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THE IMPACT OF GOVERNMENT EXPENDITURE ON EDUCATION AND R&D AS FACTOR OF HOMAN CAPITAL ON ECONOMIC GROWTH

Annotation. *The Strategies of many countries are focused on the area of growth such as sustainable and inclusive growth. These goals could be realized with a good education and training system a creative industries and a great effort to create a research-intensive economy. This couldn't be achieved without major contribution of human capital.*
This research aims study how the factors of human capital impact on economic growth. Studying contribution of human capital to economic growth, the main methodological problems is to choose the correct measure of human capital. Therefore we analyze three approaches for human capital measurement. We highlights channel through witch human capital influence on economic growth. The paper tried to reveal the role of government expenditure in education and R&D as a factors of the growth human capital in Georgia. We have used three proxies for human capital accumulation: government expenditure on education, government expenditure on R&D and number of patents application by residents. Our main results support the argument that expansion of education expenditure has a positive effect on per capita GDP and to argue that the investment in human capital influence the sustainable development of the county.
Key Words*: Human Capital; Economic Growth; R&D Expenditure; Government Expenditure in Education; Econometric Model.*

Introduction

Identifying economic and non-economic aspects, the OECD proposed a broad definition of human capital as "*The knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being*" (OECD, 2001). This definition has obtained wide acceptance.
Schultz (1961) introduced the term "human capital" and referred it to the value of human capabilities. He declared that human capital is not dissimilar to other types of capital, it could be invested in various ways such as education and training. That is, the more education and training, the higher the accumulated human capital stock is. As a result, such investment will generate higher productivity, thus raising one's earnings and resulting in higher aggregate level of production, and so does the national income (Izushi H., Huggins R., 2004).
Human capital was generally defined into five categories: Health facilities and services; On-the-job training; Formally organized education at the elementary, secondary and higher levels; Study programs for adults; Migration of individuals and families to adjust to changing job opportunities. The concept of human capital relate to the abilities and skills of human resources of countries, while human capital formation relate to the process of acquiring and increasing the number of people with the skills, good health, education and

experience that are critical for economic growth. Therefore, investment in education and health are considered as human capital components.

Human capital might affects growth through two channels. First - human capital directly participate in production as a productive factor. Consequently, the accumulation of human capital would directly generate the growth of output. Second - human capital can contribute to raising technical progress and the level of human capital affects productivity growth.

The Methodological Framework

The contribution of human capital to economic growth accepted by theoretical models and as by empirical studies. The main methodological problems is to choose the indicator used to measure human capital. In the other words how to measure human capital. There are three the approaches for human capital measurement.

The Cost-Based Approach. Among direct measurement approaches, the approach measures human capital by looking at the stream of past investments undertaken by individuals, households, employers and governments. The cost-based approach is relatively easy to apply, because of the ready availability of data on both public and private expenditures in formal education. In terms of mathematical formula, the cost-based approach can be expressed as the following.

$$C = \sum_{j=1}^{r} c_j = \sum_{j=1}^{r} \left[\sum_{i=j=1}^{m} s_i^e / (1+r)^i \right]_j$$

where C is the discounted total cost; *c* is the expected cost in the year j; *s* is the expected cost in the year i and *r* is the discount rate.

The Income-Based Approach. The approach measures human capital by looking at the stream of future earnings that human capital investment generates over the lifetime of a person. Therefore, in contrast with the cost-based approach, which focuses on the input side, the income-based approach measures the stock of human capital by looking at the output side. This approach measures human capital by summing the discounted values of all future income streams that all individuals expect to earn throughout their working life or lifetime. Mathematically,

$$Y = \sum_{j=1}^{T} y_j = \sum_{j=1}^{T} \left[\sum_{i=1}^{m} w_i^e / (1+r)^i \right]_j$$

where Y is the discounted total expected income; y is the expected income in the year j; *ei w* is the expected income in the year i, and *r* is the discount rate.

The approach elaborated by Jacob Mincer is empirically implemented by explaining the logarithm of the wage of a worker from her/his educational attainment and labour market experience (which is also source of human capital formation), while controlling for a set of background characteristics such as gender, type of labour contract (e.g. full-time or part-time, fixed term or tenure), and sector of economic activity:

$\log(wi,t) = \alpha + \beta Si + \gamma Xi,t + \varepsilon i,t$

where w is the gross hourly wage of worker i in year t, X includes background characteristics, γ is the regression coefficient of these background characteristics, α is a constant term,

and ε is an error term. The term S indicates the schooling level of the individual, and regression coefficient β measures the private return to investment.

