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Health Expenditure and Economic growth: An ARDL Approach for the Case of Iran

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Abstract: This paper examines the relationship between health expenditure and economic growth in Iran for the period 1970-2007, based on the autoregressive distributed lag (ARDL) approach. The study finds a cointegrating relationship among real GDP, health expenditure, capital stock, oil revenues and education, although among them, health spending explains just a small part of the economic growth. The results indicate that while health care expenditures are among the most important factors in the lowering of infant mortality, they do not make a significant marginal contribution to the economic growth in Iran. This findings call for pressing reforms and improved allocation of resources in health sector.

Keywords: *ARDL; Health Expenditure, Economic Growth, Iran Economy*

1. Introduction

There is now a large body of theoretical and empirical studies on the determinants of economic growth. Much of the early work emphasized that growth in labor and the stock of physical capital are the key determinants of economic growth. However, early empirical works were unable to explain a significant portion of the growth in GDP and GDP per capita, by the growth in labour and capital alone, and so attention turned to other factors-most human capital and institutions. Two key elements of human capital are education and health. There has been a growing concern to examine the impact of health on economic growth, brought about by the World Bank report (1993) on health and the seminal papers by Mushkin (1962) and Newhouse (1977). The role of health in influencing economic outcomes has been well understood at the micro level. Healthier workforces are likely to be able to work longer and more productive. Illness and disease curtail the working lives of people, thereby reducing their lifetime earnings. Better health also has a positive effect on the learning abilities of children, and leads to better educational achievements and increases the efficiency of human capital formation by individuals and households (Strauss and Thomas 1998; Schultz 1999).

Barro (1996) introduce health as a capital productive asset and an engine of economic growth. Grossman (1972), Bloom and Canning (2000) discuss healthy individuals are more efficient at absorbing knowledge and, in consequence, achieve higher productivity levels. Some Recent empirical work has sought to assess the association between health and aggregate economic performance and found that, given labour and capital, improvement in health status of population lead to a higher output (Barro and Sala-i-Martin 2004). Many empirical studies investigating the relationship between the health care expenditure and income maintain that health is a capital and hence investment on health is a prominent source for income growth (e.g., Hansen and King, 1996; Clemente et al, 2004).

In this paper we examine the short- and long-run relationships between health expenditure (as a measure of health) and real gross domestic production (GDP) for Iran over the period 1970 to 2008, using Autoregressive Distributed Lag (ARDL) approach to cointegration and error correction models (ECM) suggested by Pesaran et al.(2001). Whilst other single-equation cointegration techniques apply just under the restrictive assumption that all the model's variables are integrated of order 1, the ARDL approach based on bounds allows testing for cointegration when it is not known with certainty whether the regressors are purely I(0), purely I(I) or mutually cointegrated. Given the uncertainty concerning the time series properties of the variables, we consider this methodology as the most appropriate one in this context. The rest of the paper is organized as follows. Section 2 reviews the literature. Section 3 describes data sources and the empirical methodology. Results are reported in Section 4, conclusions and policy prescriptions are offered in the final section.

2. Review of Literature

Grossman (1972) develops a model where health is seen as a capital good. He shows an increase in the quantity of health capital reduces the time of being sick. The model assumes people are born with initial endowments of health which depreciate with age and accumulate with investment in health. Among their principal findings, it is shown a good state of health allows a more effective performance in the job and study. Grossman also finds that the principal determinants of health capital and demand for health services are wages, age and education. Mankiw et al. (1992) developed the Solow model of growth by adding human capital, indicating this variable has a significant impact on economic growth. Barro (1996), develops a growth model including physical capital, education, health capital, and the quantity of hours worked. By obtaining first order conditions, he finds an increase in health indicators raises the incentives to invest in education and a raise in health capital decreases the rate of depreciation of health.

