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Health and Healthcare Indicators – Panel Data Analysis for OECD Countries

Văidean Viorela Ligia
Ferenț-Pipaș Marina

Finance Department
Faculty of Economics and Business Administration
„Babeş-Bolyai" University Cluj-Napoca Romania

Email: viorela.vaidean@econ.ubbcluj.ro
Email: marinaferent@gmail.com
Correspondent Author: VĂIDEAN VIORELA LIGIA

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Abstract

The purpose of our paper is to present the main institutional efforts taken towards improving the health status of OECD population. Supporting the better health desideratum, our study reviewed some of the previously published scientific papers that dealt with the estimation of life expectancy at birth through econometric modelling. Our collected data included health spending, out-of-pocket payments, total expenditure on pharmaceuticals and other medical non-durables, number of physicians number of nurses, total hospital beds, number of doctors' consultations, average length of stay, pharmaceutical consumption and alcohol consumption. The step-wise estimation was carried out using the Ordinary Least squares technique, and a Fixed Effects Model as opposed to a Random Effects Model. The Random Effects model was chosen and the results were interpreted.

Keywords: Healthcare, Life Expectancy At Birth, Health Spending, Alcohol Consumption, Developed Countries

JEL codes: I19, C23, H75

1. Introduction

Healthcare has been defined as the prevention, treatment and management of illnesses, as well as the preservation of mental and physical well-being through the services offered by the medical, nursing and allied health professions. As such, all healthcare systems, regardless of their financing mechanism, are targeted to provide long and/or short term benefits to their insureds for rebuilding their health status, also targeting illness prevention and work capacity recovery.

The functions of the healthcare systems are usually classified into the following categories: financial, economic and social. Firstly, the financial aspect concerns the expenditures made through the different actions sustained by the system. Secondly, the budget deficit regularization is fulfilled by the economic goal. And thirdly, the social function deals with redistributing the income in favour of the beneficiaries, the assistance and the protection.

Nevertheless, the expected results of the implementation of a healthcare system are reflected in the medical, social and economic areas. The medical results comprise the actions meant to restore and/or preserve the beneficiaries' health status (i.e. consultations, treatments). The social results encompass the medical actions' effects reflected at the entire society level; they are revealed through a series of healthcare indicators such as life expectancy, infant/maternal mortality and so on. The economic results target the economic benefits that may arise from successfully conducting the healthcare activity.

2. Healthcare from the major global organizations' perspectives

The United Nations Organization (UN) was founded after the Second World War in order to maintain international peace and security, to develop friendly relations among nations and to promote social progress, better living standards and human rights and it currently comprises 193 member states. One of its four main purposes, mainly the third one, treats the healthcare aspect, focusing on "to help nations work together to improve the lives of poor people, to conquer hunger, disease and illiteracy, and to encourage respect for each other's rights and freedoms" ("United Nations at a Glance", 2012*)*.

More specifically, the healthcare is a stated goal in two important UN documents – "The Universal Declaration of Human Rights" and "The International Covenant on Economic, Social and Cultural Rights". Firstly, the "Universal Declaration of Human Rights" (article 25) adopted by the UN General Assembly on 10 December 1948 states that everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing, medical care, necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control.

Secondly, the "International Covenant on Economic, Social and Cultural Rights" (article 12) adopted by the UN General Assembly on 19 December 1966 states measures and actions to be taken by the States' Parties regarding the provision for the reduction of the stillbirth-rate and of infant mortality and for the healthy development of the child; the improvement of all aspects of environmental and industrial hygiene; the prevention, treatment and control of epidemic, endemic, occupational and other diseases; the creation of conditions which would assure to all medical service and medical attention in the event of sickness.

In addition to the above mentioned documents, the United Nation's commitment to the global health is to be supported by the many organizations members of the UN family among which the World Health Nation (WHN), the Joint United Nations Programme on HIV/AIDS (UNAIDS), the United Nations Population Fund (UNFPA) and the United Nations Children's Fund (UNICEF).

Furthermore, the Organization for Economic Cooperation and Development (OECD) was established in 1948 as the Organization for European Economic Cooperation (OEEC) and now comprises 34 member states. OECD started its work on health in the early 1980s. According to OECD (2011), its actions in the area have focused mainly in developing a database allowing for comparative analysis of healthcare systems, supporting research works

on improving the healthcare systems' efficiency for the OECD countries as well as collaborations with other international organizations, particularly with the European Commission (EU) and World Health Organization (WHO) since the late 1990s in order to strengthen prior efforts.

