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Influence of Health Capital on Economic Growth: Evidence from Saudi Arabia

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Abstract
This study is aimed to examine the influence of health indicators on economic growth in Saudi Arabia using time series, for the period 1990 to 2018. The study uses the bound testing Autoregressive Distributed Lag (ARDL) cointegration to estimate the short-run and long-run relationships among the variables. It was observed that the health indicators, namely, health expenditure and life expectancy at birth have significant positive influence on economic growth in the long-run. The results also revealed that there was an inverse long-run relationship between life expectancy at birth and economic growth, however, it was statistically insignificant. While the explanatory variables (expenditure on health) maintain their hypothesized values in the long-run, as expected, the variable (life expectancy at birth) does not. The theoretical model also passed the diagnostic checks for best fit. In view of these findings, the study recommends Saudi authorities to benefit from investment in health. The government should enhance development of health sector and support a conducive environment to improve the health sector.
***Key words**: health capital, economic growth, Saudi Arabia, ARDL.*
JEL Classification: I 15, I 25

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I. Introduction

Health is taken as one of the most significant investments in human capital. A healthy people are an engine for economic development of any economy. Thus, all countries have given due concern to allocate sufficient resources to provide adequate health services. Since there are very few studies on the effect of health capital on Saudi economy, this paper provides useful insights into the influence of health indicators, such as health expenditure and life expectancy at birth on Saudi's economic growth. This paper has covered the period 1990 – 2018, which ensures suitable data and information for a meaningful long-run analysis.

The aim of this paper is to examine the long-run relationship between health indicators (expenditure on health and life expectancy at birth) and economic growth, by using ARDL. Such an analysis will be helpful in determining the magnitude of influence of health policies on economic growth. The paper intends to examine link between health indicators (expenditure on health and life expectancy at birth) and economic growth in Saudi Arabia. Hypotheses that health indicators influence economic growth in the long-run would be tested.

Results and outcomes of this paper are intended to provide latest information and analysis on the subject that is necessary for decision makers for taking the right and effective decisions. Results will also be helpful for future research and studies.

The structure of the paper is as follows. Section 1 provides an introduction. Section 2 reviews the theoretical framework and relevant literature. Section 3 presents data collection and analysis methods. Results and discussions are presented in Section. The last section consists of conclusion, recommendations, and policy implications.

A brief review on theoretical framework on the subject is provided on the effects of community health on economic growth. This review has two parts: theory and empirical. In the first part, the theoretical framework for analyzing the impact of health on economic growth has been explained, while in the second part, empirical evidence for the same has been presented. Generally, health capital and economic growth are likely to be interlinked. A nation that enjoys advanced and healthy human capital accelerates in economic growth. Also, economic growth can contribute to higher national and personal incomes, which, in turn, boosts the resources available for health advancement.

There has been a growing interest among researchers to study in the relation between health capital and economic growth, since improvements in health have a positive influence on the quality of life, peace, and security in the society. Qureshi and Mohyuddin, (2006) investigated the impact of health status indices on GDP by using cross-sectional data from eighteen developing countries. They observed that health status indices do not have any significant impact on economic development.

Recent studies on economic growth reveal that health is one of the major components of economic growth (Barro, 1991, 1992; Lucas, 1988; Van Leeuwen and Foldvari, 2008). Therefore, health capital has growing focus of academic inquiry on it. Health indicators (as measured by health expenditure and life expectancy at birth) are emerging focus areas in health economics and economic growth. Studies indicated that healthy people tend to be more dynamic and deliver higher productivity in their professional fields (Loeppke et al., 2007; World Bank, 1993).

Strauss and Thomas, (1998) have stated that health and incomes clearly have an effect on each other and are linked to many other factors. The most inspiring account originates from the work of Fogel, who mentioned that the rise in the number of calories available for work over the past 200 years must have had significant influence over the growth of per capita income of France and Great Britain. Robert Barro (1997) has also revealed I his study that life expectancy is correlated to the subsequent economic growth.

In conclusion, health is instrumental in enhancing the labor productivity, which, in turn, leads to enhanced economic growth.

II. Literature Review

The significance and impact of health expenditure and life expectancy at birth on economic growth have been well recognized and documented in economic theories. Those theories have highlighted the importance of health investments in raising productivity and improving economic growth in the long-run. Many studies suggest that there is a strong relationship between health indicators and economic growth. However, some studies have also indicated that while health capital has positive impact on increasing population rate, it has a negative effect on per capita income.

