DETERMINANTS OF LIFE EXPECTANCY: A PANEL DATA APPROACH

Abdalali Monsef[1][†] --- Abolfazl Shahmohammadi Mehrjardi[2]
[1]Associate Professor, Payame Noor University, Department of economics, Tehran, Iran
[2]Master of Economics, Payame Noor University, Department of Economics, Tehran, Iran

ABSTRACT

This study is concerned with understanding the factors that affect the life expectancy in 136 countries for the period 2002–2010. According to the life expectancy literature, the determinants of life expectancy can be classified into social, economic and environmental factors. In this respect, the panel data method is employed to compute the relationship between life expectancy and selected economic, social and environmental factors. The results of this study suggest that unemployment and inflation are the main economic factors that influence the life expectancy negatively. But, the gross capital formation and gross national income and affect the life expectancy positively as well. The urbanity seems to be the main socio-environmental cause for mortality. According these results, this study presents a number of recommendations in order to improvement of life expectancy.

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Contribution/ Originality

This study is one of very few studies which have investigated the effects of inflation and unemployment, gross capital formation and economic development level (as economic factors), urbanity (as social factor) and CO2 emission (as environmental factor) on life expectancy using panel data method.

1. INTRODUCTION

Human beings have continuously sought to improve their skills and to reach a life which is more and more dignified; for this reason, improvement in health has always been, today as in the past, one of the most important social objectives (Colantonio *et al.*, 2010). Health is one of the

most important assets a human being has. It permits us to fully develop our capacities. If this asset erodes or it is not developed completely, it can cause physical and emotional weakening, causing obstacles in the lives of people. The previous connection can be seen as the relationship between income and health. Life cycle models have explained how one's health status can determine future income, wealth and consumption (Lilliard and Weiss, 1997). In essence, the main aim of a public health care policy is to maintain and improve the nation's health status. Therefore, it is crucial to identify the factors which contribute to the health of the population. The information on the nation's health status helps policy makers and practitioners in their search for cost effective mechanisms, providing health services and reallocation of health resources to optimize the gains from health expenditures. The measurement of the nation's health status is difficult to measure directly since this situation is produced by a set of economic, social and environmental factors. Therefore, the cognition of a proxy for health status in order to determine the factors which contribute to the health of the population is essential.

In a theoretical basis, Mankiw *et al.* (1992); Barro (1996) and Grossman (1972) have developed models that include health capital as a significant variable for economic growth. Nevertheless, life expectancy is the most used variable to represent it. This variable is defined by the United Nations as the average number of life years since birth according to the expected rate of mortality by age as well. Therefore, Life expectancy in a country is a broad measure of the nation's health status (Halicioglu, 2010).

This study is concerned with understanding the factors which affect the life expectancy in 136 countries for the period 2002-2010. To do this, we organized this study as bellows: After the introduction, section 2 is allocated to the literature. Section 3 discusses the method of data collection and methodology of study. The major findings are presented in Section 4 and section 5 reports the conclusions.

2. REVIEW OF LITERATURE

The review of literature on life expectancy as a proxy for nation's health status is useful in order to investigate the factors that affect it. In this respect, this section is allocated to review of literature on determinants of nation's life expectancy. For example, in a recent study, Hansen and Strulik (2015) found that that the cardiovascular revolution led to an increase in adult life expectancy by about 2 years, which caused higher education enrollment to increase by 7 percentage points across U.S. states.

Shin (2013) surveyed the impact of a pension system on the life expectancy and the lifetime utility level. This study suggested that the pension system can make life expectancy longer or shorter and it is not always true that the pension system improves the lifetime utility level.

Hazan (2012) indicated a positive correlation between the percentage change in schooling and the change in life expectancy at birth during 1960-1990.

Balan and Jaba (2011) showed that the determinants with a positive impact on life expectancy of the Roma population are wages, the number of beds in hospitals, the number of doctors, and the number of readers subscribed to libraries, while the determinants with a negative impact on life expectancy are the ratio Roma population and the ratio of the illiterate population for the year 2008.

