Coll. Antropol. **38** (2014) 1: 1–9
Original scientific paper

Determinant Factors of Life Expectancy at Birth in the European Union Countries

Vlatka Bilas[1], Sanja Franc[1] and Mile Bošnjak[2]

[1] University of Zagreb, Faculty of Economics and Business, Zagreb, Croatia
[2] Hypo Alpe Adria Bank, Zagreb, Croatia

A B S T R A C T

The main aim of this article is to explore determinants of life expectancy at birth among 28 European Union countries. Selected variables namely, gross domestic product (GDP) growth rate, population growth rate, level of education attained, education enrolment, GDP per capita and life expectancy have been considered for abovementioned countries in the period from 2001 to 2011 on a yearly basis by applying panel data analyses approach. Obtained results reveal that GDP per capita and attained education level together explain between 72.6% and 82.6% of differences in life expectancy at birth (depending on year of observation).

Key words: *life expectancy at birth, European Union*

Introduction

Life expectancy at birth (throughout the paper – life expectancy) is defined as the mean number of years still to be lived by a person at birth. It is an important synthetic indicator for assessing economic and social development of a country or a region. During the last 170 years, life expectancy has been constantly rising[1]. Yet enormous discrepancies still exist between developed and developing countries[2]. This disparity in life expectancy is believed to have its roots in differential socio-economic backgrounds of different social groups. The underlying rationale is that the socio-economic and environmental factors do exert independent, as well as, interactive influence on the life expectancy level[3].

Considering population ageing trends it is to be expected that in the future there will be a decline in active workforce, an increase in public expenditures for pensions and in health care expenses. Such changes significantly affect health care systems in developed countries, which are also faced with challenges caused by technological changes[4]. One of the principal goals of every government is to lengthen life expectancy of its population by reducing its mortality rate to its minimum possible level. Economic development determines improvements in the social conditions and an increase in the life expectancy[5]. Residents of a country with high life standards live longer, on average, and have a smaller mortality ratio[6–8]. Health and development both require the promotion of human rights, political and civic, as well as economic, social and cultural rights. It can be concluded that there is a twofold relationship between development and health. Development is the process of improving health and quality of life, and health is a central component of the development process[9].

Defining good health implies several socio-economic preconditions such as reduction of insufficient education level, reduction of unemployment and insecurity and improvement of life conditions[10]. Besides, as a dimension of life, health stands for the existence of strength, vitality and fitness which individuals can draw upon to pursue their goals and actions[11].

In order to improve health it is vital to include and connect different organizational, social, economic and legal elements and to provide adequate public health services. The public health care comprises a system of group and individual measures, services and activities related to preservation and improvement of health, prevention of diseases, early detection of diseases, timely treatment and medical care and rehabilitation. Health promotion implies integrated actions leading towards better health and equality[12]. Health promotion, in this respect, alleviates the access to health care services and encourages

Received for publication February 1, 2014

people to take care of their health. Within the framework of health promotion processes, it is crucial to create favorable surroundings for living and work, initiate actions within local communities, draw up health development policies, and develop personal skills by providing education and availability of information so as to train people to make correct health-related decisions.

Empirical data indicate that public health care expenditures, lifestyle factors (e.g. consumption of alcohol, tobacco, food), education, environmental pollution and income present significant health determinants and have a significant impact on the life expectancy and decline of premature mortality[13]. Researchers have shown that health care expenditures in many countries do not achieve value for money[13].

The main aim of this article is to explore determinants of life expectancy among sample countries. The sample includes 28 European Union countries. Selected variables namely, GDP growth rate, population growth rate, attained education level, education enrolment, GDP per capita and life expectancy have been considered for abovementioned countries in the period from 2001 to 2011 on a yearly basis by applying panel data analyses approach.