In its 2013 "OECD Work on Health" brochure, the organization stated its priority areas related to the healthcare subject as addressing the following key points:

- ✓ Measuring health system outcomes – statistics and indicators for comparative analysis of health systems;
- ✓ Quality of health care – improving performance through benchmarking;
- ✓ Value for money in health spending – increasing health system efficiency;
- ✓ Economics of disease prevention – promoting health and preventing disease;
- ✓ Health system financing – ensuring financial sustainability of health systems;
- ✓ Long-term care – addressing growing demand and higher expectations for care;
- ✓ Health workforce – ensuring a stable health workforce in the OECD.

Nowadays, OECD is one of the largest and most reliable sources of comparable statistical, economic and social data. Based on these data, OECD experts monitor, analyze and forecast trends, further creating international standards and helping OECD governments in designing efficient and effective policies, thus improving the access and quality of healthcare. According to "OECD Work on Health 2013-2014" the most important issues are:

- ✓ strengthening primary care and the prevention of illness;
- ✓ improving the efficiency of hospital services;
- ✓ paying doctors and hospitals in ways that assure high-quality care;
- ✓ adapting healthcare to address the complex needs of frail elderly;
- ✓ assuring optimal care for chronic diseases, particularly cancer and cardio-vascular diseases.

Moreover, in order to achieve and sustain the desideratum of improving population health and healthcare systems, international organisms have often joined their efforts. Probably the best example is that of Millennium Development Goals (MDGs). The MDGs were established in 2000 by the "Millennium Declaration" adopted by the United Nations' General Assembly. The eight international development goals are undertaken by the UN member states as well as by other important international organizations among which: the OECD, the European Union (EU), the World Trade Organization (WTO), the International Monetary Fund (IMF), the World Bank (WB) and many others. All the listed targets are to be achieved by 2015 and three out of eight MDGs are related to the health topic. To begin with, the fourth goal ("reduce child mortality rates"), targets reducing the less than five years old mortality rate by two-thirds. By 2013, the following issues were reported by the UN:

- ✓ as the rate of under-five deaths overall declines, the proportion that occurs during the first month after birth is increasing;
- ✓ children born into poverty are almost twice as likely to die before the age of five as those from wealthier families;
- ✓ children of educated mothers—even mothers with only primary schooling—are more likely to survive than children of mothers with no education.

To continue, the fifth goal ("improve maternal health"), targets reducing maternal mortality ratio by three quarters and achieving universal reproductive education. With respect to these targets, some of the following aspects were reported by the UN by 2013:

- ✓ in Eastern Asia, Northern Africa and Southern Asia, maternal mortality has declined by around two-thirds;

- ✓ the maternal mortality ratio in developing regions is still 15 times higher than in the developed regions;
- ✓ official development assistance for reproductive healthcare and family planning remains low;
- ✓ just half of women in developing regions receive the recommended amount of healthcare they need.

Lastly, regarding the sixth goal ("combat HIV/AIDS, malaria, and other diseases"), the following aspects were reported by the UN up to 2013:

- ✓ new HIV infections continue to decline in most regions;
- ✓ more people than ever are living with HIV due to fewer AIDS-related deaths and the continued large number of new infections with 2.5 million people are newly infected each year;
- ✓ the global estimated incidence of malaria has decreased by 17 per cent since 2000, and malaria-specific mortality rates by 25 per cent;
- ✓ countries with improved access to malaria control interventions saw child mortality rates fall by about 20 per cent;
- ✓ treatment for tuberculosis has saved about 20 million lives between 1995 and 2011.

Summing up, starting from major international organizations up to individual levels, a great stress has been put on the problematic issues related to promoting health and healthcare activities, in order to improve living standards and gaining years of life, as practically these issues address the greatest wealth of a nation, i.e. its health.

3. Literature Review

Jumard et al. (2010) have grouped the OECD countries into six clusters, according to the existing similarities between their healthcare systems. The cluster analysis was carried out based on 269 variables (mostly qualitative ones) which were further transformed into twenty indicators representing health policies and institutions. These indicators take values on a scale from 0 to 6 and they were computed based on the "OECD Health Committee Survey on Health System Characteristics" (2009); the survey was composed of three parts: health financing, healthcare delivery and governance and resource allocation.

