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Abstract

This paper has tried to analyze the socioeconomic determinants of total as well as gender specific life expectancy in Turkey from 1971 to 2017. Data stationarity has been checked by ADF, PP and DFGLS unit root tests, the time series structural breaks have been checked with the help of Zivot and Andrews (2002) unit root test, and cointegration has been checked with the help of the ARDL bound testing method. The estimated results show that the overall level of education, purchasing power and economic development have a significant role in deciding total average life expectancy in Turkey. Whereas, population growth and environmental degradation have an insignificant contribution in deciding total average life expectancy in Turkey. Estimates show environmental degradation, purchasing power and level of male education have contributed significantly in male life expectancy in Turkey. Economic development and share of the male population have an insignificant role in deciding life expectancy of male in Turkey. Environmental degradation, the level of female education, fertility rates and female population significantly effected female life expectancy, but purchasing power has an insignificant role in deciding life expectancy of female in Turkey. The results recommend that the government of Turkey should enhance the level of education and try to stable purchasing power and sustainable development with controlled fertility rates for higher level life expectancy.

Keywords: life expectancy, education, environmental degradation, population growth

Introduction

Long life the ultimate objective of human being since its emergence on the earth and most of human research circle around long life expectancy (Colantonio *et al.*, 2010; Ali, 2015). Especially from few decades, a country is socioeconomically developed if it has a long life (UNDP, 1991). Following the ideology of classical economics, a country is considered developed if it has more command of natural and human resources respective of their quality (Anand and Ravallion, 1993). But last three decades of 20th century's development economics changes the whole scenario of development, it is not development to control the resources, but the development is that how capable a nation to reduce hunger, mortality and morbidity (Sen, 1983). Low death rate and higher life expectancy represent the health status of the nation, as number of socioeconomic and environmental factors are responsible for long life. Empiric reveals that

Japan, USA and Canada have risen trend in life expectancy, but number African and Asian countries have decreased trend in overall life expectancy. Health facilities, higher literacy rate, better sanitation, clean water and technological advancement are some of the main factors which are responsible for this difference (Kakwani, 1993; Gerring et al., 2005; Grosse and Aufiey, 1989; Preston, 1980; Lake and Baum, 2001; Navarro et al., 2006; Ali and Khalil, 2014; Franco et al., 2004; Mahfuz, 2008; Shen and Williamson, 1997; WHO, 2005). A number of other studies mention that better working conditions, better living environment, intergenerational transfers, social security benefits, better maternal health care, income inequality, better education and higher income, fertility human capital investment and cost of health cares impact the average life expectancy of the nations (Poikolainen and Eskola, 1988; Navarro et al., 2006; Halicioglu, 2010; Wolfe, 1986; Hertz et al., 1994; Preston, 1976; Cumper, 1984; Lake and Baum, 2001). While discussing the importance of socioeconomic factors for life expectancy, Kakwani (1993) and Preston (1980) point out that education, sanitation, environmental degradation, coverage of social safety nets and public sector resources for the health sector.

Turkey has achieved average life expectancy at birth 78 years during 2015 and 2017. The expected life of female is higher than male i.e. female life expectancy is 80.8 years and male life expectancy is 75.3 years. 64.1 years average life expectancy has achieved, for those who start working at the age of 15 years, from them male have 61.1 years average life and female have 66.8 years average life. For 30 years old, remaining life expectancy is 49.6. This life span is 47.1 for men and 52.1 for women. 50 years old have 30.5 years more life expectancy in general, male have 28.2 years and female have 32.7 years. For 65 years old, women also outlived men by 3.2 years and this life span is 17.7 in general, male have 16 years and female have 19.2 years. Tunceli province in the eastern part of Turkey has achieved 80.7 years which is highest life expectancy in Turkey, followed by the southwestern Muğla province by 80.3 and northeastern Trabzon province with 80 years. Provinces with lowest life expectancy were southeastern Kilis province with life expectancy 76.1 years, followed by eastern Ağrı province and western Kütahya province with life expectancy 76.8 years, northeastern Ardahan province and southeastern Gaziantep province have life expectancy 76.9 years. Males in Muğla have 77.6 years life span which is the highest Turkey, Tunceli have male life expectancy 77.4 years and southeastern Adıyaman have male life expectancy 77.3 years. Kilis have lowest male life span i.e. 72.9 years, Şırnak province has male life expectancy 73.4 years and Hakkari province has 74.1 years. Tunceli province have highest female life expectancy i.e. 84.2 years, followed by the northeastern provinces of Gümüşhane, 83.5 years and Trabzon have 83.4 years. Kütahya province has lowest female life expectancy i.e. 79.1 years, followed by the eastern Agri province by 79.3 and the southeastern provinces of Gaziantep, Van, Kilis with 79.5 years. Average life expectancy was 78.7 years in Istanbul, and the figure was 79.4 in Ankara. As Turkey's most populous provinces, Istanbul and Ankara stood above the averages of the country. So, Turkey presents an interesting scenario to examine the determinants of overall and gender specific life expectancy.

Literature Review

Following the empirical and theoretical literature which highlight the determining factor of life expectancy, in this part, we have chosen the most recent and relevant studies as a review of literature. Cockerham et al. (1997) examine the determinants of adult mortality in some East European and Russian states during the last few decades. Lifestyle, social status and health policy have been given much importance as determinants of mortality rate. The estimates show that socialist states have a higher mortality rate and it is continuously rising, particularly among the manual workers of middle-aged group. The existing health policies of these countries and Russia has become ineffective to control this crisis. This study recommends that high fat diets, lack of exercise, extensive smoking, high consumption of alcohol and poor working condition need to be checked strictly to reduce high morality in these nations. Williamson and Boehmer (1997) analyzed the impact of economic development, health status, gender stratification on female life expectancy in developing and developed nations. Actually, this study has tested the gender stratification theory by taking female life expectancy as the dependent variable. For empirical analysis, cross sectional data of 97 less developed and 40 developed countries have been used. Educational status, economic status, reproductive autonomy has been used for measuring the female status. The results of this study show that in one hand female educational status, reproductive authority and economic status and are impacting on life of female positively and significantly.

Lin et al. (2003) study the effect of political and social factors on an average life span of the masses in the case of 119 developing countries from 1970 to 2004. Nutritional status, economic growth, political regime and literacy rate are explanatory factors while life expectancy is explained variable. In this study, for empirical findings ordinary least squares have been utilized. The estimated findings show that in a short run democracy has significant and positive influence on life expectancy whereas this relationship is undefined. Nutritional and socioeconomic factors have significant influence on the overall average life span of the masses. Democracy provides an encouraging environment for increasing life expectancy. Shaw et al., (2005) examine some of the main elements of average expected life of human in OECD countries from 1960-1999. For the empirical analysis, residual based maximum likelihood techniques have been applied. Expenditures on medication, have a significant and positive impact on middle aged and old aged life expectancy in OECD countries. The authors have mentioned that by ignoring the age distribution, then expenditures on medication has an insignificant effect on life expectancy in the OECD. Yavari and Mehrnoosh (2006) life expectancy and its determinant in 89 developing countries. In the cross-sectional study, 19 countries are selected from Latin America, 17 from Asia, 33 from Africa and 20 countries are selected from Europe. The estimates of this study reveal that the number of doctors per population, daily calories, literacy rate, health expenditures and income per capita have a significant role in deciding life expectancy. The study also highlights the importance of human capital expenditures on life expectancy, this article recommends that daily calories, literacy rate, health expenditures and income per capita need to be improved for higher life expectancy.

