Estimating the Relationship between Economic Growth and Health Expenditures in ECO Countries Using Panel Cointegration Approach

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Abstract- Increasing knowledge of people about health leads to raising the share of health expenditures in government budget continuously; although governors do not like this rise because of budget limitations. This study aimed to find the association between health expenditures and economic growth in ECO countries. We added health capital in Solow model and used the panel cointegration approach to show the importance of health expenditures in economic growth. For estimating the model, first we used Pesaran cross-sectional dependency test, after that we used Pesaran CADF unit root test, and then we used Westerlund panel cointegration test to show if there is a long-term association between variables or not. After that, we used chaw test, Breusch-Pagan test and Hausman test to find the form of the model. Finally, we used OLS estimator for panel data. Findings showed that there is a positive, strong association between health expenditures and economic growth in ECO countries. If governments increase investing in health, the total production of the country will be increased, so health expenditures are considered as an investing good. The effects of health expenditures in developing countries must be higher than those in developed countries. Such studies can help policy makers to make long-term decisions.

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Introduction

Investment in human capital has a great importance in economic studies and economists want to know how this type of capital changes the level of productivity. Investment in human capital is made in many ways. Two of the most important of them are an investment in health and education (1). Health changes the level of productivity in two ways:

-A healthier worker compared with other workers has more ability to work and has a dynamic and creative mind.

-A healthier worker has more ability and time to study, and being more educated is a reason for having more productivity (2).

Data of World Health Organization show that in most developed countries governments pay a handsome share of health expenditures. On average, the share of governments in health expenditures is nearly 70% in all over the world. In government budget, this share is nearly 14% in the world, and it is higher in developed countries (3). The importance of health expenditures becomes apparent when we know its share in GDP is growing more and more so that its rate has been increased to nearly 35% in 5 years (2000-2005). The reason is people's knowledge about the benefits of health care has increased. On the other hand, governments have limitations in their budget and they must find the most effective ways for distributing their budget (4).

Two contradictory theories have been expressed about the association between health spending and productivity:

In the first view, health expenditure is shown like investment, and its increase is a reason to boost productive workers, creativity, and productivity. In this view, health is a durable good (5), and it is assumed that people are born with health savings, and if an infant is

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born in a country with the high amount of life expectancy, the health saving must be larger. Also, if an infant is born with a disability and other diseases, it has fewer savings of health than a healthy one. The health saving will depreciate in time which is called aging. When the amount of health saving becomes 0, the person is dead (6).

In the second view health expenditure is not an investment good but only a consuming good. In this view, because of the budget limitations, health is a reason for decreasing of expenditure in other parts of the economy. Increasing in health expenditures is a reason for decreasing investing in public and private sectors (7). In this study, we aimed to find the association between health expenditures and economic growth in ECO countries.

Materials and Methods

This is a descriptive- analytic study that uses formal documents published by World Health Organization, World Bank, and The International Monetary Foundation and analyzed them by using econometric methods in Solow model. We used ECO countries (1995-2009) panel data for conducting this study. ECO countries are Armenia, Azerbaijan, Iran, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Turkey, Turkmenistan, and Uzbekistan. Data for Afghanistan were not available, so we excluded this country. The most important reason why we used these countries for the study is the availability of their data and equal socioeconomic and cultural features. Data of health expenditures were gathered from the World Health Organization data bank and other data were gathered from the World Bank data and statistics reports.

