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Original Article

Determinants of Healthcare Expenditure in Economic Cooperation Organization (ECO) Countries: Evidence from Panel Cointegration Tests

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ABSTRACT

Background: Over the last decade there has been an increase in healthcare expenditures while at the same time the inequity in distribution of resources has grown. These two issues have urged the researchers to review the determinants of healthcare expenditures. In this study, we surveyed the determinants of health expenditures in Economic Cooperation Organization (ECO) countries.
Methods: We used Panel data econometrics methods for the purpose of this research. For long term analysis, we used Pesaran cross sectional dependency test followed by panel unit root tests to show first whether the variables were stationary or not. Upon confirmation of no stationary variables, we used Westerlund panel cointegration test in order to show whether long term relationships exist between the variables. At the end, we estimated the model with Continuous-Updated Fully Modified (CUP-FM) estimator. For short term analysis also, we used Fixed Effects (FE) estimator to estimate the model.
Results: A long term relationship was found between the health expenditures per capita and GDP per capita, the proportion of population below 15 and above 65 years old, number of physicians, and urbanisation. Besides, all the variables had short term relationships with health expenditures, except for the proportion of population above 65 years old.
Conclusion: The coefficient of GDP was below 1 in the model. Therefore, health is counted as a necessary good in ECO countries and governments must pay due attention to the equal distribution of health services in all regions of the country.

Background

Over the last three decades, investment on human resources has received an increasing interest among the economists. The theoretical basis of this issue comes from the increase of health and education stocks (1). There are two completely contradictory views about the relationship between healthcare spending and production levels. First, healthy workers are more efficient than others (2). They have more time for working and their time is not wasted for treatment (3). Employees not only seek to employ healthy workers, but they also think that if the workers' family members do not have a good health status, the workers' efficiency will be affected (4). Second, health expenditures are considered as "costs" (5). These expenditures cause resources transfer from other sectors of economy to the health sector and are the reason why the level of production has diminished in countries. Therefore, health economists pay more attention to health expenditures and study the determinants of health expenditures (6).

For many years, an increase has been observed in demand for healthcare services leading to increase in health expenditures in countries (7). In the United States for example, the share of GDP devoted to healthcare expenditures grew from 9% in 1980 to 16% in 2008 (8). In Iran, the health expenditures per capita increased from $80 in 1995 to $247 in 2005 in average exchange rates (9,10). Long-term prediction also indicates that health expenditures continue to increase (11).

Health expenditures comprise a great share of government budget and expenditures. Governments are always looking for ways to reduce their costs and the health sector is not an exception. However, because of being forced to respond to people, it is impossible for them to reduce their costs specifically in the health sector; therefore, they are looking for more optimal ways to solve this problem (12). All these issues have encouraged the researchers to study the determinants of health expenditures.

In most studies on healthcare expenditures, the real

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health expenditures per capita is the dependent variable and "GDP", "percentage of population above 65 years old", and "percentage of population below 15 years old" are independent variables. A few of these studies have been done in developing countries, but they did not involve a long run approach. One of the first works on this issue was performed by Newhouse. In this work, income was the most important variable for determining the health expenditures. As mentioned before, only a few studies have been conducted on estimating the determinants of healthcare expenditures in developing countries. None of these studies involves a long run approach for the determinants; therefore, we decided to study the determinants of healthcare expenditures in ECO countries.

Newhouse showed a relationship between the health expenditures per capita and GDP per capita. Nevertheless, since Newhouse model did not include other major determinants of health expenditures, other studies were carried out in order to show which determinants affect the increase in health expenditures.

GDP is the most effective factor in determining the health expenditures. Studies have shown a direct relationship between the health expenditures per capita and GDP per capita (13). Countries with good economic infrastructure have more knowledge about the benefits of healthcare and, consequently, they use healthcare more than other countries. On the other hand, developed countries are forced to respond to people and spend more compared to other countries.

