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The new face of book value of listed companies in the era of global economic crises

Nowe oblicze wartości księgowej spółek giełdowych w dobie światowych kryzysów gospodarczych

Keywords:

listed company, book value, estimator, dependent variable, indicator, econometric model

Abstract: The main issue addressed in the article relates to the impact of complex economic crises on the book value of joint-stock companies. Turmoil on the stock market has a negative impact on the book value of the entities studied. This is more important because investors buying or selling shares of individual listed companies have a difficult task, since in making decisions around their investments they are exposed to enormous risk and, at the same time, uncertainty. In this case, it is worth examining which stock market indicators are most helpful in assessing the financial health of companies. The purpose of this article is to determine the impact of the selected indicators on the growth of book value of the companies listed on the Warsaw Stock Exchange during crisis circumstances. The research method used in the presented article is the estimation of an econometric model that confirms the high impact of selected metrics on the book value of listed companies. The research on the impact of estimators on the dependent variable covers the period January 2020–May 2023.

Słowa kluczowe:

spółka akcyjna, wartość księgowa, estymator, zmienna zależna, wskaźnik, model ekonometryczny

Streszczenie: Zasadnicza problematyka poruszana w artykule odnosi się do wpływu złożonych kryzysów gospodarczych na wartość księgową spółek akcyjnych. Zawirowania na giełdzie papierów wartościowych mają negatywny wpływ na wartość księgową badanych jednostek. Jest to o tyle istotne, że inwestorzy skupujący bądź zbywający akcje poszczególnych spółek giełdowych mają utrudnione zadanie, gdyż podejmując decyzje wokół realizowanych inwestycji są narażeni na ogromne ryzyko a zarazem niepewność. Warto w tym wypadku zbadać, które wskaźniki giełdowe są najbardziej pomocne w ocenie kondycji finansowej spółek. Celem niniejszego artykułu jest określenie wpływu wybranych wskaź-

JEL:
G3, M4, C1, C5

ników na wzrost wartości księgowej spółek notowanych na Giełdzie Papierów Wartościowych w Warszawie w warunkach kryzysu. Metodą badawczą zastosowaną w prezentowanym artykule jest estymacja modelu ekonometrycznego potwierdzającego wysoki wpływ wybranych mierników na wartość księgową spółek akcyjnych. Badania nad wpływem estymatorów na zmienną zależną obejmują przedział czasowy styczeń 2020–maj 2023.

Introduction

Not only small businesses, but also large joint-stock companies are facing many difficulties in the face of the complex crises that have been going on almost since March 2020, which the global economy is facing. First the coronavirus pandemic and now the armed conflict in Ukraine, which the whole world is watching with great concern, have caused chaos. First in early 2020 and soon in February 2022, stock exchanges were the first to react. The extreme reactions of all sectors triggered declines in companies' stock prices.

During the coronavirus pandemic in Poland, the largest declines of up to 50% were recorded by two sectors: apparel and pharmaceuticals. In contrast, the smallest losses were in the construction (14%), real estate-related and new technology sectors (both 18% each) [*Impact of COVID-19 on the Economy – as seen in the indices*, 2020]. Russia's invasion of Ukraine again caused negative shocks to financial markets. The Warsaw Stock Exchange was also flooded with a wave of red. Nonetheless, in the shadow of a war that has lasted more than a year, companies in the arms industry posted the biggest gains. But other sectors faced threats that could even lead to bankruptcy.

Turmoil in the stock market negatively affects the book value of joint-stock companies, the size of which investors are guided by when deciding whether to buy or sell shares. In this case, they use several metrics to facilitate the valuation of securities. One of them is the P/E ratio, which reflects the ratio of stock market capitalization to total net profits for the last four quarters, and P/BV, which examines the effect of stock market capitalization on the value of listed equity at the end of the last calendar quarter. In addition, book value can be more or less influenced by the ratio of dividends per share to net income.

Specific studies on the impact of the financial crisis on the book value of listed companies are lacking in publicly available literature and the studies' findings. A literature review covering theoretical studies and considerations of the impact of the complex economic (including financial) crisis on the essence of the book value of companies is described in the next paragraph. There are mainly articles on perceptions of market

value in assessing the financial condition of the business units studied. So, the main research aim of this article is to verify the research hypothesis by attempting to prove the impact of individual indicators on the studied volume. The purpose of this article is to determine the impact of the selected indicators on the growth of book value of the companies listed on WSE during crisis circumstances. The structure of the article consists of theoretical aspects including a literature review devoted to the problem of the book value of companies listed on the WSE shaped by global economic crises.