The variables estimated by Jumard et al.(2010) are the gains in life expectancy (at birth and at 65 for females and males), decline in infant mortality rate and the amenable mortality, as a function of healthcare expenditures, the gross domestic product (GDP), smoking, alcohol, diet, pollution, education, health professionals, number of consultations etc. Their main objective is a comparison between healthcare policies and institutions for 29 OECD countries, using OECD health indicators. Their research techniques span from principal component analysis and cluster analysis (for grouping countries) to econometric models and data envelopment analysis (for analyzing the impact of policies).

The six country clusters are portrayed in Figure no. 1:

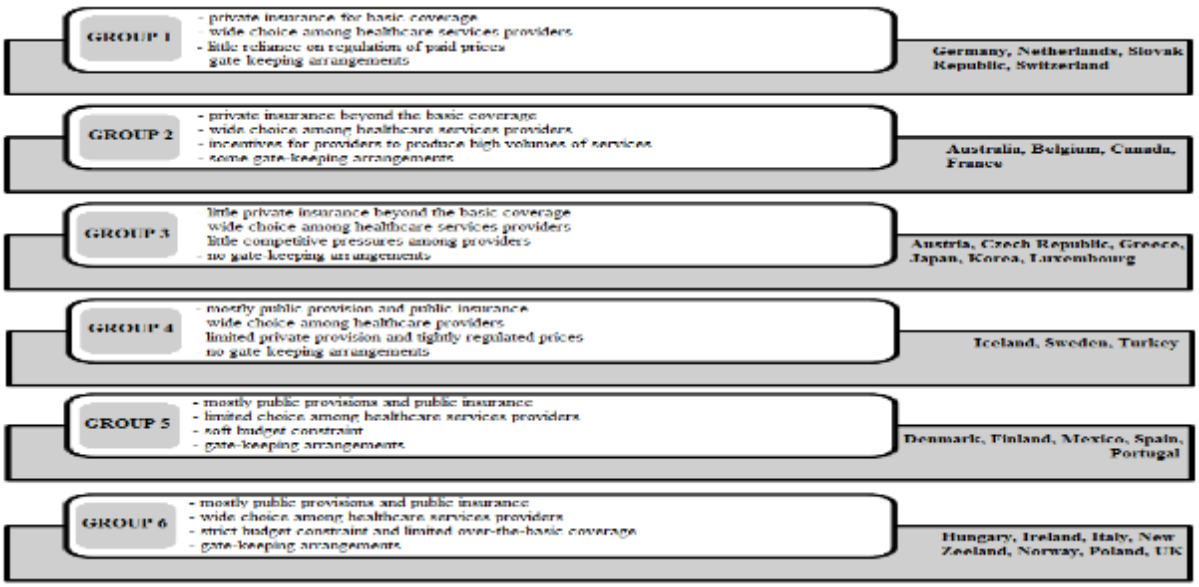


*Figure 1.*Country clusters – core characteristics
Source: Authors' processing based on Joumard et al.(2010)

Paris et al.(2010) focused on the objective of understanding current institutional arrangements and developing a limited set of quantitative indicators designed to capture the main characteristics of health systems. These indicators were obtained through factor analysis and were used to assess the role of health institutions and policies on health systems efficiency. Their statistical population includes the same 29 countries, because 5 OECD member states were not included in the country clusters developed by the above mentioned research paper as they did not participated in the survey; these countries are: Chile, Estonia, Israel and Slovenia (they entered the OECD only in 2010, after the survey was conducted) and United States.

Frech & Miller (2004) have considered life expectancy and disability-adjusted life expectancy as health proxies. Their sample included 18 OECD countries. Their main conclusion is that increased pharmaceutical consumption helps improve quality of life, as well as life expectancy. Furthermore, Shaw et al. (2005) analyzed an aggregate life expectancy production function for a sample of developed countries, finding that pharmaceutical consumption has a positive effect on life expectancy at middle and advanced ages. Their paper also presents results for lifestyle inputs into the production of life expectancy, such as tobacco consumption or dieting on fruit and vegetables.