Newhouse did not include ageing as a determinant of health expenditures (14). After Newhouse study, ageing was considered as a major variable in many studies. There are two different scenarios about the relationship between ageing and healthcare expenditures.

1) Good scenario: Increase in the percentage of elderly individuals is a reason for having a healthy society. People in such countries do not need expensive medical services because they are healthy. If the life expectancy increases in these countries in short run, healthcare spending increases, while it decreases in case of long-term increase in life expectancy.

2) Bad scenario: Old people use a lot of health resources compared to other individuals. In a country with a large percentage of elderly people, the use of health expenditures is very high and the people's health cannot compensate the extra use of health resources (15-24).

If the number of physicians as well as number of hospital beds per capita increase, depending on the country's health and economic system, it can lead to decrease or increase in health costs. Here, good and bad scenarios can be assumed again (25,26).

1) Good scenario: Increasing the number of physicians will lead to having a healthier society resulting in utilisation of less expensive recourses. Therefore, the cost of being healthy will decrease.

2) Bad scenario: Increasing the number of physicians is costly leading to spending more for our health because the physicians' services are expensive. It cannot compensate the money gained for being healthier (27-31).

Urbanisation can be illustrated as a determinant of having access to expensive and modern healthcare delivery (32). Hospitals and other health centers which deliver good healthcare services are located in cities. Thus, if people live in cities, they can use more health services (33).

In economic theory, a lot of determinants can affect the health expenditures. For instance, political factors can change healthcare spending. Government ideology is also one of these determinants. Moreover, public expenditures in a country with a socialistic system are higher than those of a liberal one. Socio-economic and cultural status of the country is yet another determinant (25,34-40). Thus, the present study aims to determine the most important indicators which affect the health expenditures in ECO countries.

Methods

We used ECO countries balanced panel data between 1995 and 2009 to estimate the determinants of health expenditures. The reason why we used ECO countries is that these countries are similar to each other regarding many socioeconomic and social indicators. The data were collected from World Bank and world health organisation data bank.

Econometric specification and data

The main objective of the present study was estimating the relationship between the health expenditure and its determinants. In doing so, we considered the following panel model:

$$H_{it} = B_0 \times GDP^{B1}{}_{it} \times AGE1^{B2}{}_{it} \times AGE6^{B3}{}_{it} \times PVT^{B4}{}_{it} \times DOC^{B5}{}_{it} \times URB^{B6}{}_{it} \quad [1]$$

In this model, *i* indicates cross sections and *t* indicates time period. For making an estimable regression, we used the logarithm form for the model. To make the model brief, we used "L" instead of log:

$$LH_{it} = B_0 + B_1 LGDP_{it} + B_2 Lage1_{it} + B_3 Lage6_{it} + B_4 Lpvt + B_5 Ldoc_{it} + B_6 Lurb_{it} + U_{it} \quad [2]$$

Where LH_{it}: the logarithm of healthcare expenditures per capita at purchasing power parity,
$LGDP_{it}$: the logarithm of gross domestic product per capita at purchasing power parity,
$Lage1_{it}$: the logarithm of the proportion of the population below 15 years old,
$Lage6_{it}$: the logarithm of the proportion of the population aging 65 and above,
$Lpvt_{it}$: the logarithm of the percentage of private healthcare expenditures relative to total healthcare expenditures,
$Ldoc_{it}$: the logarithm of the number of physicians per 1000 people, and
$Lurb_{it}$: the logarithm of the percentage of the people who live in urban regions relative to the total population.

Cross sectional dependency test

The first stage before doing any other tests in panel data econometrics is finding the cross sectional dependency or independency. This type of correlation may arise from common global shocks with different impacts across countries (41). Various tests, such as Fridman test, Breusch test, and Pesaran CD test, are used for evaluation of cross sectional dependency (42).

