

Measuring and Assessing the Wealth Influence on the Efficiency of the Health System through the Private Sector

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The aim of the paper is to provide an analysis of the dynamics of the public and private health sectors in Romania. Using descriptive statistics, it first investigates whether the public health sector follows the reformation trends suggested by official strategies and reports, and to what extent the private health sector is a viable alternative to the public one, by analysing the demand for private inpatient services. We look into the reduction in the occupancy degree in public hospitals as a means to increase the efficiency of public health expenditures, which represents one way to reform the public health sector. We also find that the increase in the occupancy degree in private hospitals is negatively correlated with the quality of services provided by public hospitals, but positively correlated with population wealth. Increase in the occupancy degree in private hospitals is an indicator of poor quality of services in public hospitals. It can also be explained by increasing expectations and requirements of beneficiaries as a reflection of increase in wealth and of their will to preserve their health capital. Using regression models, the paper then proposes the Wealth-Health Index, a composite indicator to explore the connection between wealth and health and the dynamics of the private health sector. Investment in physical infrastructure and the size of medical staff in the private sector is positively correlated with wealth increase.

Keywords: *Health Economics; Health Capital; Wealth; Public Health Sector; Private Health Sector.*

Introduction

The paper explores the dynamics of the Romanian health systems and the way demand for health services is accommodated by the public and private health sectors. The aim of the paper is to analyse how the efficiency of the health system is improved as a result of specific public policies and private initiative, and to investigate the correlation between increased wealth and higher occupancy in the private health sector. To this purpose, we investigate whether the public health sector follows the reformation trends suggested by official strategies and reports in Romania, on the one hand, and to what extent the private health sector is a viable alternative to the public one, by analysing the demand for private inpatient services, on the other hand.

The research methodology involves both qualitative and quantitative analysis. The qualitative approach is based on the descriptive analysis comparing the public and private health sectors in terms of physical and human capacities and occupancy. The quantitative approach investigates the correlation between wealth and occupancy in the private health sector using regression models. We provide evidence concerning the impact of wealth over the dynamics of private hospitals. The impact of wealth implies, among others, that if the income of individuals is higher, so is the spending for private health service. In addition, the poor quality of public health services may be an explanation for increasing demand for private health services. Efforts to

improve the efficiency of public health expenditures unveil the currently poor quality of public health services. Given that efficient spending means not only complying with budget constraints, but also providing qualitative public health services, one can argue that cost-effectiveness policy measures are a symptom of low quality services in the health public sector.

The paper is original in that previous studies conducted on the Romanian health system only deal with a descriptive analysis of public policies, whereas the present study focuses on the interplay between the public and private health sectors. We extend the mainstream approach, which associates low efficiency in the public health sector with insufficient financial resources allocated through public budgets. Thus, we highlight the quality of public health services as an indicator of efficiency. We argue that the reduction in the occupancy degree in public hospitals explains the need to increase the efficiency of public health expenditures, and it represents one way to reform the public health sector. At the same time, it may be an indicator of poor quality services in the public health sector. Considering the private health sector as an alternative to the public health sector, the increasing demand for private health services can be cumulatively explained by the poor quality of public health services and by the increased levels of wealth. In other words, evidence shows that both poor quality of public health services and increased wealth lead to shifting demand for health services from the public sector to the private one, despite effort to render the public health sector more

efficient. We investigate how investment in physical infrastructure and the size of medical staff in the private health sector are correlated with wealth increase. We additionally investigate how the increase in the occupancy degree in private hospitals, which is a proxy for demand for private health services, is correlated with the quality of services provided by public hospitals and with population wealth.

Literature Review

The extant literature in the field of health economics shows that health is both human capital and input to produce other forms of human capital. The impact of health care on the individual's capabilities and skills had already been a concern of economic research before Arrow (1963), who studied the industry of medical services. The human capital theory was starting to assert a new approach in economics, and health, along with education, was among the determinants of increase in personal incomes. According to Schultz (1961), health services and their impact on life expectancy are among the factors influencing both the quantity and the quality of human resources. Becker (1993, 2007) considers that investment in health is as important as investment in education, and is emphatic about the complementarity between health, on one hand, and education and the other components of human capital, on the other hand (Kunstova & Potancok, 2013; Dover *et al.*, 2019).

Physiological and cognitive development begins at birth – therefore, health status is important from early childhood. Investment in human capital should start from very early ages, as the formation of human capital is influenced by the health system (Arthur, 2019; Bleakley, 2010).

One of the most practical contributions in laying the foundations of the health capital concept belongs to Grossman (1972). The author argues that each individual possesses a certain stock of health, which depreciates with age and requires investment to be preserved, similarly to investment in physical capital¹. Wealthier people tend to invest more in their own health (Babiarz *et al.*, 2013; Michaud & Soest, 2008; Habibov *et al.*, 2019; Yilmazer & Scharff, 2014). The correlation between wealth and health is explained by the fact that healthier people positively affect the level of income and high levels of income positively affect the level of health (Bleakley, 2010), therefore a two-way determination is suggested. Knowles & Owen (1995) prove that there is a stronger relationship between income per capita and health capital than between income per capita and educational human capital. Hartwig (2010) argues that there might be a positive correlation between human capital accumulation in the form of health on economic growth, but that empirical evidence is mixed. On the contrary, other studies argue that

health is rather determined by institutional changes (political and economic) than by wealth increase (Acemoglu & Robinson, 2012; Acemoglu *et al.*, 2014; Antonio *et al.*, 2019).