Halıcıoğlu (2010) examines the indicators of average life span in Turkey from 1965 to 2005. The study uses environmental, social and economic related factors for determining life expectancy. Nutrition and availability of food have a significant effect over Turkish life expectancy. The article recommends that for higher level of life expectancy, Turkish government improve the socioeconomic and environmental conditions of the country. Bergh and Nilsson (2010) analyze the influence of political globalization, social globalization and economic globalization on life expectancy for 92 developing countries from 1970-2005. The findings of the study show that income per capita, nutritional intake, literacy rate, number of doctors per thousand population and economic globalization have a significant effect on life expectancy. The study recommends that for higher life expectancy in developing countries, economic globalization must be encouraged. Balan and Jaba (2011) explore the main factors impacting the average life of the masses across different regions in Romania during 2008. The results of panel OLS reveal that wage rate, hospital beds, number of doctors per thousand population and library users are impacting life expectancy positively and, significantly, but population growth and illiteracy rate have negatively influenced on Romanian life expectancy. In another study, Oney (2012) explores that how expenditures on health and lifestyle impact on health outcomes in the case of OECD countries. Lifestyle has been measured with the help of tobacco use, alcohol consumption and level of education. The estimated outcomes mention that level of education, enhance overall life expectancy and reduce mortality rate at all levels, whereas the use of tobacco and consumption of alcohol increases mortality rate and reduce life expectancy at all levels.

Bayati et al. (2013) test the Grossman model with the help of health indicators for East Mediterranean countries over the period of 1995-2007. This article, outcomes shows that the employment rate influences the gender specific life expectancy in nations, the study recommends that for higher life expectancy these countries should improve economic conditions with better health care facilities. Mahmud et al. (2013) explore the interaction between expenditure on health and growth on overall average life expectancy and gender-based life expectancy in Bangladesh over the period 1995-2011. For the last 15 years female life expectancy is higher as compare to male in Bangladesh. The study recommends that for overall higher life expectancy the government of Bangladesh should improve economic growth with more per capita health expenditures. Singariya (2013) examines the determinants average life expectancy at birth among the different states of India. The projected consequences show that socioeconomic factors have deep influence on normal life expectancy among Indian states. For higher life expectancy, the Indian government must improve electrification, housing facilities, telephone access, health expenditures, literacy rate and income per capita at the same time. Ali and Ahmad (2014) explore the influence of the availability of food, education, inflation rate, growth of population, degradation of the environment and per capita income on normal life expectancy in Oman from 1970-2012. ARDL method is applied for estimations. The available food and level of education have significant, whereas inflation rate, environmental degradation as well as per capita income have insignificant effect on life expectancy. The study recommends that for higher life expectancy socioeconomic conditions of Oman can be improved.

Murwirapachena and Mlambo (2015) study the main indicators of average expected life of masses in Zimbabwe over the period of 1970-2012. Population growth, rate of inflation, economic growth, agricultural land and dependency ratio are selected determinants of the expected lifetime of the masses. Results display that rate of inflation, population growth and economic growth have positive relationships with life expectancy, whereas, agricultural land and dependency ratio impact negatively expected lifetime in Zimbabwe. Monsef and Mehriardi (2015) highlight the factor impacting expected life of 136 countries from 2002 to 2010. This article covers the social, economic and environmental dimensions of the countries. The study finds unemployment and inflation impact negatively life expectancy, whereas income impacts positively. The study recommends that for higher life expectancy better socioeconomic and environmental conditions are needed. Shahbaz et al. (2015) highlight factors affecting life expectancy in Pakistan from 1972-2012. The study recommends that for higher life expectancy the government of Pakistan should reduce economic misery with better socioeconomic environment. Razzak et al. (2015) explore the indicators of expected life in 40 Asian countries. With the help of the PCA health index has been constructed. The estimates reveal that the infant death rate, crude mortality rate and crude birth rates have inverse effect average life span in Asian countries. Audi and Ali (2016) study the socioeconomic causes of the life span of human in the case of Lebanon from 1971-2014. Availability of food, environmental degradation, education level, income per capita and growth of population are selected socioeconomic factors of life expectancy. The study mention, the all variables has a significant effect on Lebanon's expected life over the selected time period.

Economic Model and Data Sources

This article investigates the overall and gender specific life expectancy in Turkey from 1971 to 2017. This article follows the theoretical framework of Ali and Audi (2016), Ali and Khalil (2014), Fayissa and Gutema (2005), Ali (2015) and Grossman (1972) the overall and gender specific models of our study becomes as:

$$TLE_t=f\ (SSE_t,\ SUS_t,\ INF_t,\ ECOD_t,\ PG_t) \quad (1)$$

Where

TLE= total life expectancy (average life expectancy at birth)

SSE= level of education (measured with the help of secondary enrollment)

SUS= environmental degradation (measured with the help of CO2 Emission)

INF= purchasing power (measured with the help of inflation)

ECOD= economic development (measured with the help of GDP per capita growth)

PG= population growth

t= time period

For gender specific life expectancy, the male life expectancy model becomes as:

$$MLE_t=f\ (SUS_t,\ INF_t,\ ECOD_t,\ SSEM_{t,}\ POPM_t) \quad (2)$$

Where

MLE= male life expectancy (average male life expectancy at birth)

SUS= environmental degradation (measured with the help of CO2 Emission)

INF= purchasing power (measured with the help of inflation)

ECOD= economic development (measured with the help of GDP per capita growth)

SSEM= level of male education (measured with the help of secondary enrollment of male)

POPM= male population

The female life expectancy model becomes as:

$$FLE_t=f\ (SUS_t,\ INF_t,\ ECOD_t,\ SSEM_{t,}\ POPM_t) \quad (3)$$

Where

FLE= female life expectancy (average female life expectancy at birth)

SUS= environmental degradation (measured with the help of CO2 Emission)

INF= purchasing power (measured with the help of inflation)

SSEF= level of female education (measured with the help of secondary enrollment of female)

FER= fertility rate

POPF= female population

Data of all variables is taken from the World Bank official website.

