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The Impact of Health Outcomes on Economic Growth: A Panel Data Analysis

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Abstract

The health is the better predictor of economic growth then the other indicators (human capital, investments, education savings) because if the peoples are healthy, they can do investments gain education and have savings for future. The poorest countries can put resources into health intercessions that have cost and at this time have high scale impacts on individuals' health,leads to increase in productivity.This research investigates the relationship between health and economic growth by using a balanced panel of 42 economies and time ranging from 1995 to 2017. To examine the short-run association, the panel Granger causality is applied. While for the long-run relationship, the Cointegration technique is used. Dynamic ordinary least squares (DOLS) and fully modified ordinary least squares (FMOLS) are part of our analysis to check the association between health and economic growth. There is no resent study which gives clear insight the impact of health on economic in long run as well as in short run of Asian countries. The main objective of the study is to analyze the relationship between health and economic growth in Asian economies and to investigate the short run and long run impact of health on economic growth. This study has positive and statistically significant effect on per capita income male and female. Finally, this research concludes the economic performance has a significant impact on health.

Keywords: Health, Life Expectancy, Economic Growth, GDP, Panel Cointegration Test, Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS), Panel Unit Roots, panel Granger causality.

JEL classification: O15, O11, I15

Introduction

The income differences affect health mostly, which shows the importance of this issue. The studying of income difference among economies then the operation of each can be disclosed. The specifically growth theory /development theory and economic theory to find the determinants of growth that account for income difference which is the important question. The health is a better predictor of economic growth, (Banerjee, 1999). Moreover the (Howitt, 2005), work is based on this study. The easier excess to better sanitation, good medical care, safe water, diet, nutrition, and public health infrastructure that is an essential part of welfare. There are following question that are answered in this study. Health upgrading can improve economic growth. There are in reality numerous ways by which health improvement can impact and all the more particularly increase growth (Odrakiewicz, 2012).

Moreover, healthy employees are commonly more energetic, physically, and mentally strong. They, as a result, produce in more amount and get higher wages. Moreover, it is normal that they take less leaves of absence from work because of health reasons of their

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own or of a member of their family.

In any case, productivity can be influenced by health in an indirect way, as well, through education, savings and labor market support. Changes in health standards can expand the education in various ways.Above all, the inspiration to spend on education, and thus human capital investments rise and prompt higher productivity. With respect to the savings, when somebody expects a longer lifespan, they have a higher motivating force to save for retirement. Also, illness leads high out-of-pocket medical expenditures, in this manner decrease present and accumulated savings. Accordingly, health infers an expansion in business investments, prompting higher wealth. At last, the effects of health on labor supply are not unreasonably clear. The inspiration of healthy employees to work harder increases because of the longer life expectancy and the more wages they earn. Likewise, they consider that the finding work isn't something difficult and they additionally spend less time to sickness. As a result of these two impacts, labor supply rises

There are diverse ways that one can use in order to examine the relationship between health and economic growth. First of all, the connection between health and growth can be directed at an either a singular level or on a regional level inside an economy. A few researches use microecono and other macroeconomic evidence and tools. By utilizing microeconomic studies a researcher can adjust their results and discover the size of the effect of health at an aggregate level. However, by utilizing macroeconomic data they can estimate the aggregate relationship directly. Macroeconomic methodologies consider life expectancy, health consumption, Adult survival rate (ASR) and others. At last, another separation among studies is the methodology they utilize. The main scope of this work is to research if there is a realationship among health and economic growth in both the short-run and the long-run and in which direction. We utilize life expectancy as a proxy of health and GDP per capita as determinants of growth. Where we distinct life expectancy of males from that of females and present their effects on GDP per capita. In particular, we utilize a cointegrating examination and present both equilibrium relationship and error correction models (ECMs). The benefits of the macroeconomic appoach over the microeconomic one is that the last overlooks the individual effects of health capital on society, as it measure the impact of individual health status is based on just their own income. Therefore, it doesn't consider the so-called externalities. However, macroeconomic regression catches the externalities, yet they are still suffering from omitted variable bias. Nevertheless, we don't face such an issue as an equilibrium relation does not rely upon the extension of the data set. In other words, if there exists a cointegrated relation, at that point it is an invariant of the absence of a few variables (Swift, 2011).

The study has following objectives which are given below.

- To analyze the relationship between health and economic growth in Asian economies.
- To investigate the short run and long run impact of health on economic growth.
- To find suitable policy suggestion about health standerd on the basis of empirical findings.

The commitments of our study are as follows. Initially, utilize quite a period of time going from 1995 to 2016, we utilize panel data strategies in order to estimate the desired link. The benefits of the particular data dimension are that it is more appropriate for growth dynamics analysis (Durlauf & Johnson, 1995). In addition, it expands the numbers of observations, which for our situation is 924. We follow the modern

econometric techniques, for example, panel cointegrating estimation and panel Granger causality. At last, we particular between life expectancy male's life expect from that of females and investigate their effect on growth independently.

Our main result is that health have a strong positive and statistically significant for the economic execution of a country both in the short-run and over the long run.while for long-run panel Cointegration is used. Subsequently, health improvements have a similar impact on GDP per capita in the short-run. The positive relation running from the growth rate of life expectancy to GDP per capita is, additionally, with the predictable consequences of the panel Granger causality test.

Likewise, the effect of gender, health level GDP per capita is statistically significant and the similar size, which suggests that both male and female health status influences economic growth of a country to a similar rate. Besides, after the result of the effect of both male and female life expectancy on GDP per capita is fundamentally the same. At last, we see that there is a two way causality among the growth rate of male life expectancy and the growth rate of per capita GDP. On account of female life expectancy, be that as it may, there is two way causality, however, it is weaker from life expectancy to GDP per capita. Health brings improvement not only to the social life of the man, yet additionally to the economic standard of the economy. As a consequence, policy makers should not ignore the effects of health on economic performance. In the country, they should use it as an apparatus to accelerate economic growth. Indeed, even the poorest countries can put resources into health intercessions that have cost and at this time have high scale impacts on individuals' health,leads to increase in productivity.

