

EFFICIENCY OF POLISH HOSPITALS IN YEARS 2012-2021

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Purpose: This paper aims to explore the factors influencing the profitability of hospital operations in Poland. By dividing hospitals into homogeneous groups based on various criteria, it seeks to understand the dynamics and determinants of hospital efficiency in the context of changing healthcare policies and market conditions.

Methodology: The research adopts an exploratory data analysis approach, examining profitability across different hospital types and ownership models. It utilizes statistical methods to analyze changes over time, with a particular focus on profitability indicators such as Return on Sales (ROS). The study spans the period from 2012 to 2021, covering significant healthcare policy shifts and the COVID-19 pandemic's impact.

Findings: The study reveals that profitability is influenced by several key factors: legislative changes in NFZ financing system, hospital size, type of ownership, urban versus rural location, and regional healthcare policies. It uncovers that urban and rural hospitals' profitability did not significantly differ in each studied year, especially in the last two. The legal form of hospital operation (corporate or SPZOZ) does not conclusively affect operational efficiency. The study confirms that certain factors like size and ownership type influence hospital profitability.

Research limitations: Study suggests that other factors unique to each hospital, such as department structure and management quality also influence hospital profitability. The research opens pathways for further investigation into these factors, although data limitations present challenges.

Practical implications: The findings have implications for healthcare policymakers and hospital administrators, emphasizing the need for adaptable management strategies in response to changing funding models and market conditions. They also highlight the importance of considering local factors in policy formulation.

Social implications: The research underscores the importance of efficient hospital management in ensuring quality healthcare delivery, particularly in times of crisis like the COVID-19 pandemic. It also sheds light on the broader impact of healthcare policies on societal health outcomes.

Originality: This paper contributes to the existing body of knowledge by providing a comprehensive analysis of Polish hospitals' efficiency in a changing legislative and economic environment. It offers valuable insights for healthcare professionals, policymakers, and researchers, emphasizing the multifaceted nature of hospital efficiency.

Keywords: economic efficiency, profitability, hospital, health economics, NFZ (National Health Fund).

Category of the paper: Research paper.

1. Introduction

The Polish healthcare system, akin to many others globally, aims to provide citizens with access to healthcare when needed. Fundamentally reliant on public financing, it ensures healthcare access for employed citizens contributing mandatory health insurance premiums. The National Health Fund (NFZ) administers funds from mandatory health insurance, reimbursing medical entities based on medical procedure pricing or lump-sum payments. A portion of healthcare funding stems from private insurance and ad hoc private payments. The scope of healthcare services encompasses outpatient care, hospitalization, medications, diagnostic tests, surgical procedures, and other simpler procedures. Healthcare is delivered through both public and private medical facilities. Poland has numerous public hospitals, medical clinics, and private entities. A significant portion of the NFZ budget is allocated to NFZ-authorized hospitals under contracts for medical services.

The Polish healthcare system faces challenges such as medical staff shortages, the need for medical infrastructure modernization, and long waiting lists for certain services. Challenges also include accessibility, especially in rural areas. A fundamental issue is the low profitability of hospitals, the main pillar of the healthcare system, leading to their poor financial health and, often, escalating debt (Bem et al., 2014). These problems have been persistent for years. A major challenge in healthcare financing is the availability of medical staff (doctors, nurses, and certain other medical professionals), leading to pressure on their wages amidst a general lack of funds. According to the Supreme Audit Office (NIK, 2015), sixteen out of twenty-two audited hospitals (73%), despite incurring losses, allocated staff salaries beyond their financial means. Hospitals' financial outcomes generally did not motivate management towards employment optimization.

High mandatory debts of Polish hospitals have led to systemic solutions, like the so-called Plan B for Polish hospitals, involving their debt relief and commercialization. Implemented from 1999-2005, this hospital reform program aimed at restructuring public hospitals by converting them into commercial law companies. Its objective was to improve hospital management, increase operational efficiency, and reduce the debt in the hospital sector in Poland. Plan B was part of a broader healthcare reform in Poland following the political transformation.

Despite debt relief and the commercialization of some hospitals in Poland, years after Plan B's implementation and significant NFZ budget increases, many hospitals still face financial difficulties and low or negative efficiency. The NFZ budget rose from PLN 37.1 billion in 2006 to PLN 62.6 billion in 2012 and PLN 135.6 billion in 2021. Adjusted for inflation, the 2021 NFZ budget was realistically 158% higher than in 2006 and 82% higher than in 2012. Despite such increases, the financial situation of most Polish hospitals did not improve commensurately. Research indicates that hospital restructuring is not always effective.

Restructuring goals are more often achieved in service quality than in economic aspects, such as debt reduction (Wielicka-Gańczarczyk, 2020). It was not only the Polish pro-efficiency reform of the health care system that was not fully successful. Attempt to reform the Greek NHS in 2007 failed to produce lasting improvements in hospital operational efficiency, while in economic terms there was only weak evidence of success (Fragkiadakis et al., 2016).

Given that financial situation and indebtedness stem from hospital profitability, investigating this parameter in practice is natural. This article aims to examine the financial efficiency of hospitals in Poland and identify factors influencing its variation. It is certainly interesting to analyze the temporal trends in profitability, as well as the variation in operational efficiency in spatial and entity-specific terms. Particularly pertinent is whether there are differences in hospital efficiency across various voivodeships (Polish provinces are called voivodeships) and other differentiating factors affecting their performance. Thus, the study of operational efficiency was conducted in temporal, spatial dimensions, and across homogeneous hospital groups, using various factors to categorize hospitals.

Multiple factors influence hospital financial results. Many internal factors have a direct impact on the hospital's operational efficiency. Collaboration between the hospital and the physician affects costs, clinical quality, and integration, which in turn impact financial results (Burns and Muller, 2008). Disseminating quality and cost information to physicians using a specialized decision support system builds lasting relationships, while insuring financial stability (Kohli et al., 2001). Furthermore, the use of electronic medical records is associated with improved financial outcomes for hospitals, as it affects revenues and overall hospital efficiency (Collum et al., 2016). Clinical decision support systems that go beyond pure electronic medical records improve not only hospital efficiency but also staff productivity, accuracy, and quality of care (Lee, et al., 2023). The necessity of applying innovative digital strategies to develop smart network connections that improve economic and medical outcomes in hospitals is increasingly recognized (Kordel, 2022). A study conducted in public hospitals in the Kingdom of Saudi Arabia shows that ineffective hospital management, lack of strategic planning and goals, weak administrative leadership, and lack of monitoring hospital performance have a profound impact on hospital efficiency (Alatawi et al., 2022). Furthermore, hospital ownership significantly influences financial outcomes, as corroborated by various empirical literature findings (Shen et al., 2007). Research among community hospitals in Tennessee indicate that community hospitals within networks of hospitals are more efficient than non-network hospitals (Roh et al., 2013). Additionally, clinical quality and process linkage to patient satisfaction also affect a hospital's financial results (Marley et al., 2004; Pai et al., 2019; Garcia-Lacalle, Bachiller, 2011). Integrating hospital and physician financing is recognized as a means of improving clinical processes, care quality, and care outcomes, thereby influencing financial results (Upadhyay et al., 2021). Contracts with NHS for healthcare service provision were examined to determine their impact on the financial outcomes of profit-oriented private hospitals in Spain, with specific models estimated for hospital subgroups based on size

and specialization (Ruiz-Mallorquí et al., 2021). It was also found that hospital service quality is related to patient satisfaction and financial outcomes, highlighting the importance of quality in shaping financial results (Alexander et al., 2006; Lim et al., 2018; Wiśniewska et al., 2022). Research on hospital performance includes both cross-sectional studies in a population and sample of hospitals and focuses on detailed analyses of individual cases (Paździor, Maj, 2017; Orliński, Nistrata-Ortiz, 2016; Grespan Bonacim, Procopio de Araujo, 2011).

Significant financial differences remain depending on respective hospital characteristics. Those differences are influenced by location, size, teaching status, system affiliation, and critical access designation among others (Turner et al., 2015). An important aspect differentiating hospitals, explored in academic literature, is their location (Kaufman et al., 2016; Zhang et al., 2018). In Poland, studies have compared the financial outcomes of public hospitals by location, as well as ownership and size (Miszczyńska, Miszczyński, 2021). Based on an analysis of 257 hospitals in Poland and their financial outcomes, the authors report no differences in debt levels between large and medium-sized hospitals. However, medium-sized hospitals run by voivodeships are less indebted than medium-sized county hospitals. Conversely, among large hospitals, those run by voivodeships are more indebted than large county hospitals. Similar studies concern the efficiency of rural and urban hospitals. Siedlecki et al. (2016), based on a study of 201 hospitals (103 rural and 88 urban), indicate that Polish rural hospitals have better financial indicators, are less indebted, and less prone to insolvency than urban hospitals. These are somewhat unusual findings compared to results in other countries, especially in the USA, where rural hospitals typically have worse financial outcomes and lower financial liquidity than urban hospitals. In the USA, this is such a significant issue that over 100 rural hospitals were closed from 2010 to 2019 (O'Hanlon et al., 2019). The poorer financial situation of rural hospitals is attributed to factors including lower health insurance uptake among rural residents, medical staff shortages (Bernd et al., 2016), smaller hospital sizes, and a decline in admissions in these hospitals (Pai, Dissanayake, 2022). Methods to increase their efficiency, such as expanding insurance programs, are also analyzed (Lindrooth et al., 2018). However, in European hospitals, the situation is different. For instance, Garcia-Lacalle and Martin (2010) point out that in the hospitals they studied in Spain, rural and urban hospitals perform similarly in terms of efficiency, but rural hospitals significantly outperform urban ones in patient satisfaction. The impact of agglomeration economies on hospital financial outcomes was examined by Krzeczewski, suggesting significant differences in financial outcomes depending on hospital location (Krzeczewski et al., 2019). Additionally, a cross-sectional study among Polish healthcare providers compared the financial outcomes of public hospitals, emphasizing differences depending on the size of the cities where hospitals are located (Dubas-Jakóbczyk et al., 2020). Financial outcomes of hospitals in the German hospital sector were also analyzed, providing insight into the relationship between ownership and financial outcomes (Augarzky et al., 2009). Moreover, a financial analysis of ten national

university hospitals in Korea from 2008-2011 revealed negative trends in their financial condition and business outcomes (Lee, 2015).

In summary, the literature review indicates that many factors influence the financial outcomes of hospitals, including hospital-physician collaboration, ownership and size of the hospital, clinical and process quality, use of electronic medical records, service quality, hospital location, and integration of financial activities at the hospital-physician interface. These factors play a significant role in shaping the financial outcomes of hospitals, highlighting the complex interaction of various elements determining a hospital's financial results. This study focuses on available data, excluding medical data related to internal and organizational processes not available in financial databases. It hypothesizes that the level of operational efficiency varies over time, mainly due to changes in healthcare funding levels. It also hypothesizes that the efficiency level of hospitals in different voivodeships is similar due to a uniform medical procedure pricing system nationwide. In relation to other differentiating factors, the study examines hospital performance in relation to the legal form of the entity and the dominant owner, aiming to determine the impact of these factors on operational efficiency.

