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Perspectives of the Influence of the Listed Companies' Financial Indicators on a Share Price to Sales Revenues Ratio during the Wave III, V and VII of the SARS-CoV-2 Pandemic in Poland

Keywords: multiple regression model; generalized least square method (GLS); share price to sales revenues indicator (P/S); Warsaw Stock Exchange (WSE); pandemic wave

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Abstract

Theoretical background: Market indicators are considered to be one of the most important groups of financial metrics used by investors when valuing shares. Among the quotients describing the environment of the listed entities, a security's Price-to-Sales ratio deserves a special attention. Its pattern allows the company's price to be measured in relation to quarterly/annual revenues, not profits. Thus, the C/P ratio indicates the extent to which a given company is underestimated or overestimated by the market in comparison to sales achieved.
Purpose of the article: This paper focuses on constructing a model of potential exogenous variables from financial analysis determining the dynamics of changes in the C/Ps of the public companies. Measuring enterprise's value was conducted on a sample of 172 entities listed at the Warsaw Stock Exchange during three phases of the SARS-CoV-2 pandemic, covering its financial statements as per the first quarter of 2021–2023.
Research methods: In the example below statistical tools such as linear correlation matrices and multiple regression functions were applied within a given time horizon. Due to the failure to meet the assumptions

for random components variances' homogeneity of the individual objects series a generalized least squares (GLS) method was used, comparing the obtained outcomes with its classical counterpart. The statistical significance of the parameters in each equation was verified by means of the Student's *t*-test at the significance level $\alpha = 0.05$.

Main findings: The study confirmed statistically significant relationships in fluctuations between the C/P ratios and selected financial indicators during waves III and V of the COVID-19 pandemic (the adjusted R^{2}^ coefficients in the generalized regression formulae equalled to 0.92 and 0.89, respectively). In both cases, C/P fluctuations were positively influenced by changes in the debts level, in the sense of the Financial Sustainability Ratio (FSR). On the contrary, negative impacts of C/Ps in the area of profitability, i.e. on Operating Margin (OM) indices and ROS ratios were noticed. Alternatively, the dynamics of the company's value could be described to a limited extent by financial indicators during the wave VII of the COVID-19 diffusion (adjusted R^{2}^ = 0.62), with its maximum traditionally recorded by ROS and FSR ratios. The transformation of the residuals matrices towards the generalized least squares method resulted in decreases in standard errors of coefficients building estimation intervals around the mean.

Introduction

Profitability, perceived as the company's ability to generate a surplus of revenues over costs,[1] is considered a general criterion of effectiveness (Bednarski, 2007; Skowronek-Mielczarek & Leszczyński, 2008). From the point of view of the quoted companies, the legitimacy of investing in their securities admitted to trading on one of the regulated markets of the European Economic Area (EEA)[2] is particularly important. When assessing the economic potential of these entities, one can refer to capital market measures. Ratio analysis in this matter allows to take into account all the company's assets that are not included in financial statements (e.g. tangible and intangible assets). In a broader sense, it facilitates diagnosing the economic situation, and the phase of the business cycle in which the entities' economy is, against their competition, and its further development opportunities (Gołębiowski & Tłaczała, 2005).

One of the measures for estimating a listed firms' market position is the Price-to-Sales (P/S) fraction. The paper aims to construct a model of possible exogenous variables influencing the amount of the Share Price/Sales Revenues ratio for the quoted companies using the multiple regression tool throughout the period examined. The study of the enterprise's value was carried out on a sample of 172 companies listed at the Warsaw Stock Exchange. Choosing it quarterly reports of the companies that did not contained full information on a set of the required financial indicators were eliminated from the whole population available.[3] At the same time, attempts

[1] In striving to obtain business results, the accrual accounting, matching, as well as the categorization of expenses principles are applied (see IAS 1 § 27–29 and § 102–103, L. 237/13, L. 237/27; Damodaran, 2011).

[2] The European Economic Area (EEA) consists of the EU Member States and the three EEA/EFTA States which are Iceland, Liechtenstein, and Norway (https://www.efta.int/eea).

[3] This was the case when at least one of the selected ratios in the company's index was missing, equaled to zero or reached its extremes.

were made to maintain the original structure of individual industries from the general population tending to quota samplings under non-probability techniques (Alvi, 2016; Hague, 2006; Popławski & Skawińska, 2012; Smith & Albaum, 2010; Stanimir, 2006). The financial data covered the first quarter of 2021–2023, in which entities in Poland faced waves III, V and VII of the pandemic caused by the SARS-CoV-2 virus. Each time they were obtained from the Biznes radar Internet website.