Literature Review

In order to investigate the determinants of economic growth and utilizing a panel of around 100 countries from 1960 to 1990, (Tehseen Jawaid & Raza, 2012) reasoned that the growth rate is positivelye impacted by initial schooling higher and life expectancy, bring down fertality and government spending, better mainteance of the rule of law, bring down inflation, lastly enhancements in the terms of trade (for a given initial level of real GDP per capita). Additionally, for given estimations of these parameters, the stating estimation of real GDP per capita is negtilively related with the growth rate. The Barro theoretical model that utilizes is the neoclassical one, where the growth rate depends negtively to the initial current level of per capita output and positively to the long run or steady state per capita output. He utilized the method for three-stages lest squares (3SLS) including, additionally, an arrangement of instruments. including the log of life expectancy at birth to the set of the autonomous veriables, as a health status indicators, yielded that there is an altogether positive and significant connection between life expectancy and growth rate. In particular, the coefficient on the logarithm of life expactancy is 0.042. In addition, a few ressearchers recommend permitting a fixed effect for every country with a specific end goal to maintain a strategic distance from the issue of underestimation of conervangence because of the imperfact estimates made to keep the long run per capita output is fixed. Also, he utilized ordinary least squares (OLS) taking the means for the veriables, thus making the data cross-sectional. Thus, he found that the coefficient being referred to is 0.0172. At long last, running an seemingly unrelated (SUR) technique yielded that this coefficient is 0.038. In either case, we watch a positive relationship between health indicator and the growth rate.

Likewise, utilizes 71 countries for the time period 1965-75, 86 countries for 1975-85 and 83 countries for 1985-95 out of a panel set up. His estimation depends on 3SLS (Antwi,

Mills, & Zhao, 2013). The growth rate of genuine per-capita GDP is a dependent variable. In addition, the instruments are the logarithm estimations of GDP per capita, life expectancy, and fertility rate in 1960, 1970, and 1980. The framework he utilizes depends on dummies for various time periods. He picked life expectancy at age one as the indicator of health level, as it ended up having the most independent variable contrasting with the other two veriable, life expectancy at birth and life expectancy at age five. The estimation results demonstrate that better health prompts higher economic growth. At that point evaluating the condition by alternative proportions of health (newborn child death rate, life expectancy at birth, life expectancy at age five, and malaria), yields that all variables are statistically significant rather than malaria. Subsequently, as indicated by Barro, for a fixed GDP per capita, high introductory human capital improves growth.

Barro (2013) investigate the sources of economic growth utilize 85 countries for the time of 1965-75 and 95 countries for 1975-1985. Keeping in mind the end goal to take into account the relationship of coutry random impacts, they estimate their model by SUR technique. Life expectancy at birth, which is utilized as an indicator of health status, is positive and most significant in growth regressions (growth rate of real GDP per-capita is the endogenous variable of the equation). Moreover, isolating the countries that are under the median ($1350 in 1980) from the ones that are over the median, they find that life expectancy has a bigger impact on growth on account of the poorer countries.

Grossman (2010) examine the commitment of human capital regarding schooling and health to economic growth. They exhibit a total production function in view of which a country's output is a component of the two its sources of inputs and the effectiveness with which they are utilized. The inputs considered are physical capital, labour and human capital, which has three measurements the ones of education, experience, and health. Additionally, the productivity is considered as the total factor productivity (TFP). They investigate a panel of 104 countries for the time 1960-1990 (at regular intervals) with nonlinear two stages least squares. The writers find that health has a positive and statistically significant impact on economic growth. In particular, one year improvement in a country's life expectancy increases its yield

Ecevit (2013)at al explores the connection among economic growth and health. The indicators that he decided for health and economic growth are life expectancy at birth and real per capita residential item, individually. He utilizes a pane of 21 organizations for economic co-operation and development (OECD) countries from 1970 to 2010, where the data are yearly. He utilizes panel cointegration and causality tests. At long last, he finds that the impact of life expectancy at birth on real GDP per capita is positive and statistically significant and that life expectancy Granger causes real GDP per capita.

Furthermore, Peykarjou, Gollu, Gashti, and Shahrivar (2011) analyze the connection between health and economic growth in the Organization Islamic Conference (OIC) party states. They utilize panel fixed impacts strategy for the period 2001-2009. They infer that the increase of life expectancy improves economic growth in the particular countries. However , there is a negative connection among fertility rate and economic growth.

As indicated by all the above investigations, there is a positive effect of health standard on economic growth. By the by, there are a few researchers, who support the inverse. (Acemoglu, 2008) at all utilize a panel dataset consist of 75 countries from western Europe, Oceania, the Americas, and Asia for the eras 1940-1980 and 1940-2000. They utilize two stages least squares (2SLS) estimation thinking about mortality from tuberculosis, pneumonia, malaria and other 12 infectious diseases as an indicator of life

expectancy. They find that there is a little positive effect on life expectancy on total of GDP over the initial 40 years, and somewhat more prominent one throughout the following 20 years. In any case, it isn't sufficient to make up for the increases in population. Thus, GDP per capita diminishes because of the increase in life expectancy. A similar outcome, likewise, yields for the GDP per labor.

Knowles, Lorgelly, and Owen (2002) utilize a panel of 97 countries, including 5-year time spans from 1960 to 1985. Running an inside view of Barro and Lee (1994b) with both a 3SLS and pooled OLS yields a positive statistically significant effect of health on economic growth. Notwithstanding, running the regression by generalized method of moments (GMM), with a specific end goal to wipe out the issues of related individual impacts and endogenous independent veritable, they find a negative however statistically insignificant impact of life expectancy on growth real GDP per capita.

Data and Methodology

In this examination we will research both the short-run and the long-run connection among health and economic growth. We use for this life expectancty of male and female as a indicator of health. In particular, we analyze the connection among health and GDP per capita. Along these lines, we utilize three variables in our examination. The first is GDP per capita and has been taken from World bank data. The second one is male life expectance at birth has been taken from Human Mortality Database. The last variables is female life expectance at birth is also taken from the Human Mortality Database

Methodology:

1.1.1 Stationarity and Spurious Regressions.

We realize that so as to run a regression with standard regression methods, for example, OLS, the variability of the condition should be covariance stationary. A variable covariance stationary when the mean and all autocovariances are limited and stable (don't change after some time).

$$y_t = \mu x_t + e_t \quad (1)$$

Suppose that both y_t and x_t is covariance-stationary procedures, at that point $e_{t?}$Will be covariance stationary. Referred to this issue, Granger and Newbold (1974) demonstrated that the outcomes we get from OLS regression are spurious. On the other hand, we can reject the null hypothesis that the parameter μ is zero, in spite of the fact that it is in reality zero. The asymptotic hypothesis have been determined by Phillips (1986) about 10 years after the fact and result, he explained the result of Granger and Newbold (1974). He demonstrated that the random walks y_t and x_t are first-difference stationary procedures and that the OLS estimator does not have its typical asymptotic properties when the variables are first-difference stationary.

