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## Human Capital, Economic Structure and Growth

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### Abstract

Human capital is usually viewed as one of the key determinants of competitiveness and economic growth. However, recent statistical data about unemployment and growth in EU have revealed some weak spots of this traditional view. The human capital itself seems not to be a guarantee of economic stability and presumable quick recovery from crisis. On the contrary we see countries like Spain or Cyprus where the level of human capital, expressed as a percentage of tertiary educated population, is relatively very high but the unemployment reaches critical levels and economic growth is weak or negative. In this article we continue with our previous research and show that human capital must reflect the economic structure to foster the economic growth. Otherwise it might only cause higher level of unemployment due to crowding out effect and imbalances on the labor market. We also deal with responses of regional economies on recent economic crisis, when we show asymmetric responses based on structural differences and human capital endowment.

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## 1. Introduction

The importance of human capital for competitiveness and economic growth has been discussed very intensively during last two decades. The theoretical emphasis on human capital was laid mainly by endogenous growth theory, starting with Arrow (1962) and Uzawa (1965). Nelson and Phelps (1966) were probably the first ones who emphasized the role of human capital in technology adoption and its impact on economic growth. However the concept of human capital was fully embodied later, mainly in works of Romer (1986) and Lucas (1988). Many studies and analyses focusing on human capital and growth followed – Barro (1991) finds human capital to be one of key determinants of per capita income, Aghion and Howitt (1998) stress the role of human capital as a factor promoting higher investment in technology with positive impact on growth.

Besides many country-specific or cross-country studies also regional analyses dealing with human capital and growth have been rising. Regional human capital endowment is, similarly to national models, viewed as one of the causes of regional economic growth (Cheshire and Margini, 2000 or Di Liberto, 2008). It is also often treated as one of the possible determinants of differences and divergences in regional wages, productivity and income, especially in relation to migration flows (Faggian, McCann 2009).

However, despite this general, mostly theoretically driven “feeling”, the empirical evidence is rather inconclusive (Temple 2001, Ramos et al. 2009). There are several studies which directly oppose the common attitude pointing at weak relationship between human capital and growth, possible reversal causality or presence of omitted variable which artificially links human capital with growth (Bils and Klenow 2000). Nevertheless most of the studies are not in such direct opposition. They often emphasize unequal or asymmetrical impact of human capital on competitiveness and growth. These studies usually come to the conclusion that the positive impact of human capital is different for different countries or regions. Krueger and Lindahl (2001) found that the effect of education on economic growth varies among the countries, López-Bazo and Motelón (2012) concluded that there is a difference in education effect on regional wages. Ramos et al. (2009) stressed that the effect of human capital represented by education level can have even a negative effect on unemployment, connected to over-education. Recent development in Spain and other, mainly southern European, countries truly revealed that the education level itself cannot lead to higher growth rates and lower unemployment levels. It seems more likely that education should reflect the economic structure of the region and the market needs. Čadil et al. (2013) came to similar conclusion on European level when the impact of human capital on wages and household’s disposable income was found significant only for regions with specific economic structure.

The purpose of this article is to analyse the impact of human capital on regional economic growth (on NUTS 2 level) and unemployment when controlling for economic structure. We show that it is the economic structure which mainly affects the final impact of human capital on regional economic development<sup>†</sup>. We also deal with different responses of regional economies on recent financial crisis in relation to economic structure and human capital endowment. We would like to stress that regional economies were affected differently and that human capital itself is no guarantee of quick recovery from recession.

## 2. Data and method

To analyse the impact of human capital on regional growth two substantial factors should be taken into consideration. The first one is convergence among the regions. According to neoclassical growth theory represented by Solow (1956) and his followers, there should be convergence among the countries and regions alike when poorer countries and regions should grow faster than the richer ones. The convergence theory was proved true several times but only in its conditional version. However when focusing on European regions we can presume that conditional convergence takes place here and should be taken into consideration. The second issue is somewhat related to the

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<sup>†</sup> We continue with our previous research in this field which was mainly static and oriented on human capital and regional income disparities.

first one. Naturally we want to use “real” indicators, which are indicators reflecting regional price levels. In practice, for the EU NUTS 2 regions these are indicators denominated in Purchasing Power Standard (PPS). Although the PPS indicators reflect sort of national average price level and are suitable for any cross-country analyses, they do not reflect true regional price levels. Although using regional PPS indicators is common contemporary practice, it should be stressed that it is not perfectly correct and may lead to errors in estimates. As Musil et al. (2012) show, there is quite substantial reduction in regional differences in indicators like GDP among the regions when using proper regional price levels instead of PPS. However this factor cannot be efficiently dealt with as data about regional price levels are not available for most of the member states. We still have no other option then use the PPS indicators for cross-regional researches of EU regions.