Econometric Methodology

In the process of quantitative analysis, applied Econometrics plays an important role, or simply we can say any type of quantitative analysis Econometrics is like a life blood. While using time series data, there is issue of time trend which makes the regression results of time series spurious (Nelson and Plosser, 1982). This existence of trend in data, makes data non-stationary which make the estimated results biased. Non-stationary data have two main issues such as there is no long run mean to which the series has to return, and the variance will depend on time and will approach infinity as time goes to infinity. So, estimated results become biased. The number of unit root methods which remove the non-stationarity issue of the data. Following the different properties, this paper uses Dickey-Fuller Generalized Least Squares (1996), Phillips Perron (1988) and Augmented Dickey Fuller (1981) unit root tests for removing the issue of non-stationarity of the data. For Augmented Dickey Fuller (ADF) we have to follow this procedure:

$$X_t = \phi X_{t-1} + e_t \qquad \text{AR (1)} \qquad (4)$$

If

$$|\phi| \geq 1 \text{ non-stationary}$$

and

$$|\phi| < 1 \text{ stationary}$$

If unit root exists the variable is non-stationary;

$$X_t = \phi_1 X_{t-1} + \phi_2 X_{t-2} + e_t$$

$$X_t = \phi_1 L X_t + \phi_2 L^2 X_t + e_t$$

Where L is lag operator, taking X_t common we get;

$$X_t = X_t\left(\phi_1 L + \phi_2 L^2\right) + e_t$$

Letting

$$\phi L = \phi_1 L + \phi_2 L^2$$

We get

$$X_t = \phi L X_t + e_t$$

Solving for e_t we get;

$$X_t - \phi L X_t = e_t$$

Let

$$1 - \phi L = 0$$

$$L = 1/\phi$$

If $L > 1$ Time series will be stationary

$$-1 < \phi < 1$$

$$X_t - X_{t-1} = \phi X_{t-1} - X_{t-1} + e_t \qquad \text{AR (2)} \qquad (5)$$

$$\Delta X_t = X_{t-1}(\phi - 1) + e_t$$

$$\Delta X_t = \delta X_{t-1} + e_t \qquad (6)$$

Where

$$\delta = \phi - 1$$

$\delta = 0$ non-stationary

$\delta < 0$ stationary

General equations of ADF are written as:

$$\Delta X_t = \delta X_{t-1} + \sum_{j=1}^{q} \phi_j \Delta X_{t-j} + e_{1t} \quad (7)$$

$$\Delta X_t = \alpha + \delta X_{t-1} + \sum_{j=1}^{q} \phi_j \Delta X_{t-j} + e_{2t} \quad (8)$$

$$\Delta X_t = \alpha + \beta t + \delta X_{t-1} + \sum_{j=1}^{q} \phi_j \Delta X_{t-j} + e_{3t} \quad (9)$$

The hypotheses of ADF can be developed as;

$H_0 : \delta = 0$ data is nonstationary

$H_a : \delta < 0$ data is stationary

Apply OLS and compute τ statistic of X_{t-1} and compare with the DF critical τ value. With the comparison, if the estimated τ statistic compared greater values as compare to tabulated value, we can reject H_0 and conclude that data is stationary and there is no issue of unit root. But if the case is vice-versa, then the data is not stationary and there is a unit root issue in the data.

Phillips and Perron (1988) present unit root and PP test following the drawbacks of DF and ADF, the procedure of hypothesis development is same in PP and ADF. PP has stronger power to predict serial correlation and heteroskedasticity as compared DF and ADF. In the estimation procedure of the PP, there is no need to adjust the lag length as this test automatic adjusts lag. PP test follows as:

$$y_i = \alpha + \beta y_{i-1} + \mu_i \quad (10)$$

Here we have included a constant term and for simplicity we have excluded time trend. Further, we can calculate Z_ρ and Z_τ statistic:

$$Z_\rho = n\left(\hat{\rho}_n - 1\right) - \frac{1}{2}\frac{n^2\hat{\sigma}^2}{s_n^2}\left(\hat{\lambda}^2 - \hat{\gamma}_{0,n}\right) \quad (11)$$

$$Z_\tau = \sqrt{\frac{\hat{\gamma}_{0,n}}{\hat{\lambda}^2}}\frac{\hat{\rho}_n - 1}{\hat{\sigma}} - \frac{1}{2}\left(\hat{\lambda}^2 - \hat{\gamma}_{0,n}\right)\frac{1}{\hat{\lambda}_n}\frac{n\hat{\sigma}}{s_n} \quad (12)$$

$$\hat{\gamma}_\rho = \frac{1}{n}\sum_{i=j+1}^{n} \hat{\varepsilon}_i \hat{\varepsilon}_{i-j} \quad (13)$$

$$\hat{\gamma}_n^2 = \hat{\gamma}_{0,n} + 2\sum_{j=1}^{q}\left(1 - \frac{j}{q+1}\right)\hat{\gamma}_{\mathrm{j},n} \quad (14)$$

$$s_n^2 = \frac{1}{n-k}\sum_{i=1}^{n}\hat{\varepsilon}_i^2 \tag{15}$$

Here residual term ε_i is white noise, covariates are presented by k, number of lags are presented by q the standard errors of $\hat{\rho}$ are presented by $\hat{\gamma}_n^2$ and $\hat{\sigma}$. In eq. (13) the variance of error terms is presented by $j=0$, the covariance of error term lies between two residual term if $j>0$. In eq. (14) if $\hat{\gamma}_{i,n}$ is zero then there is autocorrelation between the two error terms, and there is unit root issue in the data. In eq. (14) if $\hat{\gamma}_n^2 = \hat{\gamma}_{0,n}$ disappear then they replace each other for further analysis. In any case, if $\hat{\gamma}_n^2 - \hat{\gamma}_{0,n} = 0$ then the second term in eq. (12) will be disappeared.

$$Z_\tau = \sqrt{\frac{\hat{\gamma}_{0,n}}{\hat{\lambda}^2}}\frac{\hat{\rho}_n - 1}{\hat{\sigma}}$$

and $\frac{\hat{\gamma}_{0,n}}{\hat{\lambda}^2} = 1$ its reduce form become as:

$$Z_\tau = \frac{\hat{\rho}_n - 1}{\hat{\sigma}} \tag{16}$$

So, there is no unit root issue and no autocorrelation among the residuals.

Elliott (1998) developed a modified DF test with the help of Generalized Least Squares method. They mention that DF and ADF are unable to provide exact results when there is small size of data. DF-GLS test is best when we have trend and unknown mean of the data set. DF-GLS equation become as:

Suppose

$$z_t = (1,t) \tag{17}$$

y_t is a time series,

$$\left[y_1,(1-\alpha L)y_2,....,(1-\alpha L)y_T\right] \tag{18}$$

$$\left[\mathrm{z}_1,(1-\alpha L)\mathrm{z}_2,....,(1-\alpha L)\mathrm{z}_T\right] \tag{19}$$

regress eq. (18) on eq. (19) and get $\tilde{\beta}_{GLS}$

here $\alpha = 1+\bar{c}/\mathrm{T}, \mu_0 = 0$ and $\bar{c} = -13.5$ are without time trend. In estimation without time trend and constant term $y = \tilde{y}_t - z_t'\tilde{\beta}_{GLS}$. If t is omitted from z_t then $\bar{c} = -7.0$.

The problem with PP, DF-GLS and ADF is that these tests don't highligth the existence or non-existence of structural break in the data. Zivot and Andrews (2002) propose unit root test to solve this issue. Zivot and Andrews test proceeds with three model models to test for a unit root: modol A, uses a one-time change in the level of series, model B, it allows for a one time-change in the slope of the trend function, model C, it combines one-time chnages in the level and the slope of trend function of the series.