Literature review

Market indicators are one of the most important groups of financial ratios for the listed companies (Damodaran, 2011). There are many measures that investors use for evaluating stocks. When assessing the profitability of shares from the capital market they can be divided into internal and external. While the former regard financial data from the company itself, the latter are related to information flowing directly from the stock exchange (Gabrusewicz, 2014). Based on internal data, Earnings per Share (EPS), Dividends per Share (DPS) and Dividend-Payout-Ratio (DPR) are computed (Gabrusewicz, 2014). The external indicators of the capital market include mainly the Price Earnings Ratio (P/E) and the Dividend Yield Ratio (DYR) (Czekaj & Dresler, 1998; Gabrusewicz, 2014; Nowak, 2008). What distinguishes them is the fact that the numerator of the fraction contains the (market) price of the share (P), or, alternatively, the enterprise value (EV) (Nenkov, 2016). The denominator of the formula consists of profits, cash flows, book value per share or revenues (Damodaran, 2011; Ehrhardt & Brigham, 2011). Among the indicators pointing at the environment of the listed entities, the ratio of a security's market price to its sales revenues (Price-to-Sales Ratio) (P/S) deserves a special treatment (Bhardway, 2014; Nenkov, 2016). It is similar to the Price-to-Earnings Ratio (P/E), but assesses a company's price relative to quarterly (annual) sales rather than earnings (O'Shaughnessy, 2005). The P/S ratio is considered as the best or almost the best metric of the capital market (Fischer, 2008; O'Shaughnessy, 2005). This is a popular stock valuation measure used to identify whether a company is underestimated or overestimated by the market (FINREPO, n.d.). Its attractiveness is appreciated for several reasons. First of all, it is available even in the case of the worst-performing enterprises or the so-called start-ups. It remains objective regarding alternative accounting practices. It is more sustainable over time. On the other hand, it is subject to fluctuations in operating and financial leverage (Nenkov, 2016). The above conclusions seem to be confirmed, for example, by research from the American market. Low P/S ratios for all entities (including large companies) in 1951–2003 (1951 = USD 10,000) revealed a hidden growth potential. The distribution of rates of return in both cases remained at a satisfactory level (arithmetic mean of 14.79% and 12.99%, respectively), with high correlations with the S&P 500 (r = 0.87 and r = 0.95) (O'Shaughnessy, 2005). For a sample of 6,000 units from the European market, the average P/S ratio in 2010–2016 was 0.98,

oscillating between 0.72 and 1.13. Moreover, it was more than twice as high as the EV/P indicator, which could be explained by the relatively high financial leverage of European entities (Nenkov, 2016). In turn, the example from Nigeria for 2009–2013 with the minimum and maximum P/S range of -16.72 and 33.21, separately, showed its moderate dependence on the share price P (r = 0.4391). The regression panel proved that it was statistically significant (p = 0.00) (Shittu et al., 2016).

These facts initialized seeking for the answer to what extent the P/Ss of the listed companies in Poland were able to "shape" other financial analysis ratios throughout the specific time horizon.

Research methods

When defining links between entities market value measures, including the market price/sales revenues (P/S) fraction, with miscellaneous financial indicators, using a mathematical multiple regression formula is considered to be one of the alternatives (Gawinecki et al., 2008; Gruszczyński & Podgórska, 2003):

$$Y = \beta_0 + \beta_1 + \beta_2 + \ldots + \beta_k X_k + \varepsilon \tag{1}$$

where: Y – explained (dependent) variable (here: P/S), X_k – k-th explanatory variable, β_k – k-th structural parameter, ε – random component (error).

Provided with an n-element number of observed objects, vectors of the explained variable y, random components ε and unknown structural parameters β can be determined as follows (Gawinecki et al., 2008; Gruszczyński & Podgórska, 2003):

$$y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix}_{nx1} \tag{2}$$

$$\varepsilon = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_n \end{bmatrix}_{nx1} \tag{3}$$

$$\beta = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_k \end{bmatrix}_{(k+1)x1} \tag{4}$$

Then a matrix of explanatory variables will take the form:

$$X = \begin{bmatrix} 1 & x_{11} & x_{12} & \dots & x_{1k} \\ 1 & x_{21} & x_{22} & \dots & x_{2k} \\ \dots & \dots & \dots & \dots & \dots \\ 1 & x_{n1} & x_{n2} & \dots & x_{nk} \end{bmatrix}_{nx(k+1)} \tag{5}$$

When completing exogenous variables for the matrix 5, it is worth interpreting the Pearson's linear correlation coefficients r_{ij}, extracted from pairs of relations X_i/X_j. They should not violate inequalities: $|r_{ij}| < r^*$ and $|r_i| >= r^*$ for the Y/X_m connections vector R_0 (Gawinecki et al., 2008):

$$r^* = \sqrt{\frac{t_\alpha^2}{t_\alpha^2 + (n-2)}} \tag{6}$$

where: t_α – critical value of the Student's t-distribution for the significance level α and n-2 degrees of freedom.