The literature in the field has mainly investigated the existing correlations between health and labour market indicators such as: the impact of welfare schemes and of private insurance on incentives to work (Moffit & Wolfe, 1992; Moffit & Wolfe, 1993), the influence of different measures of health on labour supply, particularly on the decision to retire (Bound, 1991), the consequences of self-employment on health (Rietveld *et al.*, 2015; Yoon & Bernell, 2013). Also, the literature shows evidence for the positive correlation of health with life expectancy and economic growth² (Bloom & Canning, 2000; Bloom & Canning, 2010; Bloom *et al.*, 2004).

During the last two decades, investment in health capital has been analysed from the perspective of its macroeconomic implications, i.e. as a factor of development. Several studies have identified health as a determinant of increase in the quantity and quality of human capital, therefore as a source of development (Bleakley, 2010; Lee *et al.*, 2007; Bloom *et al.*, 2004). The increase in wealth and the development of the health system will ultimately generate better economic performances. Research and development will also increase concomitantly with labour productivity, the retirement age, investment in human capital and savings, as outcomes of longer life expectancy and longer working life (Cylus *et al.*, 2018). Hence, both theoretical and empirical research is making progress in demonstrating that health generates economic prosperity (Barro, 1996). This understanding has influenced health policies, especially in the European Union. Thus, health financing goes beyond the mere purpose of enhancing accessibility through public health services, and becomes source of economic growth (Bloom *et al.*, 2004, Savedoff *et al.*, 2012, Ginevicius *et al.*, 2018). Although it is assumed that there is a direct relationship between public health expenditures and the positive effects associated to such expenditures, the existing studies indicate that this relationship is not linear (OECD 2010; Joumard *et al.*, 2010). Under these conditions, the analysis of the efficiency of the public health sector recommends its reformation in order to avoid unnecessary or exaggerated expenditures (European Commission, 2013; OECD, 2018; OECD, 2019).

The efficiency of the health system in general, and of hospitals in particular, can be assessed, among others, in terms of cost-effectiveness (Siverskog & Henriksson, 2019; Longo *et al.*, 2019). Cost-effectiveness measures involve reducing hospital unit costs, with reducing the

¹ Unlike the previous approaches of the health capital concept, the Grossman model highlights the distinctiveness of health capital in that its dimension affects the period of time during which the individual can become productive, while the stock of knowledge (i.e. the other components of human capital) only influences the individual's capacity to be productive. One of the predictions of Grossman's model is that there is a positive correlation between wage rates and consumer's demand for health and medical care.

² We have been witnesses to improvements in life expectancy and the quality of life, according to the 2030 Agenda for Sustainable Development. Goal 3 on the Agenda for Sustainable Development established by the United Nations Development Programme refers to good health and well-being. From this perspective, health is both outcome and indicator of sustainable development. Despite the progress made to promote health and prosperity, there still remains a 31-year discrepancy between the countries with the shortest and longest life expectancies. In addition, every two seconds someone aged 30 to 70 years dies prematurely from non-communicable diseases: cardiovascular disease, chronic respiratory disease, diabetes or cancer (UNDP).

number of beds being a specific measure (Jacobs & Dawson, 2003). Variables used as efficiency criteria within the present study, such as length of stay and bed occupancy and costs have been previously analysed by Gaynor & Town (2011), Longo *et al.* (2019), Tsitsakis *et al.* (2017), Kounetas & Papatheanassopoulos (2013), Kuntz *et al.* (2007). In the public health sector, these indicators, along with the number of beds and size of medical staff are determined by government decision, in line with current strategies. The decrease in the length of stay has been found to be a good measure to improve hospital total factor productivity (Karman & Roesel, 2017). In private hospitals, reduced length of stay and higher occupancy are indicators of higher profitability (Villa & Kane, 2013). Quality of health services is expressed using mortality, emergency readmissions, patient reported outcome, and patient satisfaction (Longo *et al.*, 2017).

Similar studies to the present one, comparing public and private hospitals, were performed for Greece and China. Findings show that private hospitals in Greece are smaller, have lower patient occupancy and lower staffing rates in terms of nursing activity. However, the study solely focused on cost-efficiency, and the results indicate better cost-efficiency in the public sector (Konidilis *et al.*, 2011). The Chinese study reveals that average length of stay is negatively associated with technical efficiency, whereas bed occupancy rate and annual visits per doctor are positively associated with technical efficiency (Jing *et al.*, 2020). In order to improve the efficiency of public hospitals, the following are recommended: focusing on improving the management standards, determining a rational personnel structure and reduction of hospitalisation expenses, and the suggestions for private hospitals are: expanding their scale through restructuring, mergers, acquisitions, shortening average length of stay and increasing bed occupancy.

Designing composite indicators including wealth and health has been a current concern both for research and public policy purposes, starting with the Human Development Index, with income per capita and life expectancy components. Other health indices with wealth components or, conversely, wealth indices with health components, have been designed and discussed by Meijer *et al.* (2011), Hohmann & Garenne (2010), Delhey & Steckermeier (2016) and Fielding & Torres (2009).

Institutional Context

The Romanian health system is a social health insurance system that follows the revised modified Bismarck model, with influences from both the Semashko and Beveridge models (Barliba & Sinitchi 2018). Although steps have been made towards its decentralisation, it remains a highly centralised system, which is mainly a result of its socialist experience. The Ministry of Health and District Public Health Authorities are the authorities at the level of central and local administration, respectively. The National Health Insurance House manages the social health insurance system. A National Authority for Quality Management in Health Care was established in the process of health system decentralisation. The current organization has been in place since 1999 (Vladescu *et al.*, 2016).