As already stated, social environment and life conditions are recognized as vital determinants having a direct and indirect impact on the population health. Absolute and relative income, employment, education and other factors directly affect the access to health services and selection thereof, but they also have an indirect psychological influence. Socio-economic status is a complex concept consisting of two aspects, both of which may exert influences on health directly or through associated behaviors. One aspect includes resources, such as education, income, and wealth; the other includes status or rank, a function of relative positions in a hierarchy, such as social class[14]. Economic growth is also one of the main determinants of the health status and life expectancy, especially when it comes to poor and underdeveloped countries where malnutrition and infective diseases are the most common cause of death of mothers, children and preemies. In poor countries a slight increase in the gross domestic product is followed by an increase in the life expectancy, but as the GDP continues to grow, this connection gets weaker. In developed countries, a significant link between GDP growth and life expectancy has not been proven[15].

Countries with less developed educational and health care systems experience more difficulties with achieving sustainable development. Research has shown that a 10% improvement of the life expectancy is associated with a rise in the economic growth of approximately 0.3–0.4 percentage points a year[16]. Investing in health is necessary and is essential for all the countries in the world, regardless of the level of their economic development, their political circumstances or their culture.

Furthermore, in the working paper issued by the National Bureau of Economic Research (NBER) in 2006, the relationship between education and health has been explored and attempted to quantify[17]. The education gradient is found for both health behaviors and health status. The better educated are less likely to smoke, have excessive intakes of alcohol, or be overweight and are more likely to have health insurance coverage and access to care. The better educated also report lower morbidity from cardiac conditions, stroke, emphysema, diabetes, and asthma. They are substantially less likely to report that they are in poor health, and less likely to report anxiety or depression[17]. The magnitude of the relationship between education and health varies across these conditions, but is generally large. An additional four years of education was found to lower five-year mortality by 1.8 percentage points; it also reduces the risk of heart disease by 2.16 percentage points and the risk of diabetes by 1.3 percentage points.

On the other hand, some authors[18,19] point out that relationship between education and health could be spurious due to the impact of other variables on both.

Methods

The main aim of the research was to identify key determining factors of life expectancy at birth. Thereupon five independent variables were chosen and their influence on the dependent variable was tested.

Subsequent independent variables were included in the econometric model:

- GDP growth rate: annual percentage growth rate of GDP at market prices based on constant local currency (aggregates are based on constant 2005 USD)
- population growth rate: annual percentage population growth (%)
- level of attained education: persons with upper secondary or tertiary education attainment (total sex, age 15–64; %)
- education enrolment: students in public institutions (ISCED 1 to 4) as percentage of all students in public and private institutions (%)
- GDP per capita, at current prices and current exchange rates per capita (USD).

A data series from 2001 to 2011 on a yearly basis was used. The sample of the research included following 28 European Union countries. There were no available data for Netherlands and Poland, so at the end there where 26 European Union countries.

Having in mind the main goal of the research, the focus has been directed toward determinants of life expectancy, differences of determinants among countries as well as among different point in time. Due to the differences between the observed countries heteroskedasticity of variance problem has appeared. To that end we took logarithmic value of the observed variables and consequently, the heteroskedasticity problem has disappeared.

Since we found that the observed variables were stationary around zero or constant for each point in time we

took variables in levels. Afterwards we analyzed the observed variables for each country (time series for each country), variables were not stationary in levels (Table 2). Where we found observed variables integrated of same order, we employed Johansen cointegration approach.

We found significant GDP per capita and attained education with 1% level of significance. Population growth, GDP growth rate and education enrolment rate variables resulted to have no significant impact on life expectancy. Furthermore, we found slightly different influence in different points of time.

After testing all of the necessary conditions and the significance of variables, a linear regression model was applied to test the relationship among the dependent and independent variables. Model can be described with the formula: $\log (LEB)_i = \alpha_i + \log(GDPPC)_i + \log(EA)_i \varepsilon$ where $\log (LEB)_i$ is a dependent variable for year $_i$ – life expectancy at birth, and $\log(GDPPC)_i$) is an independent variable for year $_i$, GDP per capita, while $\log(EA)_i$ is the other independent variable for year $_i$ – education attained, and ε represents residuals of regression model.

