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Measurement and predictors of the financial performance of public health enterprises in Italy

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Abstract

Introduction: In the healthcare sector, hospitals are by far the largest producers. As their costs continue to rise, sustaining long-term financial sustainability is becoming increasingly difficult. The measurement of healthcare providers' financial performance is less developed in European countries compared to others; structured information on financial performance is especially scarce when providers are publicly financed.

Methods: This study constructs and validates a multidimensional financial performance measure (common factor approach) by the example of Public Health Enterprises (PHEs) in Italy, based on publicly available data. In a second step, several predictor variables are examined in a PLS-SEM model (partial least squares - structural equation model), including the environmental factor *umbrella institutions' financial performance* (Region), structural factors *size (absolute), size class, teaching/scientific function* and *specialization*, operational factor *occupancy* and *complexity of treatment* and the staffing factor *non-medical staff rate.*

Results: The proposed measure aggregates multiple dimensions of financial performance (e.g. profitability, liquidity, capital structure) and satisfies all necessary conditions of construct reliability and validity. For PHEs in Italy, financial performance is significantly negatively influenced by the Region's financial performance (financial recovery plans) and the complexity of treatment, whereas medium-sized and specialized providers show comparatively significantly better performance levels. For the variables: size (absolute), teaching/scientific function, occupancy, and non-medical staff rate, no significant influence could be found.

Discussion: This study provides insights into the financial performance of PHEs and is useful in identifying risks (negative influencing predictors and their trend) as well as favorable circumstances (positive influencing predictors and their trend). Moreover, different policymakers (the central government, the central bank, regions, and supervisory bodies, such as the court of auditors) may take an advantage from using this information and methodology to ensure the healthcare system is sustainable and adequately controlled in the long run. Our approach may also be useful for banks and credit institutions, or hospital pharmaceutical and medical device suppliers in estimating financial risks associated with their counterparty.

Take-home message: (1) Investments in process efficiency and structural improvements, which could help defeat financial problems and lead to financial sustainability, especially in Regions with recovery plans. (2) Reimbursement for more complex treatments should be raised. (3) When reorganizing health service production, medium-size should be the preferred hospital size. (4)

Simultaneously, the specialization of providers should be prioritized. Overall, indicated suggestions could be implemented by splitting large hospitals into smaller, specialized units.
Keywords: Financial performance; healthcare provider; hospitals; PLS-SEM; public health enterprises.

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INTRODUCTION

Healthcare is an integral part of the economic foundation of every developed country. Today the sector accounts for around 10% of Europe's GDP expenditure [1,2] and the figure has increased in the past few years [2]. Healthcare is produced primarily by hospitals, and therefore it is not surprising that they account for almost 40% of EU healthcare expenditure.

Healthcare providers are confronted with various challenges that are making financial sustainability increasingly demanding. Costs will increase in the future due to ageing and the increasing costs of technological advancements. Public funding prevails among hospitals in Europe [3]. The important role of hospitals in overall health budgets and rising costs make them obvious targets for governments seeking to limit or curb growth in (public) expenditures [4]. Greece, Ireland, Italy, Portugal, Spain and others have adopted austerity policies, drastically reducing public spending, particularly in the healthcare sector [5].

A combination of a susceptible financial position and the increasing debt of public healthcare providers has become an issue over the past few decades, not only in Italy but also in many different European countries (other Southern European countries and many Eastern European countries) [6–8]. The Italian public health sector is currently experiencing severe problems paying its liabilities [9]. Therefore, payment delays are common among providers, but they differ based on divergent economic contexts (funding) and varying efficiency levels. Medical materials, medical devices, and drug suppliers in particular are under considerable financial and liquidity pressure due to delays in public hospital payments [10].

The purpose of this study is to contribute to existing literature in the pursuit of the following goals: (1) create a financial performance measure for PHEs (Public Health Enterprises) in Italy, which comprehensively covers multiple dimensions of financial performance (e.g. profitability, liquidity, capital structure), is statistically valid, reliable and easy to interpret; (2) assess the influence of various internal and external factors on the financial performance of PHEs and (3) draw conclusions for the management and future design of PHE and comparable healthcare producers.

In order to accomplish these goals, we used publicly accessible data and PLS-SEM (Partial Least Squares - Structural Equation Modeling) to calculate the dependent variable financial performance and the associated predictors. This statistical method has seldom been used in analogous research contexts despite its widespread acceptance. As a result, no literature has been identified with a model that estimates the influence of internal and external predictors on the financial performance of public healthcare providers in Europe.

Potential benefits for public and private stakeholders emerge from the results of the current research. (1) Financial institutions, and hospital suppliers need measures to estimate their counterparty risk. (2) Additionally, policymakers, such as the central government, regions or the court of auditors should be provided with easily comprehensible financial performance measurement analysis to ensure sustainability and control. (3) Moreover, PHEs themselves could be supported in their decision-making processes, as non-profits or public hospitals must also consider financial dynamics [11]. (4) Other stakeholders, such as employees, research facilities and the central bank, could also benefit from this information and measurement approach.

Institutional context

Health care in Italy is mainly delivered by a region-based National Health System in Italy (NHS;"Servizio Sanitario Nazionale" - SSN"). About 75% of healthcare expenditure in Italy is funded

by public sources (national and regional taxes), and approximately 80% of hospital beds are owned by public institutions [12,13]. General objectives, basic principles and a stipulated body of health services feasible to all citizens ("Livelli Essenziali di Assistenza" – "LEA") are all established and defined at a national level. Regional governments play a crucial role in Italy's NHS, as their primary responsibility is to fund, regulate and deliver healthcare services [12]. Around 85% of the regional budget goes toward healthcare funding, making it central in political and policy terms for Regions [14,15]. Regions deliverer health services at a local level through Local Health Authorities (LHA; "Aziende Sanitarie Locali" – "ASL"; N=99 in 2020). LHAs also pay other public or private hospitals for service delivery. When health services are not directly delivered by LHAs but by other public hospitals, i.e. Public Hospital Enterprises (PHE; "Azienda Ospedaliera" – "AO"; N= 84 in 2020) and National Institutes for Scientific Research and Treatment (NISRT; "Istituto di ricovero e cura a carattere scientifico" – "IRRCS"; N= 20 in 2020), health providers cooperate within a quasi-market system.

