MODELING AND FORECASTING LIFE EXPECTANCY: THE CASE OF PAKISTAN

By

Hafiza Shumaila Hameed

Supervised by:

Dr. Ahsan ul Haq Satti
Assistant Professor
Department of Economics and Finance

A Dissertation is submitted to the Pakistan Institute of Development Economics for the Partial Fulfillment of the Requirement of the degree of

Master of Philosophy in Econometrics.

Department of Econometrics and Statistics

Pakistan Institute of Development Economics (PIDE)

Islamabad.

2018

Pakistan Institute of Development Economics

CERTIFICATE

This is to certify that this thesis entitled: **"Modeling and Forecasting Life Expectancy: the Case of Pakistan"** submitted by Hafiza Shumaila Hameed is accepted in its present form by the Department of Econometrics and Statistics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in **Master of Philosophy in Econometrics**.

Supervisor:

Dr. Ahsan ul Haq
Assistant Professor
PIDE, Islamabad

External Examiner:

Dr. Tahir Mahmood
School of Economics
Quaid-i-Azam University
Islamabad

Head,
Department of Econometrics and Statistics:

Dr. Amena Urooj

"Oh Allah, honor me by the light of understanding and take me out from the darkness of doubt and open upon us the doors of your knowledge and open upon us the treasure of your recognition, oh the best of the Merciful ones. Oh Allah, and give me Tawfeeq to study and solving all the difficult problems by your mercy, oh the best of the merciful ones."

DEDICATION

This humble effort is dedicated to

“My parents, Mr. and Mrs. Abdul Hameed Chaudhary, my beloved husband Junaid Tariq and my Family for Their Loving Wishes, Support Patience, Understanding and Guidance and All Those Who Seek Knowledge to Reach At Truth”

Acknowledgements

First of all a special gratitude and special appreciation goes to ALLAH almighty; without His blessings I would not be able to think of completing this work. After that, I offer my admirations and respect from the core of my heart to the Holy Prophet Muhammad (Peace be upon him) who urges his followers to “Seek knowledge from cradle to grave”. I would like to pay my humble thank to my beloved PARENTS, who prayed for me a lot and I would also like to thanks my loving husband ***Junaid Tariq*** to encouraged me and guide me in a proper way and advise me not to lose heart.

Being a fresh researcher and a student in the field of econometrics, this dissertation would not have been possible without the help, provision and patience of my dedicated supervisor, ***Dr. Ahsan-ul-Haq Satti***, Assistant Professor, PIDE, Islamabad, who supported me and guided me right from the first day of my research. He made valuable and fruitful comments that helped me to improve my research. I deeply appreciate and recognize all that I have received from him.

I am thankful to ***Dr. Amena Urooj***, head of department of Econometrics and Statistics PIDE I would never have been able to finish my dissertation without the kind leadership of my teacher.

I am very thankful to all my friends, department fellows and class fellows especially ***Shah Abbas*** who helped me to grasp some key concept regarding subject knowledge during this research and course work. I am also thankful to all library staff especially madam Qamar-un-Nisa for searching and managed useful material in PIDE library.

I am also very thank full to my siblings Shehla Hameed Farrukh Hameed Azhar Hameed and Shehneela Hameed, they motivate me, encourage me and help me all the time.

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

LE	Life Expectancy at Birth
INF	Inflation Rate
HE	Per Capita Health Expenditure
GNI	Gross National Income Per Capita
UR	Urbanization
PG	Population Growth
LR	Literacy Rate
SE	School Enrolment
FP	Food Production
CO2E	Carbon Dioxide Emission
IMR	Infant Mortality Rate
MR	Mortality Rate
BR	Birth Rate
DR	Death Rate
ADF	Augmented Dickey Fuller test
AIC	Akaike Information Criteria
ARDL	Autoregressive Distributed Lag Model
BG	Breusch Godfrey
LM	Langrange Multiplier
SBC	Schwarz Bayesian Criteria
VAR	Vector Auto Regressive
JB	Jerque-Berra

ABSTRACT

The main purpose of this study is to observe the impact of demographic, economics environmental and health variables influence on life expectancy in Pakistan. In this study I use the time series data for the period 1973- 2016 for experiential analysis. To investigate the integration order of the different variables, the unit root test Augmented Dickey-Fuller (ADF) were used. The study used the Auto-Regressive Distributed Lag (ARDL) and bound test for test the co-integration for short and long term analysis. In additionally, the model is used to predict life expectancy ARDL and VAR. The results of coinciding trails indicate a long term relationship between the variables as F-statistical value 6.13, which is greater than the upper limit value at 5%. The long and short term model results indicate that life expectancy is negatively related with birth rate, Carbon dioxide, income inequality and mortality, but the statistical relationship is significant only in the long run. Food production has a positive effect on life expectancy only in the long run. Expenditure on health and Schooling have a positive and significant influence on life expectancy both in short and long term, but higher inflation and population growth are inversely associated to life expectancy. As a final point, the increasing urbanization is negatively associated with life expectancy both in short and long term. The measurement of the error correction term (ECM) suggests that system will be converge to the long-term equilibrium in nearly 10 years. Our forecasts suggest that if past trends continue, almost half the Pakistan population will meet the World Health Organization (WHO) criteria for Food Production, carbon dioxide emission and urbanization by 2020, a prediction consistent with that made by positively and high life expectancy as compare to previous year. The study suggest on the basis of result that life expectancies in developing country like Pakistan can be significantly developed if proper devotion has been given to the food production increases in calorie intakes and fertility reduction government to extend contraceptive measures to every women in the reproductive age.

Keywords: life expectancy, Health Expenditure, Population Growth, Literacy Rate, Food Production, Mortality Rate, Birth Rate, Death Rate. **JEL Codes**: J17, D33, Q5, F6

CHAPTER 1

INTRODUCTION

1.1 Motivation for Current Study

Life expectancy at birth, which is normally utilized as an indicator of the general improvement of a nation. It has been expanded in the vast most of the countries in the world throughout the decade. The snappy expanded has a specific sign, as they have strongly chosen to accomplishing socio economic progress by underwriting fundamentally in social areas, for example, wellbeing, instruction, condition and demographic changes.

Economic development has been define the improvement in societal and economic status and increases the life expectancy of a country (Fritz, 2010). Wide range of factors like socioeconomic, demographic and environmental factors has major impact on life expectancy in various countries. The turnover in developing countries increases and an increase the level of expenditure on medical care and composite goods. The improvements of prevalence of poverty, nutrition, adult education and affliction of diseases were also important in the years, which are positive on life expectancy. However, in many countries of the development stage, the life expectancy is decaying. In some countries even though income and health expenditure is growing, but life expectancy is become decline.

Life expectancy is considered as one of the key health outcomes as well as a major indicator of human development. It is an important indicator for assessing economic and social development of country, the better health facilities, good education and healthy environment and long life of citizens (McGillivray, 1991). Therefore, the level of Life expectancy has significant inference for entities and cumulative human behavior, it affect fruitfulness behavior, human capital investment and economic growth.

The one of the main significant key indicator of population is life expectancy indicator of population health situation and economic development of country. The economic theories highlight the determinant of life expectancy, for example; neoclassical growth theories explain how life expectancy of country affected the economic growth and development, however the topic is debated in both microeconomics and macroeconomics literature (Acemoglu, & Johnson, 2007). The upgrades in future and death rates have been explored in many investigations over the twentieth century, particularly in created nations (Lee and Carter, 1992), (Tuljapurkar, 2007) and (Russolillo & Haberman, 2005), These movements in human life have been prompted by higher life quality, regularly connected with basic changes of therapeutic medicinal services frameworks (Shaw et al., 2005), social progressions and financial advancement (Chen & Ching, 2000).

To Identifying and summarizing the relationship between life expectancy gap and socioeconomic factors are important for the health policy. On the other hand, in the last 50 years the life expectancy has increasing progressively in developing countries. While the foremost cause of death is transferrable diseases, it was rational to associate life expectancy upsurges with enhanced health. The main issues in analyzing economic aspects of human development are selection of set of explanatory variables that explains variation in other economic phenomenon and specification of functional form. Different statistical techniques and methods are used to identify the set of human and health indicators relevant in determination of other indicators, which determines an economic model for explaining and estimating relationship between variation in life expectancy and socioeconomic, health and environmental factors. For example, (Holiciaglu & Grossman's, 1972) used the co-integration technique, (A. Ntamjokouen et, al., 2014) used the ARIMA model, vector autoregressive model and vector error correction model (VECM).

However, in case of Pakistan huge literature is available on the health expenditures and its determinants, but paid less attention to study the determinants of life expectancy and forecasting. Some studies like (Samia Nasreen et, al. 2012) investigate the impact of income inequality on health of Pakistani people. They used Johansen Co-integration and error correction model. VAR (Torri, 2011) and ARIMA have exposed enhancements in clarifying the changing aspects of life expectancy. Ali and Audi (2016) used Augmented Dickey-Fuller (ADF) and Phillip and Perron (PP) unit root tests, Auto-Regressive Distributed Lag (ARDL) approach, for investigation the causal relationship Granger Causality test is used. In tallying, the VAR model is connected to preceding literature, which has exposed stout concert in clarifying numerous time series. In addition most of the studies neglect to forecast of life expectancy.

1.2 Objective of Study

The objective of the study are given as below:

- To identify the different determinants of life expectancy i.e. economic, social, environmental, health and education. To meet this objective will start with the general model, which consider all possible determinants of life expectancy and after applying different diagnostic test of model selection, will reach to most simplified model. Basically in this study I apply general to specific model of life expectancy.
- To forecast life expectancy. For forecasting life expectancy, this study utilize the same model which is applied to meet first objective for forecasting.

1.3 Significance/ Contribution of the Study

The goal of about this study is to examine the macro factors of the life expectancy and the forecasting of life expectancy in Pakistan and give some arrangement rules to the strategy producers. The econometric outcomes got from this exploration may prompt proper and productive wellbeing arrangement plans to increase the life expectancy. The strength of the assessed econometric modeling or econometric technique is additionally especially critical to create inferences and forecast from this.