The content of the study is supplemented by the construction of an econometric model assuming the impact of the ratios of P/E, P/BV and dividend yield on the book value of listed companies. The study of the impact of selected estimators on the dependent variable covers the research period January 2020 – May 2023.

The impact of complex economic crises on the book value of publicly traded joint-stock companies. A review of the literature

Before analyzing the impact of the complex economic crisis on the book value of listed companies, it would be appropriate to consider what is at the essence of the crisis. General definition of that phenomenon confirms that global crisis is a result of the process of distribution of Gross Domestic Product. In this case GDP value is falling and financial system stops working normally.

Scientists confirms that “one peacetime recession out of four involves a financial crisis” [Jordà et al., 2013, pp. 3–28]. But on the other hand, in the era of the armed conflict in Ukraine, it is safe to assume the occurrence of even several phases of this type. Given the current financial situation having a negative impact on the global economy and the financial development of companies measured by book value, it could be said that the phase of entering a new epoch of crisis has begun [Stulz, 2023, p. 2; Bookstaber, 2023].

According to the general definition cited in almost every study, the book value of individual assets corresponds to their carrying value. Thus, the historical cost expressing the actual price at which the transaction was made is reduced by the value of accumulated depreciation [Stamatoska, 2022].

The considerations cited in the article presented by economists [Wakil, 2020, p. 434; Cheng et al., 2017, p. 311] confirm that the book value is primarily based on historical cost and is not prone to change, on the contrary. That value is due to conservatism and includes an accounting principle in accordance with which biases asset values downward. In this case, conservatism is advantageous and used for efficient debt and equity contracting [Lara et al., 2014; p. 173; Kang et al., 2017, pp. 182–183].

In era of global crises reliance on the market value of the company as market mechanism is not good solution. The market mechanism may not be helpful in another ran-

dom events [Ogaki, 2022, p. 436]. Therefore, the book value of a company, the main feature of which is conservatism, is more helpful in crisis situations as opposed to considering the value of a company in terms of its market value. Especially if we are talking about listed companies in this case.

The financial statements, which present accounting data values of public companies, which may also include listed companies provide a clear understanding of their financial condition. Stock market data (financial data) provide information about the economic environment [Belesis et al., 2020, p. 59]. However, previously, in the era of the coronavirus pandemic and now in the face of the armed conflict in Ukraine, analyzed data could be subject to constant fluctuations, the opposite of which is the book value.

The firm market value is the value of assets. In this case the book value depends on total assets and market value of equity [Altieri, Nicodano, 2023, p. 13]. The analysis of the book value of a joint-stock company becomes more useful in assessing its financial health and its survival in the financial market compared to the company's market value [Campbell et al., 2008, pp. 2899–2939].

In a paper presented by Tobin was described method of measurement of index of the market value of assets (TQ) and their replacement costs, which are connected with the book value (BV). That method was explained by a formula including TA (Total Assets) and MVE (Market Value of Equity) [Tobin, 1969, pp. 15–29; Pietraszewski et al., 2023; Baxamusa, Georgieva, 2015, p. 275]:

$$TQ = \frac{TA + MVE - BV}{TA}$$

After the transformation, the book value of the company is calculated using the following pattern:

$$BV = TA + MVE - TATQ$$

The book value combined with market value measures whether development of the joint-stock companies could reflect in the current share price. The higher value confirms this relationship. The existence of higher level of development suggests a better competitive position in that kind of companies [Mietzner, Schweizer, 2014, p. 199; Brzeszczyński, Gajdka, 2007, p. 288]. This kind of relationship is also indicative of the quality of the management process of the joint-stock company itself [Mamun et al., 2004, pp. 343–344].

On the book value impact the following indicators [WSE Statistical Bulletin, 2023, p. 48]:

- P/E ratio – market capitalization to sum of net profits for last 4 quarters and
- P/BV ratio – market capitalization to book value at the end of last quarter.

Both indicators in joining with dividend yield confirm positive correlation between book value and evaluation of the financial condition of listed companies in era of global pandemic and military conflict in Ukraine, which confirms Modigliani-Miller's claim. Miller and Modigliani [Miller, Modigliani, 1961, pp. 411–412] underlined essence of theory of dividends. They assumed that dividend changes have information embedded in them and profits of listed companies. Potential investors would try to get information about dividend changes in advance for better profit opportunities.