A study conducted by Acemoglu and Johnson (2007) on the impact of life expectancy at birth on economic using predicted mortality as a mechanism showed that that a 1% increase in life expectancy results in a 1.7–2 % increase in the population. However, life expectancy has a marginal effect on total GDP. Accordingly, there is no evidence that substantial increase in life expectancy improved income per capita. Ashraf et al. (2009) used a simulation model to study the impact of health developments on economic growth. They observed that the effects of health improvements on income per capita were considerably lower than those that are often cited by policy-makers.

Cervellati & Sunde (2011) tested the non-monotonic effect of life expectancy and income per capita using finite mixture models. Results from various empirical specifications and identification strategies revealed that the effect was non-monotonic, negative, and insignificant before the onset of demographic transition, but it is strongly positive after that.

Mehrara and Musai (2011) used ARDL approach to examine the relationship between health expenditure and economic growth in Iran during the period 1970-2007. Their findings indicated that healthcare expenditure does not significantly affect economic growth. The study also reveals a cointegrating relationship between real GDP and health expenditure. Also, health spending only minimally influences economic growth.

These studies suggest that an increase in health indicators does not result in economic growth, thereby indicating that advanced health services do not affect economic growth.

On the other hand, other recent studies reveal that human capital and health spending in particular, significantly contributes to economic growth. For example, Idowu, O. et al (2018) examined the long-term effects of health capital on economic growth in Singapore during the period 1980 to 2013. They used autoregressive distributed lag (ARDL)-ECM methodology and certain diagnostic and specification tests. Their results confirmed that health expenditure per capita had a positive effect on Singapore's economic growth in the long run. In addition, Granger causality estimation indicated that health expenditure per capita had a positive impact on GDP per capita.

Similarly, Akram et al. (2008), also used cointegration error correction and granger causality estimation to study the effects of various health indicators on economic growth in Pakistan during 1972-2006. They concluded that all the health indicators had a positive long-term impact on economic growth. Their short-term result however revealed that health indicators do not significantly influence per capita GDP.

Kurt (2015) used Feder-Ram model to analyze the effects of health expenditure on economic growth in Turkey during the period 2006-2013. The study revealed a significant positive impact of government health expenditure on economic development, while it indirectly had a substantial negative impact. The results also showed that the government's coefficient estimation for the health sector is more effective than that for the other sectors.

Similarly, Mehmood et al. (2014) used pooled mean group (PMG) to examine the effects of the health sector and high literacy rates on economic growth for 26 Asian countries for the period1990-2012. Their study showed a positive and significant relationship between education, healthcare expenditure, and economic growth. It also showed a significant long-run relationship among health expenditure, literacy rate, and income per capita,. This implies that both the indicators are statistically significant, and they positively affect per capita income.

Inuwa, N. et al (2012) tested the dynamic relationship between health expenditure and economic growth from 1980-2010 in Nigeria. The study used the ARDL Bounds testing procedure and Granger causality test. The results suggest that there is a long-run relationship between health expenditure and economic growth, indicating that there is causal relationship in at least one direction. However, it does not indicate the direction of causality. The Granger causality test indicates a strong bidirectional relationship between health expenditure and economic growth.

Frasholli and Hysa (2015) studied the influence of per capita health expenditure on GDP per capita, which is an indicator for economic growth. They performed regression analysis of data spanning a period of 2000-2011 and confirmed that there was a significant relationship between health expenditure and GDP.

Thus, it may be concluded that health indicators have a positive and significant influence on economic growth. This study aims to examine these research findings in the context of Saudi Arabia where considerable attention has been given to health services in recent years.

III. Research Methodology

This section discusses data and methodology used in estimating the empirical model as specified in equation (1). Data was obtained from secondary sources; mainly the Central Bank of Saudi (SAMA) annual reports. An ARDL approach is applied to time series data to estimate the bound test as well as the long-run and short-run relationships between (expenditure on health and life expectancy at birth) and economic growth. Following Pesaran et al. (2001) methodology, the empirical model on the relationship between human capital development and economic growth is specified as follows:

Y = βo + β1 X1 + β2 X2 + μt ……………..……………………………….................................. (1)

The variables specified in the model are defined as:

Y = Real Gross Domestic Product (proxy for economic growth) Dependent Variable

Independent Variables are:

X1 = expenditure on health

X2 = life expectancy at birth

The a priori expectations are β1and β2 > 0. This implies that all the dependent variables of the model are expected to have positive relationship in the long-run with economic growth.

Since the study uses time series data, we need to make sure that these series are stable data by applying the Augmented Dikey-Fuller Augmented (ADF) Test to the unit root. To test whether there is a long-term relationship between the variables, the Autoregressive Distributed Lag (ARDL) model proposed by Pearsen et al. (2001) will be used to verify the existence of a cointegration relationship between economic growth and education indicators in Saudi Arabia.

