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Education and Economic Dominance

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Abstract
The paper examines the role of national education in achieving leading positions in global economic relations. Theoretical part uses stock of knowledge accumulated by scholars in the sphere related to human capital. Empirical part uses logistic regressions in order to test for relationship between global economic dominance and national education. Membership in the G20 is used in the models as a dependent categorical variable indicating the fact of the worldwide leadership. The models indicate that human capital and its educational part have statistically significant influence on the probability of becoming worldwide economic leader.

Keywords
Economic leadership, education, human capital, HDI

Introduction

In a highly globalized world of nowadays, where countries are closely interacting with each other in various spheres, the question of economic leadership becomes exclusively important. Leading positions in international economic relations allow countries to ensure wellbeing of their citizens and realize relatively independent economic and social policies. In the 21st century countries gain political weight not only by developing their military potential, but also by expanding their economies. Societies with comprehensive, effective and globally competitive economic systems are becoming true power in a modern capitalistic world.

In this context it seems logical to ask, what makes a country a global economic leader? How can the cherished economic dominance be reached? The answers for these questions are rather complex. Countries should focus on a wide range of development spheres. At the same time, some of these spheres should be paid a special attention, serving as drivers for future economic progress. It is not a secret, that any kind of progress is predominantly based on knowledge. The ability to accumulate and apply knowledge determines the position of a country on the global economic arena. Knowledge, in its turn, can be obtained and spread across the society by the means of education.

This paper is an attempt to analyze the influence of education and accumulated human capital on the probability of becoming a world economic leader. It takes into account a massive luggage of previous research and also provides some statistical constructs, which allow us to test the existence of a relationship between economic leadership and the level of national education. The paper is conventionally divided into three parts. The first part analyzes theoretical background and creates a foundation for empirical study. Theoretical part presents a kind of retrospective on the evolution in the understanding of place obtained by education and human capital in economic relations. The second part states the main hypothesis and describes in details the methods used to prove or reject this hypothesis, lists the sources of data used for construction of models. The third part sets up theoretical relationship between explanatory and explained variables, launches models on data and interprets the results. Realized work provides with arguments which confirm an existence of certain positive relationship between level of education and economic leadership. Human capital and education appear to be some of the most influential factors for economic growth.

1. Theoretical foundation

An exclusive importance of education for various spheres of people's lives is emphasized by many outstanding scientists. No later than in the 18th century scholars started to point out that education has its own important place in economic theory and practice. Adam Smith in his book "An Inquiry into the Nature and Causes of the Wealth of Nations" (1977 [1776]) considered "useful abilities of inhabitants" as one of the four basic types of fixed capital, especially mentioning that education of workers is of equal importance with technical equipment and means of trade. Together with other types of fixed capital, education incurs real expenses and, at the same time, brings real profits. In 1890 Alfred Marshall published "Principles of Economics". In this fundamental work the author explicitly says that education of human beings is extremely important for the functioning of economy (Marshall 1890). Thereby, a normally functioning economy, which pays attention to the educational part of fixed capital, has all chances to be competitive at either the regional or global level and can strive for economic leadership.

With the tertiary sector absorbing more and more available workforce over time, a theory of human capital started to develop more actively and comprehensively. The tertiary sector requires more skills, knowledge and talent. From this perspective, labor force stopped to be uniform in its mass. Employees differed from each other in their abilities and skills, and firms could be successful or not depending on their employees' stock of knowledge and experience. The foundations for human capital theory were laid by prominent scholars such as Theodore Schultz, Jacob Mincer and Gary Becker. In the context of their research, education, as well as knowledge, skills and talent development, are treated as integral parts of human capital. Obtained in the process of schooling, skills and knowledge contribute to national productivity, making countries better off. High level of education in technically developed states can be seen as a source of international economic dominance (Schultz 1961). Time, effort and money spent on education, in fact, represent investments in human capital and form the stock of human skills. The stock of education accumulated through the lifetime has influence on earnings, labor force participation and time spent on work (Mincer 1975). According to Gary Becker, education is one of the three key components of human capital (the other two are health and training). Higher education has significant positive influence on earnings in a wide range of societies with different cultural and economic backgrounds. This positive income effect considerably exceeds all expenses incurred during the process of schooling. Introduction of new technologies and complex processes in industry requires more knowledge and makes education more valuable. Even with new technologies introduced, countries have no chances to reach significant economic growth without