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Panel unit root tests

If the model has cross sectional dependency, using panel data unit root testing methods, such as Hadri, Levin Lin Chu (LLC), Fisher, Beritung, and IPS, will increase the probability of the occurrence of spurious unit root. Therefore, for solving this problem, Pesaran proposed CIPS test for unit root test in the presence of heterogenous cross sectional dependency. Null hypothesis in this test is that all series are non-stationary. It seems that this test is the best one for the panel data with cross sectional dependency (42).

Panel cointegration test

If the presence of cross sectional dependency is confirmed in the model, using general cointegration panel tests, such as Pedroni and Kao, will increase the occurrence of the spurious cointegration results. Thus, for solving this problem, Westerlund proposed four cointegration tests; i.e., G_t, G_a, P_t, and P_a, for the panel data. His tests were based on the Error Correction Model (ECM). Regarding G_a and G_t, rejection of H0 should be taken as evidence of cointegration of at least one of the cross-sectional units. Considering P_a and P_t, however, it should be taken as evidence of cointegration for the panel as a whole. Westerlund employed the bootstrap approach to eliminate the cross sectional dependency effects on the tests (43).

Estimating methods

The "Continuously-Updated and Fully-Modified" (CUP-FM) estimator is an estimation technique which estimates long run coefficients. Also, it attends to cross sectional dependency generated by unobserved global stochastic trends (44). As the designers of this estimator have stated, it is the best estimator for estimating the long run relationship between the variables. This estimator was designed by Bai and Kao in 2007 (45).

Results

Table 1 shows the results of Pesaran CD test. The null hypothesis of this test is that no cross sectional dependency exists among the variables. As the table depicts, all the variables had cross sectional dependency, except for the number of physicians. This implies the existence of some correlations among the study countries.

Table 2 reports the results of some panel unit root tests. Similar to LLC test, the null hypothesis for Beritung test is having unit root. In Hadri test, the null hypothesis is that all the panels are stationary and do not have unit root, which is the same as that of Fisher test.

According to Table 2, in Beritung and Hadri tests, all the variables had unit root and were not stationary. In LLC test, the proportion of the population under 5 years old (lage1) and percentage of the people living in urban regions relative to the total population (lurb) were stationary and other variables had unit root. In fisher test, on the other hand, lage1, lage6, and lurb were stationary.

Table 2 also shows the results of IPS and CIPS tests for panel unit root. The null hypothesis for these two tests is that all the panels are non-stationary and have unit root. As shown in the table, in IPS test, GDP does not have unit root and is stationary, while the other variables are not stationary. It seems that CIPS test is the most accurate test for panel data in the presence of cross sectional dependency. This test assumes that all the variables in all the critical values have unit root and are non-stationary.

Westerlund ECM test was the cointegration test used in the present study. The *P* of applying the bootstrap approach to eliminate cross sectional dependency effects on the tests have been presented in robust *P*. As shown in Table 3, cointegration *P* without bootstrapping do not give a clear result. Cointegration is there in two of these models, but does not exist in the other two. Applying bootstrap to all the tests showed that the model had cointegration and there was a long run relationship between the variables.

Since the variables were cointegrated, no concern was there about spurious regression and, as a result, the variables could be estimated using OLS estimating technique. Furthermore, we used Hausman test to see if the model had fixed or random effects. First, we estimated the model with random effects and used Hausman test afterwards. The null hypothesis for this test is that the differences between the coefficients are not systematic. The result of this test rejected the null hypothesis and showed that the model had fixed effects ($\chi 2$= 28.09, *P*= 0.0001).

The results of estimating model

Because of having fixed effects in the model, the model was estimated using FE estimating technique. The results of this estimation have been shown in Table 4. Accordingly, in short term, all the variables had a strong relationship with health expenditures, except for lage6. In addition, the GDP coefficient which can be illustrated as income elasticity of health expenditures was under one. Thus, in short term, healthcare is a necessary good. The results also showed a negative relationship between the health expenditures and proportion of the people under 15 years old (Lage1), the percentage of private health expenditures (Lpvt), and urbanisation (Lurb) in short term. The results obtained regarding the number of physicians confirmed the bad scenario, while the results of lage1 confirmed the good scenario. Moreover, the percentage of private health expenditures was coordinated with its theoretical background (46). Therefore, if the percentage of private health expenditures increases, health expenditures will decrease.