After having substituted the coefficients for the computed vectors and matrices, we will obtain a shortened matrix notation:

$$y = X\beta + \varepsilon \tag{7}$$

An unknown in formula 7 parameter β is calculated by means of a classic least squares method (CLS), in which its unbiased estimator b is obtained by multiplying the left side of the equation $X\beta+\varepsilon$ by X^T. Hence we come to the expression:

$$b = \left(X^T X\right)^{-1}\left(X^T y\right) \tag{8}$$

A quantification of individual coefficients combines with assessing errors for a random component ε and parameters b. The standard error $S(e)$ indicates how much theoretical values differ, on average, from empirical ones, taking as a starting point the estimated variance thereof (Cieślak, 2005; Gawinecki et. al, 2008; Nowak, 2008):

$$S(e) = \sqrt{\frac{1}{n-(k+1)} e^T e} = \sqrt{\frac{1}{n-(k+1)}\left(y^T y - b^T X^T y\right)} \tag{9}$$

Multiplying it by the square root of variance and covariance estimates matrix for the structural parameters b, we obtain error quotas for each of them:

$$S(b_i) = \sqrt{S^2(e)\,(X^T X)^{-1}} \tag{10}$$

The classic least squares method (CLS) assumes random components variance "equality" (Gruszczyński & Podgórska, 2003). When this is not the case (so-called heteroskedasticity phenomenon), its generalized version can be in use (GLS). Under these circumstances, the transformation of the variance-covariance matrix V of the random component e_n will look like below (Borkowski et al., 2004; Gawinecki et.al, 2008):

$$V = \begin{bmatrix} V_1 & 0 & 0 & \dots & 0 \\ 0 & V_2 & 0 & \dots & 0 \\ \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & 0 & \dots & V_n \end{bmatrix} \tag{11}$$

The appearance of matrix V (formula 11) modifies the estimates vectors of: structural parameters b_i, random component S(e) and coefficients errors $S(b_i)$ in formulas 8÷10, while "weighting" them by outcomes derived from the inverse matrix V^{-1} which are returned consequently in expressions 12÷14 (Gawinecki et al., 2008):

$$\widetilde{b} = \left(X^T V^{-1} X\right)^{-1} \left(X^T V^{-1} y\right) \tag{12}$$

$$S(\widetilde{e}) = \sqrt{\frac{1}{n-(k+1)} \widetilde{e}^T V^{-1} \widetilde{e}} = \sqrt{\frac{1}{n-(k+1)} \left(y^T V^{-1} y - \widetilde{b}^T X^T V^{-1} y\right)} \tag{13}$$

$$S(b_i) = \sqrt{S^2(e)\,(X^T V^{-1} X)^{-1}} \tag{14}$$

The only problem left is building an estimation interval. When the standard deviation in the general population σ remains unknown, its approximation constitutes a sampling standard deviation S. By reading from the Student's tables a critical value for the quantile t_α at the probability level $\alpha = 0.05$ and for n-(k+1) degrees of freedom, one can evaluate the confidence interval around the structural parameters β_i equal to (Gawinecki et al., 2008):[4]

$$b_i - t_\alpha S(b_i) \le \beta_i \le b_i + t_\alpha S(b_i) \tag{15}$$

Upon the above methods, six research hypotheses were formulated, considering the first quarters of 2021–2023 (i.e. waves III, V, VII of the SARS-CoV-2 pandemic):

H1: There is quite a relevant correlation between P/S and OM (Operating Margin), as well as P/S vs. DPO (Days Payable Outstanding), with the mutual interactions of OMs and DPOs, in the phase III of the virus spread.

[4] At the same time, it is postulated for a large sample, usually consisting of n > 120 elements, that the unknown variable distribution asymptotically tends to the normal distribution N (see Sobczyk, 1994).

H2: There is a relatively significant relationship between P/S and ROS (Return on Sales), P/S and WC/COGS-D&A (Working Capital to Cost of Goods Sold less Depreciation & Amortization) in the wave V of the COVID-19 spread, but the level of WC/COGS-D&A is also influenced by CCLR (Cash to Current Liabilities Ratio).

H3: There is a moderate or weak correlation between P/S and CCLR (Cash to Current Liabilities Ratio) or C/P and FSR (Financial Sustainability Ratio) in the phase VII of the pandemic.

Individual financial metrics quotas participations and mutual interactions thereof can lead to modifications in the correlation directions, as reflected in the equations coefficients within the framework of the generalized regression panel (GLS). Hence:

H4: Dynamics of the C/Ps is mainly influenced by fluctuations in OMs and FSRs (wave III of the diffusion).

H5: Fluctuations in the amount of the P/S ratios are particularly caused by changes in ROSs and FSRs (phase V of the pandemic).

H6: Changes in the level of the P/S measures are weakly affected by fluctuations in ROSs and FSRs (wave VII of the SARS-CoV-2 virus).