Approximately 30% of Italian public hospitals are PHEs and NISRTs [13], which also own around half of all hospital beds. In this paper, we use the term PHE in its broad sense to also include NISRTs and University Hospitals. Funding is the fundamental distinguishing characteristic of two primary healthcare production and spending institutions (LHAs vs. PHEs). While LHAs are funded based on their population (per capita funding), PHEs are mainly receive funding based on their healthcare production (per-service funding) [6,15]. PHEs are characterized by extensive organizational, financial and decision-making autonomy, resulting in semi-independent hospital enterprise status. Similarities exist in comparable healthcare system arrangements, such as British trust hospitals, or forms of autonomous hospitals in Spain and Portugal [16]. From a theoretical viewpoint, this high degree of autonomy arises from three major reasons: (1) rapid technological advancements, (2) an increase in patient expectations regarding quality, safety, responsiveness, and choice of healthcare providers in recent years and (3) increasing political pressure for a restructuring of traditional governance models [17].

Current state of research

Currently, most research on the financial performance measurement of healthcare providers is focused on hospitals in the United States. Other healthcare systems have fewer publications on this subject, and there appears to be a gap in literature on the financial performance of European health care providers [7]. This shortcoming is especially prevalent in countries with public providers [18], such as PHEs in Italy. The literature on the financial performance measurement of healthcare providers is primarily concentrated on various financial key performance indicators (KPIs) that provide information on different dimensions of financial performance (for instance revenue, liquidity, or capital structure). Moreover, there is no hierarchy between indicators in this approach, making it impossible to rank them according to their predictive power or importance. The order of KPI importance is unclear as different studies cite different KPIs. These circumstances have given rise to ambiguous expectations and varying interpretations. Single KPIs only capture a part of the overall dimension of financial performance and cannot measure the entire construct. Unfortunately, many earlier studies did not establish a composite score or build a single common factor, yet both approaches would have overcome the difficulties mentioned, yielding more accessible and meaningful results. A common factor or composite approach is also crucial for interpreting internal and external factors influencing financial performance. Based on the results of a prior literature review, various KPIs as dependent variables are responsible for to conflicting research results and contradictory interpretations of the strength and significance of external and internal factor influence [19]. As a result, it is essential to establish a single financial performance measure that captures a broad spectrum of financial performance dimensions. Also, there also appears to exist a lack of literature on the influence of umbrella institutions (Regions in our case) or other overarching organizations or funders (such as health insurance) on healthcare providers' financial performance. Moreover, no research until now analyzed how different internal and external factors (such as the age of the population, size, and the complexity of treatment) affect the financial performance of public

health enterprises in Italy. Although there has been unquestionable progress in the area in Italy see Cantù et al. [20]), former studies have often included a restricted amount of providers, all studies to date have been published in the Italian language, [20–28] and most focus on the income statement without taking into account aspects of the statement of assets and liabilities [20]. Until now, studies referring to the Italian Healthcare System have primarily relied on descriptive statistics or the evolution of financial performance KPIs over time.

Finally, even though SEM methodology has several advantages compared to other statistical techniques, its adoption has been relatively limited in international research in this field. To the author's knowledge, to date there has never been a study that has adopted this approach with public hospitals in Europe. Using a more complex data analysis method, such as SEM, current research intends to advance the understanding of different dynamics. Even though it is not possible to transfer the findings of this research directly to other healthcare settings, they could contribute to an interesting methodological foundation for similar research in other comparable healthcare systems, such as those in Spain, Portugal, Poland, and Great Britain.

METHODS

Conceptual framework

The literature review by Oner et al. [19] indicates that financial performance has different dimensions (profitability, liquidity, capital structure, activity, cost, revenue, and utilization). In this study, financial performance is defined as the common factor underpinning these categories. The financial performance of healthcare providers is influenced by various internal and external factors, including structural, operational, environmental/market, strategic, and staffing factors.

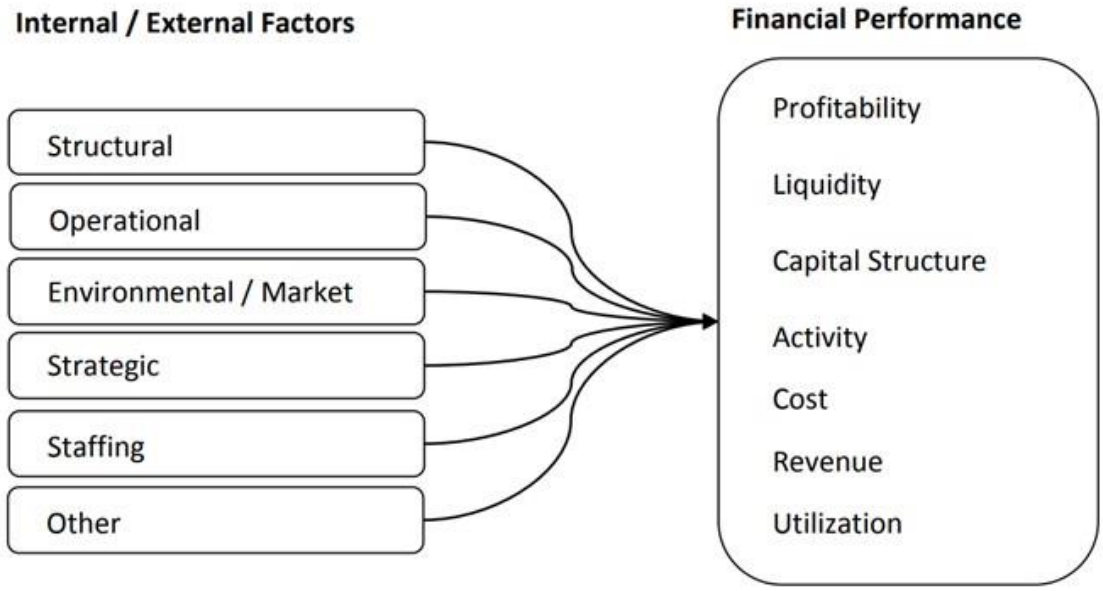

Figure 1. Conceptual Framework as reported by Oner et al. [19].

