Analysis of the Linkage Between Health Public Expenditures and Health Outcomes at the European Union Level

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Abstract

The paper investigates the linkage between public health expenditure and general health among all the European Union member states. Using the regression analysis we considered three independent variables (health expenditure, GDP/capita growth and number of nurses and midwives per 1000 inhabitants) and 2 dependent variables (life expectancy and infant mortality rate) to build two multifactorial regressions. Following the results, we were able to see that an increase in health expenditure generates an increase in life expectancy. Nevertheless, an increase in health expenditure generates a decrease in the infant mortality rate.

Key words: health public expenditure, life expectancy, European Union
J.E.L. classification: D60, H11, H51

1. Introduction

A large body of literature has investigated the connection between public health expenditure and health outcomes, especially in what concerns the low and middle-income countries (Oladosu et al., 2022). However, the studies that investigated the same connection in the case of European Union countries are far less numerous. Nixon and Ulmann (2006) reached the conclusion that increasing public healthcare expenditure in the period 1980-1995 in the case of the 15 old member states of European Union proved to be beneficial in terms of infant mortality, but only marginally beneficial in the case of life expectancy. More recently, Onofrei et al. (2021) have analysed the relationship between government expenditure on health and health outcomes in the case of the new member states of the European Union and have concluded that these variables are in a long-term equilibrium relationship.

In general, examining the relationship between health government expenditure and different health indicators is not an easy task, given the fact that public health is influcenced by a lot more factors other than the government expense that is done in this direction.

The purpose of this paper is to investigate the linkage between public health expenditure and general health among all European Union member states. Using the regression analysis we considered three independent variables (health expenditure, GDP/capita growth and number of nurses and midwives per 1000 inhabitants) and 2 dependent variables (life expectancy and infant mortality rate) in order to analyse this connection.

2. Theoretical background

In the last two decades, a growing interest has been paid to the potential economic benefits in terms of growth and development, of improving population health. There is a long-term relationship between the health of the citizens and the dynamics of per capita income (Romer, 1996). Bloom et al. (2004) point out the mechanisms through which an increased state of health of individuals actually leads to economic benefits: first, the increased productivity at the

workplace, leading to higher wages; then, the ability to work for longer periods, including later retirement; the possibility of supporting financially their education; the increased saving and investment; and the economic safety. The idea was mentioned first by Rosen (1993) long time ago, which made clear that the welfare of nations depended partially on the health of their citizens. However, this theme became a subject of attention with the 2001 Commission's report on macroeconomics and health, which suggested once again that improving health is a strategic policy in increasing income and reducing poverty in developing countries (Commission on Macroeconomics and Health, 2001). A few years later, in 2005, Suhrcke et al. (2005) provided evidence on the importance of health on the economy in well-developed countries. They implied that if Europe wants to become more competitive world-wide, investment in human capital is needed. Health should definitively be seen as a "consumer good" appreciated as an important component of general welfare and not only as a "capital good" that improves economic productivity.

There are many empirical studies that emphasized the significant relationshio between public health spending and health (Raeesi et al., 2018; Edeme et al., 2017; Arthur et al., 2017; Malhotra et al., 2016). However, the evidence provided mixed results, although the positive results of increasing health public spending prevailed in front of the negative ones (Jakovljevic et al., 2016; Ray et al., 2020; Kaur, 2020).

As far as concerns the European Union countries case, there are not many studies investgating the relationship between public health expenditure and relevant health indicators. Before the COVID-19 pandemic, health spending was growing faster than the economy. This led to an increase in the share of health expenditure in GDP from 6,4% in 2000 to 7,5% in 2018 across the European Union. In absolute figures, current health spending has increased from $1,4 trillion to $2,2 trillion. The amount spent by high- and middle-income countries on health is showing the same trend, but there are still high inequalities between countries. Health expenditure has increased at a much faster rate in middle-income countries than in higher-income countries. As a result, the difference in health expenditure per person between high- and middle- and low-income countries has fallen from 51-fold in 2000 to 28-fold in 2018.

3. Research methodology

We considered it appropriate to carry out an econometric analysis that would match health expenditure as an independent variable on the one hand and indicators describing the health system of EU member states on the other.

The sample taken into consideration covers the European Union member states, while the analysis period is 2008-2019. The source of the data for all variables used in econometric study is the database World Development Indicators, supplied by the World Bank.

The study of panel structure data allows the joint analysis of cross-section data series (in our case the countries belonging to the European Union), as well as chronological data series. The software package used for data analysis was E-views 11 Student Lite.

