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The Relationship between Health Care Expenditure, Life Expectancy and Economic Growth in Iran

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ABSTRACT

Considering the importance of healthcare for human workforce in the modern society and the increasing trend of life expectancy in developed countries, the present study aims to analyze the relationship between health care expenditure, life expectancy and economic growth in Iran through theoretical and practical considerations and provide appropriate responses to relevant questions. In this line, the study relies on annual statistical data recorded over a 23-year period (from 1989 to 2011) and deploys the ARDL econometric technique. The results indicate that life expectancy and health care expenditure have a significant positive impact on GDP both in the short-term and in the long-term. In other words, an increase in life expectancy and health care expenditure causes an increase in economic growth.
KEYWORDS: health care expenditure, life expectancy, GDP

1. INTRODUCTION

Today, concepts like justice and equality in the fields of society, economy, culture and welfare are the focus of attention for politicians and people alike in most societies. From about 1900 onwards, for the first time in the history of economics, Pareto, Lorenze, and Gini pioneered measuring inequalities in income and wealth distribution. It is clear that the unequal distribution of income and wealth, unorganized markets, differences in the levels of communities and the resulting differences in needs have an impact on the inequality of expenditure and other aspects of people's lives leading to major problems for people and governments. Measurement of the inequality of distribution of facilities is also used in areas other than economy such as the distribution of health, social and welfare facilities in urban and rural areas in different cities of a country, different levels of education, different educational opportunities, and different educational opportunities over time (Kumba, 2010).

Statement of the Problem:

In addition to enhancing quality of life and equity in income distribution, economic growth and increase in GDP are among the main objectives of economic systems and development programs. Almost all studies in the field of economy are directly or indirectly concerned with factors influencing economic growth proposing various strategies to achieve this goal. Before the introduction of the theory of human capital, physical capital was the only known way to increase economic growth. But then, in the early 1960s, the concept of human capital was introduced, besides physical capital, as a factor of economic growth gradually attaining a more prominent role. Most economists believe that what finally will determine the economic and social development of a certain country is its human workforce. The importance of the role of human capital in the growth process is no less than that of the physical capital.

Studies show that investment in human capital leads to an increase in productivity and finally to an increase in economic growth. The concept of human capital was developed alongside with such notions as training and increasing the educational level of the labor force. Not long after that, health was another issue and found a special place in the realm of human capital besides training such that today the promotion of the health of workforce is known as one of the main ways of improving human capital. Finlay argues that enjoying good and durable health is an integral part of human experience. Healthy people have more energy and freshness and have a more positive outlook toward life. These characteristics can be defined not only by their positive impact on social infrastructure but also can affect economic growth and development. Therefore, promotion of health can increase the effectiveness of labor and lead to economic growth (Emadzadeh, 2011).

Health has an indirect impact on production. For example, improving the health of the workforce is followed by increased motivation to continue studying and achieve better skills. This is because the health situation on the one hand increases the attractiveness of investment in education and training opportunities and on the other hand makes individuals more susceptible to continuing their education and improving their skills through increased learning ability. In addition, improvements in healthcare indicators are associated with reduced mortality and increased life expectancy in society and encourage people to save more. Following an increase in public savings, physical capital increases. This also indirectly affects labor productivity and leads to economic growth (Weil, 2007). Therefore, aim of this study is to analyze the effects of health care expenditure on economic

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growth, the effects of increased production and economic growth on health care expenditure, and finally, the effects of increased health care expenditure on life expectancy. To this end, the researcher has developed the following hypothesis: health care expenditure and life expectancy have a positive impact on economic growth in Iran

2. LITERATURE REVIEW

This section provides a review of relevant studies in the field. Barro and Sala (1995) examined life expectancy at birth and its impact on GDP in developing countries. The analysis suggests that a 3-year increase in life expectancy causes an annual growth rate of 1.4 percent. By recourse to recent statistical data in the United States, Raityrim (2004) examined the relationship between income inequality, poverty and public health. With a full-fledged analysis of critical literature in the field in the form of a multilevel study and by controlling the variables of race, ethnic composition, and education besides income inequality and mortality as indicators of health, Raityrim finally came to the conclusion that with or without the presence of confounding variables, there is a positive significant correlation between public health and income inequality.