I (1), and their linear combination is a stationary procedure, I (0), the variables are called cointegrated.

1.1.2 Im, Pesaran and Shin Unit Root Test:

Therefore, the primary thing we do here is to examine the stationarity of the a series in question. The fundamental test we use for this scope is the Im Pesaran and Shin (IPS) (2003) unit root test. Analytically, think about an AR (1) process:

$$y_{it} = \rho_i y_{it} + X_{it}\delta_{it} + \imath_{it} \quad (2)$$

Where i=1,… ., N cross-section units and t=1,… ., T time series. The X_{it} Shows the independent variables in the model, ρ_i The autoregressive coefficients and ι_{it} the error term (is thought to be iid). In the event that, $|\rho_i| < 1$, y_i Is said to be weakly (trend) stationary. Then again, if $|\rho_i| = 1$, at that point y_i Contains a unit root.

$$\Delta y_{it} = \alpha_i y_{it-1} + \sum_{j=0}^{\rho_t} \beta_{ij} \Delta y_{it-j} + \sum_{it}^{'} \delta + 1_{it} \quad (3)$$

The null hypothesis for all i the alternative,

They separately test the ADF, run a regression, and get average of individual ADF regression

$$t_{TN} = \left[\sum_{i=1}^{N} t_{iTi}(\rho_i) \right] / N \quad (4)$$

Where$t_{iT}(\rho_i)$ based upon specific country ADF regression.

Moreover, IPS standers t-statistic is:

$$W_{t_{NT}} = \frac{\sqrt{N}\left[t_{NT} - N^{-1} \sum_{i=1}^{N} E\left(t_{iT}(\rho_i)\right)\right]}{\sqrt{N^{-1} \sum_{i=1}^{N} Var\left(t_{iT}(\rho_i)\right)}} \rightarrow (0,1) \quad (5)$$

2.0 Cointegration tests:

There are three types of Cointegration test, which are given below.

2.1a Engle-Granger Cointegration Test

The Engle-Granger (1987) cointegration test depends on the study of the residuals of a spurious regression, with I (1) variables. We say that the variables are cointegrated if the residuals that we find by regression the variables to one another are I (0). In the event that they are I(1), at that point the variables are not cointegrated.

2.2b Pedroni Cointegration Test

With respect to the Pedroni (1999, 2004) test, it permits intercept and trend coefficients crosswise over the cross-section to be heterogeneous. The regression that is study is as follows:

$$y_{it} = \kappa_i + \nu_i t + \xi 1_i x 1_{i,t} + \xi 2_i x 2_{i,t} + \ldots\ldots + \xi M_i x M_{i,t} + f i_{,t} \quad (6)$$

Where i=1, …. , N, t=1,…., T, m=1,…., M and y,x are integrated of order one, in other words, I(1).

The main idea is to get the residuals from the above regression and then we test if the residuals are I (1) by running the regression:

$$fit = pifit - 1 + wit \quad (7)$$

The null hypothesis of the test show that there is no cointegration between the variables. What's more, the alternative that for all I (homogeneous alternative) or pi<1 for all I (heterogeneous alternative

2.3c Kao Cointegration Test:

Then again, the Kao (1999) test, in spite of the fact that it takes after a similar methodology, it determines cross-section particular intercepts and homogeneous coefficients on the first stage.

2.4d Johansen-Fisher Cointegration Test:

Concerning the Johansen-Fisher kind panel cointegration test, Fisher (1932) gives a combined test considering the results of the individual autonomous tests. Maddala and Wu (1999), in view of the Fisher's outcome, determine an alternative test for cointegration in panel data. They combined tests from an individuals cross-section and therefore they get a test statistic for the full panel data set. The way that the variables are cointegrated implies that there is long run or balance connection between the variables. By the Granger Representation Theorem, when two variables are cointegrated their relationship can be given by an Error Correction Model (ECM) (Gujarati, 2004). Accordingly, keeping in mind the end goal to portray both short-run dynamics and long-run equilibrium all the while we run a simple vector error correction model (VECM) with none and one lag with OLS. Before we study down these models, we will display the FMOLS and DOLS estimators.

3.0 FMOLS and DOLS

3.0.1 FMOLS

The FMOLS estimator was proposed by Phillips and Hansen (1990). It utilizes a semi-parametric correction, keeping in mind the end goal to minimize the issues that are caused by the long run correlation between's the cointegrating regression and stochastic regressors innovations.

Assume that u_{1t} is taken from the following equation:

$$y_t = X_t'\eta + D_{1t}'\zeta + u_{1t} \tag{8}$$

Where$D_t = (D_{1t}', D_{2t}')'$ are deterministic trend regresses?

$$X_t = \Gamma_{21}' D_{1t} + \Gamma_{22}' D_{2t}\varepsilon_{2t} \tag{9}$$

We can also find$\hat{u}_{2t}$ as $\hat{u}_{2t} = \Delta\hat{\varepsilon}_{2t}$ by the level regression

$$X_t = \hat{\Gamma}_{21}^{'} D_{it} + \hat{\Gamma}_{22}^{'} D_{2t} + \hat{\varepsilon}_{2t} \tag{10}$$

At difference regression

$$\Delta X_t = \hat{\Gamma}_{21}^{'} \Delta D_{1t} + \hat{\Gamma}_{22}^{'} \Delta D_{2t} + \hat{u}_{2t} \tag{11}$$

Based on$\hat{u}_t = (\hat{u}_{1t}, \hat{u}_{2t}{}')'$ residuals we find$\widehat{\Omega}$ and $\widehat{\Lambda}$ long run covariance matrices.

$$\mathrm{y}_\mathrm{t}^{+} = \mathrm{y}_\mathrm{t} - \widehat{\omega}_{12}\widehat{\Omega}_{22}{}^{-1}\hat{\mathrm{u}}_2 \tag{12}$$

And bias correction term.

$$\hat{\lambda}_{12}{}^{+} = \hat{\lambda}_{12} - \widehat{\omega}_{12}\widehat{\Omega}_{22}{}^{-1}\widehat{\Lambda}_{22} \tag{13}$$

The FMOLS estimator will be given by:

$$\hat{\theta} = \begin{bmatrix} \hat{\eta} \\ \hat{\zeta} \end{bmatrix} = \left(\sum_{t=1}^{T} Z_t Z_t' \right)^{-1} \sum_{t=1}^{T} Z_t \, y_t^{+} - T \left[\hat{\lambda}_{12}{}^{+;} \right] \tag{14}$$

where $Z_t = (X_t' \, , D_t')'$.