As stated above, our intention is to analyse the impact of human capital on economic growth and unemployment on regional level with relation to regional economic structure. Our approach has three stages. In the first stage we analyse the whole group of NUTS 2 regions for all EU member states (where there is data availability) in time series 2007–2010. Then we make clusters of regions with similar economic structure and do the analysis again for these separated groups. The last stage is devoted to the estimates of shorter periods: pre-crisis period 2007–2008, critical period 2008–2009 and post-crisis period 2009–2010.

For the impact of human capital on output growth we follow the approach of Ramos et al. (2009) without specific regional effects<sup>‡</sup>

$$\Delta \ln(y_i) = a_0 + a_1 \ln(y_{i0}) + a_2 \ln(hc_{i0}) + \varepsilon_i \quad (1)$$

where  $\Delta \ln(y_i)$  is average GDP per capita growth rate<sup>§</sup>,  $y_{i0}$  is GDP per capita in PPS in base year<sup>\*\*</sup> controlling for convergence among the regions.  $hc_{i0}$  is proxy for human capital endowment in the base year – a ratio of employees with tertiary education on total number of employees in the region.

For the impact of human capital on unemployment we use similar model

$$\Delta \ln(u_i) = b_0 + b_1 \ln(u_{i0}) + b_2 \ln(hc_{i0}) + \mu_i \quad (2)$$

where  $u$  stands for the rate of unemployment. We use Eurostat database for both models.

In the second stage we want to split the group of regions into several clusters with similar economic structure. To identify the structure we employed location quotient defined as

$$lq_j = \frac{\frac{E_{ij}}{E_i}}{\frac{E_j}{E}} \quad (3)$$

where  $i$  is a number of people employed in sector  $j$  in region  $i$ ,  $s$  is number of people employed in sector  $j$  at higher level region<sup>††</sup>. The location quotient shows whether the activity is concentrated in particular region (the location quotient is higher than 1) in relation to a higher level or whether the region has a deficit in this sector. Eurostat

<sup>‡</sup> We create the clusters in the second stage so including regional specific effects would be fruitless.

<sup>§</sup> For the first and the second stage it is a geometric average over period 2007–2010. For the third stage it is just a growth rate of GDP per capita in a particular year (2008,2009,2010).

<sup>\*\*</sup> For the first and the second stage it is 2007, for the third stage it is 2007, 2008 and 2009 respectively.

<sup>††</sup> A higher level region is the whole EU in this case. The reason is that regions are not isolated within the state borders – they compete with regions with a similar structure behind their national borders probably more than with regions within the country with a different structure. For example, a region with a high relative concentration of financial intermediation (like London) is, in fact, exporting these services mostly abroad competing with similar regions within the state but also in other countries (like Stockholm or Hamburg).

NACE Rev1 data for EU NUTS 2 regions in time period 2004-2008 covering 5 sectors<sup>\*\*</sup> (Agriculture, Industry, Wholesale services, Financial intermediation and Public Administration) were used. Four clusters with a similar economic structure were defined while employing a standard non-hierarchical method (Timm, 2002). Clusters we get are naturally not of the same size. Table 1 summarizes the cluster's characteristics<sup>§§</sup>.

Table 1: Clusters identification

	Cluster 1		Cluster 2		Cluster 3		Cluster 4	
	mean	std	mean	std	mean	std	mean	std
Agriculture	1.63	0.35	4.30	1.60	0.67	0.23	0.29	0.16
Industry	1.05	0.18	0.97	0.27	1.15	0.24	0.80	0.16
Wholesale services	1.06	0.18	0.92	0.26	1.01	0.14	1.04	0.11
Financial intermediation	0.66	0.19	0.42	0.12	0.85	0.17	1.31	0.32
Public administration	0.96	0.16	0.72	0.14	1.02	0.18	1.19	0.15
Unemployment	9.16	3.58	10.90	3.09	7.41	3.72	6.58	3.08

Note: std – standard deviation

Source: Eurostat, own calculation

Regions in the first cluster have relatively well diversified economic basis with a certain focus on agriculture and related industry and services. Second cluster holds regions which are strongly agricultural, focusing mainly on primary agriculture production (farming). These regions exhibit low share of secondary and tertiary sector. The third cluster is on the contrary mainly industry- oriented consisting of regions with one to three bigger industrial cities. The fourth cluster can be described as a cluster of wealthiest regions, usually capital cities and other highly urbanized areas with a high share of public administration and financial intermediation.

