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Impact of tumultuous economic periods on investments made by joint-stock companies included in the WIG-ESG index

Abstract

The aim of the article is to assess the role of ESG assumptions in dealing with complex crises that are both economic and financial in nature. The research problem is excessive fluctuations in the quotations of the WIG-ESG index, which includes listed companies characterized by adherence to the principles of socially responsible business. An attempt will be made to verify the research hypothesis, which assumes a positive impact of selected stock market indicators on the stabilization of quotations of the analyzed index. The research method will be the estimation of an econometric model built from dependent variable Y describing changes in the quotations of the WIG-ESG index and six independent variables describing selected stock market indicators exerting a greater or lesser influence on the changes in the quotations included in the monthly time interval in the research period January 2014–November 2023. It is concluded that the relationship between stock market capitalization and the value of equity estimated at the end of the last quarter is the basis for stabilizing the quotations of the index.

Keywords: WIG-ESG Index, capitalization, stock exchange quotations
JEL Classification: C58, G10, G30

Introduction

Recently a number of complex global processes have had a negative impact on the world's economies. First, in March 2020, a coronavirus pandemic destabilized global trade, as a result of which many companies, including stock companies around the world, were forced to suspend or shut down their business operations altogether. Another event that also left a big mark especially on the broader stock market capitalization was and still is the armed conflict in Ukraine, which has been ongoing since February 24, 2022. The result of the Russian aggression against Ukraine, in turn, is the energy crisis, the overcoming of which is important from the point of view of shaping the quotations of the WIG indices, which include companies considered socially responsible.

The aim of the article is to assess the role of ESG in dealing with turbulent crises, both economic and financial. In this regard, the research problem is the excessive fluctuations in the quotations of the WIG-ESG index published since September 3, 2019 (formerly the RESPECT index), based on the value of the stock portfolio of listed companies adhering to the principles of socially responsible business, particularly in terms of environmental, social, economic, and also corporate governance issues.

It is assumed that the crisis caused by the pandemic and the war in Ukraine and, consequently, the political situation around the world negatively affect the financial condition of the companies included in the index under study, whose activities are based on the widely understood corporate social responsibility moving towards sustainable development. The prerequisite for reducing the risks arising from the fear of losing energy liquidity is to strengthen ESG activities in the area of acquiring alternative energy sources, resulting in the stabilization of the WIG-ESG index listing. Referring to the above assumptions, an attempt will be made to verify the research hypothesis, which assumes a positive impact of selected stock market indicators on the stabilization of quotations of the analyzed index.

The research method used in the study will be the estimation of an econometric model to estimate its parameters in order to find values describing the relationship between the dependent variable Y describing changes in the WIG-ESG index quotations and the six independent variables describing the values of individual stock market indicators that have a greater or lesser influence on the current year's quotation changes. Due to too frequent fluctuations in quotations, monthly data covering the period January 2014 – November 2023 was used to build the model.

The concept of sustainable development of joint stock companies versus ESG. A review of the literature

In today's reality gripped by the chaos caused by the complex economic and financial crises still haunting economies around the world, including the energy crisis, joint stock companies listed on the stock exchange are trying to pursue ambitious goals of conducting business in a stable and sustainable manner. In this case, business entities should not be concerned only with their so-called 'economic interest', but first and foremost try to look after the interests of all stakeholders, the local community and even the environment as a whole.

In accordance with the idea of sustainable development based on ESG assumptions, any company, including a listed company, is able to ensure broad-based stability for itself and the environment in which it operates by transforming its business models in the spirit of social responsibility. The process of investing in the stock market by aligning the ethical standards of its business with ESG requirements can have a positive impact on the company's business in the long term. This will make it possible to increase the company's attractiveness in the eyes of investors, attract customers interested in environmentally friendly products, and also retain existing employees and recruit new ones looking forward to the opportunity to pursue a career in accordance with ethical principles [https://mojafirma.infor.pl, 2022].

In reviewing the literature on the role of the ESG concept in the investment activities of joint-stock companies included in the WIG-ESG index, it is necessary to analyze its relevant definitions as an idea that is an extension of the CSR concept. Various organizations as well as researchers around the world are trying to explain the essence and meaning of aligning the activities of a business entity with the ESG criteria.

Accordingly, ESG.Org [2023] defines the concept under study: ""ESG stands for Environmental, Social, and Governance. First coined in 2005, ESG covers a wide range of issues that may have a direct or indirect impact on financial relevance. Some of these issues that come under the purview of ESG reporting include resource management, supply chain management, organizational health, safety policies, and building trust through transparency". According to the organization, the main benefit is that the ESG environmental criteria seek to measure a company's (joint stock company) actions as a steward of the environment, which is significantly impacted by elements such as [ESG Org, 2023]:

- energy consumption levels;
- waste generation process;
- air pollution levels;
- conservation of natural resources;
- approach to treating animals with dignity.

