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# The Influence of Liquidity and Solvency on Performance within the Healthcare Industry: Evidence from Publicly Listed Companies

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**Abstract:** Any lucrative economic activity implies aiming at obtaining a profit, including companies in the healthcare industry. The present study analyzes the extent to which financial liquidity and financial solvency influenced the performance of 34 healthcare companies that are publicly traded on the New York Stock Exchange. The period of analysis spanned from Q4 2005 to Q4 2020. The research methodology favored a complex approach by running econometric models with two-stage least squares (2SLS) panel and panel generalized method of moments (GMM). Empirical evidence showed that the financial indicators current liquidity ratio, quick liquidity ratio, and debt to equity ratio significantly influenced company performance measured by return on assets, gross margin ratio, operating margin ratio, earnings before interest, tax, depreciation, and amortization. Strategies intended to improve business performance based on liquidity and solvency insights are also addressed.

**Keywords:** liquidity; solvency; performance; healthcare sector; panel data modelling; stock market



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## 1. Introduction

Company performance is a fundamental goal for any lucrative business that is run in nowadays interconnected global market [1–4]. Businesses need to become profitable in order to substantiate the value of their initial investments, keep creating value for their customer networks through products and/or services, and survive in the long run in extremely competitive environments. Failure in covering expenses from company revenue and thus obtaining long-term profit will eventually trigger the demise of the company from the business world.

Among the providers of products and services available on the market, healthcare companies that do not belong to the public health system make no exception to this rule and aim to generate profit. Moreover, in recent years, due to the advancement of science, increased specialization in the medical field, and rising interest for securing a healthy lifestyle from the general public, healthcare companies have increased their visibility, reputation, market shares, and (naturally) financial performance. Consequently, numerous healthcare providers have become major stock market players and have managed to report consistent profits [5]. For this reason, a study focused on what drives the performance of companies from the healthcare industry, which are listed on relevant stock exchanges, seemed propitious and valuable at the same time.

Company sample aimed to include economic entities successfully operating in the healthcare industry, providing a wide variety of medical products and services while being publicly traded on the New York Stock Exchange (NYSE), the biggest and the most important stock market in the world [6]. The focus on NYSE is due to the fact that the stock market is considered to be “synonymous with global finance” [7] and the symbol for cutting-edge trading facilities (i.e., a unique combination of technology and an active trading floor). Companies were selected, taking into account the decreasing value of their market capitalization and the fact that comprehensive financial data were publicly

available for the entire period of analysis. Considering these criteria, the final sample numbered 34 companies headquartered in Puerto Rico, United Kingdom, and the United States of America.

The period of time selected for the analysis was Q4 2005–Q4 2020 in order to include financial data corresponding to a decade and a half of economic growth interspersed with crises and recession caused by global meltdowns such as the 2008 financial crisis and the fairly recent health crisis. Analyzing financial data covering also a one-year period of COVID-19 is relevant since worldwide healthcare facilities played a crucial part in monitoring this health crisis amid recurring lockdown periods. For that matter, the pandemic has considerably affected the regular activity of healthcare institutions, which had to prioritize anti-COVID-19 treatments before any other medical services [8]. In addition, analyzing the performance of companies for several consecutive fiscal years using financial statements is an adequate approach when aiming to draw sound insights about their activities. While the balance sheet offers static information on company activity, the income statement provides a dynamic overview of money movement over time.

From the perspective of financial analysis, performance expresses the capacity of a company to obtain financial benefits for its owners/shareholders based on the revenue generated through its economic activity after all expenses and taxes have been subtracted from this revenue [9]. According to the same perspective, financial liquidity indicates the capacity of a company to cover its current liabilities to suppliers and creditors based on its current assets (e.g., inventory, accounts receivable, marketable securities, and cash). In turn, financial solvency indicates the capacity of a company to cover its long-term liabilities. Hence, if liquidity can be regarded as the expression of short-term financial equilibrium for a company, solvency expresses the company long-term financial equilibrium [10].

The research study aims at investigating to what extent company performance measured by indicators such as return on assets, gross margin ratio, operating margin ratio and earnings before interest, tax, depreciation, and amortization margin is influenced by financial liquidity and solvency. In order to capture the latter, current liquidity ratio, quick liquidity ratio, and debt to equity ratio were selected as explanatory variables. All the variables of interest measuring financial liquidity, solvency and performance were chosen based on relevant studies reported in the literature.

The original contribution of this study to the existing literature is that it scrutinizes the evolution of company performance through the lenses of financial liquidity and solvency for some major players in the healthcare industry, across an extended time frame, including a one-year period marked by the impact of the COVID-19 pandemic. The multimodal analysis approach comprising descriptive and inferential statistics supported the estimation of robust results concerning financial performance and its influencing factors.

The remainder of the article is the following. Section 2, titled Literature Review, draws on various research studies tackling performance within the healthcare system. Section 3 details on the sample, chosen variables, research hypotheses, and types of analyses conducted under the label Materials and Methods. Section 4 reports on econometric models and estimated results. Section 5 comprises discussions regarding the main results. Section 6 presents the policy implication of the results, lists study limitations and highlights avenues for future research studies.

## 2. Literature Review

The healthcare industry plays a key role in nowadays society because it centers around a fundamental human right, which is health [11]. As the Scottish historian and essayist, Thomas Carlyle, used to notice, “he who has health, has hope; and he who has hope, has everything”. In the same note, the British statesman and Primer Minister, Winston Churchill, used to state that “healthy citizens are the greatest asset any country can have”.

Although healthcare products and services can be provided by for-profit entities, non-profit entities and government entities [12–14], the present study is focused only on the financial performance of for-profit healthcare providers.

The interest for the financial performance of the healthcare industry has been constantly growing over the last four decades among scientists, corporations, international organizations, national authorities, and the public at large [15–21]. In this context, the capacity of a healthcare company to generate profit from its activity has become equally important, irrespective of the company size or the region where it operates. Nevertheless, growing worldwide competition in the healthcare system (which also triggered the emergence of medical tourism), constant development of new diagnosis and treatment technologies, aging population, and the surging number of patients with chronic diseases have substantially increased expenditures and mitigated profit margins, especially in the United States of America and numerous European countries. At the other end of the spectrum, healthcare facilities in Asia have implemented low-cost strategies that secured higher performance levels than those in Europe and North America [22].