Panel data studies on OECD countries have been used in many papers, such as Mohan et al. (2008), providing us with a strong base for this paper. The health care delivery system of twenty five OECD nations is analyzed in that paper, as the study seeks to assess the significance of various factors contributing to life expectancy and infant mortality mainly for the 1990-2002 period. Their panel data model considers the following independent variables: medical technology (computed tomography scanners per million individuals), health employment (practicing physicians' density per 1 000 people), in-patient utilization per capita (number of acute care bed days), prevention immunization (% of measles immunized children), total expenditure on health per capita (US dollars power purchasing parities), alcohol consumption in litres per capita, and educational level (school expectancy years).

Romanian authors have also been concerned by the problematic issue of healthcare indicators and expenditures. Nisulescu & Pana (2013) used descriptive analysis for assessing

public health and the place of Romania in the health system of the EU. In order to position Romania in the EU context, the paper uses a comparative analysis based on indicators such as total health expenditures in GDP and per capita, life expectancy at birth**,** number of hospital beds and number of doctors per 100 000 inhabitants.

Văidean et al. (2011) estimated a panel model for the EU-27 member states, including Romania, for investigating the possibility of having the weight of the population aged 65 and above in the total population as an explanatory variable for healthcare expenditures**,** besides the European per capita GDP. Furthermore, Nistor & Văidean (2010) modelled Romania's public healthcare expenses as a function of per capita GDP and the ratio of the female population to the total population, using a panel composed of Romania's 42 counties. Although the increase of the public healthcare expenditures in the GDP hasn't influenced the qualitative evolution of the Romanian healthcare system, the regional public healthcare expenditures are explained to a great extent by the regional GDP.

On the other hand, studies on developing countries have been also conducted, but the literature in the area is still poor because of insufficient healthcare data. An important study to be mentioned is that of Anton & Onofrei (2012) who expressed the under-five child mortality rate as a function of GDP/capita, healthcare expenditure, number of physicians and population from urban areas. Data was collected for 18 countries from Central and Eastern Europe, observed over three years, namely 1995, 2000 and 2008.

Romania's accession to the OECD has been repeatedly declared as a strategic objective of the Romanian foreign policy, and Romania reaffirmed in 2012 its intention to become a member of the OECD. At present, according to the Romanian Ministry of Foreign Affairs, Romania's accession to the OECD depends on various issues:

- ✓ OECD's enlargement process. At the moment, the OECD is undergoing an internal reform process in order to simplify the decision-making process among its members and to review its global role in promoting sustainable development in the current context of economic instability. In the short run, this internal reform could include the opening of a new enlargement process.
- ✓ meeting the accession criteria by candidate countries:
  - like-mindedness – referring to the existence of a market-based economy and a functional democracy;
  - significant player – regarding the size and economic importance of the candidate state;
  - mutual benefit – requiring for the accession to be advantageous for both the candidate country and the OECD;
  - global considerations – regarding the assurance of geographical balance between the OECD's members.
- ✓ the political consensus of OECD member states regarding the Romanian candidacy (political support of all member states for Romania's accession).

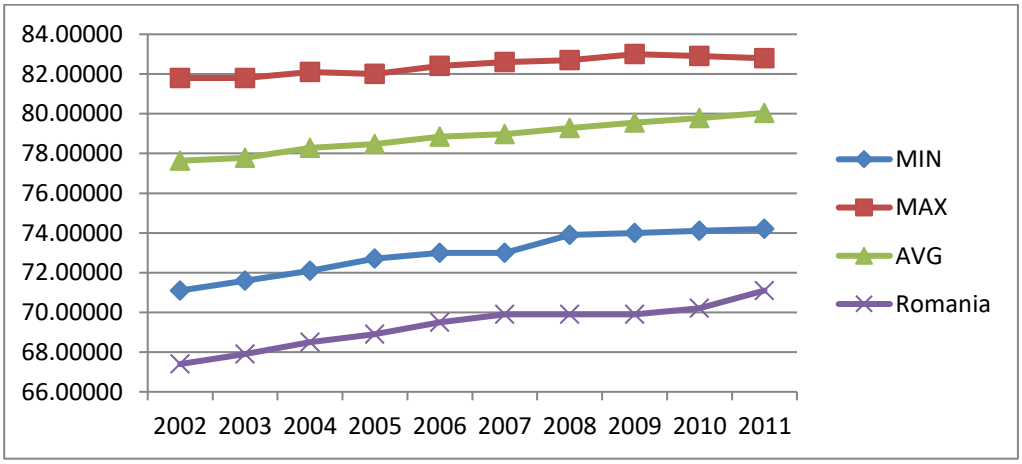
As an EU member state, Romania fulfils the OECD accession criteria, since the EU *acquis,* applied by Romania, is inspired by OECD's recommendations. At the moment, officials consider Romania as having a general favourable assessment from the OECD, in light of its relevant position in the region, its constructive involvement in the organization's activity and its economic development potential. Romania could join the OECD in the medium-run, but for now it was not included in the present study.

