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The effect of health expenditure on economic growth in Iran

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In this paper, equivalence relation and long term of five variables gross domestic product growth rate, the ratio of health expenditure to GDP, the ratio of investment to GDP, population growth, growth rate of graduates and also their influences on each other in Iran from 1973-2008 were analyzed. For this purpose vector autoregressive model (VAR) was used. First, stability of variables was examined by dickey-fuller test. Next, analysis of Johnson test was done for considering the convergence among five variables. The results of this research show that variables of the ratio of health expenditure to GDP, the ratio of investment to GDP and growth rate of graduates have positive effect on growth rate. Also variable of population growth has a negative effect on growth rate.

Key words: Population growth, health expenditure, gross domestic production growth rate, vector autoregressive model (VAR).

INTRODUCTION

Public expenditure on health refers to expenditure on health care incurred by public funds. Public funds are state, regional and local government bodies and social security schemes. Public capital formation on health includes publicly-financed investment in health facilities plus capital transferred to the private sector for hospital construction and equipment.

Health expenditure includes sum of public and private health spending; it includes fund needed for health services (treatment and prevention, food and emergency assistance predicted) but does not include the cost of providing health services infrastructure such as water and sewage networks.

It is said that the main duct that influences health and economic growth is due to the health effects on labor productivity; also evidence shows that we have better healthif the stability of other conditions leads to fewer resources which will be spent on medical expenses in the future. Thus some resources that could be spent on medical expenses will be used for other purposes.

Health expenditure has been used in many articles.

Wang (2011), in his article titled, 'Health care expenditure and economic growth: Quantile panel-type analysis' used international total health care expenditure data of 31 countries from 1986 to 2007 for exploring the causality between an increase in health care expenditure and economic growth. The empirical procedure is divided in two parts. The first is the panel regression analysis and the second is the Quantile regression analysis. The estimation of the panel regression reveals that, expenditure growth will stimulate economic growth; however, economic growth will reduce expenditure growth. With regard to the estimation of quantile regression, when economic growth is quantile, in countries with low level of growth, the influence of expenditure growth on economic growth is different. In countries with medium and high levels of economic growth, the influence of expenditure growth on economic growth is positive; when health care expenditure growth is quantile, the influence of economic growth on

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expenditure growth is more different.

Baltagi and moscone (2010), in their article titled 'Health care expenditure and income in the OECD reconsidered: Evidence from panel data' reconsidered the long-run economic relationship between health care expenditure and income using a panel of 20 OECD countries observed over the period 1971–2004. In particular, the paper examined the non-stationary and co integration properties between health care spending and income. This is done in a panel data context controlling both cross-section dependence and unobserved heterogeneity. Cross-section dependence is modeled through a common factor model and through spatial dependence. Heterogeneity is handled through fixed effects in a panel homogeneous model and through a panel heterogeneous model. Our findings suggest that health care is a necessity rather than a luxury, with elasticity much smaller than that estimated in previous studies.

Fanti and Gori (2011), in their article titled 'Public health spending, old-age productivity and economic growth: Chaotic cycles under perfect foresight' analyzed the dynamics of a double Cobb–Douglas economy with overlapping generations and public health investments that affect the supply of efficient labor of the old-aged. It is shown that the positive steady state of the economy is unique. Moreover, they provided necessary and sufficient conditions for the emergence of endogenous deterministic complex cycles when individuals are perfectly foresighted. Interestingly, (i) the equilibrium dynamics shows rather complicated phenomena such as a multiplicity of bubbling depending on the size of the public health system, and (ii) the higher the degree of thriftiness, the likely an economy is exposed to endogenous fluctuations because of the need to save when young to support consumption when old is reduced. Hartwing (2009), in his article titled, 'is health capital formation good for long-term economic growth? – Panel Granger-causality evidence for OECD countries' revisited the question whether health capital formation stimulates GDP growth in rich countries applying a new empirical methodology: the panel Granger-causality framework. The results do not lend support to the view that health capital formation fosters long-term economic growth in the OECD area.

