The Effect of Health Indicator on Economic Growth of Iran

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Abstract

The most important factors in the economic production subordinating, are work force and human capital. These factors and their functions depend on the role of hygiene, individual health and related index in improving the economy of a country. Therefore, one economic growth stimulating factor can be evaluated by using health index thorough effecting labor and human capital. Accordingly, this paper tries to study the effect of health index on economic growth during 1975 to 2012 and it does this by self-explanatory approach with distributed lag (ARDL) and the estimated long-term and short-term effects of these measures on economic growth. Results show the fact that health index related variables like fertility rate, life expectancy will bring economic index and capital growth increasing and it leads to more economic growth. These results are available in long-term and short-term period.

Keywords: health index, economic growth, ARDL model, life expectancy

1. Introduction

In traditional production function, labor and capital are main factors. After consideration of other factors like labor and technology, production index had considerable progress. Generally, labor concept in economic literature includes instruction, health, skill, experience, emigration and other investments that lead to economic growth because of labor productivity. Currently most of the studies about human capital have been focused on instruction as human capital criterion and they did not pay attention to health. Whereas, when it is spoken about the improvement of quality in labor force, the issue is not instruction, skill and experience. Hygiene and health of people should be even considered as a factor in the accumulation of human capital.

Therefore, health can affect production level of a country through various channels. The first channel that has been pointed in most of studies is productivity of healthy workers in comparison to others. Healthy workers work more and better than other workers and have creative and prepare mind. In addition to this direct effect, healthiness has other indirect effects in production like: health improvement in labor, motivation, education and better skills. Because health condition improving will increase investment attraction in instruction on the one hand, and will prepare people for education and skill gaining more and more by improving learning ability. Hygiene increasing in a society will also encourage people to saving by decreasing death and increasing life expectancy. Following saving increase in a society, physical capital will increase and it will affect labor productivity and economic growth indirectly (Weil, 2005).

It can be proposed that some factors can lead to economic growth like: life expectancy increasing, labor investment returning, investment in labor and finally investment, because they increase the number of years of resource exploitation and positive returns on investment. By increasing life expectancy, saving and private sector investment and foreign direct investment will be encouraged and economic condition of country will be recovered. With regard to health and hygiene importance on economic growth and because hygiene and health are known as human capital, it has been tried in this paper to measure related variable effects of hygiene index on economic growth in Iran by ARDL model. Therefore in second part of this paper we will talk about theories and research history, and after studying present research place among different ideas of economic growth and health index, research method will propose. Afterward, by considering empirical findings of research method which has gained from research method test present paper result will finally offer.

2. Research History and Theory

Health and healthiness have close relation with improvement and economic growth. in the health economics literature definitions Several are provided for example: the views of the World Health Organization:the health

not only the absence of disease Illness but also the welfare of complete physical, mental. People of Healthy society are happy and they are motivated in working. On the other hand, direct and indirect expense which causes the decrease of national income and improvement will decrease. Thus, nowadays, all societies pay attention to health index increase.

Four main input production index model that is introduced include: capital, labor, human capital, indicator of the level of technology. Human capital services, is a skill which is because of physical health. Investment is measured in terms of commodities. Human capital is specified level of accumulation activities effects like formal education, education and work, healthiness and healthiness index. Related researches about this topic affirm them, because the studies have shown that life expectancy in the people of a country affects economic growth of that country. Sanitation improvement in a country leads to children death decrease, life quality improvement, physical and regional health increase, human capital and investment of future generation and affects net production of the country by effect of family income on the income of society. On the other hand, healthiness of someone depends on a set of effective regional, economical and behavioral variables on him/her. Investment of one person is important in economic growth as a part of his/her human capital. Therefore, life expectancy index shows life quality, and it is affected from social programs, health care, mental relaxation and healthy nutrition. Improvement of this index can show the quality of using hygiene expenses in a country. In other words, if hygiene and cure expenses will be enough and function of using this resource will be in high level, related index of healthiness level will improve. In this regard, some studies have been done in and out of the country as following:

Marandi (1996) did a research with the name of "interactions of hygiene, efficiency and economic growth" and achieved the result that increasing the level of health services could be evaluated by improving health indexes, life expectancy improvement, and improving human capital health or active population of the country.