As said later, the theoretical model of this study was performed by Solow for the first time. The Solow model was in Cobb-Douglas form. After him, other economists developed the model. In some studies, education and health were added to the model too. You can see the developed Solow model blew:

$$Y(t) = K(t)(a)E(t)(B)H(t)(n)(A(t)L(t))u$$

Y is the total productivity, K is physical capital, E is the human capital, H is the health capital, A is the level of technology in the country, and L is the number of the active labor force. The model which is used in this study was established by David Mayer in 2001 in Mexico (8). In this model, he used the logarithm form of Solow model for estimating the long-term relationship between variables. Cobb-Douglas models are not estimable models because they are in nonlinear form, so for making an estimable regression, we must use its logarithmic form. This model is as follows:

$$Yit=c0 +c1\ Kit+c2Sit+ c3Hit + c4\ Nit$$

Yit: the logarithm of per capita gross domestic product at purchasing power parity

Kit: the logarithm of physical capital at purchasing power parity

Sit: the logarithm of the average of education rate in people over 25 years old

Hit: the logarithm of per capita health expenditures at purchasing power parity

Nit: the logarithm of the population growth rate of the country.

Because of having long time series (15 years) and cross sections (10 countries) before each estimation we must examine the cross-sectional dependency and stationary of the variables. If there is a cross-sectional dependency in the model, all ordinary calculations about the stationary and cointegration tests becomes wrong, and we must run these tests in the presence of cross-sectional dependence. Also non-stationary variables may lead to a spurious regression which will lead to wrong estimates. For solving this problem, we need some techniques to make the data stationary or show that they are co-integrated and that the estimation does not lead to spurious regression, and there is a long association between variables. All of the tests were run on STATA 11 and GAUSS 10 firmware. We used Pesaran cross-sectional dependency test to check the presence or absence of cross-sectional dependency. The null hypothesis of this test is having cross-sectional independence (9). After that, to check whether the data were stationary or not, we used Pesaran unit root test under the presence of cross-sectional dependence which is called CIPS test. The difference between this test and others is if there is a cross-sectional dependency between variables, the results of the tests are reliable (10). After that, because of having nonstationary variables, we used cointegration test to see if there is a long-term association between variables and whether the results of estimating the nonstationary variables may lead to spurious regression. To this end, we used Westerlund panel cointegration tests (2007) (11). These tests contain four different sections named Ga, Gt, Pa, and Pt. Null hypothesis in Ga and Gt means that at least one of the time series in panel cross sections are cointegrated and for the Pa and Pt tests, the null hypothesis means that the whole model is cointegrated. In these tests, we can use a bootstrap function to

eliminate the cross-sectional dependency in variables and acquire correct results. (12). After endorsement of having a cointegrated model, and not having a spurious regression, the model will estimate

For estimating the model, first we must show that the model has fixed effects or random effects by using Hausman test. Then we must show that the model is pooled or panel by using Breusch- Pagan test.

Results

Table 1 shows the results of Pesaran cross-sectional dependency test. As shown in Table 1, the CD test statistics for all variables is over 1.96 and their *P*-values are near 0 except physical capital (K). So the null hypothesis is rejected for all variables, and they have a cross-sectional dependency between their time series and cross sections except physical capital.

We can claim that if we run other tests without attention to cross-sectional dependency, their results will be valid. Table 2 shows the results of Pesaran CADF test.

For estimating the presence or absence of a long run association between variables, we used Westerlund panel cointegration tests. As said before, in the Westerlund tests we can use a bootstrap function to eliminate the cross-sectional dependency in variables and acquire correct results. Table 3 shows these results:

Table 1. Results of cross-sectional dependency in ECO countries(1995-2009)

variable	CD test	*P*-value
Y	25.33	0.000
K	1.02	0.308
S	25.91	0.000
H	15.68	0.000
N	13.68	0.000

Table 2. Results of CADF panel unit root test in ECO countries (1995-2009)

Variables	CADF test	*P*-value
Y	-2.406	0.022
K	-3.773	0.000
S	-3.894	0.000
H	-2.528	0.009
N	-1.926	0.266

The null hypothesis for this test is that all panels are nonstationary and have a unit root. As shown in the table, for CADF test, population growth rate does not have a unit root and is stationary. Its CADF statistics was -1.926, so the null hypothesis was rejected for this variable. Other variables are not stationary. It seems that CADF test is the most accurate test for panel data in the presence of cross-sectional dependency.