1.4 Outline of Study

After the brief introduction of topic along with objective and statement of problem this study is organize into following chapters. The second chapter is about Review of Literature, it is important to review the relevant literature on the determinants of life expectance. The literature review helps to identify the literature gap and theoretical framework. Third chapter is Data and Methodology in this chapter the constriction of variables and econometric model. The foremost objective of this chapter is to build econometric model for the empirical analysis. This chapter contains three sections, first section is about the model specification and estimation techniques. The second section is about the construction of variables and sources of data. Finally conclude the chapter in section three. Fourth chapter is about Results and Discussion, in this chapter estimation of model by using different econometric techniques, which are discussed in chapter four. The chief objective of this ongoing chapter is to apply the formerly created econometric model by using the different econometric techniques. Fifth chapter is Conclusion and Policy Recommendation in this chapter finally the main finding of study is summaries and provides some policy recommendations in last chapter.

CHAPTER 2

LITERATURE REVIEW

Before proceeding it is necessary to have a broad idea of the current development in the theoretical and empirical literature on determinants of life expectancy. For this purpose there is a need to research the literature to identify the gaps and to make clear the mechanism to fill the gap. There exists a large body of theoretical and empirical literature to examine and identify the determinants of life expectancy. This chapter will review the literature relevant to the objectives of the study.

The main objective of the study is to identify determinants of life expectancy in various domains including economic, social, environmental, health and education. The study utilized the general to specific methodology in order to reach to the most simplified version of the model. The study objective also includes forecasting life expectancy for which the study used the autoregressive distributive lag model.

2.1 Worldwide Literature

Recently some studies dedicated to observe conceivable determinants of life expectancy. Income, education, urbanization, health care expenses and involvements like number of over-all consultants, entree to harmless drinking water, nutritious outcome, and geographical locality of any country did to be statistically significant elements.

Information about the state of health of the nation is generally consequent from its function of health manufacture. The health fabrication function defines the input and output relationships over a specified period of time. Production has been a extent of health position i.e. life expectancy. These feedbacks could be health care, medicinal expenses, atmosphere, education, economy, lifestyle, inherent features, etc. F. Halicioglu (2011).

The Grossman's (1972) suggest that the model for health has been beneficial for abstracting the health output purposes. Rendering to the Grossman model, individuals are considered health fabricators by the selections they mark about their activities and their usage of medical care. The result of this procedure, life periods are further fewer healthy. The people are enforced to producing the health care for several reasons:

financial limitations, basic grants of physically and mentally health, the social and natural environment and the situations where they live in.

Grossman suggest the given model to study the life expectancy at micro level, however the X is a vector of indicators which can be categorize into three main divisions. Fayissa and Guteman (2005), the major advantage of this classification is that one can study some issue at micro level.

The theoretical model of Grossman's (1972) has been made compatible with the econometric process. Along these lines components of life expectancy are subsidiary of health creation work; see for instance Shaw et.al (2005) and Kabir (2008). In the exact investigation the rundown of various factors in each sub gathering may differentiate essentially because of the information imperative, culture and the natural states of a nation under examination.

Ntamjokasen et.al, (2014) investigate the modeling multi-population life expectancy by using co-integration approach with number of variables including birth population size, exposure to risk, death rate and life expectancy at birth. They found that two main methods used for quantifying future life expectancy first, the biological techniques and second, extrapolative method and then compare the diverse models in direction to demonstration which is beneficial to life expectancy in time series data amongst the Canadian Provinces. In this current paper author for different provinces in Canada. The author examined the forecasting technique power of multiple population life expectancy and accessible the major econometric models ARIMA, VAR and VECM. The performance VECM results is better than other forecasting models i.e. ARIMA and VAR models in terms of goodness of fit and future trend ambiguity quantification measure through confidence interval.

Simpach et. al (2013) presented paper will be calculation of the estimated life expectancy at birth for males and females as of 1970 to 2011 in Czech republic, Using ARIMA model and random walk with drift. These results are shown that all approaches provide same results, but ARIMA models and the random walk model with drift require less computation. Furthermore, based on them it is possible to make the predictions for the future. Calculation by ARIMA and random walk models do not require costly input data and provide comparable results with low deviation by CZSO, which calculation is unbeatably more difficult. This provides time and money savings. Hence, the challenge for research in future is to apply this method for constructing cheaper predictions.

Nyoman et.al, (2014) investigate the Life expectancy is an indicators used to evaluate the worth societies health. This following study usages six factors which are supposed distress life expectancy in East Java include social, economic, health, and education factor, they discuss the Statistics of Indonesia; the variables utilized as a part of this examination life expectancy, newborn child death rate (infant mortality rate), absence of education rate of individuals matured 10 above, level of babies matured 0-11 months who were breastfed for 4-6 months, monetary development, the level of babies matured 1-4 years who got finish inoculation, and work compel participant rate. Data of Life Expectancy and 6 factors were recorded in 2010 of East Java. Most of aspects affect the life expectancy in East Java, Indonesia, by this means modeling requirements to be complete to regulate the factors which are affect life expectancy significantly. The econometrics technique are being used to model the life expectancy that are the semi parametric spline regression. The most regular variables that's are significantly affecting life expectancy in East Java is infant mortality rate, total ratio of infants aged 0-11 and percentage of infants aged 1-4 years who were specified complete vaccination.

Bravo et. al, (2010) analyze the increasing demand of mortality indicators into small strata's acceding to area, to check the special effects of Public Health guidelines. In this paper they investigated deeply summary of the system implemented by Statistics Portugal for assessing life expectancy in low population areas. Method uses parametric graduation techniques and parametric overview and non-parametric advancement techniques and reenters the graduation procedure established by the Continuous Mortality Investigation Bureau (CMIB) and its postponement to widespread linear models.

Further discussions on the statistical tests and measures applied to estimate the goodness-of-fit of the following models. The main methodology is empirically tested by using the data for the Portuguese deputize national region of Lisbon and for the time of 2006-2008. Their result shows, the methodology is biased and it can be applied to build life tables and calculate life expectancy. The adaptability of the strategy makes it relevant to mortality information for an extensive variety of ages from any topographical conditions.

Liu (2011) in this article the writer shows however the heart rate, weight and blood pressure of dissimilar classes are connected through their life expectancy. They examine and calculate Pearson's Product Moment Correlation Coefficient to describe that the heart rate has the uppermost grade of correlation with life expectancy.

Istvan et. al, (2012) To forecast health expectancy from 1989 to 2007. Variables are used; Mortality, Longevity, Life expectancy and Health expectancy. Though, the utilization of the summed up Lee-Carter model to various informational collections may bring about poorer model fit if, for instance, the time development of progress rates is not straight. By utilizing this model change rates relating nondisabled, crippled, and dead states and to gauge incapacity related wellbeing hopes. The approach showed for wellbeing anticipations in this investigation could be utilized for working life expectancy too in light of the fact that working futures depend on comparable multistate models. Along these lines, the model system might be utilized to gauge populace health with different measures of health status.

Shaw et.al, (2005) Data are taken from the OECD Health Data 2000 database, which contains total information on the human services frameworks of 19 OECD nations. The database incorporates more than 1200 markers spreading over the period 1960 to 1999. The informational collection incorporates different measures of health status (horribleness and mortality), human services assets or health care assets and use, health expenses and financing, data identifying with population socioeconomics, nonmedical elements of health (liquor and tobacco utilization), and financial references (GDP and money related change rates). In a specimen of more created countries, utilizing OLS they find that medication utilization, as measured by per capita pharmaceutical consumptions, positively affects populace future at different ages. This exploration likewise suggests that the relationship between pharmaceutical utilization and a life expectancy makes an overlooked variable inclination in the versatility of pharmaceutical utilization when the age circulation is disregarded. However, relationships between the age dissemination of a nation and other Macroeconomic or total factors might be more sensitive and consequently, more not entirely obvious in exact examinations.

Ali and Khalil (2014) investigated life expectancy of sultanate of Oman is affected by these variables; food production, school enrollment, inflation, population growth, per capita income and CO2 emissions using the data from 1970 to 2012. By using ARDL Co integration the result shows that the food production has noteworthy association with life expectancy, the school enlistment and populace development significant association with life expectancy. The inflation and per capita wage has inconsequential association with life expectancy. In long run CO2 emanations has positive and its immaterial or insignificance association with life expectancy, however in short run it has negative and huge association with life expectancy.

Lenny et.al, (2013) dissect the distinctive mortality forecasting strategies and their presumptions in Europe, and survey their effect on forecasts of future for the Netherlands. They assess the projections of life expectancy during childbirth and at age 65 up to 2050 coming about because of various strategies utilizing comparative express presumptions in regards to the chronicled period and the hop off rates. Information utilizing from 1970 to 2009, they look at coordinate straight extrapolation, the Lee-Carter display, the Li-Lee model, an associate or cohort model, isolate projections of smoking-and non-smoking-related mortality, and the official estimate. As the decision of the unequivocal suppositions turned out to be more vital than the decision of forecasting technique, the suspicions ought to be precisely considered when determining mortality.

Razzak et al, (2015) examine the effects of human and health indicators in the deviation in life expectancy in the case of Asia. Necessary data of 40 Asian countries acquired from World Bank and Sustainable Society Foundation, Netherlands. Two statistical techniques are used. PC analysis technique will determine the set of human and health indicators relevant in determination of other indicators and backward regression analysis which determines an economic model for explaining and estimating relationship between variation in life expectancy at birth and socioeconomic risk factors. The results Stout significant optimistic correlation has found amongst life expectancy and health expenditures, gross national income, healthy life and the worthy governance. However crude birth rate, crude death rate and infant mortality rate has negative relationship with LE which shows LE decreases as crude birth rate, crude death rate and infant mortality rate increases.

Fayissa & Gutema, (2005) investigate the determinants of life expectancy at birth in Sub-Saharan Africa (SSA). They use one way and two way panel data analysis for 33 SSA countries which covers the data from 1990 to 2000. The two way irregular impact display comes about propose that a decline in illiteracy rate and an expansion in the food accessibility index are decidedly connected with enhancements in life expectancy during childbirth and health consumption has demonstrated a solid negative association with the life expectancy. In addition an expansion in urbanization and abatement in CO2 outflow are found to enhance life expectancy rate. Their outcomes can't be founded on measurable essentialness of the test.