Results

The study on a company's market value was divided into several stages. In the first one, from the available range of metrics: Price/Book Value (P/BV), Price/Sales (P/S), Enterprise Value/Sales (EV/S), Enterprise Value/EBIT (EV/EBIT) and Enterprise Value/EBITDA (EV/EBITDA) the Price-to-Sales ratio (P/S) as a representative for assessing the market value of the listed companies was selected. Thus, identifying subsequent pairs of connections, the Pearson's linear correlation index was used. Its threshold value in the Student's *t*-test for $n = 172$ objects, at the significance level of $\alpha = 0.05$, above which the data are considered to be relevant, equalled to 0.1497. Hence, P/S at $r = 0.4529$ was considered to be the most capacious. It is strongly correlated with EV/S ($r = 0.9819$), so some information may be duplicated. On the other hand, we have low indications for potential P/S vs. EV/EBIT ($r = 0.090$) and P/S vs. EV/EBITDA ratios ($r = 0.0085$) below the mentioned threshold (0.1497), which seem to support the correctness of the choice. This issue is illustrated in Table 1.

Table 1. Correlation relationship of the capital market measures of listed companies in Poland in the first quarter of 2021–2023 [data in units]

	P/BV	P/S	EV/S	EV/EBIT	EV/EBITDA
P/BV	1.0000	0.4529	0.4199	0.1601	0.2580
P/S	0.4529	1.0000	0.9819	0.0900	0.0085
EV/S	0.4199	0.9819	1.0000	0.0854	0.0135
EV/EBIT	0.1601	0.0900	0.0854	1.0000	0.0630
EV/EBITDA	0.2580	0.0085	0.0135	0.0630	1.0000

Source: Author's own study.

In the second step, the impact of micro factors, understood as subsets of financial indicators in the area of profitability, (static) liquidity, solvency and (operational) activity on the P/S ratio was measured, isolating 3 subperiods from the first quarters of 2021–2023. In each of them, a total of 6.162 potential interactions among 172 entities was analyzed, isolating eight financial measures: Operating Margin (OM) and Return on Sales (ROS) for rentability, Cash Ratio (CR), as well as Cash to Current Liabilities Ratio (CCLR) in case of (static) liquidity, Financial Sustainability Ratio (FSR) for solvency, finally, Days Payable Outstanding (DPO), along with Working Capital to Cost of Goods Sold less Depreciation & Amortization (WC/(COGS-D&A)) and Total Assets Turnover (TAT) calculating a corporate activity. The key mutual relations of the aforementioned measures in the first quarters of the given time horizon are shown in Table 2.

Table 2. Correlation relationship of the capital market measures of listed companies in Poland in the first quarter of 2021–2023 [data in units]

Q1 2021

	P/S	OM	CR	FSR	DPO
P/S	1.0000				
OM	-0.7560	1.0000			
CR	0.2858	0.0917	1.0000		
FSR	0.2510	0.0024	0.2923	1.0000	
DPO	0.7298	-0.8709	-0.0604	0.0043	1.0000

Q1 2022

	C/P	ROS	CCLR	FSR	WC/COGS-D&A
C/P	1.0000				
ROS	-0.6731	1.0000			
CCLR	0.3782	0.1338	1.0000		
FSR	0.3216	0.0094	0.3162	1.0000	
WC/COGS-D&A	0.6668	-0.2019	0.5104	0.3439	1.0000

Q1 2023

	P/S	ROS	CCLR	FSR	TAT
P/S	1.0000				
ROS	-0.2067	1.0000			
CCLR	0.4853	0.1091	1.0000		
FSR	0.3415	0.0965	0.2881	1.0000	
TAT	-0.2922	-0.0543	-0.1594	-0.4339	1.0000

Source: Author's own study.

Having a closer look at selected elements of financial analysis in the subsequent quarters of 2021–2023, one can notice easily that maximal influence of the OM (r = -0.7560) and the Days Payable Outstanding (DPO) (r = 0.7298) on the P/S amount took place in Q_1/2021 (the third wave of the SARS-CoV-2 pandemic), while the longer the DPO cycle, the lower the OM level (r = -0.8709) (H1). The impact of microeconomic factors on the enterprise value seems to be slightly weaker in Q_1/2022, reaching its upper limit for the P/S indications versus ROS (r = -0.6731) and P/S versus WC/(COGs-D&A) (Working Capital to Cost of Goods Sold less Depreciation & Amortization) (r = 0.6668) quotient (the fifth wave of the COVID-19 spread). By contrast, we have pretty significant feedback relations between the WC/(COGs-D&A) indicator and the referred CCLR (r = 0.5104) (H2). The "loosest" interaction of the selected parameters of the ratio analysis on the *P/S* metric occurs in Q_1/2023, with a maximum for CCLR (r = 0.4853) (the seventh wave of the SARS-CoV-2 pandemic), postulating the existence of determinants outside financial analysis influencing the listed companies' market value (H3). The so conducted correlation study of financial indicators enabled constructing regression equations in the defined research periods in the point three. They have been presented in Table 3.