Raeisi (1995) did a research with the name of "hygiene and health role on family efficiency" and he showed that malnutrition is the biggest factor that risks the life of children in developing countries.

Lotfalipour et al. (2011) studied the effect of health indexes on economic growth in Iran based on least squares from 1982 till 2007 (TSLS). The results show that life expectancy and health expenses have effect on the growth rate of capital income about 99 and 90 %.

Rabiei et al (2013) studied health indicators on economic growth in developed countries by input panels. The results show that capital stock and life expectancy have positive effect on both groups of developed countries. One of the unique and advanced analytical studies had done by Grossman and Krueger (1991) continued it later. This study proposed the way of preparing health services from demand point of view without paying attention to health of society in order to increasing people productivity. In human capital model, Grossman and Krueger (1991) studied hygiene demand and proposed the relation between healthiness and human capital health with production in individual level. Moreover, he proposed the accumulation of human capital and it's relation with mind level and framework modeling. In this model he also proposed two important aspects of human capital (health and education) and their relation with labor, productivity and wage. Model of Grossman introduces health and hygiene as a lasting capital stock. Health and hygiene supply utility direct or indirectly, because they are important inputs in production process of family. Therefore, hygiene and health are both final consumer good and a capital good. This theory states that individual promotion increases someone's knowledge productivity in market or free activities.

Grossman's relations with different types of human capital such as education and health raises, in this for the higher level of education leads to more investment in improving the health and Higher education and health to produce more.

Some studies have analyzed the reason between health expenses and economic growth and the result says that there is a result between these two variables in long-term and short-term times which can be used to study Ardebil Weiner.

And Devlin and Hansen noted.

Some people say that causality exists in economic growth to health expenses, while health expenses did not have any effect on economic growth.

3. Method and Materials

As it is said before, we use ARDL model to study the effect of health indicators on economic growth in Iran and following the form of the production function as logarithm.

In past times, in order to estimating studies, it had been used ordinary least square (OLS). OLS method using says that some variable series are usable when economy is Deterministic, but some believe that most of them are not deterministic in economy (Noferesti, 2012)

Granger and Newbold show by simulation that using least squares method between non deterministic variables can have seductive results, because if model variables be non-residence, parameters which are the answer of OLS can have "t" statistics and have "f" statistics and high ratio. But, because of standard normal complying failure in least squares, statistics result based on normal statistics will be wrong (Noferesti, 2012, p 36)

Phillips and others (Cited by Noferesti, 2012) show in their studies that if model variables are non-residence, least of squares will be wrong and the result will be like a wrong regression.

In this paper, it has been used Co-integration method to prevent spurious regression because of non-residency of variables and it has been used this method. It has been used this method to find result based on the advantage of "Auto Regressive Distributed Lag" (ARDL) in comparison to other methods.

Co-integration concept entered non-residence topic in 1981 by Granger. Economic concept of co-integration is that when two or some time series is related to each other based on theories, to make long-term balanced equation. But, these time series are possible to have random process. But during time passing they follow each other very well, as their difference are stable (Noferesti, 2012, p. 32)

To obtain a long-term relationship or co-integration it is possible to pint to method of Angel Granger which is not valid in studies in studies by little models, because of neglecting short-term dynamic response between variables. Because their results have bias and hypothesis test by normal test statistics like "t" will not be valid, therefore it does not suggest in regressions with two variables (Tashkini, 2014)