Kabir, (2008) looks at the socio-economic determining factors of life expectancy for 91 forming countries isolated into low, middling and extraordinary life expectancy, utilizing different regression and probit systems. In the various regression models, flexibility appraisals of the factors observed to be immaterial or unimportant other than ripeness rate and undernourished populace. In like manner, peripheral impacts of logical factors on life expectancy have been discovered extremely immaterial in probit investigation.

Balan et al, (2011) recognize the determinants of life expectancy in Romania, region, the life expectancy dynamics in Romania the time period is selected from 1970 to 2008. In order to find factors which have significance impact life expectancy by using OLS regression analysis. Through different analysis to classify the homogenous groups of countries which are based on the distinction of life expectancy and its element factors, the determinants of life expectancy are disposable nominal monthly salary, the Roma population, the total beds in hospitals, total available doctors, total available readers and the uneducated population, even though the determining factor with a negative influence on life expectancy are the ratio of the Roma population and the ratio of the uneducated population.

2.2 Studies on Life Expectancy in Pakistan

Nasreen et, al. (2012) investigate the impact of income inequality on health of Pakistani people and estimate whether this effect depends on institutional structure existing in Pakistan. By using data 1973 to 2010 and J-J Co-integration and error correction model exposed that unequal income distribution deteriorate people’s health by reducing the life expectancy rate and increasing infant mortality rate. But, this negative effect might be reduced by introducing efficient institutional structure in Pakistan.

Ali & Audi (2016) examined income inequality impact, the globalization and the environmental degradation on life expectancy in Pakistan. They purposed time series data analysis from time period 1980-2015. They used different stationary process to making data stationary i.e. Augmented Dickey-Fuller and Phillip and Perron unit root tests and also, for testing the casual relationship they used econometrics techniques that are (ARDL) approach, Granger Causality test .they suggest through the study that the on life expectancy the income inequality and environmental degradation have negative and significant influence. The other hand, on life expectancy the globalization has positive impact in Pakistan. They further found there is bidirectional relationship exist among the dependent variables and explanatory variables through the Granger causality results.

2.3 Gap in Literature

Conclusion of Literature and Research gap

From the survey of literature we conclude that there are several factors that affect life expectancy including disposable nominal monthly salary, the total beds in hospitals, total available doctors, total available readers and the uneducated population, crude birth rate, crude death rate and infant mortality rate, income, education, urbanization, health care expenses and involvements like number of over-all consultants, entree to harmless drinking water, nutritious outcome, and geographical locality among others.

The model which is used mostly in studies are ordinary least square, VECM and co-integration technique such as Johnson & Julius and ARDL. Mostly authors have concluded that ARDL is better alternative to Johnson & Julius which handle the problem of different order of integration of series.

By concluding the above literature, it is evident that there are several factors that determines the life expectancy. Therefore, the proposed study will explore the determinants of life expectancy in Pakistan in the domains of economic, social, environmental, health and education. The major studies in Pakistan that investigated the determinants of life expectancy includes (Shahbaz et al, 2016; Ali & Audi, 2016). The first study utilize the ARDL bounds testing approach to cointegration and finds that health spending, urbanization and food supply improves life expectancy while a rise in economic misery along with illiteracy deteriorates life expectancy. The second study also utilized the ARDL bounds testing approach and concludes that income inequality and environmental degradation negatively affect life expectancy while globalization positively affect life expectancy.

The analysis in this will be carried out in the framework of Auto Regressive Distributive Lag (ARDL) model to examine the determinants of life expectancy in various domains including economic, social, environmental, health and education. The previous studies did not cover all these domains in identifying the life expectancy. Moreover, the significant contribution of this study is that it will forecast life expectancy which is not previously done in case of Pakistan.

CHAPTER 3

DATA AND METHODOLOGY

This chapter contains three sections. The first section is about the data description and definition of variables and second section is about the model specification. The third section presents the econometric methodology. On the basis of previous literature our key objective of this methodology chapter is to construct well developed models for empirical analysis. This chapter is presenting the econometrics models these are explained as below:

3.1 Data Description and Definition of Variables

The present study used annual time data to analyze the impact of environmental, economic, education, social and health factors on life expectancy in Pakistan over the period of 1973 to 2016. The data source for time series data is composed from publicly obtainable sources such as Pakistan Economic Surveys, International Financial Statistics and World Development Indicators. The variables of this study are divided into four main categories, like economic, demographic, environmental and health.

3.2 Economic Variables

3.2.1 Inflation Rate (INF)

Universal increase in price of merchandise or goods and enterprises is known as inflation. It is stately against the typical level of buying or purchasing power. By looking at the two arrangements of goods at two focuses in time, and increment in the cost is figured this cost ought not to be expanded because of increment in the quality, inflation is measured. Inflation has inverse relationship with life expectancy, because an increase in inflation rate decreases the value of real money. Low value of money decreases the living standard where low living standard leads to low life expectancy.

3.2.2 Per Capita Health Expenditure (HE)

Total health expenditure is the sum of public and private health expenditures as a ratio of total population". It insurances the establishment of health services, family organization movements, nourishment activities, and alternative aid is nominated for health but it does not contain endowment of water and sanitation. For analysis are taken in current U.S. dollars. Per capita health expenditure and life expectancy are positively associated, because an increase in per capita health expenditure means people are spending more on their health related issues. More spending on health related issues increases the living standard of people and hence higher life expectancy.

3.2.3 GNI Per Capita

This calculated the gross national income divided by total population. GNI (in the past GNP) is the total value of all local producers and above any product taxes (less subsidies) not contained within in the assessment of output plus total net earnings of primary income advantage of employees and property income from abroad. Data is taken in current local currency. Higher per capita income means higher disposable income and people having higher per capita usually spend more on their health related issues. Higher living standard and higher income are directly associated which ensure high life expectancy.

3.3 Urbanization

Urbanization refers to the percentage of total population living in these areas which are defined as urban areas, Population increases in cities and towns versus countryside areas. Urbanization started because of the industrial revolution, when workers moved towards industrialized centers in cities to find jobs in factories in place of agricultural jobs became less common. Basic facilities of health and better living standard like hospital, schools, colleges, universities and number of refreshment centers are more in urban but in rural areas the number of refreshment areas are less. So higher life expectancy is expected in urban areas as compared to rural areas because availability of the basic necessities.

3.3.1 Population Growth (PG)

Population growth is the supporter rate of growth of midyear population for example year 2010 to 2011 expressed as percentage. Our assumption is that all three Urban Population, Urban Population Growth and Population Growth should have negative effect on life expectancy as there is much stress associate to living in crowded cities.

3.3.2 Literacy Rate (LR)

Literacy in percentage stands for literacy rate which is the ratio of the literate population to the illiterates. The expected sign of Literacy with life expectancy is positive. Our claim is interested by the encouragement, that people with better education can more easily survive with difficult lifetime situations and that they are much more careful about their health and good lifestyle. Therefore, life expectancy has been higher for literate people as compared to illiterate's people.

3.3.3 School Enrolment (SE)

School enrolment in percentage representation of net enrollment ratio that is a ratio of official schools children age those are registered in school to the population of the subsequent certified school age. The expected sign of school enrolment is positive as school enrolment increases literacy rate and increased literacy rate also increases life expectancy.

3.4 Food Production Index (FPI)

The food production index concealments food harvests which are deliberated eatable and that encompass nutrients. Tea and Coffee are not included in FPI because it is although eatable but they have no nutritive values. Increase in food production is also expected to increase life expectancy.

3.4.1 CO_2 Emission

Carbon dioxide emissions has been reducing on or after the piping hot of vestige fuels and the manufacturing of cement. During the consumption of solid fuels, gases, liquid and gas burnings they mostly comprise carbon dioxide production. Increase in CO2 emission will badly affect health of the people and resultantly decreases the life expectancy.

3.5 Health Variable

3.5.1 Life Expectancy at Birth Total (LE)

It is defined that how long on average a newborn be able to expected living. If present death rates would not be reformed. However, the genuine age unambiguous death rate of a particular birth unit can't be known ahead of time. On the off chance that rates are diminishing, real life periods would be higher than future compute by utilizing current death rates. Life expectancy during childbirth is a standout amongst the most every now and again utilized health status pointers. Picks up in life expectancy during childbirth can be perceived to various variables, incorporating ascend in an expectations for everyday comforts, enhanced the way of life and to show signs of improvement instruction, and also more prominent access to quality health services. This marker is introduced as an aggregate and per the two sexes and is measured in years.

3.5.2 Infant Mortality Rate (IMR)

The death of a baby before his or her first birthday is called infant mortality". The infant mortality rate is an evaluation of the quantity of newborn deaths for every 1,000 live births. This molarity rate has been frequently used to estimate or measure the health and welfare of a contrary's nation, since factors troubling the health of whole populations can also influence the mortality rate of infants or new born. Here represents the mortality is under-five mortality rate. The relationship between IMR and life expectancy (LE) are discussed widely in academics and policy circles. Literature suggest that low IMR rate in a country lead to high life expectancy. Thus this variables carries the negative expected sign.

3.5.3. Birth Rate (BR)

A gradual increase in life expectancy and the corresponding decrease in birth rates could be observed over the last few decades worldwide and also in case of Pakistan. The total number of people born per 1,000 populations, the birth rate is compared with the death rate to specify the expected population growth of a country. The birth rate most frequently arises up in economic development discussions of less developed countries and their progress through the demographic conversion. A higher net population growth are expected to negatively affect the life expectancy.

3.5.4 Death Rate (DR)

Number of deaths per 1000 of total population, usually disjointed for each sex in numerous age groups. A calculated number that shows how many people died in a specific place and from a specific reason during a specific time period. The sign of this variable with life expectancy is ambiguous. Because higher death rate on one side is considered as failure of the nation's health system then low life expectancy. While on the other hand higher death rate mean low population growth, and low population growth means low dependency ratio and higher the life expectancy.

3.6 Conceptual Framework

The core objective of this following chapter is to establish an econometric model for our empirical analysis. The statistic information about countries nation's health position. It is frequently consequent from its health production function. The association or movements of inputs and outputs over a quantified period is described by health production function. The life expectancy or morbidity's output is measure of health positions. Inputs could be health care, medical expenditures, environment, education, etc.

