The Effect of Health Capital and Accumulation of Physical Capital on Economic Growth

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Abstract: One of the main concerns of economists and policymakers in every society is the achievement of economic growth. Among the most effective factors on economic growth, it can be referred to human capital, physical capital and labor. The role of health and health expenditures and other health indicators are considered among the most effective factors on the performance of labor. Since, it is possible to consider health capital and expenditures in economic growth functions and observe positive direct and indirect effects on labor productivity level, the healthy labor in production technology developments is introduced as the basis of progress and economic growth and the physical capitals will be productive when the country has human capital. This study aimed to investigate the effect of health capital and accumulation of physical capital as well as life expectancy and mortality of children on economic growth of developing countries using panel data during 2000-2013. The data in this this study were extracted from World Bank statistic reports.

Key words: Health capital, physical capital, life expectancy, child mortality, economic growth

INTRODUCTION

The health sector (healthcare) is considered among the key sectors of each country and in economic development process is proposed as an infrastructure, because directly affects labor efficiency and increased production and economic growth (because healthy labors are more productive and have longer working life). These factors have motivated countries to increase the share of healthcare sector relative to the total Gross Domestic Product (GDP) so that even healthcare expenditures have surpassed GDPs.

Therefore, it is clear that due to the direct effects of health on total growth and production, its indicators are among the effective factors in this context and these factors have prepared the foundations for numerous discussions regarding health sector and its effective factors and encouraged policymakers and researchers to conduct studies on this context.

Generally, it can be stated that there are two groups of health indicators: health input indicators (investment) and health stock indicators including health expenditures and the availability of health facilities. The stock indicators include life expectancy, infants' mortality, adults' mortality and pregnancy. In this study, health expenditures and life expectancy and infants' mortality were selected from health input and stock indicators,

respectively. Also, health and physical capitals were used in this study simultaneously. It should be noted that although both variables are important in growth consistency, it is possible to investigate their roles in economic growth.

Literature review: Aka and Damont using time series method, investigated the relationship between human capital (education and health) and economic growth for the United States during 1927-1997. Also, to investigate the relationship between variables, reactions and analysis of variance were applied. The results showed that a causal relationship can be found from both sides (education and health) towards economic growth. Also, the growth dynamics in the United States were explained quantitatively.

Li and Wiliang in addition to analyzing the models of Mankiw, Romer and Weil, investigated panel data for provinces and concluded that both factors have significant and positive effects on economic growth.

Gong et al. (2012) analyzed the effect of health and physical capitals on the long-term economic growth in an extended boundary method using Romer production function. The economic growth is related to both growth and health levels. The health capital facilitates the economic growth and the depth of health level on economic growth depends on its effect on the accumulation of physical capital.

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Wood and coauthors conducted a study on the effect of healthcare financial supply on economic growth with focus on mutual financial supply by the government and private sectors and concluded that financial supply related to healthcare by the government significantly affects the economic growth.

Pelinoskov investigated the effect of human capital on economic growth in UN using panel method and concluded that it is not possible to be successful without intelligence, persistence, general knowledge and understanding as human capital. We can hardly believe that these goals can be achieved without appropriate training and education system, high knowledge production, and giving attention to creative industries of economic growth. Trying to reveal the role of human capital as an economic growth factor states that low investment in human capital affects economic growth.

Rabiei and Heidari (2013) investigated the effect of health indicators on economic growth of developed countries and showed that the capital stock and life expectancy have significant and positive effect on both groups of interest. Also, the mortality rate of children under the age of five had negative effect on developed and developing countries and the fertility rate in developed countries had positive effect while in developing countries it had negative effect.

Motagji and coauthors investigated the effective factors on investment in health sector of members of Islamic Conference Organization (economic-social approach) and the results indicated that first, the condition of Islamic countries is worse than developed countries and second, the research modelling indicates that increased GDP, investment on health, literacy rate, urbanization, decreased population and decreased HIV significantly increase life expectancy. Also, according to the results, it is clear that GDP economic variables and investment on health sector have the largest effect on the health of member countries.