On the other hand, according to Hansen (1992), the Wald statistic for the null hypothesis

$$W = \left(R\hat{\theta} - r\right)' \left(RV\left(\hat{\theta}\right)R'\right)^{-1} \left(R\hat{\theta} - r\right)' \tag{15}$$

Where $v\left[\hat{\theta}\right] = \widehat{\omega_{12}}[\sum_{t=1}^{T} Z_t Z_t']^{-1}$ and an asymptotic χ_g^2 – distribution, where g is

the number of restrictions imposed by R.

We should keep in mind that the FMOLS method provides consistent estimates of β coefficients (the coefficients of the cointegrating equation) in small sample sets, eliminates endogeneity in the regressors, and the serial correlation in the errors (Ramirez 2006 and Kao, Chiang 2000).

3.0.2 DOLS

With a specific end goal to remove the feedback in the cointegrating equation Saikkonen (1992) and Stock and Watson (1993) proposed DOLS as an asymptotically efficient estimator. The cointegrating condition is given by:

$$y_t = X_t'\eta + D_{1t}'\zeta + \sum_{j=q}^{r} \Delta X_{t+j}'\phi + u_{it} \tag{16}$$

Least square estimator of η has an indistinguishable asymptotic distribution of those output by FMOLS, as long as the long-run connection between's the u_{1t} and u_{2t} Is splashed up by Lages q and leads r of the differences regressors that are incorporated into the above regression

3.1 Engle-Granger two-step methodology

We take after the Engle-Granger two-step methodology (Brooks, 2008), which is: a) we look at the order of integration of the variables. On the off chance that they are all I (1) and cointegrated we run the cointegrating regression with FMOLS and DOLS and take the residuals (RESID). Note that the Engel-Granger cointegration test is recommended. By the by, the Pedroni and Kao panel cointegration tests (they are both in view of the Engle-Granger approach), we have shown in our investigation the Johansen panel cointegration test, b) we run the ECMs with OLS utilizing the residuals from the initial step. Logically, the cointegrating condition will be:

$$LGDP_t = \beta LLF_t + RESID_t \tag{17}$$

Where β is the FMOLS and DOLS estimator in view of which methodology (FMOLS

or DOLS) we use. In addition, the estimated cointegrating vector is (1– b), where b the FMOLS and DOLS estimator of β, separately. Note that in the Engle-Granger two-step methodology the OLS method is recommended. In any case, because of the way that we have panel data, we utilize FMOLS and DOLS (as literature recommends) with a specific end goal to get the cointegrating regressions. ECMs will be, separately:

$$DLGDP_t = \beta 1 DLLF_t + \gamma_4 RESID_{t-1} + \varepsilon_t \quad (18)$$

$$DLGDP_t = \beta_2 DLLF_t + \beta_3 DLGDP_{t-1} + \beta_4 DLLF_{t-1} + \gamma_2 RESID_{t-1} + \varepsilon t \quad (19)$$

Where DLGDP is the first difference of the logarithm of GDP per capita, DLLF is the first difference of logarithm of life expectancy, DLLFt-1 and DLGDPt-1 are one-period lagged estimations of the above variables, RESIDt-1 is the ECT and ε*t* is it. Notice that RESID has been estimated from the cointegration equation. Equation (19) will indicate us if DLGDP per capita relies upon DLLF, the one time frame slacked estimations of DLGDP per capita and DLLF and the RESIDt-1. The last one can be study of as an equilibrium error (or disequilibrium term) happened in the past period. If there is chance that it is non zero, the model is out of equilibrium and the other way around. The coefficient β is a long-run parameter and β1, β2, β3, β4 are short-run parameters. Thus, the vector error- correction model (VECM) has both long-run and short-run advantages. Also, γ^1, γ^2 indicate us in what period of time DLGDP per capita will reestablish to the long-run equilibrium.

3.2 Granger Causality

At long last, we test the variables being referred to for Granger causation. There are variables that are correlated, yet they don't cause one another. Therefore, correlation doesn't suggest causation. Granger (1969) tries to discover a methodology that will test if x causes y or, as it were, why is Granger-caused by x. He needed, first, to study the amount of the present estimation of y is explain by its lagged value. What's more, second, if including legged estimations of x predict better the variable

The bivariate regressions in a panel data dimension are

$$Y_{i,t} = \sigma_{0,i} + \sigma_{1,i} y_{i,t-1} + \ldots + \sigma_{l,i} y_{i,t-1} + \tau_{1,i} x_{,it-1} + \ldots + \tau_{l,i} x_{i,t-1} + \pi_{i,t} \quad (20)$$

$$X_{i,t} = \sigma_{0,i} + \sigma_{1,t} X_{i,t-1} + \ldots + \sigma_{1;i} X_{i,t-1} + \tau_{1,i} y_{,it-1} + \ldots + \tau_{1;i} y_{i,t-1} + \pi_{i,t} \quad (21)$$

Where t represents the period of time of the panel and i for the cross-section. There are two methodologies depend on which anyone can utilize Granger causality.

$$\square 0,i \square \square j ,\square 1,i \square \square 1, j ,...,\square l ,i \square \square l , j ,\square i, j$$

$$\square 1,i \square \square 1, j ,...,\square l ,i \square \square l , j ,\square i, j$$

Granger Causality equation is utilized for each cross-section independently. At that point mean W-bar statistics are taken. Note that the Z-bar statistics, which is the standardized version of the above statistics is suitably said weighed in unbalanced panel.

Results

In this segment we will explore the connection between growth utilizing GDP per capita as its indicator and health status of the two genders. We will show both short run and long run impacts of life expectancy of male and females on GDP per capita.

4.0 Stationarity

In this study we will test male life expectancy and female life expectancy for stationarity. Most importantly, we plot the graph of life expectancy of male and female together for every one of the 42 countries. Blue lines demonstrate the log of life expectancy of the male, and the red ones portray the log of life expectancy of female. As we watch, in the vast majority of the countries we consider the life expectancy of females is higher than that of males. In addition, the lines are parallel in all cases, which implies that the life expectancy of the two genders increase analogically. At long last, we see that the life expectancy of the two sexes has an upward trend, that is the arrangement appear to be non-stationary.

