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Original Article

The Study on Factors of Health Economics and Economic Growth in Iran

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Abstract

Introduction: Economic growth and public welfare are some of the macroeconomic goals for any country. Health economics is one of many parameters used as a criterion for action in the evaluation of this important subject. The present study has been examined the relationship between health economics factors and non-oil economic growth in Iran.

Materials and Methods: In this study, an attempt has been made to estimate non-oil economic growth elasticity to health economics factors by applying Dynamic Ordinary Least Squares (DOLS) approach from 1996:1 to 2010:4.

Results: The empirical results suggest that among four factors in the field of health economics in this survey, two factors, and i.e. Total health expenditures (as percentage of GDP) and population age 65 and above as a percentage of the total population have been positively and significantly effect on Iranian non-oil economic growth during the period of study. According to the theories and previous empirical studies, other known variables in economic growth models such as financial development (banking sector credit available to the private sector as a percentage of GDP) and foreign trade like export and import have also had a significantly positive effect on Iranian non-oil economic growth.

Conclusion: Thus, it seems that the authorities and policymakers in the field of healthcare may prepare the ground for a boosting in the economic growth of Iran through increasing healthcare and health expenditures by orientation of development and giving depth to the healthcare infrastructures and system in the future.

Keywords: Health economics, Non-oil economic growth, Dynamic Ordinary Least Squares (DOLS)

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Introduction

For years, the idea of "evil circle of poverty and disease" was known in the health and economic societies. Efforts of economics establishers as official doctrine started in the 1950s when the issue of the financing of health sectors and the health care was mentioned and health was considered as an "industry". Applying economic concepts in health economics is a relatively new branch that started by the 1970s. Meanwhile, the first International Conference on health economics was held in 1973 [1]. Investing in human capital increases economic growth; this theory goes back to the time of Adam Smith and the classical economists. He believes humans with improved training would transfer to capitals, and the community can benefit from more productive power and increase economic growth [2].Thus, economic growth may help better health and better health may as well contribute to economic growth. This means that there is a positive relationship between the two [3]. High-income OECD members of countries often allocate more than 7 percent of its GDP on health care costs. According to World Health Organization in 2009, 5.7 percent of GDP in Iran has been allocated to healthcare costs [4]. Lotfalipor *et al.* (2010) using the extended Solow growth model and a system of simultaneous equations examined the impact of health indices on economic growth in Iran in the period 1981 to 2006. Results showed a healthy balance of human capital (life expectancy) and health investment in human capital (health expenditure), are at 99 and 90% positively significant levels, respectively influencing the growth rate per capita income [5]. Narayan *et al.* (2010) using a growth model based on the Cobb-Douglas production function studied the production effect of health economics factors on five Asian countries using panel data assessment. The results showed a long-term co-integration relationship in these four growth model as well as with positive effect of health, investment, export, and research and development on economic growth, while import shows a negative effect on the economic growth. Education however had no significant effect on economic growth [6].

In this paper, the main objective is to study the relationship between import and export, the ratio of private credit to GDP, total health expenditure (a percentage of GDP) , the mortality rate in infants, the proportion of people over sixty -five years and the life expectancy variables on a real non-oil GDP.

Model structure: The model that has been used in this research is based on the principles of some earlier studies (e.g. Narayan *et al.*, 2010). The econometric

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model is adapted based on Augmented Cobb-Douglas Production Function. To assess the relationship between health economics factors and non-oil economic growth in a developing economy like Iran, we utilize log-linear model as follows:

$$\log Y_t = \alpha_t + \alpha_1 \log X_t + \alpha_2 \log M_t + \alpha_3 \log FD_t + \alpha_4 \log H_t + \alpha_5 \log IMR_t + \alpha_6 \log PAA_t + \alpha_7 \log LEB_t + U_t$$

Introduction of variables*:* In the following, the variables which are explored in this study, including dependent and independent variables are described as follows:

Real Gross Domestic Product (Y): In order to employ a variable, which represents economic growth in this empirical study regarding economic growth, several modes have been utilized. In some studies on national income production, the real per capita has been used as the real gross domestic product per capita along with some other items of gross domestic product, which are employed solely as agents for economic growth in econometric models. Given that in the countries with oil revenues, the main part of revenues is not originated from man power activities but of oil exports, so variables of Gross National Product (GNP) does not perfectly represent the economic realities and as a result in some studies, oil revenues are subtracted from Gross National Product (GDP) and again real GDP is used minus oil [7].