Strauss and Thomas (1998) review the empirical evidence of the relationship between health and productivity, establishing strong correlations between physical productivity and some health indicators such as nutrition or specific diseases. Likewise, Bloom and Canning (2000) indicates healthy populations tend to have higher productivity due to their greater physical and mental energy. Similarly, some empirical and historical studies have analyzed the relationship between health and economic growth. They establish an endogenous relationship between them and, at the same time, argue there are exogenous factors, which determine the health conditions of a person (Hamoudi and Sachs 1999). Bloom and Canning (2000) explain healthy people live more and have higher incentives to invest in their abilities since the present value of the human capital formation is higher. The higher education creates higher productivity and income.

In an empirical study, Bloom et al. (2001) following the Solow model with human capital, find that health capital is a significant variable for economic growth, although, key variables such as capital and schooling are not significant. Guest and McDonald (2001), using data for Australia, indicate that reduced fertility does not reduce living standards. They show that an immediate decrease in the total fertility rate has no effect on living standards. Even a reduction of total fertility to an extremely low level actually leads to an increase in the living standards. Astorga, Berges and Fitzgerald (2004) analyzed the impact of three indicators of the standard of living, including per capita income, life expectancy and literacy on the economic development of Latin America during the twentieth century. The found that the three indicators evolve positively in the period 1940-1980. Since 1980 they found that while average per capita income has generally remained steady, relative living standards have risen gradually as life expectancy in the region has converged with the USA level.

Many studies pointing out that health care expenditure must have positive effects on labor productivity, which is also frequently studied under the 'efficiency wage' hypothesis, see, For surveys, Barlow (1979), Srinivasan (1992), Behrman and Deolalikar (1988); for a growth theoretical work, Muysken et al. (2003); and for econometric evidence, Schultz and Tansel (1997); Lapez-Casasnovas, Rivera; Currais (2005); It also seems to be logical to expect that health care spending also has some explanatory power on GDP at levels and even on its growth rate, through the impact of health expenditure on human capital or education. This linkage was first pointed out by Mushkin (1962). It has been examined elaborately from different angles since then. For surveys, see Behrman and Deolalikar (1988) and Behrman (1996). For empirical studies, see, for example, Glewwe and Jacoby (1995), Glewwe et al. (2001), Miguel (2005), Alderman et al. (2006). One major problem in the empirical studies of the impact of health on economic growth is their use of an imperfect proxy variable of health such as life expectancy. Indeed, some economic analysis implying the significance of health as a determinant of economic growth, measure it as life expectancy, which does not include all the dimensions of health. Health should be measured with all its dimensions such as mortality, morbidity, disability and discomfort (Bloom and Canning, 2000). Life expectancy takes into account mortality, but it is not perfectly correlated with the rest of the health dimensions particularly life quality or the problems caused by the population aging. As a response to these problems, in this study we use health expenditure as a measure of health in the empirical analysis of the Solow growth model.

3. Data and Methodology

To allow for causality and dynamics and given that not all of our time-series are stationary to the same order (some are I(0) while others are I(1)), the cointegration technique suggested by Pesaran et al. (2001), the autoregressive distributed lag model (ARDL) procedure will be used. the approach can be implemented regardless of whether the variables are integrated of order (1) or (0) and can be applied to small finite samples. Based on empirical literature, theories of economic growth, and diagnostic tests, the long run relationship between economic growth and health expenditure can be specified as:

$$\ln RGDP_t = \beta_0 + \beta_1 \ln HEALTH_t + \beta_2 \ln K_t + \beta_3 \ln OILREV_t + \beta_4 SER_t + u_t \qquad (1)$$

Where RGDP is GDP per capita at constant price, Health is real health expenditure (including public and private ones), K is real capital stock, OILGDP is real oil revenues, SER is the secondary enrolment ratio and proxies for the quality of human capital. ε_t is an stationary error term. All variables except SER are expressed in natural logarithm (ln stands for logarithm). The main sources of variables are from the Central Bank of Iran (CBI) and Statistical Center of Iran (SCI). The time period of the study is over the years 1970 to 2008.