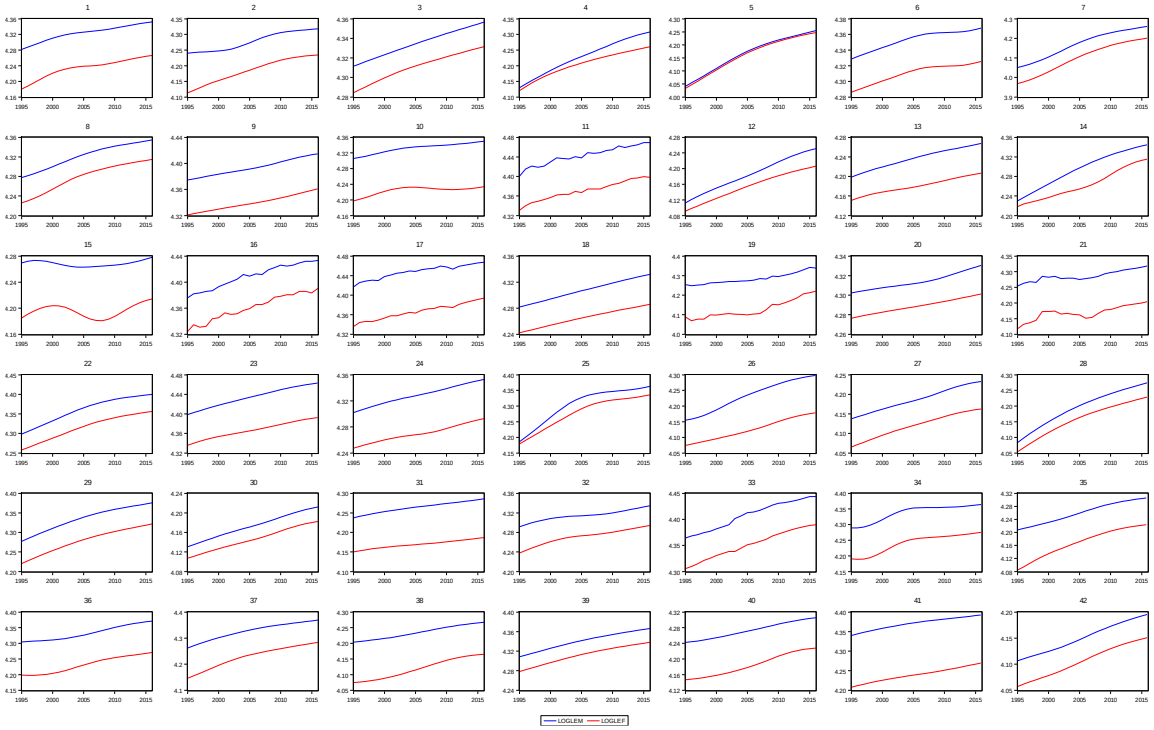

Figure 4. 1 Log of life expectancy male and female

We will utilize the IPS unit root tests, with a specific end goal to analyze if the series is stationary or not. We do the test considering about the AIC. Table 4.1 shows two cases, the result of the test in after including just individual intercept and both individual intercept and trends. The numbers of the observation for life expectancy of males in the two cases are 769 and 760, separately. With respect to the life expectancy of female it is 770 and 773.

Table 4.1: IPS unit root test

Log of life expectancy of:	**Male**		**Female**	
H_0: Unit root	**t-stat.**	**Prob.+**	**t-stat.**	**Prob.+**
Individual effects	-10.399	0.000*	-3.073	0.001*
Individual effects & trend	-2.037	0.021	-1.581	0.056

Probabilities are computed assuming asymptotic normality.Note: * denote rejection at 1%level, respectively.

As should be obvious from table 4.1, life expectancy of male and female reject the null hypothesis at 1% confidence interval in case of individual effect. In case of both individual intercept and trend does not reject at 1% intervals. Accordingly, considering the IPS unit root test, and the graphs we presume that the two series are not stationary.

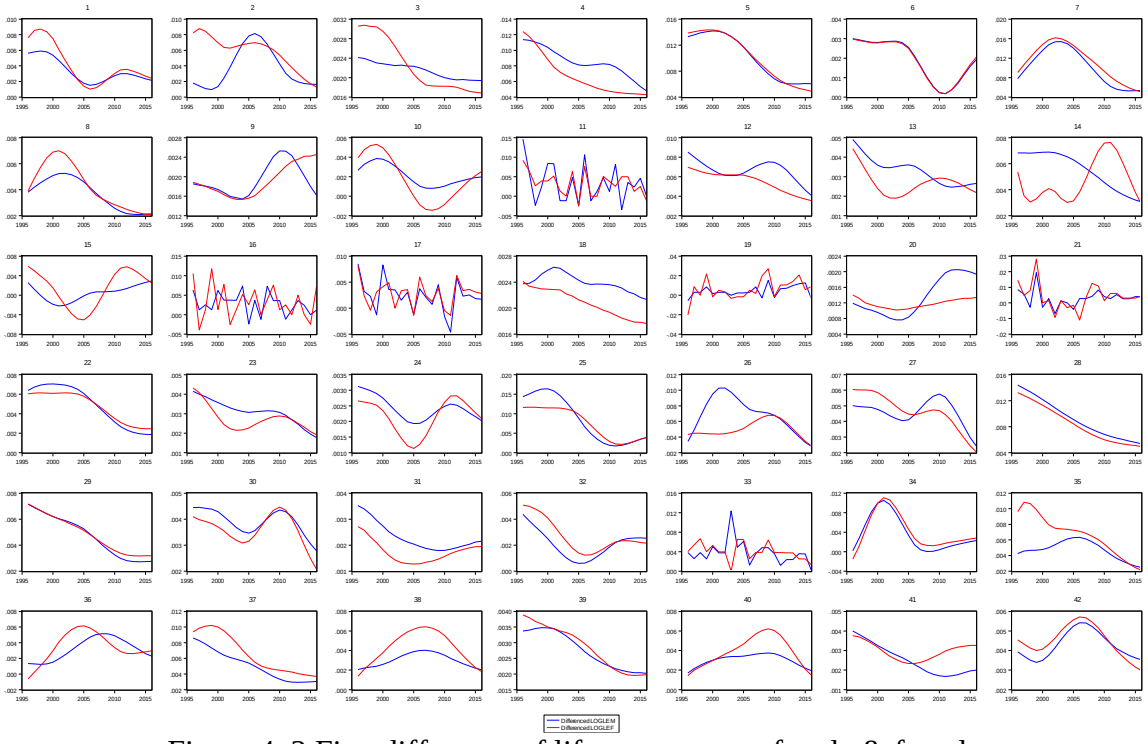

Figure 4. 2 First difference of life expectancy of male & female

As should be obvious from figure 4.1, the two variables are seems stationary. Thus, we utilize the IPS unit root tests, including individual intercept and both individual intercept and trend, keeping in mind the end goal to prove it. The outcomes are introduced in table 4.2. We again pick AIC. The number of observations on account of the male life expectancy variable is 773 and 751. Be that as it may, the number of observations on account of female life expectancy is 740 and 747, individually.