By adding the supply of education and health into it, Rivera and Currais (2004) tried to improve the explanatory function of the Cobb-Douglas production model. They used data relating to Spain for the period 1973 to 1993 to examine the impact of the components of government expenditure in the health sector on labor force productivity and economic growth. The researchers concluded that state health development costs had no significant effect on economic growth. They noted that it takes a longer time to observe the effects of development costs in this section on productivity and economic growth. Therefore, the role of current government expenditure in matters relating to health has more impact on economic growth.

Using the proposed by McDonald and Hopkins (2000), Bukhari and Butt (2007) in their study in Pakistan over the period 1972 to 2005 showed that health care expenditure led to economic growth whereas it had no impact on production. In a study on health care expenditure and economic growth, Wang (2011) examined the relationship between these two variables in 31 countries for the period 1986 to 2007 and concluded that an increase in income causes an increase in health care expenditure in these countries. Also Sunkanmi (2012) studied the relationship between health care expenditure and economic growth using the Johansen method for the period 1979 to 2009 in Nigeria. The variables of this study included foreign aid, health care expenditure, total savings, population and economic growth. The results showed that an increase in health care expenditure led to increased economic growth. However, due to the insufficiency of foreign aid and its coefficients as well as state budget expenditure on health care, they suggested that more attention should be paid to health care through increasing foreign aid and allocating a significant portion of the national budget to health care services to strengthen such programs and improve economic growth in these countries. According to studies conducted by the Pan American Health Organization on the impact of life expectancy on the GDP of Latin American and Caribbean countries, a one-year increase in life expectancy leads to a 1 percent increase in GDP for the next 15 years.

Also in another study in Iran, Mojtahed and Javadipoor (2003) used the model developed by Solow and the data relating to 33 developing countries to analyze the effects of health expenditure on economic growth. The first result of this study was that in addition to the positive effects of physical and human capital on economic growth, health capital - which entered the Solow model through health care expenditure - had also a significant positive impact on economic growth. In the next stage using simultaneous tests, the researchers concluded that health expenditure also affected economic growth.

In a study titled "the impact of health expenditure on economic growth" for the period 1979 to 2004 using the Solow model, Hadian et al. (2006) concluded that health expenditure has a significant positive impact on economic growth. In another study, Beheshti and Sojoudi (2007) examined the relationship between health expenditure and GDP in Iran for the period 1959 to 2004 using the Johansen cointegration test. The results of their study indicate that there is a long term relationship between health expenditure and GDP in which GDP has a significant positive impact on government's health expenditure. Ghanbari and Baskha (2008) examined the effects of changes in government's health expenditure on economic growth for the years 1959 to 2004. The results represent the significant and positive impact of government's health expenditure on economic growth.

3. METHODOLOGY AND RESEARCH MODEL

Since the estimated model is a function of macroeconomic variables, there is this tendency in most macroeconomic time series that move in line with each other. This is because there is a trend that is common in all of them. If unstable time series variables are used in the estimation of a model's coefficients, the results may lead to a false vector because in variables with such a trend, there is this tendency to show strong correlations even in cases where there is no significant economic relationship.

Therefore, based on the points mentioned in this article, data are considered annually for a 23-year period from 1989 to 2011. Data play a significant role in the proper accomplishment of a research project and in the deduction of results. The data used in this study are divided into two categories. The first category is related to the theoretical foundations and research background. Data of the first type were provided from local and foreign journals available on the Internet or in libraries. The second category is related to statistical data necessary for the estimation of the model. Data of the second type were retrieved from valid statistical sources consisting mainly of 1) the WDI economic software package (2008), 2) the Statistical Centre of Iran (SCI), 3) The Management and Planning Organization of Iran (MPO), and 4) The Islamic Republic of Iran Customs Administration (IRICA).

✓ **Research Model**

The Autoregressive Distributed Lag (ARDL) model is deployed in this study in order to provide a framework that best analyzes and explains the relationship between health expenditure, life expectancy, and economic value. Besides, the ARDL model can provide appropriate responses to questions about the subject as a dynamic equation with a balanced solution. The following model is presented for analyzing the proposed hypothesis.

$$LGDP_t = \beta_0 + \beta_1 LBEHDASHT_t + \beta_2 LNOMD_t + U_t$$

Where,

LBEHDAST is the logarithm of health expenditure, LGDP is the logarithm of GDP at constant prices, and LNOMID is life expectancy.