educated and experienced specialists. Moreover, education doesn't only supplement advanced technologies by skilled workforce and modern services by competent personnel. Schooling itself leads to innovations, technological development, breakthroughs in science and, consequently, to economic growth (Becker 1975).

The influence of human capital on economic development is captured in endogenous growth models in macroeconomics. These models aim to explain technological progress (previously determined exogenously and perceived as given from outside), taking into account the variables of human capital, knowledge and innovation. Previously, growth models with exogenous technology implied diminishing returns to capital. In line with such models, in the long-run and without external change of technology, economies must converge to a steady state with zero growth per unit of population. Reaching this steady state, initially different countries are becoming more and more similar in terms of productiveness and standards of living (Solow 1956). However, historical practice has shown that initially less developed countries are usually not able to catch up with more developed societies. In contrast with the model described above, endogenous growth models, for example AK model, differentiate between physical capital and human capital. While physical capital exhibits diminishing returns, human capital shows increasing returns (Romer, 1989). It results in constant returns to capital and absence of steady states. Economic growth can persist forever. Nations, which accumulate enough human capital and continue to invest in it, ensure long-term, if not everlasting, leadership in global economy. Thereby, human capital appears to be one of the key determinants for a country's position on the global economic arena.

More recent studies and extensions of basic theories are taking closer look at the role of human capital, particularly education, on economic growth and welfare of nations. Analysis of modern schooling in different countries has shown that the availability of education is necessary, but not a sufficient factor for economic development of society. Quantitative growth in school and university attendance should be combined with qualitative changes in educational institutions. Educational systems in developing countries should focus not only on the maximization of enrollment and attainment, but also on the development of cognitive skills among population. There is a strong relationship between cognitive skills development and variables such as distribution of income, earnings and economic growth (Hanushek 2008). Cognitive abilities and education are more substantial for GDP growth than the level of economic freedom. Intelligence of people contributes significantly to the welfare of nations (Rindermann 2008). Higher educational institutions are not only producing human capital, but also creating a demand for it.

Universities' research and development activities often result in spillovers to various spheres of economy. Sectors which absorb these spillovers require more employees with rich stock of human capital (Abel 2012). Moreover, specially targeted educational and foreign credential recognition programs can release the human capital of immigrants. Participating in the market of skilled workforce, immigrants will not put a strain on social system and will contribute to the economic growth of accepting country (Singer 2012).

2. Hypothesis and research methodology

The original hypothesis of this paper is that education has an influence on a country's position on the global economic arena. Based on the theoretical research realized in the first part, it is possible to conclude that education should increase chances of societies to become worldwide economic leaders. Investments in human capital, by the means of education, ensure constant economic growth and international competitiveness of states.

To test the hypothesis, two regression models were launched. The membership in the Group of Twenty or G20 was used in both models as a dependent categorical variable and indicated the fact of economic leadership on the worldwide level. The Group of Twenty was chosen as a sort of "economic leaders club" due to the outstanding economic characteristics of member countries. The G20's share in the global economy is close to 90 per cent. Moreover, 66 per cent of the world's population is living in these 20 countries. The Group of Twenty accounts for 80 per cent of global trade (OECD 2016).

In the first model Human Development Index or HDI was taken as an explanatory variable controlling for the influence of human capital on the probability of becoming a global economic leader (member of G20 in this case). HDI is a composite index which combines dimensions of health, knowledge and standard of living (UNDP 2015). Initially described and introduced by international development theorist Mahbub ul Haq (1995), HDI in its current version includes a sample of 188 countries and is used as a numerical expression of human capital formation in the societies across the globe. Besides Human Development Index, total labor force and gross capital formation in the percentage of GDP were used. Total labor force was used to indicate the influence of available labor sources on probability of economic leadership. Gross capital formation controlled for the impact of capital assets accumulation on the state level.