Table 4.2: IPS unit root test

Log of life expectancy of:	**Male**		**Female**	
H_0: Unit root	**t-stat.**	**Prob.$^+$**	**t-stat.**	**Prob.$^+$**
Individual effects	-7.757	0.000*	-6.5422	0.000*
Individual effects & trend	-14.232	0.000*	-15.266	0.000*

Probabilities are computed assuming asymptotic normality. Note: * denotes rejection at 1% level.

From table 4.2 we infer that the null hypothesis that there is a unit root is rejected at even 1% confidence interval for the two variables in the two cases, as the t-statistic p-values equivalent to zero, that is they are less than 0.01. Thus, the first difference in life expectancy of male and female is a stationary procedure. On the other hand, the levels of the series are coordinated of one degree, I (1). We remind that in segment 4.1.1 we have demonstrated that GDP per capita is, additionally, I (1). Thusly, we will test for cointegration the two variables.

4.1 Cointegration and Error Correction

The tests we utilize to explore if there is an equilibrium connection between GDP per capita and both life expectancy of male and females are the Pedroni, Kao and Johansen cointegration tests. Table 4.3 underneath report the outcomes of the Kao (no deterministic trend is prohibited) and Pedroni cointegration tests were considered three cases. The first case is that there isn't deterministic trend, the second that there is deterministic intercept and trend and the third that there is no deterministic intercept or trend. The number of observations in all cases in the two (life expectancy of male-GDP per capita and life expectancy of female-GDP per capita) is 924. The quantity of lags is, additionally, picked in light of the AIC. Besides, the null hypothesis of the Pedroni and Kao cointegration test is that there is no cointegration connection between GDP per capita and life expectancy of male and life expectancy of female. Keep in mind that the Pedroni cointegration test divided into two sections. In the first we expect a common AR coefficient for every country and in the second one individual AR efficient of female

Remember that the Pedroni cointegration test consists of two parts. In the first one we assume the same AR coefficients for each country and in the second one different coefficisn’t.

Table 4.3: Pedroni & Kao cointegration tests

		Male			Female		
		H_0: no cointegration between LGDPC and male LLF			**H_0: no cointegration between LGDPC and female LLF**		
Pedroni		No deterministic trend	Determiist c intercept and trend	No deterministic intercept and trend	no deterministc trend	deterministic intercept and trend	no deterministic intercept and trend
		Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
H_1: common AR coef.	Panel v-Statistic	2.291 (0.011) **	3.775 (0.000) *	-3.084 (0.999)	1.036 (0.149)	6.254 (0.000) *	-3.014 (0.998)
	Panel rho-Statistic	0.163 (0.565)	2.539 (0.995)	1.908 (0.972)	0.644 (0.740)	1.809 (0.694)	1.940 (0.974)
	Panel PP-Statistic	0.076 (0.530)	2.633 (0.995)	1.294 (0.902)	0.517 (0.697)	0.728 (0.767)	1.333 (0908)
	Panel ADF-Statistic	-3.889 (0.000) *	-3.208 (0.000) *	0.316 (0.624)	-2.478 (0.006) *	-4.534 (0.000) *	0.162 (0.565)
H_1: individual coef.	Group rho-Statistic	2.639 (0.995)	3.491 (0.999)	6.424 (1.000)	2.405 (0.992)	3.347 (0.999)	-3.014 (0.998)
	Group PP-Statistic	1.187 (0.883)	0.009 (0.503)	4.719 (1.000)	0.751 (0774)	-0.013 (0.494)	1.940 (0.974)
	Group ADF-Statistic	-3.284 (0.000) *	-6.251 (0.000) *	1.126 (0.874	-4.793 (0.000) *	-5.592 (0.000) *	1.334 (0.908)
Kao							
ADF-Statistic		-0.778 (0.218)			-1.076 (0.141)		

Note: *,** denote rejection at 1%,5% level, respectively. Figure in () shows p- value

Besides, the sections1-3 demonstrate the outcomes for the case of the male and the columns 3-9 for the case of females. On account of the male, as should be obvious from table 4.3, the null hypothesis is rejected at even 1% confidence interval for a few of the panels and group tests, as the probability is less than 0.01, both including individual effects and individual effects and trends (on account of females just 5 tests reject). In any case, on account of avoidance of individual effects and trends, the null hypothesis isn't rejected even at 10% confidence interval. On account of female life expectancy, when we incorporate just consistent, 5 out of 7 tests dismiss the null hypothesis at even 1% level. Counting both steady and trends, yields that 6 out of 7 tests rejected at 1% level and the last one at 10%. On account of avoidance of both intercept and

trend the null hypothesis isn't rejected. Subsequently, in light of the initial two cases, we can state that there is equilibrium connection between male life expectancy and GDP per capita in, and female life expectancy and GDP per capita in few tests.

Additionally, in light of the Kao cointegration test there is (a weaker contrasted with the initial two cases of the Pedroni tests) cointegration connection between the log of GDP per capita and life expectancy of male and females at 5% an10% confidence interval, separately. Note, likewise, that the numbers of the observation is again 924 and the quantity of lages is chosen by AIC.

