RELATION BETWEEN HUMAN CAPITAL AND REGIONAL ECONOMIC DEVELOPMENT IN ROMANIA

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Abstract
This paper is focused on the relation between human capital and regional economic development in Romania, in order to highlight the effect of human capital on economic development at regional level. Using Eurostat data from 2000-2014, in a panel model, Pooled Last Squared with cross fixed effects and cross section fixed dummy variable, we show a positive and statistically significant correlation between GDP growth at macro regional level and human capital expressed as the R&D effort at national level, and the workforce employed in research activities as theoretically expected. From the positive values of the coefficients within the model we conclude that the developed macro regions enjoy a high level of returns, while investing in human capital.

Key words*: human capital, regional economic development, econometric methods*

JEL classification*: C23, O10, O40,*

Introduction

Human capital is defined as "the knowledge, skills, competence and other attributes embodied in individuals that are relevant to economic activity" (Hartog, 1999, p. 1). Human capital definition includes in opinion of Leeuwen (2007, p.40), "both the quantitative and the qualitative aspects of human capital, i.e. all 'educational' and 'experience' components". Dakhli and de Clercq, (2004) mention the three type of human capital: *firm specific human capital*, meaning the skill and knowledge valuable only for that specific firm; *industry specific human capital* meaning the knowledge derived from experience at specific industry level; *individual specific human capital* which include knowledge applicable at firm and industry level and include the academic level of education and vocational education, training at work, managerial and entrepreneurship experience.

There are many studies dealing with the relationship between economic development and human capital at national level and few regarding regional level. Some, show a significant impact on human capital or human capital accumulation (Temple, 1999) and income inequalities on economic growth (Persson and Tabellini, 1991, Galor and Moav., 2002, Ferh, 2015). Other recent studies of De La Fuente and Doménech (2000), Riley G. (2012) show the crucial impact of human capital on growth.

Diebolt and Hippe (2016, p.2) consider that the impact on human capital on regional level is also an important topic, although less analyzed than at the national level, and they aim to address the issue by linking it with the cross-country analyses and explanation of "why some regions are richer than others".

We focus our study at macro regional level, in order to highlight the regional differences that are very high in Romania.

The paper is divided into five parts: first, an introduction, second part deals with presenting literature review, the third focuses on the data and the model, and the fourth part presents the results of the model and finally the conclusions.

Literature review

Diebolt and Hippe (2016) highlight the development of economic literature regarding the relation between human capital and economic growth starting with the second part of 20th century, citing the work of Becker (1964), Arrow (1962) and Nelson and Phelps (1966) that underline the role human capital has in promoting technological change and increasing productivity of work. They also show the contribution of new theories, that include the human capital as factor into the production function in the tradition of the work of Mankiw el all (1992) with human capital augmented Solow model, endogenous model of Romer (1986) and Lucas (1988) and Unified growth models based on Galor and his collaborators. Using literacy and numeracy as proxy for human capital and GDP per capita as growth indicator, and NUTS region classifications of European Union, a scatter plot and regression models, they analyze the relationship of regional human capital, innovation and development and find that a rise in literacy by 1% in 1930, increased the regional development in 2008 by 0.85-1.05, depending on specification (Diebolt and Hippe , 2016, p.21). Also, they prove that historical human capital formation is important to explain the economic prosperities of European regions.

Dakhli, de Clercq (2004, p.123) based on a multi country study, show significant positive effects of human capital on the county level of output and economic growth. They consider that "the beneficial effect of human capital on economic development may be based partly on the extent to which resources, experience and educational background are embedded

in open interactions within a specific community or region" and that the "overall level of human capital across all individuals within a country positively impacts overall innovative activity".

Bas van Leeuwen (2007) present a short synthesis of the theoretical use of human capital in growth regressions, starting with the exogenous growth: the augmented Solow-Swan model in a Cobb-Douglas production function, and continuing with the new growth theory, from Romer (1986) model; Lucas 1988 sees the human capital as a factor of production in his model with two sectors and Romer 1990 model based on three sectors. Significant is the fact that the knowledge in the Romer 2000 definition "is not a part of the individual as is the case of Lucas' theory (1988); but the part of human capital that is not used directly in the sector producing final output is used to create new technologies. The level of human capital, H, thus has a positive effect on the growth of technology, A." (Bas van Leeuwen, 2007, p32-33). These highlight a different view of human capital in the two models. A typical Mincer macro growth regression in the panel the logarithm of GDP per capita depend on Education expressed as average years of education in country i, in year t. Significant is the fact that more modern studies reveal a higher effect of total factor productivity (TFP) on labor growth, compared with human capital which is in decline as effect on growth. He highlights some problems in the growth model with human capital. Firstly, is linked with the proxy used for measuring the human capital, taking into consideration the variety of indicators used as measure of human capital. Secondly, is how it includes human capital in the growth equation and, thirdly, the human capital accumulation depends on the country's education programs. Leeuwen revels that Petrakis and Stamatakis (2002, 518-519) prove that "each education level has a different effect on economic growth. In addition, they also find that the effect of each level of formal education on economic growth differs among countries of different 'economic maturity'. In short, the more developed a country is, the more important secondary and higher education become compared with primary education" (Bas van Leeuwen, 2007, p.43).