For estimation of (1) and (2) in all three stages defined above we employ robust regression to suppress the weight of outliers which are likely to occur. Robust regression techniques are an important complement to classical least squares (LS) regression. Robust techniques provide results similar to LS regression when the data are linear with normally distributed errors. However, the results differ significantly when the errors do not satisfy the normality conditions or when the data contain significant outliers. For more information see e.g. Rousseeuw (2003).

Two regression methods with a high breakdown point were employed. A robust regression with a high breakdown point LTS was used to detect outliers, leverage points and influence points (the observations whose inclusion or exclusion result in substantial changes in the fitted model). Final regression equations were obtained using robust MM regression which combines a high breakdown point a good efficiency. Due to SAS and S-Plus software used in the analysis, Tukey's bisquare loss function was employed.

### 3. Results

Regression models, LS and robust regression model (RM) were used for estimation of (1) and (2). Table 1 and Table 3 show the results for GDP and Table 2 and Table 4 for unemployment. Results show also R-square and regression techniques, \*\*\*show statistical significance at 95 % level of confidence and \*\*at 90 % level of confidence.

Only in few sets analysed no outliers and bad leverage points were identified, the LS fits as fully satisfactory model in such cases as adopted. With a view to existing outliers and bad leverages, it was recommended to prefer a RM against the classical LS one in the most cases in our analysis.

<sup>\*\*</sup>This simplification comes from current data availability. A more detailed breakdown of sectors should be used in future.

<sup>§§</sup> We use the same method of clusters identification as in our previous research (see Cadil et al. 2013).

Table 2. GDP and human capital 2007–2010

Cluster	All regions	1	2	3	4
Intercept	3.13***	3.06***	1.16***	4.12***	2.95***
$\ln(y_{i0})$	0.33***	0.34***	0.77***	0.10***	0.37***
$\ln(hc_{i0})$	-0.01***	0.00***	-0.03***	0.00	-0.01
R <sup>2</sup>	0.22	0.32	0.69	0.03	0.24
Model	RM	RM	LS	RM	RM

Table 3. Unemployment and human capital 2007–2010

Cluster	All regions	1	2	3	4
Intercept	4.79***	4.60***	4.75***	4.79***	1.20***
$\ln(u_{i0})$	-0.08***	-0.04	-0.16***	-0.10***	-0.10***
$\ln(hc_{i0})$	0.02	0.06	0.09**	0.03	0.18
R <sup>2</sup>	0.11	0.02	0.30	0.12	0.23
Model	RM	RM	LS	RM	RM

Table 4. GDP and human capital 2008, 2009, 2010

Year	Cluster	1	2	3	4
2008	Intercept	5.11***	3.82***	5.59***	3.13***
	$\ln(y_{i0})$	-0.11	0.22	-0.21***	0.34***
	$\ln(hc_{i0})$	0.01	-0.06***	-0.01	-0.03
	R <sup>2</sup>	0.02	0.24	0.03	0.07
	Model	RM	LS	RM	RM
2009	Intercept	2.90***	2.32***	5.86***	6.37***
	$\ln(y_{i0})$	0.36***	0.47***	-0.28***	-0.43***
	$\ln(hc_{i0})$	-0.01	0.02	0.00	0.05***
	R <sup>2</sup>	0.07	0.49	0.08	0.20
	Model	RM	RM	RM	RM
2010	Intercept	0.03	-1.92***	0.33	2.12***
	$\ln(y_{i0})$	1.00***	1.41***	0.93***	0.55***
	$\ln(hc_{i0})$	0.00	0.01	0.01	0.00
	R <sup>2</sup>	0.39	0.83	0.21	0.10
	Model	RM	LS	RM	RM

Table 5. Unemployment and human capital 2008, 2009, 2010

Year	Cluster	1	2	3	4
2008	Intercept	4.57***	4.89***	4.40***	4.30***
	$\ln(u_{i0})$	-0.04	-0.19	-0.03	-0.02
	$\ln(hc_{i0})$	0.03	-0.01	0.07	0.09
	R <sup>2</sup>	0.01	0.10	0.02	0.02
	Model	RM	LS	RM	LS
2009	Intercept	4.93***	5.08***	4.92***	5.55***
	$\ln(u_{i0})$	-0.10**	-0.26***	-0.14***	-0.19***
	$\ln(hc_{i0})$	0.03	0.07	0.07	0.18**
	R <sup>2</sup>	0.05	0.36	0.09	0.32
	Model	RM	LS	LS	LS
2010	Intercept	4.23***	4.50***	4.70***	4.55***
	$\ln(u_{i0})$	0.04	-0.11	0.00	-0.17***
	$\ln(hc_{i0})$	0.12	0.17**	-0.02	0.13**
	R <sup>2</sup>	0.12	0.11	0.00	0.17
	Model	RM	RM	RM	RM