The simple linear regression model for panel data is as follows:

$$y_{it} = \alpha + X'_{it}\beta + \delta_i + \lambda_t + \varepsilon_{it} \quad (1)$$

where:

y_{it} - dependent variable

i=1,2,...N (countries)

t=1,2,...T (time)

X'_{it} - vector of explanatory variables (regressors)

α şi β – model parameters

δ_i şi λ_t - specific effects (random or fixed)

$\varepsilon_{i,t}$ - error term

The econometric model has three explanatory (independent) variables, which are described in Table no.1. As dependent variables, we took into account life expectancy at birth, respectively mortality rate below 5 years. The structural forms of the used regressions are shown below:

$$SVN_{it} = a_0 + a_1 \times CHS_{it} + a_2 \times PIB + a_3 \times AM_{i,t} + \delta_i + \lambda_t + \varepsilon_{it} \quad (2)$$

$$RM_{it} = a_0 + a_1 \times CHS_{it} + a_2 \times PIB + a_3 \times AM_{i,t} + \delta_i + \lambda_t + \varepsilon_{it} \quad (3)$$

Table no. 1. Variables used in the econometric model

Variables	Symbol	Computation
Dependent variable		
Life expectancy rate at birth	SVN	years
Mortality rate (under 5 years)	RM	reported at 1000 live births
Independent variables		
Health expenditure	CHS	% in GDP
GDP/capita growth	PIB	annual %
Nurses and midwifes	AM	reported at 1000 inhabitants

Source: realized by authors

4. Findings

Performing Likelyhood ratio-Redundant test analysis and also Hausman test (See Table 2 and Table 3), we have reached the conclusion a fixed-effects model is more appropriate.

Table no.2 Redundant fixed-effects test

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	101.973173	(26,242)	0.0000

Source: realized by authors

Table no.3. Hausman Test

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	28.920244	3	0.0000

Source: realized by authors

In the following tables (Table 4 and Table 5), we present the results of the FEM econometric models. The results of the first model show a direct relationship between the independent variables (health expenditure, GDP/capita growth and the number of nurses and midwives per thousand inhabitants) and the dependent variable, life expectancy at birth. A one-percent increase in health expenditure generates a 0.28-year increase in life expectancy at birth. A one percent increase in GDP results in an increase in life expectancy at birth of 0.1 years. For nurses and midwives, an increase of one percent would result in an increase in life expectancy of 0.12 years. The estimated coefficients of independent variables are statistically relevant. The standard error values of the regression function coefficients are small compared to the coefficients values, which proves the soundness of their estimation. The coefficient of determination of the model has a very

high value, of 95,5%, which shows that the explanatory variables explain to a great extent the variation of the dependent variable.

Table no. 4 Results of the first econometric model (dependent variable: life expectancy at birth)

Dependent Variable: SVN
Method: Panel EGLS (Cross-section weights)
Sample: 2008 2019
Periods included: 12
Cross-sections included: 27
Total panel (unbalanced) observations: 272
Linear estimation after one-step weighting matrix
White diagonal standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	75.53364	0.717041	105.3407	0.0000
CHS	[illegible]	[illegible]	[illegible]	[illegible]
FIB	0.101780	0.012789	7.958426	0.0000
AM	[illegible]	[illegible]	[illegible]	[illegible]

Effects Specification

Cross-section fixed (dummy variables)

Weighted Statistics

Root MSE	0.683044	R-squared	0.955016
Mean dependent var	[illegible]	Adjusted R-squared	[illegible]
S.D. dependent var	39.13718	S.E. of regression	0.738585
Sum squared resid	[illegible]	F-statistic	[illegible]
Durbin-Watson stat	0.750294	Prob(F-statistic)	0.000000

Unweighted Statistics

R-squared	0.944352	Mean dependent var	79.05588
Sum squared resid	[illegible]	Durbin-Watson stat	[illegible]

Source: realized by authors

The results of the second model show a direct relationship between independent variables (health expenditure, GDP/capita growth, number of nurses and midwive per 1000 inhabitants) and mortality rate, under 5 years (per 1000 live births). An increase in health expenditure of 1% results in a reduction in the infant mortality rate of 0.20. There is no significant influence between the independent variable nurses and midwives and the dependent variable infant mortality. An increase of one percent in GDP would result in a decrease in the infant mortality rate of 0.04. The estimated coefficients of independent variables are statistically relevant. The standard error values of the regression function coefficients are small compared to the coefficients values, which proves the soundness of their estimation.

The coefficient of determination of the model has a very high value, of 93,7%, which shows that the explanatory variables explain to a great extent the variation of the dependent variable.