Dependent Variable: Financial Performance

A literature review identified various financial performance measures [7,11,19,29–61]. As a result reclassification of the balance sheet was calculated [20,62], as well as key performance indicators (KPIs) (n = 222) from different dimensions of financial performance [19,58]. All calculated indicators were primarily evaluated by the authors for overall validity (precision of calculation, systematic reporting differences, confidence), importance, and utility.

Oner et al. [19] and other significant studies in this field [38,58] provided the framework for matching the single KPIs to the corresponding dimensions. Regarding the dimension "utilization," the reasoning of Oner et al. [19] is not cohesive. On the one hand, they argue that this is a sub-dimension of financial performance (see Fig. 1). On the other hand, in the results they claim it is an

influencing factor (independent variable) of financial performance. As in other studies of the field (for instance, Liu et al. [48]), the authors of this study modeled "utilization" as an independent variable.

Initially, exploratory factor analysis was conducted to deal with the large amount of KPIs. The following considerations were made to select the appropriate factor: (1) the one with the most different theoretical dimensions (see table 1) and (2) the one with the highest confirmation from previous research regarding the influence of the KPIs for the factor. KPIs with high factor loadings were then utilized as the dependent variable within the subsequent SEM analysis. Table 1 outlines the KPIs that were applied to the final model.

Table 1. KPIs of the dependent variable financial performance.

Id	Dimension	Indicator	Calculation	Literature Source
OIB	Revenue	Operating income to hospital beds	$\frac{\text{Operating income}}{\text{Hospital beds}}$	24,63
TM	Profitability	Total Margin	$\frac{\text{Net income}}{\text{Total revenues}}$	7,11,19,29,32,33,36,38,45,49–51,53,55,56,58
OM	Profitability	Operating Margin	$\frac{\text{Operating income}}{\text{Total revenues}}$	11,19,21–24,32,33,38,40,49,53,55,58,64
TAT	Activity	Total asset turnover	$\frac{\text{Net income}}{\text{Total Assets}}$	11,19,29,32,38,40,45,48,59,64,65
TAO	Activity	Total asset turnover (operating revenue based)	$\frac{\text{Operating income}}{\text{Total Assets}}$	21,22,30,38,55
TCR	Cost	Total Costs to total revenues (reverse coded)	$\frac{\text{Total costs}}{\text{Total revenues}}$	11
DAP	Liquidity	Days in accounts payable (reverse coded)	$\frac{\text{Debt} * 365}{\text{Costs for goods+services}}$	44
ASP	Liquidity	Average Payment Time to suppliers (reverse coded)	$\frac{\text{Debt to suppliers}}{\text{Costs for goods+services} * 365}$	20–22,28
DSO	Liquidity	Days Sales Outstanding (reverse coded)	$\frac{\text{accounts receivables}}{\text{12-month-roling sales}} * 365$	10,66
DPB	Capital Structure	Dept per Hospital bed (reverse coded)	$\frac{\text{Total liabilities}}{\text{Hospital beds}}$	67
DPD	Capital Structure	Dept per Discharge (reverse coded)	$\frac{\text{Total liabilities}}{\text{Discharge}}$	Based on [67] and [49] denominator was adapted to discharges (instead of population or beds)

EQF	Capital Structure	Equity financing	$\frac{\text{Equity}}{\text{Total Assets}}$	19,23,32,38,40,45,50,51,58,68
DSL	Capital Structure	Debt to suppliers to Total liabilities (reverse coded)	$\frac{\text{Debt to suppliers}}{\text{Total Liabilities}}$	Based on [10] and [66], who stressed the importance of payment delays (which result in debt) and recent developments [9]

Independent variables: Internal and external predictors

Not only does this study intend to examine the specific context in which PHEs in Italy operate, it also aims to introduce an unprecedented predictor variable as the influence of an umbrella institution's financial condition (Regions in our case). All internal and external factors are generally considered when public data is available. For this reason, the following predictor variables of financial performance were incorporated in the final PLS-SEM model: Regional financial status, hospital beds (absolute size and medium-size class), teaching/scientific function, specialization (specialized vs. not specialized), occupancy, the complexity of treatment and non-medical staff rate.

Environmental Factor: Region

Subnational governments are typically responsible for healthcare policy, which is also true in Italy for Regions [69]. However, regions differ broadly in terms of the strength of their economies, efficiency, and debt levels. There are Regions with abundant liabilitiy levels and therefore under financial recovery surveillance of the central government ("*Piani di rientro*"), and Regions without financial recovery plans. Out of 20 Regions, seven (Abruzzo, Apulia, Calabria, Campania, Lazio, Molise, and Sicily) are subjet to financial recovery plans [15,70].

Hypothesis 1: Recovery plans of Regions negatively influence the financial performance of PHEs.

Structural Factor: Size (absolute and size-class medium)

Different and partly interacting economic effects build the theoretical foundation of hospital size considerations. Economies of scale are the most important and extensively analyzed effects, indicating that larger organizations are able to spread fixed overhead costs across many products or service cases. This is especially important for hospitals, as their operations are primarily based on fixed costs (mainly because of high investments). However, economies of scale can also stem from an organization's learning and innovation, or arise due to new and better utilization capacity effects [71].