2. Data and methods

In the article, secondary data derived from financial statements were utilized. These data were acquired from the ORBIS database on October 5, 2022, originating from the database update of September 30, 2022. The gathered data pertain to 2,455 entities operating in Poland with the primary activity code according to NACE Rev. 2 being 8610, indicating hospital activities. However, this code is often applied incorrectly to entities providing medical services other than hospital activities, such as primary care units, outpatient clinics, health resorts, and entities specialized in certain procedures like dialysis, dentistry, or plastic surgery. This misclassification occurs in practice as entities self-declare their sector and industry affiliation without significant verification by registering institutions.

Entities not strictly defined as hospitals were excluded in several steps. Initially, 1133 entities lacking essential financial data for the study were removed, leaving 1322 entities. From the remainder, 89 entities with financial data ending before 2012 were excluded, leaving 1233 entities. Subsequently, entities with revenues from sales in the last year of operation below 2.5 million euros were removed, excluding 500 entities and leaving 733. It was assumed that the smallest hospital under study should have revenues exceeding 2.5 million euros, approximately 11.5 million PLN, based on practical observations of hospitals with the smallest contracts with NFZ in Poland. In the next step, entities with specific words and their inflected forms in their names, qualifying them for the study, were retained. These terms included: hospital, clinical, clinic, center, mother and child, group, medical, American heart, SPZOZ,

NZOZ, independent, public, facility, care, healthcare. This process excluded 103 entities, leaving 630 for further analysis. Excluded entities were manually reviewed based on their websites, and if they conducted typical hospital activities (general or specialized hospitals), they were re-included in the research set. In total, 33 entities were added back, resulting in a final count of 663 entities. This set was then subjected to further manual analysis, and 23 entities with non-hospital and homogeneous activities (e.g., health resorts, clinics, diagnostic laboratories, dialysis stations) were removed. Following these adjustments, data pertaining to 640 entities were retained. Further verification steps for data consistency revealed that one entity appeared twice in the database, identified by different "BVD id numbers" (ORBIS database's internal index). This situation concerned the University Center for Women's and Newborn's Health of the Medical University of Warsaw Sp. z o.o. Data from the two records for this entity were merged, resulting in a final database of 639 entities subject to study.

The article employed procedures for analyzing descriptive statistics of the examined indicators and data characterizing the studied entities. Positional measures and quartile analysis were used, and the significance of distribution differences and medians were examined using the Kruskal-Wallis test. For examining differences in median indicators across different years, the Mann-Whitney U test was utilized. Data processing and calculations were performed in R language (2023), using the tidyverse, ggplot2, readxl, janitor, and openxlsx packages.

The presented data selection and cleaning procedure indicates that the ORBIS database may contain certain inaccuracies or errors. This somewhat limits confidence in the obtained results. It was assumed that the impact of data errors on the outcomes is low, as they do not occur for the largest entities. This does not affect the overall picture of the situation obtained in the descriptive statistical analysis of individual data and indicators. Outlier information in the research set was not subjected to correction or exclusion procedures. However, due to distribution inconsistencies with the normal distribution, as examined by the Shapiro-Wilk test, the focus was on median and quartile analysis.

3. Financial Aspects of Hospital Efficiency

It should be noted that hospitals fulfill significant social functions as a primary component of the healthcare system. Their activity is not solely business-oriented but also carries high social significance. Therefore, in broadly examining their efficiency, it is necessary to consider not only financial but also economic, medical, health, and social outcomes. Such a multidimensional assessment of hospital efficiency goes beyond the scope of this article, which focuses exclusively on the financial measurement of hospital efficiency. However, the specificity of hospital operation and evaluation should be taken into account when interpreting financial indicators. In particular, profitability indicators based on net profit may

show lower levels, including negative ones over an extended period, especially when the owners are local governments or the State Treasury. This is an atypical situation for private businesses. Any losses reducing the net capital in companies running hospitals must be supplemented by public entities owning the hospital only to the level ensuring non-negative net capital. The second limitation in this case is the financial condition of the company running the hospital, i.e., according to bankruptcy law, it is necessary to ensure that the company is solvent. To prevent hospital insolvency, it is essential to ensure that the profitability calculated from EBITDA is positive, meaning that the hospital generates operational cash surpluses at a level sufficient to maintain financial liquidity. A negative value of such indicators quickly leads to financial difficulties for the hospital. Long-term maintenance of operational efficiency also requires asset replacement and growth investments, but these do not necessarily have to be self-financed, as the source of capital in such cases can be the public authority governing the hospital, which is interested in the development of local medical services. Of course, it would be advisable for self-financing of replacement and development to occur, but this is not a categorical condition for hospitals run by local governments or the State Treasury. Maintaining financial liquidity is in fact the only economic criterion for hospitals operating in the form of independent public healthcare facilities (a special legal form, discussed further in the article), as, due to regulations, their capital situation is irrelevant for the continuity of their operation. As practice shows, even this sole significant factor is often improperly controlled, resulting in some cases in the aforementioned phenomenon of excessive indebtedness of these entities.

In line with the above-mentioned details of measuring the financial efficiency of hospital operations, the article focuses on two types of profitability indicators: one calculated from net profits and the other from EBITDA. For both types of profitability indicators, three detailed indicators were calculated: profitability of sales, assets, and equity ($ROS = \text{Profit (Loss) before tax} / \text{Operating revenue}$; $ROA = \text{Profit (Loss) for period} / \text{Total Assets}$; $ROE = (\text{Profit (Loss) for period} + \text{Interest Paid}) / (\text{Shareholders Funds} + \text{Non-Current Liabilities})$; ROS_EBITDA , ROA_EBITDA , ROE_EBITDA are calculated similarly with $EBITDA = EBIT + \text{Depreciation replacing profits in numerators of indices}$). However, it is essential to remember the specifics of the formation and operation of Polish hospitals. This includes, among others, that many hospitals run post-commercialization in the form of commercial law companies lease the most expensive equipment from hospital governing bodies. At the time of commercialization, governing bodies sometimes decided on a low level of own capital and assets in entities running hospitals, which theoretically was to protect the most valuable hospital assets from purchase associated with liquidation in case of continued liquidity problems of commercialized hospitals. Such a structure of operation of assets and capital in companies running hospitals affects the increase in the level of asset and equity efficiency indicators, so they should be analyzed taking into account the above-mentioned distorting factor. In particular, this may affect the efficiency indicators ROA and ROE as well as ROA_EBITDA and ROE_EBITDA .

Another important factor that must be considered in interpreting the results of profitability analysis is the still-present special legal form of hospital operation, namely the independent public healthcare facility (SPZOZ). According to the provisions of the Act on Medical Activity, this is a non-continued form, which means that currently, it is not possible to create new SPZOZs. The activity of SPZOZs has been regulated since 2011 by the provisions of the Act on Medical Activity. Characteristic of SPZOZs is that they are 100% publicly owned, without the legal possibility of private entities' participation, including, among other things, the absence of bankruptcy and the financial director's non-liability for debts exceeding the company's assets. This is one of the reasons for the lack of current motivation among managers to effectively control the costs of operations and the operating profile of SPZOZs. SPZOZs are not independent entrepreneurs but organizational units of the minister or selected government administration bodies, voivodes, local government units, or state medical universities or state universities conducting educational and research activities in the field of medical sciences. Consequently, any unpaid liabilities are de facto obligations of the entity creating the SPZOZ.

4. Results

The exploratory data analysis commenced with examining changes in selected **profitability indicators in Polish hospitals for the period 2012-2021**. Descriptive statistics for the Return on Sales ratio (ROS) are presented in Table 1, while profitability according to other indicators can be found in Appendix Table 4. Based on annual data, box plots of the Return on Sales ratio for successive years were presented (see figure 1). In 2018, an interesting event was observed involving a sudden drop in efficiency. The median of the ROS indicator decreased by 2 percentage points compared to 2017, and other indicators behaved very similarly to the ROS, decreasing by approximately 2 percentage points (ranging from 1.7 to 2.8 percentage points). In the fourth quarter of 2017, the National Health Fund (Polish name Narodowy Fundusz Zdrowia, NFZ) implemented the Act on the so-called hospital network, the effects of which were fully visible for the first time in 2018. This was the most likely cause of the decline in hospital operational efficiency in 2018. An increase in the variability of efficiency indicators is also noticeable from that year onwards. This is likely due to the fact that in 2017, 594 facilities out of a total of 949 hospitals qualified for the hospital network, leaving the remaining 37% of hospitals outside it. The diversification of funding following the enactment of this law applied to both hospitals within the network, depending on hospital classification (six types of hospitals were distinguished), and hospitals outside the network (Dubas-Jakóbczyk et al., 2019). After the initial shock in 2018, adaptation to the changes is visible, leading to an increase in efficiency from 2020, reaching levels similar to those before the changes. This phenomenon is worthy of more detailed investigation, but it goes beyond the scope of this study.

Table 1.*Descriptive statistics of Return on Sales in Polish hospitals in years 2012-2021*

year (t)	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
N	428	455	458	470	458	478	510	558	502	151
Min	-45,7	-98,9	-37,8	-71,6	-81,8	-67,7	-77,6	-67,1	-68,7	-33,6
Q1	-3,2	-1,5	-2,8	-2,7	-3,6	-3,5	-6,9	-6,3	-5,0	-3,3
Median	0,3	0,6	0,3	0,2	0,1	0,0	-2,0	-2,1	0,0	0,5
p(t-1,t)		0,0010 ***	0,0000 ***	0,4513	0,0037 ***	0,0913 *	0,0000 ***	0,4441	0,0000 ***	0,0061 ***
Q3	2,4	2,6	1,7	1,9	1,5	1,6	0,4	0,6	2,1	4,5
Max	38,2	28,4	27,9	26,6	28,4	32,0	27,4	99,7	99,6	26,8
Mean	-0,6	0,0	-0,9	-0,8	-1,7	-1,3	-3,6	-3,2	-1,9	-0,2
Std.dev.	8,1	8,6	6,5	7,2	8,6	7,8	9,0	9,4	10,7	9,4
Mean_95	-0,5	0,4	-0,7	-0,6	-1,2	-1,0	-3,3	-3,0	-1,7	-0,1

Note. ROS values in %; N – number of observations in a given year; Q1, Q3 – quartiles 1 and 3; p(t-1, t) – p-value of the U Mann-Whitney test among observations in year t-1 and t; *** p <= 0.01; ** p <= 0.05; * p <= 0.1; Mean_95 – ROS mean on observations truncated by 2,5% each side.

Source: own elaboration.