Wu et al. (2010), in their article titled 'The impact of government expenditure on economic growth: How sensitive to the level of development?' re-examined the causal relationship between government expenditure and economic growth by conducting the panel Granger causality test is recently developed by Hurlin (2004) and Hurlin (2005); they utilized a richer panel data set which includes 182 countries that cover the period from 1950 to 2004. Their empirical results strongly supported both Wagner's law and the hypothesis that government spending is helpful to economic growth regardless of how they measured the government size and economic growth. When the countries are disaggregated by income levels and the degree of corruption, their results also confirmed the bi-directional causality between government activities and economic growth for the different subsamples of countries, with the exception of the low-income countries. It is suggested that the distinct feature of the low-income countries is likely owing to their inefficient governments and inferior institutions.

Moscone and Tosetti (2009), in their article titled 'Testing for error cross section independence with an application to US health expenditure' considered the problem of testing for error cross section independence in a panel where statistical units may be subject to unobserved common effects, spatial spill averment or both. They reviewed a number of diagnostics that are used for testing for error cross section independence in panels, including tests based on spacing and spatial statistics. They then argued that common use of spatial statistics might give misleading results when cross section correlation arises from common effects which are not taken into account. Hence, they studied the properties of spatial statistics applied to residuals obtained from an augmented regression, where common factors have been approximated by principal components (Bai, 2009). Small sample properties of their testing strategy were investigated in a Monte Carlo study. Their results showed that spatial tests applied to de-factored residuals detect well the presence of spatial correlation in the data. The paper concluded with a small empirical exercised on US health expenditure.

Narayan et al. (2010), in their article titled, 'Investigating the relationship between health and economic growth: Empirical evidence from a panel of 5 Asian countries' investigated the relationship between health and economic growth by including investment, exports, imports, and research and development (R and D), for 5 Asian countries using panel unit root, panel co integration with structural breaks and panel long-run estimator for the period 1974–2007. They model this relationship within the production function framework, and unravel two important results. First, they found that in all four variants of the growth model, variables share a long-run relationship; that is, they are co integrated. Second, they found that in the long-run, while health, investment, exports, EDRD (the interaction term between education and R and D), and R and D have contributed positively to economic growth, imports have had a statistically significant negative effect while education has had an insignificant effect. They drawn important policy implications from these findings

Chou (2007), in his article titled 'Explaining China's regional health expenditures using LM-type unit root tests' investigated the relationship among health care expenditure, income, and other factors that are not related to income for China with pooled cross-section and time series data. To study the stationary property of these variables, he used panel Lagrange Multiplier (LM) unit

root tests that allow for structural changes. To perform the LM unit root tests, he employed finite-sample critical values derived through the bootstrap method, instead of relying on the critical values from the asymptotic normal distribution. An important finding based on the estimated panel co integrated regressions is that the government budget deficits have a significant long-run impact on China's health care expenditure. This provided supportive evidence on the differences between rich and poor areas in China's health care financing policy, and the substantial disparities in health service coverage in China. Kuhn et al. (2009), in their article titled ‘‘the public health costs of job losses’’ studied the short-run effect of involuntary job loss on comprehensive measures of public health costs. They focused on job loss induced by plant closure; thereby addressing the reverse causality problem as job displacements due to plant closure are unlikely caused by workers’ health status, but potentially has important effects on individual workers’ health and associated public health costs. Their empirical analysis is based on a rich data set from Austria providing comprehensive information on various types of health care costs and day-by-day work history at the individual level. their central findings are (i) overall expenditures on medical treatments are not strongly affected by job displacement; (ii) job loss significantly increases expenditures for antidepressants and related drugs, as well as for hospitalizations due to mental health problems for men (but not for women); although the effects are economically small; and (iii) sickness benefits strongly increased due to job loss.

Kippersluis et al. (2009), in their article, ‘Health and income across the life cycle and generations in Europe’ expressed that an age-cohort decomposition applied to panel data identifies how the mean, overall inequality and income-related inequality of self-assessed health evolve over the life cycle and differ across generations in 11 EU countries. They declared that there is a moderate and steady decline in mean health until the age of 70 or so and a steep acceleration in the rate of deterioration thereafter. In Southern Europe and Ireland, where development has been most rapid, the average health of generations born in more recent decades is significantly better than that of older generations. This is not observed in the Northern European countries. In almost all countries, health is more dispersed among older generations indicating that Europe has experienced a reduction in overall health inequality over time. Although there is no consistent evidence that health inequality increases as a given cohort ages, this is true in the three largest countries—UK, France and Germany. The former two countries and the Netherlands, at least for males, the income gradient in health peaks around retirement age, as in the US. In most European countries, unlike the US, there is no evidence that income-related health inequality is greater among younger than older generations.

