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The impact of human capital on economic growth

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Abstract

The EU's 2020 Strategy is focused on three area of growth: smart, sustainable and inclusive that couldn't be achieved without major contribution of skills, knowledge or value of people, common knew as human capital. It is difficult to believe that these goals could be realized without a good education and training system, a large diffusion of knowledge in manufacturing services, a creative industries and a great effort to create a research-intensive economy. Using a panel methodology, the paper tried to reveal the role of human capital as a factor of the growth and to argue that the slow investment in human capital should influence the sustainable development of the countries.

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Keywords: Human capital, economic growth, panel model.

1. Introduction

There is a large body of literature, that has revealed that one of the most important factors of economic growth is human capital (Riley, 2012 Lucas, 1988, Mankiw et al., 1992, De la Fuente and Doménech, 2000, 2006) with regard to both the effect of level (so called level effect) by its decisive influence on production through labor productivity (Romer, 1990; Mankiw, Romer and Weil, 1992) and the rate effect by contributing to increased competitive advantage through innovation and diffusion technology (Pistorius, 2004 Siggel, 2000, 2001, Horwitz, 2005).

In the classical theory of economic growth, labor productivity is regarded as an exogenous factor which depends on the ratio between workforce and physical capital, plus other factors (technical progress), but the beneficial effect

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of education on potential growth of productivity is not taken into calculation. The new theory of economic growth developed in the early 80s comes to correct this shortcoming of the classical theory emphasizing the importance of education and innovation, (elements of human capital) in long-term economic growth. In contrast to this, the theory of market value, shows that studies have highlighted the influence of intangible assets such as research and development, patents, intellectual capital on the market value of companies and also on their development, leading ultimately to economic growth overall national, regional or global, as the new growth theory shows.

De la Fuente and Doménech (2000, 2006) studied the relationship between production and human capital, both in level and in first-order differences, shows a positive and significant statistical correlation (demonstrated by the Temple, 1999). Bassanini and Scarpetta (2001) revealed in a series of OECD data for the period 1971 to 1998 that increased duration of schooling by one year leads to an increase in GDP per capita by 6%. Benhabib and Spiegel (1994) have shown that the introduction of human capital as a factor of production by function type Coob -Douglas leads to its insignificant effect on growth of GDP per capita, but if taken into account the influence of human capital on total factor productivity, the effects are visible in two aspects: a) human capital influences the internal rate of innovation as evidenced by Romer (1990); b) human capital influences the rate of diffusion of technology in the spirit demonstrated by Nelson and Phelps (1966). They show that an increase of 1% of the capital stock leads to a 0.13% increase in the rate of growth and the process of catching up technological development of other countries is strongly influenced by human capital stock nationwide as demonstrated by the Funke and Strulik (2000).

Michael Funke, Holger Strulik (2000), using a model that incorporates aspects of the classical theory of economic growth with the new theories of economic growth emphasize the existence of different effects of human capital in the stage of development of the country. In their view, the model provided by Uzawa-Lucas may explain the development mechanisms if productivity in the accumulating knowledge is sufficiently high, but Grossman-Helpman model for an economy with a wide variety of products can be explained considering technological growth as endogenous factor, which involve significant expenditure on research and development. Physical capital contributes greatly to the growth income per capita in the early stages of development, when the accumulation of knowledge through continuing education and training move to higher stages of development.

Bundell and others (1999) analyzing the impact of human capital on economic growth believe that the growth rate of output depends on the rate of accumulation of human capital and innovation, whose source is the stock of human capital, education level influence labor productivity. For supporting of these ideas they quoted passage: a) the work of Griliches (1997) which showed that in the US in 50 years the change in the level of education of the labor force led to a 33% increase in productivity; b) Jenkins (1995), which revealed that during 1971-1992, a 1% share breeding of highly skilled workers has led to an increase of 0.42 to 0.63% of annual output in the UK; c) OECD record from the 60s that have experienced rapid growth as a result of increasing the number of highly educated; Englander and Gurney (1999) which showed that growth in OECD countries from 70% in 1960 to 95% in 1985 of school enrolment has led to an increase of 0, 6% per year in labor productivity (Bundell and others, 1999, p.16-17).

Mincel (1995) show that higher growth of technological change in a sector, leads to greater demand for educated and trained workforce through training courses. Ángel de la Fuente and A. Cicoone (2002) exhibit much greater role of human capital in explaining productivity differential between countries than in supporting growth. In this paper, based on the new theory of economic growth will seek to highlight the role of education and innovation in economic growth in Romania and other EU countries by applying a panel model.