The schooling level S is often measured as the number of years of education. In that case the quasi-elasticity β has a straightforward interpretation: it measures the % increase in the person's wage when (s)he would take an additional year of schooling. existing estimates of β are in the range of 5 to 15%. (Mincer, J. (2004)).

Starting point is the idea that schooling is an investment in human capital, and this investment would generate a future return in the form of a higher wage for the individual.

The Output-Based Approach. This approach measures human capital by its output. In other words, several indicators that can sufficiently represent the stock of human capital as a whole or at least as a group might be employed as the proxy. It is important to note that this approach does not directly view human capital as accumulated. Rather, it tends to find a suitable indicator or index that reflects the amount of human capital of an economy or a group of people. They might be average years of schooling, literacy rate, enrolment rate, net enrolment, gross enrolment, or some other educational attainment indexes. The formula can be expressed below.

$$\overline{H} = \sum_{i} L_i H_i,$$

Where H is human capital, $I\,L$ is the proportion of the labor force with the ith level of education and $I\,H$ is the number of years of schooling associated with the its level of education.

The Indicators-based Approach. Recently several indicators are widely used for measurement of human capital. 1. The UN Human Development Index (HDI), which combines measures of average achievements in a country in three basic dimensions of human development, i.e. health, education and knowledge, and standards of living. The structure of the index is constituted to health, knowledge, and standard living with many sub-variables such as life expectancy at birth, adult literacy rate, gross enrollment ratio, and GDP per capita. The Human Development Index (HDI) provides a single index measure which aims to capture three key dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living (https://unctad.org); 2. World Bank Human Capital Index (HCI) (https://ourworldindata.org ; 3. The PISA, which tests 15-16 year olds students for their cognitive skills in terms of reading, mathematics, science and problem solving; 4. The PIAAC, which tests adults for their competencies in terms of literacy, numeracy and ability to solve problems in technology-rich environments (http://data.uis.unesco.org).

A new approaches of human capital measurement clarifies what indicators can be considered to precisely measure more accurate human capital. Measurement is closely linked to education-related factors as proxies of human capital.

There are many study in economic literature that show the channels through which human capital accumulation and education may lead to economic growth. One of the main methodological difficulty is to choose the proxy indicator used to measure human capital. Human capital is considered as a fundamental factor for the research sector, where current research has a positive spillover for the productivity of future research. R&D is intensive in human capital relative to other sectors.

Mankiw, Romer, and Weil (1992) have built a model to explain the growth endogenously by extending the Solow growth model to enlist human capital as a separate input from labor (known as MRW models). The variables in their model can be expressed in terms of efficiency unit of labor. Based on the similar production function and by assuming that the country specific shock is not correlated with the saving rate and population growth, the OLS estimation can be employed. They use average percentage of working people in secondary school to proxy for human capital investment rate and other traditional variables as well as the baseline coefficients, and establish relations among the variables through the so called Augmented Solow model. The results show this model can explain over 67% of the cross-country difference in income per capita. Also, another interesting result is that the poor countries tend to converge to the steady state faster than the rich countries

There are research papers estimating the relationship between public funding of education and economic growth both in developed and transition countries. Results of Barro (1999) showed positive link between education quality and economic growth. Gregorious and Ghosh (2007) made use of the heterogeneous panel data to study the impact of government expenditure on economic growth. Their results suggest that countries with more government expenditure tend to higher economic growth. 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 (Pelinescu E. (2015)). 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. 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 (Pelinescu E. (2015)).

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).

The model and Empirical results

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. After analyzing above mentioned methods we applied a regression model and have used three different proxies for human capital accumulation: government expenditure on education, government expenditure on research and development and number of patents application by residents. We have applied annual statistical data during the period 2000-2017 for Georgia.