To examine long run relation among the series we implement ARDL bounds testing approach to cointegration developed by Pesaran et al., (2001). The bounds testing approach has several advantages: it applies irrespective of the order of integration for independent variables, I(0) or I(1); is better suited to small samples; and a dynamic error correction model (ECM) can be derived from the ARDL model through a simple linear reparametrization. The version of error correction model of ARDL approach is given by:

$$\begin{aligned}\Delta \ln RGDP_t &= \alpha_0 + \sum_{i=1}^{p} \phi_i \Delta \ln RGDP_{t-i} + \sum_{i=0}^{p} \theta_i \Delta \ln HEALTH_{t-i} + \sum_{i=0}^{p} \lambda_i \Delta \ln K_{t-i} \\ &+ \sum_{i=0}^{p} \varphi_i \Delta \ln OILREV_{t-i} + \sum_{i=1}^{p} \gamma_i \Delta \ln SER_{t-i} + \delta_1 \ln RGDP_{t-1} + \delta_2 \ln HEALTH_{t-1} \\ &+ \delta_3 \ln K_{t-1} + \delta_4 \ln OILREV_{t-1} + \delta_5 SER_{t-i} + \varepsilon_t \qquad (2)\end{aligned}$$

Where $\phi, \theta, \lambda, \varphi$ _ *and* γ refer to short run and δ_1 to δ_5 to long run parameters. The null hypothesis of no cointegration is H_0: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$ against the alternative hypothesis H_1: $\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq 0$. The rejection of the null based on the F-statistic suggests cointegrating relationship. The critical bounds have been tabulated by Pesaran et al. (2001). The upper critical bound (UCB) is based on the assumption that all series are I(1). The lower bounds (LCB) applies if the series are I(0). If UCB is lower than the calculated F-statistic, the null of cointegration is sustained. If the F-statistic is less than the LCB then there is no cointegration. The decision about cointegration will be inconclusive if the F-statistic lies between UCB and LCB. In such situation, we will have to rely on the lagged error correction term to investigate long run relationship. The orders of the lags in the specification (2 are selected by the Schwarz Bayesian criterion (SBC). For annual data, Pesaran and Shin (1999) recommended choosing a maximum of 2 lags. From this, the lag length that minimizes SBC is selected.

If a long run relationship exists, the ARDL representation of equation (1) is formulated as follows:

$$\begin{aligned}\ln RGDP_t &= \alpha_1 + \sum_{i=1}^{p+1} \phi_{1i} \ln RGDP_{t-i} + \sum_{i=0}^{p+1} \rho_{1i} \ln HEALTH_{t-i} + \sum_{i=0}^{p+1} \theta_{1i} \ln K_{t-i} + \sum_{i=0}^{p+1} \lambda_{1i} \ln OILREV_{t-i} \\ &+ \sum_{i=1}^{p+1} \varphi_i SER_{t-i} + \varepsilon_t \qquad (3)\end{aligned}$$

The ARDL method estimate $(p+1)^k$. number of regressions in order to obtain the optimal lags for each variable, where p+1 is the maximum number of lags to be used and k is the number of variables in the equation (Shrestha and Chowdhury, 2005). The model is selected based on the Schwartz-Bayesian Criterion (SBC) that use the smallest possible lag length and is therefore described as the parsimonious model.

The ARDL specification of short run dynamics is investigated using ECM version of ARDL model of the following form:

$$\Delta \ln RGDP_t = \alpha_2 + \sum_{i=1}^{p} \phi_{2i} \Delta \ln RGDP_{t-i} + \sum_{i=1}^{p} \rho_{2i} \Delta \ln HEALTH_{t-i} + \sum_{i=0}^{p} \theta_{2i} \Delta \ln K_{t-i} + \sum_{i=0}^{p} \lambda_{2i} \Delta \ln OILREV_{t-i} + \sum_{i=0}^{p} \varphi_{2i} \Delta SER_{t-i} + \psi ECM_{t-1} + \varepsilon_t \quad (4)$$

The lagged residual term (ECM) in equation 4 shows the disequilibrium in long renrelationship (ut in equation 1). The goodness of fit for ARDL model is checked through stability tests such as cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ).

