DETERMINANTS OF LIFE EXPECTANCY: ANALYSIS OF SOUTHEASTERN EUROPEAN COUNTRIES

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Abstract: Political, social or economic factors can significantly influence the life expectancy at birth. This is important since life expectancy is an indicator of both the quality of life and one country's development. Governments should create strategies in order to improve the quality of life, nevertheless, they should first know the main factors that determine it. Consequently, the main purpose of this analysis is to identify the key determinants of life expectancy at birth by using the cointegrated panel regression model for twelve Southeastern European countries. The research includes annual data for period 2000-2015, for twelve countries. The countries included in this analysis are Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Greece, Macedonia, Moldova, Romania, Serbia, Slovenia and Turkey. Kosovo and Montenegro are not included in the analysis due to the insufficient data for the observed period. The total number of observations is 192. The analysis examines the possible statistically significant impact that the six explanatory variables (consumer price index, employment, food production index, gross national income per capita, health expenditure per capita and immunization) may have on the life expectancy. Before the regression model is estimated, variables are tested for stationarity and cointegration. The results from the cointegrated panel regression confirm that the consumer price index, employment and gross national income per capita are statistically significant determinants that influence the life expectancy at birth in the Southeastern European countries. Consumer price index has positive impact of the life expectancy, as the life expectancy continues to increase, the demand for food also increases and so does its prices. Employment to population ratio has negative and statistically significant impact, where decline in employment is mostly due to the emigration of the active work force. While the employment rate is declining, the life expectancy, partly due to the other factors, is constantly increasing, thus the negative dependence. Gross national income has positive and statistically significant effect on the life expectancy. The result is in accordance with the expectations because greater the gross national impact per capita means better standard of living with quality housing, education, health providers, quality food. Solid economy is precondition for improvement of life expectancy and thus quality of living. Having economic factors as key determinants of life expectancy is important input while creating government policies and measures that could contribute to better quality of living.
Keywords: Life expectancy at birth, cointegrated panel regression, GNI per capita, employment

1. INTRODUCTION
Population is the foundation of each society. The development of the population determines one country's political and economic system, the development of the health system, the education, the level of social responsibility and the development of arts and culture. Numerous national governments don't prioritize the population and the quality of the living conditions. The indicator of life expectancy at birth is forecast for the future years of age that a person is expected to live on average. Simply put, the life expectancy at birth reveals the average number of years that a newborn is expected to live with the present mortality rates. The average life expectancy is determined by the level of country's economic development and also by the improvement of the socioeconomic surroundings. Life expectancy also depends on the profession, place of living, marital status, sex etc. (Risteski and Trpkova-Nestorovska, 2014). Also, life expectancy at birth is significant indicator of the development of a country. It mainly represents the quality of life and thus implies important demographic and economic implications. Therefore, many countries create and implement social programs in order to increase the average life expectancy by set of measures (constant investment in the health system, promotion of healthy life style, allowing approach to clean water, increasing the literacy and education of the population). Analysis of the SEE countries confirms that there is significant difference between the countries. Moldavia, for example, has the lowest life expectancy at birth (71,5 years in 2015), whereas in Greece this indicator marks 81,04 years in 2015. Macedonia is in the middle with life expectancy at birth of 75,6 years in 2015. For comparison, according to the World Health Organization report, in

2013 Sierra Leone has the lowest life expectancy at birth with only 51,4 years. Japan has the highest, with 83,8 years.

2. LITERATURE REVIEW

The determinants of the life expectancy at birth are subject of number of research. Concentrating on the countries of the Eastern Mediterranean, Bayati et al. (2013) perform panel regression with 21 countries for period 1995-2007. Their conclusion is that the focus must be made on the health system, in order to improve the health situation in the analyzed countries. Also, the level of economic growth and development is very important. The economic stabilization policies, which aim for productivity increase, economic growth and unemployment reduction, play important part in improving the nation's health in the analyzed region.