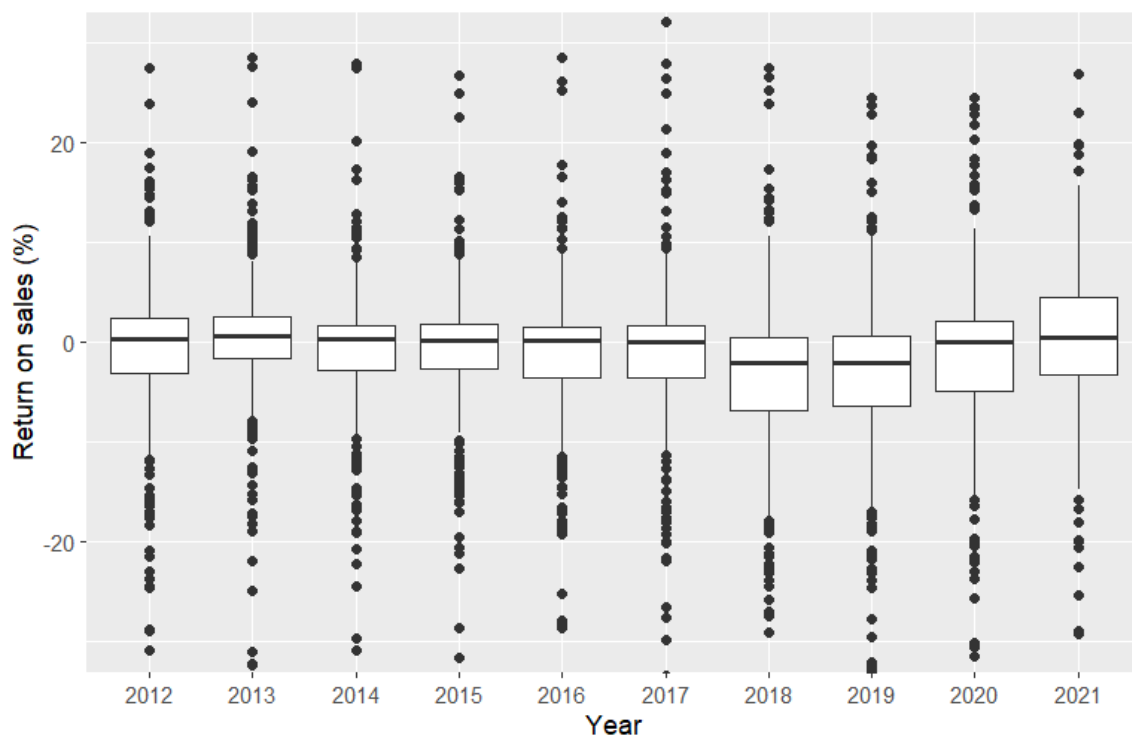


Figure 1. Hospitals' Return on sales by year.

Source: own elaboration.

The difference between the median in 2017 and 2018 is significant at the $p < 0.01$ level (see Table 1). The median difference between 2018 and 2019 was not statistically significant, indicating that hospitals adapted over two years to changes in healthcare financing rules. As evidenced by the significances of differences measured by the Mann-Whitney U test (refer to Table 1), statistically significant differences in ROS median values also occurred in other years; however, these differences were not as dramatic as between 2017 and 2018 and during the return to the previous efficiency level in 2020. It is also important to note that 2020 was the

first year of the pandemic and additional funds allocated to support medical entities due to it. Certainly, these additional funds and the reduction in regular patient admissions, effectively reducing some costs while maintaining lump-sum compensation in the hospital network, contributed to their improved financial situation that year.

The sample sizes for each year vary depending on the completeness of data, ranging from 428 to 558 for the ROS indicator in the years 2012-2020, with the year 2021 being significantly lower at only 151. This is due to the lack of data inflow at the time of their acquisition from the Orbis database (September 2020). A similar situation applies to other efficiency indicators, with a data gap in 2015 for indicators calculated from EBITDA. Further analyzes in this article, if they concern specific years, will focus on 2020, with particular emphasis on changes occurring between 2017 and 2020.

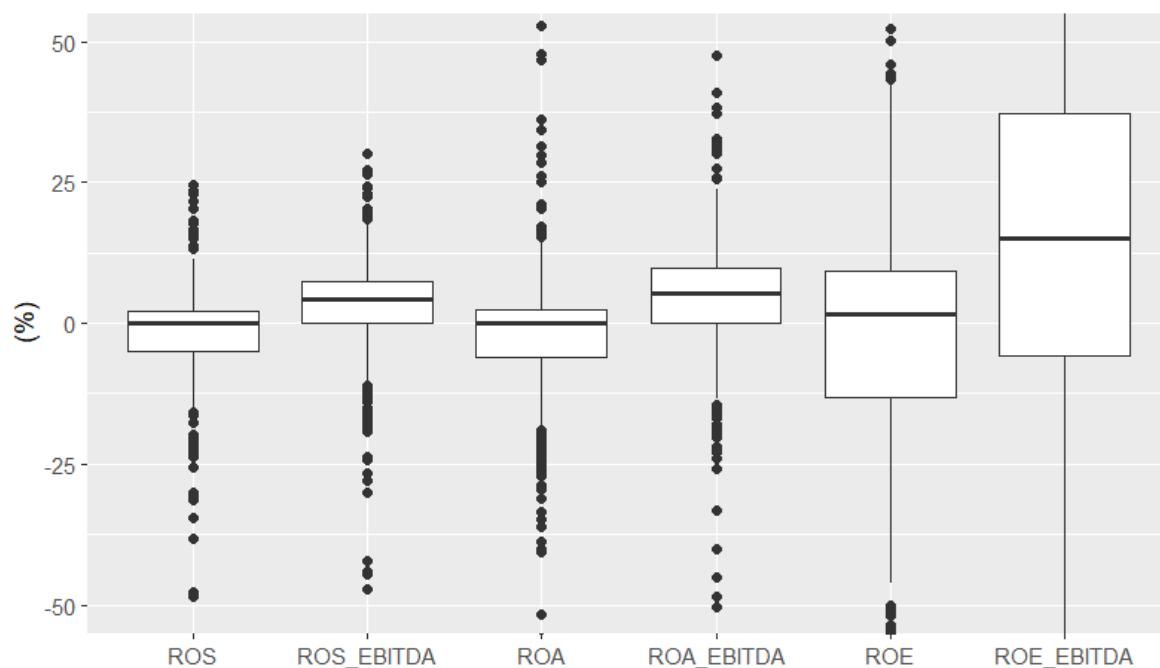


Figure 2. Hospitals' efficiency in 2020.

Source: own elaboration.

It should be noted that there is greater variability in the ROA and ROE indicators, especially those calculated from EBITDA (see Figure 2). This is due to the conservative approach of public hospital owners who, post-commercialization, equipped hospitals with relatively small assets. Often, high-value assets are not directly owned by the hospital but are merely leased from the public owner. The same applied to capital, which post-commercialization could be minimal and was supplemented only in subsequent years as needed, either for investment expenditures or to cover the previous year's losses.

The analysis, **segmented by company size**, was based on sales revenue. The study sample was divided each year into four quartiles. Comparisons were conducted between individual quartiles in selected years. The situation in years 2012-2021 is presented in Figure 3.

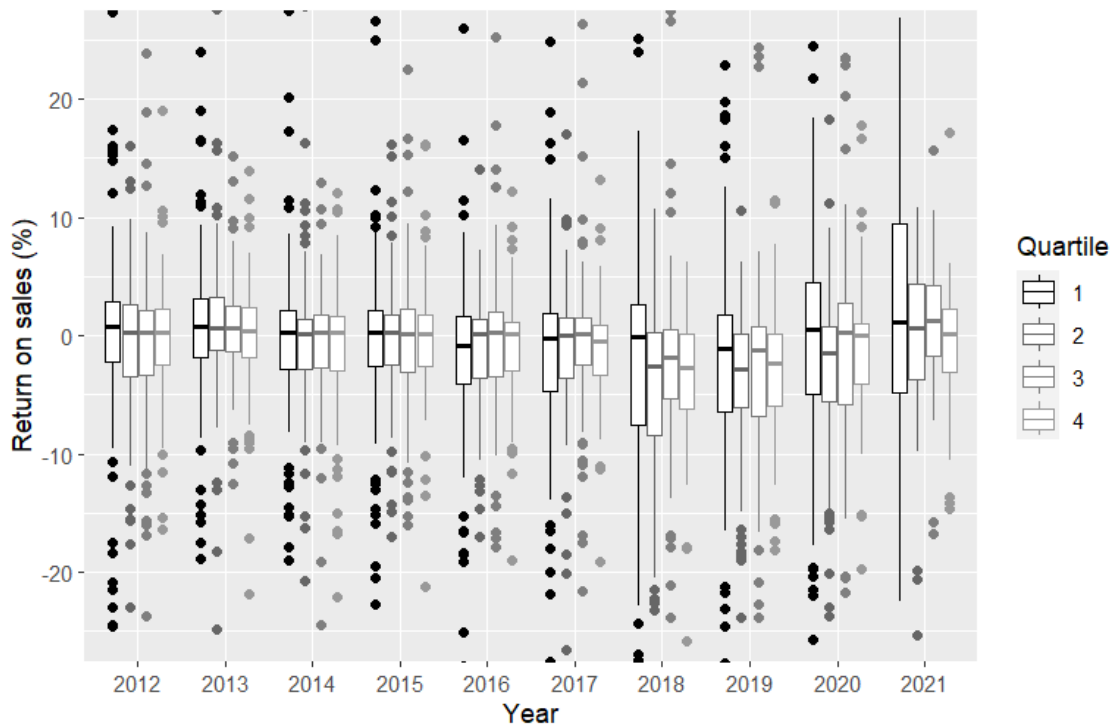


Figure 3. Return on sales by hospital size in 2017-2020.

Source: own elaboration.

The comparison of Return on Sales across groups of companies of varying sizes indicates a practically unchanged situation in these groups from 2012 to 2017. There is no statistical significance in the differences of medians measured by the Kruskal-Wallis test among all hospital size quartiles until 2018, when significant differentiation in profitability outcomes begins to appear across companies of different sizes (see Table 2). In the years 2018-2020, significant differences occur between quartiles 1 and 2, as well as 1 and 4, and in 2018 and 2020 between quartiles 2 and 3. From 2018, a decrease in the ROS median can be observed in companies of quartiles 2, 3, and 4 (refer to Table 2). The profitability of the smallest hospitals in 2018 did not decrease, although among these hospitals (from quartile 1), a decline in efficiency is noticeable in hospitals with ROS profitability lower than the median. Since 2018, there has also been an increase in the variability of profitability indicators in groups of companies of different sizes, affecting all quartiles. From 2020, there is an improvement in the situation of companies in all quartiles, and this trend continues into 2021. However, differences between quartiles remain and are statistically significant in the case of half of the pairs of indicators in the quartiles (see Appendix Table 5). It should be remembered that the sample size in the last year of the study is significantly smaller than in previous years, which may affect the significance of the results obtained in 2021.

Unusually, the smallest companies, where the ROS efficiency indicator slightly decreased only in 2019, behave differently. The change in the NFZ's financing system caused a greater dispersion of results obtained by companies of all quartiles by company size in 2018, although this is most visible in quartiles 1 and 2. It seems that in the case of hospitals in the first two

quartiles, the mechanism of qualifying hospitals to the hospital network had a sharp effect, causing both an increase in efficiency for some hospitals and a decrease in efficiency for other hospitals in these quartiles.

Table 2.

Descriptive statistics of Return on sales (2018-2020) categorized by hospital size quartiles based on revenues

Year	2017				2018			
Turnover quartile	1	2	3	4	1	2	3	4
N	119	119	120	120	125	128	129	128
Min	-67,7	-26,5	-29,8	-29,8	-77,6	-23,1	-35,2	-25,8
Q1	-4,7	-3,6	-2,5	-3,4	-7,6	-8,4	-5,4	-6,2
Median	-0,2	0,0	0,1	-0,4	-0,1	-2,6	-1,8	-2,7
Q3	1,9	1,5	1,5	0,9	2,6	0,2	0,5	0,1
Max	32,0	27,9	26,4	13,1	25,1	10,7	27,4	6,3
Mean	-2,4	-0,8	-0,7	-1,2	-3,6	-4,5	-2,7	-3,4
Std.dev.	11,8	6,2	6,5	5,0	14,2	6,5	7,9	4,8
Mean_95	-2,1	-0,8	-0,7	-1,1	-2,6	-4,3	-2,7	-3,2
Year	2019				2020			
Turnover quartile	1	2	3	4	1	2	3	4
N	139	139	140	140	125	126	126	125
Min	-67,1	-51,3	-34,3	-43,5	-68,7	-38,3	-21,7	-48,4
Q1	-6,5	-6,1	-6,8	-5,9	-5,0	-5,5	-5,8	-4,0
Median	-1,1	-2,9	-1,2	-2,3	0,6	-1,5	0,2	0,0
Q3	1,7	0,2	0,8	0,2	4,5	0,7	2,8	1,0
Max	22,8	10,5	99,7	11,5	24,5	18,3	99,6	17,7
Mean	-3,1	-3,8	-2,3	-3,4	-2,4	-3,4	-0,2	-1,7
Std.dev.	11,5	6,7	11,5	6,5	14,2	8,0	11,9	6,8
Mean_95	-2,7	-3,4	-2,9	-3,1	-1,4	-3,1	-1,0	-1,4

Note. ROS values in %; N – number of observations in a given year; Q1, Q3 – ROS quartiles 1 and 3; Mean_95 – ROS mean on observations truncated by 2,5% each side.