Siedlecki et al. [23] assessed and compared the financial states of 201 rural and urban hospitals in Poland for the year 2012, starting from the general assumption that healthcare providers from rural areas generally yielded a lower return and had fewer debts. In order to measure performance, authors used indicators, such as return on assets, operational margin ratio, net income margin, labor costs, and hospital indebtedness rate. According to their empirical results, rural hospitals (although smaller) registered considerably lower rates of indebtedness and a better financial state in terms of liquidity and performance.

Guimarães and Nossa [24] investigated the degree to which the structure of working capital impacted on company performance, liquidity, and solvency. Using data from 621 healthcare insurance companies for the year 2006, authors reported that higher levels of performance, liquidity, and solvency were registered by entities with the following working capital structure: (a) onerous current liabilities were lower than financial current assets; and (b) cyclical current liabilities were lower than cyclical current assets.

Creixans-Tenas and Arimany-Serrat [25] studied the factors driving performance levels of 80 Spanish healthcare providers during the period 2008–2015. The independent variables were current liquidity ratio, debt to equity ratio, business size, legal form, GDP per capita, population density, and corporate social responsibility indicators. Company performance was measured via the indicator return on assets. Empirical results showed that the performance of healthcare providers was significantly influenced across time by all predictors, except for business size and legal form.

Using data from ten pharmaceutical companies listed on the Indonesia Stock Exchange for the period 2014–2018, Lim and Rokhim [26] analyzed the degree to which performance was determined by multiple variables, such as firm size (captured by total sales), company efficiency (captured by assets turnover), liquidity (captured by current liquidity ratio), market power (captured by the Lerner index), and company growth (captured by sales growth and sustainable growth rate). According to results, company performance measured via return on assets, return on equity and earnings per share was significantly influenced by the indicators current liquidity ratio, sustainable growth ratio, total sales, and the Lerner index.

Considering recent financial data from large hospital chains in USA, King [27] concluded that performance levels in 2020 were mainly influenced by liquidity increases, in spite of the serious downturn triggered by the global health crisis. On the other hand, amid the health crisis, smaller healthcare facilities faced harsh liquidity constraints because of diminished profit margins.

### 3. Materials and Methods

The present research study investigates the link between financial performance and financial liquidity and solvency for a sample of 34 companies operating in the healthcare sector and publicly listed on the New York Stock Exchange (see Appendix A for company details). In order to capture the dynamics and the particularities of this link, the period 2005–2020 was considered for the analyses since it also comprises major external shocks that shaped world economic markets (i.e., 2008 global financial crisis; COVID-19 pandemic).

The 34 companies were selected in descending order of their market capitalization and their activities revolve around the following healthcare-related domains: orthotic and prosthetic care; post-acute care; spine care; kidney dialysis; sanitary supply distribution; health improvement, nutrition, fitness, and social engagement; technology-enabled healthcare; general acute care hospitals; fixed-site diagnostic imaging; home health, hospice and personal care providers; home infusion; hospital services; insurance; clinical laboratories; physician management; nature medicines; medicine developers for pharmaceutical, biotechnology, and medical device industries; services for special populations; services for both government sponsored and privately insured programs; inpatient rehabilitation; hair drug testing; molecular diagnostics tests and pathology; physical and occupational therapies; and healthcare workforce.

For the purpose of the study, relevant indicators were chosen to measure financial liquidity, financial solvency and performance. Hence, the following predictors were considered for the analyses:

- Current liquidity ratio (*CLR*). It shows the degree to which current assets (*CA*) (i.e., inventory, accounts receivable, cash and cash equivalents, marketable securities, prepaid expenses, and other liquid assets) turn into cash within one year in order to cover company current liabilities (*CL*). The indicator is computed by dividing current assets and current liabilities:

$$CLR = \frac{CA}{CL}$$

- Quick liquidity ratio (*QLR*). It shows the degree to which relatively liquid assets (i.e., accounts receivable, marketable securities, and prepaid expenses) turn into cash within one year and cover current liabilities. The indicator is computed by dividing the difference between current assets (*CA*) and inventory (*I*) to current liabilities (*CL*):

$$QLR = \frac{CA - I}{CL}$$

- Debt to equity ratio (*DER*). It shows the financial leverage of an economic entity and it is a solvency indicator, therefore measuring long-term financial equilibrium. The indicator is considered to be “more meaningful when compared over a period of time” [28]. It is computed as a ratio of total liabilities (*TL*) to shareholders’ equity (*E*):

$$DER = \frac{TL}{E}$$

In addition, the following outcome variables capturing company performance were considered:

- Return on assets (*ROA*). It is computed by dividing net profit (*NP*) and total assets (*TA*). It measures the efficiency of an economic entity to generate earnings based on its assets:

$$ROA = \frac{NP}{TA}$$

The indicator shows the profit generated by a currency unit (e.g., euro, dollar) invested in assets. Moreover, it measures the capacity of company assets to generate interest-bearing profit.

- Gross margin ratio (*GM*). It is computed by dividing gross profit (*GP*) to total revenue (*TR*). Gross profit is determined as a difference between net sales and cost of goods sold. Gross margin ratio does not depend on the company financial method or its fiscal position. The indicator is computed as follows:

$$GM = \frac{GP}{TR} = \frac{S - COGS}{TR}$$

- Operating margin ratio (*OM*). It is computed by dividing operating earnings (*OE*) and total revenue (*TR*). The indicator captures the degree of capitalization of the resources invested in the healthcare company:

$$OM = \frac{OE}{TR}$$

- Earnings before interest, tax, depreciation, and amortization (*EBITDAM*). It shows the level of company earnings as a percentage of total revenue before subtracting expenses with interest, tax, depreciation, and amortization.

The variables of interest were determined based on financial information retrieved from the annual financial statements (i.e., balance sheet, income statement), which are publicly available through the stock market webpage.