Sarlak and coauthors conducted a study on the effect of health expenditures on the economic growth of country's provinces using Romer's internal growth model and combined techniques that refer to combining data of provinces during 2000-2011. Family's health growth variables, health capital and training costs growth along with government's construction investment growth have significant effects on the economic growth of provinces.

MATERIALS AND METHODS

The purpose of this study is to investigate the effect of health capital and accumulation of physical capital on economic growth of developing countries using panel data. The data of the present study have been collected using library method. All data in this this study were extracted from World Bank statistic reports. According to HDI criteria, based on UNDP (United Nations Development Programme) from the related site, 20 countries have human development close to each other including Albania, Armenia, Azerbaijan, Brazil, Colombia, Costa Rica, Georgia, Iran, Kuwait, Kazakhstan, Bulgaria, Mexico, Romania, Poland, Russia, Turkey, Macedonia, Malaysia, Venezuela and Tunisia.

Theoretical foundations: In studying the economic growth, economists try to understand how production can be increased and why growth rates are different in various countries). Other studies try to answer this question that when economic systems can be able to have consistent growth with stable rate.

Therefore, research on the reasons of economic growth is important and has always been taken into consideration by economists. Accordingly, various theories and views exist regarding economic growth. Also, high numbers of views stem from numerous factors affecting economic growth of societies.

The entrance of human investment by Arrow (1962) to the economic context, opened a way for the effectiveness of people's health on GDP. Nowadays, when we talk about the qualitative improvement of labor, the unique issue of education will not be experienced but health should be considered as a factor in the accumulation of human capital. In this regard, the improvement of health indicators brings improved qualitative indicators of labor and economic growth.

Improved health can affect the economic growth in several ways. First, healthy labor is related to high productivity. Healthy labor is more powerful and has higher efficiency. These labors can work harder for longer time and think better. Also, improved health improved motivation for education and lead to enhanced quality of labor and economic growth. Healthy labors with high efficiency gain higher wage. Among other features of society health, it can be referred to high life expectancy and low mortality rates in infants, healthy food, medical advances and the expenditures on health sector, low cost services and pre-production care.

Studies showed that life expectancy is highly effective on country's economic growth. Improved health principles in a country lead to decreased mortality, improved life quality, increased physical health, human capital and capital of future generations. The health condition of a person is dependent on behavioral, environmental and economic variables. The capital of each person is involved in economic growth.

Grossman (1972) for the first time, incorporated the health capital into the optimization function. It is possible to consider health as a resistant good like any other economic good. All people are born by a certain levels of health that is different among people. Grossman believes that each person for the beginning of each period, has a storage of health.

As time passes, person's health decreases by age that is called pace of life and when the health storage of person is lower than the critical level that person will die. Like other resistant goods, the health storage of people produces a flow of services that lead to the achievement of satisfaction and desirability. Health, as a good is used for both consumption and investment. From consumption perspective, people are looking for health, because in this regard, will have more pleasant and desirable life. From the perspective of investment, the relationship between time and health is defined as if person's health condition is well, the disease period will be shorted and he will have more time for working as well as leisure. Grossman proposes relationships regarding various types of human capital such as education and health where higher education leads to higher investment in health improvement. It means that higher education brings higher health levels.

Model estimation for developing countries: The model of this study is based on Gong *et al*. (2012) as follows, f (HC, MO, CPH, LF):

$$LOGGDP_{it} = \beta_0 + \beta_1 LOGHC_{it} + \beta_2 LOGMO_{it} + \beta_3 LOGCPH_{it} + \beta_4 LOGLF + \varepsilon_{it}$$

Before model estimation, it should be noted that the variables of interest have been pointed out in the model. These variables include:

- LGDP: The logarithm of GDP expresses the economic growth of several countries as dependent variable in this study
- LHC: health expenditures logarithm (health capital) as an independent variable)
- LMO: mortality logarithm of children under the age of five (health indicator) as a dependent variable
- LCPH: physical capital logarithm (as an independent variable) will be investigated
- LLF: life expectancy logarithm (health indicator) as a dependent variable

Durability test of variables: One of the issues that should be taken into consideration regarding time series and panel models is the durability issue. If the variables in the