Hypothesis 2: Size positively influences the financial performance of PHEs.

Remarkable argumentation supports the assumption that the relationship between size and financial performance is non-linear (u-shaped average cost curve). This is sustained by Hefty's [72] findings on cost structures, which indicate that the long-term average cost curve tends to be U-shaped in hospitals. It has also been shown that above-medium size providers with around 300 to 600 beds benefit from the highest scale effects, and while large hospitals furthermore achieve large returns on scale, in addition they face diseconomies of scale, with their output undermined by considerable structural/organizational complexity, transaction costs and disadvantages of scope due to a higher degree of heterogeneity [73–75]. The authors introduced an independent variable (Size_M) for this reason. Three equally distributed PHE size groups were built: Small Group (Size_S) with up to 400 hospital beds; Medium Group (Size_M) from 400 to 700 hospital beds and Large Group (Size_L) with over 700 hospital beds. In this way, differences between size groups can be tested.

Hypothesis 3: Medium size positively influences the financial performance of PHEs.

Structural Factor: Teaching/scientific function

There are two subgroups of PHEs, which other than classic hospital functions, also have additional research functions (NISRT), and others with teaching and research functions (university hospitals – UH). Generally, the mission of such hospitals is, to combine patient care with research (and teaching) activities. Previous research into the impact of teaching/scientific functions on

financial aspects has yielded inconsistent results. Some authors identified positive effects of teaching/scientific functions on financial performance [48,59],while others reported negative influences [64,73,76]. Schreyögg & Reitzenstein [76] state that as an important cost-driving factor, teaching is insufficiently considered in compensation. This controversy is also confirmed by the systematic review of Oner et al. [19]. Arguably these findings should be interpreted in relation to their specific healthcare contexts and relative compensation schemes, as both studies from the USA identify a positive effect while prevalently negative effects were found in the other studies (Korea, Australia, and Germany). As the studies outside the USA indicate a negative influence of teaching/science functions on health providers' financial performance, the authors also hypothesize it for this study.

Hypothesis 4: Teaching/scientific function negatively influences financial performance of PHEs.

Structural Factor: Specialization

There are two main categories of hospital service status: general hospitals that treat all kinds of patients and pathologies; and specialized hospitals that provide a limited set of procedures or services. Normally the specialization focuses on special types of patients (such as chronic disease or long-term patients, children), or certain categories of illness or injuries, mostly based on medical disciplines (often orthopedics, cardiac, oncology, or neurology). From a theoretical perspective, general and specialized hospitals differ in their scope, i.e. an extensive service offering compared to a limited set of services. Current literature referring to economies of scope in hospitals (reduction in the cost of producing one good or service, resulting in a reduction in the cost of producing another related good) indicates that specialized hospitals are less costly and more efficient [73,77,78].

Hypothesis 5: Specialization positively influences the financial performance of PHEs.

Operational Factor: Occupancy

The occupancy rate refers to the percentage of beds in a hospital that have been occupied by patients in a given period of time, generally one year. Essentially it measures the efficiency of hospital bed use. The hospital occupancy rate is the most important parameter for evaluating utilization. It is expressed as a percent and numbers close to 100% express high utilization. Previous research on the topic affirms that higher occupancy positively influences financial performance [19,37,79].

Hypothesis 6: (High) Occupancy rates positively influence the financial performance of PHEs.

Operational Factor: Complexity of treatment (Case Mix Index)

The complexity of treatment is usually measured using the Case Mix Index (CMI), which is calculated as the average relative DRG weight of discharges. Higher CMIs indicate more complex cases. Earlier studies found that higher CMIs negatively influence hospital financial performance [19,48,59]. Operating revenue increases as complexity rises, however this also entails a rise in operating expenses. Therefore reimbursement for higher complexity patient treatments does not appear to offset the consumption of additional resources [19].

Hypothesis 7: (High) Case Mix Index negatively influences the financial performance of PHEs.

Staffing Factor: Non-medical staff rate

Human resources are a core element of healthcare systems. The healthcare workforce can be divided into two main groups, according to its contribution to the hospital's core business and patient treatment (1) medical staff in the broadest sense, including all professionally qualified clinical staff members, different medical doctors such as surgeons, anesthetists, and other specialists, nurses and midwives; (2) non-medical staff, which include those working in supporting functions, such as therapeutic staff (physiotherapists, for example), diagnostic/technical staff (workforce in laboratories or radiology, for example) and administrative staff (with a wide variety of functions ranging from other supporting functions to management ones). Labor costs are considered to make all the difference in healthcare costs and, thus, financial performance. This is specifically the case for the number of resources used for the non-core business workforce and non-medical staff.

Hypothesis 8: (High) Non-medical staff rate negatively influences the financial performance of PHEs.

Table 2 outlines the independent variables included in present research, internal/external predictor category belonging, variable type, and calculation.

Table 2. Independent variables/predictors.