Export and import (X&M): In models of economic growth and conducted studies and also many investigations, some variables regarding foreign trade activities and the variables as representatives for Foreign Economy Sector have been employed to determine economic factors from various countries. In some studies, these two variables, namely exports and imports, have been utilized as two separate variables in the related models of economic growth. In the current study, two variables of exports and imports have been incorporated into the model separately according to the model used by Narayan *et al.* (2010) [7].

Total health expenditures (as percentage of Gross Domestic Product GDP) (H): In the annual budget of the government, some division of costs for public and private expenditures is allocated to healthcare and medical purposes in the community in which these costs may cover given healthcare services (preventive and medical), family planning activities, and the activities concerning to nutrition and emergency aids determined for health purposes [8]. This variable has been studied in empirical researches in two ways. One is used as a proportion of GNP of the countries and the latter as a total expenditure of healthcare and

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medical purposes (some percent of GDP) that exist in these studies. With respect to the conducted studies within several investigations, total costs of healthcare and medical sector (as percent of GDP) have been taken as the first factors for health economy in the studied model in this survey [8].

Financial development (banking sector credit available to the private sector as a percentage of GDP) (FD): Financial development is one of the parameters which have been noticed in the identifying of effective factors on economic growth of countries by economic researchers during recent years. This factor has been considered as one of the effective factors on economic growth through channel of capital market. One of the most well- known parameters regarding financial development in empirical studies on these growth relations to the ratio of financial balance in Private Sector to GDP. Also in this study, this index has been included in the model as an independent variable [7].

Infant mortality rate (IMR): The number of children born alive to the number of live children who died before reaching one year of age is the infant mortality rate [9]. Also it is largely responsible for the increase in the remaining children live at birth, decrease in infant's mortality in childhood deaths [10], [8].

Population age 65 and above as a percentage of the total population (PAA): The percentage of people over 65 years is severely affected by life expectancy. This ratio is used to indicate aging of the population as well as the level of health care for chronic illnesses and the elderly which in turn leads to increased life expectancy in the older population. A Country with 40 percent or more of the population under 15 years of age and about 4 percent of people over 65 is considered to have a young population. This ratio is used to show the aging of the population as well as to indicate the level of health care for chronic illnesses and elderly. In a country with 10% or more of the population over 65 years of age and less than 15% are 15 years old is considered to have an old population. It is necessary to mention the overload rate, people over 65 and those under 15 years are included in the numerator. This may partly lead to the neutralized effects of life expectancy increase and infant mortality decrease and the percentage of over 65 years populations on economic growth [9], [8].

Life expectancy (LEB): The life expectancy rate is one of economic growth and development indices. If the individuals' life style is improved, then the level of life expectancy will increase in society. [9] In general, life expectancy rate is higher in advanced countries than for people in other

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countries. The economic conditions, earnings proportional to costs, environmental healthcare and clean weather, and in fact achieving sustainable development are some effective factors on life style among the people. These parameters in the Iranian economy and the relevant empirical studies regarding the relationship among factors of healthcare economy and economic growth have been less employed. But with respect to conversion of data from annual into quarterly information in this study, the possibility for using this variable has been provided in this model [3],[8].

Study period*:* Lack of access to reliable statistics and information in the field of Iranian healthcare sectors is one of serious restraints against empirical studies, based on time series analyses in the field of health economics and especially the impact of health economics on economic growth, because data must be greater in time-series. To overcome this problem and to include a wider spectrum of health economics factors in Iranian economic growth model for this study, quarterly data have been adapted. Period of study was taken from years 1995-2011 for this research. But for the sake of increasing the number of observations and possibility for application of time series data analyses, the aid of one of the most reliable techniques regarding conversion of annual data into quarterly data, which has been introduced by Lisman and Sandee[11] (1964) these data were converted. Hence, the final period was considered as 1996:1- 2010:4.