The study favored a multimodal analyses approach that comprised central tendency and variation analysis, correlation analysis, and econometric modelling. With regard to the latter, for the purpose of deciding whether to model data with cross-section fixed effects or cross-section random effects, the Hausman test was conducted in the first place. Random effects are generally recommended if the null hypothesis of the Hausman test is accepted. In the case of the present study, the rejection of the null hypothesis indicated that fixed effects should be incorporated into the econometric models. In addition, heteroscedasticity at transversal level was controlled by computing the variance–covariance matrix of the estimators by means of the White cross-section technique.

Moreover, in order to deal with potential endogeneity issues and secure consistent estimates of parameters, relationships between predictors and outcomes were estimated through two different statistical methods based on instrumental variables: two-stage least squares panel data modelling and a generalized method of moments for panel data.

In terms of the two-stage least squares (2SLS) panel data estimator, this is an extended version of the ordinary least squares approach (OLS) and it is suitable for analyzing data across several years [29,30].

There are multiple versions of the generalized method of moments (GMM) for panel data, but the present study used the one proposed in 1991 by Arellano and Bond [31]. In this case, GMM estimations are accurate if “there is no second-order serial correlation for the disturbances of the first-differences equation” [30] (p. 141).

*The Following Research Hypotheses Were Advanced to Be Investigated*

**Hypothesis 1 (H1).** *There is a significant relationship between ROA and CLR, QLR, DER.*

**Hypothesis 2 (H2).** *There is a significant relationship between GM and CLR, QLR, DER.*

**Hypothesis 3 (H3).** *There is a significant relationship between OM and CLR, QLR, DER.*

**Hypothesis 4 (H4).** *There is a significant relationship between EBITDAM and CLR, QLR, DER.*

The general form of the econometric models estimated in this study was the following:

$$Y_{it} = a_0 + a_1X_{1it} + a_2X_{2it} + a_3X_{3it} + \delta_i + \theta_t + \varepsilon_{it} \quad (1)$$

where:

- *Y* denotes the dependent variables (i.e., ROA, GM, OM, EBITDAM);
- *X* denotes the independent variables (i.e., CLR, QLR, DER);
- $a_0$  denotes the intercept;
- $a_1, a_2, a_3$  denotes the predictors' coefficients;
- *i* denotes the healthcare companies included in the sample, taking values from 1 to 34;

- $t$  denotes the period of analysis spanning Q4 2005–Q4 2020 and taking values from 1 to 16;
- $\delta_i$  denotes the time fixed effects related to the healthcare companies included in the sample;
- $\theta_t$  denotes the time fixed effects controlling for external shocks (e.g., financial and health crises);
- $\varepsilon_{it}$  denotes the error term.

Based on the ground that the aforementioned external shocks might have influenced the relationships between predictors and outcome variables, data modelling conducted via a two-stage least squares panel was estimated with and without time fixed effects. In the case of longitudinal data, the importance of controlling for time fixed effects stems from the following aspect: certain unobserved variables, which have not been included in the econometric models, may remain constant across companies yet they can still vary across the period Q4 2005–Q4 2020. Hence, the inclusion of time fixed effects eliminates the so-called omitted variable bias.

## 4. Results

### 4.1. Central Tendency and Variation Analysis

Table 1 displays the mean, median, and standard deviation values that were determined for the chosen variables: return on assets (*ROA*); gross margin ratio (*GM*); operating margin ratio (*OM*); earnings before interest, tax, depreciation, and amortization (*EBITDAM*); current liquidity ratio (*CLR*); quick liquidity ratio (*QLR*); and debt to equity ratio (*DER*).

**Table 1.** Descriptive statistics.

	<i>ROA</i>	<i>GM</i>	<i>OM</i>	<i>EBITDAM</i>	<i>CLR</i>	<i>QLR</i>	<i>DER</i>
Mean	−0.0532	0.3899	−0.0510	0.0067	1.8133	1.5030	2.7429
Median	0.0456	0.3132	0.0760	0.1084	1.4900	1.3600	1.2200
Maximum	1.7143	1.0000	1.0000	1.0000	8.4200	11.1000	1974.500
Minimum	−14.5000	−0.0208	−29.0000	−29.0000	0.0000	0.0000	−1577.070
Std. dev.	0.7387	0.2635	1.2118	1.1039	1.7187	1.0805	65.5250
Skewness	−12.4431	0.9531	−14.4961	−16.1787	7.6491	2.9456	4.9593
Kurtosis	192.6246	2.9568	258.5815	327.0585	119.9092	18.2584	600.2424
Jarque–Bera test	3,142,557 ***	310.2548 ***	5,645,865 ***	9,059,369 ***	1,171,227 ***	23,118.70 ***	30,833,195 ***
Observations	2062	2048	2048	2050	2022	2074	2074

Note: \*\*\* indicates significance at the 1% level.

The values of the standard deviation indicated that debt to equity ratio registered the largest volatility among the chosen variables, followed by *CLR*, while gross margin ratio registered the smallest volatility. In terms of skewness, four variables were skewed to the right and three variables were skewed to the left. In terms of kurtosis, except for gross margin (which had a platykurtic distribution), all the other six variables had leptokurtic distributions.

The normal distribution of the empirical data was tested with the help of the Jarque–Bera test. According to the test, all chosen variables were non-normally distributed at the 1% level, as expected.

### 4.2. Correlation Analysis

In order to check for potential multicollinearity issues regarding the independent variables, a correlation analysis was conducted and Pearson coefficients were computed,

as customary in the literature [32]. The mathematical formula for the Pearson's correlation coefficient is the following:

$$r = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}} \quad (2)$$

where:

- $r$  denotes the Pearson correlation coefficient;
- $x_i$  denotes the values of variable  $x$  in the sample;
- $\bar{x}$  denotes the mean of the values for variable  $x$ ;
- $y_i$  denotes the values of variable  $y$  in the sample;
- $\bar{y}$  denotes the mean of the values for variable  $y$ .

Table 2 presents the results of this correlation analysis. The correlation coefficient captures the strength of the association between two variables.

**Table 2.** Correlation matrix.

Variables	ROA	GM	OM	EBITDAM	CLR	QLR	DER
ROA	1						
GM	−0.01	1					
OM	0.300 *	0.021	1				
EBITDAM	0.294 *	0.027	0.979 ***	1			
CLR	0.083	0.220 *	−0.080	−0.055	1		
QLR	0.086	0.089	−0.081	0.105	0.524 **	1	
DER	0.007	−0.044	0.007	0.007	−0.010	−0.003	1

Note: \*, \*\*, \*\*\* indicate significance at the 10%, 5% and 1% levels.