4. Empirical Results

Pesaran et al. (2001) critical values are based on the assumption that the variables are integrated of order I(0) or I(1). Unit root tests insure that none of the series is integrated of I(2) or higher. Both the augmented Dickey–Fuller and Phillips–Perron unit-root tests was employed for that purpose and the results are summarized in Tables 1.Test for stationarity shows that all variables are integrated of order 1 or I(1) and thus stationary in difference.

Table 1: Unit Root Test

	ADF test statistic (with trend and intercept)		**PP test statistic (with trend and intercept)**	
Variables	**Level**	**First Difference**	**Level**	**First Difference**
ln RGDP	-1.23	-4.09**	-1.11	-3.89**
ln HEALH	-2.01	-4.34**	-1.44	-5.89***
ln K	-2.14	-3.99**	-1.73	-3.12**
ln OILREV	-1.30	-7.98***	-1.64	-11.91***
SER	-2.10	-5.65***	-1.78	-4.65***

Notes: ** and *** denote significancy at 5% 1% levels respectively.
The optimal lag structure is determined by SBC.

To investigate the presence of long-run relationships among the variables, testing of the bound under Pesaran, et al. (2001) procedure is used. Given a relatively small sample size (39) and the use of annual data, a lag length of 2 is used in the bounds test. The results of the bound test are given in Table 2. The critical values used in this paper are extracted from Narayan (2005). The calculated F-statistics is 6.98 while upper critical bound at significance level 1% is 5.642. This implies that there is long run relationship among GDP, health expenditure, oil revenues, capital stock and education over the period of 1970-2007 in Iran.

Table 2: Bounds Test Results

			Bound Critical values	
F-statistics	**Lag**	**Significance Level**	I(0)	I(1)
6.98	2	1%	4.324	5.642
		5%	3.116	4.094
		10%	2.596	3.474

The next stage of the procedure would be to estimate the coefficients of the long-run relations and the associated error correction model (ECM) using the ARDL approach. The optimal lags on variables were selected by the Schwartz Bayesian Criterion (SBC) and turned out to be the ARDL (1, 0, 1, 1, 1). The long-run estimated coefficients are shown in the Table 3. One percent rise in health expenditure is expected to increase

GDP per capita by just 0.06 percent. Although health expenditure appears with the expected positive sign, the size of coefficient is small and barely significant. The capital stock level and the extent of oil revenues have been the main ingredients for economic growth. The quality of human capital is also reported to have been an important factor.

Table 3. Estimated long run coefficients based on ARDL approach

Regressor	Coefficient	p-value
Constant	3.22	0.00
ln HEALH	0.06	0.08
ln K	0.44	0.00
ln OILREV	0.12	0.02
SER	0.21	0.07

The results of error correction model, reported in Table 4. The short run coefficient are less than the long run ones. The results suggest that the short run impact of health expenditure on the economic growth is small and insignificant. The coefficients for the other explanatory variables except education have the expected sign and significance. Moreover, the coefficient of the ECM is negative and highly significant at 1% level. This corroborates the existence of a stable long-run relationship and points to a long-run co-integration relationship among variables. The ECM represents the speed of adjustment to restore equilibrium in the dynamic model following a disturbance. The coefficient of the ECM is around -0.53, implying that a deviation from the long-run equilibrium is corrected by about 50% after each year. The diagnostic tests e.g., Lagrange Multiplier (LM) for serial correlation, ARCH effects, normality of residual terms, white heteroskedasticity and Ramsy RESET for functional form reported in Table 5 suggest that the short-run model passes all diagnostic tests. We find no evidence of serial correlation, autoregressive conditional heteroskedasticity and white heteroskedasticity. The residual terms are normally distributed and the functional form of the model appears well specified.

