HUMAN CAPITAL: RELATIONSHIP BETWEEN EDUCATION AND LABOR PRODUCTIVITY IN THE EUROPEAN COUNTRIES

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Abstract

The aim of this article is to analyze the relationship between the human capital and labor productivity. Since the late 80s, a new, broader concept of capital and a new approach of its measuring penetrate the theory of economic growth. One of the most often used methods of measuring the human capital, is the number of years of formal schooling or the share of tertiary educated people to population. The issue of incorporating of human capital into the new models of economic growth has been advanced e.g. P. Romer, R. Lucas, S. Rebelo, G. N. Mankiw, D. N. Weil. This contribution analyses the relationship between the number of years of formal schooling and the labor productivity across the selected European countries. Using the panel data analysis, the authors show what part of variability in the labor productivity (measured as GDP per employee and GDP per hour worked) can be explained by the differences in the number of years of formal schooling (measured as the school life expectancy). The findings show an increasing importance of education in the European countries and document – despite improving trends – still suboptimal situation of the Czech economy.

Key words: human capital, productivity of labor, years of formal schooling, economic growth

JEL Code: E24, I25, O47

Introduction

Economic growth is a fundamental economic issue, directly linked to the living standards of the population, with significant multi-level social and economic consequences. Growth theories form an essential part of economic theory in the broadest sense of the word. Each direction of mainstream economics has offered a specific theory of economic growth. Since the 80s, the theory of economic growth has been slowly penetrated by new, broader concept of capital and a new approach to its quantification. The issue of incorporating human capital into new models of economic growth has been advanced esp. by the works of Romer (1986, 1990), Lucas (1988), Jones and Manuelli (1990), Rebelo (1991), Mankiw and Weil (1992). Their findings indicate the contribution of capital to income growth has been much larger than the original Solow model expected, which has also been confirmed by empirical data (Maršíková and Kocourek, 2013).

The aim of this article is to analyze the relationship between human capital and labor productivity. One of the most usual used methods of human capital measurement method is the number of years of formal schooling or the share of tertiary educated people on population. This contribution investigates the relationship between the number of years of formal schooling expressed as a school life expectancy (SLE) and the gross domestic product (GDP) per employee and per worked hour in selected European countries (where data are available in adequate time series and classification). Using the panel data analysis, the authors show to which extent the variability in GDP per employee (and per hour worked) can be explained by the differences in SLE in primary, secondary, and tertiary education. The results indicate the growing importance of education across the European countries and document – despite improving trends – still a rather suboptimal situation in the Czech Republic and in other, mainly East European countries.

In the first section, the process of incorporating the concept of human capital to models of economic growth is outlined. The second part provides a summary of different approaches to human capital measurement. In the third part, there are specified the data used for our calculation, and in the fourth section the results are briefly described. The last part of the contribution concludes and comments on the achieved findings.

1 Current State of Knowledge

The economists are well aware of the role of a human in creating the wealth for quite a long time. The classical economists understood the population of the country as a crucial part of its capital. Over the last four decades, the contribution of human capital has been intensively incorporated into the models of economic growth. These models of so-called endogenous growth are based on a critical analysis of the Solow model. Their authors abandon the assumption of permanent effects of the aggregate production function in the economy and they try to endogenize the process of technological progress as well as the savings rate. By doing so, they confirm the Solow model as a crucial mile-stone for the further development of growth theory, however, exogenous nature of the pace of technological progress, technological changes, and the savings rate in this model are not capable to explain sufficiently the differences in growth dynamics of various economies. Endogenous theories come up with hypothesis, that the dynamics of accumulation of scientific and technological knowledge and human capital is the result of deliberate investments in these particular areas. These theories also incorporate the impact of positive external effects on knowledge, technological change, and capital. Investments, both in physical and human capital, lead to an increase in productivity, which is greater than private benefits. If the external effects prove to be strong enough to neutralize the impact of diminishing returns, then the positive relationship between knowledge and investment can lead to a lasting impact on the growth rate. That is the reason why the theory of endogenous growth rejects the assumption of diminishing returns to scale.

The development of new growth theory implementing human capital can be divided in two developmental phases: The first phase is represented by already mentioned contributions of Romer and Lucas, and also of Rebelo. Their main effort was to modernize and supplement the neoclassical growth model, focusing on the concept of capital. Here, capital is defined in a broad sense, i.e. it includes both physical and human capital. In their view, the returns on capital may not record a tendency to decline in relation to economic development, because of the positive externalities of human capital and diffusion of knowledge among producers. These factors prevent diminishing returns on accumulated capital.