Similar research for Eastern Mediterranean countries can be found in Gilligan and Skrepnek (2014). They have divided the countries in groups of developed and less developed countries, by using cluster analysis. Statistically significant factors that influence the life expectancy at birth in the group of developed countries are: gross domestic product, health expenses, literacy and immunization. In the less developed countries the main factors are immunization and number of doctors.

The determinants of life expectancy at birth for 28 countries from the European Union are analyzed by Bilas et al. (2014). The results indicate that the gross domestic product per capita and level of education, jointly explain 72,6% to 82,6% of the differences in the life expectancy at birth.

In the research about the determinants of life expectancy in developing countries, Kabir (2008) examines the socio-economic determinants in 91 developing countries. Using multiple regression and probit frameworks, most of the explanatory variables like income per capita, health expenditures, urbanization, access to safe water and education have no influence on the life expectancy. The author suggests that countries should construct and implement social sector policies and programs to increase physician's availability, to reduce adult illiteracy and undernourishment.

To understand the relationship between life expectancy at birth and health expenditures, Jaba et al. (2014) performed cross-country and time-series analysis. The input of the health care system is expressed by health care expenditures per capita and the output of the health care system is expressed by the life expectancy at birth. The data were collected for 175 countries for period 1995-2010. By applying panel regression, the results show a significant relationship between health expenditures and life expectancy.

Hussain (2002) was analyzing the life expectancy in 91 developing countries from South Asia, Sub-Saharan Africa and Latin America and the Caribbean. The results confirm that improvement in life expectancies can be made by proper attention to fertility reduction and increasing calorie intake.

3. RESEARCH METHODOLOGY

Cointegrated panel regression model was used in the following analysis where all variables were tested for stationarity with panel unit root tests. Consequently, panel cointegration testing was concluded. Testing for cointegration in panel regression is rather complicated issue. Cointegration among the groups must also be taken under consideration, as and cointegration within the groups (Brooks, 2014). For two groups of variables y_{it} and $x_{m,i,t}$ that are individually first order integrated and are considered cointegrated

$$y_{it} = \alpha_i + \delta_i t + \beta_{1i} x_{1i,t} + \beta_{2i} x_{2i,t} + \cdots + \beta_{Mi} x_{Mi,t} + \epsilon_{i,t}$$

where $m = 1, \dots, M$ are the explanatory variables in the potentially cointegrated regression; $t = 1, \dots, T$ and t signifies period and $i = 1, \dots, N$ where i signifies the countries. There are two methods for estimation of the cointegrated panel regression: Fully Modified OLS method and Dynamic OLS method. They provide asymptotic unbiased and normally distributed estimation of the coefficients (Phillips and Moon (1999); Pedroni, (2000), (2001); Kao and Chiang, (2000); Mark and Sul, (2003)).

4. DATA, ANALYSIS AND EMPIRICAL RESULTS

The research includes annual data for period 2000-2015, for 12 countries from Southeastern Europe. The countries included in this analysis are Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Greece, Macedonia, Moldova, Romania, Serbia, Slovenia and Turkey. Kosovo and Montenegro are not included in the analysis due to the insufficient data for the observed period. The total number of observations is 192. Data are collected from the World Bank data base. Variables included in the analysis are: LEB (Life expectancy at birth, in years); CPI (consumer price index (2010=100); EMPLOY (Employment to population ration, 15+(%); FOOD (Food production index (2004-2006=100); GNI (GNI per capita, PPP (current international $); HEALTH (Current health expenditure per capita (current US$) and IMMUN (Immunization, DPT (% of children ages 12-24 months). Data are collected from the World Development Indicators 2007 database from the World Bank.

Variable LEB signifies the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life and in this paper it is represented as depended variable. CPI (Figure 1) represents the changes in the cost to the average consumer of acquiring a basket of goods and services. It is measured as index with 2010 as base year, which explains why it shows constant growth in almost every observed country (If the base period was previous year or annual average than it is possible to have different dynamics of the CPI). Yet it supports the fact that the prices constantly grow, usually with steady rate.