According to health insurance regulations, the entire active population has to contribute to the health insurance fund. In fact, on average about 86 % of the population pays the social health insurance contributions, and is, therefore, covered. While the insured benefit from a comprehensive benefits package, those not paying social health insurance contributions only benefit from a minimum package of services. Such benefits cover communicable diseases, care during pregnancy and life-threatening emergencies (Vladescu *et al.*, 2016).

The Romanian health system is characterized by urban-rural inequities in terms of access to health services (European Commission, 2017), which was addressed in the Health Strategy (Ministry of Health, 2016). This weakness reveals the need to reconsider workforce and access to medicines (European Commission, 2017). Since 2012, the report on the Euro Health Consumer Index has shown that the reformation of the Romanian health system cannot evolve unless the wages of medical staff reach a decent level. Currently, the private sector generates additional benefits for the medical staff, but such benefits are not enough for the public health sector to function properly (Stanciu, 2013). Recent systematic increases in the wages of the medical staff have dealt with this issue. Better access to health services leads to higher costs, therefore multiple attempts have been made to reform the system using efficiency criteria and cost-saving measures (claw-back mechanisms for drug manufacturers and the introduction of co-payment for the population). Despite increasing life expectancy and declining mortality rates, Romania still ranks one of the last places in the European Union in such matters. For instance, life expectancy in Romania is 75.6 years, while the European Union average is 80.9 years (Vladescu *et al.*, 2016). Nevertheless, the global perception of the Romanian population reveals good levels of their health status (European Commission, 2017). The most alarming trends pertain to increasing numbers of HIV/AIDS diagnoses and falling immunization rates. Moreover, Romania has the lowest health expenditure as a share of gross domestic product (GDP), revolving around 5% (Vladescu *et al.*, 2016). This is in spite of the big efforts to increase budget spending on health in the last decades. However, spending per capita remains insufficient for providing good health services and public resources are inefficiently used (European Commission, 2017).

Data on the Romanian health system is fragmented and duplicated. However, the existing data indicate that the total health expenditure is mainly financed by the National Health Insurance Fund (67 %), out-of-pocket payments (19 %), state and local budget (9 % and 3 %, respectively), voluntary health insurance 0.1 % and other sources (parallel health systems, external sources of funds, national insurance fund for work accidents and occupational diseases, and voluntary and charitable financing). Informal payments are a component of out-of-pocket payments, but accurate data have not been reported (Abrokwah *et al.*, 2019; Nosratnejad *et al.*, 2016; Vladescu *et al.*, 2016).

The health reform includes measures to strengthen primary and community care, and to concomitantly reduce expenses with specialised and inpatient care. The need for increasing effectiveness in the health care system comes from a reduced productivity and increased costs (Lashgari

et al., 2013). Decreasing orientation towards inpatient care has been a public health concern in other countries as well (Elek *et al.*, 2019). To achieve this goal, hospital services are reimbursed within a certain determined limit of beds. Acute beds fell by more than psychiatric beds; by contrast, nursing and elderly homes underwent a positive trend. Therefore, the public sector has experienced a decrease in the number of hospitals and beds. As for the average length of hospitalisation, it dropped from 11.4 days in 1990 to 6.3 days in 2013 (which is also the European Union average), while the bed occupancy rose from 68 % in 1990 to 73 % in 2013. This improvement in hospital indicators was accompanied by an increase in the share of day cases. The opposite trend took place in the private sector – the number of private hospitals and beds rose. Due to this opposite trend, the total number of hospitals increased on the whole.

Despite all these measures, primary care is underused, while hospital services are overused. To sum up, the basis of care should be represented by community and primary care. These two should be the gatekeepers of outpatient and inpatient care, which should be rationalized (Vladescu *et al.*, 2016).

In Romania, the number of doctors and nurses is lower than in other European Union countries. The deficit has been generated by emigration (especially after the accession to the European Union) and by the relatively low wages received by medical staff. A particular deficit is noticed in primary care, where only a quarter of the total number of doctors are specialised in family medicine, as compared to the European Union average of roughly one third. Among the measures taken to halt the migration of medical staff, the following are worth being mentioned: benefits for doctors working in rural areas and several wage increases (Vladescu *et al.*, 2016).

Methods

The approach is twofold: the first part is a descriptive analysis that compares the public and the private health sector in terms of physical and human capacities and occupancy, while the second part is meant to investigate the correlation between wealth and occupancy in the private health sector.

The following two hypotheses are formulated: Hypothesis 1 – The reduction in the occupancy degree in public hospitals explains the need to increase the efficiency of public health expenditures and represents one way to reform the public health sector; Hypothesis 2 – The increase in the occupancy degree in private hospitals is negatively correlated with the quality of services provided by public hospitals, but positively correlated with population wealth.

For the first part of the analysis several indicators were designed in order to create an image of the private health sector: hospital beds, patients, medical staff and length of hospitalisation in both the public and private sector.

The image of the trend was obtained by creating time series for private hospital beds (PHB) (as a ratio between the number of beds in private hospitals and the total number of beds), private medical staff (PMS) (as a ratio between the medical staff in private hospitals and the total medical staff), patients in private hospitals as a share of total patients in hospitals (PP), length of hospitalisation in public hospitals

(LHPb) (as a ratio between the total number of hospitalisation days and the number of patients in public hospitals), length of hospitalisation in private hospitals (LHPv) (as a ratio between the total number of hospitalisation days and the number of patients in private hospitals), occupancy of public beds (OPbB) (as a ratio between the total number of hospitalisation days and the number of beds in public hospitals), occupancy of private beds (OPvB) (as a ratio between the total number of hospitalisation days and the number of beds in private hospitals), number of patients per doctor in public hospitals (PPbD) (as a ratio between the total number of patients and the number of doctors in public hospitals) and number of patients per doctor in private hospitals (PPvD) (as a ratio between the total number of patients and the number of doctors in private hospitals). These data were collected from the data base of National Institute of Statistics (National Institute of Statistics 2005–2018). PMS and PHB are mathematically defined in a similar manner, but they are essentially different, mainly because a doctor can work both in the public and the private sector, so double counting may have occurred in PMS, whereas beds in hospitals are counted once. In order to compare the means for PHB and PP, as well as for OpbB and OpvB, Student test was used.