Model A; $\Delta y = c + \alpha y_{t-1} + \beta t + \gamma DU_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \mathcal{E}_t$ (20)

Model B; $\Delta y = c + \alpha y_{t-1} + \beta t + \Theta DT_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \mathcal{E}_t$ (21)

Model C; $\Delta y = c + \alpha y_{t-1} + \beta t + \Theta DT_t + \gamma DU_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \mathcal{E}_t$ (22)

where DU_t is an indicator dummy variable for a mean shift occurring at each possible break-date (TB) while DT_t is corresponding trend shift variable. Formally,

$DU_t = \begin{cases} 1 ------ if\ t>TB \\ 0 ------- otherwise \end{cases}$ and

$DT_t = \begin{cases} t-TB ------ if\ t>TB \\ 0 ------- otherwise \end{cases}$

α=0 is the null hypothesis for the above three equation, this reveals the series contains a unit root with a drift that excludes any structural break, while the alternative hypothesis α<0 implies that the series is a trend-stationary process with a one-time break occurring at an unknown point in time. The Zivot and Andrews test consider every point as a potential break-date (TB) and runs a regression for every possible break-date sequentially. From amongst all possible break-points (TB), the procedure selects as its choice of break-date ($\overline{TB}$) the date which minimizes the one-sided t-statistic for testing $\widehat{\alpha}(=\alpha-1)=1$. According to Zivot and Andrews, the presence of the end points cause the asymptotic distribution of the statistics to diverges towards infinity. Therefore, some region must be chosen such that the end points of the sample are not included. Zivot and Andrews suggest the 'trimming region' be specified as (0.15T, 0.85T). Perron suggests that most economic time series can be adequately modeled using either model A or model C. As a result, the subsequent literature has primarily applied model A and/or model C. In a recent study, Narayan (2003) shows that if one uses model A when in fact the break occurs according to model C then there will be a substantial loss in power. However, if break is characterized according to model A, but model C is used then the loss in power is minor, suggesting that model C is superior to model A. Based on these observations, we choose model C for our analysis of unit roots.

Autoregressive Distributive Lag (ARDL) Approach to Co-Integration

Numerous methods of cointegration are existed in applied econometric such as; the residual based Engle-Granger (1987) test, Maximum Likelihood based on Johansen (1991/1992) and Johansen-Juselius (1990) tests. These tests need same order of integration and there is no concept of structural break in the data (Pesaran and Shin, 1999; Pesaran and Pesaran, 1997; Leybourne and Newbold, 2003; Perron, 1989, 1997). But if the data have a different order of integration and structural break, these methods are unable to provide unbiased results. So, following the weakness and shortcomings of these methods, we have applied autoregressive distributed lag model. Pesaran et al., (2001) has developed the recent and most advance process of co-integration, which is famous as the Autoregressive Distributive Lag (ARDL) bound testing approach. This method can be used same and mixed order of integration at the same time, structural changes can be covered easily while estimation of ARDL. This method uses Unrestricted Vector Error Correction Model (UVECM) in the process of a long run and short run equilibrium which is not possible with traditional techniques (Pattichis, 1999). But ARDL will fail if any variable is I(2). The general eq. of ARDL becomes as:

$$\Delta \ln Y_t = \beta_1 + \beta_2 t + \beta_3 \ln Y_{t-1} + \beta_4 \ln X_{t-1} + \beta_5 \ln Z_{t-1} + \ldots + \sum_{h=1}^{p} \beta_h \Delta \ln Y_{t-h} + \sum_{j=0}^{p} \gamma_j \Delta \ln X_{t-j} + \sum_{k=0}^{p} \phi_k \Delta \ln Z_{t-k} + \ldots + u_{it} \quad (23)$$

Here $\ln Y_t$ is used for different dependent t is for time of $\ln Y_{t-1}$ representing the lag of the dependent variable and $\ln X_t$ is first independent variable and $\ln Z_t$ is second independent variable so on. Δ represents the change in variables. The estimated F-Statistic is used for checking the tabulated value of Pesaran et al., (2001) or Pesaran and Pesaran (1997) which is further extended by Narayan (2005). If estimated F-test statistic higher than upper bound value, the null hypothesis of no co-integration is rejected regardless the order of integration I(0) or I(1). If the calculated F-test statistic is less than the lower critical value the null hypothesis is accepted and there is no co-integration among the variable of the model. But in the case of the sample data F-calculated falls between upper and lower bound, the relation is inconclusive. Whereas, all the selected variables have I(1), then upper bound is selected for decision making. But if selected variables have I(0) then the lower bound is used for decision making. Following the above equation, the null and alternative hypothesis can be developed as:

$H_0 : \beta_3 = \beta_4 = \beta_5 = 0$ (no co-integration among the variables)

$H_a : \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$ (co-integration among variables)

If there is long run co-integration relationship among the variables, then with the help of VECM short run relationship of the variables can be examined. The VECM equation becomes as:

$$\Delta \ln Y_{it} = \beta_1 + \beta_2 t + \sum_{h=1}^{p} \beta_h \Delta \ln Y_{it-h} + \sum_{j=0}^{p} \gamma_j \Delta \ln X_{t-j}$$

$$+ \sum_{k=0}^{p} \phi_k \Delta \ln Z_{it-k} + \omega ECT_{t-1} + u_t \qquad (24)$$

ECT_{t-1} presents one time period lagged of error term, which is known as error correction.

Estimated outcomes and Discussion

This paper has studied the socioeconomic determinants of gender specific life expectancy in Turkey from 1971 to 2017. Total average life expectancy, female life expectancy and male life expectancy have been selected as dependent variables in each three different cases. Level of education, environmental degradation, purchasing power, economic development, population growth, the level of male education, male population, fertility rate, female education and female populations are selected as independent variables for each three different cases. The estimated descriptive statistic has been given in appendixes Table A, Table C and Table E and correlation matrix has been presented in Table B, Table D and Table E. The appendix table A explains that total average life expectancy, level of education and environmental degradation have negative skewed values, whereas purchasing power, economic development and population growth have positive skewed values. The outcomes of descriptive statistic related to the model of total life expectancy have positive kurtosis. Jarque-Bera values are insignificant which reveal that the data of the total life expectancy model is normally distributed. The appendix table B shows that level of education, environmental degradation and economic development have significant and positive correlation with total average life expectancy, whereas growth of population has significant and negative correlation with total average life expectancy in Turkey. The purchasing power has insignificant negative correlation with total average life expectancy in Turkey. Environmental degradation and economic development have positive and significant correlation with education levels, whereas purchasing power and population growth have significant and negative correlation with level of education in Turkey. The table B show that purchasing power and population growth have negative and significant correlation with degradation of the environment, whereas development has significant and positive correlation with environmental degradation. Purchasing power has significant as well as a negative correlation with level of development, whereas, it has an insignificant correlation with population growth. The estimated results show that development has significant and negative correlation with population growth in Turkey.

The results of descriptive statistic of male life expectancy have been given in the appendix table C. The outcomes explain that male life expectancy, level of male education and environmental degradation are negative skewed whereas the share of the male population and purchasing power are positively skewed.

The selected factors of the male life expectancy model have positive kurtosis value. Moreover, estimated Jarque-Bera value is insignificant at 5 percent, which show that data on all variables of the male life expectancy model are normally distributed in Turkey. The results of the correlation matrix of the male life expectancy model have been presented in the appendix table D. The outcomes show that level of male education and environment quality have positive and significant correlation with male life expectancy, the share of the male population has significant and negative correlation with male life expectancy but purchasing power has insignificant correlation with male life expectancy in Turkey. The results show that environmental degradation has significant and positive correlation with level of male education, share of the male population has significant and negative correlation with level of male education but purchasing power has insignificant correlation with level of male education in Turkey. The outcomes show that the share of the male population has significant and negative correlation with share of the male population, but purchasing power has insignificant correlation with environmental degradation and share of male population in the case of Turkey.