**Figure 1. Consumer price index in Southeastern European countries**

EMPLOY is the proportion of a country's population that is employed (Figure 2). Employment is defined as persons of working age who, during a short reference period, were engaged in any activity to produce goods or provide services for pay or profit. Countries such as Cyprus, Slovenia and Romania have the highest ratio, while Bosnia and Herzegovina and Macedonia seem to have the lowest employment ratio. In most countries the rate fluctuates through the years, it does not mark a constant growth. Countries like Bulgaria, Croatia, Cyprus, Greece, Moldova, Romania, Serbia and Slovenia have the opposite trend; their employment to population ratio is decreasing. One possible explanation for this trend is the emigration component that is constantly increasing in the past decade, where significant percent of the active population is looking for work in the Western European countries. Thus, the implications in the native countries remain, the population is decreasing, as is the working force, creating significant problems like deficit of qualified workers that will weaken the economy and create other social problems.

**Figure 2. Employment to population ratio (%) in Southeastern European countries**
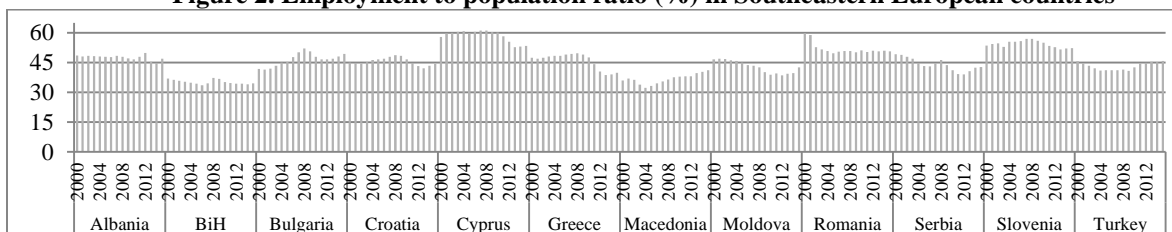
FOOD obtains food crops that are considered edible and that contain nutrients (Figure 3) The trend is different in different countries. In Albania, Macedonia and Turkey the food production continuously increases. Cyprus, Greece and Slovenia have decreasing food production index, while in remaining countries the index fluctuates, and has no definitive trend.

Figure 3. Food production index in Southeastern European countries
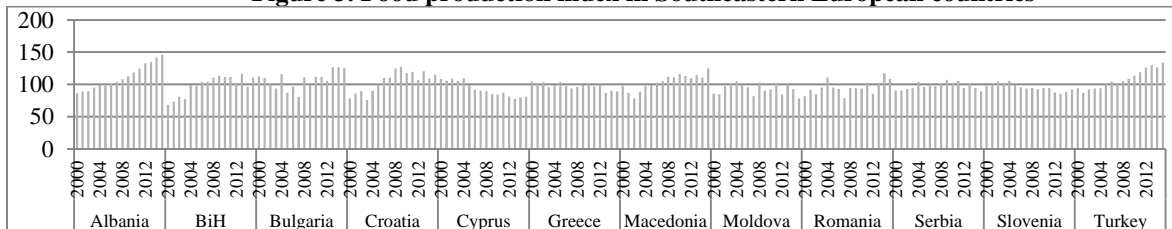
GNI is gross national income per capita based on purchasing power parity. As expected, GNI per capita marks constant growth in all observed countries. Yet, the difference between countries in the scale of this indicator is immense. In Cyprus it reaches almost 35.000 US$ per capita and in contrast it almost reaches 5000 US$ per capita in Moldavia. Cyprus, Slovenia and Greece have the highest GNI per capita, While Moldova, Bosnia and Herzegovina, Albania and Macedonia have the lowest GNI per capita. It is interesting to mention that the three countries with highest GNI per capita are also the same countries with declining food production index.