Furthermore, on a country level, we studied country specific determinants of life expectancy. Firstly we checked stationary characteristics of the observed time series on a country level. Regarding that we employed Augmented Dicky-Fuller test. Since we found the same order of integration among the observed variables for some countries (Table 2) we decided to check the existence of cointegration among variables and conduct a more detailed analysis. For that purpose Johansen cointegration approach was employed. Two tests were used: Unrestricted Cointegration Rank Test (Trace) and Unrestricted Cointegration Rank Test (Maximum Eigenvalue) and the results pointed to the existence of cointegration. The necessary but not sufficient condition for cointegration is that each of the variables should be integrated of the same order (more than zero)[20]. Additionally, in order to determine endogeneity of life expectancy we conducted Granger causality test.

Results and Discussion

After appropriate application of modelling techniques we have found the following results: on a cross-sectional level life expectancy is not always endogen variable, meaning that for some countries life expectancy variable appears first and afterwards one of the other two independent variables.

Consequently, GDP per capita and attained education level explain from 72.6% to 82.6% differences in life expectancy at birth (depending on the year of observation). Therefore, life expectancy is well explained by these two variables (Table 1).

Year specific results indicate there is a positive influence of GDP per capita, and negative influence of attained education on life expectancy at birth.

The highest expected percentage change in life expectancy when GDP per capita increases by one percent, attained education level being constant, was found in the year 2009. One percent difference in GDP per capita among the observed countries means the difference in life expectancy of 0.047%, attained education level being constant.

The highest expected negative percentage change in life expectancy when attained education level increases by one percent, GDP per capita being constant, was found in the year 2010. The difference in attained education among observed countries of one percent means the difference in life expectancy of –0.055%, GDP per capita being constant. In other words, we found negative influence of attained education on life expectancy. Likewise, there are other studies[18,19] that also suggest that the association between expanding education and population's health is spurious due to the impact of other variables.

Furthermore, we tested the order of integration among the observed model variables. After conducting Augmented Dicky-Fuller test we found life expectancy, GDP per capita and education attainment are integrated of order 1 (Table 2). Due to the same order of integration among the observed variables we additionally tested the existence of cointegration among variables and conducted a more detailed analysis. For the purpose of testing the endogeneity we employed the Granger causality test. Even though results of Granger causality test are ambiguous, in 60% of cases change in life expectancy followed the change in GDP per capita or change in attained education level (Table 3).

TABLE 1
RESULTS OF THE REGRESSION ANALYSIS

β- coefficient	Year										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Constant C	4.098	4.083	4.083	4.082	4.086	4.056	4.053	4.018	4.048	4.127	4.239
LOG GDPPC level	0.037	0.038	0.038	0.040	0.043	0.046	0.048	0.050	0.048	0.046	0.043
LOG EA level	–0.028	–0.027	–0.028	–0.033	–0.042	–0.040	–0.046	–0.043	– 0.041	–0.055	–0.074
R-squared	0.803	0.809	0.801	0.815	0.812	0.767	0.726	0.773	0.826	0.824	0.817

Source: author's calculation.
GDPPC – gross domestic product per capita, EA – education attained