Regarding the whole unstructured sample of regions in period 2007-2010 we see quite surprising result. NUTS 2 regions are likely to be diverging and the human capital endowment is slowing the regions down instead of accelerating their growth. Similar tendencies can be found when we focus on clusters – divergence takes place in all the clusters. Moreover in agricultural regions (cluster 2) the human capital endowment is controversially reducing the economic growth. When we take a look at the growth of unemployment rate we have to conclude that there is generally no relation between growth of unemployment rate and human capital endowment. The only exception is again agricultural cluster where, not surprisingly and in line with previous findings, the higher human capital level brings unemployment acceleration. On the other hand we can see a general convergence in unemployment growth rates among the regions, which is quite surprising in comparison to GDP per capita divergence. Agricultural regions are usually quite low-human capital endowed and the highly skilled labour force is either commuting to other more urbanized (industrial or service-oriented) regions or does not accept the relatively lower wages in the region remaining unemployed. Those who accept the lower wages replace the lower-educated labour force causing unemployment. This is the effect of over-education Ramos et al. (2009) discuss. Regarding the negative effect on GDP we have to bear in mind that statistically the value added of commuting population is counted towards the region of their employer not of their residence. Moreover part of their income is being spent there. These two effects together may explain why agricultural regions with higher share of highly educated people face negative impact of education on employment and growth. This problem is however partly of statistical (regional GDP accounting) nature. To conclude we cannot generally prove the positive effect of human capital endowment on unemployment and growth.

Regarding the recent economic crisis and response of regional economies we see again only limited impact of human capital on the crisis and recovery. In the period before crisis (2008) we see no effect of human capital on growth as well as in the period of recovery (2010). In the most critical year 2009 we see a possible positive growth effect, however only in the region of major cities. From the unemployment rate dynamics, the results are again inconclusive – the effect of human capital is usually insignificant. The only exception is the critical year 2009 again in the cluster of major cities. However the human capital endowment accelerates the unemployment rate despite decelerating it.

#### 4. Conclusion

Although human capital is still regarded as one of the key elements of economic growth, the empirical research in this area is rather inconclusive. Especially the recent economic crisis and dramatic increase of unemployment rate, even among highly educated people, aroused a new discussion on this topic. The problems of over-education in hand with unsuitable education structure seem to be the most important problems of human capital in EU today. It seems that higher human capital endowment is no longer a guarantee of prosperity and low unemployment. On the contrary as Ramos et al. (2009) conclude the effect could be the opposite.

In our article we focused on estimation of the effect of human capital endowment on economic growth and unemployment dynamics in period 2007–2011. We used regional NUTS 2 data and split the group of regions to clusters according to similar economic base. We also controlled the estimate for possible convergence effects among the regions. The results show that generally we cannot claim human capital being a positive factor of growth in EU regions in selected period. On the contrary, especially in agricultural regions we see a negative effect of human capital endowment on growth but also on unemployment. The reason for such a result can be caused by several factors. Firstly, highly educated population living in agricultural regions partly works elsewhere – in near urbanized regions. This is artificially reducing the output statistics. Also there is a partial shift in demand which slows down the economic performance. Regarding the negative effect on unemployment it can be explained by the over-education effect mentioned by Ramos et al. (2009) and also by structural unemployment while the highly educated population does not satisfy the regional labour market needs. When focusing on the situation before, during and after the recent economic crisis we get a very inconclusive picture again. Generally for most of the clusters we see no effect of human capital on the economic growth or unemployment at all – before crisis, during it or in the year 2010 which brought the first sign of recovery. The only statistically significant results were obtained for the critical year of 2009 when we see a positive effect of human capital on economic growth in the cluster of big cities but on the other hand there is a negative effect on unemployment.

To conclude, we found no clear positive effect of human capital on economic growth and unemployment in EU NUTS 2 regions in the period 2007–2011. On the contrary, our findings here weakly support those of Ramos et al. (2009) indicating possible negative effects of over-education and structural problems particularly in agricultural regions.

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