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Figure 4. GNI per capita (US$) in Southeastern European countries
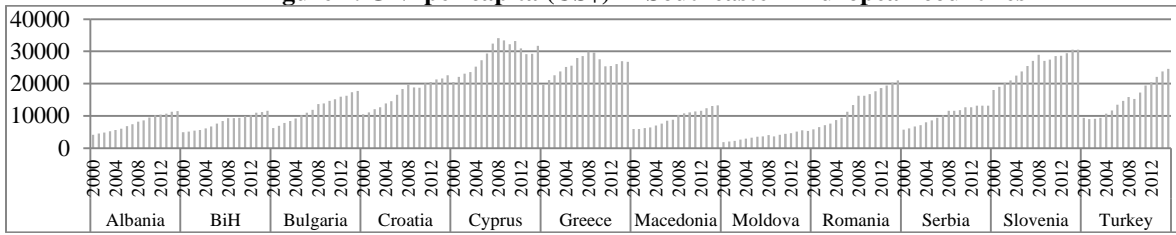
HEALTH obtains the current expenditures on health per capita in current US dollars (Figure 5). Estimates of current health expenditures include healthcare goods and services consumed during each year. Again, countries with highest GNI per capita Cyprus, Greece and Slovenia have the highest health expenditure per capita (around 2000 US$ per capita on average). Other remaining countries has significantly lower values for indicator (less than 500 US$ per capita).

IMMUN represents child immunization, DPT (diphtheria, pertussis and tetanus) measures the percentage of children ages 12-23 months who received DPT vaccinations before 12 months or at any time before the survey. As presented in Figure 6, the level of immunization is high in all observed countries. Bosnia and Herzegovina and Moldova are countries with lower immunization rate than the other countries of the group.

Figure 5. Health expenditure per capita (US$) in Southeastern European countries
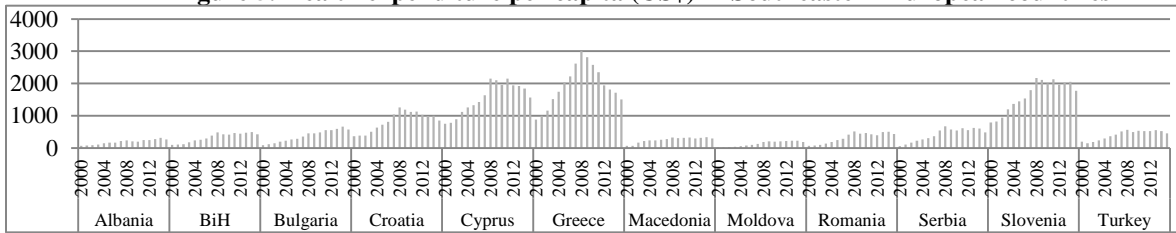
The first part of the analysis is examination of the stationarity of the variables using the unit root tests. Unit root tests in panel series are very similar to the tests used in one equation estimation (Brooks, 2014). Despite the similarities, in panel series several specially designed tests are used for this purpose.

After examining the results of the unit root tests (Levin Lin and Chu; Im, Pesaran and Shin; ADF Fisher Chi-square and PP Fisher Chi-square), the general conclusion is that the variables are stationary in their first difference. When all the variables are stationary in their first difference a possibility for cointegration also must be tested.

Figure 6. Immunization (% of children ages 12-23 months) in Southeastern European countries

Kao residual cointegration test is used in order to test the null hypothesis of no cointegration between the variables. The test has t-statistic of -2,32 and p-value of 0,01. For significance level of 0,05 the null hypothesis is rejected, or there is cointegration between the variables in the analysis. When the cointegration is confirmed, a cointegrated panel regression can be estimated. For its estimated the fully modified least squares method (FMOLS) is used. The results are:

$$LEB_{it} =$$
$$\alpha_i + \delta_i t + 0{,}024 CPI_{i,t} - 0{,}084 EMPLOY_{i,t} + 0{,}01 FOOD_{i,t} + 0{,}0002 GNI_{i,t} + 0{,}0002 HEALTH_{i,t} - 0{,}012 IMMUN_{i,t} + \epsilon_{i,t}$$
$$\quad (0{,}000^*) \qquad\quad (0{,}000^*) \qquad\quad (0{,}060) \qquad\quad (0{,}000^*) \qquad\quad (0{,}351) \qquad\quad (0{,}429)$$

where $m = 6$ explanatory variables ; $t = 16$ periods and $i = 12$ countries. P-values for estimated coefficients in brackets. Significant coefficients are marked with *.