1. The data and the model

The diversity of indicators that could measure the human capital was a great challenge for our work. We tested a lot of indicators as proxy for human capital and decided to use in our model two indicators: the *total intramural R&D expenditure (GERD) as percent of GDP* which reveals the national effort to increase the stock of knowledge, new products and technologies and the *employees professional, scientific and technical activities; administrative and support service activities* (Izushi and Huggins, 2004, used in their study the number of R&D personnel from private sector).

Maskell and Malmberg (1999, p.110) argued that "a country's overall human capital is related to a proxy of the level of business expertise and skills relevant to innovation, i.e. the number of professionals active in R&D-related activities".

As growth indicator at regional level, we used the *gross domestic product* in million purchasing power standard.

Regions are coded according to the European Union's NUTS 2 classification. We decided to analyze all macro regions of Romania: *Macroregion one* (noted M1) that include the Nord Vest and Centru regions, *Macroregion two* (noted M2) that include the Nord Est and Sud Est regions; *Macroregion third* (noted M3) that include the Sud Muntenia and Bucharest and *Macroregion four* (noted M4) that include the Sud Est Oltenia and Vest.

The selected data indicators are as follows: the *Gross domestic product (GDP)* at current market prices by NUTS 2 regions in million purchasing power standard (PPS), noted as **GDP_PPS**; *the total intramural R&D expenditure (GERD) as percent of GDP* (noted as **RD_of_GDP**); *employed persons professional, scientific and technical activities; administrative and support service activities* in thousand persons, noted as **employed-R_D** and *disposable income of household net in euro per inhabitant* noted **Disp_inc_inhab**.

In our paper we used annual data during 2000-2014, from Eurostat: *GDP in PPS* (noted **GDP_PPS**) form table nama_10r_2gdp]; the *disposable income of household net in euro per inhabitant,* noted **Disp_inc_inhab**, from table [nama_10r_2hhinc], total intramural R&D expenditure (GERD) by sectors of performance and NUTS 2 regions , table [rd_e_gerdreg] for *total intramural R&D expenditure (GERD) as percent of GDP* noted as **RD_of _GDP**, and the Employment (thousand hours worked) by NUTS 2 regions, table [nama_10r_2emhrw] for the *employed persons professional, scientific and technical activities; administrative and support service activities,* noted as **employed _R_D.** All the data are stationary in first difference.

Table 1 shows results for statistical descriptions of the model variables: mean, median, the maximum and minimum value, standard deviation, skewness and kurtosis and J. Bera coefficient.

Table 1 Descriptive statistics of variable

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
GDP_PPS_M1	48466.6	53201.0	65101.0	29198.0	12668.4	-0.2	1.6	1.2
GDP_PPS_M2	46108.7	48236.0	62259.0	29281.0	11245.4	-0.1	1.7	1.0
GDP_PPS_M3	78752.2	82152.0	112590.0	41891.0	26225.6	-0.1	1.5	1.3

GDP_PPS_M4	37901.7	40595.0	50351.0	23027.0	10028.2	-0.3	1.5	1.3
NDISP_INC_ INHAB_M1	2638.5	3100.0	4500.0	1300.0	1009.6	0.0	2.0	0.6
NDISP_INC_ INHAB_M2	2153.8	2500.0	4000.0	1000.0	860.8	0.4	2.6	0.4
NDISP_INC_ NHAB_M3	3461.5	4200.0	5700.0	1400.0	1536.5	-0.2	1.5	1.2
NDISP_INC_ INHAB_M4	2669.2	3200.0	4700.0	1300.0	1049.1	0.1	2.1	0.5
R_D_OF_GDP _M1	0.2	0.2	0.3	0.1	0.1	0.0	2.0	0.5
R_D_OF_GDP _M2	0.2	0.2	0.3	0.1	0.0	0.3	2.1	0.6
R_D_OF_GDP _M3	0.8	0.8	1.0	0.7	0.1	0.5	3.6	0.8
R_D_OF_GDP _M4	0.2	0.2	0.3	0.2	0.0	0.7	1.9	1.5
EMPLOYED_R _D_M1	81892.9	77076.7	110951.1	57195.5	18946.4	0.2	1.6	1.2
EMPLOYED_R _D_M2	102380.3	104607.4	118243.5	82258.5	11465.6	-0.6	2.3	1.1
EMPLOYED_R _D_M3	252338.1	248955.8	330914.1	185687.9	46888.1	0.1	2.0	0.6
EMPLOYED_R _D_M4	87208.8	86538.6	105212.6	69400.1	11349.2	-0.2	2.0	0.6