Table 3. Multiple regression models of the main exogenous variables shaping the P/S ratio of the listed companies in Poland in the first quarter of 2021–2023 using the ordinary least squares method (CLS)

Q_1 2021

No.	Name	Coefficients	Standard Error	*t*-Stat	*p*-value	Lower 95%	Upper 95%	Significance
0	1	2	3	4	5	6	7	8
1	Intercept	-2.80	1.06	-2.64	0.01	-4.90	-0.71	Yes
2	OM	-7.15	1.04	-6.85	0.00	-9.21	-5.09	Yes
3	CR	0.62	0.08	7.36	0.00	0.45	0.78	Yes
4	FSR	5.80	1.48	3.92	0.00	2.88	8.72	Yes
5	DPO	0.01	0.00	3.32	0.00	0.00	0.01	Yes

Q_1 2022

No.	Name	Coefficients	Standard Error	*t*-Stat	*p*-value	Lower 95%	Upper 95%	Significance
0	1	2	3	4	5	6	7	8
1	Intercept	-0.47	0.34	-1.38	0.17	-1.15	0.20	No
2	ROS	-3.76	0.22	-17.17	0.00	-4.19	-3.33	Yes
3	CCLR	0.19	0.03	5.43	0.00	0.12	0.26	Yes
4	FSR	1.76	0.53	3.34	0.00	0.72	2.79	Yes
5	WC/COGS-D&A	0.72	0.08	8.80	0.00	0.55	0.88	Yes

Q_1 2023

No.	Name	Coefficients	Standard Error	*t*-Stat	*p*-value	Lower 95%	Upper 95%	Significance
0	1	2	3	4	5	6	7	8
1	Intercept	-0.22	0.92	-0.24	0.81	-2.03	1.58	No
2	ROS	-4.53	1.00	-4.55	0.00	-6.50	-2.57	Yes
3	CCLR	0.49	0.07	6.88	0.00	0.35	0.63	Yes
4	FSR	2.86	1.17	2.44	0.02	0.54	5.17	Yes
5	TAT	-0.50	0.21	-2.41	0.02	-0.91	-0.09	Yes

Source: Author's own study.

All the financial indicators isolated in the regression analysis (Table 3), except for the intercept (in Q_1/2022, in which $p = 0.17$ and for Q_1/2023, where $p = 0.81$), turned out to be relevant at $\alpha = 0.05$ (col. 8). Interestingly, the highest $R^2 = 0.80$ was found in the P/S equation in the first quarter of 2022 and it was the same as the adjusted R Square. However, the lowest R^2 – standard and adjusted – refers to the regression model created in Q_1/2023 – 0.38 and 0.36, respectively. It should be hereby emphasized that both determination measures remain similar what suggests that representatives of financial indicators had been properly picked up from the data set. The largest standard error in it accompanies the Financial Sustainability Ratio (FSR), especially in Q_1/2021 and Q_1/2023, each creating an estimate margin of <2.88; 8.72> and <0.54;5.17> (row 4, col. 6 and 7). The smallest standard error is associated with specifying an approximation interval of <0.00; 0.01> for DPO in Q_1/2021 (row 5, col. 6 and 7), and for CCLR in Q_1/2022 which equals to <0.12;0.26> (row 3, col. 6 and 7).

The substantive usefulness of the results obtained in Table 3 implies that certain assumptions should be met. They concern individual distributions normality, the equality and randomness of residuals e_n and the lack of autocorrelation thereof. In this way, the shape of the regression curves was checked, by subtracting theoretical $F(e_i)$ from empirical $S_{n(x)}$ distribution functions in their *supremum*, in the fourth step. Because their computed maximum absolute differences for the first quarters of 2021–2023 were 3.06 (2021), 2.24 (2022) and 2.91 (2023), each time exceeding the Kolmogorov–Smirnov critical value, read from the tables for $n = 172$ and $\alpha = 0.05$, which amounted to 1.3581, the postulate of compliance of these graphs with the Gaussian curve was rejected. In the fifth stage, the premise of residuals equality was verified. By dividing the subseries of random components $S(e_1)^2$ and $S(e_1)^2$ the variances subtotals were calculated. Thus the theoretical values of $F_{m1,m2}$ in the Fischer–Snedecor test achieved equal to 1.06 (2021), 2.18 (2022) and 3.61 (2023). In 2022 and 2023, they exceeded the upper limit of 1.44 – for n_1-k-1=81 and n_2-k-1=81 in the two subseries of residuals e_1 and e_2, defining frames of the critical area of <1.44; ∞), which argued for rejecting the random components equality. In the sixth stage, the randomness of the residuals e_i was checked under the Series Test, not forgetting about the convergence of the obtained distribution with the two-sided normal curve *N* for a large number of observations. Due to the fact that the approximate absolute amounts of $\Phi(u)=|u|$, i.e. 0.12 (2021), 0.44 (2022) and 0.71 (2023) were always lower than the critical value $|u_{0.05}| = 1.96$, the assumption of randomness of all the regression curves was confirmed (Sobczyk, 1994). In the seventh step, the theorem on the existence of residuals autocorrelation in the Durbin–Watson statistic was verified. Since the $d_L <= d_n <= d_U$ inequality occurs for each of the three periods, decisions can be made, regarding the mutual influence of individual delayed subseries on each other. However, taking into account that in the first quarter of 2021–2023 the rounded amounts of d_n equal to 1.95 (2021), 1.80 (2022) and 1.84 (2023) with $d_U = 1.79$, true is the relationship $d_U < d_n < = 4$, which means no autocorrelation