Materials and Methods

Dynamic Ordinary Least Squares (DOLS): The presence of random trends may cause the interpretation of econometric results, a selection of estimation method, and reliability of the conducted predictions by the aid of the model, to encounter some problems. Certainly, despite of random trends, the diagnostic statistics may mistakenly refer to the existing relationship among variables. In the case of existing random trends and even under the conditions when there is no real relation among variables, the common techniques such as Ordinary Least Squares (OLS) may show significant relationship. Such regressions are called “Spurious Regressions”.

By equalization of OLS method, Stock and Watson [12] have purposed a method for estimation of the relationship between variables with random trends and called it ad Dynamic Ordinary Least Squares (DOLS) or Generalized Ordinary Least Squares. Dynamism in this method denotes that in this technique the time model for reaction of a dependent variable is noticed in relation to variances of independent variables.

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Results

Time series analysis and Unit Root Test: The first of step in analyses in the fields of co-integration is to study the characteristics of time series. In other words, firstly it should be characterized if model variables are stationary or non-stationary. Augmented Dickey- Fuller [13] is one of the most well-known methods to checking stationary. Table 1 shows results of unit root test on all variables used in the model. The null hypothesis of unit root is rejected by ADF test for all studied variables and so are the series stationary in the level. We conducted the same test on the first difference of all series and found them stationary. As a result, these data series can be characterized as *I* (1) for period of analysis.

Table 1: Results of Unit Root Test

variable	Level			First difference		
	ADF Statistic	Test Critical Values 5%	Position	ADF Statistic	Test Critical Values 5%	Position
LY	-0.616064	2.912631-	Non-stationary	-3.767289	-2.913549	Stationary
LFD	-0.255198	2.912631-	Non-stationary	-6.216432	-2.913549	Stationary
LX	0.655157	-2.912631	Non-stationary	-4.923791	-2.913549	Stationary
LM	-0.544478	-2.912631	Non-stationary	-4.712096	-2.913549	Stationary
LH	-2.017845	2.912631-	Non-stationary	-5.950431	-2.913549	Stationary
LLEB	-1.224295	2.912631-	Non-stationary	-7.465235	-2.913549	Stationary
LIMR	-0.422492	2.912631-	Non-stationary	-3.862006	-2.913549	Stationary
LPAA	0.837769	2.912631-	Non-stationary	-5.725238	-2.913549	Stationary

To determine the degree of integration, first difference of variables should be calculated and after their values of ADF statistic should be extracted again. Based on the needed number of difference calculation for consistency of variable one could measure the degree of variables integration. Accordingly, with respect to this point that all of variables become consistent after difference calculation once consequently it may be inferred that all the studied aggregated variables are of the first order. Hence, given that the studied variables are inconsistent as a result, it is more likely that

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employing OLS method may not lead to occurrence of spurious regression and reliable coefficients. Accordingly, Dynamic Ordinary Least Squares (DOLS) method, which creates co-integration vectors among variables, is adapted.

Estimation of model by means of Dynamic Ordinary Least Squares (DOLS) method: Here, the variable of non-oil real GDP (LY) is considered a dependent variable and variables of banking sector credit available to the private sector as a percentage of GDP (LFD), total exports (LX), total imports (LM), health expenditures to GDP (LH), and

also ratio of people older than age sixty five (LPAA), life expectancy (LLEB), and newborns' mortality rate (LIMR) are deemed for estimation of the model by means of DLOS technique. In order to equalize conditions of estimation, a dummy variable (D1) has been utilized to address the effects of economic sanction in 2009. The results of estimated long-term coefficients are given in Table 2.