Halicioglu (2010) investigated the factors of life expectancy in Turkey for the period 1965-2005. In this study the determinants of life expectancy in Turkey have been classified into selected economic, social and environmental factors. According to the results of this study, the nutrition and food availability factors were the main positive factors for improving lifetime. But, smoking was the main cause for mortality.

Bergh and Nilsson (2009) analyzed the relation between three dimensions of globalization (economic, social and political) and life expectancy using a panel of 92 countries over the period 1970-2005. They found a very robust positive effect from economic globalization on life expectancy, even when controlling for income, nutritional intake, literacy, number of physicians and several other factors.

Mariani *et al.* (2008) determined the relationship between life expectancy and environmental quality dynamics. The results showed environmental conditions affected the life expectancy.

Yavari and Mehrnoosh (2006) analyzed the effects of socio- economic factors on life expectancy using multiple regression analysis. This study showed that there is a positive, strong correlation between life expectancy as an independent variable and per capita income, health expenditures, literacy rate and daily calorie intake. Also, it revealed that there is a negative strong correlation between life expectancy and the number of people per doctor in African countries.

Leung and Wang (2003) investigated the relationship between health care, life expectancy and output using a modified neoclassical growth model. They showed income and economic development factors have positive impacts on lifetime.

Bernard *et al.* (2003) investigated the effects of saving behavior on life expectancy. They indicated that decrease in saving behavior did not relate to increase in individual life expectancy.

Castello and Domenech (2002) provided a theoretical model in which inequality affects per capita income when individuals decide to accumulate human capital depending on their life expectancy. According to the finding of this study, the distribution of education was depended on the existence of multiple steady states.

Cervellati and Sunde (2002) investigated the relationship between human Capital Formation, life expectancy and the process of economic development, experienced by the Western world when passing from an environment of economic stagnation to sustained growth. The results indicated that the human capital formation and life expectancy potentially reinforced each other due to advances in technological progress.

Summing up, the review of presented studies shows that the determinants of life expectancy can be divided into the economic, social and environmental factors. Accordingly, in this study, the impacts of these factors on life expectancy are estimated to follow the existing literature.

3. METHODOLOGY

To investigate the relationship between life expectancy and economic, social and environmental factors we use the panel data method. In panel data method, the same cross-sectional unit (say a family or a firm or a state) is surveyed over time (Gujarati, 2004). The standard panel data form can be presented as bellow:

$$y_{it} = x'_{it}\beta + \alpha_i + \varepsilon_{it} = x'_{it}\beta + u_{it} \qquad i = 1, 2, …, N \qquad t = 1, 2, …, T \qquad (1)$$

Where, y and x' denote the dependent variable and $K \times 1$ regressor vector respectively. β is a $K \times 1$ vector of coefficient and u indicates the error term. The number of cross sectional observations is N and these units are repeatedly measured. This is the conventional panel data model defined by an unobserved individual effect and time varying coefficients.

As mentioned in section 1, this paper attempts to analyze the relation between some economic, social and environmental factors and nation's health status using a panel of 136 countries over the period 2002-2010. To do this, the life expectancy factor is considered as a proxy for health status. Also, the economic factors are included: inflation, unemployment, capital information rate and economic development degree. The per capita national income factor is used to classify the countries in terms of development degree by the World Bank. In this paper this factor is used to evaluate the effect of development degree on life expectancy. The urbanization and CO_2 emission are considered as social and environmental factors. Accordingly, the model (2) is presented as bellow:

$$LE_{i,t} = a_i + \beta_1 INF_{i,t} + \beta_2 UNEM_{i,t} + \beta_3 GCF_{i,t} + \beta_4 UP_{i,t} + \beta_5 CEM_{i,t} + \beta_6 DUM_{i,t} + \varepsilon_{i,t} \qquad (2)$$

Where, LE is life expectancy at birth total, INF and UNEM are inflation and unemployment rate respectively. GCF is gross capital formation (% of GDP of selected countries), UP is Urban population (% of total population of selected countries) as a proxy for urbanization, CEM is CO_2 emissions (metric tons per capita), DUM is a dummy variable that for the countries which had the gross national income more than world average income is equal to 1 and ε_t is the regression error term. The equation (2) is estimated using STATA. It should be noted that the present study enjoys from the date which has been presented by World Bank.