The rest of the paper is organized in four main sections: Section 1 analyses previous studies. Section 2 describes the data and the econometric methodology. Section 3 discusses the results that emerge from the estimations. And the conclusions of this paper are presented in section 4.

DATA AND METHODOLOGY

We use the data from 1973 to 2008 in Iran. We found them in Central Bank of Iran. One vector autoregressive (VAR) model which possess k as exogenous variable was used. And p as time`s inhibition for each variable, in shape matrix is shown as follows:

$$Y_t = A_t Y_{t-1} + A_2 Y_{t-2} + \cdots + A_p Y_{t-p} + U_t \approx IN(0, \sum)$$

In this relation, Y_t and its lags, k×1 vectors are related to models variables. A_i , i= 1, 2,…, p are model`s coefficients for k×k matrix. And $U_t$, k×1 vector is related to terms of model`s error. Now for linking short term behavior of Y_t to long term balance values, we can bring above relation as vector error correction model as follows:

$$\Delta Y_t = \beta_t \Delta Y_{t-1} + \beta_2 \Delta Y_{t-2} + \cdots + \beta_{p-1} \Delta Y_{t-p-1} + \prod Y_{t-p} + U_t$$

Where:

$$B_i = -(I - A_1 - A_2 - \cdots - A_p) \quad i=1, 2,\ldots, p-1$$
$$\prod = -(I - A_1 - A_2 - \cdots - A_p)$$

Matrix π contains information of long term balance variables. We follow the Johansen approach in determining long-run relationships. Patterson (2000) and Doornik and Hendry (2001) provide a full treatment of the issues involved in this method. The first step is to estimate the VAR in levels with an appropriate lag structure. The next stage involves determining the co integrating rank, that is, the number of long-run equilibrium relationships or co integration vectors among the variables. Finally, to allow a reasonable interpretation of the results, co integration vectors are identified (Abouie and Safdari, 2011).

Theoretical principles

The model which is used for investigating the effect of health expenditure on economic growth in Iran is inspired from the propounded model in Bartolini and Labiri’s paper (2006).
This model is defined as follows:

$$DGDP = \beta_1 + \beta_2 HE + \beta_3 INV + \beta_4 DPOP + \beta_5 DSTUDENT$$

Where*:*

DGDP: Gross domestic product growth rate
HE: The ratio of health expenditure to GDP
INV: The ratio of investment to GDP
DPOP: Population growth
DSTUDENT: Growth rate of graduates

FINDINGS AND DISCUSSION

We use the above formulation to estimate a VAR model

Table 1. Variable definitions and descriptions.

Variable	Description
DGDP	gross domestic product growth rate
HE	the ratio of health expenditure to GDP
INV	the ratio of investment to GDP
DPOP	population growth
DSTUDENT	Growth rate of graduates

Table 2. ADF tests for unit roots.

Variable	ADF	Critical value			Lag
		1%	5%	10%	
DGDP	-3.53	-3.57	-2.93	-2.60	0
HE	-4.67	-3.61	-2.94	-2.61	0
DINV	-5.99	3.57	-2.93	-2.61	0
DDPOP	-6.14	3.61	-2.94	-2.61	0
DDSTUDENT	-12.01	3.61	-2.93	-2.61	0

Table 3. Determination of magnitude of lag of VAR model.

Schwarz information	Akaike information	Lag
-14.84	-15.06	0
-16.49	-17.80	1
-17.40*	-19.79*	2

containing five variables (Table 1).

At the time of accumulation analysis, statistical properties of variables are very important. In fact, the accumulation method tests with theory the compatibility among statistical properties of the model's variables. Economic variables are generally non stationary and they are a random process. Linear combination of non stationary series in general is a non stationary series and closely associated with economic theory. Because economic theory guarantees stagnation of combination of economic variables, in this study Dickey Fuller's generalized Test for investigation of variables stationary is used. The results of the test for the variables in levels are presented in Table 2.

The results reported in Table 2 show that variables DGDP and HE are I (0) and the variables INV, DPOP, DSTUDENT are I (1).