In highlighting the impact of human capital on economic growth will be take into the consideration other variables such a Private R & D Expenditure and high technology export but due the limited data we cannot take into account this variables. The source of the data is Eurostat, World Bank, UNESCO and UNctat. Therefore, our model is as follows:

$$Y = bo + b1\ GOVE + b2\ GERD + b3\ NoP + U, \qquad (1)$$

Where,
Y is *GDP Per Capita Atlas Method (Current $)* in country for year t, (GDP/capita is the real level of GDP per capita and is a direct function of human capital (H));
GOVE - Expenditure on education as percentage of total government expenditure % for year t;

GERD - Government expenditure on R&D as a percentage of GDP;

NoP - Patents applications by residents it is the number of patents for year T.

In the present study, two models were performed. Firstly, this method is used as a means of finding the estimators of the coefficients of the model. According to this method, we look for a line that minimizes the sum of squares of residues. For the estimated model (Linear Regression) we employ three explanatory variables, such as government expenditure on education, R&D expenditure, number of patents. The results from the estimate of the regressions are presented in the following table.

Table #1

	Coefficients	*Standard Error*	*t Stat*	*P-value*
C	1704,132818	1556,832569	1,094615344	0,292160553
GOVE	1593,315181	447,0214506	3,56429245	0,003111361
GERD	-4223,073066	1617,895603	-2,610225937	0,020563827
NoP	-14,3408208	2,363168109	-6,068472552	2,89424E-05

Source: The processing of the author

At next stage, the variables are generated as logarithmic values of the sum of GDP Real and expenditures on education and number of patents. We performed the regression by including all the variables in the model. This model therefore estimates that:

$$Ln\ (Y) = bo + b1\ Ln(GOVE) + b2\ Ln\ (GERD) + b3\ Ln\ (NoP) + U, \qquad (2)$$

Using Statistics dates, we obtain the following regression output represents in the table #2

Table #2

	Coefficients	*Standard Error*	*t Stat*	*P-value*
C	9,23641	1,254134	7,36477	3,54E-06
Ln (GOVE)	2,260754	0,579083	3,904024	0,001589
Ln (GERD)	-0,37981	0,119316	-3,18319	0,006639
Ln (NoP)	-0,86682	0,183948	-4,71232	0,000333

Source: The processing of the author

Both of models are statistically significant. The linear model revealed a positive relationship, statistically significant between GDP per capita and public expenditure on education as expected according to economic theory. Unexpected is the negative relationship between expenditure in R&D and GDP per capita.

The chosen logarithmic model we find significant results for the one of the explanatory variables - public expenditure on education. The model revealed a negative relationship, statistically significant between GDP per capita and innovative capacity of human capital (evidenced by the number of patents). Unexpected is the negative relationship between expenditure in R&D and GDP per capita. Therefore, our results should be interpreted in this context: The regression outcomes could be improved with longer time series for human capital as human capital affects economic growth with essential time lag. In the future we will use in the model as alternative variables for human capital.

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.

Conclusions

At presented paper we have empirically investigated the extent to which investments in human capital accumulation have contributed to the growth dynamics in Georgia over the last decades. We have applied statistical data with random effects during the period 2000-2017. We have used three different proxies for human capital accumulation: government expenditure on research and development government expenditure on education and number of patents application by residents.

From the Regression Results it was found that the government expenditure on education in Georgia has significant effect on Real Gross Domestic Product (RGDP). Consequently, public financing of education is a true parameter of measuring economic growth. This paper suggest that education is not the only, or the major contributing factor of per capita GDP, there are other contributing factors.

To conclude, the relationship between R & D expenditure and economic growth needs to be built in the long run in order to have a positive correlation. Survey results have shown that increasing the amount spent on R & D does not necessarily lead to economic growth. Our main results support the argument that expansion of education expenditure has a positive effect on per capita GDP. Therefore, policy makers must pay more attention to the quality of education.

The regression outcomes could be improved with longer time series for human capital as human capital affects economic growth with essential time lag. Therefore, our results should be interpreted in this context. In the future we will use in the model as alternative variables for human capital.

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ლია თოთლაძე

ეკონომიკის დოქტორი, თსუ ასისტენტ პროფესორი

განათლებასა და R&D-ზე სახელმწიფო დანახარჯების, როგორც ადამიანისეული კაპიტალის ფაქტორების ეკონომიკურ ზრდაზე გავლენის შეფასება

ვრცელი რეზიუმე

მსოფლიოს მრავალი ქვეყნის სტრატეგია ორიენტირებულია ეკონომიკური ზრდის მნიშვნელოვან ასპექტებზე, როგორიცაა მდგრადი და ინკლუზიური ზრდა.