The results confirm that the statistically significant determinants that have influence on the life expectancy at birth are consumer price index, employment and gross national income. Consumer price index has positive impact of the life expectancy. Historically, there is statistically significant relationship between prices of food and mortality. This

relationship is explained in a model created by Malthus which explains that with the growth of population the demand for food also increases, so the prices of food also have continuous growth (Livi-Bacci, 2007). Basically, as the life expectancy continues to increase, the demand for food also increases and so does its prices. It seems that life expectancy causes the growth in prices, rather the other way around. Employment to population ratio is the second variable that has statistically significant impact on the life expectancy at birth. The dependency yet seems to be negative, meaning the decline in employment increases life expectancy. One explanation for this is that most of the countries mark reduction in employment, probably due to the emmigration of the active working force. While the employment rate is declining, the life expectancy, due to the other factors, is constantly increasing, thus the negative dependence. Gross national income has positive and statistically significant effect on the life expectancy. The result is in accordance with the expectations because greater the GNI per capita means better standard of living with quality housing, education, health providers, quality food. This variable is one of the primary variables that influence the life expectancy at birth. Research from Bilas et al. (2014), Gilligan and Skrepnek (2014), Bayati et al. (2013), Wilkinson (1996) and Ananad and Ravallion (1993) confirm the importance of the national (or gross national product) for improvement in life expectancy in different groups of countries. The conclusion is that good economy is precondition for improvement of life expectancy and thus quality of living.

Food production index, health expenditures per capita and immunization prove to be insignificant determinants of life expectancy. Countries with high life expectancy such as Slovenia, Greece and Cyprus are reducing their food production. This could mean that sources of food are not necessary produced in native countries and food can be imported, so that food production does not influence the life expectancy significantly. Probably in less developed economies (such as African countries), with poorly developed trade, food production might have greater impact on life expectancy. Regarding the health expenditures, analysis of the Southeastern European countries prove not to influence the life expectancy at birth. Yet, there is research where this relationship is confirmed (Subramanian et al., 2002 and Starfield and Shi, 2002). Other analysis confirms a negative relationship between these two variables (Hitris and Posnet, 1992). The model confirmed that immunization also is not significant factor for life expectancy and this is mostly due to the high percent of immunization where it has already made its contribution to increasing the life expectancy. The percentage of immunized population must remain high due so that various diseases are prevented, and for further increase in life expectancy other factors must be considered and analyzed.

5. CONCLUSION

The purpose of this paper was to identify the main determinants of life expectancy at birth, important indicator of quality of living. If the people live longer in one country, it is very likely that that same country has developed economy, quality education and health system, awareness about the environment and people there are nurturing healthy life style by good nutrition and physical activity. The results of the cointegrated panel regression analysis of 12 countries from Southeastern Europe confirm three determinants that have statistically significant impact on the life expectancy at birth: consumer price index, employment and gross national income.

Gross national income proves to be indicator of high life expectancy in most of the research on this subject. The wealth of the country and its people improves the quality of living. Employment enables people to have jobs and create their own income. Low employment signifies poor nation with reduced quality of living. Consumer price index marks constant growth as is the life expectancy rate, mostly because the needs and the demand of the population for goods and services increase, so does the production, and at the end it is the prices that are constantly increasing. These results should be taken into consideration by the national governments while creating economic and social policies, in order to improve national quality of living.

According to the previous, the focus of the governments must be on the economic growth. They should create policies that provide employment and growth in salaries. Other factors also must be part of the overall strategy for improvement of the quality of life. Health expenditures per capita, food production and immunization must be taken into consideration since they are basis for quality of life. Comprehensive knowledge of one nation's economic, political, social and health conditions can also contribute in creating the best strategy for improvement in quality of life.

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