The second development phase of the new theory of growth is characteristic by direct incorporation of research and development (R&D) and imperfect competition to the model framework. Among the most distinguished authors of these theoretical concepts, the following ones must not be omitted: Romer (1990), Grossman and Helpman (1991), Aghion and Howitt (1992). In their models, the technological progress is a result of intentional research and development and revenues from these activities are derived from the ex-post monopoly position. Technological progress and economic growth are endogenous results of imperfect competition markets. As Romer shows, the pace of growth and the extent of R&D do not have to be necessarily Pareto optimal in this framework.

Another step forward in the development of economic theory is represented by the article of Jones and Romer (2010). Symmetrically with Kaldor, they put together a group of six "stylized facts" on growth, where the fifth and the sixth one deal with the issue of human capital. The fifth one states: "Accumulation of human capital per worker. The human capital has been rapidly growing in the countries all around the world" (Jones, Romer 2010 p. 225). This stylized fact is a counterpart of Kaldor's sustainable growth of capital-labor ratio applied on the human capital. Jones and Romer document this fact by a long-run increase in the number of years of formal schooling in the U.S. economy approximately by one year in a decade, contributing by 0.6 percentage points to the U.S. rate of economic growth (assuming 6% Mincer rates of return to education). That is quite a significant contribution. The long-run growth rate of the GDP per capita was in the USA only around 2 %.

The sixth Jones-Romer stylized fact says: „The long run stability of relative wages. The increasing stock of human capital of highly qualified employees in comparison to low-skilled workers is not in compliance with ongoing decrease of relative price of low-skilled labor" (Jones, Romer 2010 p. 225). The authors studied the college and high school wage premiums in the USA. They realized that despite increasing accumulation of human capital (growing number of school years and growing share of tertiary educated population), its wage premiums do not tend to decline. The explanation lies probably in skill-biased technological change. Acemoglu (1998), "emphasizing nonrivalry and the interaction between scale and incentives, argues that a key determinant of the direction of technical change is the number of people for whom the new technology will be useful. The rising supply of highly educated labor tilts technical change in its own direction" (Jones, Romer 2010 p. 241).

Thus, the still unsettled issue of human capital, its measurement and its firm incorporation in the theory of growth offers a space for further research and for growing interest of theoreticians as well as economic policy makers.

2 Methods of Measuring Human Capital

The approaches to human capital measurement are generally classified to:

Output-Based Approach: According to Barro and Lee (1993), the stock of human capital can be estimated by the school enrollment rates. Nehru, Swanson, a Dubey (1993) tried to quantify the human capital as an accumulated years of schooling in the employable age. While Romer (1990) suggested the ratio between skilled-adults and total adults. Psacharopoulos and Arriagada (1986) used the average years of schooling to measure the stock of human capital.

Cost-Based Approach: The human capital is considered a function of total costs invested for one's human capital. Kendric (1976) utilized an individual's investment costs including their depreciation. Jorgenson & Fraumeni (1989) presented discounted income in the future as a measure of human capital.

Income-Based Approach: The returns (or wage premiums) which an individual obtains from an employer due to his/her education investment. Mulligan and Sala-i-Martin (1996) define the aggregate human capital as a sum of each individual's labor force, and present the stock of human capital utilizing the individual's income.

3 Data

Despite various drawbacks (e.g. years of schooling can be only slightly related to labor productivity), we decided to follow the output-based approach to human capital, similarly to Psacharopoulos and Arriagada (1986). We use the school life expectancy for a measure of human capital stock in the national economy. Our data were provided by UNESCO Institute for Statistics. They are available in the 15-year long time series (1999–2013) for 25 European countries (all the EU countries, except Bulgaria, Croatia, Cyprus, Germany, Malta, Romania, plus Iceland, Norway, and Switzerland). The major advantage of this approach and also of this data source is the chance to analyze separately the primary, secondary, and tertiary education. The obvious shortcoming lies in the differences of national schooling systems. The classification of education to primary, secondary, and tertiary, however, respects the International Standard Classification of Education (ICSED) and as therefore the data for different countries should be comparable.

The labor productivity is measured by the GDP per employee and by the GDP per worked hour. The data are provided by the statistics database run by Organization for Economic Co-operation and Development. We are working with the software eViews 8.1 on our analysis.

Since the use of panel data analysis assumes the stationarity of the data, we ran the augmented Dickey-Fuller test (ADF), although the ADF test sometimes fails when the time series are not long enough. We confirmed the stationarity of our data also using Levin, Lin & Chu test and Phillips and Perron (PP) Fisher Chi-square test. All of them indicated our data were non-stationary. The problem of non-stationarity was solved by logarithmic data transformation, as the distribution of the data seemed skewed.