2. Data and methodological aspects

The literature on this subject reveals a wide methodological series from Solow structural econometric models extended by Mankiw, Rommer and Weil (1992) known as MRW models, to the convergence analyzes proposed by Barro and Sala i Martin (1992) and also to the panel models dedicated to cross-country data analysis (Islam, 1995).

The models used in the literature provides the opportunity to highlight some derived limits either from the election of the indicators used, either in their form of expression (as pace, level or logarithm) or the method of calculation.

One of the main methodological problems is to choose the proxy indicator used to measure human capital, since the amount of influence is affected by the indicator chosen for this purpose. Nonnemen and Vanhoudt (1996) use as proxy in MRW model, the share of education expenditure in GDP and they conclude that the relationship between human capital and economic growth is insignificant. Murthy and Chien (1997) as a proxy of human capital using a

weighted average of the population registered in tertiary education, secondary and primary and they conclude that there is a significant positive and direct links with economic growth. Barro and Lee (1993), Islam (1995) used as a proxy for human capital the average number of years of schooling of the population over 25 years. María Serena (2001) used as a proxy for human capital both individual income (assuming these increase as the accumulation of human capital increases) and the educational attainment of the population aged 25 years and over, as an average years of education. Izushi and Huggins (2004) used as a proxy for human capital the number of people in research-development in the private sector, while Baldwin (1971) and Outreville (1999) use as proxy the share of university graduates in the workforce. In many papers, because the average number of years of schooling is difficult to determine, this indicator was replaced by gross enrolment rate in primary, secondary and tertiary school or by enrolment rate (literacy rate).

Using the number of years of schooling in comparisons between countries, has the disadvantage that it is not known exactly whether the knowledge gained in one year of schooling in a country coincide with those obtained in another country to ensure comparability of data and it is assumed that the knowledge is achieved only at school, while ignoring other sources of training.

The positive impact of education quality more than quantity is highlighted by Hanushek and Woessmann (2007) and Hanushek and Kimbo (2000) , who use as indicators of human capital the results of PISA and TIMS tests. Hanushek and Schultz (2012) for example showed that a deviation of 100 points in PISA test results may lead to a difference of 2 percentage points in the growth rate of GDP per capita.

Another problem of the methodology derived from the existence or not of a causal relationship between education and economic growth on one hand, and by the other hand of the meaning of this causal relationship (OECD, 2010) which according to some authors is solved by the use of econometric techniques (Glaeser et al, 2004).

Another weakness of the models used is derived from the indicators in logarithms either in level. In the opinion of researchers Fuente and Cicoone (2002) using logarithmic values lead to underestimation both coefficients and reduce the level of errors in assessing the impact of education on economic growth. Furthermore they reveal differences in level between the values of indicators used in different studies as a proxy for human capital such as: the number of years of schooling or PISA and TIMS test results. To highlight this impact we illustrate in table 1 the values of this indicator for various EU countries in 1990 and 2000.

Table 1 Average years of schooling in the countries used in different studies

Country	1990			2000			
	D & D01	C & S01	B & L00	C & S01	B & L00	OECD *	BM *
Belgium	94.7	91.8	95.0	94.11	91.55	106.63	109.29
Bulgaria		96.9	104.36	91.94	102.14		77.14
Czech Republic			105.83		99.29	87.03	83.57
Denmark	110.2	105.6	114.2	105.92	105.81	102.02	96.43
Germany **	121.7	120.9	102.1	112.43	102.24	99.14	102.86
Estonia			103.35		96.16		80.36
Ireland	88.4	87.2	95.8	88.29	94.59	92.22	90.00
Greece	74.3	79.7	86.3	85.95	89.24	89.91	90.0
Spain	66.7	77.2	68.6	82.48	76.01	99.71	
France	98.2	94.8	85.2	93.15	87.77	95.10	99.64
Croatia							
Italy	75.6	83.3	69.4	89.68	73.4	91.07	
Cyprus		81.16	94.78	77.01	91.97		
Latvia			107.52		100.04		90.36
Lithuania			104.81		97.52		
Luxembourg							
Hungary		99.46	98.16	94.37	92.38	92.22	83.57
Malta			76.3		79.38		
Netherlands	102.9	98.1	97.0	98.45	96.89	98.56	102.86
Austria	106.3	100.1	92.6	99.23	92.28	92.22	93.21
Poland			108.2		103.82	92.22	83.57
Portugal	60.2	54.1	48.8	63.20	51.49	96.83	93.21
Romania		91.5	104.16	86.82	99.73		77.14
Slovenia			78.22		77.07		
Slovakia			102.22		96.37		