For the second part of the analysis, a number of four independent variables were selected in order to describe wealth. Two other dependent variables were used to reflect the private health sector performance in Romania, during the 2004–2017 period, as proxies for the impact of wealth on the development of the private health sector.

The four independent variables are described below:

- Mean years of schooling (MYS), defined as the average number of years of education received by people ages 25 and older, converted from education attainment levels using official durations of each level (UNDP, 2018a).
- Life expectancy index (LEI), defined as the life expectancy at birth expressed as an index using a minimum value of 20 years and a maximum value of 85 years (UNDP, 2018b).
- Income Index (II), defined as GNI per capita (2011 PPP International \$, using natural logarithm) expressed as an index using a minimum value of \$100 and a maximum value \$75,000 (UNDP, 2018c).

• Domestic private health expenditures (DPHE), which was calculated as follows:

$$DPHE = \text{GDP in billion EUR} \times \% \text{ Current Health expenditure as percentage of GDP} \times \% DPHE \quad (1)$$

(%DPHE is calculated as the difference between Domestic health expenditure as percentage of current health expenditure and Domestic general government health expenditure as percentage of current health expenditure). Briefly, the indicator DPHE estimates the amount in billion EUR paid by the private sector for medical services (National Institute of Statistics, 2019; National Bank of Romania, 2018; World Health Organisation, 2018).

The two dependent variables are specified below:

- Private Hospital Beds in total % (PHB), defined as a ratio between the number of beds in private hospitals and the total number of beds in all hospitals in Romania for every year between 2004 and 2017 (National Institute of Statistics, 2005–2018).

- Private Medical Staff in total% (PMS), defined as a ratio between the total number of doctors in the private hospitals and the total number of doctors in all hospitals in Romania for every year between 2004 and 2017 (National Institute of Statistics, 2005–2018).

The difficulty related to the data collection phase was the inexistence of a value for DPHE for the year 2017. The only data source available discloses values until 2016. Considering the fact that data were available for all the other variables for the year 2017, and given that DPHE is a strong

explanatory factor for the development of the private health sector, its value for the year 2017 was estimated. More precisely, the mean of %DPHE is 21.42 % of Domestic health expenditure, which was calculated over the 14 years. Using the value of the GDP for year 2017, i.e. 187.5 billion, and the Current health expenditure 5.1 % of GDP, we obtained the value for DPHE for 2017 to be 2.0482 billion EUR.

The data for the 6 variables is presented in Table 1.

Table 1

Values for PMS, PHB, MYS, LEI, II and DPHE between 2004 and 2017

Year	PMS in total %	PHB in total %	MYS	LEI	II	DPHE billion EUR
2004	10.77	0.38	9.9	0.79	0.74	0.84
2005	10.66	0.45	10.1	0.80	0.74	0.85
2006	11.67	0.57	10.3	0.80	0.76	1.00
2007	13.40	0.69	10.5	0.81	0.77	1.13
2008	15.05	0.81	10.6	0.82	0.78	1.32
2009	16.91	0.99	10.6	0.82	0.78	1.34
2010	21.12	2.09	10.7	0.83	0.77	1.43
2011	21.64	2.76	10.8	0.83	0.78	1.53
2012	23.70	3.22	10.9	0.84	0.78	1.45
2013	25.93	3.88	10.9	0.84	0.78	1.56
2014	25.98	4.38	10.9	0.84	0.79	1.59
2015	37.66	5.04	10.9	0.85	0.80	1.73
2016	37.73	5.27	11	0.85	0.80	1.85
2017	37.20	6.41	11	0.85	0.81	2.04

The first step was to build a regression model between the four independent variables, on one hand, and each of the dependent variables (2 regression models). However, the multicollinearity effect occurred.

Subsequently, simple linear regression models were generated between each of the four independent variables and the two dependent variables. More exactly, eight resulting regression models were generated between PHB and PMS, respectively, as endogenous variables, and each of the following exogenous variables: MYS, LEI, II and DPHE, following the equation below:

$$Y = \alpha_0 + \alpha_1 X_i + \varepsilon_i \tag{2}$$

Eventually, the influence of the four independent variables was cumulated into a newly-designed composite indicator – Wealth-Health Index (WHI), and the dependent variables used were PHB and PMS. This indicator was built in order to picture the combined impact of the four wealth-health indicators, which were assigned equal shares within the model. The resulting indicator is described below:

$$WHI = \frac{1}{4} \sum_{k=0}^4 x_k, \tag{3}$$

where x_k is each of the four independent variables MYS, II, LEI, DPHE.

The linear regression model between the PHB and WHI is described by the equation:

$$PHB = \alpha_0 + \alpha_1 WHI_i + \varepsilon_i \tag{4}$$

The regression linear model between the PMS and WHI is described by the equation:

$$PMS = \alpha_0 + \alpha_1 WHI_i + \varepsilon_i \tag{5}$$

The data analysis and the descriptive statistics for the variables concerning the private health sector were made using Microsoft Excel and SPSS. The SPSS software was used in order to enlarge the sample by bootstrapping. Since only 14 values are available for each variable, between 100 and 1000 samples were made for each regression model tested. Both linear and logarithmic regression models were tested in the course of the analysis. In addition, the correlations between MYS, LEI, II and DPHE were checked using Pearson.