3.1 Steps to apply the ARDL model

3.1.1 The first step is the cointegration test within the UECM framework, which takes the following formula by assuming the relationship between (*GDP*$_t$🡐Y) the dependent variables (*EXHEA*$_t$🡐X1, and *LEXB*$_t$🡐X2 the independent variables:

$$\Delta Y_t = a_0 + \sum_{i=1}^{m} \beta_i \Delta Y_{t-1} + \sum_{i=0}^{n} \theta_i \Delta X_{t-1} + \lambda_1 Y_{t-1} + \lambda_2 X_{t-1} + \eta_t$$

Both λ_1 & λ_2 ~~indicate~~ coeffici~~ents~~ of (long-run relationships. While both β & θ reflect the coefficients of short-run relationship. Whereas, Δ denotes the first differences of the variables while each of the lags for the variables. Finally, η is the random error term has an arithmetic mean equal to zero, a constant variance and no serial correlation correlations between them.

3.1.2 The second step: the stage of verifying the existence of a long-term relationship between the variables using the bound-test according to the Pesaran et al (2001) procedure based on the F-test.

3.1.3 The third stage: getting the specifications of the ARDL model for short-term movements by building the following Error Correction Model, ECM:

$$\Delta Y_t = c + \sum_{i=1}^{p} \vartheta_i \Delta Y_{t-i} + \sum_{i=0}^{q} \delta_i \Delta X_{t-i} + \psi ECT_{t-1} + \nu_t$$

Where ECT_{t-1} represents the Error Correction Term and all the coefficients of the short-run equation are coefficients related to the short-run dynamics of the model's convergence to the equilibrium state. ψ indicates the error correction factor that measures the speed of adjustment with which the disequilibrium is adjusted in the short-term towards equilibrium in the long-term. It is assumed that ψ takes a negative value and is significant as a condition for accepting the model estimates in the short-run.

The maximum length of the slowest one is chosen in the (ARDL) model for annual data using the (Akaike) criterion (AIC) and by choosing the lowest value for the criteria the criteria will be used to determine the optimal lag periods for the ARDL level relationship model. To verify the fit of the ARDL autoregressive model, diagnostic tests (serial correlation and Heteroskedasticity) and stability by cumulative residuals (CUSUM.

IV. Results & Discussion

4.1 Unit Root Tests

Unit root test estimation is necessary before testing for the long-run cointegration. However, a unit root test using the standard Augmented-Dickey Fuller (ADF) (1979) test is required to determine the degree of stationarity and to ensure conformity. AIC is used for establishing the lag length. Table (1) presents the results for the ADF unit root tests. D(Y), D(X1) and D(X2), are considered to be I (1) stationary at the first difference. To conclude, the stationarity test results justify the use of the ARDL bound test developed by Pesaran et al. (2001).

Table (1)
Unit Root Tests using ADF Tests Statistics

Variables	Levels	1st Difference
Y	-0.180013	-4.236348*
X1	4.086409	-4.074227*
X2	4.291020	6.779195*

Note: * represents significance at 5% and 10% levels respectively.
Source: Author's Computation using EViews 11.0 Software

4.2 Autoregressive Distributed Lag (ARDL) Bound Test Result

The bound test enables testing of long-run dynamic relationship among the variables in ARDL modeling approach following Pesaran and Shin (1999) procedure. Table (2) reveals that F-statistics is 8.012686 which exceeds both the upper and lower bounds at1%, 2.5%, 5% and 10% critical values Hence the null hypotheses for no cointegration are rejected. This implies that there are long-run cointegration relationships amongst the variables. Therefore, we can proceed to ARDL Error Correction Model. Also, there is substantial evidence that there is a long-run relationship between health indicators and economic in Saudi Arabia.

Table (2)
ARDL bounds test for Co-integration Analysis

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: =1000	
F-statistic	8.012686	10%	2.63	3.35
k	2	5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5

Source: Author's Computation using EViews 11.0 Software

4.3 Long-run ARDL Relationships

After confirming that the ARDL bounds testing approach is the best fit in the study, the next step is to perform ARDL model testing, which examines the existence of a long-run relationship among the estimated variables. The result obtained from Table (3) show the estimate of the long-run dynamic relationship between (X1 and X2) and economic growth in Saudi Arabia. Given the established linkage among the constructs as shown from above, it can be deduced that a long-run relationship exists among the variables when regression is normalized in the variables are co-integrated in the model. The ARDL results indicate that there is a long-run cointegrating equation which implies that there is a long run relationship between the variables stated in the model specification above.

