HEALTH EXPENDITURES AND HEALTH OUTCOMES IN CENTRAL EUROPE AND THE BALTIC REGION

S. Singh[1]
A. Singh[2]
A. Mohan[3]
M. Batola[2]
N. Kumar[4]

[1] Symbiosis International Deemed University, India,
Lavale, Tal, Pune, Maharashtra, 412115, India

[2] Graphic Era Hill University, India,
600, Bell Road, Clement Town, Dehradun, Uttarakhand, 248002, India

[3] Graphic Era Deemed to be University, India,
566/6, Bell Road, Clement Town, Dehradun, Uttarakhand, 248002, India

[4] Christ University, India,
Hosur Road, Bengaluru, Karnataka, 560029, India

Received 24 November 2023
Accepted 03 May 2024
doi: 10.5922/2079-8555-2024-2-7
Singh, S., Singh, A., Mohan, A., Batola, M., Kumar, N., 2024

In Central Europe and the Baltic region, healthcare expenditure has been growing slightly faster than across the euro area and in OECD countries. However, health outcomes as regards chronic diseases prove to be modest in the euro area and OECD countries compared to Central Europe and the Baltic region. Panel data analysis and country-specific regressions were conducted using World Bank data spanning from 2000 to 2019. Evidence suggests a significant correlation between private and current health expenditures and reduced mortality from chronic diseases in males, females and the total population across the panel, leading to improved longevity. Yet, public health expenditure does not correlate with a substantial reduction in mortality or a higher lifespan among the population, whether considered collectively or among males and females separately. Similarly, an increase in current health expenditure by one unit leads to significant reductions in mortality from non-communicable diseases: by 29 percent in the total population, 22 percent in females and 36 percent in males. Public health spending in Lithuania and Russia has been shown to decrease mortality from non-communicable diseases. Furthermore, chronic mortality is associated with a significant decline in labour productivity: by 42 percent in the total population, 40 percent in males and 45 percent in females. Therefore, interventions implemented through public health systems may reduce mortality from chronic conditions in the study countries.

Keywords:
Baltic region, health expenditures, health outcomes, seemingly unrelated regression

Introduction

The exponential growth rate of health expenditures has become a concern to policymakers. In this context, a fundamental issue in contemporary debates on health policy revolves around the extent to which increased healthcare spend-

To cite this article: Singh, S., Singh, A., Mohan, A., Batola, M., Kumar, N. 2024, Health expenditures and health outcomes in Central Europe and the Baltic Region, *Baltic Region*, vol. 16, № 1, p. 126—143.
doi: 10.5922/2079-8555-2024-2-7

ing results in the anticipated benefits, such as reduced mortality across various conditions and extended life expectancy among the population. In previous empirical studies, the dynamics of health expenditure and health outcomes appear difficult to disentangle. For instance, Leu concludes that medical spending is not significantly associated with lower mortality [1]. Hitiris et al. argue that there is scant evidence supporting the notion that increased health expenditure reduces mortality rates in developed countries [2]. Nixon and colleagues have found a correlation between increased medical expenditure and a notable reduction in infant mortality [3]. Caroline et al. have established that lower health expenditure is linked to higher infant mortality rates and reduced life expectancy in Canada [4]. Ullah and his co-researchers have demonstrated that higher public health expenditure leads to substantially improved health outcomes in Pakistan [5]. Oladosu's study reveals that despite relatively low levels of public health expenditure in Nigeria and Ghana, it still contributes significantly to improved health outcomes [6]. Singh's findings indicate that increased public health spending reduces mortality rates for children under five, also from non-communicable diseases (NCDs), while also enhancing life expectancy. However, only in Brunei and Singapore did private health spending improve health outcomes among the countries of Southeast Asia [7]. Similarly, Ivankova et al. established that higher health spending is significantly associated with lower mortality for treatable respiratory diseases for both males and females in OECD countries [8]. Arthur's research shows that health expenditure has a significant, though inelastic, impact on health outcomes in the Sub-Saharan African continent [9]. Akinkugbe et al. have found that among other factors considered in the model, public health spending determines health status in Lesotho [10]. Anyanwu's analysis indicates that under-five and infant mortality rates are significantly associated with government health expenditures in Africa [11]. Hlafa's research reveals that the impact of public health spending on health outcomes varied across the nine provinces of South Africa [12]. Kumar et al. have found that public expenditure on health has little effect on mortality reduction (infant and under-five) in India [13]. Novignon has found that public and private health spending improves health status in Africa [14]. Rahman and colleagues have found that both public and private expenditures reduced infant mortality rates in Southeast Asian countries [15]. Heuvel's research indicates that social protection expenditures, rather than healthcare expenditures, are the major drivers of longevity in a comparative study of European countries [17]. Anwar's investigation into OECD countries concluded that health expenditures negatively impact infant mortality and positively impact life expectancy [18]. Longitudinal studies by Roffia et al. on OECD countries indicate that healthcare expenditures, physician density, temperature, and population density significantly impact life expectancy at birth [19]. Linden et al. in the study on OECD countries, found evidence supporting a positive link between both public and private health expenditures and life expectancy at birth [20].

However, this research investigates whether different components of health expenditures are significantly associated with better health outcomes within and across the countries of Central Europe and the Baltic region. The rest of this paper has the following arrangement. The methods follow in section two, and the result is analysed in section three. Section four discusses the results, and section five concludes this research.

Methods

Primarily, this paper investigates the impact of different components of health expenditures on health outcomes in the context of Central Europe and the Baltic region. The components of health expenditures employed are per capita public health expenditure (Pub. Hea. Exp.), per capita private health expenditure (Pvt. Hea. Exp.), per capita current health expenditure (Crn. Hea. Exp.). Similarly, the variables employed as health outcomes are life expectancy at birth (total) (Lyf. Exp. at birth {total}), life expectancy at birth (female) (Lyf. Exp. at birth {female}), life expectancy at birth (male) (Lyf. Exp. at birth {male}), mortality rate from chronic diseases (total) (NCDs mort. {total}), mortality rate from chronic diseases (female) (NCDs mort. {female}), mortality rate from chronic diseases (male) (NCDs mort. {male}). The general form of the parametric model seeks to investigate whether different components of per capita health expenditures are significantly associated with improvement in health outcomes (mortality reductions from chronic diseases and higher life expectancy). Therefore, the baseline of the model can be written in a log-linear form as:

$$HealthOutcome_{it} = \alpha_0 + \beta_1 ln(pubhexp_{it}) + \beta_2 ln\left(pvthexp_{it}\right) + \beta_3 \ln\left(Crnhexp_{it}\right) + \\ + \beta_4 \ln\left(lbpro_{it}\right) + \beta_5 \ln\left(depop_{it}\right) + \varepsilon_{it}.$$