Results

A qualitative analysis of the public and private health sector in Romania

During the period 2004–2017, the Romanian private health sector experienced significant changes. This is revealed by the evolution of both PHB and PMS. Such changes reflect a transition from a highly centralised public health sector towards a mixed system accommodating a strong growth of the private health sector. The two indicators were selected as critical elements for the operation of the health system. The evolution of PHB and PMS is pictured in Figure 1.

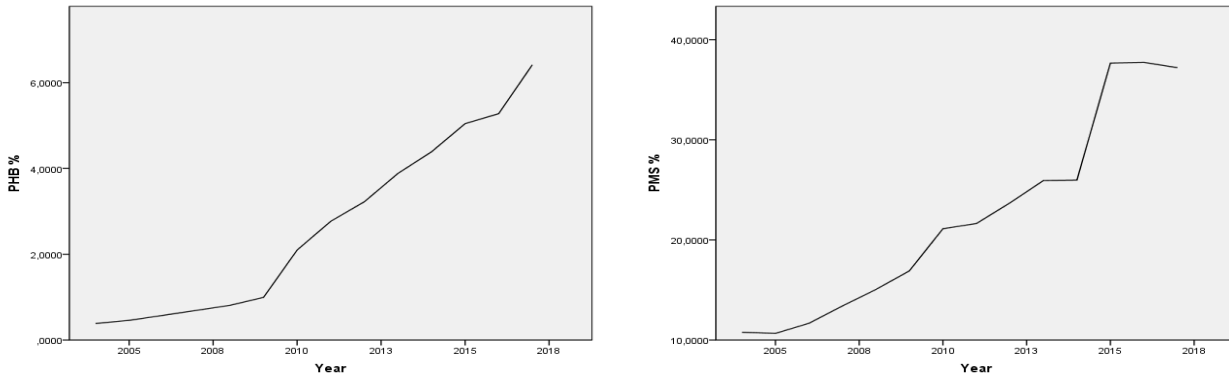


Figure 1. The Evolution of PHB and PMS during 2004–2017

During the investigated time span, both PHB and PMS followed an ascending trend over the entire period. PHB increased 16.6 times (from 0.38 % in 2004 to 6.41 % in 2017), while PMS increased only 3.45 times (from 10.77 % in 2004 to 37.2 in 2017). Such a difference may be explained by the fact that doctors are hired under part-time contracts or under fee-per-service collaboration contracts, while the same doctors work in the public sector, as well. In absolute terms, the total medical staff rose by 21 % (i.e. an increase from 48150 doctors in 2004 to 58583 doctors in 2017). We may conclude that PMS increased only 3.45 times for the above mentioned reason.

The response of the physical infrastructure (i.e. beds) in the private sector is still weak in terms of weight as compared to the evolution of the medical staff. Even if the PHB grew exponentially, it still represents barely 6 % of the total beds in hospitals, while the PMS is almost 40 % of medical employees. Another empirically-explained argument is that PHB rose from less than 1000 beds in 2004 to almost 10000 beds in 2017. Meanwhile, the public hospital beds fluctuated, following a decreasing trend during the same period (the number of beds in 2004 was 140406, it reached a minimum of 124667 in 2011, and it then grew at 131337 in 2017). This evolution confirms the development of private hospitals and may explain the need for reforming public hospitals.

Another critical part of the analysis is to test whether there is a strong correlation between PHB and PP, as can be seen in Figure 2. The data analysis reveals that both variables had an exponential increase. However, there is a large gap between the evolutions of the two variables. This large gap has two explanations: first, the reduction in the total number of beds, explained mainly by the reduction in the number of public beds; and second, the increase in the number of patients in private hospitals.

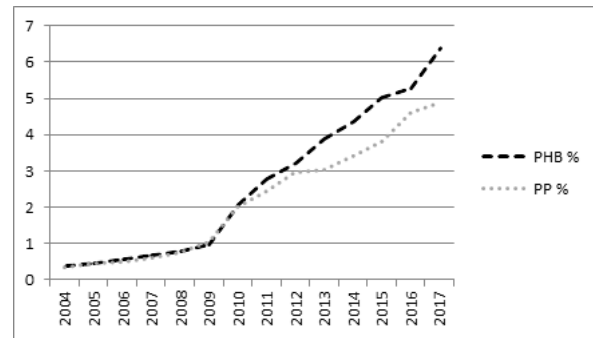


Figure 2. The Evolution of PHB and PP during 2004–2017

Using Student test (Table 2), it was found that PHB is significantly higher than PP, with a probability higher than 99 %. Equally noteworthy is the correlation coefficient of 99.2 %.

Table 2

t-Test: Paired Two Sample for Means: PHB-PP

	PHB	PP
Mean	2.64	2.19
Variance	4.32	2.58
Observations	14	14
Pearson Correlation	0.99	
Hypothesized Mean Difference	0	
df	13	
t Stat	3.18	
P(T<=t) one-tail	0.00	
t Critical one-tail	1.77	

Another descriptive component of the research is the comparative analysis of the evolution of the length of hospitalisation in public (LHPb) and private hospitals (LHPv), respectively (Figure 3). We found that the length of hospitalisation in the public sector decreased, while the length of hospitalisation in the private sector increased. The two variables converge towards a common value, which is close to the European Union average (6.3 days). These findings reveal a better management in both public

and private hospitals, albeit for different reasons. Public hospitals try to meet the requirements set out in strategies, i.e. decreasing LHPb as a cost-saving measure, due to budget constraints. The length of stay in the private sector has increased as the demand for private health services increases, on one hand, and for entrepreneurial reasons, on the other hand.