The results of descriptive statistic of female life expectancy have been given in the appendix table E. The outcomes explain that female life expectancy, female education, share of the female population and environmental degradation are negative skewed whereas the fertility rate and purchasing power are positively skewed. The selected variables of the female life expectancy model have positive kurtosis value. Moreover, the estimated Jarque-Bera value is insignificant at 5 percent, which show that data of all the selected variables of the female life expectancy model is normally distributed in Turkey. The results of the correlation matrix of the female life expectancy model have been presented in the appendix table F. The outcomes show that female education, share of the female population and environmental degradation have positive and significant correlation with female life expectancy, fertility has negative and significant correlation with female life expectancy but purchasing power has insignificant correlation with female life expectancy in Turkey. Environmental degradation and share of the female population have positive and significant correlation with female education, fertility rates and purchasing power have negative and significant correlation with female education in Turkey. The share of the female population and environmental degradation have significant and negative correlation with fertility rate, but purchasing power has insignificant correlation with fertility rates in Turkey. The results show that the share of the female population has significant and positive correlation with degradation of environments, the estimated outcomes explain that purchasing power has insignificant correlation with environmental degradation and the share of the female population in Turkey.

In the previous section, we have explained the issue of unit root and its solution procedures. As this study has studied factors affecting total life expectancy and gender specific life expectancy Turkey. This study has used ADF, PP and DFGLS unit root tests. The estimated unit root tests of all the three models have been given in the Table 1. Outcomes of ADF show that total average life expectancy, male life expectancy, the share of the male population, the fertility rate and share of the female population are stationary I (0). The results of ADF explain that all the selected variables of three models are stationary I(1). The results of PP test show that total average life expectancy, male life expectancy, female life expectancy, level of female education, the fertility rate and share of the female population are stationary I(0). The estimated results of PP test show that all the variables of selected three models are stationary I(0). The results of DFGLS show that female life expectancy, economic development, share of the male population, the fertility rate and share of the female population are stationary I(0), but all the variables are stationary I(1). The estimated results of ADF, PP and DFGLS show that all the variables of three models have a mixed order of integration which is suitable for the apply ARDL method to find cointegration among the variables.

Table-1 Unit Tests Results

Variables	ADF		PP		DFGLS	
	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)
TLE	-2.33532*	----	-7.67544***	----	0.82939	-3.42409***
MLE	-3.07342**	----	-5.36355****	----	0.80409	-3.43486***
FLE	-1.189222	-2.09638**	10.36324***	----	-2.123289*	----
SSE	-1.29245	-6.71711***	-1.29984	-6.71708***	1.08481	-5.97080***
SUS	-1.84243	-6.54471***	-2.18315	-6.63889***	1.60454	-4.82740***
INF	-1.72122	-7.19346***	-1.66188	-7.23340***	-1.65522	-7.22227***
ECOD	0.69683	-6.44060***	0.75068	-6.44301***	2.32118*	----
PG	-1.60490	-2.62486*	-1.46774	-2.43097*	-0.23313	-2.52929**
SSEM	-1.32294	-6.54059***	-1.32153	-6.54059***	0.47686	-5.79616***
POPM	-2.24697*	----	-1.68075	-16.1185***	-2.94922**	----
SSEF	-1.50037	-6.15142***	-1.81001*	----	0.87015	-5.47211
FER	-4.49506***	----	-5.80002***	----	-2.14460**	----
POPF	-2.21529*	----	-2.68596*	----	-4.7576***	----
"***1 percent significant level **5 percent significant level *10 percent significant level"						

The results of Zivot-Andrew structural break have been given in the table 2. The results show that in the presence of structural break total average life expectancy, fertility rate and share of female population are stationary at I(0) in the presence of structural breaks, 2007, 1997 and 2012 respectively. The estimated results show that all the selected variables are stationary at I(1) for different individual structural breaks. In the presence of time trend the results of Zivot-Andrew structural break reveal that only fertility rate is stationary at I(0) with the structural break in 1997. The estimated results show that with time trend all selected variables are stationary at I(1). The overall results of Zivot-Andrew structural break reveal that in the presence of different structural breaks there is mixed order of integration among the selected variables which is suitable situation to apply ARDL method of cointegration.

Table-2: Zivot-Andrews Structural Break Trended Unit Root Test

Variable	I(0)		I(1)		I(0) Time-trend		I(1) time-trend	
	T-statistic	Break	T-statistic	Break	T-statistic	Break	T-statistic	Break
TLE	-4.444(2)**	2007	-7.42 (1)***	1995	0.01687(7)	2009	-7.405(1)***	2009
MLE	-2.30487(8)	2009	-4.589(9)***	2000	-3.67172(5)	2008	-8.763(1)***	2009
FLE	-1.64560(4)	2002	-4.8385(1)**	1994	4.28693(9)	2010	-3.8346(6)**	1990
SSE	4.00520(8)	2007	-4.028(7)*	2007	0.312776(9)	2008	-6.722(7)*	2007
SUS	2.91270(9)	1998	-6.573(0)***	2012	-4.06092(8)	1998	-6.150(1)***	1998
INF	-2.46356(3)	1997	-7.368(0)***	1981	-3.20083(7)	2002	-5.361(2)***	1998
ECOD	4.22381(6)	1998	-5.702(0)***	1981	1.81422(6)	1998	-4.8783(5)**	1993
PG	-2.34211(7)	1987	-5.113(1)***	1980	-3.36099(5)	1994	-6.609(1)***	1982
SSEM	1.93307(8)	2007	-4.5784(7)**	2007	-1.88200(8)	2007	-5.34(9)***	2003
POPM	-3.48190(8)	1997	-3.7344(1)**	1990	-0.11785(8)	1998	-5.568(1)***	1986
SSEF	6.67337(8)	2007	-7.193(0)***	2013	4.10437(8)	2008	-7.185(7)***	2007
FER	-6.48(8)***	1997	-6.456(1)***	2000	-4.932(5)**	1997	-6.012(7)***	2012
POPF	-6.50(8)***	2012	-4.1970(1)**	2000	1.99489(8)	2012	-5.953(7)***	2012
Note: ***1 percent significant level **5 percent significant level *10 percent significant level. Lag order is shown in parenthesis.								

The results of lag selection criterion have been given in appendix table G, table H and table I, this study has used Sequential Modified LR test statistic, Final Prediction Error, Akaike Information Criterion, Schwarz Information Criterion, Hannan-Quinn Information Criterion lag selection Criterion for this purpose. ARDL estimates of "total average life expectancy model", "male life expectancy model" and "female life expectancy model" have been given in table-3. The measured F-statistic of total average life expectancy model is higher than the upper-bound critical value presented by Pesaran et al., (2001) at 5%, so, this is the surety of cointegration. The calculated F-statistic of the male life expectancy model is higher than the upper-bound critical value developed by Pesaran et al., (2001) at 5%, so, there is cointegration among variables. Measured F-statistic of female life expectancy model is larger than the upper-bound critical value presented by Pesaran et al., (2001) at 5%, so, this confirms cointegration among variables. This is approved that total average life expectancy model; male life expectancy model and female life expectancy model have a co-integrational relationship with their respective determinants in Turkey during the time period under consideration.