Table 1: The collective test and examining the durability of variables

Test variable	pp-Fisher		Levin, lin and Chut	
	Statistic	Prob	Statistic	Prob
DLHC	133.2	0.00	-9.28	0.00
LLF	158.9	0.00	-8.8	0.00
LCPH	55.6	0.03	-6.27	0.00
LMO	107.0	0.00	-8.70	0.00
DLGDP	69.2	0.00	-7.047	0.00

Researcher's estimations. d: shows the first order differencing, *indicates the significance at 10% level

Table 2: The results of pedroni co-integration test

Result	Method	Statistic	Prob.
Alternative hypothesis:	Panel v-statistic	-3.393597	0.9997
common AR coefs	Panel rho-statistic	3.190667	0.9993
(within-dimension)	Panel PP-statistic	-3.141121	0.0008
	Panel ADF-statistic	-4.930058	0.0000
Alternative hypothesis:	Group rho-statistic	4.950395	1.0000
individual AR coefs	Group PP-statistic	-2.007606	0.0223
(between-dimension)	Group ADF-statistic	-3.135636	0.0009

study are not durable, the results of model estimation will be artificial and we will face spurious regression. In this study, regarding durability analysis of variables, first, we change the variables into logarithmic mode and is examined using Lin, Lowin and Cho test. The results of unit root test are presented in the following Table 1.

According to small difference in the results of durability test and for more confidence, pedroni panel co-integration test was used to ensure the lack of spurious regression and the existence of long-term relationship between variables.

Pedroni panel co-integration test: There are seven prepositions in Pedroni co-integration test where four propositions are intra-dimensional and three propositions are inter-dimensional. Whenever the significance of one of intra-dimensional propositions and one inter-dimensional proposition is <0.05, the null hypothesis regarding the existence of spurious regression and lack of co-integration curve is rejected. With this definition and according to the results, we conclude that our model lacks spurious regression and there is a long term relationship between variables (Table 2).

Determination test for the model type in panel data Before talking about model estimation, it should be cleared that is it possible to use panel method for model estimation or Ordinary Least Square (OLS) method should be used. Then null hypothesis and hypothesis 1 can be expressed in simpler terms (Table 3):

- H_0: cannot be examined as panel
- H_1: can be examined as panel

The results of Chaw test show that the p-value is <0.05. As a result, the null hypothesis is rejected. Therefore, it can be concluded that individual heterogeneity (unobservable individual effects) exists and

Table 3: Chow test

Test summary	Effects test	Statistic	df	Prob.
Panel data method	Cross-section f	336.956800	19.255	0.0000

Table 4: Hausman test

Test summary	Statistic (χ^2)	df (χ^2)	Prob.
Cross-section random	31.070806	4	0.0000

Rresearcher's estimations

Table 5: Fixed effects model

Variable	Coefficient	t-statistic	Prob.
C	-4.738794	-2.221249	0.0272
LHC	0.232241	17.13119	0.0000
LLF	3.674789	7.342664	0.0000
LCPH	0.172071	8.098909	0.0000
LMO	-0.550980	-18.86802	0.0000

R^2 bar = 0/97; Prob (F-statistic) = 117/02 (0/00)

panel data method should be used for model estimation. Thus, to determine the use of fixed effect model against random effect model, the Hausman test will be implemented in the next stage.

Fixed and random effect selection test: To determine which method is suitable in estimating panel data models (fixed and random effects), Hausman test will be used. In this test, the null hypothesis and hypothesis 1 are as follows:

- $(U_i, X_i) = 0$
- $(U_i, X_i) \neq 0$

The null hypothesis states that there is not any relationship between error sentences (containing individual effects) and explanatory variables that are independent from each other. On the other hand, the hypothesis 1 states that there is a correlation between error sentences and explanatory variables. If the hypothesis is rejected, it is better to use fixed effect method. According to the findings of panel model, the Hausman model confirms the existence of fixed effect model; because, the large test statistics is the reason for the existence of random model (Table 4).

The results of Hausman test, reject the null hypothesis. Therefore, it order to select among patterns with random effects and fixed effects, the Hausman test is used. Is Hausman test, the the other hand, the hypothesis 1 shows the preference of fixed effects model. As the results on the table show, the null hypothesis is rejected and the results led to the selection of fixed effects model (Table 5).