Source: own elaboration.

The division of companies **operating in different voivodeship** should not, in theory, indicate differences in efficiency, as most of the analyzed hospitals derive their revenue primarily from contracts with the National Health Fund (NFZ), usually covering over 95% of revenues. However, an analysis of efficiency indicators reveals significant differences in some voivodeships. In the case of the Return on Sales ratio, lower efficiency indicators occur in the Mazowieckie, Śląskie, and Podkarpackie voivodeships (refer to Figure 4, detailed data in Appendix Table 6). Similar results apply to other profitability indicators. Considering all efficiency indicators, the Świętokrzyskie voivodeship should be added to the three voivodeships with the least efficient hospitals (see Table 3). The median ROS in Mazowieckie is statistically significantly different from the median ROS in other voivodeships in 60% of cases (9/15), in Śląskie in 27%, in Podkarpackie in 20%, and in Świętokrzyskie in 27% of cases. The best efficiency results are found in hospitals in the Lubuskie, Kujawsko-Pomorskie, Małopolskie, and Pomorskie voivodeships. The medians of the ROS indicator in these voivodeships are significantly different from medians in other voivodeships in 27% of cases comparing other voivodeships to Lubuskie, 33% to Kujawsko-Pomorskie, 20% to Małopolskie, and 27% to Pomorskie.

Such varied profitability results of hospitals in individual voivodeships are surprising due to theoretically identical financing principles. However, differences in profitability may result from the specificity of voivodeships, both in terms of the health situation in individual voivodeships and the structure of hospital types in their area. As indicated by the report of the Supreme Audit Office, there are also differences in the prices of the same services purchased by the National Health Fund from medical entities (NIK, 2019). This phenomenon is justified in the NIK report (2019) by regional differences, the reference level of entities, as well as the financial capabilities of individual provincial branches of the Fund, i.e. the offer by medical entities of a price lower than expected in the competition procedures announced by the provincial branches of the National Health Fund or the results of negotiations. There are also differences in access to services, which ultimately affect the efficiency of hospitals. According to the Supreme Audit Office (2019), the factors influencing differences in access to services include: uneven distribution of the material base of the system, including the structure of the services provided, differences in the development and distribution of medical potential throughout the country and voivodeships, especially medical staff, historical events, provision of similar services in various scopes, behavior of healthcare providers, but also the financial status of patients, level of education, place of residence and age.

The observed decrease in efficiency in 2018 across the entire sample affected hospitals in individual voivodeships differently. The changes in efficiency in 2018 are practically cosmetic and positive in the Lubuskie voivodeship, where an increase in hospital efficiency measured by the median ROS of 0.3 percentage points was noted, while the largest decrease in operational efficiency was recorded in the Podlaskie voivodeship – a decrease in the median ROS of 4.2 percentage points.

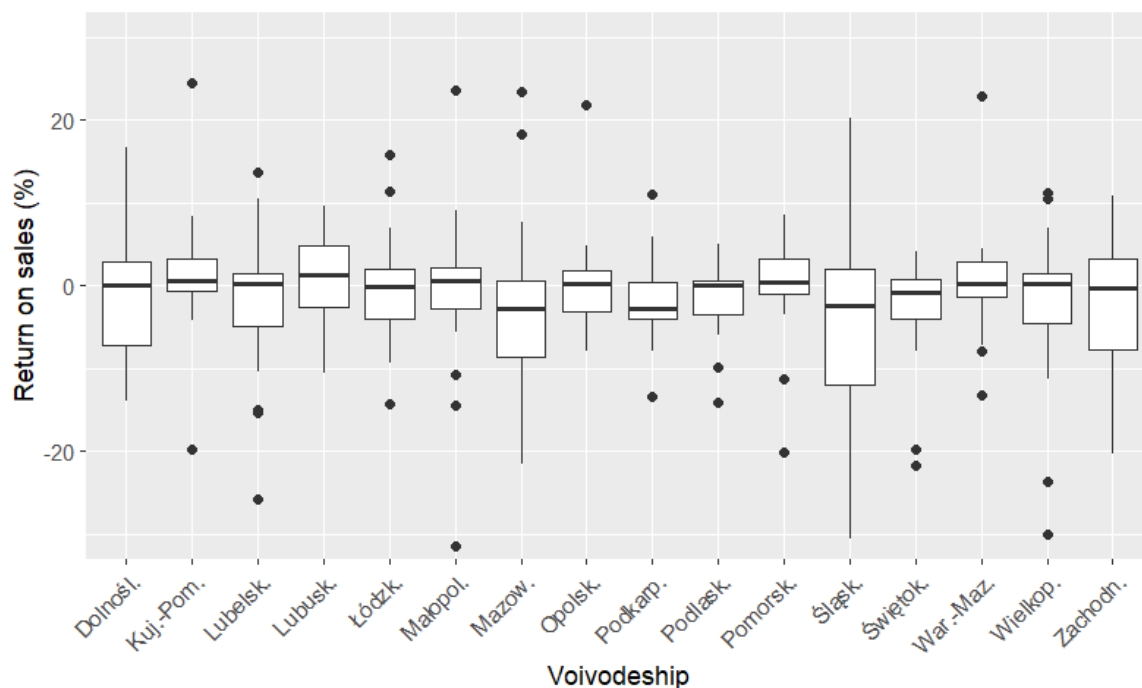


Figure 4. Return on sales in hospitals by voivodeship in 2020.

Source: own elaboration.

Table 3.
Profitability of hospitals by voivodeships in 2020

Voivodeship	ROS	ROA	ROE	ROS EBITDA	ROA EBITDA	ROE EBITDA
Dolnośląskie	0,0	0,0	3,0	4,2	6,0	17,5
Kujawsko-Pomorskie	0,6	0,6	4,8	4,1	8,2	15,8
Lubelskie	0,2	0,2	3,5	4,3	5,1	2,0
Lubuskie	1,3	0,8	10,1	6,6	7,1	33,3
Mazowieckie	-2,8	-3,0	-3,6	3,6	3,2	6,6
Małopolskie	0,5	0,5	2,9	5,8	5,6	24,3
Opolskie	0,2	0,1	1,6	4,7	6,7	19,1
Podkarpackie	-2,8	-3,0	0,6	3,1	2,8	13,9
Podlaskie	0,1	0,1	2,6	6,0	7,1	18,8
Pomorskie	0,4	0,6	1,7	6,6	6,1	17,7
Warmińsko-Mazurskie	0,2	0,3	2,7	5,0	6,0	7,1
Wielkopolskie	0,2	0,2	1,5	3,9	5,9	18,7
Zachodniopomorskie	-0,3	-0,8	-5,2	4,2	7,6	-11,3
Łódzkie	-0,1	0,0	5,2	3,2	6,4	19,0
Śląskie	-2,4	-2,7	1,3	1,9	2,5	11,1
Świętokrzyskie	-0,9	-1,1	1,1	2,9	4,2	8,3

Note. values in %.

Source: own elaboration.

The comparison of efficiency by voivodeships shows differences in health policy and the structure of hospitals and medical procedures in various regions of the country. The literature also highlights differences in the efficiency of **urban (regional) and rural (local) hospitals**. For the purposes of this study, urban (regional) hospitals are those located in larger cities where they are not the only hospitals. Conversely, rural (local) hospitals are those situated in smaller towns, where they are the sole hospitals. The efficiency of hospitals in both groups is illustrated in Figure 5.

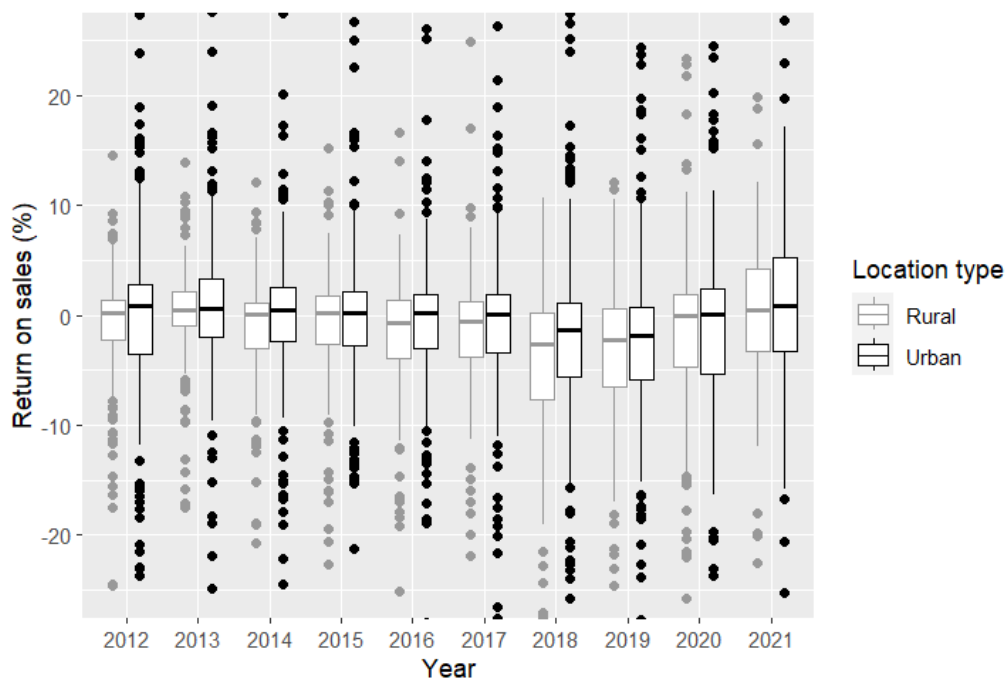


Figure 5. Return on sales in hospitals by location type in 2012-2021.

Source: own elaboration.

In almost all the studied years, rural hospitals exhibit a lower level of efficiency, yet the significance of the difference in the Return on Sales (ROS) medians only appears in the years 2012, 2014, 2016, 2017, and 2018 (refer to Appendix Table 7). In the years 2020 and 2021, the difference between the efficiency of urban and rural hospitals was practically eliminated, largely due to the funds supporting hospital operations in response to the COVID-19 pandemic. It can be said that these additional funds saved the efficiency of rural hospitals in 2020 and 2021. A very similar situation occurs with respect to other efficiency indicators, with almost all indicators in 2018 showing a statistically significant difference in median efficiency between the two types of hospitals (urban and rural) at a high significance level of $p < 0.01$ (except for the ROE_EBITDA indicator, for which the significance of the median difference does not occur). This indicates that the changes to the financing system introduced by the NFZ in 2017 affected rural hospitals more, as evidenced by the increase in the ROS median difference in 2018 and the shape of the statistical distribution of this indicator in 2018 compared to 2017.