Table 1. Pesaran cross sectional dependency test: ECO countries (1995-2009)

Variable	CD Test	*P*
LH	15.68	0.000
LGDP	25.33	0.000
Lage1	25.72	0.000
Lage6	17.15	0.000
Ldoc	-0.82	0.414
Lpvt	5.83	0.000
Lurb	2.20	0.028

NOTE:
ECO countries: Armenia, Azerbaijan, Iran, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Turkey, Turkmenistan, Uzbekistan. Data for Afghanistan were not available, so we eliminated this country.

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Table 2. Panel unit root tests: ECO countries (1995-2009)

Variables	Beritung	Hadri	LLC[1]	Fisher[2]	IPS test	CIPS test[3]
LH	2.2915 (0.9890)	15.3604 (0.0000)	-1.5969 (0.0551)	21.1103 (0.3907)	-1.5228 (0.5782)	-1.329 (0.865)
LGDP	2.3853 (0.9915)	10.7618 (0.0000)	-3.2204 (0.0006)	1.2873 (1.0000)	-2.6622 (0.0474)	-1.333 (0.863)
Lage1	4.9558 (1.000)	14.5319 (0.0000)	-0.9548 (0.16980	33.9856 (0.0262)	-0.9601 (0.8119)	-1.950 (0.243)
Lage6	7.4319 (1.000)	12.7967 (0.0000)	-13.5558 (0.0000)	140.0676 (0.0000)	0.5162 (1.0000)	-0.669 (0.999)
Ldoc	1.0742 (0.8586)	8.5185 (0.0000)	-1.7329 (0.0416)	22.7307 (0.3022)	-1.8436 (0.1905)	-0.972 (0.984)
Lpvt	1.2446 (0.8934)	11.4404 (0.0000)	-3.6272 (0.0001)	19.4630 (0.4919)	-1.9511 (0.2482)	-2.130 (0.112)
Lurb	6.8140 (1.000)	17.1424 (0.0000)	-0.3945 (0.3466)	38.4596 (0.0078)	-0.4484 (0.9994)	-0.126 (1.000)

NOTE:
Figures contain critical values at above of each cell and P-values for beritung, Hadri, LLC , T-values for IPS and CIPS and χ2 for fisher test
1. LLC test results for adjusted t, with time trend.
2. Fisher test results without lags
3. CIPS test for Cross-sectional average in first period extracted and extreme t-values truncated

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

Statistic	Value	Z-value	*P*	Robust *P*
Gt	-11.142	-27.015	0.000	0.475
Ga	-0.099	5.216	1.000	0.685
Pt	-11.695	-4.167	0.000	0.288
Pa	-0.080	3.585	1.000	0.790

Table 4. Results of estimating for fixed effects (short run relationship) and CUP-FM (long run relationship) between health expenditures and its determinant): ECO countries (1995-2009)

Variable	Results for short run relationship		Results for long run relationship	
	Coefficient	t-statistics	Coefficient	t-statistics
LGDP	0.4621088	5.93	0.82664109	8.1421250
Lage1	-1.930727	-5.44	-0.93326583	-3.1899887
Lage6	-0.1802784	-0.54	-0.62134712	-2.1233781
Ldoc	0.5070991	4.38	0.20486076	2.4313799
Lpvt	-1.242724	-10.33	-1.0816367	-13.050838
Lurb	-1.694937	-2.86	0.74211240	1.8407018
Constant variable	18.37112	5.19	-	-

Estimating the long run relationship

It seems that CUP-FM is the best estimator for determining the long run relationship between the variables. As shown in Table 4, all the variables had long run relationships with health expenditures. Besides, GDP per capita, the number of physicians per 1000 people, and the percentage of urbanization had a positive relationship with the health expenditures. Thus, increase in these variables would increase the health expenditures. In contrast to the short term results, this confirms the theoretical background. The number of physicians confirmed the bad scenario.