The other method is "maximum likelihood" of Juhansen Juseloius which relies on (1) degree, therefore when co-integration degree of variables will be different this method will not be valid. So that, using models which have short-term dynamism and lead to exact factors of model are focused. Altogether, dynamic model is a model which variable lags enter it like model (1) relation:

$$Y_t = aX_t + bX_{t-1} + cY_{t-1} + U_t \qquad (1)$$

To decrease related model factor bias in little models it is better to use a model which have many lags in variables like model number (2):

$$\emptyset(L, P)Y_t = \sum_{i=1}^{k} b_i (L, q_i)X_{it} + \acute{c}w_t + u_t \qquad (2)$$

This model is an ARDL which has:

$$\emptyset(L, P) = 1 - \emptyset_1 + \emptyset_2 L^2 - \cdots - \emptyset_p L^p \qquad (3)$$

$$b_i(L, q_i) = b_i + b_{11}L + \cdots + b_{iq}L^q, i = 1, 2, \ldots, k \qquad (4)$$

"L" as lag operator and "W" is an operation of the fixed variables like intercept, virtual variables, time or exogenous variables or fixed variables.

Im et al (2003) have proved that if the vector of convergence achieved from using least square method, based on ARDL relation that have obvious lags will have less skew and more productivity in little models in addition to least distribution normal. Other advantages of this model is that paying attention to variables gathering up degree is not important and it is possible to achieve unique vector which make long-term relation by determining suitable lag numbers for variables without prejudice or using economic theories (Noferesti, 2012)

Microfit estimates the equation for all situations and all possible arrangements which is $(m+1)^{k+1}$. "m" is the maximum lag that is determining by researcher and "k" is number of explanatory variables (Tashkini, 2014)

On next step, by using one of Akaike Information Criterion (AIC), Schwarz-Bayesian Criterion (SBC) and Hannan-Quinn Criterion (HQC) or R-Bar Squared (R^2) one of the equations are selected. Generally in models less than 100 it is used (SBC) to keep freedom degree (Tashkini, 2014, p. 133)

To calculate long-term factors it is used the same dynamic model. Long-term factors related to X-variables are achieved from this relation:

$$\emptyset_i = \frac{\hat{b}_i(1, q_i)}{1 - \hat{\emptyset}(1, p)} = \frac{\hat{b}_{i0} + \hat{b}_{i1} + \cdots + \hat{b}_{iq}}{1 - \hat{\emptyset}_1 - \cdots - \hat{\emptyset}_p} \quad i = 1, 2, \ldots, k \qquad (5)$$

Now, the following hypothesis is testing to show long-term relations of this method are not false.

$$H_0: \sum_{i=1}^{p} \emptyset_i - 1 \geq 0$$
$$H_a: \sum_{i=1}^{p} \emptyset_i - 1 < 0$$

(6)

Zero hypothesis shows that there is not long-term between variable models, for having long-term balance from dynamic short-term relation total coefficients should be less than zero. To do this test number one should minus from continuous dependent variable fraction and the result should share to overall standard deviations above (Tashkini, 2014, p. 133). If absolute value of achieved "t" be bigger from absolute value of the numbers proposed by Banergee, Doaldo and Mester, zero hypothesis will be rejected and the presence of long-term relation will be accepted (Tashkini, 2014, p. 133).

Accumulation existence among the set of economic variables, provides the statistical base of Error Correction Model (ECM). The popularity of these models is that they connect short-term variable swing to balanced long-term amounts. This paper it has been tried to show the result and analysis of error correction model. In fact these models are a kind of balanced detail models, effective powers in short-term and long-term equilibrium approaching speed is measuring by entering stable waste from a long-term relation, effective powers in short-term and long-term balanced equilibrium approaching speed. Achieving this model has two levels: the first level is achieving a long-term relation and being sure that it is not false and then in the second level waste lag of long-term relation is used as error correction factor and model (7) will be proposed:

$$\Delta Y_t = a + b\Delta X_t + cU_{t-1} + e_t$$

(7)

If you see "C" error correction factor in negative form, it will be possible show quick error correction factor and long-term balance. This factor shows that in every period how many percent of dependent variable imbalance have been adjusted and approached to long-term relation. The above method, at first introduced by Saregan (1984) and then became famous by Angel and Granger (1987). (Tashkini, 2014, p. 135)

Therefore, the following model has been proposed for effect of health indicators on economic growth:

$$gGDP_t = \alpha_0 + \alpha_1 LK_t + LF_t + LLife_t + Trend_t + \varepsilon_t$$

(8)

The gGDP shows economic growth rate, LK shows logarithm of capital, LF shows log fertility rate, Llife shows life expectancy logarithm and trend shows the time period.