Statistical Population

The intended range and scope of the study determines the statistical population. Therefore, the target population is defined as all the elements under consideration which belong to a certain group and have at least one common characteristic. This characteristic should be shared by all elements of the target population and distinguish the considered population from other communities. In this study, in order to increase the likelihood of more complete and faster access to information, the scope of the target population is limited to companies listed on the Tehran Stock Exchange (Hafeznia, 1998). The statistical population of this study includes the Ministry of Health. Statistics on health expenditure are retrieved from the websites of the Management and Planning Organization of Iran (MPO) and the Central Bank of Iran (CBI).

4. METHODS OF ANALYSIS

Methodology is composed of a set of reliable and systematic rules, procedures, tools and methods for analyzing realities, discovering the unknown and finding solutions to problems. For data analysis, the augmented Dicky-Fuller unit root test was deployed for determining the time series, the validity of the variables, and their levels of aggregation. After that, the Microfit software package was deployed for determining optimal intervals for the ARDL model in order to analyze the relationship between variables and evaluate the significance of these relationships. Finally, we deployed the dynamic equation test, the chi-square goodness-of-fit test, and long-term tests and evaluated the structural validity of the model using the CUSUM and CUSUMSQ tests.

Testing the Hypotheses

A) Augmented Dicky-Fuller unit root test to check the validity of the variables

To test the validity of the variables by the Dicky-Fuller unit root test, it is assumed that the time series under consideration is characterized by a first order self-explanatory process. The hypothesis is tested based on this assumption. Now, if the time series under consideration is characterized by a first order self-explanatory process, the estimated relationship will lack a correct specification for the P test. As a result, we need to use the augmented Dicky-Fuller unit root test so that the obtained limiting distribution and critical parameters be valid. For this purpose, first we carry out the augmented Dicky-Fuller unit root test on each of the variables. If the absolute value of the ADF statistic is smaller than the absolute critical values at the 1 and 5 percent significance levels, it can be accepted that the time series under study is not valid on the level of data. In this case, we can conduct another differential on the data and carry out the augmented Dicky-Fuller unit root test on that differential. If the absolute value of the ADF statistic is higher than the absolute critical values at the 1 and 5 percent significance levels, it can be accepted that the time series under study is valid and a first-order aggregated series. The results of these tests are presented in the following table. In this table, letter C in parentheses in front of each variable shows that the ADF unit root test has been performed based on an estimation equation with constants only. Letter T indicates that the variable has a trend as well. The column on the right-side of the table shows the results of the ADF unit root test on the level of data and the column on the left shows the results of the ADF unit root test for the first-order differential. According to the description above, the Eviews software package is deployed for conducting the Dicky-Fuller and the augmented Dicky-Fuller unit root tests for each of the variables under study. The results are summarized in the table below.

Table 1: Results of Augmented Dicky-Fuller unit root test of the "main variables" on the level of data

Overall result	Critical value			ADF statistic	Variable	
	10%	5%	1%			
Not valid	-2.66	-3.04	-3.85	-1.53	(LBEH)(c)	Logarithm of health expenditure
	-3.28	-3.69	-4.57	-2.43	(LBEH)(c,t)	
Not valid	-2.64	-3.00	-3.76	-1.33	(LGDP)(c)	Logarithm of GDP
	-3.26	-3.64	-4.46	-3.03	(LGDP)(c,t)	
valid	-2.64	-3.012	-3.78	-1.63	(LOMID)(c)	Logarithm of life expectancy
	-3.25	-3.63	-4.44	-6.01	(LOMID)(c,t)	

Source: Calculations by the researcher

According to the description above, the Eviews software package is deployed for conducting the Dicky-Fuller and the augmented Dicky-Fuller unit root tests for each of the variables under study. The obtained results indicate that the variables of health expenditure and GDP are not valid whether with or without the trend. However, the variable of life expectancy is valid. Now, we conduct a first-order differential on the remaining variables to conclude whether one differential leaves the variables valid or not. The results are presented in Table 2.