4. Data and methodology

Data used by this study are structured into an unbalanced panel dataset, for the 2002-2011 time interval, for 29 OECD countries. The total number of missing values is below the 10% threshold, decreasing up to 0.69% for the dependent variable, for example. Data are OECD public data for the OECD member states, excepting Estonia, Slovakia, Israel and Chile as they only entered the OECD in 2010. The study also excluded the USA from the panel as the USA has a completely different healthcare system, mainly based on private health insurances. The USA only has two healthcare programs for helping the poorest people and the elder than 65 people, i.e. Medicare and Medicaid. Except for these two, the healthcare system of the USA had been financed through voluntary private health insurance premiums, subscribed by those who afforded them.

The life expectancy indicator is defined by OECD (2011) as the average number of years that a person could expect to live if he or she experienced the age-specific mortality rates prevalent in a given country in a particular year. To be mentioned, this does not include the effect of any upcoming decline in age-specific mortality rates. The exact comparability between countries based on this indicator can be affected by methodological differences, as each country calculates its life expectancy according to somewhat varying methodologies.

Our study uses life expectancy at birth as a dependent variable. For the 2002-2011 time period, an increase in the life expectancy at birth accompanied by a large reduction in cross-country differences, reflecting rapid catching-up relative to the country with the best performance has been reported.



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
MIN	71.1000	71.6000	72.1000	72.7000	73.0000	73.0000	73.9000	74.0000	74.1000	74.2000
MAX	81.8000	81.8000	82.1000	82.0000	82.4000	82.6000	82.7000	83.0000	82.9000	82.8000
AVG	77.6366	77.7794	78.2735	78.4735	78.8382	78.9794	79.2794	79.5500	79.7727	80.0424
STDDEV	2.6205	2.59122	2.62705	2.59128	2.59569	2.62676	2.55589	2.52674	2.51648	2.48307
Romania	67.400	67.900	68.500	68.900	69.500	69.900	69.900	69.900	70.200	71.100

Figure 2. Life expectancy at birth (number of years) in 34 OECD countries (minimum, maximum, average) and Romania, 2002-2011
Source: Authors' processing based on healthcare indicators from http://www.oecd.org/ and http://epp.eurostat.ec.europa.eu

Figure no. 2 presents the minimum, maximum and average life expectancy at birth values expressed in years for 34 OECD countries for the years 2002-2011. The graph also contains data for Romania as comparison for the period under analysis. To be mentioned, the years of life expectancy are represented on the ordinate axis, while the periods are to be found on the abscissa axis. The minimum values range from 71.1 years in Estonia in 2002 to 74.2 years in Mexico in 2011. Turkey also experienced minimum life expectancy values in 2008. Maximum life expectancy values were encountered in Japan and vary from 81.8 years in 2002 to 83 years in 2009. Other higher performers include Switzerland and Australia. The gap between the country with the highest life expectancy, Japan, and the countries with the lowest, Estonia and Mexico, is constantly narrowing from 10.7 years in 2002 to 8.6 years in 2011. Thus, a person living in one of the OECD countries would expect to live, on average, 78.9 years with an average standard deviation of 2.57 years. As it is better illustrated by the graph, the average OECD life expectancy values are closer to the maximum than to the minimum ones suggesting that most of the countries experience above the mean values. As regarding Romania, the values are below the OECD minimum (3 years average gap). Overall, both in the case of the OECD countries (average) and in that of Romania it has been registered an increase in the life expectancy variable for the 2002-2011 period. In the first case, there was a constant increasing trend, while in the second one there were two periods of increase from 2002-2007 and from 2009-2011, respectively, and one period of stagnation in between.