TABLE 2
AUGMENTED DICKY-FULLER TEST RESULTS

Variable		Austria	Belgium	Bulgaria	Croatia	Cyprus	Czech R.	Denmark	Estonia	Finland	France	Germany	Greece	Hungary
GDP	Inlevels around zero	0.9896	0.9843	0.9937	0.9487	0.9859	0.9758	0.9771	0.9449	0.9750	0.9782	0.9881	0.9053	0.9459
	Inlevels around intercept	0.3864	0.2518	0.9103	0.3065	0.4646	0.7812	0.6811	0.6298	0.3501	0.1942	0.2457	0.2704	0.5084
	Inlevelswith trend andintercept	0.9929	0.9970	0.1101	0.7354	0.1756	0.4699	0.8574	0.1716	0.9973	0.9988	0.9974	0.9995	0.9998
	First diference around zero	0.3520	0.3278	0.4512	0.0744	0.3283	0.0486	0.0726	0.3662	0.3298	0.2802	0.305	0.2416	0.3096
	First diference around intercept	0.0103	0.0163	0.0298	0.2831	0.0206	0.0719	0.1390	0.0508	0.0226	0.9403	0.011	0.9736	0.1001
	First difference trend and intercept	0.1130	0.0085	0.1920	0.2974	0.0295	0.1981	0.0492	0.9994	0.0186	0.0073	0.0061	0.9762	0.0419
EA	Inlevels around zero	0.9939	1	0.9939	0.9961	0.9933	0.9997	0.5333	0.9432	1	0.9999	0.8335	0.9957	0.9999
	Inlevels around intercept	0.3421	0.6179	0.9876	0.8531	0.8722	0.9182	0.6865	0.9459	0.8822	0.3517	0.9096	0.7005	0.0005
	Inlevels with trend and intercept	0.3093	0.9292	0.0835	0.5566	0.0832	0.2058	0.1312	0.8874	0.7739	0.7608	0.6583	0.2735	0.9952
	First diference around zero	0.0464	0.2615	0.0796	0.1372	0.0678	0.5799	0.0025	0.0057	0.4909	0.3087	0.0119	0.1218	0.0286
	First diferenc earound intercept	0.1903	0.1287	0.0807	0.0104	0.0800	0.0014	0.0263	0.0405	0.0238	0.0757	0.0648	0.1648	0.9047
	First difference trend and intercept	0.4641	0.3004	0.3511	0.0001	0.2578	0.0069	0.1426	0.0162	0.0307	0.0681	0.0253	0.3515	0.0001
LEB	Inlevel saround zero	0.9989	0.9991	0.9988	0.9996	0.9841	0.9997	0.8883	0.9999	0.9987	0.9993	0.9994	1	0.9985
	Inlevels around intercept	0.8949	0.8769	0.9944	0.8057	0.9998	0.9837	0.9992	0.9965	0.5961	0.9059	0.9891	0.8423	1
	Inlevels with trend and intercept	0.1953	0.2448	0.8507	0.0347	0.0943	0.0131	0.5283	0.8515	0.0192	0.0895	0.5727	0.1792	0.9858
	First diference around zero	0.0724	0.6325	0.2734	0.2489	0.9862	0.6056	0.8301	0.3243	0.5720	0.6067	0.3143	0.5363	0.9223
	First diference around intercept	0.0277	0.0080	0.1169	0.0003	0.1163	0.0504	0.8427	0.2560	0.0241	0.0021	0.1199	0.0108	0.0026
	First difference trend and intercept	0.1415	0.2464	0.196	0.0028	0.3778	0.1076	0.8865	0.1905	0.1013	0.2764	0.2922	0.0629	0.0017