As indicated by the results of the correlation analysis, the highest correlation among the independent variables was established between current liquidity ratio and quick liquidity ratio ( $r = 0.524$ ), while the lowest correlation was set between quick liquidity ratio and debt to equity ratio ( $r = -0.003$ ). Therefore, the assumption was that multicollinearity would pose no issues for the estimated empirical results.

#### 4.3. Econometric Models

The statistical software EViews version 9.0 was employed to estimate the relationships between predictors and outcome variables.

Table 3 presents the econometric models estimating the influence of the predictors on the dependent variables ROA and GM. Three econometric models were estimated for each dependent variable: the first model used a GMM approach; the second model used two-stage least squares (2SLS) panel data modelling without time fixed effects; and the third model used two-stage least squares (2SLS) panel data modelling with time fixed effects.

The specific forms of the models focused on the dependent variables return on assets (ROA) and gross margin ratio (GM) were the following:

$$ROA_{it} = a_0 + a_1CLR_{it} + a_2QLR_{it} + a_3DER_{it} + \delta_i + \theta_t + \varepsilon_{it} \quad (3)$$

$$GM_{it} = a_0 + a_1CLR_{it} + a_2QLR_{it} + a_3DER_{it} + \delta_i + \theta_t + \varepsilon_{it} \quad (4)$$

The first econometric model (M11) estimated via the GMM approach showed that all predictors had a significant influence on the evolution of ROA and explained 41.27% of its variance. Namely, should current liquidity ratio increase by one percent, ROA would follow the same trend with 0.008%. Similarly, if quick liquidity ratio augmented by one percent, the performance of assets would increase also by 0.06%. Moreover, in case debt to equity ratio improved by one percent, ROA would considerably decrease by 5.24%. The

*p*-value corresponding to the Arellano–Bond test for AR(2) was above 0.1, thus indicating a lack of second-order autocorrelation with the error terms.

**Table 3.** Econometric models estimations corresponding to the dependent variables *return on assets (ROA)* and *gross margin ratio (GM)*.

	Models for ROA:			Models for GM:		
	M11	M21	M31	M12	M22	M32
Constant	-	-0.2926 *** (-5.0771)	-0.2925 *** (-5.7994)	-	0.3865 *** (24.4431)	0.3928 *** (34.3428)
CLR	0.0084 *** (4.4042)	0.0560 *** (2.9692)	0.0674 *** (3.1899)	0.0124 *** (212.7971)	0.0149 *** (2.8492)	0.0131 *** (2.8025)
QLR	0.0553 *** (27.2078)	0.0890 *** (3.1062)	0.0757 ** (2.5839)	0.0099 *** (135.2082)	-0.0137 * (-1.8478)	-0.0161 ** (-2.1825)
DER	-5.2400 ** (-2.0255)	0.0002 (0.2397)	-0.0002 (-0.2008)	-3.4300 (-0.2497)	-0.0004 (-1.1323)	-0.0002 (-1.1003)
White period instrument weighting matrix	Yes	Yes	Yes	Yes	Yes	Yes
White cross-section standard errors & covariance (d.f. corrected)	Yes	Yes	Yes	Yes	Yes	Yes
Cross-section effects	-	Yes	Yes	-	Yes	Yes
Time fixed effects	-	No	Yes	-	No	Yes
Prob. > F	-	0.0000	0.0000	-	0.0000	0.0000
R <sup>2</sup>	0.4234	0.4234	0.4408	0.8376	0.8376	0.8628
Adjusted R <sup>2</sup>	0.4127	0.4127	0.4126	0.8345	0.8345	0.8558
F-statistic	-	41.0402	16.0503	-	296.9771	126.9704
J-statistic	32.4482	-	-	46.6676	-	-
Prob(J-statistic)	0.35	-	-	0.05	-	-
Arrelano–Bond test AR(2) ( <i>p</i> -value)	0.3311	-	-	0.8013	-	-
Instrument rank	34	37	96	36	37	96
Observations	1941	1977	1977	1925	1963	1963

Note: Robust *t*-statistics are shown in parentheses. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5% and 1% levels. The probability of not including fixed effects is denoted by Prob. > F. Multicollinearity was tested across all models via the variance inflation factor (VIF). Since all VIF values were below 5, this indicated a low risk of multicollinearity. Moreover, the White test rejected the null hypothesis of heteroscedasticity. The post-estimation diagnostic tests (reported at the end of the table) confirmed the validity of the GMM estimator. Namely, the Arellano–Bond test for AR(2) was statistically insignificant, thus confirming the lack of the second-order serial correlation and it satisfied the validity of its instruments. The Hansen *J*-statistic of over-identifying restrictions was insignificant at the 5% level, the null hypothesis of valid instruments cannot be rejected. Hence, the proposed econometric models are valid.

With the help of 2SLS panel modelling and in the absence of time fixed effects, the second econometric model (M12) showed that 41.27% of the variance was explained by the independent variables ( $F = 41.04, p < 0.001$ ). In this sense, the impact of *CLR* and *QLR* turned out to be relevant: if *CLR* rose by one percent, *ROA* would increase by 0.06%; and if



*QLR* improved by one percent, *ROA* would also increase by 0.09%. The impact of debt to equity ratio did not reach significance according to this model.

The third econometric model (M13), which considered the time fixed effects under the aegis of 2SLS panel modelling, indicated that 41.26% of the variance in *ROA* was explained by the predictors ( $F = 16.05$ ,  $p < 0.001$ ). Again, the influence of current liquidity ratio and quick liquidity ratio remained significant. In this sense, should *CLR* improve by one percent, the performance of assets would increase by 0.07%. Moreover, if *QLR* rose by one percent, *ROA* would also augment by 0.08%. Debt to equity ratio did not trigger any significant change in performance.

The results of the econometric models M11-M31 (Table 3) supported the first research hypothesis.

The following paragraphs will detail on the relationship between gross margin ratio and the chosen predictors.