Table 2: Estimated long-term coefficients of the DOLS approach

Variable	Coefficient	Std. Error	t-Statistic	Prob
LFD	0.106511	0.040958	2.600498	0.0157
LX	00.83574	0.035226	2.372533	0.0260
LM	0.100486	0.026547	3.785194	0.0009
LH	0.334400	0.031748	10.53311	0.0000
LIMR	0.155828	0.183678	0.848361	0.4046
LPAA	0.843071	0.138668	6.0797779	0.0000
LLEB	-1.724498	1.835491	-0.939530	0.3568
D1	-0.024352	0.004105	-5.931981	0.0000
C	16.04475	8.733903	1.837066	0.0786
R-squared	0.999894		**Mean dependent variable**	12.74489
Adjusted R-squared	0.999753		**S.D. dependent variable**	0.232896
Durbin-Watson stat	1.921773		**Sum squared resid**	0.000322

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As it is shown in the results of the estimations, all the estimated coefficients correspond to the relevant theories in terms of quantity and sign. Variables of life expectancy (LLEB) and newborns' mortality rate (LIMR) are the only variables which their signs are not expected so these two coefficients are statistically insignificant. Thus, of the four considered factors in this model of health factors, variables of total health expenditures (as percent of GDP) and ratio of people older than sixty five years in the population had a positive and significant impact on economic growth in Iran at 95% level whereas the impact of variables of life expectancy and newborns' mortality rate on Iranian economic growth minus oil was not approved. Alternately, coefficient of virtual variable also indicates that the economic embargoes imposed by western countries on Iran in 2009 had a negative impact on Iranian non-oil economic growth.

Another fitting index that raised here is Durbin–Watson statistic which equal to 1.92 in this regard indicating that the model does not have any Autocorrelation of the errors. Figure 1 shows this better.

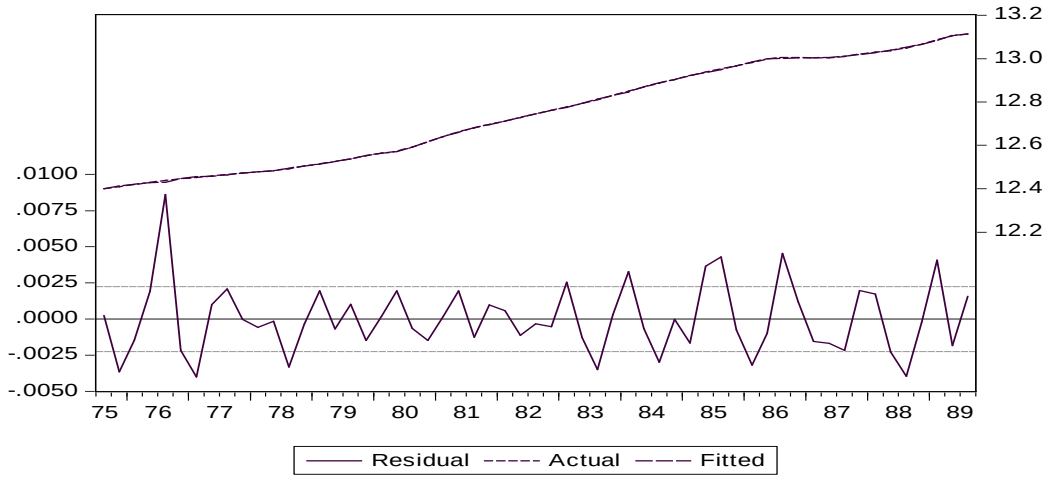

Figure 1: Actual, Fitted and Residual Graph

Again, in order to test the stability of the estimated coefficients from the DOLS method the stability test of Hansen is used. Table 3 shows results of Hansen Parameter Instability.

Table 3: Hansen Parameter Instability Test

statistic *Lc*	Stochastic Trends(m)	Deterministic Trends(k)	Prob
0.163389	8	o	>0.2

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Discussion

Total health expenditure (a percentage of GDP) and economic growth in Iran: As the results of the estimation indicated, Iranian economic growth elasticity minus oil in relation to the total costs of healthcare and medical sectors in this country are at level 0.33. It seems that the allotted costs in healthcare and medical sectors may affect positively on economic growth of this country to some extent. Hence, although there seems an increase in these costs will be effective on Iranian economic growth minus petroleum by several years in the future but if these costs are oriented more qualitatively and by more control over spending the annual budget of the government so this trend may affect further as well. Iranian economic growth elasticity minus oil in relation to total costs of health and medical sectors in this country are at level 0.33 so this value is very close to estimated elasticity derived from studies done by Salmani and Mohammadi[14] (2009), who have extracted this elasticity as 0.19 and this suggests the significance of this variable for interpretation of economic growth in this country. In this regard, Rivera and Kovaryz (2004) found a positive relation for Spain [15], although unlike previous researches, in this study, economic growth minus petroleum had been examined.