Table 4. Error correction representation for the selected ARDL model

Regressor	Coefficient	p-value
Δln HEALH	0.02	0.12
Δln K	0.24	0.00
Δln OILREV	0.11	0.07
ΔSER	0.07	0.14
ECM	-0.53	0.00

Serial Correlation LM = 0.56 (0.67)
ARCH Test = 0.17 (0.86)
Normality Test = 1.25(0.48)
Heteroscedisticity Test = 0.96 (0.59)
Ramsey RESET Test = 1.98 (0.26)
Notes: The probability values for the diagnostic tests are given in parenthesis

The plots of the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) stability tests as shown respectively in figures 1 and 2 indicate that all the coefficients of estimated model are stable over the study period as they fall within the critical bounds.

Figure 1: CUSUM Plots for Stability Tests

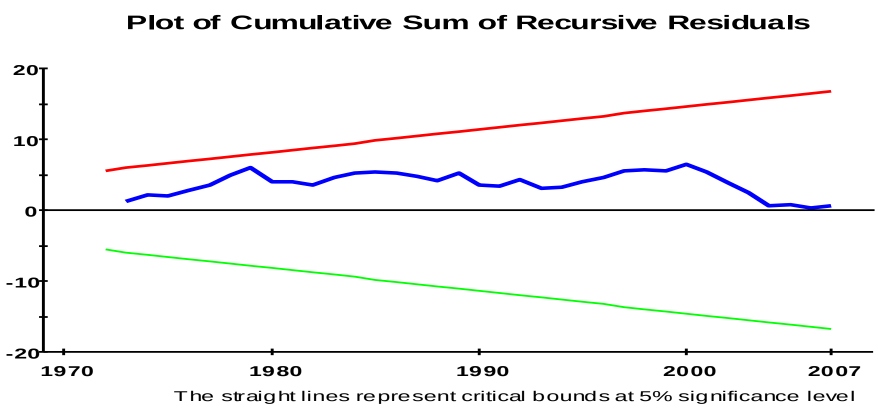
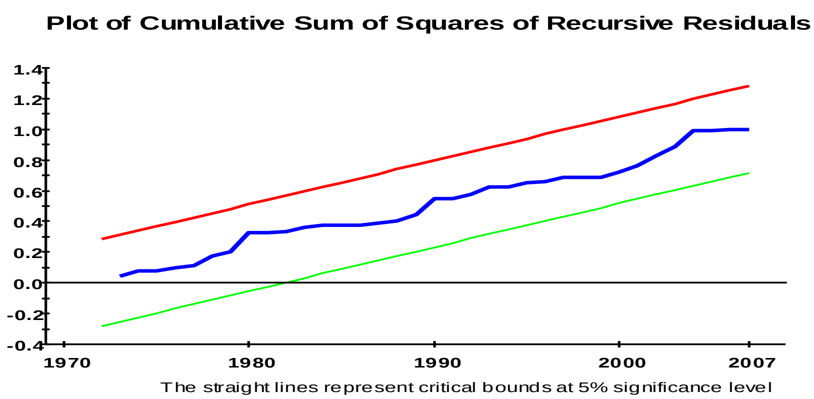


Figure 1: CUSUMSQ Plots for Stability Tests



5. Conclusion

The effect of economic growth on health is well known: rising income per capita leads to increasing spending on health care and improved health position. But the reverse link from improved health to economic growth has recently drawn growing attention. The natural mechanism that relates health position to economic performance is human capital theory. Health stock is a component of an individual's human capital. Poor health reduces both the quality and quantity of labor supply. It also results in low levels of human capital accumulation. Improvements in health have both level and growth rate effects on income per capita.

The paper has examined the relationship between health expenditure and economic growth in Iran over the period 1970-2007. The ARDL and bounds testing approach to cointegration was adopted to estimate the long run relationship and short run dynamic parameters of the model. The test suggests that there exists a cointegrating relationship among GDP, health expenditure, capital stock, oil revenues and the secondary enrolment ratio (as a proxy of education). The results suggest that the impact of health expenditure on output is trivial in size and statistically insignificant. In other words, health expenditure has not been contributing to the output level of the economy in both short and long run. This finding can be attributed to low productivity of inputs and inefficiency of investments and facilities in health sector.

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