In the general model we assume the variability of GDP per employee (*GDPpE*) and of GDP per worked hour (*GDPpH*) can be explained by the differences in primary school life expectancy (*SLEp*), secondary school life expectancy (*SLEs*) and tertiary school life expectancy (*SLEt*). Since all the European countries have individual, specific conditions for labor productivity growth, we apply the cross-sectional fixed effects. In the equation (1) and (2), we estimate the coefficients (*C*) and also the fixed country effect (*CX=F*).

$$\log(GDPpE) = C_1*\log(SLEp) + C_2*\log(SLEs) + C_3*\log(SLEt) + C_4 + [CX=F] \quad (1)$$

$$\log(GDPpH) = C_1*\log(SLEp) + C_2*\log(SLEs) + C_3*\log(SLEt) + C_4 + [CX=F] \quad (2)$$

We apply the least square method to estimate the coefficients of these equation with fixed cross-section effects. We followed a step-wise procedure to control for cointegration of the explanatory variables. The relevance of all the coefficients is tested at the 95% level of significance.

4 Results

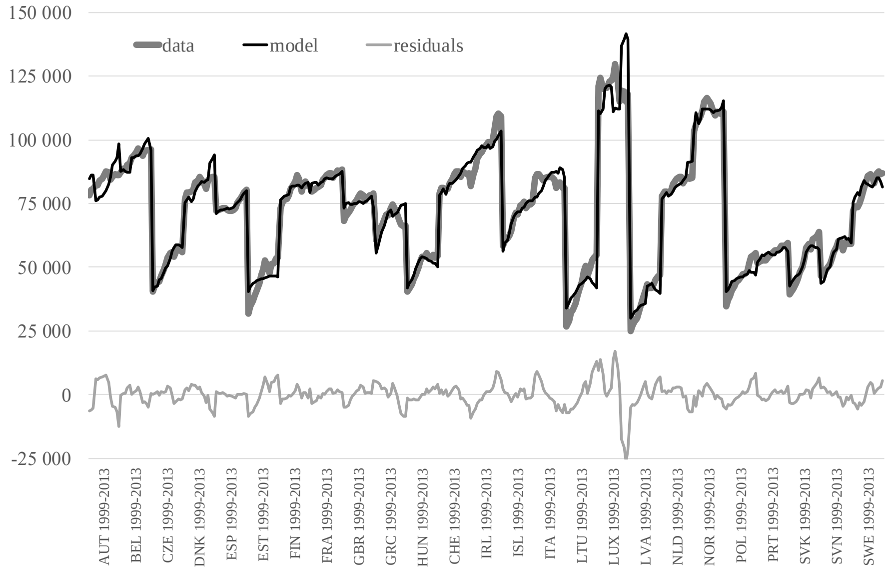
The results of our estimations are represented by the following two equations (3) and (4) and illustrated by Figure 1 and Figure 2. The normality of residuals distribution passed "eye-ball" test and was confirmed by Jarque-Bera test.

$$\log(GDPpE) = 0.310*\log(SLEp) - 0.162*\log(SLEs) + 0.436*\log(SLEt) + + 10.462 + [CX_E=F] \quad (3)$$

$$\log(GDPpH) = 0.320*\log(SLEp) - 0.147*\log(SLEs) + 0.490*\log(SLEt) + + 2.901 + [CX_H=F] \quad (4)$$

Both equations show the contribution of primary and tertiary education to productivity of labor is significant and also quite a strong one. They indicate, that 1% increase in the school life expectancy in primary education is associated with more than 0.3% increase in labor productivity, while 1% increase in the school life expectancy in tertiary education is associated with more than 0.4% increase in labor productivity. On the other hand, the years of secondary education tend to (slightly) decrease the pace of productivity growth, which seems an interesting point providing an attractive space for further research.

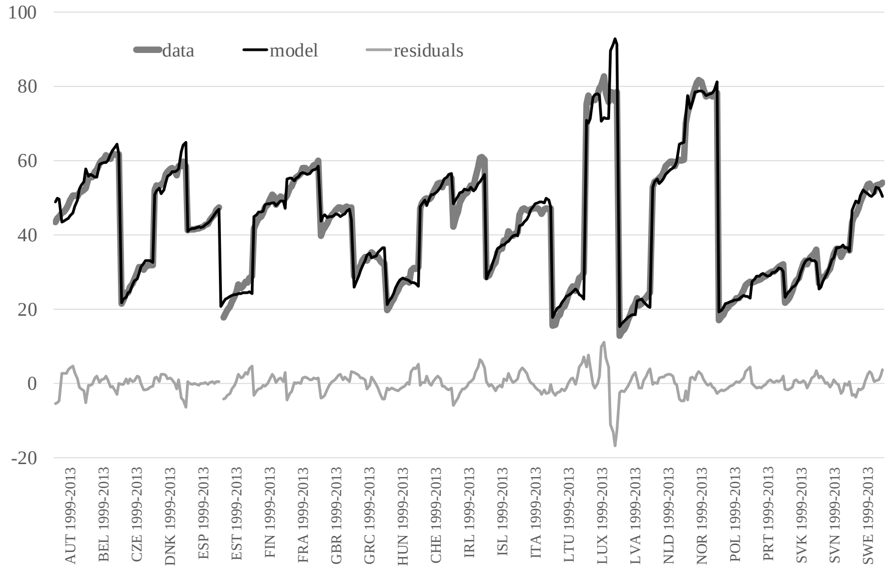
Fig. 1: Panel Data Model of GDP per Employee (in USD)