Hypo-thesis	Internal / External Predictor Category	Predic-tor	Variable Name	Variable Type	Calculation / Annotation	Impact on Fin. Perform.
H1	Environmental Factor	Region	RegReco-veryYes	Dichotomous	Dummy: RegRecoveryYes=1	↓
H2	Structural Factor	Size	Size	Continuous	Absolute Size in hospital beds	↑
H3	Structural Factor	Size Class Medium	SizeM	Ordinal	Size Class Medium: Between 400 and 700 hospital beds	↑
H4	Structural Factor	Teaching/ scientific function	Teaching-Scientific	Dichotomous	Dummy: TeachingScientific= 1 (UH/NISRT)	↓
H5	Structural Factor	Specializa-tion	Specialized	Dichotomous	Dummy: Specialized=1	↑
H6	Operational Factor	Occupan-cy	Occupancy	Continuous	Department Occupancy aggregated weighted on a PHE basis	↑
H7	Operational Factor	CMI	CaseMix-Index	Continuous	Department CMI aggregated weighted on a PHE basis	↓
H8	Staffing Factor	Non-medical staff rate	NonMedical Staff	Continuous	$\left(\frac{\text{Non-medical staff}}{\text{Total staff}}\right)$	↓

COVID-19 pandemic had undoubtedly an meaningful impact on different aspects of Italy's healthcare system [80] with several different restriction policies [81]. To make sure that COVID-19's implications (on the data of the year 2020) does not affect the results of this analysis we performed a Multigroup analysis in SmartPLS. No significant difference between 2020 and 2019 on path coefficients or factor loadings can be reported. According to this, as also acknowledged by current literature [82,83], arguably most additional costs caused by COVID-19 pandemic have been covered by the central government.

Data sources

Based on publicly available secondary data, this study analyzed all PHEs (N = 97 per year) in Italy over a three-year period 2018-2020 (N = 291 in total). LHAs were not included in this study due to differences in funding.

We used data from publicly available data sources. Balance sheet data were obtained from the website of the Ministry of Economy and Finance [84]. Data on days-sales-outstanding were provided

by "*Confindustria Dispositivi Medici*" (association of medical device suppliers). The authors obtained information on the recovery situation in Regions from the Ministry of Health, [85]. Additional data, such as hospital beds (size), teaching/science function, specialization, occupancy, Case Mix Index and non-medical staff, were obtained from the Ministry of Health website [13]. Information on specialization was obtained in a 2 step process. First, the authors calculated the proportion of all department discharges to overall discharges. If a certain department had a very high proportion of discharges (an outlier), in a second step, the authors then investigated further on the PHE's website to ascertain its specialization. In the extracted database, the occupancy rate is measured by hospital department or at a hospital level, and PHEs may have multiple hospitals. The ward occupation rate was then multiplied by ward beds, summed up to a PHE level, and divided by complete PHE hospital beds. In this way, PHE occupancy rate level is weighted according to ward occupancy rates. In the downloaded database, CMI comes from a hospital ward or hospital level, and PHEs may have multiple hospitals. Therefore, ward CMI was multiplied by its ward beds, summed up to a PHE level, and divided per overall PHE hospital beds. In this way, every PHE CMI is weighted on ward CMI basis level. Similarly, single CMIs become aggregated to hospital CMIs on a regular basis.

Statistical analysis

The PLS-SEM model in this study was implemented using Smart-PLS version 3.3.9 [86]. SEM is a multivariate technique used to simultaneously analyze diverse statistical relationships by integrating two analytical techniques: factor analysis and regression analysis. SEM models come in a variety of forms; in recent years, the non-parametric method PLS-SEM has become more widespread in different research fields, especially management and social science [87]. PLS-SEM can be considered an adequate analysis technique for this study, based on the following considerations,: (1) the objective of current research is to test a theoretical framework from a prediction viewpoint; (2) secondary/archival data, financial ratios, and similar data artifacts are at the basis of the research; (3) The size of the investigated population is" "naturally" small; (4) a lack of normality in the distribution of data is an issue of concern [87]. The authors used a three-year data approach (2018-2020) in order to increase the sample size and thereby be able to discover smaller data effects.

Table 3 contains the characteristics of the PHEs (97 in 2018, 97 in 2019 and 97 in 2020) analyzed in the final model.

Table 3. PHE characteristics.

Variable	Total
PHEs (N)	291 (2018: 97; 2019: 97; 2020: 97)
RegRecoveryYes (N,%)	102 (35%)
Size (Median, 95% CI)	557 (548; 623)
SizeM (N,%)	106 (36%)
TeachingScientific (N,%)	105 (36%)
Specialized (N,%)	48 (16%)
Occupancy (Median, 95% CI)	81 (79; 82)
CaseMixIndex (Median, 95% CI)	1.02 (0.99; 1.03)
NonMedicalStaff (Average, 95% CI)*	37 (36; 38)

Note: Median and 95% CI when Kolmogorov-Smirnov or Shapiro-Wilk do not show normal distribution; * Shapiro-Wilk is not significant.

RESULTS

Assessment of the measurement model

Indicator reliability

Indicators that achieve factor loadings of > 0.7 should be integrated in the model. It is recommended that factor loadings between 0.4 and 0.7 should be considered, if significant [88]. Indicator reliability and significance level of the latent construct financial performance are shown in Table 5.

Table 5. Factor loadings of the dependent Variable financial performance.

Id	Indicator	Oouter Loading	Significance Level
OIB	Operating income to hospital beds	0,848	***
TM	Total Margin	0,945	***
OM	Operating Margin	0,890	***
TAT	Total asset turnover	0,914	***
TAO	Total asset turnover (operating revenue based)	0,891	***
TCR	Total Costs to total revenues (reverse coded)	0,912	***
DAP	Days in accounts payable (reverse coded)	0,607	***
ASP	Average Payment Time to suppliers (reverse coded)	0,706	***
DSO	Days Sales Outstanding (reverse coded)	0,703	***
DPB	Dept per Hospital bed (reverse coded)	0,807	***
DPD	Dept per Discharge (reverse coded)	0,781	***
EQF	Equity financing	0,818	***
DSL	Debt to suppliers to Total liabilities (reverse coded)	0,634	***

*Note: Significance level: p-Value <0,05 = *; p-Value <0,01 = **; p-Value <0,001 = ****

Construct reliability and convergent validity

Reliability is normally measured using Cronbach Alpha (>0.7), Composite Reliability (CR; >0.7), and Rho Alpha (Rho_A; >0.7) [87]. Convergent validity is assessed through the average variance extracted (AVE) with a threshold value >0.5 commonly applied [87]. According to Table 6, construct reliability and convergent validity are established in this analysis.