Table (3) shows that there is a positive long-run relationship between the expenditure on health and economic growth and the relationship is statistically significant at 5% level. The estimated coefficients of the long-run relationship indicate a very high and significant impact of health expenditure (X1) on economic growth. It was seen that a 1% increase in health expenditure results in approximately 34.84926% increase in economic growth, with all other parameters remaining same. These results are in line with the growth theories developed by Idowu, O. et al (2018), Lucas (1988) and Romer (1990) and Mankiw et al, (1992) which asserted that spending on health promotes human capital and enhances economic growth. These findings also support the earlier observations made by Mehmood et al, 2014, Onisanwa, 2014, and Kurt, 2015) that health capital in the form of health expenditure has a positive and statistically significant effect on economic growth.

The results revealed that there is a negative long-run relationship between life expectancy at birth and economic growth and the relationship is statistically insignificant. These results are also similar to the earlier studies conducted by Acemoglu and Johnson (2007) and Ashraf et al. (2009).

Table (3)
Estimated long run coefficients using the ARDL approach

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(X1)	34.84926	2.739685	12.72017	0.0000
D(X2)	-56134.04	75862.01	-0.739949	0.4763
C	4354619.	5505705.	0.790928	0.4473

Source: Author's Computation using EViews 11.0 Software

It is seen that the estimated coefficients of expenditure on health have the hypothesized sign. However, the variable (life expectancy at birth) does not have that sign. The long-run estimated equation (2) can be written as follows:

$$EC = D(Y) - (34.8493*D(X1) -56134.0386*D(X2) + 4354618.9958) \quad (2)$$

4.4 ARDL Short-run Analysis

The next step in the analysis is to model the short-term dynamics and the results of short-term coefficients. The error correction model (ECM) and short run analysis is presented in Table (4). It shows that in the short-run, (X1) and (X2) contribute significantly to economic growth. Notably, both (X1and X2) maintain their positive and negative signs on economic growth in short-run and in long-run.

The coefficient of the lagged error-correction term needs to be significant and show negative signs. Table (4) provides the short-run analysis under the Error Correction Terms (ECM). The ECM_ARDL (4,4,3) model results show that the error correction term or the restoring force ECt-1, is negative, as expected, and is significantly different from zero at 5% significance level. Therefore, there is an error correction mechanism: long-term imbalances between economic growth, expenditure on health and life expectancy at birth. In fact, this is the evidence of the co-integrating relationship between the variables of the model. In particular, the estimated ECt-1 value is -2.961083, implying that the adjustment of the long-run equilibrium in response to the imbalance caused by short-run shocks in the previous period is 269%.

The R-squared adjusted test shows that the two explanatory variables in the equation explain 64% of the systematic variations in the dependent variable that is explained by changes in the independent variables. This implies that the model has a very good fit.

Table (4)
ARDL Error Correction Regression Short-run Dynamic Analysis

Dependent Variable: D(DGDP)				
Selected Model: ARDL (4, 4, 3)				
Case 2: Restricted Constant and No Trend				
Sample: 1990 2018				
Included observations: 24				
ECM Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DY(-1))	2.171040	0.369592	5.874149	0.0002
D(Y(-2))	1.307178	0.313968	4.163408	0.0019
D(Y(-3))	1.056559	0.239007	4.420619	0.0013
D(X1)	33.69366	16.86952	1.997310	0.0737
D(DX1(-1))	-66.22692	21.89799	-3.024338	0.0128
D(DX1(-2))	-25.99883	16.64483	-1.561976	0.1494
D(DX1(-3))	-39.47652	12.39663	-3.184457	0.0097
D(DX2)	-1060640.	424750.0	-2.497091	0.0316
D(DX2(-1))	17310595	3187524.	0.000000	0.0000
D(X2(-2))	-16902518	3134378.	0.000000	0.0000

CointEq(-1)*	-2.961083	0.458733	-6.454918	0.0001
R-squared	0.795920	Sum squared resid		2.51E+11
Adjusted R-squared	0.638936	Log likelihood		-310.8829
S.E. of regression	138838.7	Durbin-Watson stat		2.481134

Source: Author's Computation using EViews 11.0 Software

4.5 Post Estimation Tests

4.5.1 Serial LM Test

The probability of the observed R- squared is more than 0.05, and is satisfactory, and so the null hypothesis of absence of serially correlated residuals (i.e. autocorrelation) is not rejected, as reflected in Table (5).

