

# LABOUR PRODUCTIVITY AND HUMAN CAPITAL IN THE EU COUNTRIES: AN EMPIRICAL ANALYSIS

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*The role of the human capital in the economy is highlighted in several studies of human capital, endogenous growth and macroeconomic literature. A special part of this literature is dedicated to the mechanism and the various channels through which human capital influences economic growth. As an expression of the macroeconomic performance, the labour productivity depends on the accumulation of human capital in the economy. To analyze and discuss this dependency is essential for appropriate human capital policies aiming to stimulate the human capital accumulation in the economy and the enhancement of the labour productivity.*

*The paper explores the link between labour productivity and the estimates of the human capital stock in the EU countries.*

*Human capital theory explains the labour productivity level by the workers' level of educational attainment level. Four different effects of human capital on labour productivity can be found in economic literature: worker, allocative, diffusion and research. Other researchers used a production function to estimate the productivity impact of changes in educational attainment.*

*Research on the impact of human capital on productivity at the country level encountered many difficulties over the years. The main methodological issue is how to measure skills and human capital investment and to model possible channels of skills of influence the economic performance. The UNESCO attainment levels and enrollment series and other data sets, constructed by researchers, have been used in a large number of empirical studies of the link between education and productivity.*

*What is innovative in the present study is the estimation of human capital stock based on educational costs by level (primary, secondary, tertiary) weighted by the proportion of labour force with corresponding educational attainment and the testing of linear regression model for the dependency of labour productivity on human capital stock.*

*The assumption of the study is that the labour productivity is strongly and positively correlated with the human capital stock in the European economies. In order to confirm this, the following steps were completed: First, the appropriate method to estimate the human capital stock in the economy was identified and then, the estimations were calculated for the EU's countries, based on EUROSTAT data. Second, the correlations between statistical indicators of labour productivity and estimates of human capital stock, for each European country were identified and discussed. Third, a regression linear model was tested for each of 22 European countries included in the study.*

*A strong correlation between labour productivity and human capital stock, statistically tested through regression equations with data from EUROSTAT, was found. The variation of labour productivity can be explained in proportion of 85-95% by the variation of human capital stock, considering all other factors as constant.*

*The added value of the paper consists of: (i) the estimation of human capital stock using the educational costs method for the European countries; (ii) the use of these estimates to show the correlation with the labour productivity levels and (iii) testing econometrical models of the dependency between labour productivity and human capital stock in 22 European countries.*

*An interesting and useful task for future research is to explore the details of the institutional and incentive structure that best allocates a fixed amount of educational expenditures.*

*Key words human capital stock, labour productivity*

*JEL Codes J 24, J 21*

## **Introduction**

The topic of the present paper belongs to the research area dealing with the role of the human capital in the economy, and specifically, the association of the human capital stock with the level and growth of the labour productivity. To know the facets of this association could orient the human capital policies able to stimulate human capital accumulation and enhancement of the labour productivity, as expression of the macroeconomic performance.

The aim of the paper is to explore and analyze the link between labour productivity and human capital stock in the European countries. The assumption of the study is that the labour productivity is strongly and positively correlated with the human capital stock in the European economies. In order to confirm this, the following steps were completed: First, the appropriate method to estimate the human capital stock in the economy was identified and then, the estimations were calculated for the EU's countries, based on EUROSTAT data. Second, the correlations between statistical indicators of labour productivity and estimates of human capital stock, for each European country were identified and discussed. Third, econometrical models are tested for each of 22 European countries included in the study.

The paper is organized as follows: the section 1 presents a short literature review on the link between labour productivity and human capital, in the section 2 is described the methodology of the study, the section 3 exposes the main findings and the final section is dedicated to conclusions.

### **1. Human capital and labour productivity: a short literature review**

Human capital theory explains the labour productivity level by the workers' level of educational attainment level (Mincer, 1974; Becker, 1997). Four different effects of human capital on labour productivity can be found in economic literature: worker, allocative, diffusion and research. These effects are based on the studies of Nelson and Phelps (1966) Welch (1970), Ram (1980), Pencavel (1991).

Jenkins (1995) examined the role of education in the labour productivity in UK using a production function to estimate directly the productivity impact of changes in educational attainment.

Research on the impact of human capital on productivity at the country level encountered many difficulties over the years. The main methodological issue is how to measure skills and human capital investment and to model possible channels of skills of influence the economic performance.