Table 2: Results of Augmented Dicky-Fuller unit root test of the "main variables" for the first-order differential

Overall result	Critical value			ADF statistic	Variable	
	10%	5%	1%			
Valid	-2.66	-3.05	-3.88	-4.65	(LBEH)(c)	Logarithm of health expenditure
	-3.29	-3.71	-4.61	-4.87	(LBEH)(c,t)	
Valid	-2.64	-3.01	-3.78	-3.41	(LGDP)(c)	Logarithm of GDP
	-3.26	-3.64	-4.46	-3.21	(LGDP)(c,t)	

Source: Calculations by the researcher

Base on the Dickey-Fuller test calculations, we can conclude that the variables under study are aggregations of various orders. Therefore, it is not possible to use vector auto-regression (VAR) to estimate the coefficients of the model because this method can be applied only when all of the variables belong to the same level of aggregation. If all the variables in the model were valid, there was no need to use the ARDL method and we could use the method of ordinary least squares (OLS) for estimating the coefficients of the model. In this regard, the results of the Dicky-Fuller and the augmented Dicky-Fuller unit root tests can ensure us of using the Autoregressive Distributed Lag (ARDL) method.

B) Determining the length of the interval:

Usually in annual data, the interval value is considered 1 or 2. Also in data with greater frequencies (e.g., quarterly and monthly data), we can consider higher interval values (Tashkinit, 2005, 153). In this study, we choose one criterion from among four criteria including the adjusted coefficient of determination, the Akaike information criterion, Schwarz's Bayesian information criterion and the Hannan Quinn criterion. Our selected criterion for estimating the model is Schwarz's Bayesian information criterion because it provides the possibility to estimate coefficients with minimal intervals.

C) Dynamic equation test:

In this section, we identify the factors affecting economic growth in Iran in relation to health expenditure and its effectiveness. In this model, it is assumed that life expectancy and health expenditure are variables affecting economic growth. Table 3 summarizes the results of estimating the dynamic equation.

Table 3: Results of the dynamic equation (dependent variable: LNGDP)

T-Ratio[Prob]	Standard error	Coefficient	Regressor
13.7491[.000]	0.058496	0.80427	LNGDP(-1)
3.0243[.009]	0.016399	0.049595	LNBEHDASHT
.93180[.367]	0.017373	0.016188	LNBEHDASHT(-1)
3.5629[.003]	0.016229	0.057823	LNBEHDASHT(-2)
.069059[.946]	1.5276	0.1055	LNOMID
-2.1213[.052]	1.1364	-2.4107	LNOMID(-1)
3.8871[.002]	2.8975	11.2629	C

Source: Calculations by the researcher

Table 3 shows that all of the variables, based on the t statistic, are significant and explain a significant portion of economic growth in Iran. The estimated short-term dynamic equation is presented below.

LGDP = 11.26 + 0.80 LnGDP(-1) + 0.04 LnBEHDASHT +0.01 LnBEHDASHT (-1) +0.05
(13.74) (3.02) (0.93) (3.56)
LnBEHDASHT (-2) +0.10 LnOMID - 2.1 LnOMID (-1)
(0.06) (-2.12)

D) Diagnostic tests

In this model, economic growth is the dependent variable. Independent variables include life expectancy and health expenditure.

Table 4: Diagnostic and goodness of fit tests for the short term model

Diagnostic tests		
Variance anisotropy	**Conditioned form of the model**	**Serial correlation**
CHSQ(1)= .55977[.454]* F(1, 19)= .52033[.479]	CHSQ(1)= .78735[.375]* F(1, 13)= .50639[.489]	CHSQ(1)= 1.9622[.161]* F(1, 13)= 1.3399[.268]
Goodness of fit		
F statistic		Adjusted coefficient of determination $(\overline{R}^2)$
F(6, 14) 732.1586[.000]		0.99

(Variables marked with asterisk are significant at a confidence level of 0.95)

As can be seen in Table 4, the coefficient of determination is equal to 99% and F statistic is equal to 732 which indicate the explanatory power of the model. In addition, the results confirm the lack of serial correlation (http://prd.moc.gov.ir/Report/611/bakhsh4.htm), conditioned form (http://prd.moc.gov.ir/Report/611/bakhsh4.htm), and variance anisotropy (http://prd.moc.gov.ir/Report/611/bakhsh4.htm) in the model.

Computational quantity of F statistic at the ten percent significant level also indicates that the regression equation is not rejected statistically. Moreover, the explanatory power of the model is 0.99. Before estimating the long-term coefficients using the ARDL method, it is necessary to conduct a cointegration test to ensure the long-term relationship between variables and their impact on economic growth. The equation becomes dynamic after adding the intervals. The presence of intervals in the economic growth of Iran (Ln GDP) prevents the problem of spurious regression caused by the instability of independent variables. It also prevents the effects of factors eliminated from the model. In the estimated model for economic growth, significant variables are considered as explanatory variables in the Granger causality test. In this connection, as expected, preliminary estimates indicate that the variables are significant in all models based in the t statistic.