Estimated with the GMM approach, model M21 indicated that financial liquidity proxies had a relevant impact on gross margin ratio and explained 83.45% of its variance. In this sense, if *CLR* augmented by one percent, *GM* would follow a similar pattern with a 0.01% increase. At the same time, should *QLR* increase by one percentage point, *GM* would also increase by 0.01%. The solvency indicator did not have any significant impact. The  $p$ -value corresponding to the Arellano–Bond test for AR(2) was above 0.1, thus indicating a lack of second-order autocorrelation with the error terms.

Model M22 estimated with a 2SLS panel and no time fixed effects showed that 83.45% of the variance in *GM* was explained by liquidity indicators ( $F = 296.98$ ,  $p < 0.001$ ). Namely, an increase of 1% in *CLR* would be mirrored by an increase of 0.01% in *GM*. Should *QLR* improve by one percentage point, *GM* would decrease by 0.01%. Debt to equity ratio had no impact on the evolution of gross margin ratio.

Last but not least, model M32 included time fixed effects and indicated that 85.58% of the variance in *GM* would be driven by liquidity indicators ( $F = 126.97$ ,  $p < 0.001$ ). That is, if *CLR* increased by one percent, *GM* would slightly improve by 0.01%. Furthermore, should quick liquidity ratio rise by one percentage point, gross margin ratio would decrease by 0.02%. Again, the solvency proxy did not have a relevant impact on gross margin ratio.

The results of the econometric models M12-M32 (Table 3) supported the second research hypothesis.

Table 4 presents the econometric models estimating the influence of the predictors on the dependent variables *OM* and *EBITDAM*. The specific forms of the models focused on the dependent variables operating margin ratio (*OM*) and earnings before interest, tax, depreciation, and amortization (*EBITDAM*) were the following:

$$OM_{it} = a_0 + a_1CLR_{it} + a_2QLR_{it} + a_3DER_{it} + \delta_i + \theta_t + \varepsilon_{it} \quad (5)$$

$$EBITDAM_{it} = a_0 + a_1CLR_{it} + a_2QLR_{it} + a_3DER_{it} + \delta_i + \theta_t + \varepsilon_{it} \quad (6)$$

In the case of both *OM* and *EBITDAM*, three econometric models were estimated: the first model used a GMM approach; the second model used two-stage least squares panel data modelling without time fixed effects; and the third model used two-stage least squares panel data modelling with time fixed effects.

The econometric model M41 (GMM approach) showed that all predictors had a significant influence on the evolution of *OM* and explained 33.09% of its variance. Namely, should current liquidity ratio increase by one percent, *OM* would follow a decreasing trend with  $-0.021\%$ . Similarly, if quick liquidity ratio augmented by one percent, the operating margin ratio would decrease by  $-0.239\%$ . Moreover, if debt to equity ratio improved by one percent, *OM* would also decrease by  $-1.32\%$ . The  $p$ -value corresponding to the Arellano–Bond test for AR(2) was above 0.1, thus indicating a lack of second-order autocorrelation with the error terms.

**Table 4.** Econometric models estimations corresponding to the dependent variables *operating margin ratio (OM)* and *earnings before interest, tax, depreciation, and amortization (EBITDAM)*.

	Models for OM:			Models for EBITDAM:		
	M41	M42	M42	M51	M52	M53
Constant	-	0.4928 (1.3830)	0.5120 (1.2984)	-	0.5838 * (1.6277)	0.6059 (1.5252)
CLR	-0.0212 *** (-1.5466)	-0.1078 * (-1.8356)	-0.0990 * (-1.8437)	-0.0004 *** (-12.8424)	-0.0290 (-1.0329)	-0.0217 (-0.7002)
QLR	-0.2399 *** (-5.7614)	-0.2399 (-1.0934)	-0.2637 (-1.1188)	0.0577 *** (1789.418)	-0.3578 * (-1.6675)	-0.3822 * (-1.6430)
DER	-1.3200 *** (-1.1454)	0.0014 (0.9953)	0.0016 (1.0918)	-1.7100 (-128.0197)	0.0015 (1.0927)	0.0020 (1.2271)
White period instrument weighting matrix	Yes	Yes	Yes	Yes	Yes	Yes
White cross-section standard errors & covariance (d.f. corrected)	Yes	Yes	Yes	Yes	Yes	Yes
Cross-section effects	-	Yes	Yes	-	Yes	Yes
Time fixed effects	-	No	Yes	-	No	Yes
Prob. > F	-	0.0000	0.0000	-	0.0000	0.0000
R <sup>2</sup>	0.3309	0.3309	0.3468	0.3099	0.3099	0.3218
Adjusted R <sup>2</sup>	0.3184	0.3184	0.3136	0.2970	0.2970	0.2874
F-statistic	-	30.3857	12.0027	-	28.8770	11.4019
J-statistic	9.5017	-	-	7.1670	-	-
Prob(J-statistic)	0.9999	-	-	0.9999	-	-
Arellano–Bond test AR(2) (p-value)	0.2723	-	-	0.2120	-	-
Instrument rank	39	37	96	37	37	96
Observations	1925	1963	1963	1928	1966	1966

Note: Robust *t*-statistics are shown in parentheses. \*, \*\*\* indicate statistical significance at the 10% and 1% levels. The probability of not including fixed effects is denoted by Prob. > F. Multicollinearity was tested across all models via the variance inflation factor (VIF). Since all VIF values were below 5, this indicated a low risk of multicollinearity. Moreover, the White test rejected the null hypothesis of heteroscedasticity. The post-estimation diagnostic tests (reported at the end of the table) confirmed the validity of the GMM estimator. Namely, the Arellano–Bond test for AR(2) was statistically insignificant, thus confirming the lack of the second-order serial correlation and it satisfied the validity of its instruments. The Hansen *J*-statistic of over-identifying restrictions was insignificant at the 5% level, the null hypothesis of valid instruments cannot be rejected. Hence, the proposed econometric models are valid.

With the help of 2SLS panel data modelling and in the absence of time fixed effects, model M42 revealed that the evolution of *OM* was explained in proportion of 31.84% by current liquidity ratio. According to results,  $F = 30.39$ ,  $p < 0.001$ . In this sense, should *CLR* increase by one percent, *OM* would mitigate by 0.11%. This model showed that the impact of quick liquidity ratio and debt to equity ratio did not reach significance.