The social criteria, meanwhile, take into account how the company treats its employees, suppliers, customers, and the entire community within which the prospective listed company

operates. Corporate governance criteria take into account how the company under review conducts its business. These criteria include such issues as [ESG Org, 2023]:

- leadership;
- the level of executive salaries;
- regulations that set the direction for conducting inspections and audits within the company;
- shareholder rights.

Therefore, "the WSE Group is focused on conducting its business in a sustainable and responsible manner, and is making a significant effort to influence the development of responsible attitudes among participants in the markets it organizes. The WSE Group's ESG strategy makes a positive contribution to the achievement of the Global 17 Sustainable Development Goals 2030 set by the UN and adopted by all 193 UN member states, including Poland. The WSE actively supports the 6 selected Sustainable Development Goals (SDGs) that are relevant to its business and its affiliated companies and their corresponding stakeholder groups" [https://www.gpw.pl/esg-gpw, 2023]. It was within the framework of the ESG concept that the WIG-ESG stock index was created, published as of September 3, 2019, based on the value of the stock portfolio of companies considered socially responsible, i.e. those that adhere to the principles of socially responsible business, particularly with regard to environmental, social, economic and corporate governance issues.

According to the WSE, "the index's base value was set at 10,000.00 points as of December 28, 2018. WIG-ESG is an income index, which means that its calculation takes into account both the prices of its transactions and dividend income. The share of a single company in the index is limited to 10%, while the aggregate share of companies whose share of each exceeds 5% is limited to 40%" [https://gpwbenchmark.pl, 2023]. In accordance with Useche et. al. [2023], "ESG considerations have been incorporated into portfolio selection, an approach known as socially responsible investment".

Pástor et al. [2021] analyze the channels through which consideration of ESG criteria can affect asset prices and investment portfolios, showing that responsible investors are willing to pay a higher price for sustainable stocks issued by greener listed companies, lowering the cost of capital and resulting in negative Alpha values determining the CAPM model. Stock companies adhering to ESG assumptions will have a higher market value, while companies disregarding the idea of ESG will lose value.

Jin [2022] argues that responsible investors derive personal utility from owning assets with high ESG ratings. In his view, if there is a majority of ESG-compliant investors in the market, then they can help increase demand for so-called *green stocks* by inadvertently creating a herd effect, in effect generating an increase in the market value of those stocks. Yet in this case, Jin recognizes that making timely ESG investment decisions can increase systematic risk. Thus, unexpected events that change some companies' perceptions of ESG concepts can lead to common stock price movements and greater volatility in financial markets.

To meet the demands and challenges of ESG, so-called *green innovations* are widely recognized as an effective instrument that can benefit both stock companies and society.

However, existing market imperfections cannot perfectly internalize the problem of aligning investments made in the stock market with green innovations introduced into the market to reduce environmental degradation. Therefore, according to many researchers, it is necessary for regulators to intervene in this area [Chang et. al, 2015; Youssef, Dinar, 2011; Zhang, Kong, Shen, 2023; Zhang, Kong, Wang, Vigne, 2023; Zhang, Meng, Zhang, 2023].

According to Cohen [2023], "ESG holds social and environmental responsibilities to corporations that are used to sanctify revenues and profts above all other corporate goals and missions ensuring the long life of a company through a combination of fnancial proftability, environmental protection, and social responsibilities". Kawaguchi [2017] claimed that "incorporating ESG factors mean including issues relating to the environment such as carbon emissions, energy efciency, resources efciency, recycling, water resources, renewable energy, preservation of forests, and marine resources".

The research presented in an article written by Dikolli et. al. [2022] tried to explain "shareholder proposals, which typically address ESG factors. While popular nomenclature usually pools these factors together, it is important to recognize their nuances. "*Corporate governance* proposals (G) generally relate to voting rights, compensation structure, and eligibility requirements of the shareholders' agents – the board and management. *Environmental* and *social* proposals (ES) focus on the company's engagement with other stakeholders on issues related to the environment, animals, discrimination, charitable contributions, and human rights".