In this model, it is assumed that $\beta_1$measures the elasticity coefficient of per capita Pub. Hea. Exp., β_2 for per capita Pvt. Hea. Exp., β_3 for per capita Crn. Hea. Exp., β_4 for the productivity of labour and β_5 for the elderly population. The health outcomes are the dependent variables of this model and are taken as NCDs mortality (total), NCDs mortality (female), NCDs mortality (male), Lyf. Exp. at birth (total), Lyf. Exp. at birth (female), Lyf. Exp. at birth (male). In addition, α_0 is a constant term that measures the country-specific effect in the regression and ε_{it} is the composite error that takes into account the unaccounted errors in the regression, and thus, it is assumed to be independently and normally distributed. Importantly, in line with economic theories, the size of per capita health expenditure is a strong indicator of the share of funding a particular health system receives. Therefore, all else is held constant; health expenditures are expected to lower mortality rates from all conditions and better the life span of the population in the health system. Thus, an increase in different components of per capita health expenditures should be central to ensuring wider and greater access

to health services, leading to improved health outcomes. This paper follows the decomposition method of Cheng and colleagues [16] by taking the ratio of some of the variables considered in the model.

Table 1

Definition and the variables

Variable	Definition
Per capita public health expenditure (PPP* USD)	The ratio of domestic government health expenditure per capita to GDP per capita
Per capita private health expenditure (PPP USD)	The ratio of domestic private health expenditure per capita to GDP per capita
Per capita current health expenditure (PPP USD)	The ratio of current health expenditure per capita to GDP per capita
Labor productivity	The ratio of the working population to the total population
Dependent population	The ratio of the elderly population to the total population
Life expectancy at birth (total)	The average years an individual is expected to live in a country (total)
Life expectancy at birth (female)	The average years an individual is expected to live in a country (female)
Life expectancy at birth (male)	The average years an individual is expected to live in a country (male)
Mortality rate from chronic diseases (total)	The number of deaths specific to cancer, diabetes, cardiovascular, and respiratory diseases in a country (total)
Mortality rate from chronic diseases (female)	The number of deaths specific to cancer, diabetes, cardiovascular, and respiratory diseases in a country (female)
Mortality rate from chronic diseases (male)	The number of deaths specific to cancer, diabetes, cardiovascular, and respiratory diseases in a country (male)

Note: * PPP means Purchasing Power Parity.

The data is obtained from the World Bank Development Indicators spanning 2000 to 2019. The countries for this study are Denmark, Estonia, Finland, Germany, Iceland, Latvia, Lithuania, Norway, Poland, Russia, and Sweden. The variables employed in this study and their definition is given in Table 1. The different components of per capita health expenditure employed are measured in terms of international purchasing power parity in each country. The mortality rate is measured per 1,000 population in each country and across gender groups. The data is analysed using STATA version 15.1.

Results

Figure 1 in the appendix section illustrates the trends in different components of health expenditures specific to Central Europe and the Baltic region, the Euro Area, and the OECD countries. In the Central Europe and the Baltic region, Crn.

Hea. Exp. maintains a steady upward trend from 2000 to 2010, and the trend changes slowly, and towards the end of the sample, it continues to rise without a sign of a decline. Similarly, Pub. Hea. Exp. increases slowly at the beginning of the sample, changes trend after 2009, thereafter, it starts declining until 2016 and finally continues to rise slowly. Pvt Hea. Exp. grew steadily without any form of contraction throughout the sample period. However, for the OECD countries and the Euro Area, the data shows the same patterns — Crn. Hea. Exp. and Pub. Hea. Exp. grew in a similar trend, rising slowly, and eventually changing patterns as the sample continued to expand. The Pvt. Hea. Exp. increased slowly until 2009; thereafter, it grew and declined steadily as it approached the end of the sample. Therefore, the trend analysis shows that the OECD countries and the Euro Area have shown similar growth trends in the three components of health expenditures. However, in Central Europe and the Baltic region, the growth trend is comparatively lower for the Pub. Hea. Exp. and Pvt. Hea. Exp. relative to the Crn. Hea. Exp.

In the panel analysis, the Hausman test can be used to decide whether to choose a fixed effect (FE) or a random effects (RE) model. In this case, the null hypothesis for a Hausman specification test is that the RE model is more efficient. On the other hand, the alternative hypothesis tells that the FE model is the prepared model, assuming that the RE model is inconsistent. Thus, applying the Hausman test helps to decide the most consistent and efficient estimates between the FE and the RE models. Specifically, if the results indicate p-values smaller than 0.05, the FE model is chosen. Conversely, if the *p*-value is greater than 0.05, the RE model is chosen. The FE estimates of health outcomes regressions are shown in Table 2. Across the panel, the estimate indicates that per capita private and current health expenditures improved health outcomes significantly. This implied that a unit rise in per capita private and current health expenditure would lower the mortality rate from chronic conditions by 5 % and 29 % in the entire population, specifically for the Crn. Hea. Exp, the reduction is even higher, 32 % for males relative to females value of 26 %. Similarly, an increase in per capita private and current health expenditure by one unit will increase life expectancy at birth by 1 % and 5 %, respectively. In the same way, per capita Pvt. Hea. Exp. is associated with a greater impact on life expectancy at birth for females, 7 %, compared to 1 % for males. However, there is no sufficient evidence to say that public health expenditure improves health outcomes in Central Europe and the Baltic region.

Figure 2 in the appendix section illustrates the trend in NCDs mortality in Central Europe and the Baltic region, the Euro Area, and the OECD countries. In Central Europe and the Baltic region, NCDs mortality declines gradually in the same direction for the entire population, males and females. However, in the Euro Area and the OECD countries, a similar pattern is observed in the mortality declines for chronic conditions in the entire population and across gender

groups. This highlights that there is lower NCDs mortality in the Euro Area and the OECD countries relative to Central Europe and the Baltic region. Figure 3 in the appendix section portrays the trends in NCDs mortality in Central Europe, the Baltic region, the Euro Area, and the OECD countries. In the Central Europe and the Baltic region, Lyf. Exp. at birth increases steadily for the entire population and across gender groups without significant variations. In the Euro Area, it expanded steadily until 2015, suddenly declined in 2016, and continued to grow towards the end of the sample. However, in the OECD countries, it expanded greatly without any form of contraction throughout the sample period.