Model M43, which took into account time fixed effects when estimating the relationship via 2SLS panel, showed that only the influence of *CLR* was relevant across the time span. The liquidity proxy explained 31.36% of the variance in *OM* ( $F = 12$ ,  $p < 0.001$ ). In this

sense, should *CLR* augment by one percentage point, *OM* would decrease by 0.1% across time. Again, quick liquidity ratio and debt to equity ratio did not have a relevant impact.

The results of the econometric models M41-M43 (Table 4) supported the third research hypothesis.

According to the model M51 (GMM estimator), both liquidity proxies explained 29.7% of the variance in the performance level measured by *EBITDAM*. This time, if *CLR* improved by one percent, performance would slightly decrease by 0.0004%. At the same time, a one-percent increase in *QLR* would be followed by a 0.06% augmentation in performance. The solvency indicator did not have a significant influence. The *p*-value corresponding to the Arellano–Bond test for AR(2) was above 0.1, thus indicating a lack of second-order autocorrelation with the error terms.

Model M52 conducted via a 2SLS panel and no time fixed effects indicated that 29.7% of the variance in *EBITDAM* was due to quick liquidity ratio. In this case,  $F = 28.88$ ,  $p < 0.001$ . If quick liquidity ratio improved by one percent, performance captured by *EBITDAM* would decrease by 0.36%. The other variables measuring liquidity and solvency did not exert any significant influence on performance over the course of time.

Last but not least, model M53 (which considered time fixed effects) reported that 28.74% of the variance in performance was triggered by *QLR* ( $F = 11.40$ ,  $p < 0.001$ ). Namely, a one-percent increase in *QLR* would be followed by a 0.38% decrease in *EBITDAM*. Again, the impact of current liquidity ratio and debt to equity ratio did not reach significance.

The results of the econometric models M51-M53 (Table 4) supported the fourth research hypothesis.

## 5. Discussion

Nowadays, the healthcare industry is an extremely attractive, competitive, ever-changing, and profitable market since it captures more than 10% of GDP in many developed countries around the world [33,34]. When taking only the case of the United States of America, the average percentage is exceeded by far. Namely, on the US market, healthcare products and services account for 18% of the country's GDP. For this reason, many companies enter the market, manage to differentiate themselves from competitors, increase their market shares, and secure high levels of financial performance. In addition, many companies go public and succeed in providing adequate profit margins to their shareholders.

In this context, a long-term analysis of the factors that have an effect on financial performance within the healthcare industry is both timely and important. The empirical results presented in this research study showed that financial performance within the healthcare industry can be analyzed across several years with the help of relevant indicators emphasized in the literature, such as return on assets, gross margin ratio, operating margin ratio and earnings before interest, tax, depreciation, and amortization. Financial liquidity and financial solvency, which are connected to company financial performance, were measured with standard indicators used in the literature such as current liquidity ratio, quick liquidity ratio and debt to equity ratio.

According to results, the impact of current liquidity ratio and quick liquidity ratio on *return on assets* was positive, just as expected. This outcome could be explained by the fact that an increase in medical supplies, medicines, inventory items (e.g., medical utensils, modern beds and furniture pieces, bed mattresses and linen, refrigerators, storage boxes, medical protective clothing, hospital dishes and cutlery), and food supplies purchased by healthcare institutions generally leads to the improvement of medical acts, which, in turn, generates increasing total revenues and higher financial returns for the healthcare units.

The positive link between current liquidity ratio and *gross margin ratio* could be due to the fact that healthcare companies registered optimal levels of *CLR* across time. When *CLR* ranges between 150%–250%, businesses generate enough revenue to cover expenses and also register higher profit margins. On the other hand, the negative impact of quick liquidity ratio could mean that *QR* registered a level outside its safety gap of 50%–100%. If

QR was below the lower threshold limit of 50%, it means that companies did not obtain sufficient cash from their activities to cover short-term liabilities. If QR was above 100%, it means that too many current assets may have turned into idle cash, which was not used to increase company value and financial performance.

When considering the dependent variable *operating margin ratio*, both liquidity ratios and the solvency indicator had a significant impact on it, which was negative. Again, the levels of the three variables outside the standard range might explain this negative influence over financial performance.

In terms of the performance measured via *earnings before interest, tax, depreciation, and amortization*, both current liquidity ratio and quick liquidity ratio seemed to have a mitigation effect, probably due to levels far from the standard safety gaps.

Debt to equity ratio (*DER*) exerted a substantial influence only on company performance measured by *return on assets*. The negative impact of *DER* can be explained by the fact that the solvency ratio increased over time because of higher long-term liabilities. As financial analysts point out, *DER* should be as low as possible, ideally in the safety range of 0–30%. The rationale for this mandatory condition is rather simple. At the end of the day, as other companies, healthcare units need to be granted loans that can be used to develop new technologies or expand business activities. Such loans are often more than necessary considering the high costs that usually stem from research and development in this particular industry [35]. Nevertheless, once the ratio exceeds this safety gap, the increasing debt level puts a pressure on the company's financial state (i.e., loans must be repaid until maturity), which, in turn, may significantly mitigate the long-term financial performance of the company.

These empirical results have pointed out that healthcare companies need to keep an eye on liquidity and solvency indicators in order to operate financially performant activities. As Hefner, Al-Amin, and Huerta [36] (p. xvii) stressed in a clear manner, healthcare companies are “businesses, and regardless of their ownership status, they need to generate profit in order to sustain their operations, to acquire essential and strategic resources, and to achieve their mission by contributing to their communities”.

## 6. Conclusions

Like all economic entities, companies that operate in the healthcare system aim to generate revenue and become performant in the short and long run through their activities. Considering the importance of the healthcare products and services for human societies and everyday life, this research study delved into the factors driving company performance in close connection with financial liquidity and financial solvency.

The sample comprised 34 economic entities, selected in the descending order of their market capitalization values and listed on the New York Stock Exchange. The vast majority of companies operate in the United States of America. Companies provide a wide variety of healthcare products and services from medicine and medical devices to healthcare insurance, management and professional workforce. The period of time chosen for the analyses was Q4 2005–Q4 2020 in order to also include financial data spanning notable crisis periods (i.e., the 2008 global financial crisis; the 2020 health crisis).