Table no. 5 Results of the second econometric model (dependent variable: mortality rate -under 5)

Dependent Variable: VD2
Method: Panel EGLS (Cross-section weights)
Sample: 2008 2019
Periods included: 12
Cross-sections included: 27
Total panel (unbalanced) observations: 272
Linear estimation after one-step weighting matrix
White diagonal standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.197519	0.316471	19.58322	0.0000
CHS	-0.202527	0.037538	-5.395277	0.0000
PID	-0.041960	0.004908	-8.551032	0.0000
AM	0.019666	0.016887	1.164520	0.2454

Effects Specification

Cross-section fixed (dummy variables)

Weighted Statistics

Root MSE	0.572520	R-squared	0.937798
Mean dependent var	9.533802	Adjusted R-squared	0.930344
S.D. dependent var	6.508805	S.E. of regression	0.606970
Sum squared resid	89.15596	F-statistic	125.8118
Durbin-Watson stat	0.432695	Prob(F-statistic)	0.000000

Unweighted Statistics

R-squared	0.900263	Mean dependent var	4.640441
Sum squared resid	104.7016	Durbin-Watson stat	0.194742

Source: realized by authors

5. Conclusions

The results indicate that when public health expenditure increases, the overall mortality of a population reduces and an increase in life expectancy is being generated. An increase with 1 % of the public health expenditure leads to a 0.20% decrease in infant mortality. We have also identified a positive and significant relationship between public health spending and population life expectancy at birth. A 1% increase in public spending leads to an increase in life expectancy at birth of 0.28 years.

6. References

- Arthur, E., Oaikhenan, H.E. 2017. The Effects of Health Expenditure on Health Outcomes in Sub-Saharan Africa (SSA), *African Development Review,* 29, 524–536.
- Bloom, D.E., Canning, D. 2000. The health and wealth of nations, *Science*, 287, 1207-1209
- Edeme, R.K., Emecheta, C., Omeje, M.O. 2017. Public health expenditure and health outcomes in Nigeria, *American Journal of Biomedical and Life Sciences,* 5(5), 96-102.
- Jakovljevic, M.B., Vukovic, M., Fontanesi, J. 2016. Life expectancy and health expenditure evolution in Eastern Europe—DiD and DEA analysis. *Expert Review of Pharmacoeconomics & Outcomes Research.*, 16, 537–546.
- Kaur, A. 2020. Health Status, Government Health Expenditure and Economic Growth Nexus in India: A Toda–Yamamoto Causality Approach. *Arthaniti: Journal of Economic Theory and Practice.*
- Malhotra, C., Do, Y.K. 2016. Public health expenditure and health system responsiveness for low-income individuals: Results from 63 countries, *Health Policy and Planning*, 32(3), 314–319.
- Nixon, J., Ulmann, P. 2006. The relationship between health care expenditure and health outcomes. *European Journal of Health Economics,* 7, 7–18.
- Oladosu, A.O., Chanimbe, T., Anaduaka, U.S. 2022. Effect of public health expenditure on health outcomes in Nigeria and Ghana, *Health Policy*, 3, 100072.
- Onofrei, M., Vatamanu, A.F., Vintilă, G., Cigu, E. 2021. Government health expenditure and public health outcomes. A comparative study among EU developing countries, *International Journal of Environmental Research and Public Health*, 18(3), 1134.
- Raeesi, P., Harati-Khalilabad, T.; Rezapour, A., Azari, S., Javan-Noughabi, J. 2018. Effects of private and public health expenditure on health outcomes among countries with different health care systems: 2000 and 2014. *Medical Journal of the Islamic Republic of Iran*, 32, 205–209.
- Ray, D., Linden, M. 2020. Health expenditure, longevity, and child mortality: Dynamic panel data approach with global data. *International Journal of Health Economics and Management*., 20, 99–119.
- Romer, D. 1996. *Advanced macroeconomics*. 3rd Edition, New York: MGraw Hill.
- Rosen G. 1993. *A history of Public health (expanded edition).* Baltimore: Johns Hopkins University Press.
- Suhrcke M., McKee, M., Sauto Arce R., Tsolova, S., Mortensen, J. 2005. *The contribution of health to the economy in the European Union.* Brussels, [online] Available at: https://ec.europa.eu/health/ph_overview/Documents/health_economy_en.pdf
- World Health Organization Commission on Macroeconomics and Health & World Health Organization. 2001. *Macroeconomics and health: investing in health for economic development: executive summary/report of the Commission on Macroeconomics and Health*