Moreover, the mortality rate from chronic conditions is significantly associated with a lower level of labour productivity and an increased dependent population for males, females, and the total population. This suggests that a substantial share of the active labour force and the elderly population are dying from chronic conditions in these countries, resulting in a 42 % reduction in labour productivity across the entire population. It is important to note that the percentage decline in labour productivity (42 %) due to sudden death from chronic diseases is considerably higher than the overall contribution of labour productivity to raising life expectancy at birth (6 %) in the total population. Similarly, the estimates indicate that 48 % of the elderly are dying from chronic conditions, while the contribution of the elderly population to raising life expectancy at birth is a mere 3 %.

Table 2

Estimates of the Fixed Effects Regression Model

Variable	NCDs mort			Lyf. Exp.		
	total	female	male	total	female	male
Per capita Pub. Hea. Exp.	0.01 (0.57)	0.02 (1.10)	0.01 (0.28)	– 0.01 (– 0.29)	– 0.02 (– 0.71)	0.01 (– 0.04)
Per capita Pvt. Hea. Exp.	– 0.05 (– 3.2)***	– 0.05 (– 3.3)***	– 0.05 (– 2.8)***	0.01 (3.14)***	0.07 (3.00)***	0.01 (3.07)***
Per capita Crnt. Hea. Exp.	– 0.29 (10.4)***	– 0.26 (– 9.4)***	– 0.32 (– 9.8)***	0.05 (8.47)***	0.04 (9.20)***	0.06 (7.66)***
Labour productivity	– 0.42 (– 11.3)***	– 0.45 (– 12.8)***	– 0.40 (– 9.6)***	0.06 (7.57)***	0.05 (9.08)***	0.07 (6.34)***
Dependent population	– 0.48 (– 10.5) ***	– 0.39 (– 8.8)***	– 0.54 (– 10.3)***	0.03 (3.43)***	0.02 (3.62)***	0.04 (3.10)***
Constant	12.1 (16.8)***	10.6 (15.4)****	13.0 (16.0)****	3.5 (24.0)***	3.76 (35.7)***	3.29 (16.4)***

Note: *** indicates significance at 1 %.

Similarly, Table 3 presents the RE regression between health expenditures and health outcomes. The FE and RE models have shown almost the same results regarding the sign and statistical significance of the parameters employed. In this case, per capita private and current health expenditure reduces the NCDs mortality rate for the total population and males and females. Equally, it significantly improves the life span of the male and female. However, it does not better the lifespan of the total population. The result shows that per capita Pub. Hea. Exp. is not associated with a significant improvement in health outcomes across the panel. The estimates of the RE model differ from those of the FE model regarding the coefficient of life expectancy at birth in relation to labour productivity and the dependent population.

Table 3

Estimates of the Random Effects Regression Model

Variable	NCDs mort			Lyf. Exp.		
	total	female	male	total	female	male
Per capita Pvt. Hea. Exp.	−0.04 (−2.8)***	−0.05 (−3.8)***	−0.04 (−2.1)***	−0.04 (−2.75)***	0.01 (3.18)***	0.01 (2.1)**
Per capita Crnt. Hexp	−0.34 (−15.3)***	−0.28 (−13.7)***	−0.38 (−14.6)***	−0.34 (−15.3)***	0.04 (15.8)***	0.08 (14.5)***
Labour productivity	−0.35 (−10.7)***	−0.39 (−13.3)***	−0.33 (−8.9)***	−0.35 (−10.7)***	0.05 (11.8)***	0.07 (9.33)***
Dependent population	−0.11 (−4.1)***	−0.13 (−4.5)***	−0.13 (−4.3)***	−0.11 (−4.1)***	0.01 (1.32)***	0.01 (1.47)
Constant	5.8 (11.2) ***	6.2 (11.9) ***	6.1 (10.4) ***	5.8 (11.2)***	4.13 (63.3)***	3.92 (32.8)***

Note: ***, **, * indicates significance at 5, 10 % and 1 %, respectively.

The Hausman specification test is performed, and the results show *Chi*-square values of 92.887, 153.075, and 158.0 for total, female and male, respectively, with corresponding *p*-values of 0.000, 0.000 and 0.001 for health outcomes specific to NCDs mortality regressions. This suggests that the null hypothesis is rejected, and thus, the FE model is the most efficient model for estimating the dynamics of different health expenditures and reductions in mortality from chronic conditions. In addition, the Hausman test shows Chi-square values of 326.00, 16.375, and 20.882 for total, female and male health outcomes specific

to life expectancy at birth, with statistically significant *p*-values of 0.001, 0.006, and 0.001, respectively. This indicates that the alternative hypothesis is accepted; thus, the FE regression model is chosen as the prepared model.

Table 4

Estimates of the seemingly unrelated regression model for public health expenditure and health outcomes

Country	NCDs mortality			Lyf. Exp. at birt		
	total	female	male	total	female	male
Denmark	26.7 (2.79)***	−16.1 (−1.48)	0.01 (1.81)	−2.00 (−1.20)	1.47 (2.17)***	−1.28 (−1.17)
Estonia	8.50 (2.08)***	4.62 (0.87)	0.01 (2.10)**	−1.45 (−3.20)***	−1.59 (−4.56)***	−0.03 (−0.07)
Finland	0.08 (0.03)	19.9 (4.85)***	0.02 (0.20)	0.95 (0.35)	−1.81 (−1.52)	−1.45 (−0.82)
Germany	67.4 (0.65)	−50.3 (−0.38)	0.03 (0.41)	−65.2 (−1.87)	23.5 (1.82)	36.4 (1.56)
Iceland	−2.18 (−0.58)	20.0 (4.66)***	0.03 (0.34)	−0.98 (−2.44)***	−2.73 (−2.55)	0.40 (1.98)
Latvia	17.0 (2.33) ***	−0.19 (−0.02)	0.02 (0.21)	−2.30 (−1.00)	−2.73 (−1.46)	2.48 (2.84)***
Lithuania	−25.9 (2.09)***	56.7 (3.26)***	0.04 (0.31)	−7.43 (−1.30)	−3.12 (−4.2)***	7.74 (1.43)
Norway	9.19 (2.76)***	9.14 (2.04)***	0.06 (0.40)	2.06 (0.66)	−2.64 (−1.27)	−0.93 (−0.77)
Poland	9.43 (0.08)	14.0 (2.29)***	0.01 (0.34)	−21.2 (3.28)***	4.02 (1.86)	12.8 (2.92)***
Russia	−53.3 (−4.61)***	88.4 (5.39)***	0.01 (0.13)	−28.4 (−3.57)***	−1.81 (−0.39)	30.9 (7.57)***
Sweden	35.9 (7.02)***	−18.2 (−2.80)***	0.02 (0.24)	3.09 (1.51)	−2.07 (−2.15)***	−2.87 (2.37)***

Note: ***, **, * indicates significance at 5, 10 % and 1 %, respectively.