Grossman's (1972) display an ideal model about health is helpful for hypothesizing of the health production work. As indicated by Grossman's model, individuals are seen as makers of health by the decisions they make about their practices and their utilization of therapeutic care or medical care. As a result of this procedure, lifetimes are pretty much sound. People are obliged in their chances to create health for different reasons: budgetary imperatives, pattern blessings of physical and psychological health and the social and indigenous environmental and settings they involve. Grossman (1972) hypothetical wellbeing model can be disentangled as takes after:

$$LE = f(Y)$$

Where LE (life expectancy) is a measurement of health output and Y is a vector of distinct inputs including economic, environmental, health and educational variables to the health production function. Grossman suggest the given model to study the life expectancy at micro level, however the Y is a vector of indicators which according to Fayissa and Gutema (2005) can be categorize into four main divisions.

$$LE = f\,(ECO, ENVI, HEA, EDUCATION)$$

Where LE is representing the life expectancy at birth of population, ECO is a vector of economic, ENVI is a vector of environmental variables, HEA is a vector of health variables and EDU is a vector of educational variables. The determinants of life expectancy function are derivative of health production function (Shaw et al., 2005; Kabir, 2008). In the experiential analysis, the variables in each sub group might be fluctuate noticeably because of data boundaries and environmental conditions of a country under study.

A number of empirical studies have explored the factors that can affect the life expectancy and several factors have been identified which are discussed on pervious chapter. This study utilized following econometric model similarly used by Freda (Halicioglu, 2011) for the investigation of determinants life expectancy.

$$LE = \beta_o + \beta_1 INF + \beta_2 PCI + \beta_3 FP + \beta_4 LR + \beta_5 HE + \beta_6 CO_2E + \beta_7 SE + \beta_8 PG$$
$$+ \beta_9 EG + \beta_{10} UR + \beta_{11} IMR + \beta_{12} BR + \beta_{13} DR + \varepsilon_t \ldots\ldots\ldots (1)$$

Where, the LE is representing the life expectancy at birth which is in (logarithm), INF is inflation rate (in logarithm), PCI is per capita income in (logarithm), FP is food production index (in logarithm), LR is literacy rate, HE is health expenditure per capita (in logarithm), CO2E is CO_2 emission, SE is school enrolment, PG is population growth, EG is economic growth, UR is urbanization, IMR is infant mortality rate, BR is birth rate, DR is death rate and ε_t is error term.

This section briefly discussed the estimation techniques which will further used in our empirical analysis. To achieve the objective of this study including the short run and long run relationship in life expectancy and its determinants unit root and ARDL bound test of Co-Integration test are used in the study.

3.7 Unit Root Test

Almost the time series data contains with time trend, structural breaks and seasonal pattern, as a result the variance is changed over the time and the actual values depends on the time. In order to model time trend and seasonality the box Jenkin (1978) differencing methodology is used in literature. It is most important to check the stationary of the series through the unit root test which is proposed by Augmented Dickey Fuller test (ADF-1980). The following non stationary hypothesis is tested in ADF test against alternative hypothesis.

$$H_0: \tau_1 = 0 \ldots\ldots\ldots (a)$$
$$H_0: \tau_1 \neq 0 \ldots\ldots.. (b)$$

The decision could take on the bases of t- statistics of the estimated coefficients of τ_1 and critical values. As decision rule, if the t-statistics calculated value is greater or more than the critical value, then null hypothesis i.e. the series is unit root, do not rejected otherwise the null be rejected in case if the calculated value less than the critical value. Co-integration is defined as the presence of a long-run equilibrium association among two variables or having unit root at level (Gujarati, 2004). With the objective to gauge the economic, demographic, environmental variable and health variables impact on long-run life expectancy, the proposed study expresses life expectancy as a set of economic, demographic, environmental and health variables, including lags of both the dependent and independent variables, in the form of an ARDL Model (Auto Regressive distributed lag model). Alternative to static model, an ARDL model is chosen in order to detect that how the dependent variable respond in a dynamic way to a change in its own lags and the contemporaneous and lagged values of the other independent variables (M'Amanja & Morrissey, 2005).

That is why this study implement the bound testing framework of ARDL established by (Pesaran et al. 2001). This technique is justified in the following lines. It suggest that the model parameter be projected or estimated by the simple Ordinary Least Square (OLS) method, once the lag order of the ARDL model has been recognized. This approach of co-integration technique does not care whether the series are I (0) or I(1) as well as it gives efficient estimate in case of small sample and also cure endogeneity problem (Pesaran & Pesaran, 1997). Still, it is suggested to test stationary properties because Auto Regressive distributed lag model technique does not work in the occurrence of I (2) series.

This research investigate the economic, demographic, environment and health variables impact on life expectancy through bound testing method of Auto regressive disseminated lag model (ARDL). In first direction this study will test the long run relationship between our dependent variable i.e. Life expectancy and independent variables while in the second direction the study will also determine the short run aspect of the model. The conventional co-integration techniques are incapable to estimate separately the long run and the short run dynamics of the model whereas the Bound testing approach of auto regressive distributed lag model is the alternative technique to be used for such purpose.

Fundamentally, the ARDL approach is designed to the error correction version for long term life expectancy and its determinants. There are two stages of ARDL. In the first stage which is based on bound testing and established by (Pesaran et al. 2001) the ultimate objective is to test whether the series under consideration are co-integrated or not. Following (Pesaran et al. 2001) modeling approach, in order to capture the economic, demographic, environment and health variables and to explain the influence of health variables like Infant mortality rate, birth rate and death rate on the life expectancy, the ARDL model is generally specified as follows.

$$LE_t = f(INF_t, HE_t, GNI_t, UR_t, PG_t, SE_t, FP_t, CO2_t, IMR_t, BR_t\ \ DR_t) \qquad (3.7.2.1)$$

Where (INF) is Inflation Rate; (HE) is Health expenditure; (GNI) is GNI per capita (BR) is (UR) is urbanization, (PG) is the population growth, (SE) is school enrolment, (FP) is food production, (CO2) is Co2 Emission , (IMR) is infant mortality rate, (BR) is birth rate and (DR) is death rate.

The general specification of ARDL used in our study are as follows.

$$\Delta LE_t = \alpha_0 + \gamma_1 LE_{t-i} + \gamma_2 INF_{t-i} + \gamma_3 HE_{t-i} + \gamma_4 GNI_{t-i} + \gamma_5 UR_{t-i} + \gamma_6 PG_{t-i} + \gamma_7 SE_{t-i} + \gamma_8 \mathrm{FP}_{t-i} + \gamma_9 \mathrm{C02}_{t-i} + \gamma_{10} \mathrm{IMR}_{t-i} + \gamma_{11} \mathrm{BR}_{t-i} + \gamma_{12} \mathrm{DR}_{t-i} + \sum_{i=1}^{s} \pi_i \Delta LE_{t-i} + \sum_{j=1}^{u} \rho_j \Delta INF_{t-j} + \sum_{v=1}^{k} \sigma_v \Delta HE_{t-v} + \sum_{w=1}^{y} \tau_w \Delta GNI_{t-w} + \sum_{m=1}^{b} \omega_\mu \Delta UR_{t-\mu} + \sum_{q=1}^{l} \emptyset_q \Delta PG_{t-q} + \sum_{c=1}^{h} \varpi_c \Delta SE_{t-c} + \sum_{g=1}^{i} \psi_g \Delta FP_{t-g} + \sum_{s=1}^{f} \psi_s \Delta \mathrm{CO2}_{t-s} + \sum_{q=1}^{f} \epsilon_q \Delta \mathrm{IMR}_{t-q} + \sum_{r=1}^{f} \epsilon_r \Delta \mathrm{BR}_{t-r} + \sum_{x=1}^{f} \epsilon_x \Delta \mathrm{DR}_{t-x} + \varepsilon_t \qquad (3.7.2.2)$$

Where α_0 is the autonomous parameter, the short run parameters is represented by the Coefficients $\pi_i, , \rho_j, \sigma_v, \tau_w\ \omega_\mu, \emptyset_q, \varpi_c, \psi_g, \psi_{s,} \epsilon_q, \epsilon_r$ and ϵ_x while long run parameters is given by $\gamma_1, \gamma_2 \ldots\ldots\ldots., \gamma_{11}$ and γ_{12}.

Null hypothesis of the above model describes no long run relationship among LE and INF, HE, GNI, UR, PG, SE, FP, CO2, IMR, BR, DR decision whether to accept or reject this hypothesis depend upon the F-critical values (Pesaran, et al., 2001)). If the calculated values of F-statistics exceeds the upper bound critical value (which assume that the explanatory variables integrated of order one), null hypothesis is that there is co-integration has not been accepted. Similarly if lower critical value (which assume that the explanatory variables of order zero), exceeds the F-calculated values, then the null hypothesis can be rejected. If the calculated value of F-statistic lies in the middle of upper bound critical value and lower bound critical values the results remains indecisive.

The null hypothesis is given below (no long run relationship)

H_o: $\gamma_1 = \gamma_2 = \gamma_3 \ldots\ldots..\gamma_{12} = 0$ (3.7.2.3a)

Alternate hypothesis is as under (long run relationship)

H_1: At least one of them is not equal to zero (3.7.2.3b)

The bound testing procedure to co-integration assumed that the error terms are independent of each other (there is no autocorrelation among the error terms). For that reason, one must decide about the optimal lag length of the VAR model. Particularly, in small sample case (Pesaran, et al., 2001) argued that optimal number of lags is crucial to avoid the autocorrelation and over parameterized problem. Resultantly a tradeoff exist between over parameterized model and autocorrelation problem which is probably to be optimized by choosing optimal lag length.

In order to select the optimum lag of the model, this study use Akaike information criteria (p) is the number of lags for explanatory variables and (q) is the number of lags of dependent variables.

If the test results fail to reject the null hypothesis then only short run version of the model would be estimated using the first differenced variables (Reungsri, 2010).