The second model took a closer look at the direct influence of education on the probability that a country will have leading positions in the global economy. Instead of the whole HDI, its separate components were used. Those separate components are: education index, life expectancy index and GNI

index. The amount of total labor force and gross capital formation in the percentage of GDP were included into the second model as well.

Arrays of data for analysis were taken from a number of official sources. The values of HDI and its separate components were retrieved from the webpage of UNDP's Human Development Reports (2015). The World Bank and International Monetary Fund databases served as source for data on capital formation (World Bank 2015) and amount of labor force (International Monetary Fund 2015). Studied sample covers 188 countries (by the number of countries included into HDI statistics) with indicators' values as of 2014.

3. The models and empirical results

In both cases, relationship between explanatory and explained variables were modeled by logistic regressions. Logistic setup was chosen due to the categorical nature of a dependent variable. The variable of total labor force was log transformed because of extremely large original values. Due to the fact that increase for one unit is actually a very big change for HDI and its component indices (education, life expectancy and GNI indices), the values of these variables were multiplied by 100. It allowed to see the influence of relatively small variations in the indicators.

A theoretical relationship for the first model can be expressed by the following equation:

$$G20memb = \beta_0 + \beta_1\, HDI100 + \beta_2 logLab + \beta_3 CapForm$$

Where

G20memb - dependent categorical variable equal to 1, if country is an individual member of The Group of Twenty or represented in it as a member of the European Union, and equal to 0 otherwise; HDI100 - the values of HDI multiplied by 100; logLab - the logarithms of total labor force values; CapForm - capital formation in the percentage of GDP.

Running the model on available data gave the following estimated relationship (see full information about the model in Appendix, Model 1):

$$G20memb = -28.852 + 0.196 HDI100 + 0.96 logLab - 0.092 CapForm \quad (Model\ 1).$$

Coefficients for HDI100 and logLab are individually significant on the 99 per cent confidence level. These coefficients are positive numbers as expected. However, CapForm's coefficient is negative and significant only at the 90 per cent confidence level. Since the paper focuses mainly on the influence of human capital and education on economic leadership, the variable HDI100 should be studied in details. It should be mentioned, that coefficients in logistic regression can't be directly interpreted. To understand clearly the relationship

between the dependent variable of membership in the G20 and level of accumulated human capital, the slopes have to be used (can also be found in Appendix, Model 1). Slopes show a change in probability of depending categorical variable being equal to one, if one individual variable is increased by one unit, holding all other variables at their means. The slope for HDI100 is approximately equal to 0.011. It means that when HDI of some country increases by one hundredth, the country's chances to become world economic leader increase by 1.1 per cent (all other variables in the model are held at their mean values). For example, if Human Development Index of some hypothetical state increases from 0.687 to 0.697, the probability of entering the group of economic leaders increases by 1.1 per cent. Average HDI level in a medium human development group has increased from 0.473 in 1990 to 0.630 in 2014. Hence, the probability of economic dominance for countries from this group has increased approximately by 16 per cent. As it was mentioned in the beginning of this paragraph, the described relationship between Human Development Index and probability of economic dominance is highly statistically significant.

A theoretical setup of the second model looks in the following way:

$$G20memb = \beta_0 + \beta_1\, EducInd100 + \beta_2 LifeInd100 + \beta_3 IncInd100 + \beta_4 logLab + +\beta_5 CapForm.$$

where

EducInd100, LifeInd100, IncInd100 - the values of education index, life expectancy index and GNI index respectively, multiplied by 100. All other notations are identical to those used in the Model 1.