Life expectancy: An estimated coefficient for this variable in studied model was considered statistically insignificant as well. Thus in the future studies, by substitution in composition of the used variables, further studies can be conducted on the relationship with the way of impact by life expectancy on economic growth in the country. In this regard, Baroo (1996) studying 84 countries [16], Bloom and Malani (1998) studying 78 countries [17] and Wilson et al. (2004) studying 43 countries [18] have recognized the positive effect of life expectancy on economic growth.

Population age 65 and above as a percentage of the total population: One of the unique innovations in this study is the estimation of Iranian economic growth elasticity minus oil in relation to people older than sixty five years whereas the investigation in research backgrounds inside the country showed that this factor from healthcare economy has been less employed in economic growth models regarding Iran. But, this study is totally complied with investigations, which has been done by Bargava et al. [19] (2001) about the positive impact of ratio of variable in people older than sixty five years on variable of economic growth within ninety two countries under investigation.

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Infant Mortality Rate: This variable is one of those variables which have been less addressed in quality of impact on Iranian economic growth by economic researchers and expert in healthcare sectors. In this study, this variable is incorporated into the economic growth model minus oil for the country and its elasticity was estimated. But, significance of estimation coefficient was not statistically approved for this variable. It is obvious that during recent years newborns' mortality rate has been reduced in comparison to the past two decades; however, lack of its significance in this study may be examined further by researchers in the future. In this regard Macdonald and Roberts (2002) found positive relation for77 countries. [20]

Foreign Trade and Economic Growth in Iran: Two variables were included as agents of foreign sectors in this model based on the existing theories regarding economic growth minus oil of the model in this study. The results indicated that Iranian economic growth elasticity minus oil is positively and significantly related both to exports and imports. The findings from this study show that Iranian non-oil economic growth elasticity in relation to imports (0.1) is a slightly greater than exports (0.08). These results suggest that foreign trade may play a relatively remarkable role in Iranian non-oil economic growth. Thus it seems that if status foreign trade is addressed by economic authorities of this country and their activities to be improved this may provide the grounds for further economic growth in the country. This variable has been already utilized in studies on Iranian economic growth as well. However, in this study, according to Narayan *et al.* (2010), this variable was used along with factors of health economy once more.

Indicators of financial development and economic growth: The indices of financial and banking development are one of the parameters, which have been used several times during recent years whether as time series and or panel data in economic growth models. Also according to research model in this study, parameter of financial development was included in this model and its elasticity was estimated proportional to Iranian non-oil economic growth as 0.1. In general, the rate of this elasticity, which was estimated as a figure among 0.1 to 0.17, corresponds to the conducted studies on developed countries (Seetanah, 2010) [21]. Hence, in any country the financial development may be considered as one of the ways for improving nonoil economic growth in the country.

Suggestions for further study: Recent developments in the field of studies of economic growth in developed countries and in developing countries show that the field of

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health economics and its related indicators can greatly help in promoting the economic growth of these countries. By examining the relationship between indicators of health economics and growth in non- oil economy, it was concluded that some factors such as general health and health expenditure (a percentage of GDP) and the impact of people over sixty- five years will have a significant positive impact in economic growth if Iran. Overall, the survey results are based on clear objectives and include a number of well known indicators of health. Therefore, if researchers want to further research on the relationship between health and economic indicators they are recommended to use this research model using panel co-integration method for countries with similar economic structures to estimate the health system . Specifically it is recommended to propose the model to be used in estimating the effects of world outlook of economic factors on the health of non-oil economic outlook of Iran and other countries.

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