ESG is connected to SRI (Social Responsibility Investing) defined as "social investment or another investment considered socially responsible due to the nature of the business the company conducts. A common theme for socially responsible investments is socially conscious investing. Socially responsible investments can be made into individual companies with good social value, or through a socially conscious mutual fund or exchange-traded fund (ETF)" [Chen, 2022]. According to that definition, SRIs are known as conscious capitalism, which could include eschewing investments in joint-stock companies that produce or sell addictive substances or activities in favour of seeking out companies that are engaged in social justice, environmental sustainability, and alternative energy.

SRI is very often considered as a potential channel through which firm environmental performance may link to financial performance. That concept is named as an investment discipline connected with environmental, social, and corporate governance (ESG) criteria [Wang et. al., 2023, p. 2]. SRI investors combined with ESG focus on long-term returns, which could be the most important goal in an activity of every joint-stock company [Eccles et al., 2014; Kecskes et al., 2014]. According to Heinkel et al. [2001], polluting firms face relatively limited risk sharing opportunities compared to clean firms. Therefore, those companies need to offer higher expected returns to investors that still hold their shares. Hence, SRI and ESG increase the cost of equity capital of polluting firms, which have to change their management model according to environmental protection activities.

To summarize the above theoretical considerations, listed companies should make every effort as much as possible to carry out their investments in accordance with ESG and also

SRI assumptions, which will ultimately contribute to reducing the value of the costs incurred. Business units included in the WIG-ESG index should aim not only at generating profits, but also at shaping responsible attitudes among all capital market participants.

The estimation process of the econometric model as the research method used

In order to verify the main research hypothesis assuming a positive effect of selected stock market indicators on the stabilization of the quotations of the WIG-ESG index, which is a measure of the number of joint-stock companies comprising it (60 companies as of today), the authors built a linear econometric model. Using Gretl and Excel, the following variables were used to build it:

- dependent variable Y: change in the index quotation in the current year YTD (% EUR); and six independent variables:
- x_1 – correlation coefficient assuming a relationship between the WIG20 and WIG-ESG stock index;
- x_2 – Beta coefficient as a measure of systematic risk and volatility compared to the WIG20 index [Popovska, 2023];
- x_3 – coefficient of variation generally defined as the quotient of the standard deviation of a trait and its arithmetic mean;
- x_4 – P/E ratio, which is the ratio of stock market capitalization to sum of net profits for last 4 quarters;
- x_5 – P/BV ratio, which is the ratio of stock market capitalization to book value at the end of last quarter;
- x_6 – dividend yield (%).

Due to the constant fluctuations in the quotations of the WIG-ESG index and the shares of its constituent companies, the estimation process of the econometric model used monthly data for the period January 2014 – November 2023 (Appendix, Table 1). Highlighting the essence of the issue addressed in the article, it seems reasonable to illustrate the fact of how the quotations of the WIG-ESG index developed in the period 03.2019–11.2023 (Figure 1).

The above quotations of the index clearly indicate that, despite the introduction of so-called *green innovations* into the market as part of the investments made in accordance with the ESG concept, the companies included in the WIG-ESG were characterized by unsatisfactory financial results, as the armed conflict in Ukraine has resulted in the scales still being tipped by the huge demand for coal as the primary source of energy over renewable energy sources sourced in accordance with the ESG concept.

On September 3, 2019, the WIG-ESG index replaced the former RESPECT stock index. Accordingly, in the period of 01.2014–08.2019, volumes describing the RESPECT index were presented, while in the period of 09.2019–11.2023, volumes describing the WIG-ESG index

were presented. Parametric estimation of the linear econometric model showed that the variables x-x, x_{124} and x_6 were excluded from the six independent variables due to too high p-value. The data are presented in Table 1.

Figure 1. WIG-ESG index monthly quotations for the period 03.2019–12.12.2023

Source: https://www.stockwatch.pl/gpw/indeks/wig-esg,sklad.aspx#informacje [accessed: 26.12.2023].

Table 1. OLS Model, using observations 2014.01–2023.11 (T = 119). Dependent variable: Y. Study sample N=119

Specification	*Coefficient*	*t-ratio*	*p-value*
Const	–76.0301	–6.718	<0.0001***
x3	–0.506704	–3.248	0.0015***
x5	77.7877	8.797	<0.0001***
Mean dependent var	0.660420	S.D. dependent var	16.89975
Catfish squared resid	15457.79	S.E. of regression	11.54369
R-squared	0.541325	Adjusted R-squared	0.533417
F(2, 116)	68.45128	P-value (F)	2.33e-20
Log-likelihood	–458.4250	Akaike criterion	922.8500
Schwarz criterion	931.1874	Hannan-Quinn	926.2356
rho	0.877646	Durbin-Watson	0.329209

Source: own elaboration based on the data from the Appendix (Table 1).