Table 6. Construct reliability and convergent validity.

Construct	Cronbach's Alpha	rho_A	Composite Reliability (CR)	Average Variance Extracted (AVE)
Financial Performance (FIN_PERF)	0.955	0.969	0.961	0.658

Discriminant validity

For conceptually different constructs HTMT threshold is <0.85 and for conceptually similar constructs <0.9 are considered appropriate. Table 7 shows the HTMT values of the factors of the model. As a result, the authors can affirm that discriminant validity is established.

Table 7. Discriminant validity.

	CaseMix Index	FIN_PERF	NonMedicalStaff	Occupancy	RegRecoveryYes	Size	SizeM	Specialized	Teaching Scientific
CaseMix Index									
FIN_PERF	0.221								
NonMedicalStaff	0.056	0.159							
Occupancy	0.168	0.065	0.185						
RegRecoveryYes	0.140	0.367	0.607	0.085					
Size	0.124	0.129	0.028	0.151	0.279				
SizeM	0.137	0.135	0.289	0.020	0.192	0.075			
Specialized	0.122	0.102	0.236	0.229	0.023	0.546	0.298		
TeachingScientific	0.346	0.127	0.142	0.080	0.102	0.115	0.316	0.534	

Structural Model

Figure 2 presents the results of the structural model (left side) with the outer loadings of the measurement model for the dependent variable financial performance (right side). The black circle in the center of Figure 2 represents the dependent variable financial performance with its R2 value of 0.230.

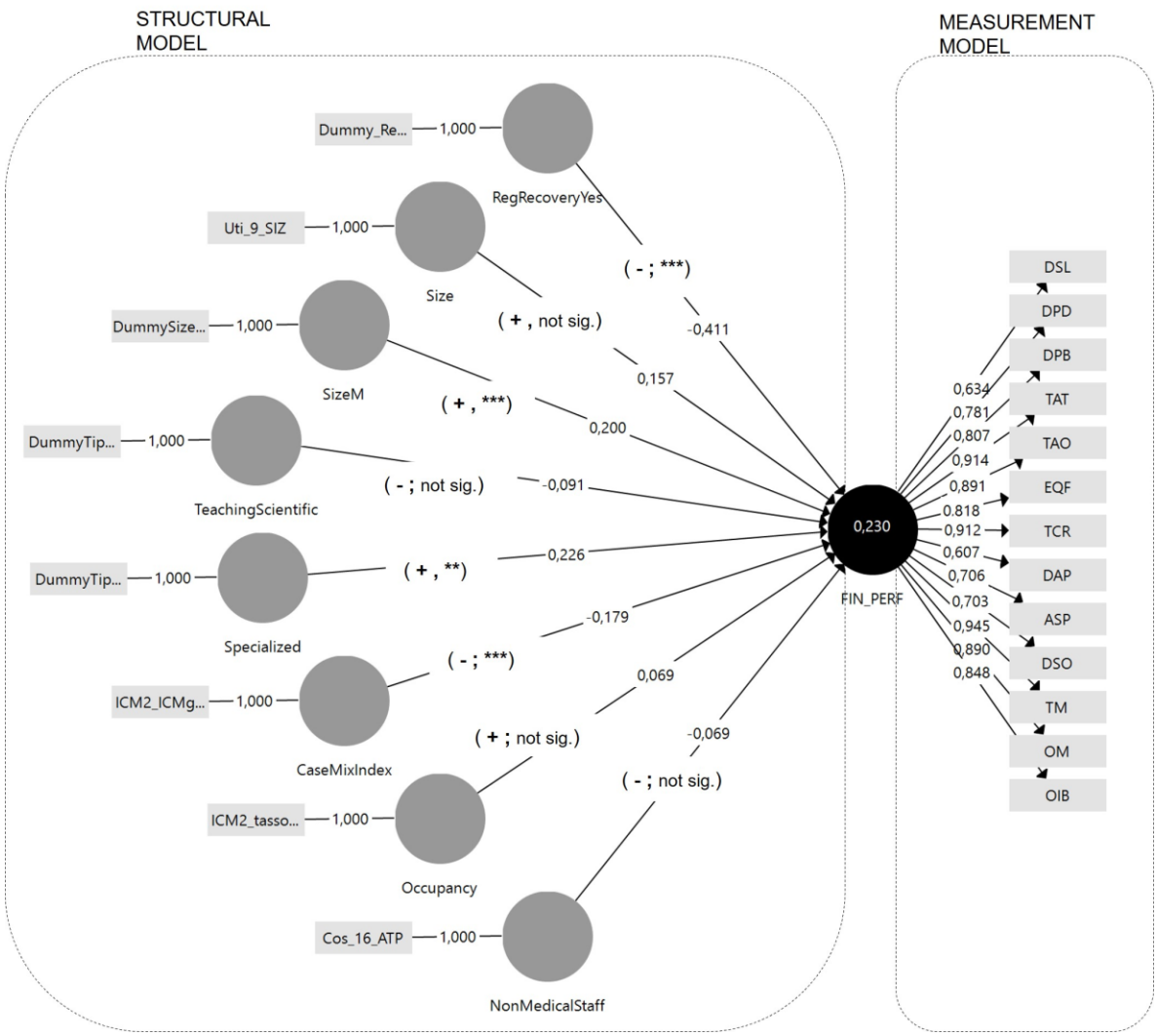

Figure 2. Structural model with path coefficients, their corresponding expected direction and significance level, outer loadings and R2.
*Note: Significance level: p-Value <0.05 = *; p-Value <0.01 = **; p-Value <0.001 = ***;*

Predictive accuracy/ coefficient of determination R2 and predictive relevance Q2

Using the R2 statistic, it can be determined to what extent the independent variables (RegRecoveryYes, Size, SizeM, TeachingScientific, Specialized, CaseMixIndex, Occupancy, and NonMedicalStaff) explain the dependent construct (financial performance). R2 should be evaluated in relation to the research field in which the study is being conducted. Similar analysis demonstrates rather low coefficients of determination with pseudo- R2 of 0.21 [48] and 0.14 [59] and R2 of 0.05 and 0.19 [61]. In light of the coefficients of determination values of previous studies that have analyzed similar issues, the authors consider the R2 obtained in this study to be moderate. Predictive relevance is achieved as Q2 exceeds 0 [89]. Table 8 represents R2, R2 adjusted and Q2.