Variable		Ireland	Italy	Latvia	Lithuania	Luxembourg	Malta	Portugal	Romania	Slovak R.	Slovenia	Spain	Sweden	UK
GDP	Inlevels around zero	0.8598	0.9605	0.9356	0.9374	0.9788	0.9937	0.9531	0.9477	0.9867	0.9611	0.9371	0.9618	0.8601
	Inlevels around intercept	0.2605	0.1105	0.7913	0.7813	0.7685	0.7958	0.1769	0.8361	0.8925	0.5499	0.2710	0.3709	0.4935
	Inlevels with trend and intercept	0.9980	0.9997	0.0964	0.2495	0.3995	0.0563	0.9999	0.2331	0.1594	0.2274	0.9978	0.1835	0.8876
	First diference around zero	0.2841	0.2348	0.3404	0.0372	0.0912	0.4010	0.2612	0.0636	0.1153	0.3225	0.2781	0.3477	0.0429
	First diference around intercept	0.9813	0.9645	0.0418	0.0625	0.0741	0.0097	0.9872	0.0986	0.0478	0.0397	0.9565	0.0173	0.9174
	First difference trend and intercept	0.8818	0.0046	0.9999	0.1656	0.0925	0.0441	0.9685	0.9972	0.1835	0.0669	0.9539	0.0206	0.4118
EA	Inlevelsaround zero	0.9995	0.9964	0.8962	0.9999	0.8753	0.9755	0.9999	0.9884	0.9997	1	0.9999	0.7350	0.9981
	Inlevels around intercept	0.9575	0.0457	0.906	0.9998	0.8858	0.9664	0.9955	0.9204	0.9821	0.0077	0.8168	0.3397	0.7172
	Inlevelswith trend and intercept	0.5730	0.1185	0.3535	0.8918	0.1796	0.3405	0.3424	0.0263	0.8430	0.8037	0.4811	0.3446	0.6116
	First diference around zero	0.6623	0.0603	0.3586	0.8960	0.0030	0.0184	0.7085	0.0873	0.1684	0.0837	0.2133	0.0042	0.0551
	First diference around intercept	0.1381	0.0009	0	0.2886	0.0145	0.0568	0.6908	0.0917	0.1646	0.0066	0.1505	0.0621	0.0321
	First difference trend and intercept	0.9939	0.0003	0.3394	0.0059	0.1049	0.0899	0.8505	0.5060	0.1339	0.2817	0.3151	0.2461	0.0747
LEB	Inlevels around zero	0.9988	0.9991	0.9701	0.8708	0.9731	0.9746	0.9964	0.9851	0.9986	1	0.9999	1	1
	Inlevels around intercept	0.8029	0.8876	0.8558	0.4835	0.8696	0.9993	0.9890	0.9999	0.9999	0.1692	0.9797	0.9761	0.9964
	Inlevels with trend and intercept	0.0715	0.0559	0.3467	0.7168	0.0001	0.8595	0.7717	0.8456	0.9996	0.5728	0.4087	0.1223	0.0310
	First diference around zero	0.4129	0.6268	0.0416	0.0850	0.0110	0.0113	0.7259	0.8736	0.9243	0.3654	0.5514	0.6849	0.5206
	First diference around intercept	0.0080	0.0010	0.1970	0.3573	0	0.0276	0.7673	0.5771	0.9690	0.0438	0.0350	0.0288	0.0218
	First difference trend and intercept	0.9578	0.0073	0.3852	0.2657	0.0001	0.0117	0.9773	0.0043	0.8240	0.1460	0.1001	0.2922	0.0900

Source: author's calculation.

GDP – gross domestic product, EA – education attained, LEB – life expectancy at birth

TABLE 3
PAIRWISE GRANGER CAUSALITY TESTS (p-value [0; 0.05])

Country	Lag (years)		
	1	2	3
Austria		no conclusions	
Belgium	from EA to LEB	from EA to LEB	–
Bulgaria	–	from LEB to EA	–
Croatia		no conclusions	
Cyprus	–	–	from LEB to EA
Czech Rep.	from EA to LEB	from EA to LEB	from EA to LEB
Denmark	from EA to LEB	from EA to LEB	from EA to LEB
Estonia		no conclusions	
Finland	from EA to LEB and vice versa	from EA to GDPPC	–
France	from EA to LEB	–	–
Germany	from LEB to EA	–	from EA to GDPPC
Greece		no conclusions	
Hungary		no conclusions	
Ireland	from LEB to EA	from GDPPC to LEB; from LEB to EA	–
Italy	from EA to LEB	from EA to LEB	–
Latvia	from LEB to EA	from GDPPPC to EA	from GDPPPC to EA
Lithuania	from GDPPC to LEB	–	from EA to LEB
Luxembourg	from GDPPC to LEB; from LEB to EA; from GDPPC to EA	–	–
Malta	–	from GDPPC to EA	–
Portugal	from EA to LEB	from LEB to GDPPC	from LEB to GDPPC
Romania	–	from LEB to GDPPC	–
Slovak Rep.	from GDPPPC to EA	–	–
Slovenia	–	–	from GDPPC to EA
Spain	–	from EA to LEB	from GDPPC to EA, from EA to LEB
Sweden		no conclusions	
UK	–	–	from GDPPPC to EA

Source: author's calculation.
GDPPC – gross domestic product per capita, EA – education attained, LEB – life expectancy at birth

Our research results regarding the influence of GDP per capita on life expectancy at birth are in accordance with previous research results and confirm a positive relationship, as mentioned above.

Following previous studies, we wanted to test and measure the influence of attained education on life expectancy. However, we found opposite results than expected and that are found in most of previous research. Since the initial assumption for the regression model is stationarity of the observed variables the potential shortfalls are possible in the sense that modeling and observing variables can be misleading. If the relationship among non-stationary time series is modeled, then spurious regression will be the result and it will show only the trend between variables, but not the influence of one on another.

