function to establish a long-run relationship between the educational level of the active population and aggregate output. The models tested here are derived from a production function with three inputs ─ labor, physical capital and human capital. In case of constant returns to scale, it has the following general form:

$$Y = A * K^{\alpha} * H^{\beta} * L^{(1-\alpha-\beta)} \quad (1)$$

Y is output, K denotes the stock of physical capital, H is the stock of human capital and L is the supply of labor; α and β measure the output elasticity with respect to physical and human capital, respectively. Dividing by L, the logarithmic form of the function becomes:

$$\ln y = \ln A + \alpha * \ln k + \beta * \ln h \quad (2),$$

where: *y*, *k* and *h* are quantities per unit of labor. The parameters α and β measure the elasticity of output with respect to production inputs. In case of developing economies export is added as an additional determinant in the production function. The economic reasoning is the existence of scale effects and externalities associated with export production and sales (Balassa, 1978; Tyler, 1981). It is appropriate to add export in the case of transition economies as well. The reduced form specification includes also a variable for foreign direct investments.

The statistical sample consists of quarterly seasonally and cyclically adjusted real data sets over the period 2000:1 – 2012:2 – the latest available data. The dependent variable is real GDP per unit of labor force. The stock of physical capital (K) is calculated using the perpetual-inventory method.

The formula is:

$$K_t = (1 - \delta) * K_{t-1} + I_t \quad (3),$$

where I_t -denotes domestic business investments while δ -the annual depreciation rate is set to 0.05.

The number of people in the labor force having completed at least upper secondary education is used as a proxy for the quantity of human capital. In the model, the variable SEC includes active population with upper secondary education (ISCED 3-4). Alternatively, the variable HIGH denotes the labor force with tertiary education (ISCED 5-6). In addition, the variable PRIM represents the share of people with no education, primary or lower secondary education. Export (EXP) and foreign direct investments in Bulgaria are included as ancillary determinants of growth. Equity capital is used instead of total FDI inflows (the variable FDI)

because the existence of negative values in the latter makes seasonal adjustment impossible. All variables are expressed as ratios to active population and in logs.

Economic time series are usually non-stationary. The existence of a unit root and the order of integration are proven by the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979) as well as the Kwiatowski-Phillips-Schmidt-Shin (KPSS) test (Kwiatowski et al., 1992). According to both of them, the variables are integrated of order 1. The structural stability has been tested by the method proposed by Yamatoto (1996) and Hayashi (2005).

The long-run dependence between non-stationary economic processes is modeled by the co-integrating regression. If more than one co-integrating relations are expected, the Johansen test (Johansen, 1988) is preferred to, for example, the two-step procedure suggested by Engel and Granger (1987). The model comprises real output, the capital stock, export, the educational indices of primary, secondary and tertiary education and the FDI inflows. Restricted trend and unrestricted constant are included. The results indicate the existence of at least one long-run relationship between the variables.

Real GDP is a dependent variable in the co-integrating regression models which I build. The equations are solved using the method of OLS with heteroscedasticity corrected errors. Models 1 and 3 (see, Table 1) include FDI, export and a human capital index – SEC or HIGH. The stock of physical capital participates in model 2, model 4 and model 5. The high R^2-value contrasts with the low DW-test statistics. The latter is significant at the 5% level under the Co-integrating Regression Durbin-Watson (CRDW) test, thus denoting the adequacy of the models.

When a physical capital stock proxy is excluded, the regression coefficient for the variable SEC is positive and significant at the 10% level. On the contrary, when the full model is considered (see model 2 in table 1), the result clearly indicates that an increase of the share of people with upper secondary education is not associated with higher output levels. Tertiary education is significantly and positively related to growth (see model 3 and model 4 in table 1). However, its long-run elasticity to output decreases by 0.2 units whereas the estimated p-value gets larger when the variable KSTOCK is added to the regression.

Table 1. Estimation of the long-run effect of human capital on output per capita
Dependent variable: RGDP

	Model 1	Model 2	Model 3	Model 4	Model 5
constant	3.194	2.102	3.276	1.286	1.975
	(0.000)	(0.002)	(0.000)	(0.004)	(0.025)
SEC	0.341	-0.058			
	(0.099)	(0.811)			
HIGH			0.600	0.406	
			(0.003)	(0.021)	
PRIM					0.004
					(0.960)
KSTOCK		0.431		0.353	0.406
		(0.000)		(0.000)	(0.000)
EXP	0.448	0.192	0.353	0.202	0.212
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
FDI	0.013	0.044	0.027	0.043	0.041
	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)
N of obs.	50	50	50	50	50
Adj. R^2	0.967	0.948	0.927	0.948	0.964
F	487.778	225.080	209.870	224.212	332.137
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DW	0.487	0.635	0.670	0.902	0.597

Note: All variables are expressed per unit of active population in a logarithmic form. P-values are presented in parentheses.
Source: author's calculation based on Eurostat data, http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/themes

Model 5 in table 1 evaluates the link between the lowest educational levels and per capita output; the coefficient is not statistically significant. The figures give evidence that FDI, export and business investments sustain the upward growth

trend in the Bulgarian economy. The elasticity of export to output ranges from 0.192 to 0.245 with an average of 0.213. The effect of physical capital is even stronger: the slope coefficient is 0.371 on average. These values imply decreasing returns to scale.