Source: author's calculations

Both figures (Figure 1 and Figure 2) document, how capable our models are in explaining the variability in labor productivity. In fact, they both can explain more than 95 % of differences in labor productivity in European countries across the period 1999–2013.

Fig. 2: Panel Data Model of GDP per Worked Hour (in USD)

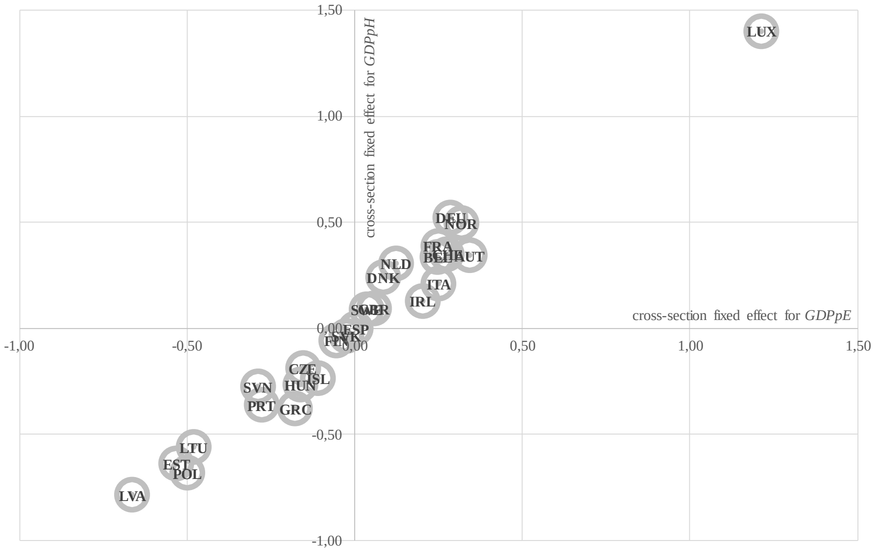


Source: author's calculations

Although it is generally rather difficult to comment on the value of cross-section fixed effect in panel data analysis as it represents an artificial dummy variable, the results of our analysis seem to indicate another interesting finding. In Figure 3, the estimated values of cross-section fixed effects for GDP per employee (ie. [CX_E=F] in equation 3) are shown on the horizontal axis and values of cross-section fixed effects for GDP per worked hour (ie. [CX_H=F] in equation 4) on the vertical axis.

We recognize an almost diagonal layout of these values, where most of them are concentrated around zero. There is one apparent outlier, Luxemburg, whose labor productivity is way above the European average, although they experienced one of the lowest rates of growth over the period 1999–2013. On the other side of the diagonal, there can be identified a group of Baltic countries (Estonia, Latvia, Lithuania) and Poland, whose labor productivity was really low at the break of millennium, but they experienced the highest rates of labor productivity growth.

Fig. 3: Cross-sectional Fixed Effects for Analyzed European Countries



Source: author's calculations

The Czech Republic falls into a mixed group of countries consisting of Greece, Hungary, Iceland, Portugal, and Slovenia. It seems obvious, the other factors – besides the school life expectancy – affecting the labor productivity in the Czech Republic are not set optimally. They impede the positive effects of education and hinder the transformation of the accumulated human capital to high labor productivity.

Conclusion

Over the period of 1999–2013, the labor productivity (GDP per employee) across the 25 analyzed European countries rose at an annual average pace of 1.46 % (GDP per worked hour at a pace of 1.79 % yearly), while the school life expectancy in primary, secondary, and tertiary education altogether rose by 0.74 % (on average 1.17 years in a decade). These results are quite in a compliance with those published by Jones and Romer (2010) for the USA.

We have found a strong relationship between the school life expectancy and the labor productivity in the countries across Europe. Not surprisingly, the labor productivity is to the highest extent affected by the growing number of tertiary educated employees (i.e. growing school life expectancy in tertiary education). The tertiary school life expectancy grew at an average annual pace of 2.63 % (primary 0.23 % and secondary 0.45 %), whereas the Czech Republic recorded 6.09 % a year (the highest pace among all the European countries). Still, the labor productivity in the Czech Republic remains at 50 % or even less when compared with the developed West European countries. In other words, not only the quantity of tertiary educated people guarantees the high labor productivity.

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