Figures in parenthesis are z-values NCDs mort mean mortality rates from chronic diseases, and Lexp means life expectancy at birth.

Furthermore, a country-specific analysis of the impact of per capita public, private, and current health expenditures on health outcomes is performed using the analytical technique of multiple equation model popularly known as Seemingly Unrelated Regression (SUR). Applying SUR to this analysis will give a clearer understanding of the dynamics of each component of health expenditures on health outcomes specific to each country under investigation, which the aggregate analysis will not highlight. Therefore, using SUR would yield more efficient results and allow for comparison across the panel. Table 3 shows the country-specific estimates of the impact of per capita Pub. Hea. Exp. on health

outcomes, other explanatory variables of the model are held constant. The coefficient of the estimates differs between male and female and the total population specific to each of the health outcomes. For instance, the coefficient of Pub. Hea. Exp. rightly contributes to reductions in NCDs mortality (total) only in Lithuania and Russia. Though it is not significant, it contributes to mortality reductions in Iceland. However, in Denmark, Estonia, Latvia, and Norway, the estimates are significant but do not contribute to a lower mortality rate for the total population. Additionally, only in Sweden, Pub. Hea. Exp. significantly lower NCDs mortality (female), and it does the same in Estonia for NCDs mortality (male). Moreover, in Denmark, Pub. Hea. Exp. only improved Lyf. Exp. at birth (female), and it does the same in Latvia, Norway, and Russia for Lyf. Exp. at birth (male).

Table 5

Estimates of the seemingly unrelated regression model for private health expenditure and health outcomes

Country	NCDs mortality			Lyf. Exp. at birth		
	total	female	male	total	female	male
Denmark	45.4 (4.63)***	37.2 (−11.2)***	2.34 (0.23)	−1.62 (−0.70)	1.70 (1.82)	−1.91 (−1.25)
Estonia	6.13 (0.65)	10.7 (0.87)	1.23 (1.23)	−1.19 (−1.23)	−4.63 (−6.40)***	2.52 (3.22)***
Finland	117.4 (3.61)***	−125.9 (−3.06)***	2.01 (0.89)	−2.32 (−0.13)	2.57 (0.47)	−4.02 (−0.34)
Germany	53.6 (5.93)***	−43.9 (−3.81)***	0.06 (0.06)	−6.69 (−3.01)***	3.69 (4.56)***	0.70 (0.47)
Iceland	16.9 (2.44)***	7.06 (0.85)	0.12 (0.07)	2.23 (−3.89)***	0.07 (0.11)	−0.74 (−2.48)
Latvia	6.53 (1.16)	9.59 (1.270)	0.34 (1.01)	−0.10 (−0.08)	−2.90 (−2.80)	0.32 (0.66)
Lithuania	−15.4 (−1.23)	44.3 (2.57)***	0.21 (1.14)	27.8 (−1.30)	−1.24 (−2.66)***	−14.9 (0.94)
Norway	5.27 (1.22)	8.51 (1.48)	1.23 (0.56)	0.99 (0.35)	−1.86 (−0.98)	−0.20 (−0.18)
Poland	9.74 (2.06)**	13.4 (2.52)***	1.43 (1.03)	7.21 (1.08)	−5.55 (−2.48)***	−5.51 (−1.21)
Russia	−5.58 (−0.43)	22.6 (1.23)	2.45 (1.43)	−2.99 (−0.43)	−14.4 (−3.5)*	17.7 (4.91)*
Sweden	52.3 (6.64)***	−36.7 (−3.7)***	1.67 (1.32)	−3.64 (−1.29)	1.23 (0.93)	0.54 (0.32)

Note: ***, **, * indicates significance at 5, 10 % and 1 %, respectively.

Figures in parenthesis are z-values NCDs mort mean mortality rates from chronic diseases, and Lexp means life expectancy at birth.

Table 5 shows the dynamics of per capita Pvt. Hea. Exp. and health outcomes obtained using the country-specific regression. Though statistically significant, per capita Pvt. Hea. Exp. is not associated with NCDs mortality (total) reductions in Denmark, Finland, Germany, Poland, and Sweden. In contrast, per capita Pvt. Hea. Exp. is significantly associated with reductions in NCDs mortality (female) in Finland, Germany, and Sweden. However, for NCDs mortality (male), no significant impact is observed in any country of the panel. In the same way, in Iceland Pvt. Hea. Exp. contributes significantly to higher Lyf. Exp. at birth (total), in Germany, Lyf. Exp. at birth (female), and in Estonia Lyf. Exp. at birth (male). However, in Lithuania, Norway, and Poland, Pvt. Hea. Exp. is associated with an increase in Lyf. Exp. at birth (total) but not significant. The same is the case in Denmark, Finland, Iceland, and Sweden for Lyf. Exp. at birth (female). Further, it was the same case with Germany, Latvia, and Sweden for Lyf. Exp. at birth (male).

Table 6

Estimates of the seemingly unrelated regression model for current health expenditure and health outcomes

Country	NCDs mortality			Lyf. Exp. at birth		
	total	female	male	total	female	male
Denmark	34.9 (4.78)***	−25.1 (−3.04)***	0.65 (1.04)	−1.54 (−0.93)	1.14 (1.71)***	−1.39 (−1.27)
Estonia	10.3 (2.99)***	2.54 (0.57)	1.23 (1.10)	−1.32 (−3.04)***	−1.81 (−5.51)***	−0.09 (0.26)
Finland	6.21 (1.78)	12.0 (2.72)**	1.03 (1.31)	4.87 (2.50)***	−3.16 (−3.61)***	−4.05 (−3.16)
Germany	63.8 (5.37)***	−55.7 (−3.66)***	0.76 (0.98)	−13.8 (−4.85)***	8.91 (8.58)***	3.51 (1.81)
Iceland	2.07 (0.66)	17.5 (4.65)***	1.04 (1.03)	−1.21 (−3.74)***	−0.91 (−2.59)***	0.05 (0.27)
Latvia	10.2 (2.16)***	6.72 (1.07)	1.07 (1.01)	0.05 (0.03)	−3.79 (−2.59)***	1.05 (1.51)
Lithuania	−9.06 (−1.13)	36.0 (3.24)**	0.45 (0.87)	44.0 (2.16)**	−1.42 (3.23)***	−28.9 (−1.93)
Norway	−19.8 (−1.40)	48.0 (2.54)**	1.22 (0.90)	11.1 (1.61)	−10.3 (−2.26)**	−1.15 (−0.43)
Poland	10.4 (1.84)	13.2 (2.09)***	1.34 (0.67)	−13.5 (−2.84)***	0.61 (0.37)	8.59 (2.63)**
Russia	−31.1 (−2.63)***	58.1 (3.48)***	2.10 (1.56)	−18.5 (−2.52)***	−5.64 (1.32)	24.4 (6.57)***
Sweden	63.0 (8.83)***	−44.7 (−4.99)***	1.76 (0.56)	−5.59 (−2.28)***	1.24 (1.09)	−1.98 (1.36)**