4. Hypothesis or Research Answers

In this way, we can ask the questions of this paper as following questions:

1- Does capital stock have an important effect on economic growth of Iran?

2- Does fertility rate have an important effect on economic growth of Iran?

3- Does life expectancy have an important effect on economic growth of Ian?

Hypothesis based on these questions will be as followings:

1- Capital sock has an important effect on economic growth of Iran.

2- Fertility rate has an important effect on economic of Iran.

3- Life expectancy has an important effect on economic growth of Iran.

5. Result and Discussion

5.1 Research Data

To reach the goals of this research, it has been used the information of Iran which is in global bank and the world health organization during 1975 till 2012.

- Data reliability study

The measure reliability, shows stability and compatibility of the concept which is measuring and helps correct evaluation or processing of a test. The ability of a measure is for stability over time, the index of stability and low vulnerability to change. Inner compatibility of measure is an index of congruence of articles in a measure which shows a concept (Ibrahimi et al., 2014)

In this research unit test roots of Dikki-fuller which have been generalized has been done to study stability of variables. In this thesis the stability of variables is testing at first, because most of macroeconomics time series

variable are not stable and have random process. In fact, when there is a random process and unstable situation, the result of econometrics which has been done by these unstable time series can lead to incorrect interpretations that are invalid. Unstable variables can change to stable variables by making difference between them, but there is necessary sometime to make difference more than once to reach stable variable.

The important point in making ARDL model is that before making it stability test should be done for all of the variables to make sure that none of these variables are not from level (2), so that fake results will be rejected, because when there is variable level (2), the calculated (F) statistic will not be correct. "F" test is based on this hypothesis that all of the variables exist in models I (0) and I (1). Therefore unit root test doing in ARDL model is necessary to define that all of the variables are from level one or more (Azerbaijani, 2009).

Dikki Foller test that has extended for research variables has done by considering intercept and microfit[4] software. To do the test, the amount of result statistics has compared to critical values in 5% level, if the absolute value of calculated statistics be bigger than critical value, the hypothesis based on the existence of unit root will reject and the series will be unstable.

Table 1. Extended stability test of Dikki Foller with intercept and time

Results	5% Critical Value*	ADF Test Statistic	Variable
Stable	4.1937-	5348.3-	gGDP
Stable	823.36-	5348.3-	LK
Stable	664.5-	5348.3-	LF
Stable	9074.7-	5348.3-	Llife

The results of Table 1 shows that all of the variables are stable model and from level I(0). Therefore calculated "F" statistic will be valid.

5.2 Model Estimating

Now we can estimate the stability relation between variables of model as following model:

$$gGDP = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} gGDP_{t-i} + \sum_{i=1}^{q1} \alpha_{2i} LK_{t-i} + \sum_{i=1}^{q2} \alpha_{3i} LF_{t-i} + \sum_{i=1}^{q3} \alpha_{4i} Llife_{t-i} + Trend_t + U_t$$

The result of this estimation is summarized in Table 2. As you see the results show estimated model ARDL (1, 3, 0, 0) by Bizzy Schwartzer model by 3 suggested maximum lags. ARDL (1, 3, 0, 0) estimated model shows that entered variables in model are 5%. Model also does not have variance and correlation difference, which shows model validity. On the other hand Watson's camera's statistics confirms this validity. The most important element which is the coefficient of determination shows economic growth rate by dependent variables with the amount of 95% of explanation ability which shows the high estimation validity. In addition, the amount of "F" statistic shows the validity of the whole estimated regression in dynamic relation of ARDL.