The independent variables previously validated by other papers and used by this study may be grouped into different categories. A first category would be that of healthcare expenditures, including health spending (expressed in US dollars per capita), out-of-pocket payments (households, expressed in US dollars per capita) and total expenditure on pharmaceuticals and other medical non-durables (expressed in US dollars per capita). The second category of variables includes healthcare associated resources: number of physicians (density per 1 000 population), nurses (density per 1 000 population) and total hospital beds (per 1 000 population). The third category is that of healthcare activities: number of doctors' consultations (per capita), the average length of stay (all causes, days in healthcare units) and pharmaceutical consumption (antibiotics as daily dose). The fourth category refers to risk factors such as alcohol consumption (litres per capita (age 15+)). All data were carefully examined and the summary statistics, using the observations for the 29 OECD countries for the ten year time period, by skipping the missing values are presented in Table no.1.

Table no. 1 Summary statistics for the explanatory variables for the 29 OECD countries

	Mean	Median	Minimum	Maximum
alcohol_cons	9.7821	10.000	1.2000	17.700
doct_cons	7.0053	6.6000	2.5000	14.100
length_stay	8.1366	7.5000	3.9000	22.200
nurses	8.4785	8.7200	1.1000	16.600
pharma_cons	20.911	19.800	9.8000	45.300
physicians	3.0553	3.0800	1.3900	6.1400

GDP_cap	29881.	30683.	9484.2	73913.
hosp_beds	5.3979	4.8450	1.6700	14.430
out_pocket	491.67	475.03	79.811	1454.7
spending	2138.1	2247.6	256.14	4812.6

Source: Authors' processing in Gretl

Our prior assumptions are based on the literature review. Thus, we expect a positive impact of the healthcare expenditures' category on the life expectancy variable and a most probably positive relationship between life expectancy at birth and healthcare resources and activities. On the other hand, we would intuitively expect a negative relationship between life expectancy and tobacco or alcohol consumption. The econometric regressions were estimated with the help of Gretl software, through the Pooled Ordinary Least Squares (OLS) technique, the Fixed Effects Model (FEM) and the Random Effects Model (REM) for panel data.

5. Results and interpretation

In order to fulfil the objective of multiple regression analysis of using the above mentioned predictor variables whose values are known for predicting the single dependent value of life expectancy at birth, we've used the most popular sequential search method, i.e. step-wise estimation, which enabled us to examine the contribution of each independent variable to the regression model. After assessing the basic assumptions for regression analysis, we've determined the correlation coefficients' matrix.

Multicollinearity is defined by Hair et al. (2010) as the correlation among two or more independent variables, evidenced when one is regressed against the others and is not desirable within a regression model. As such, in order to maximize the prediction from a given number of independent variables, the researchers should look for independent variables that have low multicollinearity with the other independent variables, but also have a high correlation with the dependent variable. So, we have firstly estimated a simple regression model, in order to estimate life expectancy at birth as a function of public healthcare spending per capita, the exogenous variable with the highest explicative power. Secondly, according to Hair et al. (2010), we added independent variables that had the greatest additional predictive power. The sum of squared errors decreased. We continued in this manner of adding more dependent variables in our model as long as they were not correlated with the previously introduced variables and as long as they increased the Adjusted R^2 of the overall model. According to Hair et al.(2010), the addition of more independent variables in based on trade-offs between increased predictive power versus overly complex and potentially misleading results. So, the optimal model in model (3) from Table no. 2, estimated with the Pooled OLS technique.

Table no. 2 Models estimated with the OLS technique

LE_birth independent variable	**Model (1)**	**Model (2)**	**Model (3)**
Constant	75.0549*** (0.0000)	72.9435*** (0.0000)	73.8835*** (0.0000)
Spending	0.001897*** (0.0000)	0.00201477*** (0.0000)	0.002144*** (0.0000)

length_stay		0.225636*** (0.0000)	0.245695*** (0.0000)
alcohol_cons			-0.140903*** (0.0000)
R^2	0.504033	0.585526	0.610529
Adjusted R^2	0.502249	0.582275	0.605578

Source: Authors' processing

Specialists consider the Pooled OLS as unlikely to be adequate, but it provides a baseline for comparisons with more complex estimators. So, we have panel diagnosed model (3) as follows:

- The F test probability tests the null hypothesis of OLS against the alternative of FEM. A low p-value counts against the null hypothesis that the pooled OLS model is adequate, in favour of the FE alternative. The F test compared the calculated F of model (3) with its tabled value, the p-value of 0.98 being higher that 0.05, so we accepted H_0.
- Breusch-Pagan test statistic tests the null hypothesis of OLS (i.e. no panel effect) against H_1 of REM. A low p-value counts against the null hypothesis that the pooled OLS model is adequate, in favour of the RE alternative. The obtained p-value of 0.03 is smaller than 0.05, so we reject H_0 and accept H_1, in favour of REM.
- Hausman test tests H_0 of RE against H_1 of FE. A low p-value counts against the null hypothesis that the REM is consistent in favour of the FEM. The p-value was of 0.72, which is higher than the 0.05 threshold, so random effects give the best estimation.

Indeed, the Gretl Help confirmed that a greater efficiency may be gained using Generalized Least Squares (GLS) taking into account the covariance structure of the error term. Unfortunately, in Gretl, heteroskedasticity and/or autocorrelation may be tested for OLS and FEM, but not currently for RE. Still, the Durbin-Watson value of the previously considered models stayed close to the value of 2, pointing towards no autocorrelation of errors. Then, the sum of squared residuals continued to decrease as we added more independent variables in the model, up to 572.2.

Random-effects (GLS), using 240 observations
Included 29 cross-sectional units
Time-series length: minimum 2, maximum 10
Dependent variable: LE_birth

coefficient	std. error	t-ratio	p-value	
const	73.8835	0.490102	150.8	1.32e-236 ***
spending	0.00214449	0.000115151	18.62	3.14e-048 ***
length_stay	0.245695	0.0316832	7.755	2.64e-013 ***
alcohol_cons	-0.140903	0.0387651	-3.635	0.0003 ***

Mean dependent var 79.06625 S.D. dependent var 2.479385
Sum squared resid 572.2177 S.E. of regression 1.553841
Log-likelihood -444.8109 Akaike criterion 897.6218

Schwarz criterion 911.5444 Hannan-Quinn 903.2316
'Within' variance = 2.582
'Between' variance = 0.202103
Breusch-Pagan test -
Null hypothesis: Variance of the unit-specific error = 0
Asymptotic test statistic: Chi-square(1) = 4.43973
with p-value = 0.0351118
Hausman test -
Null hypothesis: GLS estimates are consistent
Asymptotic test statistic: Chi-square(3) = 1.32403
with p-value = 0.723435

Figure no 3. GLS estimation of Model (3)
Source: Authors' processing in Gretl

Regarding model selection criteria, in some contexts formal hypothesis testing is used in order to choose a better estimation technique. For our case, all tests pointed towards the REM of life expectancy at birth as a function of healthcare spending, length of stay and alcohol consumption, presented in Figure no 3.

All the estimated coefficients are significant at a 1% threshold, given by ***. According to our expectations, there's a direct relationship between life expectancy at birth and healthcare spending and the length of stay in healthcare units. Moreover, there's an indirect relationship between alcohol consumption and life expectancy at birth. As such, at a one liter per capita increase in alcohol consumption in OECD countries, the life expectancy at birth of its population would decrease with 0.14 years (almost two months) on average, all other things equal.

In other contexts, model selection is carried out based on measured criteria. As such, we have carefully checked the adjusted R^2 of models (1) - (3), which penalizes the inclusion of additional parameters, other things equal. When we estimated a potential $(4)^{th}$ model with pharmaceutical consumption introduced as the fourth explanatory variable, the adjusted R^2 decreased to 0.553012, so we didn't consider that model.

According to Stata website, the R-squared statistic is an OLS concept that is useful because of the unique way it breaks down the total sum of squares into the sum of the model sum of squares and the residual sum of squares. When you estimate the model's parameters using GLS, the total sum of squares cannot be broken down in the same way, making the R-squared statistic less useful as a diagnostic tool for GLS regressions. Specifically, an R-squared statistic computed from GLS sums of squares need not be bounded between zero and one and does not represent the percentage of total variation in the dependent variable that is accounted for by the model.