Polish hospitals are essentially **operated in two legal forms**. The first is the historically dominant form of an independent public health care facility (abbreviated as SPZOZ), an entity providing health care that is not an entrepreneur. Such an entity does not have a separate legal personality and constitutes a separate part of the entity creating the hospital. The founding entity is most often a local government, a university or a ministry. The entire responsibility for the activities of SPZOZ rests with the founding body. They are responsible for entrusting the day-to-day management of the hospital to competent persons and for supervising their activities and results. The second legal form is commercial law companies, most often a limited liability company, less often a joint-stock company. In this case, the company operating the hospital as a legal entity bears all the consequences of its actions, therefore operational efficiency directly affects its functioning and survival. Additionally, there are completely private hospitals, of which there are exactly nine in the sample. They operate in the form of a limited partnership or a general partnership, and in some cases, a partner in a civil partnership is also a limited liability company. These entities are various forms of civil partnerships in which the owners (or selected owners in the case of limited partnerships) are responsible for the company's activities with their entire assets. The hospitals run by these entities are not multi-specialty and operate on the basis of several departments, only a small part of which is financed under contracts with the National Health Fund. Figure 6 shows that these entities are much more effective than other hospitals, which are mainly multi-specialty and almost entirely financed by the National Health Fund.

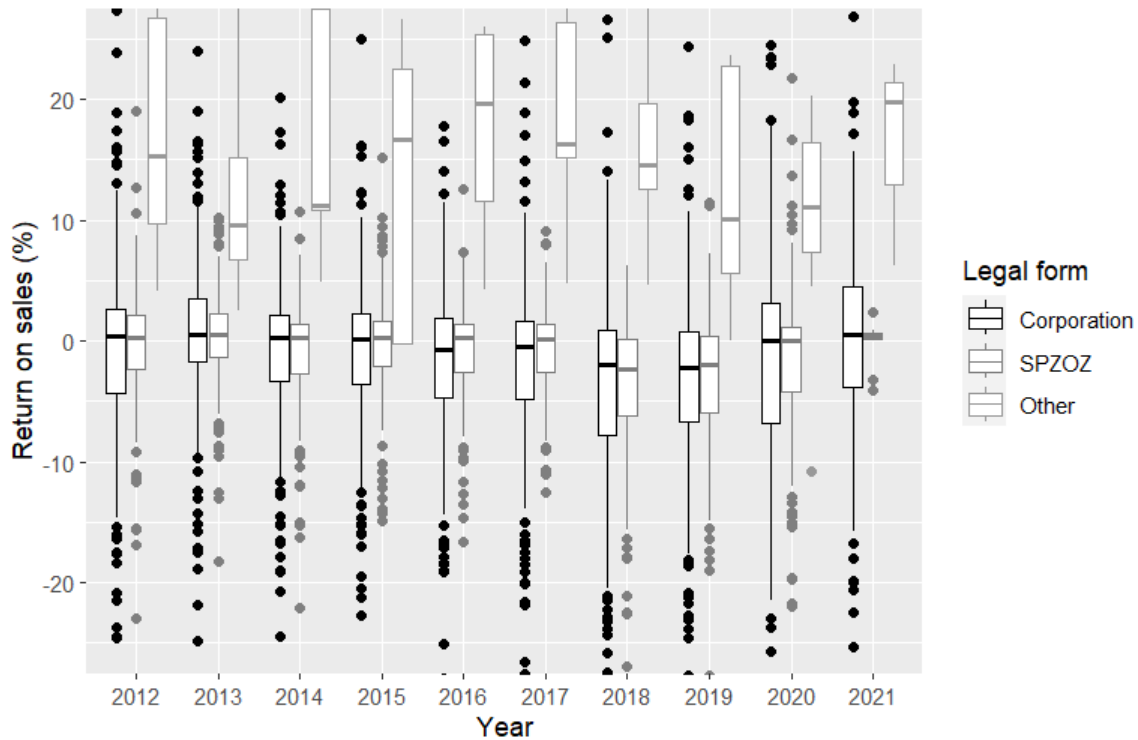


Figure 6. Return on sales in hospitals by legal form in 2012-2021.

Source: own elaboration.

Entities operating in the two dominant legal forms demonstrate very similar profitability across all years. Only in the years 2016, 2017, and 2018 are minor differences in median levels noticeable (refer to Appendix Table 8), with only in 2016 these differences being statistically significant (except for the ROE and ROE_EBITDA indicators). This suggests that legal form is not a significant characteristic affecting the achievement of markedly better economic outcomes. This is a consequence of almost complete funding of these entities from the NFZ, impacting both types of entities similarly. It also implies that these entities are managed very similarly, with even a slightly greater diligence observed in hospitals operated as SPZOZs in achieving better results. In 2016 and 2017, worse results can even be observed in hospitals operating as commercial law companies compared to the somewhat archaic form of SPZOZs, which, as it turns out, even manages better than corporate entities. Of course, these statements do not apply to hospitals operating as civil partnerships, most often single-profile or with a small number of departments and significantly lower NFZ funding than other hospitals. These entities achieve much higher profitability (median ROS and other indicators above 10%). It seems, therefore, that the problem lies in NFZ funding. However, it should be remembered that hospitals have low bargaining power relative to main workers (doctors) due to a shortage of doctors in most specialties in Poland. The ratio of doctors per 100,000 inhabitants is significantly lower in Poland compared to other European Union countries (344 in 2021 compared to an EU average of 406 doctors per 100,000 inhabitants, Eurostat data).

The last criterion examined is the **ownership of the hospital** or the entity operating the hospital. The main owners of hospitals or entities operating hospitals are local government units (communities, counties, and voivodeships), universities, ministries, and commercial law companies. It is very rare for hospitals to be owned by private individuals, foundations, associations, or churches. These last cases were grouped into one category labeled 'Other'. Owners marked as community, county, and voivodeship refer to hospitals operated by local authorities at various levels. Community hospitals are usually hospitals operated by medium and large cities. County hospitals are typically rural-type hospitals located some distance from larger cities. Voivodeship-supervised hospitals are multispecialty hospitals, usually larger, and sometimes very large or specialized hospitals located in various locations (both in large cities and away from major centers). Hospitals classified as 'State' are hospitals operated by various ministries, usually located in larger cities. These include, for example, multispecialty hospitals operated by the Ministry of National Defense. However, most hospitals in this group are directly under governance of the Ministry of Finance. University hospitals are clinical hospitals that handle the most severe medical cases. They also conduct scientific research and implement innovations. Hospitals operated by corporations are usually two types of hospitals. These are privatized multispecialty hospitals in various locations and specialist hospitals focusing on well-paid medical procedures.

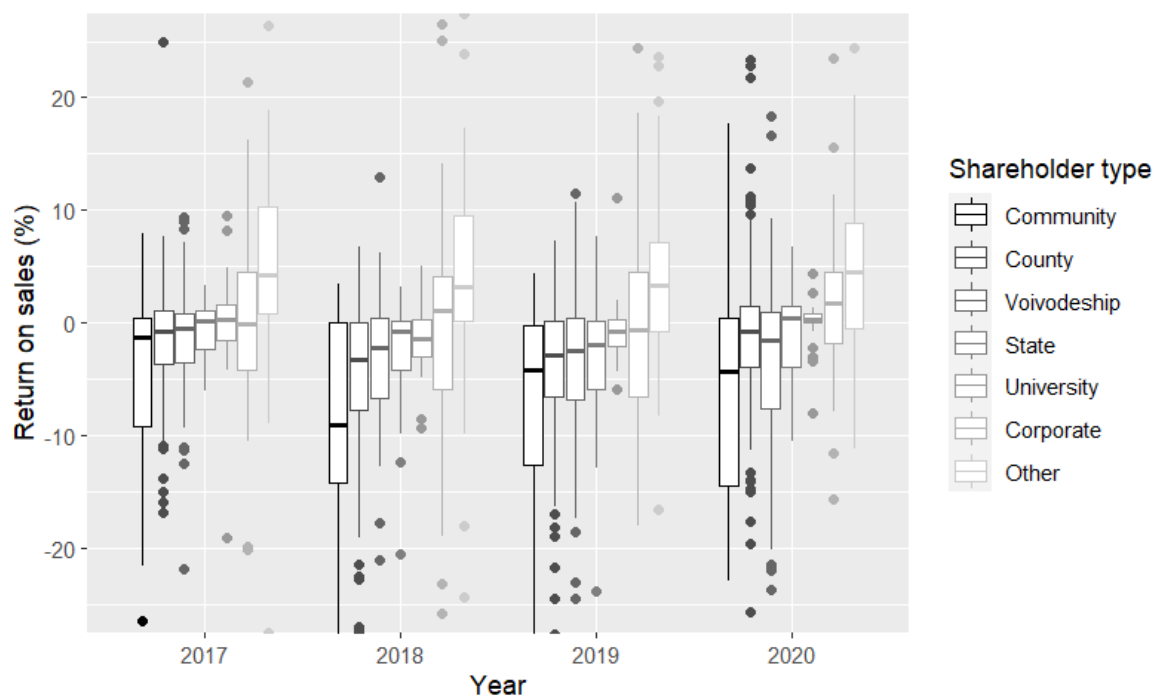


Figure 7. Return on Sales in hospitals by shareholder type in 2017-2020.

Source: own elaboration.

The results of the profitability analysis indicate that the type of owner has a significant impact on profitability outcomes. The impact of the changes to the NFZ financing system in 2017 most significantly reduced the efficiency of community hospitals (see Appendix Table 9). It can be surmised that some of these hospitals simply did not make it into the hospital network

and consequently received poorer funding for their operations. Since 2018, the ROS profitability level for these hospitals has been significantly lower than for other hospital groups in this division. County and voivodeship hospitals do not differ significantly in terms of operational profitability measured by the ROS indicator. Also, the profitability of hospitals overseen by the State Treasury maintains similar levels, although hospitals with very low profitability are less common in this group. University clinics achieve very similar results to hospitals managed by the State. Hospitals operated by corporate entities achieve better results than local government hospitals. Finally, the last of the examined groups – other owners, have decidedly better profitability outcomes compared to the previously mentioned owner groups. However, it should be remembered that hospitals in the Other category often generate revenues outside of the NFZ, which naturally allows them to achieve higher levels of profitability.

5. Discussion

The study presents results from an exploratory data analysis concerning the profitability of hospitals in various segments. The identified differences in profitability shaping can often be attributed to objective factors influencing the observed differences in profitability indicators. However, in many instances, the results are surprising and different from those in previous studies.

The differences in the profitability results of Polish hospitals are influenced by the following objective factors and processes identified in this study:

1. Changes in the law and financing rules implemented by the NFZ during the observed period, evident in the decrease in hospital profitability in 2018.
2. Hospitals' adaptation to the aforementioned changes, visible in maintaining lower profitability in 2018-2019 and an increase in hospital profitability in 2020 and 2021.
3. Additional funding for hospitals during COVID-19 prevention measures in 2020 and 2021, resulting in increased profitability in those years. Similar effects of COVID-19 prevention measures were present in the USA (Li et al., 2023).
4. Hospital size, which started to significantly differentiate hospital profitability from 2018 onwards following changes in the law and NFZ financing rules. Interestingly, the worst profitability results were achieved by the biggest hospitals (fourth quartile measured by revenues), but from 2018, hospitals in the third size quartile began catching up, and from 2019, hospitals of this quartile recorded the worst results. Conversely, since 2018, the smallest hospitals have better results than the others. This contradicts the theoretical expectations that scale effect would result in higher efficiency in the largest hospitals what is generally observed in other countries (Rosko et al., 2020). It turns out this is not the case in Poland.