Finland	103.1	98.2	106.8	101.40	106.33	105.48	102.86
Sweden	99.8	110.2	107.9	101.75	119.13	117.0	93.21
UK	98.9	112.4	98.5	113.9	98.05	108.93	106.07
Norway	104.4	112.7	122.3	108.35	124.37	103.17	99.64
Switzerland	114.9	118.6	111.8	110.52	108.95	93.95	93.21
Media EU14	92.25	93.81	90.6	95	91.77	99.63	98.30

Note: * estimates; ** West Germany; data refer to the population aged 25 and over in D&D01 and the population aged 15-64 years in C&S01; D&D01 refers to de la Fuente and Doménech, 2001; R&S01 refers to Cohen and Soto, 2001; B&L00 refers to Barro and Lee, 2000; OECD refers to OECD Report 2000 *Education at a glance* and BM refers to a World Bank Report *World Development Report 2000*
Source: Ángel de la Fuente and A. Cicoone, 2002, Human capital in a global and knowledge-based economy, Final Report, European Commission, p.76, 77

A recent study by the OECD (2014) underline the correspondence between years of schooling and PISA test results, the experts considering that an average of 200 PISA points equivalent to six years of schooling, an average of 300 points PISA equivalent to seven years of schooling, and that exists a relationship between performances on PISA and life chances of those interviewed. Moreover, it is considered that there is a relationship between the opportunities offered by the resources allocated to education and tests results, better performance existing when there are higher socio-economic conditions. Increasing the share of the performance in mathematics, reading and science indicates that the education system can provide academic excellence if the level of performance is above the OECD average, since the possession of such high performance is essential for a country's economic development and also for the construction of a knowledge-based society.

Measurement of human capital is realised by human capital index, which in determination of the European Union is based on four group of areas: investment in education, the use of human capital stock (Romania using 48.5% of the stock of human capital in 2006 (Ederer and all, 2007) compared to 55.2% in the Czech Republic), the productivity of human capital and demographics and also employment of human capital. According to calculations, Romania recorded a human capital index of 29.9, ranking position 7 of the 12 new EU countries (zero position is the best and 48 the worst), better than Hungary (30, 6) and Poland (34). Human capital index determined by the World Economic Forum includes 4 pillars: Educations, Wealth and Wellness, Workforce and Employment and Enabling Environment (which includes infrastructure, legal and other factors that ensure valuing of human capital), its level in 2012 in Romania and other countries are shown in Figure 1 a and b.

a) b)

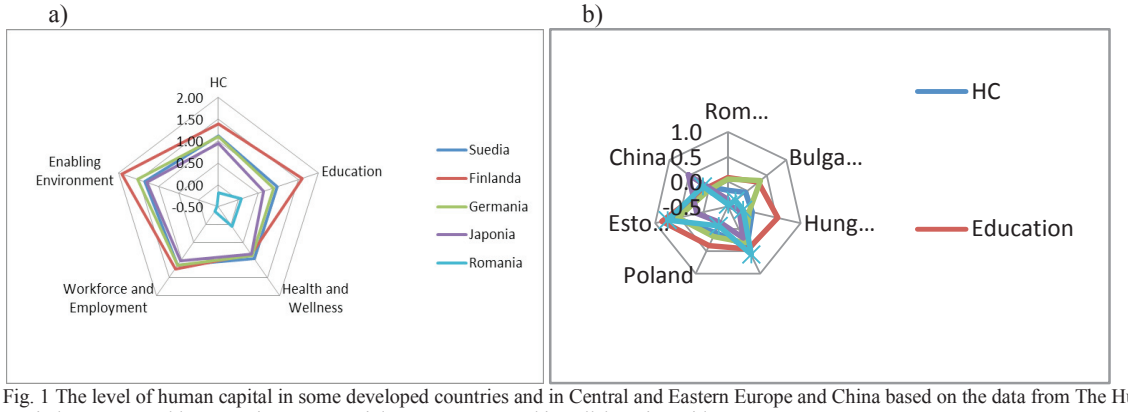

Fig. 1 The level of human capital in some developed countries and in Central and Eastern Europe and China based on the data from The Human Capital Report, World Economic Forum, Insight Report, Prepared in collaboration with Mercer, 2013

Note that Romania has the lowest levels in employment, being at the same level with Bulgaria on education and health and below the level of the Czech Republic and Estonia.