4. EMPIRICAL RESULTS AND DISCUSSION

As mentioned before, to evaluate the model (2) and after determining the stationary of selected variables, the selection of the best techniques, fixed or random effects, is necessary to analyze panel data.

According to equation (1), in Random Effect Model (REM) α_i is uncorrelated with ε_{it} and the observed regressors x_{it}. But, if α_i is correlated with regressors, this can be called the Fixed Effect Model (FEM) (Hubler, 2005). To decide between fixed or random effects the hausman test has been used where in that the null hypothesis is that the preferred model is random effect vs. the alternative the fixed effect.

It basically tests whether the unique errors (u_i) are correlated with the regressors, the null hypothesis is they are not (Greene, 2008). The estimated results showed that the hausman statistic and its prob. are equal 86.27 and 0.00 respectively. Accordingly, the model (2) can be estimated by FEM. The results are provided in table 1.

According to the table 1, the estimated results based on the GLS method indicate that except CO_2 emission factor, all of variables in the model (2) are statistically significant at the 1% level. As can be seen, the coefficient of inflation rate (- 0.173) and unemployment rate (- 0.24) are statistically significant at the 1% level, indicating the negative relationship between life expectancy and inflation and unemployment.

Table-1. The estimated results of model (2)

Variables	Coef.	Std. Err.	z	P>|z|
INF	- 0.173	.0256096	-6.75	0.000
UNEM	- 0.24	.0316361	-7.59	0.000
GCF	0.18	.0243131	7.41	0.000
♀UP	0.196	.0107095	18.28	0.000
CEM	$2.31*10^{-7}$	2.47×10^{-7}	0.94	0.35
DUM	6.377	.4952146	12.88	0.000
Intercept	52.911	.8172971	64.74	0.000

Source: calculated by authors

Also, the gross capital formation variable has a significant positive effect on life expectancy. On the other hand, the estimated value for urbanization is equal to 0.196. This means that, with the increase of one percent in urban population as an indicator of urbanization, the life expectancy increases by 19.6 percentage or almost 71.5 days in intended countries. The coefficient of dummy variable is equal to 6.377, indicating that the average of longevity in the countries that have the gross national income (GNI) more than the average GNI in the world countries is more than poor countries by 6.377 years.

5. CONCLUSION

The present paper examines the link between health status and economic, social and environmental factors for 136 countries during 2002-2010. The life expectancy is considered as the proxy of health status. According to the previous study that indicated the determinants of life expectancy we can classify these factors into economic, social and environmental factors. In this study, the inflation rate, unemployment rate, gross capital formation and gross national income are the main economic factors. To our knowledge, this is the first study that engages inflation and unemployment rate as economic factors that affect life expectancy. Also, we use the urbanization and CO_2 emission as the social and environmental factors. To do this, the panel data method is used. The obtained results by using STATA software show that inflation rate and the unemployment rate has a significant negative impact on life expectancy in 136 selected countries,

while the unemployment rate is more effective. The urban population factor, as a proxy for urbanization, as well as gross capital formation has a significant impact on life expectancy as well. To investigate the effect of economic development degree on life expectancy, the intended countries are divided into two groups: the countries that have the gross national income more than global average income and the countries that have the gross national income less than global average income. The results indicated that the countries with more income than the global average income have a higher life expectancy by 6.377 years. Summing up, the economic indices that used in this study have a significant impact on life expectancy as well as urbanization. So, planning for improvement of these indexes can provide the basis for the enhancement the health status of the global community.

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