Table-3 ARDL Bound Test

Significance Level	Total Life Expectancy		Male Life Expectancy		Female Life Expectancy	
	F-statistic = 110.1105		F-statistic = 26.88613		F-statistic = 27.50429	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
10%	2.26	3.35	2.26	3.35	2.26	3.35
5%	2.62	3.79	2.62	3.79	2.62	3.79
2.5%	2.96	4.18	2.96	4.18	2.96	4.18
1%	3.41	4.68	3.41	4.68	3.41	4.68

The long run outcomes of total average life expectancy, male life expectancy and female life expectancy are given in the table-4. Overall education has a positive and significant effect on total average life expectancy. A rising level of education directly impacts the life style of people and rising education enables the masses to improve their health structure. Our estimates are in-line with the results of Rogot et al., (1992), Guralnik et al., (1993), Hill and King (1995), Ali and Audi (2016), Ali and Bibi (2017), Audi and Ali (2017), Audi and Ali (2017), Ali and Khalil (2014). Sen (1999) mentions that rising education increases the health awareness which further increases the overall life expectancy of the people. 1 percent increase in the overall education brings (0.176652) percent rise in total average life expectancy in Turkey. The estimates explain that environmental degradation has an insignificant impact on total average life expectancy in Turkey. Fiala (2008) mentions that in developing countries and emerging countries, the environmental degradation has an insignificant role in deciding life expectancy. Being the emerging country, Turkey still cannot sustain its environmental conditions to affect overall life expectancy. Purchasing power has a significant and positive effect on life expectancy in Turkey. Mahfuz (2008), Ali and Khalil (2014), Ali and Audi (2016) and Ali and Bibi (2017) find the same type of relationship between purchasing power and overall life expectancy. A 1 percent increase in purchasing power raises (0.000641) percent life expectancy in Turkey. Economic development has a significant and negative effect on total average life expectancy. Easterlin (1974) points out that in the beginning stages of development higher development is attached to lower human welfare. The findings of this study show that Turkey is in earlier stages of development, so, Turkey has a negative association between overall life expectancy and development. The coefficient reveals that 1 percent increase in development, brings (0.135435) percent decrease in total average life expectancy in Turkey. Population growth has a positive, but insignificant impact on life expectancy in Turkey. Todaro (2003) mentions that in developing and emerging countries low population growth does not mean higher human welfare.

Environmental degradation has a positive and significant impact on male life expectancy. It has been witnessed that emerging economies have risen life expectancy with increasing environmental degradation parallel. The coefficient reveals that 1 percent rise of environmental degradation brings (0.149110) percent increase in male life expectancy in Turkey. The estimated outcomes highlight lower purchasing power is depressing male life expectancy, 1 percent lower purchasing power reduces male life expectancy in Turkey by (0.000474) percent. Economic development has insignificant effect on male life expectancy in Turkey. The results explain that level of male education is improving the expected life of male, 1 percent increase in the level of male education brings (0.098972) percent increase in male life expectancy in Turkey. Share of population male has an insignificant impact on male life expectancy in the case of Turkey.

The long run results of female life expectancy explain that environmental degradation has a positive effect on female life expectancy in Turkey. The coefficient shows that 1 percent increase in environmental degradation brings (0.017453) percent increase in female life expectancy. Purchasing power has an insignificant impact on female life expectancy in Turkey. The results highlight that the level of female education is improving the expected life of female, 1 percent increase in the level of education brings (0.043776) percent increase in female life expectancy. The fertility rate has a negative and significant impact on female life expectancy, 1 percent increase fertility rate brings (0.059644) percent fall in female life expectancy in Turkey. The share of female population has a negative and significant impact on female life expectancy. The coefficient reveals that 1 percent increase share of female population brings (5.375062) percent decrease in female life expectancy in Turkey.

Table:4 Long Run Results

Variables	Total Life Expectancy ARDL(1, 0, 0, 0, 0, 0)	Male Life Expectancy ARDL(1, 1, 1, 1, 1, 0)	Female Life Expectancy ARDL(1, 0, 1, 0, 0, 0)
	Coefficient	Coefficient	Coefficient
SSE	0.176652***(2.940917)	-	-
SUS	-0.008789(-0.077461)	0.149110***(5.499819)	0.017453*(1.926906)
INF	0.000641*(1.656432)	-0.000474***(-6.124815)	0.000033(0.882786)
ECOD	-0.135435*(-1.692832)	0.016878(0.759560)	-
PG	0.004655(0.128228)	-	-
SSEM	-	0.098972***(6.902196)	-
POPM	-	-0.454782(-0.178877)	-
SSEF	-	-	0.043776***(5.041638)
FER	-	-	-0.059644***(-7.476101)
POPF	-	-	-5.375062***(-3.099375)
C	5.075724***(4.025760)	3.522104(0.348684)	25.192079***(3.656247)

“***1 percent significant level **5 percent significant level *10 percent significant level”, T-statistic is shown in parenthesis.

The short run estimates of all the selected models have been given in table 5. Most of the explanatory variables have an insignificant short run impact on total average life expectancy in Turkey. The male life expectancy model shows that environmental degradation and level of male education have a significant and positive impact on male life expectancy in Turkey over the selected time period. Purchasing power and share of the male population have a significant and negative impact on male life expectancy in Turkey. Economic development has an insignificant short run effect on male life expectancy in Turkey. Female life expectancy model outcomes reveal that environmental degradation, the level of female education and fertility rate have a significant and positive impact on female life expectancy, but purchasing power has insignificant effect on female life expectancy in Turkey. The value of ECT in all three cases explain that short runs converge into the long runs. Total average life expectancy model needs 37 years to converge in the long and only 2 percent short run deviation is corrected very next year. The ECT results of male life expectancy explain that male life expectancy needs 6 years to converge, the estimated coefficient shows that approximately 18 percent short run deviation is corrected very next year in male life expectancy model. The results of ECT of female life expectancy model explain that short run needs 34 years to converge. ECT result reveals that only approximately 3 percent short deviations are converged in the next year.

Table:5 Short Run Results

Variables	Total Life Expectancy	Male Life Expectancy	Female Life Expectancy
	Coefficient	Coefficient	Coefficient
SSE	0.004857**(2.408860)	-	-
SUS	-0.000242(-0.079877)	0.011066***(3.687587)	0.000513*(1.831467)
INF	0.000018***(3.561212)	-0.000235***(-3.117653)	0.000001(0.899275)
ECOD	-0.003724(-1.417092)	-0.003035(-0.734660)	-
PG	0.000128(0.126796)	-	-
SSEM	-	0.006313*(1.756832)	-
POPM	-	-84.114010***(-2.906730)	-
SSEF	-	-	0.001288*** (3.910155)
FER	-	-	0.005408***(4.697187)
POPF			-0.158088**(-3.574575)
ECT	-0.027497**(-2.086318)	0.179804***(3.275423)	-0.029411***(-9.869646)
“***1 percent significant level **5 percent significant level *10 percent significant level” T-statistic is shown in parenthesis.			