3. The model and its results

In highlighting the impact of human capital on economic growth we followed the approach of Eric Hanushek (2013), de la Fuente and Doménech (2000) and we applied a panel model based on the following function:

$$Log(PIB/LOC) == \alpha \log H + \beta \log X + \theta i + \gamma t + \varepsilon \quad (1)$$

where: GDP/capita is the real level of GDP per capita and is a direct function of human capital (H) and other factors (X) and a stochastic element ε, and α, β are parameters to be estimated γt şi θi are dummy variables capturing the time and country fixed effects.

The data used in the model are annual data for the period 2000-2012 from the Eurostat database, stationary by logarithm. The dependent variable is GDP per capita (GDP_PPP) which is "positively correlated with the ability of a country to develop a knowledge society" (UN, 2005, p.149), and as independent variables were considered: for human capital: education expenditure in GDP (Exp_Edu) and other indicators such as: number of employees with secondary education (Empl_Sec), exports of goods and services (EXP), the number of patents (Patent).
Table 2 presents the results of statistical registrations of dependent and independent variables in the model, mean, median, maximum and minimum value, the standard deviation, skewness and kurtosis and J. Bera coefficient.

Table 2 Descriptive statistics of the time

	Log(GDP_PPP?)	Log(Empl_Sec?)	Log(Exp_Edu?)	Log (EXP?)	Log (Patent?)
Mean	9.922442	7.398319	1.640347	4.426633	5.103250
Median	9.989665	7.463822	1.648659	4.531524	4.875197
Maximum	11.18720	10.04772	2.174752	4.842611	9.040382
Minimum	8.556414	3.113515	1.057790	3.424263	0.000000
Std. Dev.	0.442915	1.480101	0.212609	0.300462	2.122549
Skewness	-0.533142	-0.585531	0.124990	-1.340314	0.045875
Kurtosis	3.370399	3.360562	2.870257	4.046416	1.860496
Jarque-Bera	16.93564	19.95601	1.054343	110.0651	17.37070
Probability	0.000210	0.000046	0.590272	0.000000	0.000169
Sum	3165.259	2360.064	523.2708	1412.096	1627.937
Sum Sq. Dev.	62.38335	696.6425	14.37437	28.70819	1432.658
Observations	319	319	319	319	319
Cross sections	28	28	28	28	28

Source: The processing of the author

Statistical analysis of the series shows big differences, standard deviations vary in reaching an extremely wide range, depending on the unit and the indicator used. Also there is a asymmetry, Skewness values were mostly negative and zero around except for export, while Kurtosis indicator varies around 3 except exports and the number of patents and the high level of the Jarque –Bera test indicate the non-normality of the distributions. (see Table 2).

The chosen model is with fixed effects for countries and periods since both national and specific changes in different periods influenced the relationship between indicators. The model revealed the existence of negative coefficients in 2008 and 2009 could be the impact of the financial crisis started in autumn 2007 and felt late in EU member states (Table 3).

Table 3 Pooled Least Squares model in 2002-2012 period

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.492918	0.304005	4.910828	0.0000
LOG (GDP_PPP? (- 1))	0.807862	0.029388	27.48981	0.0000
LOG (EMPL_SEC?)	0.036138	0.021492	1.681434	.0939
LOG (EXP_EDU? (- 1))	-0.055892	0.023587	-2.369589	.0186
LOG (EXP?)	0.049624	0.015347	3.233508	0.0014
LOG (PATENT? (- 2))	0.010715	0.004900	2.186849	.0297

Source: Author computation

The R-squared is 0.996870 and Adjusted R-squared is 0.996349. Statistically, the data model indicates a positive and significant correlation between GDP per capita and the explanatory variables. Negative relationship with education expenditure is less than the theoretically expected; however, an explanation could be heterogeneous group of countries analyzed. To check this hypothesis in the future is required a differentiated analysis according by the level of economic development of countries.

Conclusions

This paper highlighted the importance of human capital in ensuring economic growth expressed as gross domestic product per capita. The model revealed a positive relationship, statistically significant between GDP per capita and innovative capacity of human capital (evidenced by the number of patents) and qualification of employees (secondary education) as expected according to economic theory.

Unexpected is the negative relationship between education expenditure in GDP and GDP per capita, a possible explanation being the heterogeneity of countries considered. However, the low level of coefficients leads us to conclude that the results are validated against those of Nonnemen and Vanhoudt (1996) which were used as a proxy for human capital share of education expenditure in GDP.

Moreover, the model showed negative influence both the economic crisis and differences deriving from specific countries. In the future we will use in the model as alternative variables for human capital, weighted average of the population enrolled in primary education, secondary and tertiary to highlight how the results were influenced by choosing the proxy for human capital.

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