Table 8. Predictive accuracy (R2, R2 adjusted) and predictive relevance (Q2).

Dependent Variable	R^2	R^2 Adjusted	Q^2
Financial Performance (FIN_PERF)	0.230	0.208	0.126

Hypothesis Testing

Bootstrapping is adopted to determine the significance of path coefficients. A p-value lower than 0.05 is generally considered to be significant.

Table 9. Significance of path coefficients and effect size (F2).

Independent Variable	Path coefficients	F^2	p-Values
RegRecoveryYes	-0.411	0.116	***
Size	0.157	0.017	not sig. (p-Value 0.064)
SizeM	0.200	0.040	***
TeachingScientific	-0.091	0.006	not sig. (p-Value 0.157)
Specialized	0.226	0.027	**
Occupancy	0.069	0.005	not sig. (p-Value 0.248)
CaseMixIndex	-0.179	0.032	***
NonMedicalStaff	-0.069	0.003	not sig. (p-Value 0.377)

*Note: Significance level: p-Value <0.05 = *; p-Value <0.01 = **; p-Value <0.001 = ****

Hypothesis 1: Recovery plans of Regions negatively influence the financial performance of PHEs.

The hypothesis can be confirmed (path coefficient: -0.411; p-Value: 0.000).

Hypothesis 2: Size positively influences the financial performance of PHEs.

This hypothesis cannot be confirmed. A moderate positive influence can be observed, however, the effect is not significant by a very small margin (p-Value: 0.064).

Hypothesis 3: Medium-Size positively influences the financial performance of PHEs.

A somewhat inverse u-shaped relationship emerges, as medium-sized PHEs are significantly positively influenced in terms of financial performance. In contrast, both small-sized PHEs (path coefficient: -0.200; p-Value: 0013) and large PHEs (path coefficient: -0.231; p-Value: 0.001) show a significant negative effect on financial performance.

Hypothesis 4: Teaching/scientific function negatively influences financial performance.

This hypothesis cannot be confirmed. The path coefficient indicates a slightly negative influence (-0.091), however the effect is not significant.

Hypothesis 5: Specialization positively influences financial performance of PHEs.

This hypothesis can be confirmed.

Hypothesis 6: (High) Occupancy rates positively influence the financial performance of PHEs.

The hypothesis cannot be confirmed. The path coefficient demonstrates a slightly positive influence (0.069), however the effect is not statistically significant.

Hypothesis 7: (High) Case Mix Index negatively influences the financial performance of PHEs.

This hypothesis can be confirmed.

Hypothesis 8: (High) Non-medical staff rate negatively influences the financial performance of PHEs.

This hypothesis cannot be confirmed. As hypothesized, the direction of the influencing effect is negative, but not statistically significant.

DISCUSSION

Although several studies have been conducted on the measurement of the financial performance of (public) healthcare providers [7,11,19,29–61], just a small amount of research projects have succeeded in constructing a comprehensive yet easy-to-interpret and comprehensive financial performance measure. Our study has enabled the development and statistical validation of such a common factor measure. Literature is lacking in studies investigating the impact of external and internal factors on the financial performance of health providers in Italy. The use of a more sophisticated methodology like PLS-SEM, which to date has never been applied in the field of public healthcare provider financial performance measurement and predictors, has enabled the simultaneous testing of different predictors in a single model. Overall, the results are consistent with international literature, and provide interesting insight in the field.

Our first hypothesis was based on the influence of an environmental factor, such as Regional Recovery Plans ("RegRecoveryYes"), on the financial performance of PHEs. Bootstrapping results confirmed this hypothesis and a large extent of influence can be reported. Such an influence has never been empirically tested in other national or international studies of similar scope. These results also provide us with an understanding of how subordinate organizations and healthcare providers are linked. By looking at the specific context of Italy, results show how the financial performance of public healthcare actors is linked and how (low) financial performance is transmitted from overarching level (Region) to the subordinate level (PHE).

Regional recovery plans should not purely aim to reduce liabilities by imposing spending cuts, since this unavoidably reduce health care in qualitative and quantitative terms (longer waiting lists, for example). Rather, the goal should be to achieve long-term structural improvements and process efficiency improvements. Long-term structural developments and improvements in process efficiency should be pursued, especially in regions under recovery plans. In addition to implementing further efficiency incentives, policy makers should increase accountability and responsibility for financial performance. For PHEs with poor financial performance and liquidity problems, the implementation of bankruptcy-like procedures may be appropriate, similar to what is currently applied in Italian municipalities. As a result, regional governments and PHEs would be separated more on an institutional level, especially so in the case of PHEs with poor financial performance. Suppliers would also be required to closely monitor the financial performance of PHEs in order to ensure adequate counterparty (financial) risk estimation. On an investment level, it can be assumed that the NextGenerationEU fund investments will strengthen both Regions and health service providers in terms of improving overall health service quality and reducing overall health care costs through large investments in digitalization [90].