Considering the above mentioned, we point out the distinction of our research in comparison to some previous study results, which is the outcome of methodology applied. Potential explanation of negative influence of attained education on life expectancy at birth can be found in the lifestyle factors of people with higher education that include: more stress due to more complex responsibilities at work, bad nutrition habits, long working hours, less physical activity etc.

In the following part an overview of previous studies on different life expectancy determinants is given.

Generally, the determinants of life expectancy can be grouped, in academic literature, into three main categories: resources of the health care system, factors related to lifestyle, and socio-economic factors[13]. The first category of factors refers to health care expenses (public and

private expenses) and to material resources of the health care system. The determinants connected to lifestyle refer to individual behaviors that determine health such as smoking and alcohol consumption and to eating habits. The third category of factors, the socio-economic ones, includes income per capita, income differences, education level, poverty level, unemployment level, ethnic structure of the population, the environment, and the degree of air pollution.

On that note, there is ample of empirical research dedicated to determining what influences life expectancy. For instance, Kossis (2010)[2] investigated influence of eight different factors on life expectancy. His research consisted of data from 117 countries and he measured the effects of different variables as follows: Carbon Dioxide emissions per capita, gross domestic product (GDP) per worker, per capita health expenditures, average years of school, national healthcare system, percentage of adults with HIV, physicians per 1,000 people and countries with an extended period of conflict. His findings reinforce what is the current thinking on how to improve average life expectancy throughout the world. Increases in education, wages, and healthcare expenditures all significantly contribute to higher average life expectancies. Yet his analysis indicates that the variable with the biggest impact on a nation's average life expectancy is the percentage of adults who are infected with HIV.

Balan and Jaba (2011)[21] have also studied the factors that determine life expectancy. In their analysis they have included the following determinant factors: unemployment ratio; net nominal monthly salary; number of readers subscribed to libraries (persons); illiterate population aged 10 and over from the total population); ratio of the Roman population; ratio of the Hungarian population; number of beds in hospitals; number of doctors; ratio of abandonment in pre-university education, for the school year 2007/2008. The significance of the influence of the determinant factors on life expectancy was assessed using the regression analysis. Authors have identified, based on the data recorded at the level of Romanian administrative departments for the year 2008, following determinants of life expectancy: net nominal monthly salary, the Roma population, the number of beds in hospitals, the number of doctors, the number of readers and the illiterate population.

In the 1970s the demographer Samuel Preston investigated the inluence of economic conditions on life expectancy[22,23]. For the mean curve of this relationship he used a logistic model with fixed coefficients. Three waves of data from 1900, 1930 and 1960 were used in this cross-sectional analysis. As a measure of economic performance Preston used national income per capita as the independent variable to model the mean trend. The logistic model that Preston used to describe the relationship is a restrictive assumption of the functional form of this relationship. To our knowledge Preston's work has never been formally extended to measure the frontier but focusses on describing the mean trend, although Easterlin (1996)[24] stated that Preston's curve could be described as a production frontier of income as input and life expectancy as output.

Rodgers (1979)[25] suggests that there is a relationship between life expectancy at birth (LEB) and income at the individual level and observes an asymptotic behavior from empirical data. He proposes a non-linear model using the inverse, logarithm or other transformation for income as the independent variable. In his paper he continues to investigate in detail the relationship between life expectancy, income and income distribution. The results for life expectancy at birth suggest that the difference in average life expectancy between a relatively egalitarian and a relatively inegalitarian country is likely to be as much as five to ten years. The distribution of income may not be the only factor operating, of course, inequality in income distribution is likely to be associated with inequality in access to health and social services, in education, and in a number of other aspects of society relevant to mortality.