phenomenon (Gawinecki et al., 2008; Sobczyk, 1994). Noteworthy is thereby the result of the formula $0 <= d_n < 2$ itself which appears to point at a discrete positive correlation ($\rho > 0$) for the periods of Q_1/2022 and Q_1/2023. Guided by the premise of variances homogeneity, generalized regression models (GLS) were created, by transforming unequal variances in the step eight. They are shown in Table 4. The calculated autocorrelation index ρ stood between 0 and 0,10, hence it was omitted in further regression function modifications.

Table 4. Multiple regression models of the key exogenous variables, determining the P/S ratio quotas of the listed companies in Poland, in the first quarter of 2021–2023, using the generalized least squares method (GLS), in case when residuals autocorrelation index $\sigma < 0.10$

Q_1 2021

No.	Name	Coefficients	Standard Error	*t*-Stat	*p*-value	Lower 95%	Upper 95%	Significance
0	1	2	3	4	5	6	7	8
1	Intercept	-2.59	0.16	-16.43	0.00	-2.90	-2.28	Yes
2	OM	-6.48	0.29	-22.30	0.00	-7.05	-5.90	Yes
3	CR	0.63	0.08	8.21	0.00	0.48	0.78	Yes
4	FSR	5.00	0.27	18.78	0.00	4.48	5.53	Yes
5	DPO	0.01	0.00	14.72	0.00	0.00	0.01	Yes

Q_1 2022

No.	Name	Coefficients	Standard Error	*t*-Stat	*p*-value	Lower 95%	Upper 95%	Significance
0	1	2	3	4	5	6	7	8
1	Intercept	-0.44	0.09	-4.71	0.00	-0.63	-0.26	Yes
2	ROS	-3.79	0.19	-19.73	0.00	-4.17	-3.41	Yes
3	CCLR	0.21	0.02	11.87	0.00	0.18	0.25	Yes
4	FSR	1.69	0.16	10.39	0.00	1.37	2.01	Yes
5	WC/COGS-D&A	0.62	0.06	9.65	0.00	0.49	0.74	Yes

Q_1 2023

No.	Name	Coefficients	Standard Error	*t*-Stat	*p*-value	Lower 95%	Upper 95%	Significance
0	1	2	3	4	5	6	7	8
1	Intercept	0.02	0.17	0.12	0.91	-0.32	0.36	No
2	ROS	-3.23	0.44	-7.35	0.00	-4.09	-2.36	Yes
3	CCLR	0.39	0.05	7.49	0.00	0.29	0.50	Yes
4	FSR	2.09	0.26	8.04	0.00	1.58	2.61	Yes
5	TAT	-0.44	0.06	-7.46	0.00	-0.56	-0.32	Yes

Source: Author's own study.

Table 4 reveals that during the third wave of the SARS-CoV-2 pandemic (Q_1/2021), the market value of the listed companies seemed to be determined significantly by financial measures – apart from their intercept, mainly by the OM (-6.48) and the FSR (5.00), building the GLS equation, in which the adjusted R^2 was as high as 0.92 (H4). It can be postulated that in the fifth wave of the pandemic spread (Q_1/2022), the C/P ratios of the WSE entities were still reflected in financial analysis, with the key participation of Return on Sales (ROS) (-3.79) and the FSR (1.69), where adjusted $R^2 = 0.89$ (H5). In turn, financial metrics had the least impact

on the enterprise value during the seventh wave of the COVID-19 diffusion (adjusted $R^2 = 0.62$), with their maximum effect, traditionally for the Return on Sales (ROS) (-3.23) and the FSR (2.09) (H6).