Nevertheless, if the test result reject the null hypothesis then we have sufficient evidence to estimate the following long run version of the model:

$$LE_t = \beta^{/} + \sum_{i=1}^{q} \pi_i^{/} LE_{t-i} + \sum_{j=1}^{p} \rho_j^{/} INF_{t-j} + \sum_{v=1}^{k} \rho_v^{/} HE_{t-v} + \sum_{x=1}^{z} \rho_x^{/} GNI_{t-x} + \sum_{w=1}^{y} \tau_w^{/} UR_{t-w} + \sum_{m=1}^{b} \omega_m^{/} PG_{t-m} + \sum_{q=1}^{l} \emptyset_q^{/} SE_{t-q} + \sum_{c=1}^{h} \varpi_c^{/} FP_{t-c} + \sum_{s=1}^{f} \psi_s^{/} CO2_{t-s} + \sum_{x=1}^{z} \epsilon_x^{/} IMR_{t-x} + \sum_{u=1}^{y} \epsilon_u^{/} BR_{t-u} + \sum_{a=1}^{b} \epsilon_a^{/} DR_{t-a} + \mu_t$$

(3.7.2.4)

Where all the long-run coefficient are given by $\pi^{/}$, $\rho_j^{/}$ $\rho_v^{/}$, $\rho_x^{/}$, $\tau_w^{/}$ $\omega_m^{/}$, $\emptyset_q^{/}$, $\varpi_c^{/}$, $\psi_s^{/}$ $\epsilon_x^{/}$, $\epsilon_u^{/}$ and $\epsilon_a^{/}$ The relative number of lags will be chosen on the basis of Akaike information Criterion.

For short run dynamics, finally the following error correction model (ECM) is estimated:

$$\Delta LE_t = \beta^* + \sum_{i=1}^{q} \pi_i^* \Delta LE_{t-i} + \sum_{j=1}^{p} \rho_j^* \Delta INF_{t-j} + \sum_{v=1}^{k} \rho_v^* \Delta HE_{t-v} + \sum_{x=1}^{z} \rho_x^* GNI_{t-x} + \sum_{w=1}^{y} \tau_w^* \Delta UR_w + \sum_{m=1}^{b} \omega_\mu^* \Delta PG_{t-\mu} + \sum_{q=1}^{l} \emptyset_q^* \Delta SE_{t-q} + \sum_{c=1}^{h} \varpi_c^* \Delta FP_{t-c} + \sum_{s=1}^{f} \psi_s^* \Delta CO2_{t-s} + \sum_{c=1}^{h} \epsilon_x^* \Delta IMR_{t-c} + \sum_{c=1}^{h} \epsilon_s^* \Delta BR_{t-c} + \sum_{c=1}^{h} \epsilon_c^* \Delta DR_{t-c} + \lambda ECM_{t-1} + \epsilon_t \quad (3.7.2.5)$$

Where the dynamic adjustment coefficient is given by π_i^*, ρ_j^*, ρ_v^*, ρ_x^* , τ_w^*, ω_μ^*, $\emptyset_q^*$, ϖ_c^*, ψ_s^*, ϵ_x^*, ϵ_s^* and ϵ_c^* while the coefficient of ECM_{t-1} (which is the lag of the residuals) i.e. ω indicate the speed of adjustment .

3.8 Theory of Forecasting Life Expectancy

After estimating auto regressive distributive lag model, the study proceed to forecast life expectancy on the basis of other independent variables. It is conceivable to prompt a subjective presumption straight on the parameter vector θ or indirectly on the dependent variable $Y_{t+1}$to be forecasted because if the choice creator can express a guess on θ, the theory can be applied directly. It can be more neutral to forecast in most of the cases the future behavior of dependence variable Y_{t+1} relatively than about model parameters and vector θ.

Let's denote the subjective guess as Y_{t+1}using the ARDL model this study will forecast life expectancy on the basis of previous year data from 1973-2016 and forecast four years life expectancy up to year 2020.

The most important use of ARDL model is to forecast the future values of the Y_t series. To clear this discussion it is assumed that the actual data generating process and current past realizations of the Y_t and others independent variable lags values are known to researcher (Enders, 2013). First we will consider a general AR (1) model and start forecasting from it.

$$Y_t = \alpha_0 + \alpha 1 y_{t-1} + \epsilon_t \ldots\ldots (3.1)$$

If the coefficients of α_0 and α_1 is known then we can forecast Y_{t+1} on the bases of conditioned and information available to us at time period t.

$$E_t Y_{t+1} = \alpha_0 + \alpha 1 y_t \ldots\ldots.. (3.2)$$

Where $E_t Y_{t+j}$ = a short hand way to write the conditional expectation of Y_{t+j} given the information available at time t.

Although unbiased the forecast from VAR and ARDL model are necessary inaccurate. To find the variance of the forecast error, continue to assume that the elements of the ϵ_t sequence are independent with variance σ^2 then from equation 3.2 the variance of the forecast error is

$$VAR[f_t(j)] = \sigma^2[1 + \alpha_1^2 + \alpha_1^4 + \alpha_1^6 + \cdots . \alpha_1^{2(j-1)}$$

Since the one step forecast error variance is σ^2, the two step ahead forecast error variance is $\sigma^2(1 + \alpha_1^2)$ *and so on*. The important point to note is that the variance of the forecast error is an increasing function of j. In the limit as $j \to \infty$ the forecast error converges to $\sigma^2/(1 - \alpha_1^2)$ hence the forecast error variance converges to the unconditional variance of the Y_t series.

3.9 Model Diagnostic Tests

3.9.1 Normality Test

A normality test is utilized to decide whether information tests have been taken from a noramly distributed circulated populace. Some statistical tests, for example, the student's t-test and the one way ANOVA and two-way ANOVA, require a typically appropriated populace of tests.

A suspicion of the classical linear regression model which is the residuals are normally disseminated or distributed with zero mean and steady variance. The infringement of this supposition prompts the measurable finishes of the regression demonstrate being the measurements t, insights F, and so on. It is essential to attempt the smoothness.

It is very important to test the normality. To test this, we first have to calculate the second, third and fourth moments of residues, and then calculate the JB Jarque-Berra (1990) statistics used to check for normality.

$$JB = n\left[\frac{\mu_3^2}{6} + \frac{(\mu_4 - 3)^2}{24}\right]$$

This has a χ^2 distribution with 2 degree of freedom. If JB is greater than χ^2 critical value then we reject the null hypothesis that the data is normally distributed.

3.9.2. Lagrange Multiplier Test LM Test

This study use the LM test in our analysis to detect the presence or absence of autocorrelation in our regressions used to estimate the unit root test of the series of levels. To check whether the residuals in the regression are serially correlated, first it is needed to estimate the regression to obtain the residuals ε_t and then carry out the following regression.

$$\mu_t = \alpha_1 + \alpha_2 t + \alpha_3 LE_{t-1} \_ \alpha_4 \Delta LE_{t-1} + \alpha_5 \Delta LE_{t-2} + \alpha_6 \Delta LE_{t-3} + \alpha_7 \Delta LE_{t-4} + \sum_{j=1}^{m} p_j \mu_{t-j} + \varepsilon_t$$

3.9.3 Wald Test

A Wald test is based on parameter estimates and their covariance's, for example, the standard errors derived using the maximum likelihood or the least squares whereas a likelihood ratio test has been based on the function of likelihood..

$$W = \frac{(\hat{\beta} - \beta_o)}{\hat{S}E(\hat{\beta})} \approx N(0,1)$$

Where $\hat{\beta}$ is estimated parameter, β_0 is parameter of interest and this is usually 0 as the objective is to test whether the coefficient differs from 0 or not.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

To presents the estimation as well as the investigation of the previous chapter equations is the objective of this chapter. The main analysis includes in this chapter are the discussion of the descriptive analysis of all variables, unit root test results and the bounds test for co-integration. Moreover, the chapter also includes the discussion about the results of the long-run and the short-run dynamic effects of economic, social, environmental and demographic variables on life expectancy.

4.2 Descriptive Statistics

In the descriptive analysis, the basic statistics of individual series is calculated along with coefficient of variation is calculated, shown in the below different tables for different variables. Before analyzing the further empirical estimations, the unit root of individual series is also tested according to the frequency of data. In this thesis data of having annual frequency is analyzed, therefore Augmented-Dicey Fuller (ADF) is suitable for unit root test.

For descriptive analysis, the complete sample period for all the variables has been divided into different sub samples (decades) in table 4.1. The average life expectancy for the complete sample period from 1973 to 1980 is 55.79 and the standard deviation is 0.91, while the stability ratio (coefficient of Variation) is 1.63%. The standard deviation and stability ratios are the measures of volatility. The average Gross National Income (GNI) for the complete sample period from 1973 to 1980 is 2119.60 and the standard deviation is 734.63, while the stability ratio (coefficient of Variation) is 34.63%. The value of both the standard deviation and stability ratio for the complete sample period of life expectancy.