For example, the UNESCO attainment levels and enrollment series have been used in a large number of empirical studies of the link between education and productivity. Enrollment rates can be considered an acceptable, imperfect, proxy for the flow of educational investment but they are not necessarily a good indicator of the existing stock of human capital since average educational attainment (which is often the more interesting variable from a theoretical point of view) responds to investment flows only gradually and with a very considerable lag. In an attempt to remedy these shortcomings, a number of researchers have constructed data sets that attempt to measure directly the educational stock embodied in the population or labour force of large samples of countries during a period of several decades. These data sets have generally been constructed by combining the available data on attainment levels with the UNESCO enrollment figures to obtain series of average years of schooling and of the composition of the population or labor force by educational level. The best known early attempts in this line are the work of Kyriacou (1991), the versions of the Barro and Lee data set (1993, 1996, 2000, 2010) and the series constructed by World Bank researchers (Lau, Jamison and Louat (1991), Lau, Bhalla and Louat (1991) and Nehru, Swanson and Dubey (NSD, 1995).

In 2006, dela Fuente and Domenech developed estimates of educational attainment for 21 OECD countries and in 2011 revised them, in order to demonstrate that the contribution of investment in human capital to productivity growth is positive and quite sizeable.

Razak and Timmins(2007) found that university qualification and its product with R&D have a positive effect on the average economy productivity. Jones and Chiripanhura (2010) set out an experimental approach to measuring human capital stock, relevant to explanation of productivity performance, that estimates the economic value to individuals of their highest level of attainment gained in the formal education system.

Masson, O'Leary and Vecchi(2012) found evidence of positive human capital effect on growth in average productivity, particularly when using composite human capital measure and multifactor productivity growth is related to the use of high-skilled labour.

The general model of human capital and growth is a production function of Cobb-Douglas type. What is innovative in the present study is the estimation of human capital stock based on educational costs by level(primary, secondary, tertiary) weighted by the proportion of labour force with corresponding educational attainment and the testing of linear regression model for the dependency of labour productivity on human capital stock.

## 2.The methodological approach of the study

Exploring the link between labour productivity and human capital stock poses the problem of measurement of the two variables. While, the labour productivity is measured through statistical indicators available from general statistical sources, adequately measuring of human capital stock is controversial in the human capital literature. For labour productivity, there are several recognized statistical indicators that can be used: output per capita, output per worker, output per hour worked. Regarding the measurement of the human capital stock, the things are more complicated. Three general approaches to measuring the human capital stock can be identified in the relevant literature: measures based on educational attainment, measures based on the value of the inputs that enter the production of human capital (input or cost-based approach) and output (typically measured by labour market income) that stems from human capital (output or income based approach).For the purpose of this paper, the second method is be used.

In this method, the value of the human capital stock is calculated as being the depreciated value of the monetary amount spent on investment in human capital. Kendrick (1976) and Eisner (1985) provide seminal examples of this approach.

According to Judson (2002), the average human capital per worker,  $h$ , is:

$$h = \sum_i d_i \cdot a_i \quad (1)$$

where:

$d_i$  is educational expenditures for the  $i$  level of education, as share of GDP;

$a_i$  is the educational attainment of the labour force

Extending the work of Judson, the human capital stock in the economy can be estimated using the formula (2):

$$H = \sum_i ED_i \cdot EP_i \quad (2)$$

where:

$H$ - human capital stock per capita

$ED_i$  -educational expenditures per student for  $i$ -educational level( primary, secondary, tertiary) in PPS based on full-time equivalent ;

$EP_i$  - employment population population with  $i$ -educational level.

In order to test the dependency between labour productivity and human capital stock, a linear regression model will be used:

$$Y = \alpha + \beta \cdot x + \varepsilon \quad (3)$$

where:

$Y$  - labour productivity, expressed in Eur/hour

$\alpha$  -constant

$\beta$  -regression coefficient

$x$  - human capital stock, expressed in thousand Euro

$\varepsilon$  -error

The study was carried out in three stages. In the first stage the estimates of human capital, according to the formula (2) was calculated for each of 22 european countries included in the study. The decision of inclusion was based on the availability of data for the period 1996-2010 from EUROSTAT.

In the second stage, the correlation coefficients were calculated (Table 1).

In the third step, the regression equation (3) was used for each country, to test the link between labour productivity and the human capital stock in the economy and the statistical validity of the econometric models was checked.

### 3. Main findings

#### 3.1. Labour productivity, human capital stock and gross domestic product

**Table 1 Partial correlation coefficients, EU countries, 1996-2010**

Country	Correlation coefficient between labour productivity and human capital stock	Correlation coefficient between human capital stock and gross domestic product	Correlation coefficient between gross domestic product and labour productivity
Belgium	0,81	0,96	0,85
Bulgaria	0,96	0,98	0,94
Czech Republic	0,99	0,97	0,98
Denmark	0,88	0,95	0,9
Germany	0,94	0,97	0,98
Estonia	0,92	0,98	0,96
Ireland	0,98	0,98	0,89
Greece	0,90	0,99	0,95
Spain	0,96	0,99	0,82
France	0,96	0,98	0,96
Italy	0,52	0,81	0,83
Cyprus	0,99	0,99	0,98
Latvia	0,92	0,99	0,92
Lithuania	0,96	0,99	0,96
Malta	0,32	0,94	0,37
Netherlands	0,97	0,99	0,98
Austria	0,98	0,98	0,99
Poland	-0,09	0,95	0,39
Portugal	0,95	0,97	0,97
Slovenia	0,95	0,93	0,95
Slovakia	0,98	0,98	0,96
Finland	0,97	0,97	0,98
Sweden	0,89	0,97	0,95
United Kingdom	0,95	0,89	0,90