E) Estimation of the long-term model:

Since the coefficient of the variable dependent on interval on the right side of the equation in the model estimated by ARDL is zero, the unit root test of the zero hypotheses (lack of cointegration) is rejected based on Banerjee and Dolado test statistic. As a result, the existence of cointegration between variables is confirmed. After ensuring the long-term relationship, the ARDL method provides an explanation of the effectiveness of variables on the dependent variable in the long-term in addition to measuring the length of the interval. The results of the long-term coefficients are valid when the t statistic value is greater than its critical value.

By comparing the statistical and critical values of the test at the 90% level presented by Banerjee et al. (1992), the hypothesis concerning the existence of a long-term relationship between the variables of the model is confirmed. In this way, we estimated the long-term model for economic growth in the economy of Iran and obtained the following results. To perform this test, the sum of the coefficients with lags of the dependent variable, in the case of LNGDP (-1), is subtracted from one and divided by the total standard deviation. After estimating the dynamic equation, we must ensure that the existence of a long-term relationship.

$$t = \frac{\sum_{i=1}^{p} \hat{\Phi}_i - 1}{\sum_{i=1}^{p} S_{\hat{\Phi}_i}} = \frac{0.80 - 1}{0.05} = -4$$

Here, the absolute value of the t statistic is higher than the absolute value of the critical value of Banerjee, Master and Dolado's table which is equal to -4 with 22 instances of observation, the existence of intercept, and the presence of 2 explanatory variables. Therefore, the existence of a balanced long-term relationship between the variables is confirmed. In other words, the null hypothesis concerning the absence of a long-term relationship is rejected. After conducting the Banerjee test, we estimated the long-term relationship. The estimation results of balanced long-term relationship are reported in Table 5.

Table 5 - estimation results of long-term relationship (dependent variable= LNGDPi)

T-Ratio[Prob	Standard Error	Coefficient	Regressor
4.8470[.000]	0.13029	0.63151	**LNBEHDASH**
-2.6246[.020]	4.4872	-11.7772	**LNOMID**
3.1894[.007]	18.0421	57.543	**C**

Source: Calculations by the researcher

We can interpret long-term relationships after ensuring their existence. The coefficients presented in this table represent a long term relationship between the variables of the model and shows that health expenditure has a significant positive impact on economic growth. The coefficients of health expenditure represent an effectiveness of 0.63 in economic growth. In other words, a 1 percent increase in health expenditure leads to a 6 percent growth in economy. In addition, life expectancy has a significant positive impact on economic growth. The coefficients of life expectancy represent an effectiveness of 11 on economic growth. In other words, a 1 percent increase in life expectancy leads to an 11 percent growth in economy.

F) Error correction test for model selection:

We can interpret long-term relationships after ensuring their existence. Based on the results of this long-term relationship, we use the ECM model for evaluating how short-term imbalances in economic growth are adjusted toward a long-term equilibrium. The ECM coefficient indicates what percentage of short-term imbalances at the general level of economic growth is adjusted toward a long-term equilibrium in each period. In other words, it takes several periods for economic growth to return to its long-term trend. The coefficient of the error correction model is equal to 0.19. Therefore, in each period, 0.19% of the imbalance in economic growth is adjusted toward its long-term trend. The error correction model is extracted from a general to specific approach to evaluate how short-term imbalances in economic growth are adjusted toward a long-term equilibrium. A very important item in error correction models is the varying coefficient of ECM (-1). The estimation results of the error correction model are presented in Table 6.

Table 6: Estimation results of the equation error correction (dependent variable= LNGDPi)