Table (5)
Breusch-Godfrey Serial Correlation LM Test

Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	1.072767	Prob. F (2,8)	0.3866
Obs*R-squared	5.075417	Prob. Chi-Square (2)	0.0790

Source: Author's Computation using EViews 11.0 Software

4.5.2 Heteroskedasticity Test: Breusch-Pagan-Godfrey

The probability of the observed R- squared is greater than 0.05, and is satisfactory, and so the null hypothesis of absence of Homoskedasticity is not rejected as shown in Table (6).

Table (6)
Heteroskedasticity Test: Breusch-Pagan-Godfrey

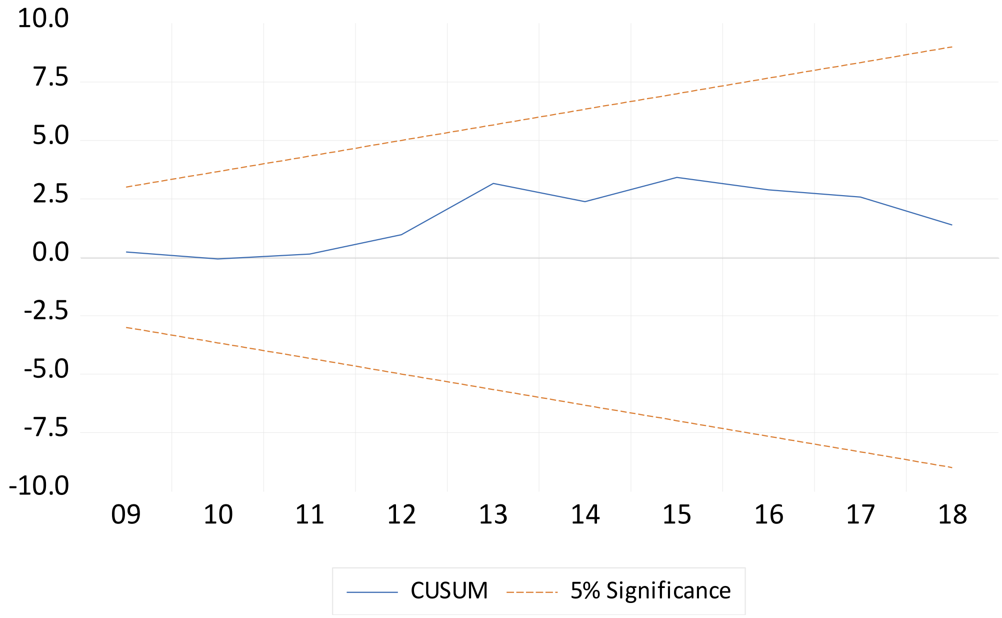
Null hypothesis: Homoskedasticity			
F-statistic	0.839223	Prob. F(13,10)	0.6238
Obs*R-squared	12.52218	Prob. Chi-Square(13)	0.4854
Scaled explained SS	5.491245	Prob. Chi-Square(13)	0.9627

Source: Author's Computation using EViews 11.0 Software

4.5.3 Stability Tests

The long-term coefficients stability is tested by the short-term dynamics. Once the ECM model is estimated, testing the cumulative sum of the recursive residuals (CUSUM) is applied to assess the stability of the parameters in the long-run. The graphical representation, CUSUM, Figure (1) plot of the recursive residuals implies that none of the parameters falls outside of the critical values at 95% confidence level. This eliminates any inconsistencies in parameter estimates.

Figure (1)



Source: Author's Computation using EViews 11.0 Software

These diagnostic tests confirm the validity of the model and as such, the model can therefore be relied upon for analysis and policy formulation by relevant government authorities and state planners.

IV. Conclusion and recommendations

The study examined the relationship between health indicators (health expenditure and life expectancy at birth) and economic growth in Saudi Arabia during the period of (1990 – 2018). The study employed health expenditure and life expectancy at birth as components of health which turns out to be great predictors of economic growth. The findings show that expenditure on health is having statistically significant positive effect on economic growth in the long-run. While the life expectancy at birth is having an insignificant negative effect on economic growth in the long-run. It is established that the explanatory variable (health expenditure) leads to improvement in short-run and long-run economic growth. These findings indicate that if expenditure on health services is increased, then it could have a significant positive impact on human productivity and thereby enhancing Saudi's economic growth. More resources have to be allocated to capital expenditures on health to improve the sector. The Government policies in health should be given priority. Moreover, government has to create enabling environment through macroeconomic stability and financial commitment that will encourage improved human capital development in health. Thus, policy makers in the government are encouraged to allocate the required fund to improve basic health services. The paper calls for future research and studies in the field.

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