Note: ***, **, * indicates significance at 5, 10 % and 1 %, respectively.

Figures in parenthesis are z-values NCDs mort mean mortality rates from chronic diseases, and Lexp means life expectancy at birth.

The estimates of the country-specific regression for the Crn. Hea. Exp. and health outcomes are depicted in Table 6. Evidence shows that only in Russia, Crn. Hea. Exp. is significantly associated with lower NCDs mortality (total). Moreover, in Denmark, Germany, and Sweden, it exerts a significant impact on lower NCDs mortality (female). However, it has no significant impact on lower levels of NCDs mortality (male) across the countries under investigation. Similarly, only in Finland and Lithuania, Crn. Hea. Exp. contributes significantly to higher Lyf. Exp. at birth (total). In Denmark and Germany, it exerts a greater influence on raising Lyf. Exp. at birth (female). In Poland and Russia, it significantly induces higher Lyf. Exp. at birth (male).

Discussion

This study presents interesting findings on the dynamics of the exponential growth in the three components of health expenditures and health outcomes for the countries of Central Europe and the Baltic region. Initially, the paper compares the trends in the growth rate of three components of health expenditures — Crn. Hea. Exp., Pub. Hea. Exp., and Pvt. Hea. Exp. and observed that the trend in growth for Pub. Hea. Exp. and Pvt. Hea. Exp. is comparatively quite low in Central Europe and the Baltic region. However, the trend shows a similar growth pattern for the Euro Area and the OECD countries for the three components of expenditures. The same trend analysis is performed for the variables employed as health outcomes — NCDs mortality (total), NCDs mortality (female), NCDs mortality (male), life expectancy at birth (total), life expectancy at birth (female), and life expectancy at birth (male). It is observed that there is comparatively lower mortality for NCDs in the Euro Area and the OECD countries relative to Central Europe and the Baltic region. Similarly, life expectancy at birth expanded significantly higher in the OECD countries compared to the Euro Area and the Central Europe / Baltic Countries. In addition, the parametric technique of FE and RE models are applied in estimating the model; thus, estimates of the FE model are more efficient.

The panel result highlights that Pvt. Hea. Exp. and Crn. Hea. Exp. are significantly associated with mortality reductions for chronic NCDs and higher life spans for the entire population and for males and females, respectively. Noteworthy, an increase in Pvt. Hea. Exp. by a particular unit is significantly associated with a reduction in NCDs mortality by 5 % for the overall population and for both males and females, respectively. An increase in Crn. Hea. Exp. by one unit is associated with significant reductions in NCDs mortality by 29 % for the total population, 22 % for females, and 36 % for males, respectively. Specific to

Pvt. Hea. Exp., these results are not similar to the results of prior studies conducted by S. Singh et al. [7], M. M. Rahman et al. [15], and J. Novignon et al. [14]. In contrast, Pub. Hea. Exp. is neither associated with a significant reduction in NCDs mortality nor with greater longevity for the entire population and both males and females. These results differ from the results of some previous studies by S. Singh et al. [7], B. Hlafa et al. [12], J. C. Anyanwu et al. [11], and J. Novignon et al. [14]. It is also found that NCDs mortality significantly reduces labour productivity by 42 %, much better than the extent to which labour productivity contributes to raising life expectancy by 6 % in the population. In addition, 48 % of the population is significantly dying from chronic NCDs conditions, and only 3 % of the elderly population is accounted to a higher life span of the population.

Furthermore, estimates of the country-specific regression show that Pub. Hea. Exp. respond to lower NCDs mortality (total) only in Lithuania and Russia. Pub. Hea. Exp. responds to lower NCDs mortality (female) in Sweden and Estonia for lower NCDs mortality (male). In addition, Pub. Hea. Exp. improved life expectancy at birth for (females) in Denmark, Latvia, Norway, and Russia, and it improved life expectancy only for (males). Moreover, across these countries, Pvt. Hea. Exp. is not associated with significant reductions in NCDs mortality (total). However, in Finland and Germany, Pvt. Hea. Exp. responds to lower NCDs mortality (female). This result is consistent with the findings of S. Singh et al. [7] and J. Novignon et al. [14] in their country-level analysis with respect to mortality reductions. In Iceland, it is significantly better for Lyf. Exp. at birth (total), in Germany for Lyf. Exp. at birth (female), and in Estonia for Lyf. Exp. at birth (male). Finally, the estimates of the country-specific regression for the Crn. Hea. Exp. reveals that it significantly responds to lower NCDs mortality (total) only in Russia. The same is true for Denmark, Germany, and Sweden, for lower NCDs mortality (female). In Finland and Lithuania, Crn. Hea. Exp. significantly improve Lyf. Exp. at birth (total), and in Denmark and Germany, it increases Lyf. Exp. at birth (female). In Poland and Russia, it significantly induces higher Lyf. Exp. at birth (male).