The results of diagnostic tests have been given in appendix table J, table K and table L. The results of diagnostic tests show that there is no serial correlation, no heteroscedasticity, the models have correct functional forms and the selected data is normality distributed. For the checking the constancy of parameters. The CUSUM and CUSUMsq tests are used. Brown et al., (1975) mention that both tests given proper glimpse of the change in estimated parameters. If the expected coefficient of recursive residual is zero, then we can reject the null hypothesis and conclude that estimated parameters are consistent visa-versa. Figure-A, B, C, D, E and F in the appendix are CUSUM and CUSUMsq. Results indicate that all plots are within their critical boundaries. So, estimated models are consistent.

Conclusions and Suggestions

This paper has analyzed the socioeconomic determinants of total and gender specific life expectancy Turkey from 1971 to 2017. The estimated results show that the overall level of education, purchasing power and economic development have a significant role in deciding total average life expectancy in Turkey. Whereas, environmental degradation and growth in population have an insignificant contribution in deciding total average expected life in Turkey. Male life expectancy model highlights that environmental degradation, purchasing power and level of male education has contributed significantly in male life expectancy in Turkey. Economic development and share of the male population have an insignificant role in deciding male life expectancy in Turkey. The results of the female life expectancy model show that environmental degradation, the level of female education, fertility rates and share of the female population have significant impact on female life expectancy, but purchasing power has an insignificant role in in deciding female life expectancy in the case of Turkey. The results recommend that the government of Turkey should enhance the level of education for the getting the targeted total life expectancy, male life expectancy and female life expectancy. For enhancing the total average life expectancy and male life expectancy the government of Turkey should manage purchasing power, as purchasing power has a direct impact on masses health and food expenditures. For enhancing female life expectancy unwanted fertility can be controlled, moreover the government should manage the share of each gender in total population, because imbalance gender can create many other socioeconomic issues in the society.

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Appendixes

Table: A Descriptive Statistics of Total Life Expectancy Model

	TLE	SSE	SUS	INF	ECOD	PG
Mean	4.183552	4.049661	11.94288	38.73671	9.253681	1.786148
Median	4.195351	4.087936	11.97752	31.39027	9.237292	1.619467
Maximum	4.331154	4.635216	12.83141	105.2150	9.951110	2.397248
Minimum	3.968158	3.292963	10.77339	6.250977	8.717671	1.203624
Std. Dev.	0.111040	0.422455	0.594713	29.12999	0.346309	0.381397
Skewness	-0.361217	-0.173787	-0.245591	0.525758	0.362877	0.335340
Kurtosis	1.884819	1.670152	1.880158	2.026472	2.061009	1.695366
Jarque-Bera	3.457518	3.699886	2.928306	4.021324	2.758160	4.214102
Probability	0.177505	0.157246	0.231274	0.133900	0.251810	0.121596
Sum	196.6269	190.3341	561.3155	1820.625	434.9230	83.94897
Sum Sq. Dev.	0.567179	8.209549	16.26946	39033.60	5.516761	6.691312
Observations	47	47	47	47	47	47

Table: B Correlation Matrix of Total Life Expectancy Model

Variables	TLE	SSE	SUS	INF	ECOD	PG
TLE	1.000000					
SSE	0.989707***	1.000000				
SUS	0.992322***	0.981365***	1.000000			
INF	-0.215419	-0.243564*	-0.238566	1.000000		
ECOD	0.951445***	0.951815***	0.972912***	-0.371745**	1.000000	
PG	-0.92861***	-0.92213***	-0.91582***	0.089395	-0.83300***	1.000000
"***1 percent significant level **5 percent significant level *10 percent significant level"						

Table: C Descriptive Statistics of Male Life Expectancy Model

	MLE	SSEM	SUS	POPM	INF
Mean	4.130577	4.238868	11.94288	3.899463	38.73671
Median	4.137212	4.276095	11.97752	3.898333	31.39027
Maximum	4.287625	4.648251	12.83141	3.905743	105.2150
Minimum	3.914600	3.668636	10.77339	3.895182	6.250977
Std. Dev.	0.114662	0.315840	0.594713	0.003714	29.12999
Skewness	-0.287638	-0.230191	-0.245591	0.552293	0.525758
Kurtosis	1.828083	1.684553	1.880158	1.839962	2.026472
Jarque-Bera	3.337648	3.803775	2.928306	5.024689	4.021324
Probability	0.188469	0.149287	0.231274	0.081078	0.133900
Sum	194.1371	199.2268	561.3155	183.2747	1820.625
Sum Sq. Dev.	0.604776	4.588713	16.26946	0.000635	39033.60
Observations	47	47	47	47	47

Table: D Correlation Matrix of Male Life Expectancy Model

Variables	MLE	SSEM	SUS	POPM	INF
MLE	1.000000				
SSEM	0.979506***	1.000000			
SUS	0.992869***	0.965883***	1.000000		
POPM	-0.97780***	-0.95917***	-0.96857***	1.000000	
INF	-0.240440	-0.195309	-0.238566	0.140632	1.000000
"***1 percent significant level **5 percent significant level *10 percent significant level"					

Table: E Descriptive Statistic of Female Life Expectancy Model

	FLE	SSEF	FER	SUS	POPF	INF
Mean	4.236041	3.794910	3.221389	11.94288	3.924415	38.73671
Median	4.253596	3.852400	2.809000	11.97752	3.925528	31.39027
Maximum	4.372121	4.623009	5.529000	12.83141	3.928585	105.2150
Minimum	4.020662	2.713437	2.037267	10.77339	3.918264	6.250977

Std. Dev.	0.107024	0.589303	1.107955	0.594713	0.003630	29.12999
Skewness	-0.456475	-0.182455	0.715660	-0.245591	-0.558119	0.525758
Kurtosis	1.970828	1.736536	2.134720	1.880158	1.845616	2.026472
Jarque-Bera	3.706486	3.386938	5.478214	2.928306	5.049734	4.021324
Probability	0.156728	0.183881	0.064628	0.231274	0.080069	0.133900
Sum	199.0939	178.3608	151.4053	561.3155	184.4475	1820.625
Sum Sq. Dev.	0.526890	15.97481	56.46795	16.26946	0.000606	39033.60
Observations	47	47	47	47	47	47

Table: F Correlation Matrix of Female Life Expectancy Model

Variables	FLE	SSEF	FER	SUS	POPF	INF
FLE	1.000000					
SSEF	0.991682***	1.000000				
FER	-0.991088***	-0.971337***	1.000000			
SUS	0.990204***	0.988387***	-0.975106***	1.000000		
POPF	0.984070***	0.966879***	-0.988779***	0.968286***	1.000000	
INF	-0.183842	-0.257027*	0.085132	-0.238566	-0.138873	1.000000
"***1 percent significant level **5 percent significant level *10 percent significant level"						

Table: G Total Life Expectancy Model

```
*******************************************************************
***********
 Order    LL        AIC      SBC              LR test
Adjusted LR test
 1   969.4555  927.4555  889.0540            ------              -
-----
 0   -74.3837  -80.3837  -85.8696  CHSQ(36)=   2087.7[.000]
1770.0[.000]
*******************************************************************
***********
 AIC=Akaike Information Criterion     SBC=Schwarz Bayesian Criterion
```