ამ მიზნების მიღწევა შეიძლება განხორციელდეს განათლებისა და ტრენინგის გამართული სისტემის, კვლევებსა და დამუშავებებზე (R&D) ორიენტირებული ინდუსტრიებისა და მეცნიერებატევადი ეკონომიკის შექმნით. ეს კი შეუძლებელია ადამიანისეული კაპიტალის მნიშვნელოვანი წვლილის გარეშე.

ნაშრომი მიზნად ისახავს ადამიანისეული კაპიტალის ეკონომიკურ ზრდაზე ზეგავლენის ემპირიული ასპექტების გამოკვლევას, რისთვისაც უპირველეს ყოვლისა მნივნელოვანია ადამიანისეული კაპიტალის გაზომვა. აღნიშნულიდან გამომდინარე შემოთავაზებულია ადამიანისეული კაპიტალის გაზომვის შემდეგი მიდგომები: დანახარჯების მიხედვით, რომელიც ემყარება ადამიანისეული კაპიტალის შეფასებას იმ დანახარჯების მიხედვით, რომელსაც სახელმწიფო/კერძო სტრუქტურები ახორციელებენ მისი განვითარებისათვის; შემოსავლების მიხედვით, რომელიც ემყარება მინსერის მიდგომას - ადამიანისეული კაპიტალი შეფასდეს იმ შემოსავლების მიხედვით, რასაც იღებს ადამიანი მისი სამუშაო გამოცდილების შესაბამისად; ინდექსების მიხედვით, რომელიც ემყარება ფართოდ გავრცელებულ ისეთ ინდექსებს, როგორიცაა: გაეროს ადამიანის განვითარების ინდექსი (HDI), მსოფლიო ბანკის ადამიანისეული კაპიტალის ინდექსი (HCI), PISA ტესტი და სხვა.

ნაშრომში განსაკუთრებული ყურადღება აქვს დათმობილი იმ არხების ანალიზს, რომელთა მეშვეობითაც ადამიანისეული კაპიტალი გავლენას ახდენს ეკონომიკურ ზრდაზე. დადგენილია ადამიანისეულ კაპიტალში განხორციელებული ინვესტიციების ქვეყნის მდგრად განვითარებაზე ემპირიული ზეგავლენის ხარისხი. ნაშრომში გამოვლენილია განათლებასა და R&D–ში სახელმწიფო ხარჯების ადამიანისეული კაპიტალსა და ეკონომიკურ ზრდაზე გავლენის წვლილი საქართველოში. ზემოთ მოტანილი მიზნის მისაღწევად აგებულია როგორც წრფივი, ისე ლოგარითმული მოდელები, რომლებშიც ამხსნელ ცვლადებად განხილულია სახელმწიფო დანახარჯები განათლებაზე, კვლევებსა და დამუშავებებზე (R&D), ასევე რეგისტრირებული პატენტების რაოდენობა. საქართველოს ემპირიული მონაცემების მოდელირების შედეგები განათლებაზე გაწეული დანახარჯების შემთხვევაში თანხვედრაში აღმოჩნდა თეორიულ ეკონომიკურ დებულებებთან. რაც შეეხება დანარჩენ ეკონომიკურ ცვლადებს - დანახარჯებს კვლევებსა და დამუშავებებზე (R&D) და რეგისტრირებული პატენტების რაოდენობას, მიუხედავად მათი სტატისტიკურად მნიშვნელოვნებისა, ისინი უარყოფით კორელაციაში აღმოჩნდა შედეგობრივ ცვლადთან. ამ შედეგის ინტერპრეტაცია მხოლოდ შემდეგი შეიძლება იყოს: აღნიშნული ცვლადების ზემოქმედების შეფასებისათვის გასათვალისწინებელია დროითი ლაგი და აუცილებელია უფრო გრძელვადიანი პერიოდის მოდელირება.

საკვანძო სიტყვები: ადამიანისეული კაპიტალი; ეკონომიკური ზრდა; R&D სახელმწიფო დანახარჯები; სახელმწიფო დანახარჯები განათლებაში; ეკონომეტრიკული მოდელი.