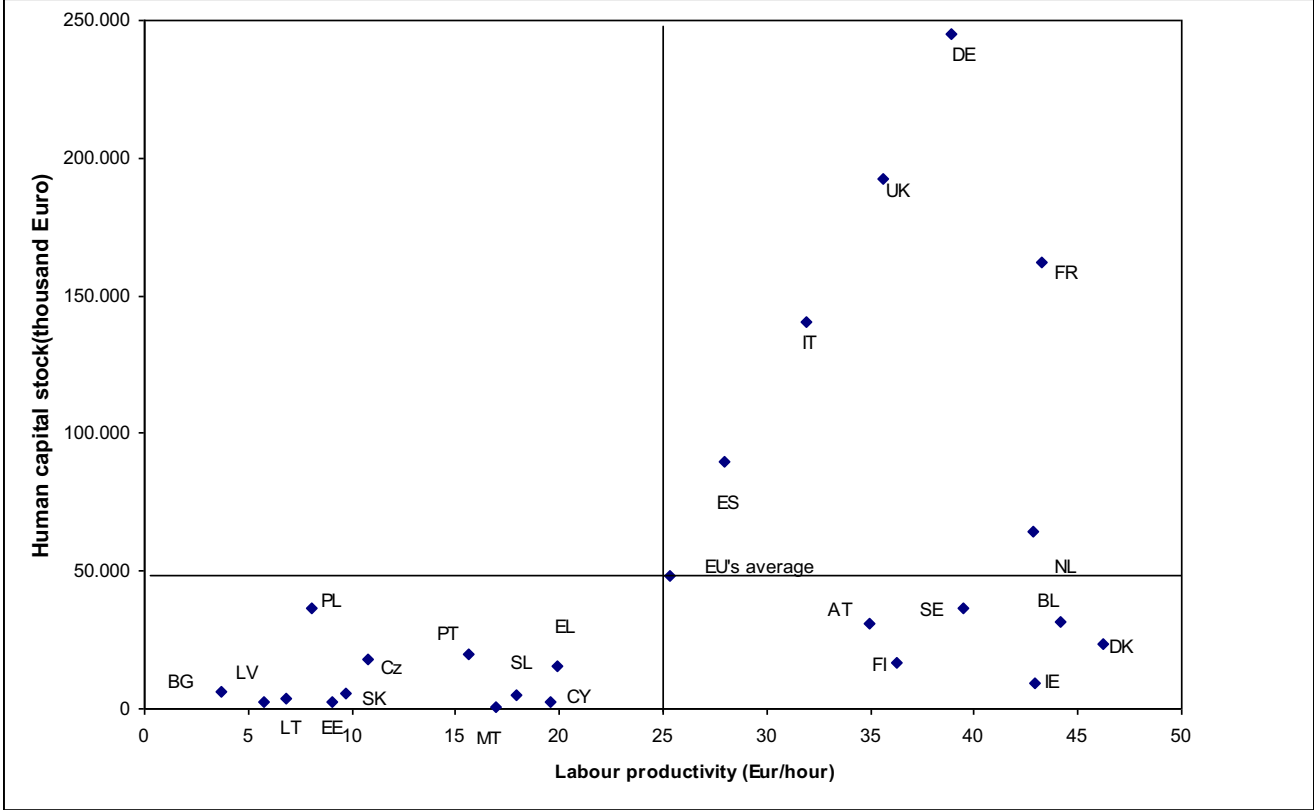
Source: author's own calculations based on EUROSTAT data

Note: Luxembourg, Hungary, Romania were excluded due to unavailable data for all years.

As we can see in the Table 1, in all european countries there are very strong correlations between labour productivity and human capital stock, gross domestic product and human capital stock, gross domestic product and labour productivity. There are two exceptions, in Malta and in Poland. In Malta, labour productivity is weakly correlated with the human capital stock(0,32), but the gross domestic product is strongly and positively associated with the human capital stock. In the case of Poland, there is an inverse correlation between the labour productivity and human capital stock and, as in Malta and other european countries, human capital stock is positively and strongly correlated with the gross domestic product.