Source: Author computation

The statistical analysis of the model reveals significant differences with a relative large standard deviation. Also, there is an asymmetry on the left side for the GDP_PPS series and NDISP_INC_INHAB_M3 and EMPLOYED_R_D_M2 and EMPLOYED_R_D_M3 data series, while Kurtosis increases from 1.5 (GDP_PPS M3 and EMPLOYED_R_D_M3) to a maximum of 3.6% (R_D_OF_GDP_M3).

We use a panel data technique that captures non-time varying unobservable and other unobservable factors. So, this might explain structural differences at the level of each individual macro region of Romania, regarding the level of human capital and economic growth. The period taking into consideration was from 2000 to 2014 and at the level of 4 macro regions; the fixed effects panel model has been selected for the scope of the research.

The results of the model

The model is Pooled Last Squared with cross fixed effects and cross section fixed dummy variable, where the independent variable was the GDP growth noted (**GDP_PPS**). The dependent variables, indicators measuring the *human capital,* were *total intramural R&D expenditure (GERD) as percent of GDP* noted as **RD_of _GDP**, and *employed persons professional, scientific and technical activities administrative and support service*

activities, noted as **employed _R_D.;** and other dependent variable was disposable income of household net in euro per inhabitant, noted **Disp_inc_inhab.** the results are presented in table 2

Table 2 The Pooled Last Squared model with cross fixed effects and cross section fixed dummy variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1585.092	722.1353	2.195007	0.0381
D(NDISP_INC_INHAB?(-3...	6.750605	2.561549	2.635361	0.0145
D(R_D_OF_GDP?)	17061.10	7975.394	2.139217	0.0428
D(EMPLOYED_R_D?(-4))	0.112802	0.069782	1.616485	0.1191
Fixed Effects (Cross)				
_M1--C	-651.2285			
_M2--C	-224.1037			
_M3--C	1855.505			
_M4--C	-980.1730			
Fixed Effects (Period)				
2005--C	-285.1317			
2006--C	4895.503			
2007--C	2587.814			
2008--C	-173.6503			
2009--C	-5907.657			
2010--C	-4220.008			
2011--C	-3016.659			
2012--C	5562.268			
2013--C	-2105.190			
2014--C	2662.710			

Source: Author computation

The tests for fixed effects indicate that the two statistics value (2.465047 and 10.743972) and the associated p-values do not reject the null hypothesis that the cross-section effects are redundant. The forms of statistics of the next two tests (for significance of the period dummies in the unrestricted model against restricted specification and for the joint significance of the all effects) strongly reject the null hypothesis of no period effects and the restricted model in which there is only a single intercept, as we can see in table 3.

Table 3 The redundant fixed effect test. Test cross-section and period fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	2.465047	(3,24)	0.0867
Cross-section Chi-square	10.743972	3	0.0132

Period F	4.671552	(9,24)	0.0012
Period Chi-square	40.490677	9	0.0000
Cross-Section/Period F	5.675284	(12,24)	0.0002
Cross-Section/Period Chi-square	53.794323	12	0.0000

Source: Author computation

As we expected, the model data shows a positive and statistically significant correlation between GDP growth at macro regional level and human capital expressed as the R&D effort at national level, and persons employed in research activities, as was expected from theories. In addition, based on established theories, we expected the positive correlation between GDP growth and disposable income of household. However, if we look at regional effects, there are significant differences between Romanian macro regions (with negative coefficients on transversal effects), except the macro region three that include Bucharest with a positive coefficient on transversal effects. A possible explanation is that Bucharest has a concentration of investment in high tech research area and a great human capital. Storper and Scott (2009) consider that the location of the firms, the movements of labor, and the skilled labor in cities could explain the difference in economic growth at regional level. Also, the model highlights time differences, one possible explanation being related with the 2007-2011 financial and economic crises, closely followed by sovereign-debt crisis, which had an impact on Romania economy.

Conclusions

Human capital is an important factor of economic growth at macro regions level in Romania. The disparities between the disposable incomes alter the positive effect of human capital in three of the macro regions, except the macro-region three which includes Bucharest.

From the positive values of the coefficients within the model we conclude that the developed macro regions record a high level of returns while investing in human capital. Also, the corresponding coefficients for other regions that are negative in value, shows a relative low level of return from investment in human capital, possibly linked with heavy losses in mature human capital, due to its migration to developed economies (Italy, France, Germany or Great Britain).

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