Hypothesis 2 investigated whether the financial performance of PHEs is influenced by the structural factor (absolute) size of providers. The influence is positive as imagined, although the hypothesis cannot be confirmed. However, this structural factor still matters, as medium-sized hospitals are influenced strongly and in a statistically significantly positive way (Hypothesis 3). It was also found that large PHEs (>700 hospital beds; path coefficient: -0.231; p-Value: 0.001) and small PHEs (<400 hospital beds; path coefficient: -0.206; p-Value: 0.013) are influenced in a significantly negative way. These results support previous findings [72,73]. While small hospitals are typically quite efficient, their financial performance is hampered by a low return on scale. Wang et al. (2006) found that small hospitals are more labor-intensive than large hospitals, which also negatively impacts financial performance. This is especially important considering that it is estimated that labor costs constitute more than half of hospital expenses [71]. It has been shown that above medium-size providers with around 300 to 600 beds benefit from the highest scale effects, and that while large hospitals still achieve high returns on scale, they are also faced with diseconomies of scale, since

considerable structural/organizational complexity, transaction costs and disadvantages of scope due to a higher degree of heterogeneity undermine their output [73–75] and therefore this should be taken into consideration in future hospital reforms. Respectively, small hospital organizations should be enlarged (only if acceptable occupancy rates can be ensured); large hospitals should not be further enlarged, a frequent occurrence in response to new investments; rather they should be downsized over time, or divided into specialized units. In combination with the results of hypothesis 1, Regions under recovery fund restrictions in particular should take these results into account, as healthcare organizations must be overhauled in order for fundamental transformations to take place.

A further structural factor of teaching and scientific functions of PHEs as a predictor does not have a significant influence on financial performance (hypothesis 4).

In contrast, an additional structural factor, specialization, turned out to have a significantly positive influence on the financial performance of PHEs (hypothesis 5). These findings corroborate the results of prior studies. An implication of these findings is the potential for improvement from a financial viewpoint, which ties in with results regarding the size classes of hospitals (hypothesis 3). Certain specialized units could be dislocated from large hospitals and granted sizeable autonomous status. This would facilitate the downsizing of large facilities, and free them from negative financial consequences stemming from their size, with the creation of financially successful specialized units and financial advantages.

A positive relationship between the organizational factor occupancy rate and financial performance could be hypothesized (hypothesis 6) according to prior literature [19]. The results of this study show that the influence is positive, but not statistically significant, which leads to considerations on the manifold unique characteristics of the healthcare industry. On the one hand side, hospitals produce a large number of services, and bed occupancy is able to capture just a limited amount of the entire organization's occupancy. On the other hand, there are elective (postponable) and emergency (non-postponable) cases, meaning that hospitals always have idle capacity, a "safety margin" so as to handle service demand fluctuations. Thus preventing any delays or denial of admissions is crucial for hospitals, as this would impact patients in a highly negative way (greater pain, increased probability of death, or disability for example) [91]. So the most important issue is how to minimize the probability of delayed or denied admissions, while simultaneously minimizing the probability of the inefficient use of hospital resources. The latest studies in this field suggest an optimal bed occupancy of around 85% [92].

Several previous studies have indicated that CMI is negatively correlated with financial performance [19,48,59]. This relationship was also confirmed in this study (hypothesis 7). In earlier research projects within other healthcare systems, researchers found that financial compensation for higher complexity is insufficient for reimburse the increased costs of treatment. The results indicate that this also seems to be the case in Italy. Therefore, a fitting policy recommendation would be to increase reimbursement for high-complexity treatment in order to avoid penalizing healthcare providers that handle patients with more complex conditions.

Finally, in contrast with Hypothesis 8, a significant relationship between the non-medical staff rate and financial performance could not be verified.

Study limitations

At least two limitations arise from our study (1) Firstly, a lack of available data makes it impossible to examine all possible influencing factors of financial performance. Further research in this field should also try to examine strategic factors and additional staffing factors, as the latter will arguably become one of the most important topics across the entire healthcare industry. The financial performance of providers is greatly affected by these external factors, yet they are beyond their control. Consequently, some regional differences in policy setting are overlooked in this study, making it possible to draw generally valid conclusions [21,24]. Secondly, critical internal factors have been neglected, such as management quality, decision-making processes, and corporate policies. (2) Data validity is a critical issue. This study bases its analyses on financial indicators from balance

sheets. As a result, this type of data tends to be backward-looking [23]. Fiscal and budgetary policies can also influence balance sheet data, which may lead to distortions [21,23].

CONCLUSIONS

This study provides insights into the financial performance of PHEs, with relative risks (negative influencing predictors and their developments) and opportunities (positive influencing predictors and their developments). Policymakers such as the central government, the central bank, regions, and supervisory institutions as for instance the court of auditors, can benefit from this information to ensure the healthcare system is sustainable and adequately controlled in the long run. This is especially important also with regard to COVID-19 pandemic and it's several consequences on the healthcare system as for instance mortality [93], protection measures [94] or stress and anxiety of healthcare workers [95,96]. If there are similar emergencies in the future, measures could be taken more quickly as the financial performance of the providers are monitored more closely in advance using appropriate tools and additional funding could be deployed in a more targeted manner. The results of this study are valuable for estimating overall counterparty risks of banks, credit institutions, hospital pharmaceutical and medical device suppliers and may also be helpful for private institutions.

Research on other internal and external factors influencing the performance of PHEs is required. Longitudinal effects of different predictors should also be examined. Researchers in countries with comparable healthcare systems, such as Spain, Portugal, Poland, or Great Britain, could make use of SEM models to estimate the financial performance of healthcare providers in their institutional context. As a concluding observation, it should be noted that financial performance affects the quality of healthcare. Although this connection was not examined and is beyond the scope of this study, literature indicates that financially successful hospitals produce also higher quality services [97–99]. It has been proposed that this correlation can be explained by the fact that the condition of high financial performance allows hospitals to invest and maintain highly reliable systems and allocate ongoing resources for quality improvement. This indicates that the importance of financial performance is paramount in ensuring a sustainable healthcare system that delivers the best possible care for each individual.

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