Life Expectancy Determinants in Turkey:
An ARDL Cointegration Analysis[*]

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Abstract: Life expectancy is one of the key indicators the UN created that measures the general state of health of a country's population. This indicator is divided into two parts: at birth and at the age of 65. While the first one is an expectation related to how many years life will last from birth, the other is the expectation of how many years more one will be able to live after the age of 65. This study aims to determine the parameters that increase or lower life expectancy in Turkey. Due to the limited data set, the study attempts to form the most appropriate data set that can be used in determining life expectancy. The analysis covers the years 1961-2014.

Keywords: ARDL cointegration analysis • life expectancy • gross domestic product per capita • health expenditures • population growth

JEL Codes: C22 • I12

The United Nations has defined life expectancy at birth as the number of years a newborn baby will live if the current mortality rates at birth remain unchanged throughout the life of the child (United Nations Development Programme [UNDP], 1997). Life expectancy at birth shows the extent that developing countries in particular have invested in areas such as education, environment, health, and other social-security networks. The leaps in developed countries' per-capita income have opened the way to changes in spending structures that affect poverty levels, literacy rates, sanitation improvements, access to healthy drinking water, and better nutrition. Each of these factors contributes to life expectancy increases (Shahbaz, Loganathan, Mujahid, Ali, & Nawaz, 2016). Life expectancy at birth, which corresponds to the ability to lead a long and healthy life, forms one of the three basic dimensions of the human development index. Apart from this, the ability to obtain information is measured by the average education period and expected years of education, and the standard of living is measured by the gross national income per capita; a composite index with three basic dimensions has been obtained (UNDP, 2018).

While the life expectancy in countries with high human development is 79.5 years, countries with low levels of human development have an average of 60.8 years. The country with the highest life expectancy at birth is China's special administrative region of Hong Kong with 84.1; the country with the lowest life expectancy is Sierra Leone with 52.2 (UNDP, 2018). Turkey, ranked 64th on the human development list, has a life expectancy at birth of 76 years (UNDP, 2018).

This study aims to identify the parameters that increase or decrease life expectancy in Turkey. Due to the limited set of related data, the study has attempted to form the most appropriate data set that can be used in identifying life expectancy using the variables from 1961-2014 for life expectancy at birth, gross domestic product per capita, health expenditures, urban population growth, food production, energy consumption, inflation, schooling rates, and carbon emissions.

The Model and Data Set

The variables mentioned in our study researching life expectancy are listed as life expectancy at birth (ln *lfex*), gross domestic product per capita (ln *gdpc*), urban population growth (ln *upop*), energy consumption (ln *euse*), inflation (ln *inf*), and carbon emissions (ln CO_2). The study uses annual data obtained from the World Bank. In the theoretical background, the impact of the variable of per capita income is expected to be positive; the impact of the variables of urban population, energy consumption, and carbon emissions to be positive or negative; and the impact of the variable of inflation to be negative. The following model has been created for econometric analysis:

$$\ln(\text{lfex})_t = a_0 + a_1 \ln(\text{gdpc})_t + a_2 \ln(\text{upop})_t + a_3 \ln(\text{euse})_t + a_4 \ln(\text{inf})_t + a_5 \ln(CO_2) + u_t$$

Evaluating the Empirical Results

Unit Root Test Results

In order to be able to do a time-series analysis, the series must first be tested for stability. Series stability has been tested using the augmented Dickey-Fuller (ADF) and the Philips-Perron (PP) methods. The results from both tests have been compared.

Analysis Results

Table 1

Expected and Estimated Effects of the Variables

Variable	Expected	Result
ln(*gdpc*)	+	+
ln(*upop*)	+/-	-
ln(*euse*)	+/-	-
ln(*inf*)	+/-	+
ln(	+/-	+

The variables' expected and estimated effects are compared in Table 1. According to the estimated results, the impact of per capita income on life expectancy at birth came out positive in the long term and is compatible with the expectations. In addition to the positive effects of urbanization, such as access to hospitals regarding human health, employment, and an abundance of income opportunities, urbanization has also been found to have negative effects such as stress and air pollution. According to the estimation results, the emergence of a negative long-term impact of urban population growth on life expectancy shows the negative effects to be more dominant than the positive impacts. The uneven population growth in certain cities in Turkey further increases the negative impacts factors like stress and air pollution have on human health. For example, almost 30% of gross added-value is produced in Istanbul. This unbalanced metropolization in Turkey can be explained as the reason for the negative impact of the model's variable of urbanization rate on life expectancy at birth. Energy consumption, while on one hand shows the increase in production and industrialization, on the other hand also reflects the increase in factors that have a negative impact on human health. Through the impact of these negative factors, energy consumption has a negative impact on life expectancy. The negative impact of inflation on life expectancy at birth is expected because of the reduced real income and its greater impact on the low income group in income distribution. Contrary to this expectation, the relationship of inflation has a positive aspect with life expectancy at birth in the study's model. Therefore, the reason for the emergence of inflation should also be addressed in order to understand the effects of inflation on health. Public deficits, credit increases, rapid population growth, and wage increases in Turkey are also among the reasons that have increased demand-oriented inflation. For this reason, the long-term relationship between inflation and life expectancy in countries like Turkey are able to come up positive in the model.

Lastly, carbon-dioxide emissions have a negative impact on health. However, the positive relationship of carbon-dioxide emissions with life expectancy at birth can be observed especially in developing countries when the causes are urbanization, increases in transportation vehicles, and industrialization. According to the estimated results in this study, carbon-dioxide emissions have a long-term positive effect on life expectancy.

Results

According to the study's empirical results, the results of the variables influencing life expectancy at birth are seen to differ from the analysis of developed countries. Based on the estimation results, certain policies that need to be given weight come to the fore for Turkey. Firstly, the long-term impact of income on life expectancy is high and positive. For this reason, the policies that can be recommended first are income-enhancing policies. Social-state policies that reduce unemployment, increase new employment opportunities, and equalize income distribution are other policy recommendations that have been considered.

Increasing the level of social education also presents importance in terms of providing a positive impact on both income and health awareness. The impact of increasing urban population and energy consumption, despite the positive or negative expectation, has been identified as negative in the long term. For this reason, an urbanization policy that increases life quality can be said to be necessary for Turkey. In the model, energy use also has a negative impact on life expectancy. Industrialization policies that address both environmental safety and sustainability and policies that increase renewable energy consumption can be evaluated at this point. On the contrary, carbon emissions have had a long-term positive impact. Because industrialization is high in developed countries, carbon emissions affect health negatively. The positive impact of carbon emissions in developing countries like Turkey can be explained through the impact of industrialization and urbanization. In this situation, once industrialization is has been completed, the long-term impact can be expected to become negative. Lastly, inflation has also had a long-term positive effect on life expectancy. The increase in demand-based inflation such as public deficits, deposit and credit increases, rapid population growth, and wage increases can be expected to have a positive impact on life expectancy. Turkey's differences in regional development and the backwardness of some regions in the urbanization sense have also determined the effects on regional development.

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