After investigation of persistent of variables, one of the important stages in evaluation of vector regression model is choosing rank of pattern.

For choosing optimum rank of pattern, we can use criterion of Akaike or Schwarz. The most lag which is given in model is 2, and considering Table 3, the least quantity of Schwarz, Akaike statistic is prepared in second lag; we can indicate that the optimum lag of VAR model is equal to 2.

Table 4. Test statistics for co integrating rank (max tests).

Null	alt	Critical value		Probe
r=0	r≥1	33.87	87.51	0.0000
r≤1	r≥2	27.58	27.51	0.0511
r≤2	r≥3	21.13	18.97	0.0976
r≤3	r≥4	14.26	7.45	0.4377
r≤4	r≥5	3.84	0.21	0.6463

In this article we follow vectors and accumulated vector among variables of gross domestic product growth rate, the ratio of health expenditure to GDP, the ratio of investment to GDP, population growth, growth rate of graduates by the use of Johansson's method. In Johnson's method after doing necessary calculations for studding existence of convergence we use two criteria λ_{max} λ_{trace} consisting of and .

If existence of convergence among variable be verified, we can say that balance and long term relation among variable is established.

Results which are concluded from effect's examination and examination of maximum specific values for determination of accumulated vectors among model's variables are presented in Tables 4 and 5.

Results of maximum of specific values for determination magnitude of accumulated vector are reported in Table 4.

The magnitudes of vectors which are prepared by statistic of examination effect matrix are equal to 2 vector and magnitudes of vectors which are prepared statistic of maximum specific values are equal to 1, considering that examination of maximum specific values is stronger than examination of effected matrix. Therefore, for determination of magnitude of accumulated vector, examination of maximum specific values is used; considering results of above tables in level of probability of 90%, magnitude of long term relations among variables compatible pattern with economic theory is equal to (r=1)1.

In Table 5, Numbers in parentheses are statistic of accounting t. estimated coefficients of all variables in a meaning full level, 5 percent are significant from statistical aspect.

Considering prepared results within investigated period, variables of the ratio of health expenditure to GDP, the ratio of investment to GDP and growth rate of graduates had positive effect on growth rate and variable of population growth had a negative effect on growth rate.

Table 5. Test statistics for co integrating rank (Trace tests).

Null	alt	Critical value		Probe
r=0	r≥1	69.82	141.66	0.0000
r≤1	r≥2	47.86	54.14	0.0114
r≤2	r≥3	29.79	26.63	0.1109
r≤3	r≥4	15.49	7.56	0.5027
r≤4	r≥5	3.84	0.21	0.6463

Table 6. Co integrating vectors.

Variables	Vector 1
DGDP	1.00
HE	-3.72(-15.77)
DINV	-0.42(-0.89)
DDPOP	6.32(1.93)
DDSTUDENT	-0.98(-1.91)
C	23.90

According to results, with an increase of one percent in the ratio of health expenditure to GDP, the ratio of investment to GDP and growth rate of graduates will increase by 3.72, 0.42 and 0.98% and with an increase of one percent in population growth rate in order, growth rate will decrease by 6.32%.

Conclusion

Generally, in this article connectivity between health expenditure and economic growth in Iran is investigated. In this article, first we presented a model and estimated this model; in order to fit VAR pattern we used unit root test; then the magnitude of inhibition of VAR model was determined after using Johansson's test and existence of accumulated vectors long term relations among variables is shown.

After certainty about existence of long term relation, we estimated this relation and then interpreted these coefficients.

The results of this research show that variables of the ratio of health expenditure to GDP, the ratio of investment to GDP and growth rate of graduates have positive effect on growth rate. Also variable of population growth has a negative effect on growth rate.

In developing countries such as Iran health expenditure is very efficient and augmentation in health spending increases life expectancy; thus it leads to longer life of people and in this way economic growth increases.

Increase in graduates leads to increase in workforce performance and in this way it leads to an augmentation in labor productivity. In this way, increase in graduates has a positive effect on economic growth.

When in developing countries there is surplus labor force, fast increase of population causes an augmentation in unemployment, augmentation of consumption as a result of population growth, it hurts propensity to save or decrease total investment and finally causes a negative effect on production infrastructures; this problem, in its turn, hurts national products growth.

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