Table: H Male Life Expectancy Model

```
*******************************************************************
***********
 Order    LL        AIC      SBC              LR test
Adjusted LR test
 1   696.5742  654.5742  616.1727            ------              -
-----
```

```
 0   298.5404  292.5404  287.0545  CHSQ(36)= 796.0675[.000]
674.9268[.000]
********************************************************************
***********
 AIC=Akaike Information Criterion     SBC=Schwarz Bayesian Criterion
```

Table: I Female Life Expectancy Model

```
Order    LL        AIC      SBC            LR test
Adjusted LR test
 1     1380.5    1338.5    1300.1            ------             -
-----
 0   417.9900  411.9900  406.5041  CHSQ(36)=   1925.0[.000]
1632.1[.000]
********************************************************************
***********
 AIC=Akaike Information Criterion     SBC=Schwarz Bayesian Criterion
```

Table: J Total Life Expectancy Model

Diagnostic Tests		
Test Statistics	LM-Version	F-Version
A-Serial Correlation CHSQ(1)	.67541[.411]* F(1,24)*	.51748 [.479]*
B-Functional Form CHSQ(1)	.0038766[.950]*F(1,24)*	.0029078 [.957]*
C-Normality CHSQ(2)	1.4482[.485]*	Not- applicable
D-Heteroscedasticity CHSQ(1)	1.4318[.231]*F(1,30)	1.4051[.245]*
A: Lagrange multiplier test of residual serial correlation B: Ramsey's RESET test using the square of the fitted values C: Based on a test of Skewness and kurtosis of residuals D: Based on the regression of squared residuals on squared fitted values		

Table: K Male Life Expectancy Model

Diagnostic Tests		
Test Statistics	LM-Version	F-Version
A-Serial Correlation CHSQ(1)	.097476[.755]*F(1,22)	.067220[.798]
B-Functional Form CHSQ(1)	.70387[.401]*F(1,22)	.49479[.489]
C-Normality CHSQ(2)	.84671[.655]	Not applicable
D-Heteroscedasticity CHSQ(1)	.26562[.606]*F(1,30)	.25110[.620]
A:Lagrange multiplier test of residual serial correlation B:Ramsey's RESET test using the square of the fitted values		

C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

Table: L Female Life Expectancy Model

Diagnostic Tests		
Test Statistics	LM-Version	F-Version
A-Serial Correlation CHSQ(1)	1.3867[.239]*F(1,15)*	.70240[.415]*
B-Functional Form CHSQ(1)	1.5212[.217]*F(1,15)*	.77406[.393]*
C-Normality CHSQ(2)	1.3313[.514]*	Not- applicable
D-Heteroscedasticity CHSQ(1)	.79430[.373]*F(1,29)*	.76260[.390]*
A: Lagrange multiplier test of residual serial correlation B: Ramsey's RESET test using the square of the fitted values C: Based on a test of Skewness and kurtosis of residuals D: Based on the regression of squared residuals on squared fitted values		

Figure: A CUSUM test Total Life Expectancy Model

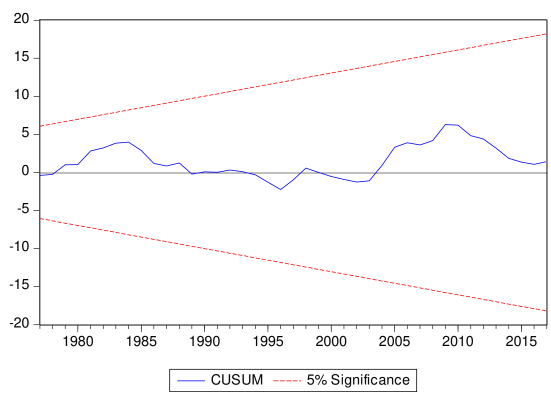

Figure: B CUSUM-Sq test Total Life Expectancy Model

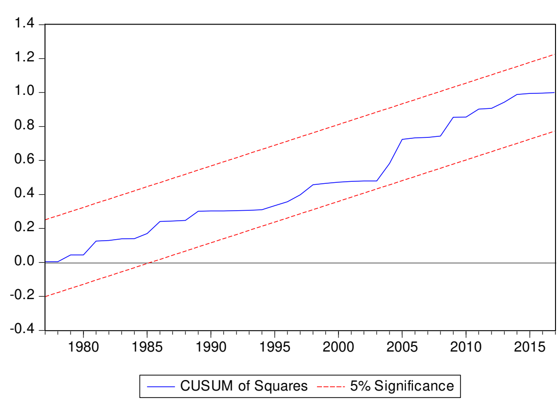

Figure: C CUSUM test Male Life Expectancy Model

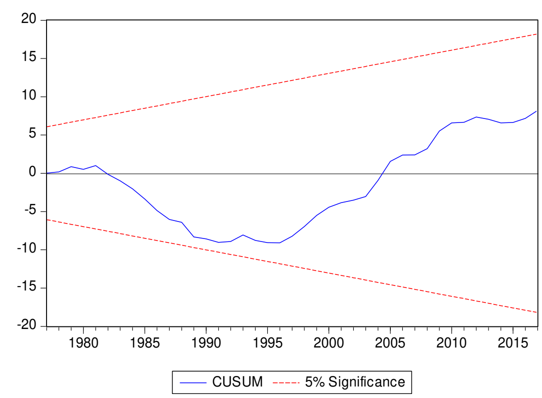

Figure: D CUSUM-Sq test Male Life Expectancy Model

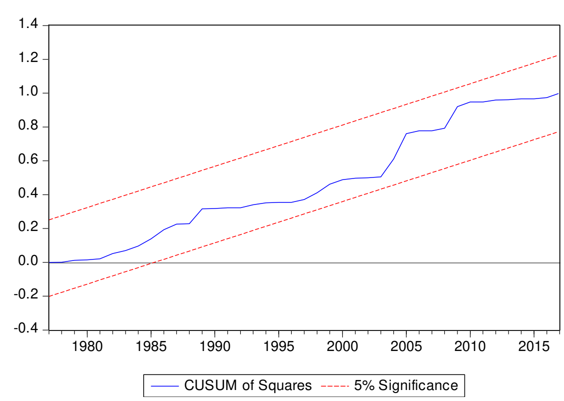

Figure: E CUSUM test Female Life Expectancy Model

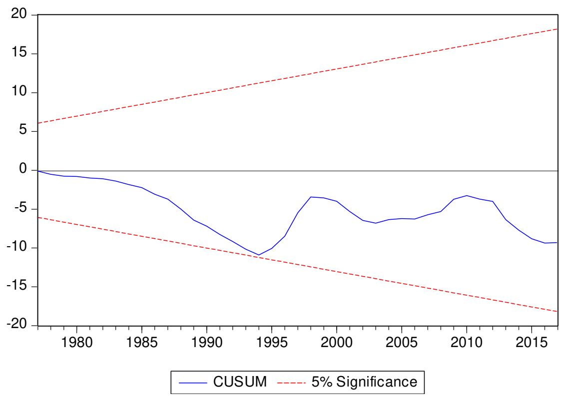

Figure: F CUSUM-Sq test Female Life Expectancy Model