Data sources and statistical methodology

The data used in the process of building a linear econometric model is an attempt to prove the greater or lesser impact of the P/E, P/BV ratio and dividend yield on the book value of listed companies, which, as the author cited in the literature review above, is considered a more stable value of a company in times of complex economic crises, as opposed to market value, which is often prone to fluctuations due to the uncertain times in which business has come. Here, the effect of the aforementioned indicators on the main market of the Stock Exchange on the monthly averaged book value of companies listed on the WSE is examined.

The estimated model contains three explanatory variables that exert more or less influence on the explanatory variable. Accordingly, the following variables were extracted:

- y – averaged book value of companies listed on the WSE (PLN mil.),
- x_1 – P/BV ratio (%),
- x_2 – P/E ratio (%),
- x_3 – dividend yield (%).

The author tries to prove by trial and error which of the indicators has the strongest effect on the book value of joint-stock companies, while looking for a cause-and-effect relationship between the dependent variable and the independent variables. The estimated econometric model includes a time series describing the impact of the studied indicators on the book value of companies.

In the process of estimation, the author used GRETL and Excel. The analysis of the fit of the variables began by determining the effect of the three estimators on the y variable. The research period covered 41 months'. The data is for the research period January 2020–May 2023, a detailed description of which is presented in Table 1.

An analysis of data for the period January 2020–May 2023 shows that in the months of August 2022–January 2023, listed companies experienced a decline in book value, due to the consequences of the ending coronavirus pandemic and disturbing reports from across Poland's eastern border about Russia's alleged invasion of Ukraine at the time. In the February 2022–May 2023 period, the surveyed volume even rose

to 1,761 million. Nevertheless, mostly only because a bull market began in companies in the arms industry, which continues to this day. The data presented in the previous table are used to estimate the linear econometric model.

Table 1. January 2020 – May 2023 data determining the impact of selected indicators on the book value of listed joint-stock companies

Lp.	Research period	Book value (PLN mil.) y	P/BV ratio (%) x_1	P/E ratio (%) x_2	Dividend yield (%) x_3
1.	January 2020	1323.64	1.02	15.00	3.10
2.	February 2020	1333.40	0.89	13.30	3.60
3.	March 2020	1344.66	0.75	11.10	4.20
4.	April 2020	1331.97	0.83	14.40	3.70
5.	May 2020	1339.15	0.87	20.20	2.70
6.	June 2020	1342.53	0.90	25.00	2.00
7.	July 2020	1347.38	0.92	32.70	1.60
8.	August 2020	1364.78	0.92	32.00	1.00
9.	September 2020	1365.29	0.88	40.40	1.00
10.	October 2020	1374.32	0.77	42.20	1.10
11.	November 2020	1397.27	0.93	56.80	1.00
12.	December 2020	1398.68	1.01	53.20	0.90
13.	January 2021	1398.41	1.02	54.00	0.90
14.	February 2021	1408.10	1.03	62.20	0.90
15.	March 2021	1414.35	1.05	34.60	0.90
16.	April 2021	1415.63	1.11	31.90	0.90
17.	May 2021	1432.90	1.19	21.80	0.90
18.	June 2021	1439.71	1.17	21.10	1.20
19.	July 2021	1434.19	1.19	23.20	1.60
20.	August 2021	1436.94	1.24	18.30	1.50
21.	September 2021	1453.55	1.24	17.60	2.10
22.	October 2021	1465.95	1.32	16.60	2.10
23.	November 2021	1490.80	1.20	13.30	2.20
24.	December 2021	1478.43	1.24	13.60	2.20
25.	January 2022	1485.59	1.20	12.40	2.30
26.	February 2022	1453.69	1.12	10.50	2.50
27.	March 2022	1464.37	1.18	9.20	2.40
28.	April 2022	1490.09	1.06	8.00	2.80
29.	May 2022	1514.76	1.03	7.20	2.80

Lp.	Research period	Book value (PLN mil.) y	P/BV ratio (%) x_1	P/E ratio (%) x_2	Dividend yield (%) x_3
30.	June 2022	1520.33	0.97	6.80	2.80
31.	July 2022	1528.13	0.99	6.90	3.00
32.	August 2022	1463.37	0.93	6.10	3.80
33.	September 2022	1483.58	0.84	5.60	3.80
34.	October 2022	1488.70	0.92	6.20	3.50
35.	November 2022	1478.06	1.03	7.50	3.20
36.	December 2022	1480.49	1.05	7.70	3.10
37.	January 2023	1469.65	1.11	8.10	2.90
38.	February 2023	1613.91	0.99	6.70	3.00
39.	March 2023	1645.51	0.95	6.70	3.10
40.	April 2023	1660.40	1.00	7.00	2.60
41.	May 2023	1760.91	0.93	6.80	2.80

Source: own elaboration based on: <https://www.gpw.pl/statystyki-gpw#2> (12.06.2023).