RESULTS AND DISCUSSION

The purpose of the present study was to determine the effect of health capital (health expenditures, mortality rates, life expectancy) and the accumulation of physical capital on economic growth of developing countries by applying panel data during 2000-2013. The results show that health expenditures, physical capital and life expectancy have positive and significant effect on the countries of interest to this study and on the other hand, the mortality rates of children under the age of five have negative effect on economic growth of developing countries. In this study, first, the test related to unit root with panel data was conducted and it was concluded that there is a long term relationship between the Hausman test and health and economic growth indicators. Also, the results showed that the fixed effects model is better.

The results from pattern estimation show that all coefficients are consistent with the theory and are statistically significant. Generally, the results of this study can be proposed as follows.

Health expenditure has a significant effect on the economic growth of developing countries: The coefficient of LHC equals 0/23 and is significant at the error level of 0/05%. It means that, for 1% change in this variable, it is possible to increase economic growth by 0/23%.

Hosoya (2003) investigated the effects of health expenditures on economic growth. The first result of their study was pointing to this issue that in addition to the positive effect of physical and human capital on economic growth, the health capital that has entered the model through health expenditures with significant and positive effect on economic growth. In the next stage, the researchers concluded that health expenditures are affected by economic growth.

Bhargava *et al.* (2001) confirmed the previous results in other studies by different researchers in investigating the relationship between health expenditures and GDP and pointed to the significant and positive relationship between these variables.

Life expectancy has a significant effect on the economy of developing countries: The Logarithm of Life Expectancy (LLE) in the countries of interest is 3/67 and is significant at the error level of 5% and for 1% change in the explanatory variable, increases the dependent variable by 3/67%.

Also, since life expectancy in developing countries has a positive effect on the growth, it can be said that health awareness, promoting healthy life, physical activities, healthy food, fat avoidance, smoking, alcohol, improving the environment and fighting pollutions can be improved by various factors in this context.

The mortality of children under the age of five (LMO) has a significant effect on the economy of developing countries: The mortality logarithm is-0/55 and at the error level of 5% is significant. For 1% change in mortality rate, the economic growth will decrease by -0/55%.

The effect of mortality for children under the age of five, is negative for the economic growth of developed and developing countries. In fact, the important point is that this mortality rate is a reflection of social and economic system in countries and affects various aspects. Therefore, in order to lower the mortality rate of this group, it is better to include proceedings such as improved health, training mothers, improving food, avoidance of malaria, vaccination and increasing the services in hospitals and health insurance. Another point that can be effective in decreasing the mortality rate, refers to communication facilities, public education, promoting culture, education, increasing nutritional knowledge, defeating illiteracy and expanding higher education.

Physical capital (LCPH) has a significant effect on the economy of developing countries: The physical capital logarithm (LCN) equals 0/17 and is significant at the error level of 5% and for 1% change in the explanatory variable, increases the economic growth indicator by 0/17. The results of this study are consistent with Amin, Loom (2004).

Due to the increased physical capital, there is no doubt that it increases health, because rich people have more access to healthcare products but what is important is the effect of health on decreasing poverty and increasing economic growth. The main property and capital of each person is the body and any damage to it leads to poverty in the society. In the annual report of the World Health Organization (WHO) this has been describes as:

With a quick look at the theories of classic economists such as Smith, Ricardo, Maltus and after that neoclassic such as Solo, Kelard, Norkes, Mirdal, Roden, Romer, Lucas, Helpman, Grossman and others, we understand the importance of fixed capital in the growth and development of economy. Economists such as Baran, Dobb and Amin consider the loss of capital in developing economies as the main barrier against development. In most of the growth models whether internal and external growth models, capital and investment have their own

place. This role is more significant in internal models due to considering the positive external effects of capital accumulation that lead to the omission or reduction of diminishing efficiency effect.

Gong *et al.* (2012) investigated the effect of health investment and physical capital on long term growth and concluded that there is a significant relationship between these two categories.

CONCLUSION

According to the results, health capital and physical capital as well as life expectancy and child mortality under the age of five had positive and significant effect on the economic growth of developing countries. With decreased child mortality, the economic growth in these countries increases.

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