The main policy implication driven from the empirical results is that healthcare companies must constantly monitor the levels of financial equilibrium indicators to prevent substantial deviations from the ranges recommended in the literature. Proactive concerns for liquidity and solvency states could materialize into efficient business strategies that may secure in the end satisfactory profit levels or at least the continuation of healthcare activities (in times of crisis).

Taking a specific look at the 2020 worldwide context, PricewaterhouseCoopers noted that US hospitals were facing a liquidity crisis because of rising COVID-19-related hospitalizations. Hence, the leading audit and consulting provider recommended a set of strategies that healthcare companies could apply to mitigate the impact of liquidity shortage on their financial performance: (1) grasp liquidity requirements through forecasting cash flows and

updating budgets and business plans; (2) strengthen capital structure via support from financial institutions; (3) apply short and medium-term tax strategies; (4) enhance cash collections through a better management of working capital and related costs; (5) resize company staff to ensure continuous activity and a better control of workforce costs, amid an uncertain market; and (6) assess financial reporting needs and resources [37].

Like all empirical endeavors, the present study entails certain limitations. In the first place, the sample of companies from the healthcare industry includes 34 economic entities. Future studies might consider expanding the sample and including a higher number of major healthcare providers listed of the New York Stock Exchange and/or other relevant capital markets. In the second place, the number of explanatory variables was limited to those related to financial liquidity and solvency. In the third place, this study focused solely on the factors influencing the performance of for-profit companies, publicly listed. Other studies could run comparisons between for-profit, non-profit, and state-owned institutions and see whether liquidity and solvency indicators have a significant impact. In addition, the sample included only large companies operating in healthcare. Future research endeavors might consider investigating the determinants of financial performance on smaller companies, which are also publicly listed.

In terms of future research directions, upcoming studies could focus on other predictors that might influence performance, such as inventory turnover, debt turnover, accounts receivable turnover, financial structure, etc. Moreover, as future research directions, one could consider running comparative analyses across different regions in the world regarding financial performance in the healthcare system. Last but not least, such comparative analyses might also target healthcare performance before and during financial and health crises that unraveled in recent decades.

In conclusion, research studies geared towards the healthcare industry can provide valuable insights at all times. They can contribute to the growth of the literacy level [38] among businesspeople interested in becoming more profitable in the long run while monitoring financial equilibrium indicators.

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## Abbreviations

The following abbreviations are used in the manuscript:

<i>CLR</i>	Current liquidity ratio
<i>DER</i>	Debt to equity ratio
<i>EBITDAM</i>	Earnings before interest, tax, depreciation and amortization margin
<i>GM</i>	Gross margin ratio
<i>GMM</i>	Generalized method of moments
<i>QLR</i>	Quick liquidity ratio
<i>NYSE</i>	New York Stock Exchange
<i>OM</i>	Operating margin ratio
<i>ROA</i>	Return on assets
<i>VIF</i>	Variance inflation factor
<i>2SLS</i>	Two-stage least squares

## Appendix A

The 34 companies operating in the healthcare system that were included in the sample were the following: Amedisys; AMN Healthcare Services; Anthem; Artemis Therapeutics; Centene; Chemed Corporation; Community Health Systems; DaVita; Encompass Health; Hanger; HCA Healthcare; Humana; ICON; Interpace Diagnostics Group; LHC Group;

Magellan Health; Mednax; ModivCare; Molina Healthcare; Ontrak; Option Care Health; Psychemedics; Quest Diagnostics; RadNet; Select Medical Holdings; SunLink Health; Surgalign Holdings; Tenet Healthcare; Triple-S; Trivity Health; UnitedHealth Group; Universal Health Services; U.S. Physical Therapy; Viatrix.