Discussions

The negative consequences of the outbreak of the SARS-CoV-2 pandemic appear to have an impact on the enterprises' financial condition, which should be reflected in the levels of properly grouped financial indicators. Within Europe, the statistical tests on a dataset of 1,618 Slovak companies confirm that the macroeconomic development, including the COVID-19 pandemic in 2020 and 2021, has significantly affected the corporate financial stability of enterprises, showing significant differences in the indicators of self-financing ratio, current indebtedness ratio, and equity leverage ratio in all the monitored periods of 2018–2021 (Valaskova et al., 2023). In Poland we come across very interesting findings on COVID-19 fear level at the Stock Exchange. They depict that the main Polish indices – WIG and WIG20 – are significantly correlated with the "anxiety" embodied by WIV20 and VIX indexes (Jasiniak et al., 2023). French studies prove that factors like a firm's profitability, solvency and liquidity still play a key role in estimating its bankruptcy. However, traditional determinants of insolvency were mitigated in 2020. In particular, the sectors hardest hit by the "health crisis" were typically less likely to experience bankruptcy under normal conditions, the period of crisis increased their vulnerability to it. Even business entities with a greater environmental or social background did not avoid lower stock returns during the COVID-19 shock (Bureau et al., 2022; Garel & Petit-Romec, 2021; Maadini & Hadjibeyli, 2022). It is worth mentioning that in Germany businesses typically regarded as high performers – such as innovative, digitally or internationally active enterprises or companies with a high credit rating – grappled with turnover losses more frequently than the others at the beginning of the pandemic but that their turnover losses were often less severe (Köhler-Geib & Zimmermann, 2023). Exploring the influence of the SARS-CoV-2 at the Italian Stock Exchange (ISE) (from December 2019 until October 31, 2020), in terms of return rates and market capitalization, revealed that companies, belonging to the MIB 30, have benefited from the shock and brought anomalous positive returns, especially driven by the sectors of health, technology, consumer goods (Mauro et al., 2023; Tibiletti et al., 2021). Finally, an example from the United Kingdom of 374 construction companies from 2015 to 2021 demonstrated the relationship between the dependent variable ROA and other financial ratios like current ratio, inventory turnover, working capital, etc. Gearing, debtor collection, turnover growth, and stock turnover decreased, on average, in 2020, from which all of them recovered somehow in 2021 except gearing. The results of the survey point out that the impact of COVID-19 is significantly correlated with the decline in the financial performance

of construction firms, and the outcomes are positive and statistically significant at the 1% level. It was also verified that large firms coped worse with the pandemic (Zhang & Sun, 2024).

Outside Europe, the investigations of three sectors conducted at the Palestinian Stock Exchange (PEX) revealed that the spread of the SARS-CoV-2 resulted in significant fluctuations in liquidity (depicted by the current and cash ratios) and solvency (in the context of the debt to equity) during the pre-pandemic (2018 and 2019) and the pandemic (2020 and 2021) periods in the industrial, investment and service sectors. According to the outcomes there was a significant decline in liquidity after the outbreak of COVID-19 in both industrial and investment sectors. On the contrary, the study showed a noticeable improvement in liquidity among service companies. Moreover, the results indicated a relevant growth in the debt to equity ratio during the COVID-19 pandemic in service companies. However, this indicator remained stable before and during the virus spread in the industrial and investment sectors. Additionally, a decline in a net profit margin as a measure of profitability was proven after the outbreak of the COVID-19 epidemic in all sectors, while no significant difference was found in profitability before and after the SARS-CoV-2 pandemic diffusion (Darabee, 2022). Alternatively, the readings of the entities' financial metrics from the Indonesian Stock Exchange (IDX) in Q2/2019-Q2/2020 pointed at an increase in the leverage and receivables turnover indicators. Furthermore, there was a decline in current liquidity and asset return ratios in public companies during the COVID-19 pandemic. However, no significant difference was noticed in the current liquidity and leverage ratios. On the other hand, a remarkable polarity in ROA and the receivables turnover ratios among public companies between the SARS-CoV-2 pre-pandemic and pandemic time was observed. The sector that recorded an increase in liquidity, profitability and activity rates was the consumer goods sector, while the sectors that stated a decrease in the liquidity and profitability rate were real estate, construction, finance, trade, services and the investment sector. There was no relevant change in the current ratio and leverage ratio throughout the time examined. We also had a decline in the average value of the current ratio and a growth in the average value of leverage (Devi et al., 2020). Another instance stems from the Vietnamese Stock Market, in where a sample of 415 units was drawn. The study employed quarterly financial data from Q1-2010 to Q1-2021, while making comparison between the two main periods, including the time of the COVID-19 occurrence (from Q1/2020 to Q1/2021), and the time before it (from Q1/2010 to Q4/2019). Sampled companies were assigned to different nine industries. The results proved that firms had experienced a significant decrease in operational performance (measured by ROA) due to the COVID-19 pandemic. Given cash being necessary for each enterprise's daily operations, Vietnamese companies were supposed to have a higher level of cash holdings to prevent the sudden cash gap during the SARS-CoV-2. However, a decline in firm's performance and cash flows was only statistically "binding" for these operating in the manufacturing, transportation and public utilities, wholesale trade

and public administration sectors. Businesses were also inclined to reduce its leverage to avoid the possibility of bankruptcy due to the pandemic (Vo & Tran, 2021).