Then, several information criteria have to be considered: Akaike's Information Criterion, Schwarz-Bayesian Information Criterion and Hannan-Quinn Criterion. Smaller values are better, one wants to minimize the chosen criterion. As such, the values of these criteria decreased from as high as 1129.941 in model (1) to 897.6218 in model (3) on RE.

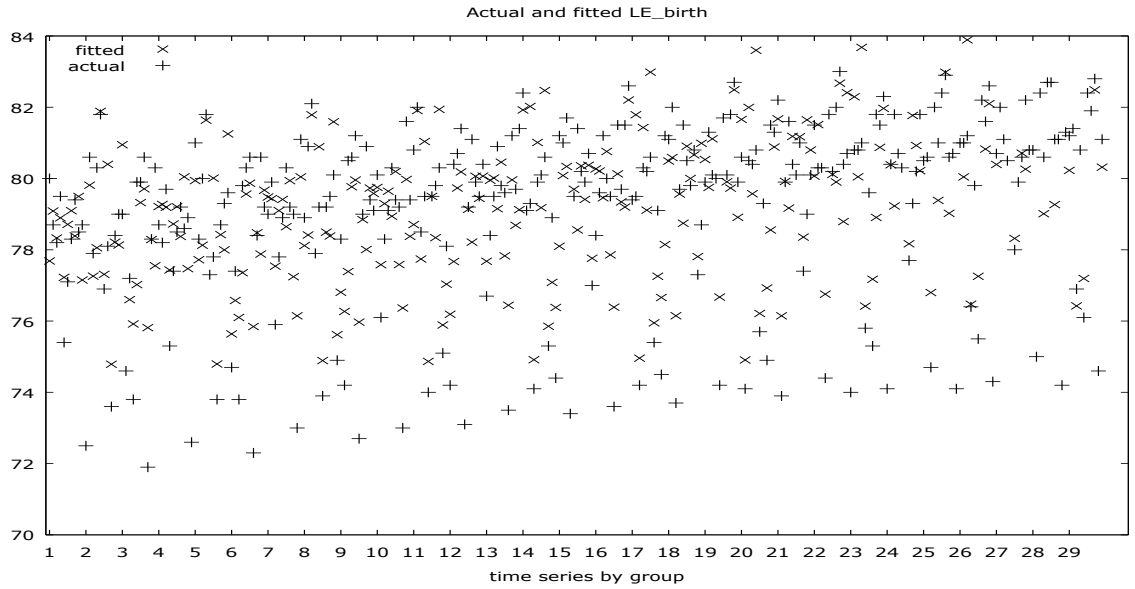


Figure 4. Actual and fitted values of LE_birth with the REM
Source: Authors' processing in Gretl

According to Figure 4, we may notice that the optimal chosen model, both based on hypothesis testing and information criteria, fits the real actual values of life expectancy at birth pretty well.

6. Conclusions

Our study targeted a detailed radiography of life expectancy at birth in OECD countries, as a proxy for the health status of their population and an expression of the healthcare efficiency. Starting from multiple international organizations, up to individual levels, people have realized the alienable truth of the Latin proverb "mens sana in corpora sano", i.e. "A sound mind in a healthy body". Targets were fixed and strong courses of actions were directed towards improving health and healthcare systems.

Our findings point out that a great deal of the life expectancy at birth is explicated by the healthcare public spending, so the more public investments towards the healthcare systems of OECD countries, the better rising of overall life expectancy. The number of days spent in healthcare units has also positively influenced life expectancy at birth, while alcohol consumption was negatively correlated with life expectancy at birth, which is not a surprise.

Indeed, we are thinking to develop future studies having some other dependent variables, such as life expectancy at the age of 65, infant or neonatal mortality rates and/or possible years of life lost. It would be interesting to test separately for gender differences or age groups as significant such results were obtained by other researchers. Furthermore, we are considering some other estimation techniques for panel data, one potential option being that of a dynamic panel model. We are thinking to expand our analysis on a larger data set, by including Romania as well, further pointing out its position with the help of a dummy variable. Other explanatory variables might be included, especially risk factors such as obesity or tobacco consumption, if data become available.

All in all, although the life expectancy at birth has maintained its upward trend, if we are expected to live longer, it doesn't necessarily mean that we would live better or healthier. So a great importance has to be given to improvements in individual life style and promoting healthier living.

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