Therefore, these results could inform policy decisions in these countries. If health outcomes are to be improved in Central Europe and the Baltic region, priority should be given to private health financing relative to other forms of financing in the health system. However, this alone will not improve outcomes specific to chronic conditions unless lifestyle and dietary levels are altered. If this

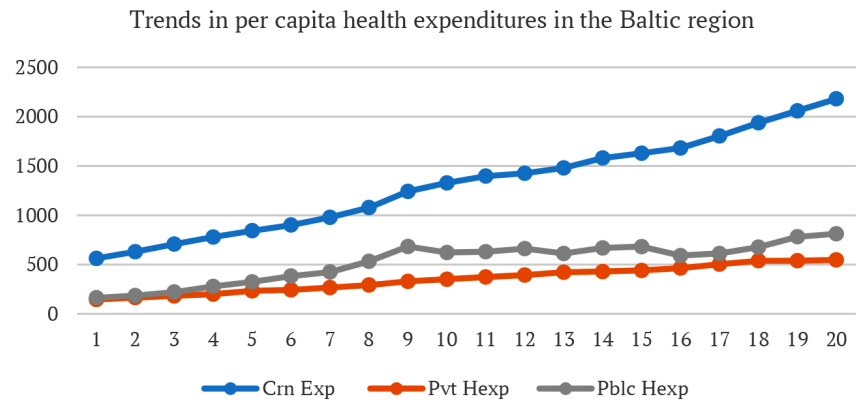
is the case, a combined approach channelled through private sector dominance is highly needed to achieve improvement in health outcomes that correspond with increased health expenditures.

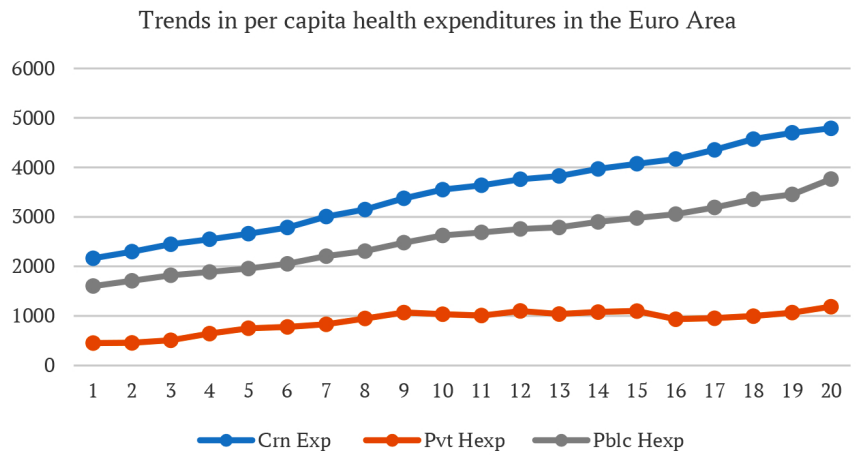
Potential limitations of this study may include an over-reliance on available panel data regarding the factors affecting health outcomes. Additionally, lifestyle and dietary patterns significantly influence health outcomes, but panel data on these variables is not freely accessible to the authors. The methodology generally assumes that an increase in health expenditure will lead to improved health outcomes. However, if health expenditures are not efficiently utilised, or if there are inequities in the utilisation of healthcare resources, an increase in health expenditure may not yield the anticipated benefits for the population.

Conclusion

This study investigates the dynamics of three components of health expenditures on health outcomes in Central Europe and the Baltic region for the 2000 to 2019 period. The technique of panel data regression and seemingly unrelated regression is applied to the data for the panel and the country-specific analysis. It is found that Pvt. Hea. Exp. and Crn. Hea. Exp. are associated with better health outcomes. Therefore, an increase in private health expenditure by a particular unit is significantly associated with a reduction in NCDs mortality by 5 % for the overall population and for both males and females. To policymakers in these countries, private health spending could be a potent way to lower the burden of NCDs mortality. An increase in current health expenditure by one unit is associated with significant reductions in NCDs mortality by 29 % for the total population, 22 % for females, and 36 % for males. Thus, current health expenditure could be more effective in reducing the burden of NCDs in the studied countries. In addition, Pub. Hea. Exp. is neither associated with a significant reduction in NCDs mortality nor a higher longevity across the panel. However, at a country-level analysis, it is found that Pub. Hea. Exp. responds to reduced NCDs mortality (total) in Russia and Sweden for females. Similarly, Pvt. Hea. Exp. reduces NCDs mortality (female) only in Finland, Germany, and Sweden. In Russia, Crn. Hea. Exp. is associated with lower NCDs mortality (total). Overall, Pvt. Hea. Exp. and Crn. Hea. Exp. are significantly associated with better health outcomes within and across countries. However, a significant difference is observed between the total population, males and females. What may have been responsible for a lower level of health expenditures' elasticity for males relative to females may warrant a future investigation.

Appendix





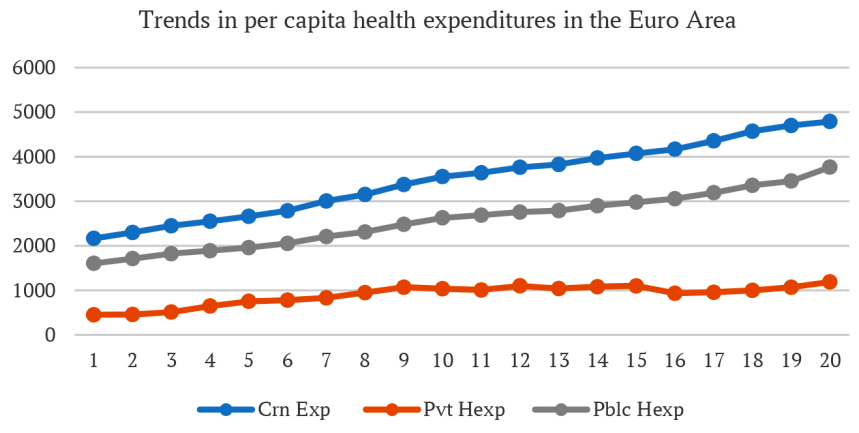
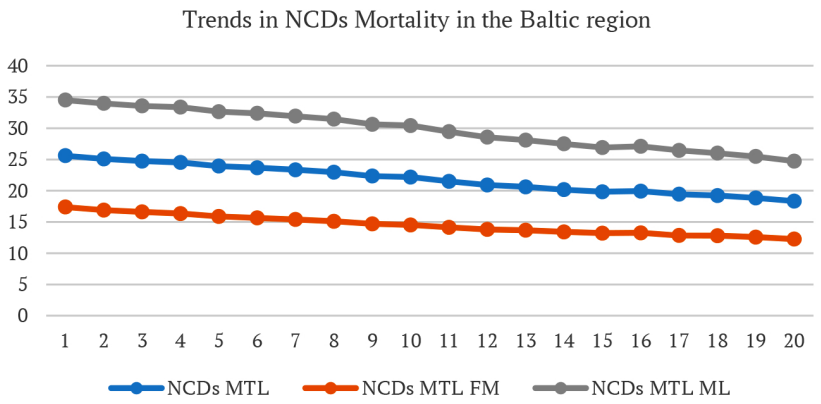
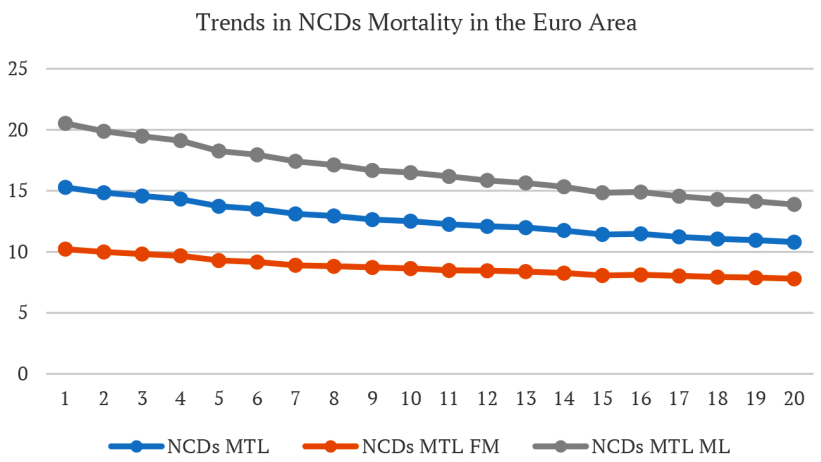