In opposite to the investigations gathered above, which attempted to identify the relationships of the selected financial indicators shaping the entities' financial condition across individual industries, this study was focused on the construction of formulas showing the general dependence of the enterprise's market value, measured as the price/revenue fraction. This knowledge is ought to help managers to make an appropriate decision, when evaluating the company's position against the competition. Since not all the assumptions of the regression function in the sense of the classical least squares method (CLS) were met, its generalized variant (GLS) was implemented, by correcting k-th residuals variances.

Conclusions

This paper has the task to determine whether and to what extent the market value of the listed companies could be shaped by financial analysis indications within the three phases of SARS-CoV-2 virus exposure during the pandemic wave III, V and VII. By tracing the connections of individual capital market indicators with each of the tested interaction measures in the area of profitability, (static) liquidity, solvency and operational efficiency, the Price/Sales ratio (P/S) was selected as its representative. Among the available measures showing the company's market position, it turned out to be the most universal one for the first quarter of 2021–2023 ($r = 0.4529$), slightly "overtaking" the Enterprise Value/Sales ratio (EV/S) ($r = 0.4199$) with feedbacks occurred between them ($r = 0.9819$).

The results of the in-depth correlation study identified the pattern ratios: profitability (OM and ROS), (static) liquidity (CR, CCLR), solvency (FSR) and (operational) activity (DPO, WC/COGS-D&A, TAT). Strong relations between the *P/S* and profitability ($\max r_{OM} = -0.7560$, $\max r_{ROS} = -0.6731$) as well as (operational) efficiency of the listed entities ($\max r_{DPO} = 0.7298$, $\max r_{WC/(COGS\text{-}D\&A)} = 0.668$) seem to be visible in the phase III and V of the COVID-19 pandemic (Q_1/2021 and Q_1/2022). During the seventh wave of the SARS-CoV-2 virus spread, the *P/S* quota should be, by contrast, influenced mainly by static liquidity ($\max r_{CCLR} = 0.4853$) (Q_1/2023). The financial measures selected in the correlation analysis became the basis for building multiple regression models for the above-mentioned periods. The conducted research revealed that formulae returned did not match with the Gaussian curve. As one knows, this fact does not determine the estimation quality. This is because, having a relatively large sample of $n = 172$ listed entities, covering approximately 48% of the general population in the depicted time horizon, a "cautious" judgment on the interactions taken place in the entire population seems fully justified. However, there remains an issue of meeting further assumptions of the CLS panel with regard to residuals equality, randomness and absence of autocorrelation between them. The postulates

for stochasticity and "non-existence" of random components autocorrelation were *ex definitione* fulfilled, with a discrete positive correlation ($\rho < 0.10$) observed in $Q_1/22$ and $Q_1/23$. Meanwhile, it was found that the variances in the *P/S* regression chart (Y_{PS} variable) in the first quarter of 2022 and 2023 exceeded the critical area of <1.44; ∞), what implied rejecting their homoscedasticity. The lack of residuals variances equality δ^2 brought transformations in them for each of the described cases by means of a generalized least squares approach (GLS). As a result, the amounts of determination coefficients R^{2}^, corrected by n-k-1 degrees of freedom, increased – especially for $Q_1/2021$ and $Q_1/2023$ (from 0.73 to 0.92 and from 0.36 to 0.62, respectively). The "adjusting" procedure also caused decreases in the standard errors of the main coefficients in the following models: in the first regression equation – for the OM of -6.48 (from 1.04 to 0.29) and the FSR of 5.00 (from 1.48 to 0.27) ($Q_1/2021$), in the second one – for the ROS of -3.79 (from 0.22 to 0.19) and the FSR of 1.69 (from 0.53 to 0.16) ($Q_1/2022$), and in the third one – with the ROS of -3.23 (from 1.00 to 0.44) and the FSR of 2.09 (from 1.17 to 0.26) ($Q_1/2023$).

Summarizing, the research depicted in this paper appears to expand the literature *status quo* on corporate finance in many aspects. First of all, basic financial ratios sensitivity study showing their impact on a Price/Revenues fraction, which remains an important company's market value indicator, was carried out. Secondly, the influence of the Sars-CoV-2 virus on the market value of the listed companies of a key importance to the economy was presented. Thirdly, taking the ratio analysis quotations at the first quarter of 2021–2023 as the comparison basis, the negative seasonality side effects were limited. The outcomes of the study should be of interest to a wide range of decision-makers, especially investors who want to learn more about the microeconomic conditions for the business entities quoted at the Warsaw Stock Exchange. On the other hand, surveys on macroeconomic factors affecting the market value of the aforementioned companies, deepened ratio analysis of firms grouped into significant industries of the economy, could constitute a relevant contribution to further discussions.

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