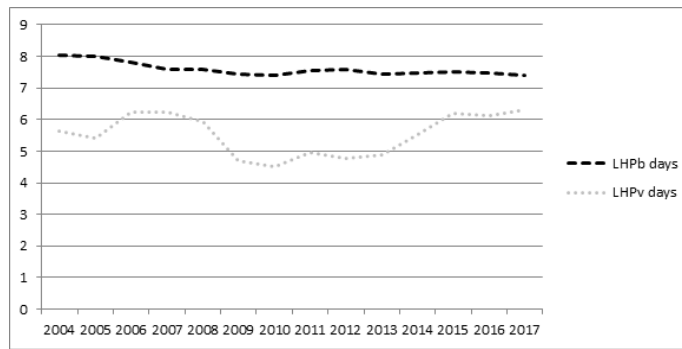


Figure 3. The Evolution of LHPb and LHPv During 2004–2017

In order to measure cost effectiveness and the extent of reform in the public health sector, we used bed occupancy. During the period 2004–2017, OPbB dropped, as required by the National Health Strategy (Ministry of Health, 2016).

More precisely, strategy recommends for medical services to be rather placed in primary and community care, rather than in outpatient and inpatient units.

Table 3

The evolution OPbB and OPvB during 2004–2017

Year	OPbB	OPvB	Year	OPbB	OPvB
2004	303.74	187.34	2011	274.20	157.21
2005	301.01	203.83	2012	264.77	151.80
2006	290.69	197.41	2013	259.50	131.10
2007	290.11	211.07	2014	248.21	141.02
2008	297.76	217.58	2015	244.54	149.26
2009	289.06	190.65	2016	238.62	170.04
2010	289.04	168.07	2017	224.08	142.53

As can be seen in Table 3, bed occupancy in private hospitals (OPvB) is much lower than bed occupancy in public hospitals (OPbB). The values of OPbB constantly decreased despite the fact that the number of public beds decreased. Actually, during the investigated period, OPbB decreased by 25 % (from 303 days in 2004 to 224 days in 2017), while the public beds decreased by 10 % (from 140406 beds in 2004 to 131337 beds in 2017) and the number of patients also decreased by 25 % (from 5299573 in 2004 to 3975498 in 2017). This evolution may be the expression of the reforming process through which public

hospitals are going through, being determined by the need to increase the efficiency of public health expenditure, but also, partially, by patients’ choice of private hospitals. This last remark is confirmed by the evolution of both PHB and PP, as shown above. OPvB largely fluctuated, mainly due to the exponential growth of the number of private hospital beds. Comparing OPbB and OPvB, one can notice the overoccupancy in public hospitals. Using Student test, a large difference between OPbB and OPvB was identified, i.e. 100 days per bed, as can be seen in Table 4.

Table 4

t-Test: Paired Two Sample for Means: OPbB-OPvB

	OPbB	OPvB
Mean	272.52	172.78
Variance	670.14	807.83
Observations	14	14
Pearson Correlation	0.78	
Df	13	
t Stat	20.61	
P(T<=t) one-tail	1.3E-11	
t Critical one-tail	1.77	

The quality of medical services can be investigated using the number of hospitalised patients per doctor. The number of hospitalised patients per doctor is much higher in the public sector (PPbD) than in the private one (PPvD). The comparative analysis reveals that the number of patients in the private sector follows an ascending trend, while the one in the public sector follows a descending trend. The latter could, again, be explained, by the efforts made to render the medical activity efficient. The need to diminish the workload per doctor is also explained by the fact that, after a certain threshold, an overloaded doctor is less likely to provide quality services. To conclude, the data show that there is a 10-time difference between the

two sectors: doctors in the public sector are ten times more loaded with patients than in the private sector. Unlike the comparison of length of hospitalisation, where a certain convergence was noticed, there is a huge gap in terms of overloaded medical staff between the public and the private sector. This gap can be a source of explanation for the differences in quality of services in the two sectors. The evolutions are presented in Table 5 and Figure 4. To sum up, the need for reforming the public health sector is reflected by the improvements already made in the period 2004–2017. However, there is still room for improvement, and this opportunity is grabbed by the private health sector.

The Evolution of PPbD and PPvD During 2004–2017

Year	PPbD	PPvD	Year	PPbD	PPvD
2004	123.36	3.47	2011	110.15	9.913
2005	125.53	4.85	2012	106.76	10.44
2006	125.67	4.66	2013	109.31	9.71
2007	124.09	4.96	2014	102.34	10.28
2008	124.90	5.36	2015	116.64	7.60
2009	126.50	6.51	2016	111.91	8.95
2010	121.61	9.25	2017	108.06	9.31

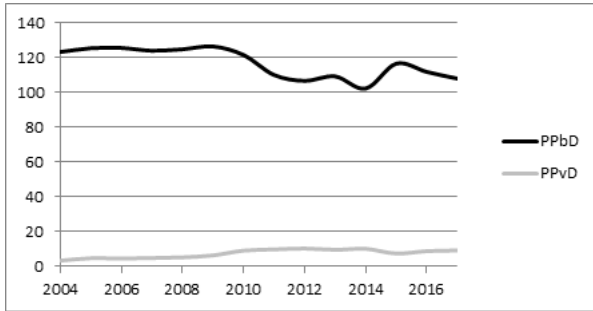


Figure 4. The Evolution of PPbD and PPvD During 2004–2017

The Wealth-Health Index and the Private Health Sector: a Quantitative Analysis

Using the following four variables – MYS, LEI, II and DPHE for Romania, we built a composite index showing the level of wealth and health – WHI. Due to the strong correlations found between the above-mentioned four independent variables when they are simultaneously introduced in a regression model, the effect of multicollinearity appears even for log models. In this case, the estimation of the parameters becomes even contrary to expectations, although the models are valid and the parameters are significant for high probabilities, as can be seen in Table 6. Thus, the regression model with the four independent variables and the two dependent variables is rejected.