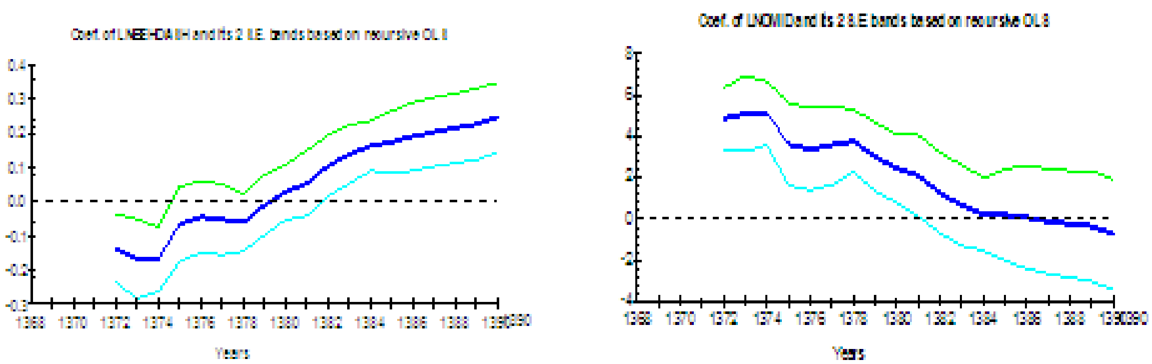
T-Ratio[Prob]	Standard Error	Coefficient	Regressor
3.0243[.008]	0.016399	0.049595	**dLNBEHDASH**
-3.5629[.003]	0.016229	-0.05782	**dLNBEHDASH1**
.069059[.946]	1.5276	0.1055	**dLNOMID**
3.8871[.001]	2.8975	11.2629	**dC**
-3.3460[.004]	0.058496	-0.19573	**Ecm (-1)**

In the table above, d represents the first-order differential between variables. As can be seen, all model coefficients are statistically significant at a confidence level of 90 percent considering t-statistic parameters. What is essential in the short term ECM equation, is the coefficient of ECM (-1) which indicates the speed of the adjustment process from short-term imbalances toward a long-term equilibrium. As specified in Table 8-4, the estimated coefficient of ECM (-1) is equal to -0.19 which suggests the low speed of adjustment rom short-term imbalances toward a long-term equilibrium, indicating that 0.19 of lack of economic growth disappears in each period.

G) Stability tests:

In the ARDL method, we use graphic tests such as CUSUM and CUSUMSQ - first employed by Durbin, Brown, and Evans, (1975) - on the remaining sentences of the short-term pattern to evaluate the structural stability of the estimated model in the long-term pattern.

Figure 1 - CUSUM and CUSUMSQ tests



As it can be seen in Figure 1, the path of test statistics is constantly in straight lines and implies no instability in the model. Based on these tests, it is not possible to reject the hypothesis of the stability of coefficients at the 5% significant level and it can be concluded that the model has been stable all throughout the study period.

5. RESULTS

By improving health indicators, health expenditure improves and enhances human capital and thereby provides the possibility to increase production and economic growth. The statistical data used are related to the period 1989 to 2011 and the estimation method is the ARDL method which evaluates the long-term relationship between the variables of economic growth, health expenditure and life expectancy. The results showed that life expectancy and health expenditure have a positive impact on the economic growth rate. Any increase in life expectancy and health expenditure leads to an increase in economic growth. The positive effect of life expectancy on GDP suggests that with the improvement of human development indicators and the performance of human resources through health indicators, GDP will have a greater ability to improve. Mediated increase in life expectancy is the product of social and economic development and advances in health technology. This reduces the mortality and is associated with a healthy environment. This in turn will improve the performance of individuals and accelerate economic growth and development. As long as people are healthy and well off in terms of nutrition, they contribute more and more to economic growth and economic activity. Increased life expectancy has a direct impact on labor productivity which in turn causes people to have a greater ability to achieve economic opportunities. Life expectancy refers to an individual's expectation of survival at birth. This index is affected by health, quality of life, health facilities, access to minimum sustenance, lack of anxiety, peace, and a secure economic and social life. In other words, long-term health reduces vulnerability to disease and sudden death. The results of the present study are consistent with the results of empirical studies carried out by researchers such as Wang (2011), Barrosala (1995), Rivera and Currais (2004), Bukhari and Butt (2007) and San Kahn Mee (2012). On the other hand, the results are alsi consistent with studies conducted by Iranian researchers such as Hadian et al. (2006), Beheshti and Sojoodi (2007), Ghanbari (2008), and Mojtahed and Javadipour (2003). According to these findings, we offer the following recommendations:

1. Considering the positive effect of government health expenditure on economic growth in Iran, it is recommended that the government increase funding for the health sector in order to improve health care services without increasing the governmental interventions and increase economic growth.
2. It is recommended that the government allocate part of health expenditure to public awareness, the promotion of health and the development of non-governmental organizations (NGO's) working in the field to improve public health.

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