At long last, we will show the results of the Johansen unrestricted cointegration rank test. Table 4.4 underneath present the outcomes of Trace and Maximum-Eigenvalue tests. The null hypotheses are; a) there isn't cointegrating regression between the log of GDP per capita and life expectancy of male and females (4rd and sixth line), b) there is at most one cointegrating regressions somewhere in the range of them (5th and seventh lines). The outcomes for male can be seen at 3-6 segments and that of females at 7-10. Besides, we assume two cases, that there is no intercept or trend in cointegrating equation and Var (lines 4 and 5) , and that there is both intercept and trend in cointegrating regression and just trend in Var (columns 6 and 7). Note, likewise, that the numbers of the lags is two

Table 4.4: Johansen Cointegration Test

Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)									
		Male				**Female**			
	Null Hypothesis	**Trace**	**Prob.+**	**Max-Eigen**	**Prob.+**	**Trace**	**Prob.+**	**Max-Eigen**	**Prob.+**
No intercept or trend in CE or Var	**None (r=0)**	512.7	0.000*	485.3	0.000*	464.8	0.000*	442.7	0.000*
	At most 1 (r<=1)	123.6	0.003**	123.6	0.003**	116.4	0.011**	116.4	0.011**
Intercept & trend in CE & no trend in Var	**None (r=0)**	4031.	0.000*	1052.	0.000*	4407.	0.000*	1010.	0.000*
	At most 1 (r<=1)	185.9	0.000*	185.9	0.000*	205.4	0.000*	205.4	0.000*

Probabilities are computed using asymptotic Chi-square distribution. Note: * denote rejection at 1%level respectively.

Based on table 4.4, in case of male life expectancy, the null hypothesis that there is no cointegrating equation between the variables in question, is rejected at even 1% confidence interval, in both cases we consider. On the other hand, the null hypothesis that there is at most one cointegrating equations between the variables is not rejected even at 10% confidence interval. As for female life expectancy, we get the same results in the case of exclusion of constant and trend. However, in the case of inclusion both constant and trend in cointegrating equation and only constant in Var, we obtain the same results but at 1% confidence interval. In other words, there is evidence of an equilibrium relation between log of GDP per capita and log of life expectancy of males and females in a weaker way.

All in all, we can say that there exists an equilibrium relationship between both the health status of males, and females and GDP per capita. As a result, we are going to examine these links by running both cointegrating regressions with FMOLS and DOLS methods and ECMs with OLS.

First of all, table 4.5 shows the cointegrating equations of logarithm of life expectancy at birth of male and female (LLF for both of them) and the logarithm of GDP per capita. Columns 3-5 account for the case of male and 6-8 of female employed both with FMOLS and DOLS methods,. The number of observations when we take into account life expectancy of males is 882 and 798 in the case of FMOLS and DOLS method, respectively. However, taking into account life expectancy of females, it is 882 and 798, respectively.

Table 4.5: Cointegrating Equations

		Male			**Female**		
	1.LGDPC= βLLF						
Method	**Variable**	**Coefficient**	**t-stat.**	**R^2**	**Coefficient**	**t-stat.**	**R^2**
FMOLS	**LLF**	6.977*	18.349 (0.000)	0.982	29.160*	19.414 (0.000)	0.982
DOLS	**LLF**	10.551*	20.168 (0.000)	0.995	35.852*	20.415 (0.000)	0.996

Note: * denotes significance at 1% level. Figure in () shows p- value

As should be obvious from table 4.5 the log of life expectancy of both male and female is statistically significant it is possible that we utilize FMOLS or DOLS at even 1% confidence interval. We observe, additionally, that the R-squares are too large. When we utilize FMOLS, R-square is around 98% for the instance of male and 98% for the instance of female. This is recommended health standard of male (females) show the model by 98% (98%). Moreover, the coefficient in interest, that explain to us the long run connection between GDP per capita and life expectancy of male or females is around 6.97 or 29. 10, for the situation our analysis the model by

FMOLS. This implies, if life expectancy at birth of male or female increase by 1%, GDP per capita will increase by 6.97% and 29.10%, individually. Also, the same that we analysis the model utilizing DOLS method, these coefficients will be 10.5 and 35.8, separately. That is, if life expectancy of male or female increase by 1%, GDP per capita will increase by 10.5% and 35.8%. We observe, from the above examination, that the coefficient of life expectancy at birth of males and that of females are much close in the two cases (FMOLS, DOLS). Subsequently, the health level of male and females has positive, statistically significant, and of same size effect on GDP per capita.

The above was the initial step of the Engle-Granger two-step methodology (Brooks, 2008). Beneath we estimate the second one. In this method we get the residuals from the initial step estimations (with FMOLS and DOLS) on account of male life expectancy and female future. We assume that the two regressions. In the first we do exclude the lages, however in the second one we include one lag in the two variables. Note that including more Lages the outcomes are fundamentally the same as. These results are displayed in table 4.41 and 4.42. In table 5.41 we present the consequences of the two ECMs for both male and female life expectancy considering the residuals that yielded from FMOLS estimation of cointegrating equations and in table 4.6 from DOLS.

Table 4.6: ECMs

		Male			**Female**		
	2.DLGDPC=$\alpha_1+\beta_1$DLLF+γ_1ECT(-1)						
Method	**Variable**	**Coefficient**	**t-stat.**	**R^2**	**Coefficient**	**t-stat.**	**R^2**
OLS	**DLLF**	0.189*	7.702 (0.000)	0.317	0.121*	3.531 (0.000)	0.302
	ECT(-1)	-0.019*	-5.917 (0.000)		-0.018*	-5.069 (0.000)	
	C	0.019*	24.022 (0.000)		0.019*	23.544 (0.000)	
	3.DLGDPC=$\alpha_2+\beta_2$DLLF+β_3DLGDPC(-1)+ β_4DLLF(-1)+γ_2ECT(-1)						
Method	**Variable**	**Coefficient**	**t-stat.**	**R^2**	**Coefficient**	**t-stat.**	**R^2**

OLS	**DLLF**	0.177*	7.327 (0.000)	0.347	0.127*	3.645 (0.000)	0.335
	LGDPC(-1)	0.204*	9.446 (0.000)		0.208*	9.681 (0.000)	
	DLLF(-1)	-0.014	-0.598 (0.549)		0.062***	1.810 (0.070)	
	ECT(-1)	-0.018*	-5.732 (0.000)		-0.018*	-5.149 (0.000)	
	C	0.015*	16.839 (0.000)		0.015*	15.823 (0.000)	

Note: * and *** denote significance at 1% and 10% level, respectively. ECMs are estimated by OLS using the residuals from FMOLS cointegrating regressions. Figure in () are p-value.