Table 3. Westerlund panel cointegration tests: ECO countries (1995-2009)

Statistic	Value	Z-value	*P*-value	Robust *P*-value
Gt	-2.355	-1.155	0.124	0.120
Ga	-2.603	3.236	0.999	0.530
Pt	-4.997	0.091	0.536	0.250
Pa	-2.346	1.630	0.938	0.420

The results with and without applying for bootstrap show that in all of the tests, variables are co-integrated, and there is a long run relationship between them, but because of having crossed sectional dependency, we must only notice the results of robust *P*-value. The robust *P*-value for all 4 tests was above 0.05, so we can claim that we have a co-integrated model.

For estimating the model, first we used chaw test to see if the model is panel or pool. The $\chi 2$ statistics of chaw test was 334.10, and its *P*-value was 0.000, so the null hypothesis of having a pool model is not acceptable.

So, we can say that the model is a panel one. The $\chi 2$ statistics for Breusch- Pagan test was 354.33, and its *P*-value was 0.000, too. The results show that the model has random effects against pooled effects. In the end, we used Hausman test. The result of this test shows that the model has random effects, too. (*P*-value=0.433). After doing all these tests, the model was estimated with random effects OLS estimator. The results of the estimation are shown in Table 4.

Table 4. Results of estimation the model in ECO countries (1995-2009)

variable	coefficient	value	*P*-value
K	-0.000208	-0.20	0.840
S	1.5022066	4.85	0.000
H	0.5538415	5.28	0.000
N	0.443467	10.04	0.000
constant	-4.874208	-2.67	0.008

The R2 of the whole model was 0.88901. R2 indicates the Excellency of the estimation. The results of the estimating model show that all variables have a strong association with GDP except physical capital. Because the variables were estimated in logarithm form, the results show the elasticity between independent variables and dependent variable. The elasticity of per capita health expenditures in per capita GDP is 0.55, which shows the importance of health stocks in changing the GDP. The education rate has also a big coefficient. These two variables show the importance of human capital in productivity.

Discussion

In this study, we showed the association between economic growth and health expenditures in ECO countries. We found a strong positive association between these two variables. This result shows that health expenditure is an investing good, not a consuming good. If governments increase investing in health, the total production of the country will be increased, too. So, they must not take health expenditures as a consuming good. The results of this study show that physical capital does not have any relationship with GDP, so the view which is enforced in increasing this type of capital is not acceptable in ECO countries. In these countries, the role of human capital is much more.

Knowles and Owen used health capital in Solow model, so they could increase R^2 factor of the whole model. In this cross-sectional study, they found a strong relationship between health expenditures and economic growth (13).

Rivera and Currais used health savings in the Cobb-Douglas model in Spain. Unlike our study, they did not find a significant relationship between health expenditures and economic growth. They recommended finding the association of these variables in the long term (14). Using Schumpeter growth theory, Howitt found a long-term relationship between health expenditures and economic growth. Also, the results of his study showed that the infant and mother health has an important effect on productivity (15). Bloom and Malaney, in their study in Russia, found that mortality crisis in the first half of the 1990s caused a decrease in life expectancy in Russia from 70 to 65 years. This decrease caused a reduction in GDP from 8.1 to 7.2% in these years (16).

Clarke and Islam compared the relationship between health expenditures and social welfare in Thailand and Australia. They used economic growth as an indicator for demonstrating social welfare. The most important result of this study was that the impact of health expenditures in Thailand was much more in comparison with Australia (17). Like current study, Sevilla and Bloom's findings showed health had a strong impact on economic growth (18). For estimating the long-term relationship between health expenditures and economic growth, Naeem Akram conducted a study in 2007. He used a vector autoregressive model for his study and like our study, he found that health had a major impact on economic growth (19).

This study was conducted in some developing countries in ECO region. The results of this study cannot be extended to other countries. The effects of health expenditures in undeveloped countries must be higher than developed countries. Such studies can help policy makers to make long-term decisions. For example, they will know what population policy is necessary for the country.

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