Results of econometric model estimation

The econometric model used in the article is a linear model with three explanatory variables. It takes the following form [Kuszeński, 2004, pp. 7–9]:

$$Y_t = \alpha_0 + \alpha_1 x_{1t} + \alpha_2 x_{2t} + \dots + \alpha_j x_{jt} + e_t \Rightarrow Y_t = \alpha_0 + \alpha_1 x_{1t} + \alpha_2 x_{2t} + \alpha_3 x_{3t} + e_t$$

$(t = 1, 2 \dots n)$

where:

numbers: n – the number of units studied,

j – the number of explanatory variables,

$x_t, \alpha, \alpha_0, \dots, \alpha_j$ – model parameters,

α_t – random component

Estimation of the parameters used in that model is carried out using the classical least squares method with time series. The correlation analysis showed that the set of explanatory variables $x - x_{13}$ may not be strongly correlated with each other, although the sample size of $n = 41$, combined with the p-values calculated for the individual variables, further confirms the fact that the P/E ratio and the dividend yield have the strongest effect on the growth of the overall book value of listed stock companies. The results of the final estimation are presented in Table 2.

Table 2. Final model estimation. OLS, using observations 2020:01–2023:05 (T = 41).
Dependent variable: y

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
const	1631.14	73.6927	22.13	<0.0001	***
x2	−4.81946	1.36034	−3.543	0.0011	***
x3	−36.5055	21.4878	−1.699	0.0975	*
Mean dependent var	1452.038	S.D. dependent var		94.08421	
Catfish squared resid	247954.3	S.E. of regression		80.77818	
R-squared	0.299710	Adjusted R-squared		0.262852	
F(2, 38)	8.131598	P-value (F)		0.001149	
Log-likelihood	−236.6788	Akaike criterion		479.3575	
Schwarz criterion	484.4982	Hannan-Quinn		481.2295	
rho	0.950270	Durbin-Watson		0.293977	

Source: own elaboration.

The explanatory variable x_1 , determined by the P/BV ratio, was excluded from the original model structure. Research on the power analysis of the tests performed clearly confirms that the variable x_2 has the strongest impact on the book value of companies. The null hypothesis H_0 should be rejected in favor of the alternative hypothesis H_1 , assuming that the P/E ratio and, to a lesser extent, the dividend rate have strongest effect on the averaged book value. The author conducted selected tests to verify the established detailed research hypotheses, as shown in Table 3.

Table 3. The results of the model verification based on the tests performed for the explanatory variables x_2 and x_3

Specification	Statistic of test	p-value for test
Non-linearity Test (LM squares)	LM = 23.6342	p = P(Chi-square (2) > 23.6342) = 7.37715e-06
Non-linearity Test (logs)	LM = 26.5866	p = P(Chi-square (2) > 26.5866) = 1.68574e-06
RESET test for specification	F(2, 36) = 15.5298	p = P(F(2, 36) > 15.5298) = 1.37134e-05
White's test for heteroskedasticity	LM = 2.94106	p = P(Chi-square(5) > 2.94106) = 0.709072
White's test for heteroskedasticity (squares only)	LM = 2.67714	p = P(Chi-square(4) > 2.67714) = 0.613221
Breusch-Pagan test for heteroskedasticity	LM = 1.8488	P(Chi-square(2) > 1.8488) = 0.39677
Breusch-Pagan test for heteroskedasticity (robust variant)	LM = 0.949822	P(Chi-square(2) > 0.949822) = 0.621941

Specification	Statistic of test	p-value for test
Test for normality of residual	Chi-square(2) = 10.0043	p = 0.00672343
Chow test for structural break at observation 2021:09 -.	F(3, 35) = 16.7774	P(F (3, 35) > 16.7774) = 6.35524e-07
LM test for autocorrelation up to order 12 -.	LMF = 6.07103	P(F(12, 26) > 6.07103) = 6.12426e-05
Test for ARCH of order 12 -.	LM = 25.5137	P(Chi-square(12) > 25.5137) = 0.0125675
QLR test for structural break -	chi-square(3) = 67.1992 at observation 2022:07	p = 2.01968e-13
CUSUM test for parameter stability -	Harvey-Collier t(37) = 5.93438	P(t 37) > 5.93438) = 7.70429e-07

Explanations: significance level: x_2 *** $\alpha < 0.01$; x_3 * $\alpha < 0.1$

Source: own elaboration.