5. The country's region (voivodeship). These results were quite unexpected, as it was assumed that there would be no differences in hospital operating efficiency between voivodeships due to theoretically the same financing rules and levels of medical procedure valuation. As indicated by the report of the Supreme Audit Office in reality, there are differences in the prices of the same services purchased by the National Health Fund from medical entities (NIK, 2019) and regional differences in access to services, which ultimately affect the efficiency of hospitals.
6. Division into rural and urban hospitals – since the COVID-19 pandemic, there has been virtually no differences in the profitability of rural and urban hospitals. In previous years, a slight yet sometimes statistically significant advantage in efficiency was observed for urban hospitals, thus findings were consistent with international literature (O’Hanlon et al., 2019; Pai, Dissanayake, 2022) but contradicting with findings from Polish hospitals (Siedlecki et al., 2016). However, this has changed since 2020. It is important to remember that comparable studies' findings were also pre-COVID, and it is unknown whether the situation changed there during the COVID-19 pandemic as it did in Poland.
7. The legal form of hospital operation (SPZOZ or a company) does not affect their operating efficiency except for 2016, when statistically significant difference in efficiency was observed in favor of entities operated as SPZOZs, which is also quite unexpected. The lack of differences in efficiency among entities does not apply only to private hospitals other than multispecialty operating as civil partnerships. The literature notes the assertion, backed by research (Tiemann, Schreyögg, 2012), that commercial law entities (corporate companies) take better care of profitability (Augarzky et al., 2009; Herr et al., 2011), as they operate under the pressure to maintain financial liquidity and capital financial stability. However, the situation reported in international literature is not entirely comparable to the situation in Poland, as both types of entities in Poland are operated by public authorities at various levels and public institutions. The lack of differentiation in profitability of hospitals operated in different legal forms can be attributed to equal funding of both types of entities by the NFZ. A greater diligence in operating efficiency by SPZOZ entities can even be observed, evidenced by the clearly lower range of interquartile deviation (IQR) in the profitability of these entities in each year.
8. Hospital owner – there is a differentiation between the profitability of local government hospitals and hospitals of other owners. This particularly applies to community hospitals, which in practically all years have significantly lower median efficiency indicators compared to other types of owners. A similar situation applies to county hospitals, which usually had significantly lower profitability indicators than other local government hospitals, although in 2020, county hospitals achieved significantly higher profitability than voivodeship hospitals.

Beyond the presented results, the quite large deviations in observed profitability across all segments are puzzling, both towards lower and higher values. This means that apart from the studied factors influencing hospital operating efficiency, there are other factors differentiating the profitability of these entities. These are likely specific factors for individual hospitals such as the structure and size of hospital departments, hospital cooperation with doctors, clinical quality and process quality, patient satisfaction, use of electronic medical records and electronic document flow, cooperation with the payer, and solutions used in contracts with the NFZ, which are studied in the literature cited earlier. This opens the possibility for further research on the dependency of profitability on other shaping factors. A desirable direction for research would be to link hospital operating profitability with their medical activity structure and detailed organization methods. Identifying which hospital departments are part of the organizational structure and how they influence achieving high or low levels of financial efficiency would be extremely valuable in this aspect. Of course, the results would generally depend on the valuation of medical procedures, and specifically on the structure of medical procedures in each department, as well as on their actual costs. Unfortunately, such a study, albeit extremely valuable and interesting, is very demanding in terms of input data, which is not available in typical databases describing the operation of economic entities, including hospitals.

Another direction for extending hospital profitability research is to link it with economic and medical parameters describing the operation of each hospital, such as the number of beds, number of procedures and operations, number of medical staff, patient readmission rate, and other detailed medical and economic data. In this analysis expansion, there are also very significant difficulties in data acquisition. The mentioned characteristics are indeed reported by hospitals to the NFZ and the Ministry of Health, but access to these data, even for research purposes, is limited.

Further research should also cover identifying the impact of additional funds related to COVID-19 pandemic prevention. As the data analysis shows, the COVID-19 pandemic generally helped hospitals achieve a higher level of efficiency thanks to the additional funds pumped into hospitals during this period. The smallest effect of this assistance occurred in hospitals run by communities.

Another important topic for further exploration arising from this study is the reaction of hospital profitability to changes in the NFZ financing system in 2017. Overall, this reaction is negative and reduced hospital operating efficiency in 2018 and 2019. What this analysis failed to investigate is the impact of qualifying or not qualifying hospitals for the so-called hospital network on their operating efficiency. The study did not have data on qualification for the hospital network, and it is unknown whether the decrease in efficiency in 2017 affected only entities outside the hospital network, entities within the network, or both groups of hospitals simultaneously. Therefore, this presents an assumption for further research.

Of course, the techniques used to divide the population into homogeneous groups and the applied data cleaning procedure were not entirely unambiguous, as in some points they relied on qualification for individual subgroups of the studied hospitals according to characteristic formulations in the hospital's name itself or in the name of the entity establishing the hospital (or dominant entity – in the case of commercial law companies). This means that in individual groups, there may have been individual cases of hospitals that were misclassified, especially misclassified generally among hospitals subject to the study. This is due to some voluntariness in the entity's decision regarding the main type of activity shown in the NACE code, which additionally is not strictly verified by register courts and other public institutions. Often, there is a factor of ennoblement to a respected group of entities (hospitals) based on the mere declaration of the primary activity as hospital activity despite the fact that the actual activity includes fragmentary medical activity in addition to non-hospital character. This could have caused minor distortions in the results obtained, but the study's advantage was the manual verification of approximately 20% of entities qualified for the study and the relatively small extent to which non-hospital activities were included in this group.

6. Summary

The search for factors influencing the profitability of hospital operations through division into homogeneous groups does not always yield entirely unambiguous results, and in some aspects, further research is required. It was determined that factors such as time and changes in financing methods with the payer (NFZ) occurring during the study period, location in a selected region of the country, hospital size, urban or rural location, and type of owner influence efficiency. However, no differences in the efficiency of hospitals operated in different legal forms (corporate or SPZOZ) were confirmed. Also, differences between the efficiency of urban and rural hospitals are not significant in every studied year, especially in the last two years of the study.

The findings of this study add valuable insights to the ongoing discourse on operational efficiency within healthcare institutions, opening avenues for additional investigative queries that extend beyond the context of Polish hospitals. These insights hold relevance for a diverse audience encompassing academic researchers, policy makers at both local and central levels, healthcare sector practitioners, as well as academic institutions overseeing clinical hospitals. Moreover, they bear significance for governmental bodies such as the Ministry of National Defense, which administers hospitals for uniformed services, and the Ministry of Health alongside the National Health Fund, which collectively steward the healthcare system in Poland.

Acknowledgements

I would like to express my profound appreciation to the participants of the Finance Departments Conference in Poznań in 2023, with a special mention to Prof. Wojciech Stiller and Prof. Justyna Rój. Their constructive feedback and insightful contributions have been invaluable in significantly enhancing and advancing this work.

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Appendix

Table 4.
Profitability of Polish hospitals in years 2012-2021

	ROA									
year (t)	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
N	426	455	461	470	458	477	510	558	502	151
Min	-85,7	-68,3	-87,3	-93,7	-88,4	-77,5	-93,9	-97,4	-82,9	-90,2
Q1	-3,7	-2,2	-4,0	-3,4	-5,1	-4,4	-8,8	-8,6	-6,1	-4,1
Median	0,5	0,8	0,2	0,2	0,1	0,0	-2,8	-2,8	0,0	0,7
p(t-1,t)		0,0074	0,0000	0,3594	0,0041	0,4542	0,0000	0,7997	0,0000	0,0834
		***	***		***		***		***	*
Q3	3,0	3,3	1,9	2,1	1,7	1,7	0,5	0,5	2,4	6,0
Max	42,3	41,0	47,9	48,4	57,1	79,3	68,8	69,6	70,0	62,7
Mean	-0,9	0,3	-1,9	-1,1	-1,9	-1,3	-5,2	-5,2	-2,4	-0,9
Std.dev.	12,3	9,9	11,5	9,1	9,9	10,8	14,9	14,9	13,3	18,1
Mean_95	-0,3	0,8	-1,2	-0,8	-1,5	-1,3	-4,7	-4,7	-2,2	-0,4
	ROE									
year (t)	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
N	335	370	372	381	360	368	372	394	350	128
Min	-951,7	-519,4	-527,3	-544,7	-752,5	-627,9	-844,6	-903,3	-874,7	-285,6
Q1	-4,7	-1,7	-5,0	-5,6	-10,2	-8,3	-20,1	-20,8	-13,2	-4,1
Median	2,1	2,3	0,9	1,2	0,5	0,4	-2,1	-2,8	1,5	3,8
p(t-1,t)		0,0903	0,0000	0,0222	0,0000	0,1323	0,0000	0,0041	0,0087	0,1578
		*	***	**	***		***	***	***	***
Q3	10,1	9,6	5,8	6,5	4,8	5,3	2,6	2,8	9,3	12,6
Max	387,1	758,7	680,1	187,0	570,2	826,1	718,1	199,3	243,6	117,8
Mean	-4,6	4,4	-3,2	-6,4	-11,9	-6,7	-18,1	-33,2	-23,9	-2,7
Std.dev.	93,6	80,5	58,4	48,5	83,3	75,9	95,3	112,4	118,2	52,5
Mean_95	0,5	3,0	-1,5	-3,4	-5,0	-4,0	-12,5	-22,4	-13,0	0,7
	ROS_EBITDA									
year (t)	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
N	387	411	416	0	459	479	514	560	503	151
Min	-1862,5	-97,2	-2644,8	NA	-80,8	-134,9	-145,2	-171,6	-47,1	-23,9
Q1	2,6	3,4	2,4	NA	0,9	1,0	-2,2	-1,4	0,1	-0,1
Median	5,4	5,9	5,1	NA	4,3	3,9	2,1	2,4	4,2	4,9
p(t-1,t)		0,0003	0,0000		0,0443	0,5252	0,0000	0,3315	0,0000	0,1106
		***	***		**		***		***	
Q3	8,4	8,9	8,2	NA	7,7	7,2	6,0	5,8	7,3	9,1
Max	44,6	38,7	39,0	NA	33,9	43,3	4385,7	99,8	99,7	27,0
Mean	0,7	5,8	-3,3	NA	3,8	3,7	9,3	1,3	3,0	4,0
Std.dev.	95,3	8,8	134,2	NA	9,2	10,0	193,9	13,0	9,9	9,0
Mean_95	5,5	6,2	5,0	NA	4,2	4,1	1,7	1,9	3,2	4,1
	ROA_EBITDA									
year (t)	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
N	387	411	416	0	460	480	514	561	503	151
Min	-265,7	-162,6	-95,1	NA	-122,7	-1621,4	-180,5	-188,8	-157,0	-90,2
Q1	3,4	4,2	2,8	NA	1,2	1,4	-3,3	-2,0	0,1	-0,2
Median	7,4	7,6	6,4	NA	5,4	5,1	3,1	3,2	5,4	6,3
p(t-1,t)		0,0364	0,0000		0,1071	0,7852	0,0000	0,0436	0,0000	0,0488
		**	***				***	**	***	**
Q3	11,6	11,9	10,7	NA	9,7	8,9	7,0	7,2	9,7	12,5
Max	180,5	57,4	67,0	NA	76,8	110,4	79,2	85,2	93,2	100,8
Mean	6,9	7,8	5,9	NA	4,6	1,3	0,7	1,6	4,2	6,3
Std.dev.	21,1	13,2	12,8	NA	13,3	76,5	19,5	17,3	15,6	19,3
Mean_95	7,7	8,3	6,5	NA	5,2	5,3	1,6	2,1	4,3	6,3