The LEB, that is, the effects of different socio-economic factors on life expectancy at birth across a number of countries by analyzing national level data has been employed by Mohammad Sufian (2013)[3]. He tried to classify 106 countries of the world into three groups: group 1 (low LEB), group 2 (medium LEB), and group 3 (high LEB). The goal was to identify variables that discriminate among the groups most. The discriminating variables used in the analysis are: percentage of population living in urban areas; percentage of currently married or in-union women of reproductive age who are currently using modern methods of contraception; gross national income; population per square kilometer; percentage of rural population with access to improved water supply; infant mortality rate; total fertility rate; percentage of the dependent population; and percentage of population living on less than $2 per day. The »discriminant analysis technique« has been employed as the technique for analyzing data in the paper. The analysis shows that the infant mortality rate is the most influential variable in discriminating among the three groups, while poverty is the second most influential variable. Other important discriminators are total fertility rate, percentage of currently married or in-union women of reproductive age who are using modern methods of contraception, percentage of rural population with access to improved water supply, population density, and percentage of urban population.

Conclusion

Health is the result of many intertwining factors. The conditions in which people live affect their health status and contribute to the creation of a gap between socio-economic groups. Socio-economic inequalities in the health status are present in all the countries of the world, even in the most developed ones. In order to create sustainable and efficient health care sector that would result in desired health outcomes that include, among others, longer life span, there has to be cooperation between the health sector and other sectors in a country.

The results of the research conducted in this paper indicate which variables determine life expectancy. To be precise, the results indicate that economic development, measured by GDP per capita, and social status measured by the level of attained education level, significantly influence life expectancy.

The highest expected percentage change in life expectancy when GDP per capita increases by one percent, attained education level being constant, was found in the year 2009 and the highest expected negative percentage change in life expectancy when attained education level increases by one percent, GDP per capita being constant, was found in the year 2010.

The difference in attained education among observed countries of one percent means the difference in life expectancy of –0.055%, GDP per capita being constant, and one percent difference in GDP per capita among the observed countries means the difference in life expectancy of 0.047%, attained education level being constant. Therefore, based on the defined sample we found no positive impact of attained education level on life expectancy. On the contrary, results show that attained education level has the opposite effect than expected. Potential explanation of these empirical findings is the assumption that highly educated people perform more responsible tasks and thus face greater stress.

Additional endogeneity testing confirmed that in 60% of cases life expectancy was indeed a dependent variable determined by economic and social factors. However, within countries at lower level of development, there were cases where the conclusion regarding endogeneity could not be confirmed, and within countries at higher level of development was found that change in life expectancy does come after the change in attained education or GDP per capita which means that the latter two factors affect life expectancy of a population.

Limitation of the research is the short period of observations and not including other variables such as nutrition habits, food quality or any other variable that represents life quality in the model, due to the lack of available and comparable data.