Further there are different decades or subsamples for which the standard deviation and stability ratio shows the volatility of variables in each decade. There are different values of standard deviation and stability ratios and higher value is an indication of higher volatility. If we use standard deviation as a measure of volatility, then the sample of 2011 to 2015 for the life expectancy have higher standard deviation. Therefore this sub sample is more volatile than others and the sub sample of 1973 to

1980 has lowest standard deviation therefor this sample is less volatile. But the standard deviation alone cannot be called the best volatility measure. So we use stability ratio as a measure of volatility instead of standard deviation. Therefore among different sub samples of life expectancy 70's (eight years) has the lowest ratio i,e., it is a least volatile and sub samples of 20's has the highest stability ratio i.e., this sub sample is more volatile. Similarly with all other variables

Table No. 4.1 Descriptive Statistic

Years		LE	BR	DR	MR	PG	UR	FP	CO2E	INF	HE	SE	GNI
	Mean	55.79	42.34	13.30	127.25	3.01	26.86	35.44	0.35	14.28	181.24	481.50	2119.60
	SD	0.91	0.13	0.54	3.92	0.17	0.84	2.71	0.03	8.02	38.04	30.92	734.11
1973-1980	SR	1.63	0.30	4.02	3.08	5.67	3.12	7.64	8.39	56.15	20.99	6.42	34.63
	Mean	58.76	41.85	11.64	113.72	3.21	29.47	50.09	0.52	6.98	465.39	722.90	5791.28
	SD	0.93	0.66	0.55	4.97	0.15	0.74	6.58	0.07	2.45	216.59	149.63	1481.18
1981-1990	SR	1.57	1.59	4.70	4.37	4.67	2.51	13.13	12.77	35.13	46.54	20.70	25.58
	Mean	61.60	35.83	9.60	96.06	2.51	31.97	76.49	0.71	9.25	1532.81	1470.60	16455.34
	SD	0.80	2.56	0.61	5.61	0.15	0.78	9.02	0.05	3.18	416.65	220.60	5599.23
1991-2000	SR	1.30	7.14	6.39	5.84	5.80	2.44	11.80	7.21	34.42	27.18	15.00	34.03
	Mean	64.03	30.33	8.14	79.52	2.07	34.95	101.74	0.89	8.92	4503.20	2171.30	52708.67
	SD	0.71	0.40	0.26	4.17	0.04	1.06	10.78	0.08	5.60	1710.78	415.76	21470.54
2001-2010	SR	1.11	1.33	3.14	5.24	2.02	3.04	10.59	9.11	62.78	37.99	19.15	40.73
	Mean	66.33	30.13	7.50	69.00	2.11	37.87	96.94	0.88	7.80	9335.00	3199.80	131148.60
	SD	1.16	0.05	0.13	2.50	0.02	0.69	20.23	0.04	3.48	1272.59	412.11	17756.27
2011-2015	SR	1.75	0.18	1.72	3.62	0.88	1.83	20.87	4.55	44.64	13.63	12.88	13.54

4.2 Unit Root Test

The above mention table 4.2. All variables are tested for unit root before proceeding with the ARDL bounds test in order to determine the long run relationship in the variable. This initial step is necessary to avoid the problem of spurious results. If variables are I(2), the computed F-statistics will be no more valid as it is assumed prior in ARDL that the series should either be I(0) or I(1) but not I(2).

Table 4.2: Augmented Dickey Fuller (ADF) Test

	Unit Root Test at level		**Unit Root Test at First Difference**		
Variables	Constant	Constant, Linear Trend	Constant	Constant, Linear Trend	Decisions
Birth Rate	-2.55 [0.11]	-3.73 [0.03]			I(0)
Death Rate	-0.70 [0.83]	-7.09 [0.00]			I(0)
Inflation Rate	-3.33 [0.01]	-3.43 [0.06]			I(0)
Urbanization	-1.06 [0.72]	6.17 [0.00]			I(0)
Mortality Rate	0.07 [0.95]	-5.51 [0.00]			I(0)
Life Expectancy	4.22 [1.00]	0.11 [0.99]	-6.76 [0.00]	-3.54 [1.00]	I(1)
Food Production	-2.39 [0.14]	1.93 [1.00]	-4.38 [0.00]	-5.26 [0.00]	I(1)
Health Expenditure	0.13 [0.96]	-2.63 [0.26]	-6.35 [0.00]	-6.31 [0.00]	I(1)
CO2 Emission	-2.50 [0.12]	0.07 [0.99]	-6.26 [0.00]	-7.36 [0.00	I(1)
School Enrolment	-0.08 [0.94]	-2.85 [0.18]	-4.31 [0.00]	-4.27 [0.00]	I(1)
Population Growth	-0.19 [0.93]	-2.25 [0.44]	-2.73 [0.07]	-4.83 [0.00]	I(1)
GNI Coefficient	-1.57 [0.48]	-2.75 [0.22]	-5.50 [0.00]	-5.51 [0.00]	I(1)

Table 4.2 shows birth rate, death rate, inflation, urbanization and mortality rate are stationary at level it means these are integrated of order I(0), while on the other hand life expectancy at birth, food production, health expenditure, carbon dioxide emission, school enrolment, population growth and GNI representing the variables are stationary at first difference I(1). Results indicate that the all variables are stationary in difference

ways some variables are stationary at level I(0) and some of these variables are stationary at first difference I(1). Therefor we apply auto regressive distributed lag (ARDL) model to investigate the long run relationship and short run relationship between life expectancy and other remaining variables suggested by (Pessaran et al, 2001).

4.3 ARDL Bounds Test for Co-integration

The results of long run co-integration are testified in Table 4.3. The calculated F-statistics which jointly test the coefficients of the lagged levels of the variables is illustrated in Table 4.3 this was done by estimating equation (3.7.2.3) for the F-statistics using the OLS method. The null hypothesis represents there is no long run relationship exist among the variables (i.e. the joint coefficient of all the lagged levels without difference in equation (3.7.2.3) are zero are tested through the F-statistic against the alternative that they are not all equal to zero. It is clarify by (Pesaran, *et al.,* 2001) that whether the variables are integrated of order one or zero depend on whether the critical value is above the bound or below. It is assumed that lower bound critical value is that the explanatory variables are integrated of order zero and vice versa. Table 4.3 below describing the results of the calculated F-statistics for the long-run co-integration relationship.

Table 4.3: Bound Test for Cointegration

Test Statistic	Value	DF	Probability
F-statistic	6.132232	(12, 7)	0.0117
Chi-square	73.58678	12	0.0000

Above Table 4.3 shows the results of the calculated F-statistics for the long-run co-integration relationship. If we compare F statistics value with below table 4.4 so F-statistics value 6.13 is higher than upper bound value at 5% so we can reject our null hypothesis of no co-integration. Rejection of null hypothesis means there is co-integration exist among life expectancy and others economic, demographic, environmental and health variables. In next step we calculate short run coefficient as will as long run coefficient.

Table 4.4: Values of Bound Test for Cointegration Analysis Based on Equation

Critical Value	Lower Bound Value	Upper Bound Value
1%	3.74	5.06
5%	2.86	4.01
10%	2.45	3.52

4.3.1 Long Run Analysis

The long-run coefficient is estimated of the ARDL (1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1) the lag of which is based on the Schwarz Bayesian information Criterion. Once the study established the long-run co-integration relationship between the health variables and life expectancy. This study uses Schwarz Bayesian information Criterion because it gives consistent and parsimonious specification in case of small sample as compare to Akaike Information Criterion (Perasan *et al*., 1997).

Table 4.5 Estimated Short Run and Long Run Coefficients using the ARDL

Short Run Variable Name	Dynamics Coefficient (prob.)	Long Run Variable Name	Dynamics Coefficient (Prob).
D(LE(-1))	1.45 (0.25)	LE(-1)	0.08 (0.00)
D(LBR(-1))	-18.11 (0.67)	LBR(-1)	-1.28 (0.03)
D(LCO2E(-1))	-1.25 (0.42)	CO2E(-1)	-1.45 (0.04)
D(LDR(-1))	-1.79 (0.26)	LDR(-1)	-1.31 (0.03)
D(LFP(-1))	-7.02 (0.23)	LFP(-1)	1.83 (0.01)
D(LGNI(-1))	-0.18 (0.83)	LGNI(-1)	-1.34 (0.07)
D(LHE(-1))	0.83 (0.03)	LHE(-1)	0.87 (0.02)
D(LINF(-1))	-0.04 (0.03)	LINF(-1)	-0.23 (0.07)
D(LMR(-1))	-3.27 (0.00)	LMR(-1)	-2.80 (0.03)
D(LPG(-1))	-5.95 (0.03)	LPG(-1)	-4.15 (0.07)
D(LSE(-1))	1.92 (0.03)	LSE(-1)	0.23 (0.04)
D(LUR(-1))	-2.85 (0.00)	LUR(-1)	-3.89 (0.02)
C	47.09 (0.01)	ECM(-1)	-0.10 (0.00)

Generally, it could be seen in table 4.5 above that the results are mostly consistent with the literature. From Table 4.5 one can observe that lag of life expectancy has positive impact on life expectancy in both short run and long run but significant only in long run. Also we can see from the table 4.5 that birth rate negatively associated with life expectancy, but the association is statistically significant only in the long run. So if in long run birth rate increase it will decrease the life expectancy. This could be because of increase in dependency ration with the increase in birth rate. Carbon dioxide emission are also inversely related with life expectancy both in short run and long run, but the association is significantly only in the long run. It means that consistent increase in Carbon dioxide emission in the long run is hazardous to health and thus effect life expectancy negatively. Similar association is also exist between death rate and life expectancy because too high death rate in long run means lesser life expectancy. Food production are negatively but insignificantly associated with life expectancy in short run but a consistence increase in food production in the long run is a sign better nutrition and hence positively affect life expectancy.

A higher Gross national income means more income inequality in the society. It also means that very lesser portion of the society afford basic necessity of life i.e. excess to education and health, recreation and other life affecting indicators. The study results show that an increase in income inequality (increase in Gini coefficient) reduces life expectancy significantly in the long run but the association between the two is insignificant in the long. Health expenditure has positive and significant impact on life expectancy both in short run and long run. Higher health expenditure means better availability of health instrument and services, low diseases rate and hence long life expectancy.

Inflation has indirect association with life expectancy via expenditure on basic necessities of life specifically food item which directly affect life expectancy. Higher inflation in our case are inversely associated with life expectancy both in short run and long run. Thus our data support the expected theoretical association between the two variables. Pakistan is the second fastest growing country with respect to population after Afghanistan. The population growth of Pakistan is 2.03 percent according to 2017 estimates while that of Afghanistan it is 2.8 percent. Because of this higher population growth rate of Pakistan and other political issues along with health remains a forgotten priority in Pakistan causes low life expectancy, because life expectancy and better health facility are closely related. Results shows that an increase in population growth leads to decreases in life expectancy both in short run and long run but the magnitude of decrease is very low.

Higher the school enrolment, higher will be the education ratio, more human capital more awareness about health issues and the required prevention measures. Moreover, more human capital, better the earning and higher spending on health in turn will improve life expectancy. This prediction is evident from our model estimation where school enrolment is positively and significantly associated with life expectancy both in short run and long run. As the urbanization across the world[1] specifically in developing nations is increasing day by day, resultantly, the mode of living is now concentrated towards cities (Vlavoh et al, 2005). Due to this increasing urbanization, the provision of basic services including health, education and shelter to the urban poor might be one of Pakistan immediate problem, which in turn effect life expectancy. Literature on health and diseases in urban settings is increasing among academics. With the increase in cities size and density along with increase in growth through migration and commerce leads to higher morbidity and mortality (Grob, 2002). Thus increasing urbanization is negatively associated with life expectancy both in short run and long run which is evident from our results.