Furthermore, ageing for the people below 15 and above 65 years old had a negative relationship with health expenditures. Thus, the good scenario was confirmed for ageing in ECO countries. Private health expenditures also had a negative lung run impact on the health expenditures. Similar to short term results, it is consistent with the theoretical background. Besides, income elasticity was below 1 in this model.

Discussion

The present study estimated both long and short run relationships between the health expenditures and their determinants. Our study showed that income elasticity was below 1 in both short and long term estimation of healthcare expenditures in ECO countries; therefore, healthcare is a necessary good. Baltagi rejected the results of the previous studies, such as Newhouse, showing health as luxury good (14). Gbesemete found that income elasticity was near one in Africa (34). Moscone and Tosetti also measured income elasticity of healthcare and came to similar conclusions to those of Baltagi and Moscone (47). In this study, a negative long-term relationship was found between the health expenditures and ageing groups. In case the proportion of the individuals below 15 and over 65 years old is more in a country, the country is considered healthy and, as a result, people consume less expensive healthcare compared to a country with unhealthy people. Banins found that health expenditures increased when a country reached higher life

expectancy and started to decrease after achieving its peak. Similar results were also obtained by Seshamani, Lubitz, and Hansen (18,21,48). Leu found that the proportion of population below 15 years old had a positive relationship with the health expenditures (49). However, no such significant relationship was reported in the study carried out by Getzen on 20 OECD countries (50). He explained that specific health expenditures for each age group should be used instead of the total health expenditures. There has been some evidence in OECD countries that the elderly in many of these countries are healthier and less disabled and use lower health expenditures in comparison to the previous decades (51).

In the present study, the number of physicians had a positive relationship with the health expenditures in both long and short run confirming the bad scenario for the number of physicians. If the number of doctors increases, people use more expensive cares resulting in increase in the health expenditures.

The findings of the current study revealed a positive long-term relationship between the percentage of urbanisation and the health expenditures. This is due to the fact that the individuals in urban regions have more access to healthcare providers, such as hospitals and clinics, and use more healthcare services leading to higher healthcare expenditures. In the same line, Leu showed a positive relationship between urbanisation and healthcare expenditures (49). On the other hand, Gerdtham showed that this relationship was negative but not statistically significant (52). Other studies have shown a strong and positive relationship between the health expenditures and urbanisation (34,53).

According to the study findings, the percentage of private health expenditures had a strong negative relationship with the health expenditures. It shows that due to the social and cultural issues, ECO countries mostly tend to use public resources. Many of these countries were one day a state of the Soviet Union. Thus, the people of these countries are habited to use public expenditures.

Christiansen showed that increase in the government's spending on healthcare services leads the individuals to use more health services (11). Similar results were also obtained by Hotchkiss and O'Connell (54,55).

Conclusion

The present study was conducted on some developing countries in ECO region. Such studies are of great importance for poorer countries in which, the expenditures in all parts of economy are a critical issue. These studies can help the policymakers to make long term decisions. For example, they could find out what population policy is necessary for the country. One of the limitations of this study was that the data of Afghanistan was not available and this country was excluded from our analysis.

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Ethical issues

Ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submissions, and redundancy, have been completely observed by the authors.

Competing interests

The authors declare no competing interests.

Authors' contributions

EHR initiated the idea of the study, while the methods and techniques were conducted by AHS. Data analysis and interpretation of results and writing the manuscript was performed by EHR. AHS reviewed the manuscript and reported the errors of analysis, methods and interpretation to EHR.

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