Fig. 1. Trends in per capita health expenditures in the selected region of the world





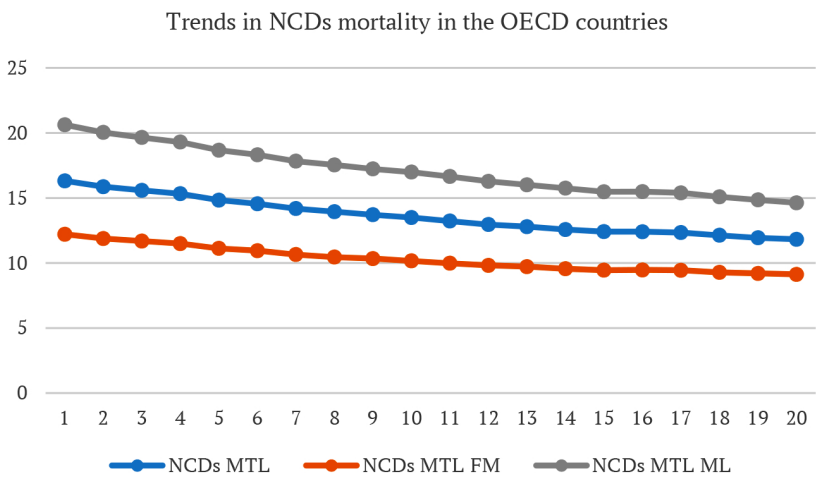


Fig. 2. Trends in NCDs mortality in the selected region of the World

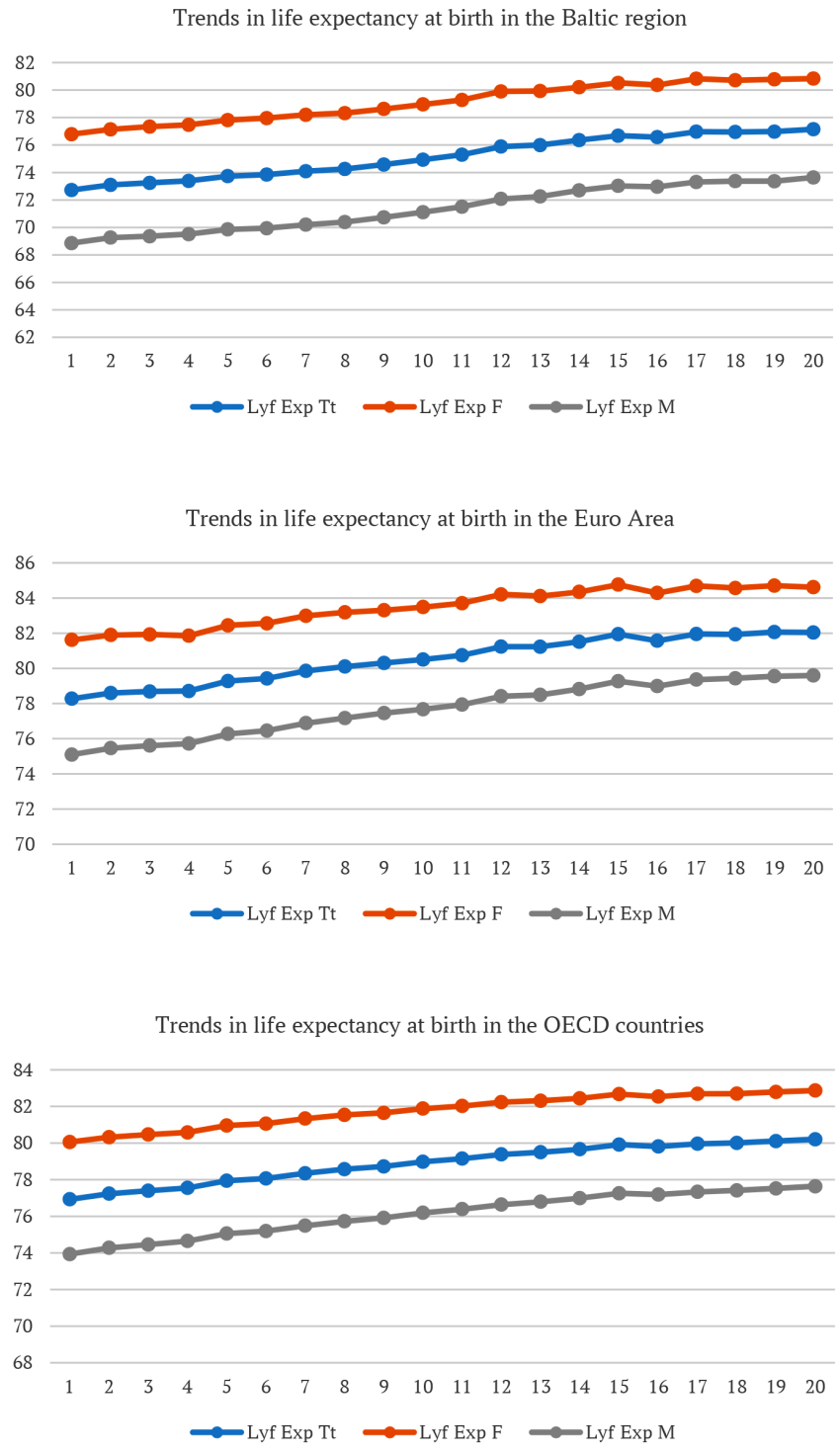


Fig. 3. Trends in life expectancy at birth in the selected region of the World

Link to Dataset: https://data.mendeley.com/preview/mn8hmfg5pm

References

1. Leu, R. E. 1986, The Public-Private Mix and International Health Care Costs, in: Cuyler, A. J., Jönsson, B. (eds.), *Public and Private Health Services,* Basil Blackwell, p. 41—63.