Various factors affect the life expectancy which are assessed by many studies around the world and identify the determinants of life expectancy. A summary of most common factors that affect life expectancy are presented in table 4.6 below. Table 3 is self-explanatory. One could observe from the table that the most important determinants that identified by most of the authors are health expenditure, urbanization, inflation, per capita income, literacy rate, school enrolment, food availability and environmental degradation denoted by CO2 emission. The factors that in most of the study positively affect life expectancy are health expenditure, per capita income, food availability, and literacy rate and school enrolment. On the other inflation rate, population growth, urbanization and environmental degradation negatively affect life expectancy. Our results are mostly consistent with these results.

---

[1] See Brockerhoff MP, 2000 for detail.

Table 4.6: Summary of Results of Previous Studies

Variables and its signs	Country and Study								
IMR	Ali & Ahmed (2014) [Oman]	Halicioglu, 2010 [Turkey]	**Bayati, 2013** [Eastern Mediterranean Region]	Delavari et al, 2016 [Iran]	Monsef & Mehrjardi, 2015 Panel study	Ananthara man, 2017 India	Sede & Ohemeng, 2015 [Nigeria]	Shahbaz et al, 2015 [Pakistan]	Ali & Audi, 2016 [Pakistan]	Nasreen & Anwar, 2012 [Pakistan]
INF	-			-	-					
HE		+	_				+	+		+
GNI	-		+	+	+	+	+			
UN		-	+	+	+			+		
PG	-									
LR				+		+				+
SE	+		+				+			
FPI	+	+	+	+				+	+	
COE	+		+	+					-	

Note: IMR= Infant mortality rate, INF= Inflation rate, HE= Per Capita Health expenditure, GNI= GNI Per Capita, UN= Urbanization, PG= Population Growth, LR= Literacy rate, SE= School enrolment, FPI= Food production index, COE= CO2 emission, LE= Life expectancy at birth total, BR=Birth rate, DR= Death rate

The per period adjustment from a short-run deviation back to the long run equilibrium relationship is represented by the coefficient of the error correction term (ECM). The estimated value error correction term coefficient statistically significant and it has the expected symbol (sign). The ECM coefficient is interpreted as the system shows about 10% percent per period adjustment to the long run equilibrium. This short run discrepancies validate the long-run effect relationship between life expectancy and economic, demographic, environmental and health variables.

This recommends that the speed of adjusting to long-run deviations or shocks is relatively slow and highly significant.

4.4 Model Diagnostic Tests

The model diagnostic test and their probability values is given in Table 4.6. The null hypothesis of serial autocorrelation is that there is no serial correlation in the model, the results suggest the null hypothesis cannot be rejected. The functional form is correctly specified and No Heteroscedasticity cannot be rejected. The results of normality test shows that the residuals normally distributed which is analysis through the regression.

Table 4.7: ARDL-ECM Model Diagnostic Tests

Test Statistics	LM Version [Probability]	F-Version [Probability]
A: Serial Correlation	χ^2 (1) = 10.86 [0.44]	F(2, 13) = 2.34 [0.1351]
B: Functional Form	χ^2 (1) = 1.860 [0.1725]	F(1, 14) = 01.4497 [0.2374]
C: Normality	χ^2 (2) = 1.31 [0.51]	Not Applicable
D: Heteroscedasticity	χ^2 (1) = 1.79 [0.7447]	F(25, 15) = .573725 [0.8938]

A: Lagrange multiplier test of residual serial correlation

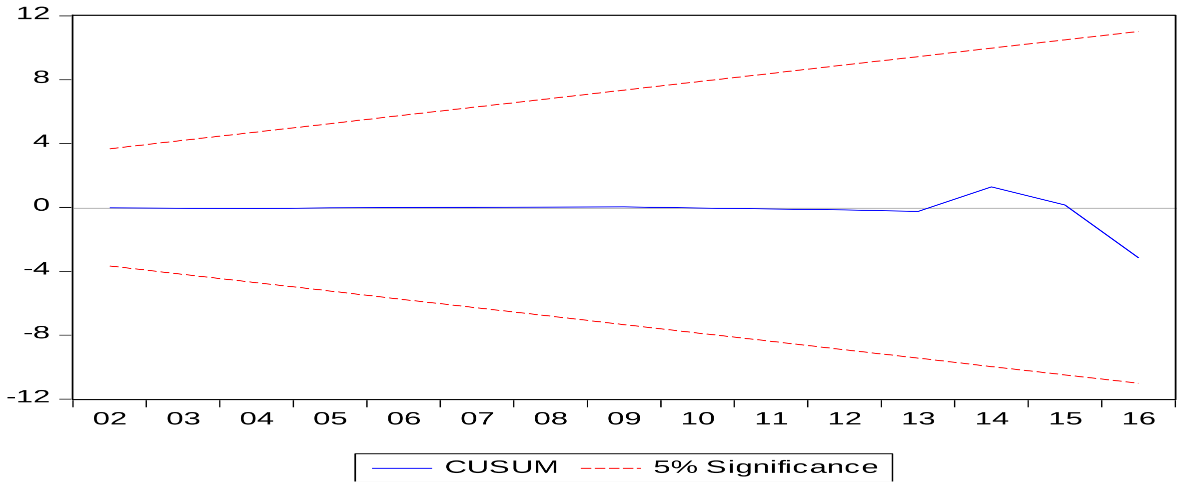
A: Ramsey's RESET test using the square of the fitted values

B: Based on a test of skewness and kurtosis of residuals

C: Based on the regression of squared residuals on squared fitted values

After estimating the ECM version of ARDL model, we test the stability of parameters of the model by cumulative sum of recursive residuals (CUSUM) and the CUSUM of square (CUSUMSQ) (Pesaran & Pesaran, 1997) the result of which is presented in Graphs 1 and 2. It is evident from the graph that since the plot of the CUSUM and CUSUMSQ statistic fall inside the critical bands of the 5% confidence interval, so we have strong evidence that the model parameters are stable.

Figure 4.1 Parameter stability test Cumulative sum of Recursive Residuals



It is evident from the graph that since the plot of the CUSUM fall inside the critical bands and CUSUMSQ statistic fall inside the critical bands of the 5% confidence interval, so we have strong evidence that the model parameters are stable.

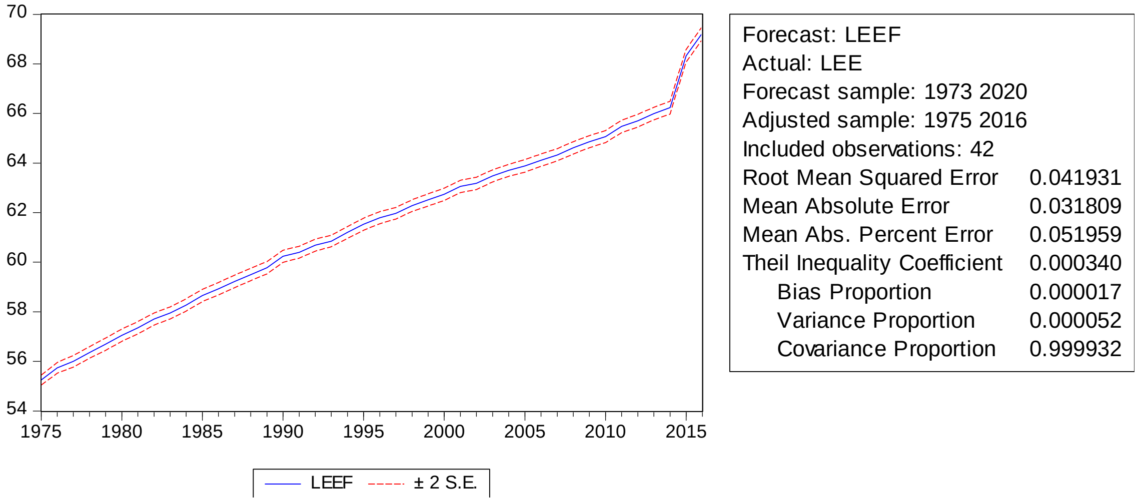
4.4 Forecasting Life Expectancy through ARDL Model

This section deals with forecasting life expectancy through ARDL model. Our forecasts suggest that if past trends continue, almost half the Pakistan population will meet the World Health Organization (WHO) criteria for Food Production, carbon dioxide emission and urbanization by 2020, a prediction consistent with that made by positively and high life expectancy as compare to previous year.

The forecasts are plotted using the continuous line, while a confidence interval is given by the two dotted lines in each case. Several other useful measures concerning the forecast errors are displayed in the plot box, including the square root of the mean squared error (RMSE), the (MAE), the (MAPE) and the Theil's U-statistic. The mean squared forecast error can be decomposed into a bias proportion, a variance proportion and a covariance proportion. The bias proportion measures the difference in the mean of forecast and actual data while variances proportion measures difference in variances and co variance captures the rest of forecast error. The accurate forecast has low mean and variance proportion and most of the bias is attributed to covariance part. But here the 0.0017% of the error is attributed to bias in mean so the model does provide reliable forecast containing such a high difference in mean of actual and forecast data. The

MAPE for the dynamic of life expectancy is well over 100% indicates that the model forecasts are good.