In fact, this regression output is not unexpected. It confirms one of the major problems in Bulgaria's educational system – a lack of qualified labor resources at the middle educational level. The share of active population with upper secondary or post-secondary education is about 55%; it is the economy's backbone and should be the driving force of its development. Comparatively, highly educated people account for only 1/4th of the labor force. This means that the gaps in secondary education translate into a holdback for economic growth.

The general conclusion emerging from that econometric exercise is that it does not explicitly prove that the higher average educational attainment determines the positive trend of output per capita observed in Bulgaria after the year 2000. Although the models including tertiary education favor the theoretical hypothesis that education facilitates growth, the result for upper secondary education unequivocally points out that it is not related to the long-run economic development. The estimates show that the aggregate production function with physical capital, foreign direct investments and export best describes economy.

A reasonable explanation of the non-significant role of secondary education is that the quality of human capital is a crucial factor for growth especially in countries where the average educational level is comparatively high. In order to test that hypothesis, I conduct a simple experiment which aims to compare the impact of the quantity of human capital on aggregate activity with the effect of its quality measured by foreign language proficiency of active population. Comparable data for the EU member states are available since the year 2004. So, the average number of foreign languages learnt per pupil at upper secondary school in 2004 approximates the quality of human capital (fig. 1). Year 2004 is the first year for which a database for the EU exists. Four years later (between 2008 and 2010), pupils at the secondary school in 2004 were 20-24 years old. Therefore, an index of the human capital stock is the average number of active persons with upper

secondary education aged 20-24 years over the period 2008-2010. The dependent variable is the average real GDP per person of labor force between 2008 and 2010. Real GDP per capita in 1995 is a control variable in both cases. All variables are expressed in logs. For the purposes of this descriptive analysis, I switch from the 25-64 age-group to people between 20 and 24 years old because pupils at upper secondary school in 2004 (between 16 and 19 years of age) formed the 20-24 age group between 2008 and 2010.

Figure 1. Number of foreign languages learnt per pupil at secondary school vs. output per head
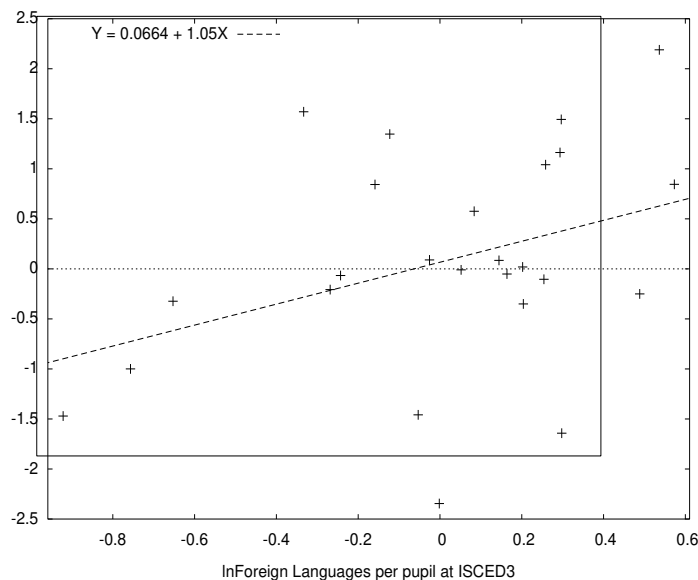
Note: United Kingdom and Ireland are excluded from calculations; missing values for Austria. Data for Island and Turkey are added.
Source: author's   calculation   based   on   Eurostat   data, http://epp.eurostat.ec.europa.eu/portal/page/portal/education/data/database

The correlation analysis presented above shows a statistically significant positive relationship between language qualification and output: one additional foreign language is expected to increase output by 22 units. On the contrary, the correlation when the quantity of human capital is used is close to zero and statistically insignificant. Thus, the descriptive analysis implies that foreign language

proficiency explains a large part of the variation in output per capita across the EU. A similar pattern appears when the share of people who speak English is linked to GDP per active person.

An alternative explanation for the econometric result might be that when human capital is above a given threshold level, it is not significantly related to economic activity because the existence of diminishing returns. Given the quality of education, a similar statistically insignificant effect should be expected for all post-communist member states due to the high levels of human capital. Such an explanation is consistent with the neoclassical theory specifically the existence of diminishing returns.

4. Conclusion, Limitations and Future Research

My study tries to illuminate the impact of educational attainment on the long-run dynamics of output per capita in the Bulgarian economy. It gives clear-cut evidence that the increase of the quantity of people with upper secondary education does not matter for the rate of economic growth. When tertiary education is considered, the result is positive and statistically significant both in the short- and the long-run. On the basis of that, it cannot be concluded that the higher average educational level was a significant growth determinant in Bulgaria in view of the fact that the share of active population having completed upper secondary education is twice as large as the share of people with tertiary education. Moreover, the regression output suggests that the upward trend of real output is attributed mainly to FDI, physical capital and export.

In order to explain the econometric outcome I focus on the quality of human capital. According to the cross-country correlation analysis, foreign language proficiency explains a larger part of the variation in output per capita across member states in comparison with the human capital quantity. This probably means that more attention should be drawn on the quality of education. A logical extention of this study would be an inclusion of different countries in the sample and verification of the hypothesis raised above.

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