The tests performed confirm the fact that the model has an inaccurate specification, as there is autocorrelation. Analyzing the CUSUM test for parameter stability, there are changes in parameters. QLR test for structural break confirms the process of breaking the structure of the estimated econometric model, which means that the model does not best fit the empirical data. As for the Test for normality of residual, in this case also confirms the assumption that the error does not have a normal distribution. The RESET test for specification unfortunately also confirms that the assumed linear form of the model is not the best possible form of the estimated model, which is confirmed by the next two tests: Non-linearity test (squares) and Non-linearity test (logs). However, heteroskedasticity of the residuals does not occur. Therefore, the estimated model takes the following logarithmic form:

$$Y^* = \alpha_0 + \alpha_2 \ln x_2 + \alpha_3 \ln x_3 + \varepsilon_t$$

where:

Y – the explanatory variable defined as the book value of joint-stock companies listed on the stock exchange,

x_2 – explanatory variable examining the impact of the P/E ratio on book value,

x_3 – explanatory variable examining the effect of the dividend rate on the book value of joint-stock companies

α , α_0 , α_2 , α_3 – model parameters,

ε_t – random component

The author has carried out the process of forecasting the impact of individual indicators on the averaged book value over the entire period under study. A model that takes into account the impact of two explanatory variables x_2 and x_3 on the explanatory variable y can provide a more or less clear reflection of the studied reality in the era of complex economic crises that have a significant impact on the financial condition

of these business entities. Thus, based on the output equation below, this forecasting process was carried out:

$$Y^* = 1631.138885 - 4.819459367 \ln x_2 - 36.50547207 \ln x_3$$

Table 4. Data describing the forecast econometric model

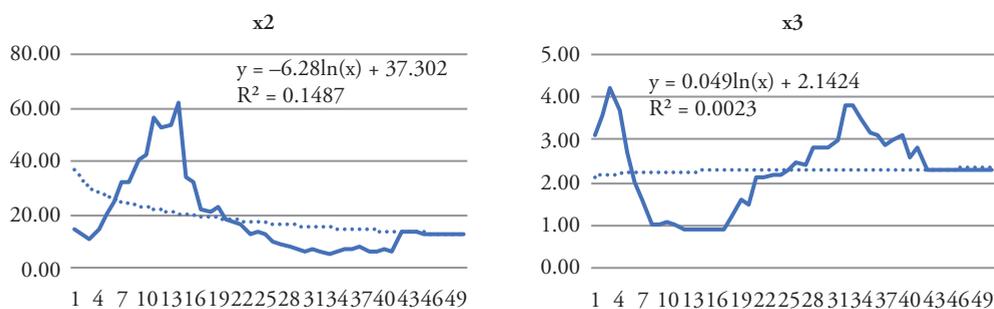
t	Time	Book value (PLN mil.) Y	P/E ratio (%) x_2	Dividend yield (%) x_3
1	January 2020	1323.64	15.00	3.10
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3	March 2020	1344.66	11.10	4.20
4	April 2020	1331.97	14.40	3.70
5	May 2020	1339.15	20.20	2.70
6	June 2020	1342.53	25.00	2.00
7	July 2020	1347.38	32.70	1.60
8	August 2020	1364.78	32.00	1.00
9	September 2020	1365.29	40.40	1.00
10	October 2020	1374.32	42.20	1.10
11	November 2020	1397.27	56.80	1.00
12	December 2020	1398.68	53.20	0.90
13	January 2021	1398.41	54.00	0.90
14	February 2021	1408.10	62.20	0.90
15	March 2021	1414.35	34.60	0.90
16	April 2021	1415.63	31.90	0.90
17	May 2021	1432.90	21.80	0.90
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28	April 2022	1490.09	8.00	2.80
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t	Time	Book value (PLN mil.) Y	P/E ratio (%) x_2	Dividend yield (%) x_3
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32	August 2022	1463.37	6.10	3.80
33	September 2022	1483.58	5.60	3.80
34	October 2022	1488.70	6.20	3.50
35	November 2022	1478.06	7.50	3.20
36	December 2022	1480.49	7.70	3.10
37	January 2023	1469.65	8.10	2.90
38	February 2023	1613.91	6.70	3.00
39	March 2023	1645.51	6.70	3.10
40	April 2023	1660.40	7.00	2.60
41	May 2023	1760.91	6.80	2.80
42	<i>June 2023</i>	<i>1588.05</i>	<i>13.90</i>	<i>2.30</i>
43	<i>July 2023</i>	<i>1588.12</i>	<i>13.70</i>	<i>2.30</i>
44	<i>August 2023</i>	<i>1588.15</i>	<i>13.60</i>	<i>2.30</i>
45	<i>September 2023</i>	<i>1588.52</i>	<i>12.60</i>	<i>2.30</i>
46	<i>October 2023</i>	<i>1588.26</i>	<i>13.30</i>	<i>2.30</i>
47	<i>November 2023</i>	<i>1588.33</i>	<i>13.10</i>	<i>2.30</i>
48	<i>December 2023</i>	<i>1588.37</i>	<i>13.00</i>	<i>2.30</i>
49	<i>January 2024</i>	<i>1588.41</i>	<i>12.90</i>	<i>2.30</i>
50	<i>February 2024</i>	<i>1588.48</i>	<i>12.70</i>	<i>2.30</i>
51	<i>March 2024</i>	<i>1588.52</i>	<i>12.60</i>	<i>2.30</i>