REFERENCES

1. MÜNZ R, Demographic trend in the world. In: Collection of Papers (Innovative Health Initiative, Rovinj, 2012). — 2. KOSSIS L, The Determinants of Average Life Expectancy: A Cross-Country Analysis, accessed 12.01.2014. Available from: URL: http://www.honors.ufl.edu/ apps/Thesis.aspx/Download/414. — 3. MOHAMMAD SUFIAN AJ, International Journal of humanities and Social Science, 3 (2013) 303. — 4. ECKHOLM A, The future need for care: results from LEV project. Stockholm: Ministry of Health and Social Issues of Sweden, accessed 28.12.2013. Available from: URL: www.government.se/content/1/c6/15/ 36/57/d30b0968.pdf. — 5. POTTER LB, Demography 28 (1991) 303. — 6. CUTLER DM, DEATON AS, LLERRAS-MUNEY A, The Determinants of Mortality, NBER Working Paper, accessed 05.01.2014. Available from: URL: www.nber.org/papers/w11963. — 7. HITIRIS T, POSNETT J, Journal of Health Economics, 11 (1992) 173. — 8. PRITCHETT L, SUMMERS L H, Journal of Human Resources, 31 (1996) 841. — 9. WORLD FEDEREATION OF PUBLIC HEALTH A SSOCIATIONS, Health, Economics, and Development: a People-Centered Approach. Position Paper, accessed 15.10.2013. Available from: URL: http://www.wfpha.org/ tl_files/doc/resolutions/positionpapers/global/HealthEconomicsDevelopmentPeopleCenteredApproach.pdf. — 10. WILKINSON R, MARMOT M (Eds), Social determinants of health. The solid facts. 2nd edition (WHO Regional Office for Europe, Copenhagen, 2003). — 11. BLAXTER M, Biology, social class and inequalities in health: their synthesis in health capital. In: WILLIAMS S (Ed) Debating Biology (Routledge, London, 2003). — 12. WHO, Milestones in Health Promotion. Statements from Global Conferences (World Health Organization, Geneva, 2009). — 13. JOURMAD I, ANDRE C, NICQ C, CHATAL O, Health status determinants. Lifestyle, environment, health care, resources and efficiency, OECD Economic Department Working Paper, accessed 23.11.2012. Available from: URL: http://www.oecd-ilibrary.org/content/workingpaper/ 240858500130. — 14. AMERICAN ACADEMY OF PEDIATRICS, Pediatrics 105 (2000) 1349. — 15. MADOVSKY P, ALIN S, MASSERIA C, HERNANDEZ-QUEVEDO C, MCDAID D, MOSSIALOS E, Health in the European Union. Trends and analysis (Cromell Press Group, Trowbridge, 2009). — 16. OECD OBSERVER, Health and the economy: a vital relationship, accessed 25.04.2012. Available from: URL: http:// www.oecdobserver.org/news/fullstory.php/aid/1241/Health_and_the_economy:_A_vital_relationship_.html. — 17. CUTLER DM, LLERAS-MUNEYA, Education and health: evaluating theories and evidence. NBER Working Paper No 12352, accessed 15.01.2014. Available from: URL: http://www.nber.org/papers/w12352. — 18. BLOOM DE, Education, Health, and Development. Cambridge (American Academy of Arts and Sciences, MA, 2007). — 19. FEINSTEIN J, Elderly health, housing, and mobility. NBER Working Papers 4572. National Bureau of Economic Research, accessed 29.12.2013. Available from: URL: www.nber.org/chapters/c7329.pdfý. — 20. GRANGER CWJ, Oxford Bulletin of Economics and Statistics, 48 (1986) 213. — 21. BALAN C, JABA E, Romanian Journal of Regional Science, 5 (2011) 26. — 22. PRESTON SH, Population Studies, 29 (1975) 231. Reprinted in the International Journal of Epidemiology, 36 (2007) 484. — 23. PRESTON SH, Mortality patterns in national populations. With Special Reference to Recorded Causes of Death (Academic Press, New York, 1976). — 24. EASTERLIN RA, Growth triumphant: the twenty-?rst century in historical perspective (The University of Michigan Press, Ann Arbor, 1996). — 25. RODGERS GB, Population Studies, 33 (1979) 343. — 26. Eurostat, accessed 22.12.2013. Available from: URL: http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/. — 27. World Bank, accessed 03.01.2014. Available from: URL: http://data.worldbank.org/. — 28. United Nations Population Division, accessed: 02.02.2014. Available from: URL: http://www.un.org/esa/population/. — 29. UNCTAD, accessed: 04.01.2014. Available from: URL: http://unctad.org/en/pages/Statistics. aspx.

V. Bilas

University of Zagreb, Faculty of Economics and Business, J. F. Kennedy square 6, 10000 Zagreb, Croatia
e-mail: vbilas@efzg.hr

ODREDNICE OČEKIVANOG TRAJANJA ŽIVOTA PRI ROĐENJU U ZEMLJAMA EUROPSKE UNIJE

S A Ž E T A K

Cilj ovog rada je istražiti odrednice oČekivanog trajanja života pri rođenju na uzorku odabranih 28 zemalja Europske unije. Analizirano je pet varijabli, bruto domaći proizvod (BDP), stopa rasta stanovništva, dosegnut stupanj obrazovanja, broj upisanih u obrazovni sustav, BDP po glavi stanovnika te njihov utjecaj na oČekivano trajanje života u razdoblju 2001.–2011. na godišnjoj razini primjenom panel analize. Dobiveni rezultati pokazuju da BDP po glavi stanovnika i ostvarena razina obrazovanja objašnjavaju od 72,6% na 82,6% razlike u oČekivanom trajanju života pri rođenju (ovisno o godini promatranja).