year (t)	ROE_EBITDA									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
N	387	411	416	0	460	480	515	561	503	151
Min	-3038,1	-4100,0	-96766,7	NA	-4206,6	-6148,7	-1871,9	-2350,2	-11700,0	-223,8
Q1	1,4	5,1	2,7	NA	-0,4	-3,1	-9,0	-5,1	-5,9	2,5
Median	14,4	17,3	14,3	NA	11,2	10,5	8,1	9,5	15,1	18,2
p(t-1,t)		0,4261	0,0000		0,0119	0,0139	0,0002	0,4836	0,2089	0,2824
			***		**	**	***			
Q3	32,7	37,2	31,6	NA	25,8	24,6	24,3	26,8	37,1	43,2
Max	14895,3	12003,7	1479,8	NA	1281,4	6320,0	9446,2	42815,0	23890,2	2619,8
Mean	51,8	46,3	-243,2	NA	-9,2	16,5	34,7	140,9	25,9	40,5
Std.dev.	802,0	635,4	4762,8	NA	297,6	435,9	451,3	2026,2	1265,3	229,6
Mean_95	15,5	22,4	16,8	NA	11,0	12,3	11,5	10,0	15,2	20,3

Note. values in %; N – number of observations in a given year; Q1, Q3 – quartiles 1 and 3; p(t-1, t) – p-value of the U Mann-Whitney test among observations in year t-1 and t; *** p <= 0.01; ** p <= 0.05; * p <= 0.1; Mean_95 – mean on observations truncated by 2,5% each side, NA – not available.

Source: own elaboration.

Table 5.

Statistical significance of median Return on Sales variations by revenue-based hospital size quartiles in Polish hospitals in 2018-2020

Year	2017			
Quartile	1	2	3	4
1		0,5980	0,4823	0,8825
2	0,0178**		0,8714	0,3791
3	0,4330	0,0627*		0,2536
4	0,0660*	0,5339	0,1680	
Year	2018			
Year	2019			
Quartile	1	2	3	4
1		0,0607*	0,3947	0,0966*
2	0,0014***		0,2692	0,7407
3	0,3178	0,0198**		0,3806
4	0,0317**	0,1693	0,2980	
Year	2020			

Note. p-values of the Kruskal-Wallis test among observations in respective quartiles of a given year; *** p <= 0.01; ** p <= 0.05; * p <= 0.1.

Source: own elaboration.

Table 6.

Return on sales in Polish hospitals by voivodeships in 2012-2021

Voivodeship	Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Dolnośląskie	N	43	46	45	42	44	46	44	42	36	19
	Median	0,2	0,6	0,4	0,2	-0,9	0,1	0,1	-1,1	0,0	1,7
	Mean	-2,9	-0,4	-2,0	-3,2	-2,8	-0,3	-2,8	-3,5	-2,1	0,1
	Std.dev.	10,2	8,0	8,5	8,7	7,0	5,7	10,6	11,5	11,9	10,5
Kujawsko-Pomorskie	N	23	23	20	19	17	16	22	30	28	9
	Median	0,3	0,6	0,3	0,0	0,3	0,1	-0,3	-0,6	0,6	1,3
	Mean	-0,1	0,0	-0,4	-1,3	1,2	1,5	-1,5	-0,9	1,4	4,9
	Std.dev.	4,4	5,1	3,9	8,8	4,1	5,7	6,1	5,9	6,7	10,2
Lubelskie	N	30	30	28	30	31	30	33	33	29	4
	Median	0,6	0,3	-0,2	0,6	0,4	0,6	-2,4	-2,7	0,2	0,0
	Mean	-1,0	-0,3	-1,8	0,0	-1,4	0,4	-2,3	-3,3	-1,8	1,2
	Std.dev.	5,8	4,9	4,0	4,3	10,7	3,9	7,3	7,6	8,2	8,7

Lubuskie	N	15	16	17	19	19	20	19	19	17	12
	Median	0,9	1,5	0,4	3,0	0,9	-0,5	-0,2	-1,1	1,3	1,0
	Mean	1,1	2,1	2,6	3,0	1,0	-3,5	-2,6	-0,7	1,0	3,0
	Std.dev.	2,4	3,9	5,4	3,6	3,3	15,8	8,2	5,2	5,3	3,6
Mazowieckie	N	61	68	65	63	59	59	62	71	65	24
	Median	-4,4	-1,3	-1,8	-1,4	-2,7	-2,5	-4,7	-3,5	-2,8	-2,5
	Mean	-5,5	-6,0	-4,3	-4,1	-5,4	-4,6	-7,0	-5,1	-3,5	-4,7
	Std.dev.	11,0	15,9	8,1	11,4	11,8	8,8	11,5	15,3	18,2	11,5
Małopolskie	N	32	34	37	36	33	37	30	40	36	4
	Median	1,3	1,2	0,5	1,2	0,6	0,7	0,1	0,2	0,5	10,4
	Mean	2,5	2,9	1,0	2,3	1,2	1,3	0,1	0,2	-0,4	8,3
	Std.dev.	6,6	6,7	5,8	5,7	4,5	4,7	8,0	8,1	7,9	5,4
Opolskie	N	14	14	14	21	18	21	19	19	17	6
	Median	0,9	0,9	0,6	0,6	0,0	0,3	-0,6	-1,3	0,2	-5,6
	Mean	1,6	1,4	1,1	0,1	-0,7	-0,9	-1,9	-1,3	0,4	-5,0
	Std.dev.	2,0	1,6	1,4	3,6	3,0	3,1	4,6	3,9	6,3	12,3
Podkarpackie	N	23	22	24	19	12	15	24	26	21	3
	Median	-1,1	0,2	-2,4	-2,7	-3,7	-2,3	-2,9	-6,0	-2,8	-2,8
	Mean	-1,3	-0,5	-1,6	-1,5	-2,0	-1,3	-4,4	-6,8	-1,8	0,4
	Std.dev.	2,9	3,2	5,0	6,3	5,5	5,2	7,3	9,2	5,2	6,0
Podlaskie	N	15	15	16	18	18	20	22	22	15	2
	Median	1,8	2,5	1,3	0,9	1,3	0,3	-3,9	-2,9	0,1	10,5
	Mean	2,0	3,4	3,1	2,3	2,8	1,4	-2,8	-2,5	-1,8	10,5
	Std.dev.	1,8	3,7	6,8	6,6	6,4	8,3	7,6	8,3	5,1	13,0
Pomorskie	N	17	21	24	22	23	25	26	25	26	15
	Median	0,3	0,9	0,3	-0,9	0,2	0,0	-1,9	-1,1	0,4	2,2
	Mean	1,1	1,3	0,2	-0,6	-0,7	-0,9	-2,2	-1,9	0,1	1,9
	Std.dev.	7,8	4,3	3,8	3,6	3,6	3,5	3,8	3,0	5,7	4,4
Warmińsko-Mazurskie	N	14	14	16	23	12	14	25	26	23	6
	Median	0,1	0,6	0,1	0,0	-0,3	-0,2	-0,7	-1,2	0,2	0,1
	Mean	-0,2	0,0	-2,4	-0,2	-1,2	-0,1	-2,0	-2,9	-1,6	2,3
	Std.dev.	4,3	2,6	5,9	2,1	4,7	3,3	5,7	8,9	12,1	6,6
Wielkopolskie	N	42	46	42	49	51	54	51	54	50	8
	Median	0,4	0,5	0,6	0,3	0,2	0,3	-2,7	-2,2	0,2	2,5
	Mean	0,4	1,0	0,1	0,7	-1,6	-0,5	-3,2	-2,6	-1,7	0,8
	Std.dev.	7,0	5,1	5,0	5,4	12,4	5,6	5,3	3,8	6,9	6,2
Zachodniopomorskie	N	12	14	16	22	21	21	23	25	18	6
	Median	1,0	1,1	0,3	-1,6	-2,5	-3,4	-3,5	-2,4	-0,3	0,2
	Mean	-0,9	-0,2	-2,6	-3,4	-3,1	-6,0	-6,0	-4,0	-1,8	-3,0
	Std.dev.	8,5	5,6	7,5	7,3	7,9	9,0	8,0	7,9	8,3	9,1
Łódzkie	N	27	28	27	28	30	29	32	34	32	8
	Median	1,0	1,0	0,1	0,3	0,5	0,2	-2,2	-1,7	-0,1	2,2
	Mean	0,8	2,1	0,2	0,5	0,3	0,9	-2,1	-2,9	-1,9	2,6
	Std.dev.	7,7	4,4	4,4	4,3	4,0	5,5	8,1	8,3	10,4	2,2
Śląskie	N	57	63	64	54	68	66	65	72	69	25
	Median	0,8	1,2	0,4	0,3	0,1	-0,9	-4,4	-3,1	-2,4	-0,9
	Mean	1,1	1,5	-0,1	-1,4	-2,9	-3,1	-5,7	-4,6	-4,6	-3,3
	Std.dev.	9,1	8,1	7,0	7,4	9,2	10,8	13,3	11,0	12,5	10,8
Świętokrzyskie	N	3	1	3	5	2	5	13	20	20	0
	Median	-2,0	7,6	4,9	1,1	-9,6	1,1	0,0	-0,2	-0,9	NA
	Mean	0,5	7,6	-0,3	1,7	-9,6	4,4	-4,0	-3,3	-3,2	NA
	Std.dev.	8,4	NA	10,5	2,8	22,0	11,6	7,2	6,1	6,7	NA

Note. ROS values in %, NA – not available.

Source: own elaboration.