**3.2. The link between labour productivity and human capital stock in the european countries**

Taking into consideration the association of labour productivity with the human capital stock, the european countries can be divided in three groups. The first group includes Germany, United Kingdom, France, Italy, Spain and Italy, where the labour productivity and human capital stock are above the average of European Union. The economic output and the labour productivity (25-50 Eur/hour) in these countries are at the highest level of European Union. There are strong economies where the stock of human capital is better valorised on employment than the EU's average.



**Fig.1 The relation between labour productivity and human capital stock, in european countries, average values for 1996-2008**

Source: author's calculations based on EUROSTAT data

In the second group, countries as Austria, Sweden, Belgium, Finland, Ireland and Denmark have the level of the labour productivity above of the EU's average and the level of their human capital stock is under the EU's average. In the case of these countries, the human capital stock has a lower impact on the national labour productivity as the EU's average.

The third group consists of countries with labour productivity and human capital stock under the EU's average (Bulgaria, Poland, Portugal, Greece, Czech Republic, Slovenia, Slovakia, Latvia, Lithuania, Malta and Cyprus). In these countries, the value of human capital stock is under 50.000 thousand Euro and the labour productivity is under 25 Euro/hour.

In order to further analyze the association of labour productivity with human capital stock, the econometric model presented in section 2 was tested for 22 European countries with 1996-2008 data. 5 of the 27 Member States were excluded due to unavailable data for all years (1996-2008). In 20 of 22 countries, the linear regression model was statistically validated. The values of the multiple correlation coefficients between labour productivity and human capital stock indicate a strong positive correlation between these variables. The variation of labour productivity can be explained in proportion of 85-95% by the variation of human capital stock, considering all other factors as constant (see Appendix).

## Conclusions

The paper is based on estimation of human capital stock in European countries using the costs method developed by Judson (2002). Empirical analysis of the estimation of human capital based on educational costs weighted by the educational attainment of the labour force are quite rare.

Accordingly, the added value of the paper consists of: (i) the estimation of human capital stock using the educational costs method for the European countries; (ii) the use of these estimates to show the correlation with the labour productivity levels and (iii) testing econometrical models of the dependency between labour productivity and human capital stock in 22 European countries.

The findings of the study show that there is a strong linkage between labour productivity and human capital, expressed as a stock, and differences in labour productivity across the European countries can be explained, in proportion of 85-95% by the differences in the level of human capital stock. The proposed linear regression model is validated in 20 of 22 countries.

Measuring the association of human capital with the labour productivity is important for policy makers, especially in decisions about education spending based on empirical evidence. Due to the fact that policy on education can have many ends other than raising productivity, an interesting and useful task for future research is to explore the details of the institutional and incentive structure that best allocates a fixed amount of educational expenditures.

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## Appendix

### Regression equations for the european countries

Country	Equation	Statistically validated /not validated
Belgium	$y = 36,95 + 2,49E - 05 \cdot x + 0,93$	validated
Bulgaria	$y = 2,78 + 1,84E - 07 \cdot x + 0,1$	validated
Czech Republic	$y = 4,37 + 3,62E - 07 \cdot x + 0,25$	validated
Denmark	$y = 33,07 + 5,74E - 07 \cdot x + 0,79$	validated
Germany	$y = 23,2 + 6,61E - 07 \cdot x + 0,70$	validated
Estonia	n.a.	
Ireland	$y = 33,8 + 0,0008 \cdot x + 1,16$	validated
Greece	n.a.	validated
Spain	$y = 26,54 + 1,23E - 05 \cdot x + 0,14$	validated
France	$y = 30,93 + 7,59E - 05 \cdot x + 0,73$	validated
Italy	$y = 5,06 + 0,0002 \cdot x + 2,38$	validated
Cyprus	$y = 17,08 + 0,001 \cdot x + 0,14$	validated
Latvia	$y = 3,08 + 0,0008 \cdot x + 0,39$	validated
Lithuania	$y = 4,18 + 0,0008 \cdot x + 0,29$	validated
Malta	$y = 16,51 + 0,0005 \cdot x + 0,81$	<i>not validated</i>
Netherlands	$y = 31,7 + 0,0001 \cdot x + 0,65$	validated
Austria	$y = 19,9 + 0,0004 \cdot x + 0,57$	validated
Poland	$y = 9,1 - 1,5E - 05 \cdot x + 1,86$	<i>not validated</i>
Portugal	$y = 12,36 + 0,0001 \cdot x + 0,13$	validated
Slovenia	$y = 7,94 + 0,002 \cdot x + 0,59$	validated
Slovakia	$y = 4,85 + 0,0009 \cdot x + 0,29$	validated
Finland	$y = 19,26 + 0,001 \cdot x + 0,78$	validated
Sweden	$y = 19,12 + 0,0005 \cdot x + 1,39$	validated
United Kingdom	$y = 28,27 + 4,39E - 05 \cdot x + 0,76$	validated