Table 6

Correlations: MYS, LEI, II, DPHE Billion EUR

		MYS	LEI	II	DPHE billion EUR
MYS	Pearson Correlation	1	.96**	.93**	.93**
	Sig. (2-tailed)		.00	.00	.00
	N	14	14	14	14
LEI	Pearson Correlation	.96**	1	.93**	.96**
	Sig. (2-tailed)	.000		.00	.00
	N	14	14	14	14
II	Pearson Correlation	.93**	.93**	1	.97**
	Sig. (2-tailed)	.000	.00		.00
	N	14	14	14	14
DPHE billion EUR	Pearson Correlation	.93**	.96**	.97**	1
	Sig. (2-tailed)	.00	.00	.00	
	N	14	14	14	14

** . Correlation is significant at the 0.01 level (2-tailed).

The linear regression models between PHB and PMS, respectively, and all four independent variables MYS, LEI, II and DPHE explains the variation of PHB in a proportion of 96.8 % and the variation of PMS in a proportion of 95.3 %.

$$PHB = \alpha_0 + \alpha_1 MYS_i + \alpha_2 LEI_i + \alpha_3 II_i + \alpha_4 DPHE_i + \epsilon_i \quad (6)$$

$$PMS = \alpha_0 + \alpha_1 MYS_i + \alpha_2 LEI_i + \alpha_3 II_i + \alpha_4 DPHE_i + \epsilon_i \quad (7)$$

However, considering the multicollinearity shown by rapidly dropping eigenvalues and exponentially growing Condition Index, we considered adequate to build simple linear regression models to determine the influence of each of the four variables on the two analysed dependent ones. Besides, it is not within the scope of this research to estimate the future evolution of the indicators depicting the private sector, but only to demonstrate the intensity and the direction of the correlations. Such prediction is a research concern that will be dealt with in a future endeavour.

We build eight simple linear regression models between PHB and PMS, respectively, as endogenous variables, and each of the following variables: MYS, LEI, II and DPHE, as described by equation (2), where α_0 is negative and α_i is positive. The four variables explain the variation of PHB and PMS in a range starting from 84 % up to 93 %.

In order to picture the combined impact of the four wealth-health indicators, we propose a new composite indicator reflecting the wealth-health status, WHI:

$$WHI = \frac{1}{4} \sum_{k=0}^4 x_k, \quad (8)$$

where x_k is each of the four independent variables MYS, II, LEI, DPHE.

The four variables were assigned equal shares within the model. In our opinion, a hierarchy of the four variables cannot be made, all of them being equally important within the model. The values of the WHI are shown in Table 7.

Table 7

The Evolution of WHI During 2004–2017

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
WHI	3.07	3.13	3.22	3.31	3.38	3.39	3.43	3.49	3.50	3.52	3.54	3.57	3.63	3.68

Table 8

Essential Diagnostic Statistics for the Built Models

Model	Adj R sq	F	Prob F	DW stat	HAC/BPG	Prob. F (BPG)
PMS-II	0.76	44.01	2.41E-05	0.90	0.13	0.72
PMS - LEI	0.87	89.14	6.64E-07	0.85	5.39	0.03
PMS - MYS	0.68	29.55	0.000151	0.56	0.44	0.51
PMS - DPHE	0.87	91.54	5.76E-07	1.08	0.53	0.47
PMS - WHI	0.81	56.56	7.03E-06	0.77	0.04	0.84
PHB - II	0.73	36.90	5.55E-05	0.46	0.00	0.93
PHB - LEI	0.88	100.85	3.42E-07	0.40	0.07	0.79
PHB - MYS	0.68	28.97	0.000164	0.33	0.03	0.86
PHB - DPHE	0.86	81.48	1.07E-06	0.43	0.78	0.39
PHB - WHI	0.80	53.90	8.95E-06	0.34	1.15	0.30

The linear regression model between the PHB and WHI is described below:

$$PHB = -32.56 + 10.3WHI \tag{9}$$

The variation of the PHB is explained by this model in a proportion higher than 80%. The model is valid with almost 100% probability, the coefficients are significant from a statistical point of view, and by applying the linear regression model hypotheses it was found out that they are validated.

The estimation for α_1 using bootstrapping is 10.3, which means that an increase in WHI by 1 unit will result in a 10 % growth of PHB.

The regression linear model between the PMS and WHI is described below:

$$PMS = -146.02 + 49.19WHI \tag{10}$$

The variation of the PMS is also explained by this model in a proportion higher than 80 %. The model is valid with almost 100 % probability, the coefficients are significant from a statistical point of view, and by applying the linear regression model hypotheses it was found out that they are validated.

The estimation for α_1 using bootstrapping is 49.19, which means that an increase in WHI by 1 unit will result in a 49.19 % growth of PMS.

The huge difference between the coefficients of these two regression models is coming mainly from the fact that the doctors in private sector are not full-time employees.

A synthesis of the essential diagnostic statistics for the built models is presented in Table 8.

We tested the hypotheses of the ten simple linear regression models, and we notice:

1. Error homoscedasticity – applying the Breusch-Pagan-Godfrey test, the null hypothesis is checked, the error variance is constant. This hypothesis is accepted for all the ten models.