Table 2. ARDL (0, 0, 3, 1) dynamic estimated model's results

Variable	Coefficient	Std. Error	t-Statistic [Prob.]
GGDP(-1)	1.0234	1.0233	2.9124[.003]
LK	1.3837	1.4485	2.9524[.003]
LK(-1)	.92344	1.5751	2.9265[.004]
LK(-2)	.86773	1.2039	2.7207[.007]
LK(-3)	.53832	.65878	2.3351[.027]
LF	.46927	.21021	2.2324[.034]
LLIFE	.72718	.53161	2.5805[.015]
C	33.5969	10.8743	3.0896[.004]
TREND	.088236	.030255	2.9164[.007]

R-Squared	.94279	R-Bar-Squared	.92849
S.E. of Regression	.062641	F-stat. F(7, 28)	7.7487[.001]
Mean of Dependent Variable	.016980	S.D. of Dependent Variable	.082861
Residual Sum of Squares	.10987	Equation Log-likelihood	53.1738
Akaike Info. Criterion	45.1738	Schwarz Bayesian Criterion	38.8397
DW-statistic	2.0892		

*A:Serial Correlation   *   CHSQ (1) =   .34850[.555]   *   F (1,   27)   =   .26393[.612*]
*   *   *   *

*B:Functional Form   *   CHSQ (1) =   1.3066[.253]   *   F (1,   27)   =   1.0169[.322*]
*   *   *   *

*C:Normality   *   CHSQ (2) =   1.4665[.480]   *   Not applicable*
*   *   *   *

*D:Heteroscedasticity *   CHSQ   (1) =   .93862[.333] *   F (1,   34)   =   .91021[.347*]

The coefficients show that variable effect of capital, fertility rate and life expectancy will have positive effect on economic growth as a variable of health index, because by increasing every unit of capital investment economic growth rates increases about 1.38 units. Therefore

$$\Delta gGDP = \alpha_0 + \sum_{i=1}^{p} \beta_{1i}\Delta gGDP_{t-i} + \sum_{i=1}^{q1} \beta_{2i}\Delta LK_{t-i} + \sum_{i=1}^{q2} \beta_{3i}\Delta LF_{t-i} + \sum_{i=1}^{q3} \beta_{4i}\Delta Life_{t-i} + \beta_{4i}Trend_t + \lambda ECM_{t-i} + U_t \text{'}$$

one unit increasing in related variables with health indexes, which are fertility rate and life expectancy leads to economic growth about 0.46 and 0.72 every period.

The result of long-term relation is summarized in Table 2. As you see entered coefficients in this model are 5% and they are compatible with theories.

Table 3. Long-term relation ARDL (0, 0, 3, 1) estimated results

Variable	Coefficient	Std. Error	t-Statistic [Prob.]
LK	2.0121	.67766	2.9691[.006[
LF	.46927	.21021	2.2324[.034[
LLIFE	1.3718	.53161	2.5805[.015[
C	33.5969	10.8743	3.0896[.004[
TREND	.088236	.030255	2.9164[.007[

Error correction model based on what has been introduced in ARDL model for studying the effect of short-term powers and speed of closing to long-term balanced amount is estimated as following:

Error correction coefficient has been added to the above model.

As you can see in table 3 all of the error correction coefficients are possible more than 90% and the sign of all variables estimates theoretical expectations and econometrics. Because the related variables to health indexes have positive effect on economic growth even in short-term.