Source: own elaboration.

The forecasts for the June 2023–March 2024 timeframe presented in Table 4 attempt to reflect the state of the financial condition of the surveyed joint-stock companies in the future, which will continue to be strained by the severe consequences caused by the global economic crisis. Throughout the forecast period, both the explanatory variable y and the explanatory variables x_2 and x_3 show fluctuations in the value of the P/E ratio affecting book value, which also decreased to remain at a similar level in subsequent periods. As for the dividend yield, on the other hand, this variable is still at the same level. This may be due to the fact that the p -value of the regressor was practically 0.1. Consequently, the explanatory variable described by the P/E ratio had the strongest effect on the y variable (see Figure 1).

Chart 1. Trend lines describing the impact of the P/E ratio and dividend yield on the book value of companies listed on the Warsaw Stock Exchange in the period June 2023–March 2024



Source: own elaboration.

Analyzing the value of the explanatory variables x_2 and x_3 influencing the explanatory variable y , described by a trend line, it was clear that the coefficient of determination R^2 calculated for the research period June 2023 – March 2024 was characterized by rather low values showing even declining trends. Nevertheless, this was due to the fact that, as of March 2020, we are living in a continuous crisis that is spreading on a global scale, and most likely this crisis will continue due to the increasingly dangerous armed conflict in Ukraine.

Summary

In an era of crisis spreading on a global scale, joint-stock companies listed on the stock exchange are more often than not exposed to loss of liquidity. From the point of view of the investments being made, the problem becomes all the more serious because potential investors are then reluctant to purchase shares in a company that may be threatened by the vision of bankruptcy.

Therefore, it is very important to take a common-sense approach to valuing the value of such joint-stock companies, guided not by the market value prone to too frequent fluctuations, but rather by the book value, which is characterized by the fact that it is simple to calculate and information about it can be found in the company's balance sheet. In addition, it is useful for investors when deciding whether to buy shares.

In view of the above, the estimation of the econometric model presented in the article clearly shows that of the three metrics that had a greater or lesser impact on the book value of companies listed on the WSE, which in turn constituted the explanatory variables under study, the P/E ratio (p -value = 0.0011) and the dividend yield had

the highest p-value. Although in the case of the latter, the impact was much smaller, as the p-value was 0.0975.

Considering the process of construction of that model and its final verification on the basis of the tests carried out, it can be clearly stated that despite the fact that the variables adopted in the model were not highly correlated with each other and the form of the model is regarded as a log-linear model with autocorrelation as opposed to the lack of heteroskedasticity of the residuals. It confirms the positive effect of the independent variables on the dependent variable y .

The research contained in the presented article can be useful for practitioners of economic life who deal with the analysis of a company's market value on a daily basis. All the more so because recently there have been many studies on the essence of the market value of the form. However, there is a lack of literature describing the importance of book value in assessing the financial health of listed companies, which was already highlighted in the introduction of the article.

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