Table 7.
Profitability of Urban and Rural Hospitals in the Years 2012-2021

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
ROS (urban)	0,8	0,6	0,4	0,2	0,2	0,1	-1,4	-1,8	0,1	0,9
ROS (rural)	0,2	0,5	0,1	0,2	-0,7	-0,6	-2,7	-2,3	-0,1	0,5
p	0,0585 *	0,5896	0,0087 ***	0,4125	0,0677 *	0,0752 *	0,0042 ***	0,3091	0,8501	0,7716
ROA (urban)	0,8	0,8	0,4	0,2	0,1	0,1	-1,4	-2,4	0,0	0,9
ROA (rural)	0,3	0,6	0,1	0,2	-0,8	-0,9	-3,9	-3,4	-0,1	0,5
p	0,2324	0,7727	0,0263 **	0,5111	0,0689 *	0,0174 **	0,0002 ***	0,0787 *	0,6366	0,8509
ROE (urban)	2,7	2,6	1,2	1,2	1,0	0,7	0,1	-3,2	1,6	3,8
ROE (rural)	1,4	2,0	0,4	1,2	0,1	-0,1	-5,5	-2,2	1,2	3,8
p	0,0416	0,3948	0,0195 **	0,6898	0,0118 *	0,0669 **	0,0001 ***	0,4378 *	0,3928	0,9033
ROS EBITDA (urban)	5,7	6,1	5,8	NA	5,1	4,8	3,2	2,5	4,3	5,6
ROS EBITDA (rural)	5,2	5,7	4,5	NA	3,5	3,5	1,6	2,2	4,0	4,2
p	0,2509	0,5493	0,0247 **		0,0071 ***	0,0188 **	0,0008 ***	0,0906 *	0,4975	0,4600
ROA EBITDA (urban)	7,6	7,3	6,8	NA	5,8	5,5	3,8	3,4	5,1	6,3
ROA EBITDA (rural)	7,4	8,0	6,0	NA	4,7	4,7	2,0	3,1	5,6	6,3
p	0,5248	0,5067	0,1500		0,1192	0,1173	0,0007 ***	0,1920	0,9011	0,9985
ROE EBITDA (urban)	14,0	17,2	14,7	NA	12,2	12,2	9,8	10,0	17,5	17,3
ROE EBITDA (rural)	15,4	17,6	12,6	NA	9,5	8,8	6,7	9,5	12,6	19,5
p	0,3639	0,6682	0,9771		0,2891	0,1852	0,1716	0,3676	0,0120 **	0,6166

Note. values in %, p-values of the Kruskal-Wallis test between urban and rural hospitals in respective years; *** p <= 0.01; ** p <= 0.05; * p <= 0.1, NA – not available.

Source: own elaboration.

Table 8.
Profitability in Polish Hospitals by Legal Form in the Years 2012-2021

	Legal form	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
ROS	Corporation	0,4	0,5	0,2	0,1	-0,8	-0,5	-1,9	-2,2	0,0	0,5
	SPZOZ	0,3	0,5	0,2	0,3	0,2	0,1	-2,4	-2,0	0,0	0,4
	p	0,7834	0,7415	0,9430	0,4798	0,0491 **	0,1215	0,5288	0,7981	0,3400	0,6302
	Other	15,3	9,6	11,2	16,6	19,6	16,3	14,5	10,1	11,1	19,7
ROA	Corporation	0,6	0,9	0,2	0,1	-0,9	-0,7	-2,5	-3,0	-0,1	0,7
	SPZOZ	0,3	0,6	0,2	0,3	0,1	0,1	-3,1	-2,9	0,0	0,5
	p	0,4521	0,6902	0,8325	0,3975	0,0345 **	0,1539	0,5843	0,4563	0,3642	0,6020
	Other	21,6	23,7	24,9	6,8	42,9	49,9	43,7	39,7	39,2	60,3
ROE	Corporation	1,7	2,1	0,6	0,6	0,1	0,0	-2,0	-3,6	1,4	3,8
	SPZOZ	2,2	2,5	1,0	1,6	1,0	0,7	-3,2	-2,2	1,3	2,0
	p	0,9410	0,2396	0,3058	0,2124	0,1071	0,1774	0,2321	0,5804	0,4600	0,6649
	Other	44,2	204,0	63,5	22,5	61,1	94,2	88,1	87,2	74,3	82,1

ROS EBITDA	Corporation	5,1	5,7	4,4	NA	3,5	3,5	2,1	1,9	4,2	4,9
	SPZoz	5,4	5,9	5,3	NA	5,1	4,0	2,0	2,4	4,0	3,7
	p	0,4551	0,1570	0,0763		0,0268	0,1549	0,5096	0,5562	0,7043	0,6765
				*		**					
ROA EBITDA	Other	22,4	14,1	17,7	NA	25,8	24,8	18,8	14,0	14,5	24,7
	Corporation	8,1	7,8	6,3	NA	4,5	4,6	3,1	2,7	5,5	6,3
	SPZoz	6,9	7,4	6,2	NA	5,8	5,4	3,0	3,7	5,1	4,1
	p	0,1648	0,9916	0,5730		0,0699	0,3369	0,6136	0,4425	0,6806	0,6648
ROE EBITDA						*					
	Other	48,0	34,9	38,6	NA	56,8	71,6	60,6	51,5	48,3	71,8
	Corporation	15,9	17,3	13,5	NA	10,2	10,2	6,8	9,3	15,9	19,5
	SPZoz	13,6	17,2	14,3	NA	11,8	10,5	8,8	9,4	13,9	6,3
ROE EBITDA	p	0,2535	0,7468	0,8196	0,6071	0,6071	0,2241	0,8321	0,8822	0,6010	0,1377
	Other	59,8	296,2	88,9	NA	94,2	131,2	104,1	97,1	99,7	94,0

Note. values in %, p-values of the Kruskal-Wallis test between hospitals run in the form of corporation and SPZoz in respective years; *** p <= 0.01; ** p <= 0.05; * p <= 0.1.

Source: own elaboration.

Table 9.

Profitability of Polish Hospitals by Owner Type in the Years 2012-2021

	Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
ROS	Community	-1,9	0,2	-1,9	-2,2	-1,7	-1,3	-9,0	-4,2	-4,4	-3,3
	County	0,2	0,4	0,0	0,2	-0,7	-0,7	-3,3	-2,9	-0,7	-0,1
	Voivodeship	0,4	0,4	0,3	0,2	0,0	-0,5	-2,2	-2,5	-1,6	0,3
	State	0,3	1,0	0,2	0,3	0,5	0,1	-0,8	-2,0	0,4	1,3
	University	0,3	1,3	1,5	0,8	0,8	0,2	-1,4	-0,8	0,2	0,2
	Corporate	1,1	1,3	0,3	1,8	-0,3	-0,1	1,1	-0,7	1,8	4,1
	Other	4,1	5,6	3,2	3,0	2,7	4,2	3,2	3,3	4,5	6,4
ROA	Community	-1,2	0,1	-1,5	-2,8	-1,2	-1,2	-7,8	-5,7	-5,6	-5,6
	County	0,3	0,5	-0,3	0,2	-1,4	-1,1	-4,7	-4,6	-1,1	0,0
	Voivodeship	0,5	0,5	0,3	0,2	0,0	-0,7	-2,7	-2,5	-1,7	0,1
	State	0,5	0,7	0,2	0,2	0,4	0,1	-0,7	-2,0	0,3	1,5
	University	1,2	2,2	3,2	0,7	0,9	0,4	-2,6	-2,2	0,2	0,2
	Corporate	1,1	2,0	0,2	1,8	-0,9	-0,4	0,3	-0,5	1,0	6,5
	Other	7,7	7,6	5,4	4,4	3,4	6,1	3,4	1,9	4,5	8,8
ROE	Community	-0,5	0,6	-2,7	-1,8	-1,4	-1,0	-26,4	-11,4	-11,8	-7,8
	County	1,4	1,6	0,2	0,6	0,2	-0,3	-8,9	-5,7	1,1	0,8
	Voivodeship	2,1	1,7	1,1	1,0	0,1	0,0	-1,3	-1,5	0,5	0,4
	State	2,4	2,0	0,8	1,3	1,1	0,3	-1,0	-7,8	1,0	6,0
	University	8,4	8,1	7,7	3,8	2,5	2,1	-1,3	-0,9	2,0	1,5
	Corporate	7,0	4,7	1,1	7,8	2,4	6,6	5,8	3,7	5,8	14,0
	Other	17,0	14,5	9,2	9,0	10,7	11,2	6,7	6,5	7,8	16,0
ROS EBITDA	Community	3,5	4,1	3,6	NA	2,8	1,9	-2,9	0,4	1,1	0,4
	County	5,0	5,4	4,3	NA	3,2	3,0	0,7	1,5	3,4	2,5
	Voivodeship	5,3	6,0	6,0	NA	4,3	3,7	1,9	1,8	2,8	4,9
	State	5,6	6,8	5,6	NA	7,3	6,0	4,3	2,6	5,9	7,5
	University	5,3	5,2	5,4	NA	5,3	4,5	3,1	4,4	4,4	3,2
	Corporate	7,5	6,1	5,2	NA	6,8	7,3	7,3	5,8	6,8	9,1
	Other	10,0	11,1	9,1	NA	7,8	8,0	8,3	7,6	9,0	10,8
ROA EBITDA	Community	4,0	4,5	3,3	NA	2,2	2,6	-2,3	0,7	1,3	0,7
	County	7,7	8,2	6,1	NA	4,7	5,3	1,4	2,6	5,7	5,1
	Voivodeship	5,9	5,8	5,5	NA	4,3	4,0	2,0	2,1	2,8	3,9
	State	6,3	7,4	5,3	NA	5,7	4,9	4,1	2,6	5,4	7,6
	University	10,6	9,0	9,9	NA	9,0	7,4	5,4	6,8	8,0	5,4
	Corporate	11,5	11,8	11,3	NA	8,8	8,1	9,2	7,7	9,4	12,7
	Other	15,5	16,7	12,8	NA	11,0	12,2	11,8	11,8	12,6	15,5

ROE EBITDA	Community	8,2	14,3	9,2	NA	9,3	7,6	-0,1	11,4	16,5	8,5
	County	13,5	17,6	12,9	NA	9,9	9,3	6,0	9,2	13,6	17,5
	Voivodeship	12,6	14,1	11,5	NA	9,1	6,6	5,1	6,3	9,7	8,4
	State	13,8	13,2	10,5	NA	10,5	9,6	3,7	3,8	13,7	25,6
	University	16,6	16,7	15,3	NA	17,8	19,3	10,6	20,6	23,1	14,6
	Corporate	26,6	23,9	27,0	NA	20,2	18,2	18,7	20,4	22,4	33,8
	Other	27,6	30,7	30,1	NA	22,8	25,0	25,1	21,0	22,7	38,1

Note. values in %, NA – not available.

Source: own elaboration.

Table 10.
Statistical Significance of Differences in Median Return on Sales Between Hospitals by Owner Type in the Years 2017-2020

2017							
	Community	County	Voivodeship	State	University	Corporate	Other
Community		0,0451**	0,0593*	0,0206**	0,0039***	0,0248**	0,0000***
County	0,0120**		0,7806	0,2600	0,0337**	0,1619	0,0000***
Voivodeship	0,0004***	0,0442**		0,1994	0,0243**	0,1928	0,0000***
State	0,0015***	0,0234**	0,4332		0,3642	0,6416	0,0001***
University	0,0008***	0,0082***	0,1401	0,5719		0,9186	0,0011***
Corporate	0,0002***	0,0010***	0,0109**	0,0655*	0,2650		0,0069***
Other	0,0000***	0,0000***	0,0000***	0,0000***	0,0009***	0,0344**	
2018							
2019							
	Community	County	Voivodeship	State	University	Corporate	Other
Community		0,0373**	0,0150**	0,0810*	0,0005***	0,0039***	0,0000***
County	0,0010***		0,4992	0,8282	0,0048***	0,0189**	0,0000***
Voivodeship	0,1025	0,0253**		0,8103	0,0274**	0,0536*	0,0000***
State	0,0039***	0,3494	0,0289**		0,0277**	0,0944*	0,0000***
University	0,0022***	0,1377	0,0372**	0,9711		0,9434	0,0046***
Corporate	0,0008***	0,0182**	0,0009***	0,1482	0,1843		0,0371**
Other	0,0000***	0,0000***	0,0000***	0,0008***	0,0062***	0,0432**	
2020							

Note. p-values of the Kruskal-Wallis test between hospitals run by different owners in respective years; *** p <= 0.01; ** p <= 0.05; * p <= 0.1.

Source: own elaboration.