Table 4. The result of estimated ARDL error correction relation

Variable	Coefficient	Std. Error	t-Statistic [Prob.]
dGGDP	1.3837	0.4485	2.76543[.008[
dLK	0.7324	2.4345	2.95524[.008[
dLK1	2.4061	.87801	2.7404[.011[
dLK2	1.5383	.65878	2.3351[.027[
dLF	.46927	.21021	2.2324[.034[
dLLIFE	.73718	.53161	2.5805[.015[
dC	33.5969	10.8743	3.0896[.004[
dTREND	.088236	.030255	2.9164[.007[
ecm(-1)	-0.2134	.1423	3.0114[.006[

Error correction sentence coefficient sign is negative as we expected which shows unbalance will solve in the future to make a long-term balanced relation that is 21% period balance up to achieving long-term balance. In other words error correction coefficient sentence shows that in every period how many percent of imbalance of dependent variable will balance as a long-term relation. In any scientific period 21 % of imbalance of short-term period will balance to achieve long-term balance.

-Structural stability test model

There are different methods for estimated coefficients of structural stability test model. In this thesis it is using repetitive solidarity interfere for estimated fixed coefficient models, because this method is usable in the situation which is not possible to make change in structure of it. Repetitive models are done in two forms: total cumulative residuals tests (CUSUM) and total cumulative squared residuals (CUSUMSQ).

Test of model sustainability are obvious in models 1 and 2. As you see statistics are about 95% in both tests and zero based on coefficient sustainability are accepted and the 5 percent of results are valid.
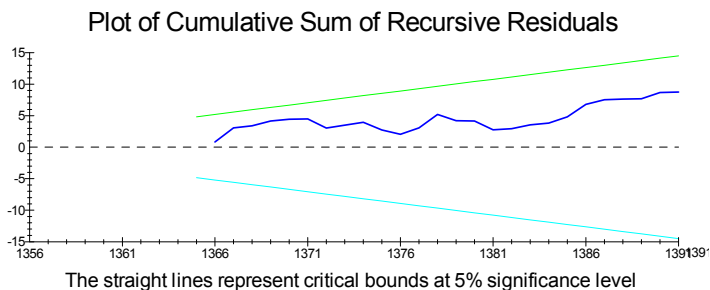

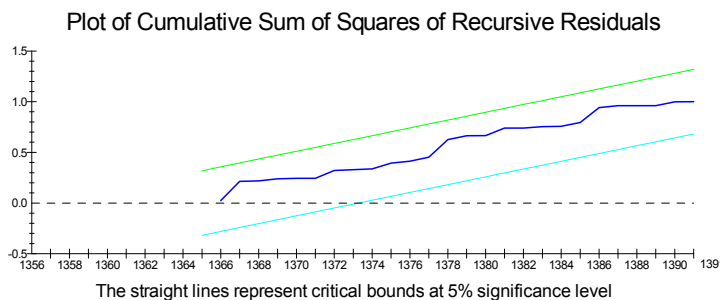Figure 1. Total cumulative residuals for model ARDL

Figure 2. Cumulative sum of squared residuals for the model ARDL

6. Conclusion

The goal of this research is to achieve the effects of health indexes on economic growth of Iran between the years 1975 to 2012. The results show that capital stock, life expectancy and fertility rate have had positive effect on GDP growth of Iran. In this research it has been ensured at first that using data are stable by Dikki and Fuller stability test. Then ARDL model estimated in 3 forms as: dynamic, short-term and long-term. The result illustrates that coefficients show that variable effect of capital stock, fertility rate and life expectancy as health indexes will have positive effect on economic growth of Iran and by increasing every unit economic growth rate investment increases about 1.38. One unit increasing in variables related to health indexes lead to increase on economic growth of Iran about 0.46 and 0.72. The sign of expected sentence error correction has negative that shows imbalance in short-term period will balance to make long-term balance and this means that every periods balance which is 21% is up to long-term balance. In addition to this in studying the structure of model null hypothesis of stability of coefficients is accepted and 5 percent of results are valid. Therefore in this scientific test of studying health index effect we understand that they have positive effect on economic growth of Iran and life expectancy and fertility have an important effect on economic growth of Iran. However because of high effect of social stress, poverty, inequality and injustice decreases life expectancy and fertility rate it is suggested for government to decrease these stresses. Capital stock of both of the countries that have been studied are positive and having domestic and foreign investment will increase both countries economic growth.

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