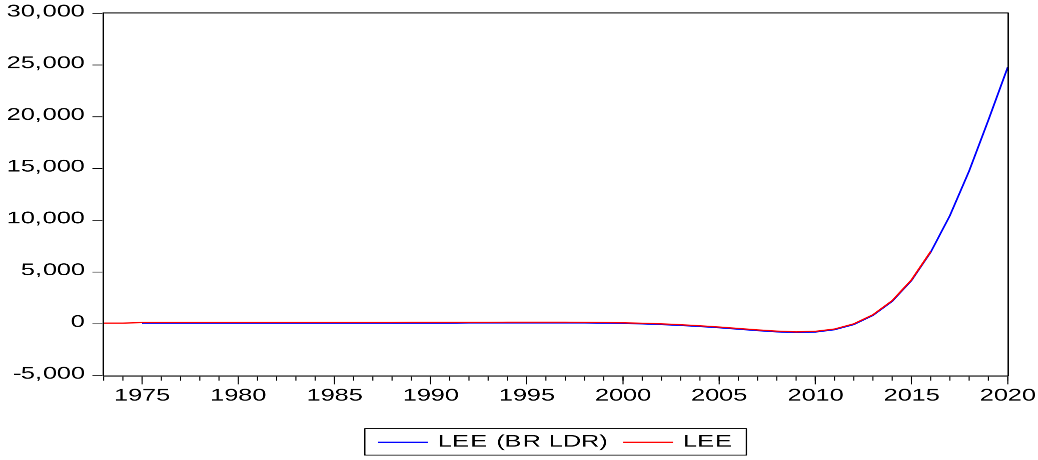
Figure 4.2 Forecasting Life Expectancy through ARDL Model



4.4 Forecasting Life Expectancy through VAR Model

The forecast of life expectancy through VAR model is given in this section. Our forecasts suggest that if past trends continue, almost half the Pakistan population will meet the WHO criteria for birth rate, mortality rate by 2020, a prediction consistent with that made by positively and high life expectancy as compare to previous year.

Figure 4.3 Forecasting Life Expectancy through VAR Model



The life expectancy forecast from ARDL model is consistent with that of VAR model.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

This chapter deals to summarize the main findings of this study together with to discuss its policy suggestions. Moreover, this chapter also presents the main inferences drawn on the basis of results and policy suggestion for practitioners of Pakistan lastly the chapter is closed by disclosing the study limitations.

5.1 Conclusion

The main objective of this study is to scrutinize that how the economic, demographic, environmental and health variables affect life expectancy in Pakistan. The study approach to achieve this objective in the framework of ARDL model with an objective to apprehend the short-run and long-run dynamics by regressing life expectancy on all economic, demographic, environmental and health variables along with to forecast future life expectancy.

This study draw three types of analysis from estimation of ARDL model. The first conclusion from the study is that the bound test results suggest that there exist long run relationship among all variables. Second, by estimating the long run and short run version of ARDL model results suggest that life expectancy are negatively associated with birth rate, Carbon dioxide emission, income inequality and death rate, but the association is statistically significant only in the long run. Food production positively affect life expectancy only in the long run. Health expenditure and School enrolment has positive and significant impact on life expectancy both in short run and long run, but higher inflation and population growth are inversely associated with life expectancy. Lastly, increasing urbanization is negatively associated with life expectancy both in short run and long run. Third, the coefficient of the error correction term (ECM) suggest that the system will converge back to the long run equilibrium in about 10 years. Forecasting from ARDL model and VAR model shows upward direction that in future life expectancy is predicted to be high.

5.2 Policy Recommendations

Life expectancy is one of the serious challenge for Pakistan economy and could be addressed. On the basis of the above results and conclusions some policy suggestions are recommend for improving life expectancy in Pakistan. Birth rate, death rate, school enrolment, education and urbanization would be significant policy options to enhance life expectancy in Pakistan. The policymakers should try to off the negative effects of inflation and food production and adopt the positive effects of globalization. Moreover, by reducing the economic misery and increasing the availability of food to the general public and increasing the school enrolment and level of literacy rate, and shifting from rural areas towards urban areas the policymakers will get an increase in the level of life expectancy in Pakistan. Government action is required towards increasing food production by providing subsidies to the agricultural sector to create incentives for farmers to produce more of the basic food grains consumed by low-income households. The study suggest on the basis of result that life expectancies in developing country like Pakistan could be significantly improved if proper attention is given to food production increase in calorie intakes and fertility reduction government to extend contraceptive measures to every women in the reproductive age.

REFERENCES

Acemoglu, D., & Johnson, S. (2007). Disease and development: the effect of life expectancy on economic growth. *Journal of political Economy*, *115*(6), 925-985.

Alam, M. S., Raza, S. A., Shahbaz, M., & Abbas, Q. (2016). Accounting for contribution of trade openness and foreign direct investment in life expectancy: The long-run and short-run analysis in Pakistan. Social Indicators Research, 129(3), 1155-1170.

Ali, A., & Ahmad, K. (2014). The Impact of Socio-Economic Factors on Life Expectancy for Sultanate of Oman: An Empirical Analysis.

Ali, A., & Audi, M. (2016). The Impact of Income Inequality, Environmental Degradation and Globalization on Life Expectancy in Pakistan: An Empirical Analysis.

Ali, A., & Audi, M. (2016). The Impact of Income Inequality, Environmental Degradation and Globalization on Life Expectancy in Pakistan: An Empirical Analysis.

Alogoskoufis, G., & Smith, R. (1995). On error correction models: specification, interpretation, estimation. *Surveys in Econometrics*, 139-170.

Anantharaman, S. K. 2017. Prime determinants that influence “Life Expectancy”: an analysis

across Indian states using multiple regressions. Indian Journal of Economics and Development, Vol 5 (7), July 2017

Balan, C., & Jaba, E. (2011). Statistical analysis of the determinants of life expectancy in Romania. *The Journal of the Romanian Regional Science Association*, *5*(2), 25-38.

Balan, C., & Jaba, E. (2011). Statistical analysis of the determinants of life expectancy in Romania. The Journal of the Romanian Regional Science Association, 5(2), 25-38.

Bayati, M., Akbarian, R., & Kavosi, Z. (2013). Determinants of life expectancy in eastern mediterranean region: a health production function. International journal of health policy and management, 1(1), 57.

Bravo, J., & Malta, J. (2010). Estimating life expectancy in small population areas.

Delavari, S., Zandian, H., Rezaei, S., Moradinazar, M., Delavari, S., Saber, A., & Fallah, R. (2016). Life Expectancy and its Socioeconomic Determinants in Iran. Electronic physician, 8(10), 3062.

Ecevit, E. (2013). The impact of life expectancy on economic growth: Panel cointegration and causality analyses for OECD countries. *The International Journal of Social Sciences*, *16*(1), 1-14.

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: journal of the Econometric Society*, 251-276.

Fayissa, B., & Gutema, P. (2005). The Determinants of Health Status in Sub-Saharan Africa (SSA). The American Economist, 49(2), 60-66.

Fritz, J. M. (2010). Socioeconomic developmental social work. *Peace Studies, Public Policy And Global Security–Volume VII*, 362.

Grob, G. N. (2002). The Deadly Truth: A History of Disease in America. Cambridge, MA: . *Harvard University Press;*

Grossman, M. (1972). On the concept of health capital and the demand for health. Journal of Political economy, 80(2), 223-255.

Gujarati, N. D. (2004). *Basic Econometrics,* (4th Edition. ed.). The McGraw-Hill, Inc., Singapore.

Halicioglu, F. (2011). Modeling life expectancy in Turkey. *Economic Modelling*, *28*(5), 2075-2082.

Halicioglu, F. (2011). Modeling life expectancy in Turkey. Economic Modelling, 28(5), 2075-2082.

Hibon, M., & Makridakis, S. (1997). ARMA models and the Box–Jenkins methodology.

Hyndman, R. J., & Athanasopoulos, G. (2014). *Forecasting: principles and practice*.

Kabir, Mahfuz. "Determinants of life expectancy in developing countries. “The journal of developing areas 41.2 (2008): 185-204.

Liu, J. (2011). Correlation among Different Variables and Life Expectancy. *Undergraduate Journal of Mathematical Modeling: One+ Two*, *3*(2), 2.

Lütkepohl, H. (2005). *New introduction to multiple time series analysis*. Springer Science & Business Media. 13-36

Majer, I. M., Stevens, R., Nusselder, W. J., Mackenbach, J. P., & van Baal, P. H. (2013). Modeling and forecasting health expectancy: theoretical framework and application. *Demography*, *50*(2), 673-697.

M'Amanja, D., & Morrissey, O. . (2005). Fiscal policy and economic growth in Kenya. Centre for Research in Economic Development and International Trade, . *University of Nottingham.*

McGillivray, M. (1991). The human development index: yet another redundant composite development indicator?. *World Development*, *19*(10), 1461-1468.

Monsef, A., & Mehrjardi, A. S. (2015). Determinants of life expectancy: a panel data approach. Asian Economic and Financial Review, 5(11), 1251-1257.

Nasreen, S., Anwar, S., & Ahmad, N. (2012). Health Status, Income Inequality and Institutions: Evidence from Pakistan Economy. *Pakistan Journal of Life and Social Sciences (Pakistan).*

Nixon, J., & Ulmann, P. (2006). The relationship between health care expenditure and health outcomes. *The European Journal of Health Economics*, *7*(1), 7-18.

Ntamjokouen, A., Haberman, S., & Consigli, G. (2014). Modeling multi-population life expectancy: a cointegration approach.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics, 16(3),* 289-326.

Peterson. (1998). 6th Edition. Income, Employment and Economic Growth. W. W. Norton and Company, New York.

Razzak, H., Ali, M., & Ali, M. (2015). Principal Component Analysis of Socioeconomic Factors and Their Association with Life Expectancy at Birth in Asia. *International Journal of Multidisciplinary Academic Research*, *3*(1), 14-23.

Reungsri, T. (2010). *The impact of public infrastructure investment on economic growth in Thailand* (Doctoral dissertation, Victoria University Australia).

Sede, P. I., & Ohemeng, W. (2015). Socio-economic determinants of life expectancy in Nigeria (1980–2011). Health economics review, 5(1), 2.

Shahbaz, M., Loganathan, N., Mujahid, N., Ali, A., & Nawaz, A. (2016). Determinants of life expectancy and its prospects under the role of economic misery: A case of Pakistan. Social Indicators Research, 126(3), 1299-1316.

Šimpach, O., Dotlačilová, P., & Langhamrová, J. I. Logistic and ARIMA models in the Estimation of Life Expectancy in the Czech Republic. In *Proceedings of the*

31 st International Conference of Mathematical Methods in Economics (pp. 915-920).

Stoeldraijer, L., van Duin, C., van Wissen, L., & Janssen, F. (2013). Impact of different mortality forecasting methods and explicit assumptions on projected future life expectancy: The case of the Netherlands. *Demographic Research, 29,* 323.

Vlahov, D., Galea, S., & Freudenberg, N. (2005). The urban health "advantage". *Journal of urban health, 82(1),* 1-4.