As we said before table 5.6 shows two models for each gender, the one without legs and the one with one leg in first differences of log of life expectancy of male or female and GDP per capita. The coefficients of the first difference, give us the short-run connection between the variables being referred to. They are on the whole positive and statistically significant at even 1% confidence interval, aside from DLLF (- 1), the one final time frames growth rate of life expectancy, which on account of male life expectancy is irrelevant at even 10% level and on account of female life expectancy is significant at the 10 % level. Additionally, we give it a second thought, likewise, about the error correction term (ECT). As should be obvious from table 4.6, this parameter is statistically significant at even 1% confidence interval in both two models and for both genders. Additionally, we see that it is negative, which guarantees that it adjusts the deviation from the long-run equilibrium relationship. Additionally, when we consider male life expectancy at birth as an is independent variable, the ECT is around - 0.019, however, when we consider female life expectancy it is - 0.018. That is, 1.9% or 1.8% of the inconsistency between GDP per capita and male or female life expectancy in the earlier year is wiped out this year. On the other hand, 1.9% or 1.8% of the last time frame's equilibrium error is adjusted.

Table 4.7: ECMs

		Male				**Female**	
	2.DLGDPC=β_1DLLF+γ_1ECT(-1)						
Method	**Variable**	**Coefficient**	**t-stat.**	**R^2**	**Coefficient**	**t-stat.**	**R^2**
OLS	**DLLF**	0.157*	6.523	0.311	0.093*	2.731	0.298

			(0.000)			(0.006)	
	ECT(-1)	-0.013*	-3.724 (0.000)		-0.013*	-3.671 (0.002)	
	C	0.020*	24.634 (0.000)		0.021*	24.508 (0.000)	
	3.DLGDPC=α_2+β_2DLLF+β_3DLGDPC(-1)+ β_4DLLF(-1)+γ_2ECT(-1)						
Method	**Variable**	**Coefficient**	**t-stat.**	**R^2**	**Coefficient**	**t-stat.**	**R^2**
OLS	**DLLF**	0.151*	6.328 (0.000)	0.342	0.115*	3.284 (0.001)	0.333
	DLGDPC(-1)	0.202*	9.252 (0.000)		0.205*	9.427 (0.000)	
	DLLF(-1)	0.021	0.908 (0.364)		0.104*	3.028 (0.003)	
	ECT(-1)	-0.014*	-4.164 (0.000)		-0.015*	-4.54 (0.000)	
	C	0.016*	17.131 (0.000)		0.015*	16.335 (0.000)	

Note: * denotes significance at 1% level. ECMs are estimated by OLS using the residuals from DOLS cointegrating regressions. Figures in ( ) are p-value

As indicated by table 4.7 The short run coefficients are again positive and statistically significant at even 1% intervals, aside from DLLF (- 1) which is statistically insignificant, just on account of male life expectancy. Besides, the ECT is again statistically significant at even 1% confidence interval in both two models and for both genders. It is, likewise, negative and again this guarantees it amends the deviation from the long-run equilibrium relationship. When we consider male life expectancy at birth as an independent variable, the modification term is around - 0.013 and - 0.014 out of both models, separately. When we consider female life expectancy as an independent variable, it is around - 0.013 and - 0.016, separately. That is, 1.3% or 1.4% of the inconsistency between GDP per capita and male life expectancy in the earlier year is wiped out this year. Likewise, 1.3% or 1.6% of the discrepancy between GDP per capita and female life expectancy in earlier year doesn't exist this year. Therefore, both male and female health standard influence economic growth not only in the short- run as well as over the long run. At last, in table 4.43 panel Granger causality tests are given. As we said in past sections, they reveal if there is any causation connection among male and female life expectancy at birth and GDP per capita.

Table 4.8: Panel Granger causality test

	Male			Female		
Null Hypothesis:	**W-Stat**	**Zbar-Stat.**	**Prob.**	**W-Stat**	**Zbar-Stat.**	**Prob.**
DLLF does not Granger Cause DLGDPC	5.131	6.566	0.000*	4.450	4.968	0.000*
DLGDPC does not Granger Cause DLLF	2.694	0.847	0.396	3.755	3.339	0.000*

Note *, denote rejection at 1% level. The test is based on Dumitrescu- Hurlin (2012) technique.

In table 4.8 the null hypothesis considered are: (I) the growth rate of life expectancy of either male (lines 2-4) or female (lines 5-7) does not cause the growth rate of GDP per capita and (ii) the growth rate of GDP per capita does not cause the growth rate of life expectancy of either male or female. On account of male, one invalid theories are rejected at even 1% confidence interval. Subsequently, lag value growth rate of male life expectancy clarifies the present estimation of the growth rate of GDP per capita and alternately. Accordingly, there is a weak causation running from the growth rate of life expectancy to the growth rate of GDP per capita. The second null hypothesis, however, is rejected at even 1% level in female case. In this manner, lagged estimations of the growth rate of GDP per capita clarify the present estimation of the growth rate of female life expectancy. By and large talking, there is a two way causality between the two sets of variables. At long last, the causation running from life expectancy to GDP per capita is predictable with the result of the statistically significant and positive short-run coefficients that we get from tables 4.7 and 4.8.

Therefore, we locate a positive and measurable noteworthy effect of the two sexes' health standard on GDP per capita in the short-run and over the long Run.

Conclusion and Policy Recommendation

Health enhancements can cause a rise in total GDP through both the rise of population, yet for the most part, through the additions in human and physical capital which have subsequently the rise in productivity and GDP per capita. In this examination we utilized a balanced panel of 42 countries, for the time period 1995-2017. Additionally, we tried if there isn't just short-run, yet in addition long-run connection among health and growth. We, analyzed the connection among growth and every gendder’s life expectancy.

Above all else, we test for unit root all variables and yielded that they are all non-stationary, or integrated of degree one, I (1). At that point we present that there are balance relations between life expectancy (total, male, and

female) and GDP per capita. Cointegrating equation, that were utilized through FMOLS and DOLS methodologies, present that health standard of the citizens of a nation have a positive and statistically significant impact on total and per capita output over the long run. A similar outcome yielded after the discrimination of the two genders. Both health levels of male and females have positive and statistically significant effect of a similar size with one another. Moreover, error correction models suggested that there is both short-run and long-run connection between total, male and female life expectancy and GDP per capita. At long last, we found that there is a turn around causality in the three pairs of variables, the growth rate of male life expectancy and both growth rate of GDP per capita, and growth rate of female life expectancy and growth rate of per capita income. Thusly, there is a solid, proven that the health status of the total male and females has a positive, sizable and statistically significant effect on the economic growth of the country. The policy recommendations are:

- It would be useful if policy makers considered health enhancement as an approach to accelerate the economy's growth.

- Also, higher need can be given to illness that don't have high burden of mortality, yet do influence productivity

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