2. Hitiris, T., Posnett, J. 1992, The determinants and effects of health expenditure in developed countries, *Journal of Health Economics*, vol. 11, № 2, p. 173—181, https://doi.org/10.1016/0167-6296(92)90033-w

3. Nixon, J., Ulmann, P. 2006, The relationship between health care expenditure and health outcomes: evidence and caveats for a causal link, *European Journal of Health Economics*, vol. 7, № 1, p. 7—18, https://doi.org/10.1007/s10198-005-0336-8

4. Crémieux, P., Ouellette, P., Pilon, C. 1999, Health care spending as determinants of health outcomes, *Health Economics,* vol. 8, № 7, p. 627—639, https://doi.org/10.1002/(SICI)1099-1050(199911)8:7<627::AID-HEC474>3.0.CO;2-8

5. Ullah, I., Ullah, A., Ali, S. et al. 2021, Public health expenditures and health outcomes in Pakistan: evidence from quantile autoregressive distributed lag model, *Risk Management and Healthcare Policy*, vol. 14, p. 3893—3909, https://doi.org/10.2147/RMHP.S316844

6. Oladosu, O., Chanimbe, T., Anaduaka, U. S. 2022, Effect of public health expenditure on health outcomes in Nigeria and Ghana, *Health Policy OPEN*, vol. 3, 100072, https://doi.org/10.1016/j.hpopen.2022.100072

7. Singh, S., Bala, M. M., Kumar, N. 2022, The dynamics of public and private health expenditure on health outcome in Southeast Asia, *Health and Social Care in the Community*, vol. 30, № 5, p. e2549—e2558, https://doi.org/10.1111/hsc.13698

8. Ivankova, V., Gavurova, B., Khouri, S. 2022, Understanding the relationships between health spending, treatable mortality and economic productivity in OECD countries, *Frontiers in Public Health*, vol. 10, p. 1036058, https://doi.org/10.3389/fpubh.2022.1036058

9. Arthur, E., Oaikhenan, H. E. 2017, The effects of health expenditure on health outcomes in Sub-Saharan Africa (SSA), *African Development Review*, vol. 29, № 3, p. 524— 536, https://doi.org/10.1111/1467-8268.12287

10. Akinkugbe, O., Mohanoe, M. 2009, Public health expenditure as a determinant of health status in Lesotho, *Social Work in Public Health*, vol. 24, № 1-2, p. 131—147, https://doi.org/10.1080/19371910802569716

11. Anyanwu, J. C., Erhijakpor, A. E. 2009, Health expenditures and health outcomes in Africa, *African Development Review*, vol. 21, № 2, p. 400—433, https://doi.org/10.1111/j.1467-8268.2009.00215.x

12. Hlafa, B., Sibanda, K., Hompashe, D. M. 2019, The impact of public health expenditure on health outcomes in South Africa, *International Journal of Environmental Research and Public Health,* vol. 16, № 16, p. 2993, https://doi.org/10.3390/ijerph16162993

13. Kumar, K., Ram, F., Singh, A. 2013, Public health spending on infant and child mortality in India during the years 1980—2006, *The Lancet*, vol. 381, p. S76, https://doi.org/10.1016/S0140-6736(13)61330-6

14. Novignon, S., Olakojo, A., Nonvignon, J. 2012, The effects of public and private health care expenditure on health status in sub-Saharan Africa: new evidence from panel data analysis, *Health Economics Review,* vol. 2, № 1, https://doi.org/10.1186/2191-1991-2-22

15. Rahman, M. M., Khanam, R., Rahman, M. 2018, Health care expenditure and health outcome nexus: new evidence from the SAARC-ASEAN region, *Globalization and health*, vol. 14, № 1, https://doi.org/10.1186/s12992-018-0430-1

16. Cheng, Y., Li, S. 2006, Income inequality and efficiency: A decomposition approach and applications to China, *Economics Letters*, vol. 91, №1, p. 8—14, https://doi.org/10.1016/j.econlet.2005.09.011

17. van den Heuvel, Wim, J. A., Olaroiu, M. 2017, How important are healthcare expenditures for life expectancy? A comparative, European Analysis, *Journal of the American Medical Directors,* vol. 18, №3, p. 276.e9—276.e12, https://doi.org/10.1016/j.jamda.2016.11.027

18. Anwar, A., Hyder, S., Mohamed Nor, N., Younis, M. 2023, Government health expenditures and health outcome nexus: A study on OECD countries, *Frontiers in Public Health*, vol. 11, 1123759, https://doi.org/10.3389/fpubh.2023.1123759

19. Roffia, P., Bucciol, A., Hashlamoun, S. 2023 Determinants of life expecatncy at birth: A longitudinal study on OECD countries, *International Journal of Health Economics and Management,* vol. 23, p. 189—212, https://doi.org/10.1007/s10754-022-09338-5

20. Linden, M., Ray, D. 2017, Life expecatncy effects of public and private health expenditures in OECD countries 1970-2012: A panel time series approach, I*nternational Economic Analysis and Policy*, vol. 56, p. 101—113, https://doi.org/10.1016/j.eap.2017.06.005

The authors

Shailender Singh, Head Research and Associate Professor, Symbiosis International Deemed University, India.

E-mail: reshu111us@yahoo.com

https://orcid.org/0000-0002-1710-7504

Amar Singh, Assistant Professor, Graphic Era Hill University, India.

E-mail: connectamar@gmail.com

https://orcid.org/0000-0003-4798-3617

Arvind Mohan, Professor, Graphic Era Deemed to be University, India.

E-mail: arvindmohan.mba@geu.ac.in

https://orcid.org/0009-0002-3809-5423

Megha Batola, Assistant Professor, Graphic Era Hill University, India.

E-mail: batolamegha85@gmail.com

https://orcid.org/0000-0001-5557-2012

Nishant Kumar, Associate Professor, Christ University, India.

E-mail: nishantkumar00@gmail.com

https://orcid.org/0000-0003-0124-9337