The model launched on data of 2014 provided with the following estimates of statistical interactions (see Appendix, Model 2):

$$G20memb = -27.91 + 0.14\, EducInd100 - 0.02 LifeInd100 + 0.06 IncInd100 + +1.06 logLab - 0.09 CapForm\ (Model\ 2).$$

Confidence levels and signs of coefficients remain the same for CapForm and logLab variables. At the same time, the characteristics of HDI components differ dramatically from each other. If the coefficients of LifeInd100 and IncInd100 have high p-values and can't be considered as statistically significant, EducInd100 shows individual significance of coefficient on 99 per cent confidence level. This result statistically confirms an exclusive importance of national education for global economic leadership. The slope for EducInd100 variable equals to 0.007. Increase in education index by one hundredth leads to 0.7 per cent increase in the probability of economic dominance, holding all other variables at their means. This value can seem relatively small. However, according to the formulae for education index calculation (described in technical notes of Human Development Report), increase in the mean year of schooling by 1 year will lead to growth of

education index by 0.03 (three hundredth). Hence, increase in the mean year of schooling by 1 will lead to 2.1 per cent growth in probability of economic leadership.

Conclusion

An exclusive importance of human capital for countries' economic leadership has been proven theoretically and statistically. Among all components of human capital covered by Human Development Index, education plays the most significant role. This fact suggests that policymakers in developing countries should focus on the development of education system. Available and consistent schooling ensures economic growth, promotes accumulation of human capital, and creates a base for economic dominance. It should be mentioned that the launched models analyzed only a quantitative side of education. The components of education index take into account only an average and expected number of years spent in educational institutions. The study omits the qualitative sides of educational system, e.g. correspondence to international standards or qualification of alumni. Incorporation of appropriate qualitative determinants of education into the model will, in the author's opinion, increase the overall effect of education on the probability of international economic leadership. Moreover, further researches can use longitudinal approach. Data analyzed in the paper covered only 2014, while it can also be interesting to see how the influence of education changes throughout the years of observations.

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Appendix

Model 1: Logit, using observations 1-188 (n = 155)
Missing or incomplete observations dropped: 33
Dependent variable: G20memb
Standard errors based on Hessian

	Coefficient	*Std. Error*	*z*	*p-value*		*slope*
const	−28.8525	5.34668	−5.3963	<0.0001	***	
HDI100	0.195688	0.0372899	5.2477	<0.0001	***	0.0112468
logLab	0.959643	0.218054	4.4009	<0.0001	***	0.0551537
CapForm	−0.092758	0.0482046	−1.9243	0.0543	*	-0.005331

Mean dependent var	0.270968	S.D. dependent var	0.445900
McFadden R-squared	0.527226	Adjusted R-squared	0.483053
Log-likelihood	−42.81159	Akaike criterion	93.62317
Schwarz criterion	105.7969	Hannan-Quinn	98.56786

Number of cases 'correctly predicted' = 132 (85.2%)
f(beta'x) at mean of independent vars = 0.446
Likelihood ratio test: Chi-square(3) = 95.4847 [0.0000]

Model 2: Logit, using observations 1-188 (n = 155)
Missing or incomplete observations dropped: 33
Dependent variable: G20memb
Standard errors based on Hessian

	Coefficient	*Std. Error*	*z*	*p-value*		*Slope*
const	−27.908	5.56918	−5.0112	<0.0001	***	
EducInd100	0.142153	0.0394159	3.6065	0.0003	***	0.00743
LifeInd100	−0.0231754	0.0466501	−0.4968	0.6193		-0.00121
IncInd100	0.0604082	0.0375839	1.6073	0.1080		0.00316
logLab	1.0358	0.234486	4.4173	<0.0001	***	0.05414
CapForm	−0.0893461	0.048783	−1.8315	0.0670	*	-0.00467

Mean dependent var	0.270968	S.D. dependent var	0.445900
McFadden R-squared	0.552861	Adjusted R-squared	0.486603
Log-likelihood	−40.49017	Akaike criterion	92.98033
Schwarz criterion	111.2409	Hannan-Quinn	100.3974

Number of cases 'correctly predicted' = 137 (88.4%)
f(beta'x) at mean of independent vars = 0.446
Likelihood ratio test: Chi-square(5) = 100.128 [0.0000]