2. Error normality – applying the Jarque-Bera test, we can assert that errors are normally distributed, which is true for all the ten models. However, there are limitations regarding the testing of this hypothesis especially due to the reduced sample size.

3. Error autocorrelation – applying the Breusch-Godfrey Serial Correlation LM Test, we accept the null hypothesis according to which errors are not autocorrelated. Although this hypothesis is checked for all the ten models, there is a clear distinction between PHB and PMS models: all PMS models do not have autocorrelated errors starting with the 1st lag. The only exception is the PMS model as a function of MYS, where the null hypothesis is checked starting with the 2nd lag. On the other hand, for the PHB models this hypothesis is checked starting with the 4th lag. Exceptions are the PHB models as functions of LEI and DPHE, respectively, where the hypothesis is checked starting with the 3rd lag, and with the 5th lag, respectively.

Discussion

Based on the research results, each of the two hypotheses is validated as shown below.

The length of hospitalisation constantly increased in private hospitals, while it decreased in public hospitals. The two evolutions converge towards the same value, between 6 and 7 days. Such trend reflects the steps made towards a more efficient public health sector. Although the occupancy of public beds constantly decreased, there is still an average gap of 100 days per bed between the public sector and the private one. It results there is overoccupancy of beds in the public health sector. Overoccupancy is not explained by the higher length of hospitalisation per patient, but rather by the much larger number of patients in public hospitals. Gains in efficiency of the public health sector are additionally explained by the diminishing of both the length of hospitalisation per patient and the occupancy degree per bed. However, the number of patients per doctor is difficult to be compared across the two sectors, because in 2017, the gap between the two sectors is almost 12 times higher in the public health sector. The existing data show that the public health sector experienced an increase in efficiency as the number of patients per doctor constantly decreased. Meanwhile, the same variable increased in the private health sector.

The occupancy degree in private hospitals is highlighted by the following two variables over time: the share of private hospital beds in total hospital beds and the

share of private medical staff in total medical staff. Both variables increased during the period 2004–2017. The share of private hospital beds in total hospital beds increased roughly 17 times. The share of private medical staff in total medical staff rose almost 4 times. At the same time, private hospital beds represent less than 7 % out of the total number of beds, although in 2017, the number of private hospitals in Romania almost equalised the number of public hospitals (National Institute of Statistics, 2005–2018). It results that private hospitals are endowed with a comparatively smaller number of bed than the public ones. At the same time, the share of private medical staff in the total medical staff represents 40 %. Based on the data, we argue that this percentage is highly overestimated, because it only reflects an absolute value (number of doctors), but not full-time work contracts. More precisely, some of the doctors working in the private health sector are employed under part-time contracts or under fee-per-service collaboration contracts. Furthermore, despite the massive immigration of medical staff from Romania, the added reported numbers of medical staff from both sectors would show a strong increase (National Institute of Statistics, 2005–2018). In other words, certain doctors are double counted in the two sectors. Occupancy in the private health sector is also described by the increasing number of patients per doctor by almost 3 times during the analysed period (National Institute of Statistics, 2005–2018). The share of private hospital beds in total hospital beds and the share of private patients in total patients increased exponentially, but there is a large gap between them. The gap can be explained by the reduction in the total number of beds, explained mainly by the reduction in the number of public beds and by the increase in the number of patients in private hospitals. The length of hospitalisation in the private health sector increased year by year, reaching almost its value in the public health sector.

The quality of medical services in the public health sector is inferior to the one in the private medical sector, despite the recent efficiency improvements and cost effectiveness measures. Based on the existing data, it can be noticed that the occupancy degree of beds in public hospitals is, on average, 100 days higher than in private hospitals. Also, the number of patients per doctor in the public health sector is almost 12 times higher than in the private one. Based on the correlations discussed above, we defined a new indicator. The WHI, comprising the four independent variables, is positively and highly correlated with the share of private hospital beds in the total number of beds and with the share of private medical staff in total

medical staff. The values of WHI for Romania indicate that, the size of the private health sector grew concomitantly with the increase of wealth and health levels between 2004 and 2017. There has been a shift of health care services consumption predominantly provided by the public sector to the private sector. The lower quality of health services in the public health sector along with increased wealth has generated this shift. Although other composite indicators involving health and wealth have been previously designed, data limitations for Romania make them impossible to be used for the purposes of this research. Our findings are in line with those of the research carried out in Greece and China (Konidilis *et al.*, 2011; Jing *et al.*, 2020).

Conclusions

The Romanian health system has recently undergone major changes. Currently, the private health sector is a complement to the public health sector, but also a competitor. In terms of quality, the private health sector is more attractive for patients and brings incentives for the reformation process of the public one.

The paper contributes to the gap of knowledge with a specific study on the Romanian health system using the newly-designed indicator, WHI. We demonstrate the impact of the current status of wealth and health in Romania onto the development of the private health sector. According to our analysis, an increase in WHI by 1 unit will result in a 49.19 % growth of PMS. Wealth generates higher investment in the health system, which will lead to an increase in the future health of the population, and subsequently, in wealth, due to the double determination between wealth and health (Bleakley, 2010).

The main research limitation refers to the inexistence of data for DPHE in the year 2017, reason for which its value was estimated. Another limitation is that data for the health sector go back only 14 years and that values are reported on an annual basis. Such fact led to the use of bootstrapping.

The present research can be extended in the direction of estimating the future evolution of the investigated indicators, including the WHI for the private health sector in Romania. The WHI can also be calculated for other European Union countries to identify its correlation with the development of the private health sector and to draw valuable conclusions regarding different health policies across countries.

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