## References

- Mueller, D.C. (Ed.) *The Dynamics of Company Profits: An International Comparison*; Cambridge University Press: New York, NY, USA, 2005.
- Donegan, M.C. *Growth and Profitability. Optimizing the Finance Function for Small and Emerging Businesses*; John Wiley & Sons: Hoboken, NJ, USA, 2002.
- Torok, R.M.; Cordon, P.L. *Operational Profitability: Systematic Approaches for Continuous Improvement*, 2nd ed.; John Wiley & Sons: New York, NY, USA, 2002.
- Valášková, K.; Gavurová, B.; Ďurana, P.; Kováčová, M. Alter ego only four times? The case study of business profits in the Visegrad group. *E M Econ. Manag.* **2020**, *23*, 101–110. [CrossRef]
- Laszewski, R. Profitability in the Health Care Market Has Never Been Better. *Forbes*, 2020. Available online: <https://www.forbes.com/sites/robertlaszewski2/2020/02/05/profitability-in-the-health-care-market-has-never-been-better/> (accessed on 10 July 2021).
- Winck, B. Here Are the 10 Biggest Stock Exchanges in the World, Ranked by Market Cap. 2020. Available online: <https://markets.businessinsider.com/news/stocks/biggest-stock-exchanges-world-ranked-market-cap-nyse-nasdaq-trading-2020-6> (accessed on 10 July 2021).
- NYSE. 2021. Available online: <https://www.nyse.com/markets/nyse> (accessed on 1 July 2021).
- D'Aeth, J.C.; Ghosal, S.; Grimm, F.; Haw, D.; Koca, E.; Lau, K.; Miraldo, M. Optimal national prioritization policies for hospital care during the SARS-CoV-2 pandemic. *Nat. Comput. Sci.* **2021**, *1*, 521–531. [CrossRef]
- Batrancea, I.; Batrancea, L.; Nichita, A.; Gaban, L.; Masca, E.; Morar, I.-D.; Fatacean, G.; Moscviciov, A. An econometric approach on production, costs and profit in Romanian coal mining enterprises. *Econ. Res.-Ekon. Istraživanja* **2019**, *32*, 1019–1036. [CrossRef]
- Batrancea, L. An econometric approach regarding the impact of fiscal pressure on equilibrium: Evidence from electricity, gas and oil companies listed on the New York Stock Exchange. *Mathematics* **2021**, *9*, 630. [CrossRef]
- Adhanom Ghebreyesus, T. Health Is a Fundamental Human Right. 2017. Available online: <https://www.who.int/news-room/commentaries/detail/health-is-a-fundamental-human-right> (accessed on 15 June 2021).
- Horwitz, J.R. Making profits and providing care: Comparing nonprofit, for-profit and government hospitals. *Health Aff.* **2005**, *24*, 790–801. [CrossRef] [PubMed]
- Kahn, K. How Do Nonprofit and For-profit Hospitals Differ? It's Complicated. *Nonprofit Quarterly*, 2019. Available online: <https://nonprofitquarterly.org/how-do-nonprofit-and-for-profit-hospitals-differ-its-complicated/> (accessed on 12 June 2021).
- Horwitz, J.R. Do different types of hospitals act differently? *Law Quad. Notes* **2005**, *48*, 94–97.
- Cleverly, W.O. Profitability analysis in the hospital industry. *Health Serv. Res.* **1978**, *13*, 16–27.
- Popesco, B.; Novák, P.; Papadaki, S. Measuring diagnosis and patient profitability in healthcare: Economics vs ethics. *Econ. Sociol.* **2015**, *8*, 234–245. [CrossRef] [PubMed]
- IBM. Healthcare Performance Measurements. Available online: <https://www.ibm.com/watson-health/learn/healthcare-performance-measurements> (accessed on 12 June 2021).
- Barber, S.L.; Lorenzoni, L.; Ong, P. *Price Setting and Price Regulation in Health Care: Lessons for Advancing Universal Health Coverage*; OECD, World Health Organization Centre for Health Development: Kobe, Japan, 2019.
- Jeurissen, P.A. Comparative and Longitudinal Study of the For-Profit Hospital Sector in Four Western Countries. Ph.D. Thesis, Optima Grafische Communicatie, Rotterdam, The Netherlands, 2010.
- Batrancea, L.; Nichita, A. Which is the best government? Colligating tax compliance and citizens' insights regarding authorities' actions. *Transylv. Rev. Adm. Sci.* **2015**, *44E*, 5–22.
- Romaniuk, P.; Poznańska, A.; Brukało, K.; Holecki, T. Health system outcomes in BRICS countries and their association with the economic context. *Front. Public Health* **2020**, *8*, 80. [CrossRef] [PubMed]
- Health Management. A Closer Look at Financial Performance in Healthcare. *HealthManagement.org*, 2016, Volume 16. Available online: <https://healthmanagement.org/c/healthmanagement/issuearticle/a-closer-look-at-financial-performance-in-healthcare-1> (accessed on 2 September 2021).
- Siedlecki, R.; Bem, A.; Ucieklak-Jeż, P.; Prędkiewicz, P. Rural versus urban hospitals in Poland. Hospital's financial health assessment. *Procedia-Soc. Behav. Sci.* **2016**, *220*, 444–451. [CrossRef]
- de Souza Guimarães, A.L.; Nossa, V. Working capital, profitability, liquidity and solvency of healthcare insurance companies. *Braz. Bus. Rev.* **2010**, *7*, 37–59. [CrossRef]
- Creixans-Tenas, J.; Arimany-Serrat, N. Influential variables on the profitability of hospital companies. *Intang. Cap.* **2018**, *14*, 171–185. [CrossRef]
- Lim, H.; Rokhim, R. Factors affecting profitability of pharmaceutical company: An Indonesian evidence. *J. Econ. Stud.* **2021**, *48*, 981–995. [CrossRef]

27. King, R. Large Hospitals Chains Post Profits in 2020 Thanks to Higher Acuity and Liquidity. *Fierce Healthcare*, 2021. Available online: <https://www.fiercehealthcare.com/hospitals/large-hospital-chains-post-profits-2020-thanks-to-higher-acuity-and-liquidity> (accessed on 10 June 2021).
28. OECD. Debt to equity ratio in financial corporation. In *National Accounts at a Glance 2014*; OECD Publishing: Paris, France, 2014. [[CrossRef](#)]
29. Woolridge, J.M. Instrumental variables estimation with panel data. *Econom. Theory* **2005**, *21*, 865–869.
30. Baltagi, B.H. *Econometric Analysis of Panel Data*, 3rd ed.; John Wiley & Sons: Chichester, UK, 2005.
31. Arellano, M.; Bond, S. Some tests of specification for panel data: Monte Carlo evidence and an application to employment conditions. *Rev. Econ. Stud.* **1991**, *58*, 277–297. [[CrossRef](#)]
32. Batrancea, I.; Batrancea, L.; Rathnaswamy, M.M.; Tulai, H.; Fatacean, G.; Rus, M.-I. Greening the financial system in USA, Canada and Brazil: A panel data analysis. *Mathematics* **2020**, *8*, 2217. [[CrossRef](#)]
33. Pearson, G.E. *Thriving in the Healthcare Market: Strategies from an Industry-Insider for Selling Your Product*; CRC Press: Boca Raton, FL, USA, 2020.
34. Smiljanic, S. The State of Healthcare Industry—Statistics for 2021. Available online: <https://policyadvice.net/insurance/insights/healthcare-statistics/> (accessed on 10 August 2021).
35. Bryant, M. Healthcare Will Outspend all Other Industries on R&D by 2020, PwC Says. 2018. Available online: <https://www.healthcarediver.com/news/healthcare-will-outspend-all-other-industries-on-rd-by-2020-pwc-says/542070/> (accessed on 1 June 2021).
36. Hefner, J.L.; Al-Amin, M.; Huerta, T.R. (Eds.) *Transforming Healthcare: A Focus on Consumerism and Profitability*; Emerald Publishing: Bingley, UK, 2020.
37. PricewaterhouseCoopers. US Hospitals Face Liquidity Crises as They Treat the Nation’s COVID-19 Patients. 2021. Available online: <https://www.pwc.com/us/en/industries/health-industries/library/covid-hospital-liquidity-crisis.html> (accessed on 2 September 2021).
38. Nichita, A.; Batrancea, L.; Pop, C.M.; Batrancea, I.; Morar, I.D.; Masca, E.; Roux-Cesar, A.M.; Forte, D.; Formigoni, H.; da Silva, A.A. We learn not for school but for life: Empirical evidence of the impact of tax literacy on tax compliance. *Eastern Eur. Econ.* **2019**, *57*, 397–429. [[CrossRef](#)]