The estimated econometric model includes two independent variables that have a significant impact on the fluctuations of the WIG-ESG index quotation. Accordingly, it takes the following form:

$$Y_t = \alpha_0 + \alpha_1 x_{1t} + \alpha_2 x_{2t} + \ldots + \alpha_j x_{jt} + \varepsilon_t \Rightarrow Y_t = \alpha_0 + \alpha_3 x_{3t} + \alpha_5 x_{5t} + \varepsilon_t \ (t = 1, 2 \ldots n)$$

where:
Numbers: n – the number of units studied,
j – the number of explanatory variables,
x_t, α, α_{01},…, α_j – model parameters,
ε_t – random component.

Econometric model estimation results

The next step in the estimation of the linear econometric model is the process of conducting tests, the main core of which is the verification of the assumptions made above. As a result of the estimation of linear parameters, the authors conducted the following tests to verify the detailed research hypotheses:

1. Non-linearity test (squares) – null hypothesis: relationship is linear.
   Test statistic: LM = 2.85229 with p-value = P(Chi-squared(2) > 2.85229) = 0.240234.
2. Non-linearity test (logs) – null hypothesis: relationship is linear.
   Test statistic: LM = 2.51397 with p-value = P(Chi-squared(2) > 2.51397) = 0.284511.
3. RESET test for specification – null hypothesis: specification is adequate.
   Test statistic: F(2, 114) = 1.59547 with p-value = P(F(2, 114) > 1.59547) = 0.207308.
4. RESET test for specification (squares only) – null hypothesis: specification is adequate.
   Test statistic: F(1, 115) = 3.19636 with p-value = P(F(1, 115) > 3.19636) = 0.0764359.
5. RESET test for specification (cubes only) – null hypothesis: specification is adequate.
   Test statistic: F(1, 115) = 1.81077 with p-value = P(F(1, 115) > 1.81077) = 0.181063.
6. White's test for heteroskedasticity – null hypothesis: heteroskedasticity not present.
   Test statistic: LM = 15.4999 with p-value = P(Chi-squared(5) > 15.4999) = 0.00842683.
7. White's test for heteroskedasticity (squares only) – null hypothesis: heteroskedasticity not present.
   Test statistic: LM = 13.7859 with p-value = P(Chi-squared(4) > 13.7859) = 0.00801055.
8. Breusch-Pagan test for heteroskedasticity – null hypothesis: heteroskedasticity not present.
   Test statistic: LM = 5.32608 with p-value = P(Chi-squared(2) > 5.32608) = 0.069736.
9. Breusch-Pagan test for heteroskedasticity (robust variant) – null hypothesis: heteroskedasticity not present.
   Test statistic: LM = 2.96538 with p-value = P(Chi-squared(2) > 2.96538) = 0.227026.
10. Test for normality of residual – null hypothesis: error is normally distributed.
    Test statistic: Chi-squared(2) = 11.6273 with p-value = 0.00298645.
11. Chow test for structural break at observation 2018:12 – null hypothesis: no structural break.
    Test statistic: F(3, 113) = 0.825289 with p-value = P(F(3, 113) > 0.825289) = 0.48258.
12. LM test for autocorrelation up to order 12 – null hypothesis: no autocorrelation.

Test statistic: LMF = 25.7797 with p-value = P(F(12, 104) > 25.7797) = 6.9712e-26.

13. Test for ARCH of order 12 – null hypothesis: no ARCH effect is present.
    Test statistic: LM = 88.1759 with p-value = P(Chi-squared(12) > 88.1759) = 1.11222e-13.
14. QLR test for structural break – null hypothesis: no structural break.
    Test statistic: chi-squared(3) = 21.9828 at observation 2022:05 with asymptotic p-value = = 0.00151217.
15. CUSUM test for parameter stability – null hypothesis: no change in parameters.
    Test statistic: Harvey-Collier t(115) = 0.506382 with p-value = P(t(115) > 0.506382) = = 0.613558.

Since the independent variable previously excluded from the model was the correlation coefficient assuming a relationship between the WIG20 and WIG-ESG stock index (variable x_1), it is also worth analyzing the degree of correlation between the current independent variables x_3 and x_5. The data are presented in Table 2.

Table 2. Correlation coefficients, using the observations 2014.01–2023.11. Using 5% critical value (two-tailed) = 0.1801 for n = 119

Y	x3	x5	
1.0000	–0.4851	0.7068	Y
	1.0000	–0.4246	x3
		1.0000	x5

Source: own elaboration.

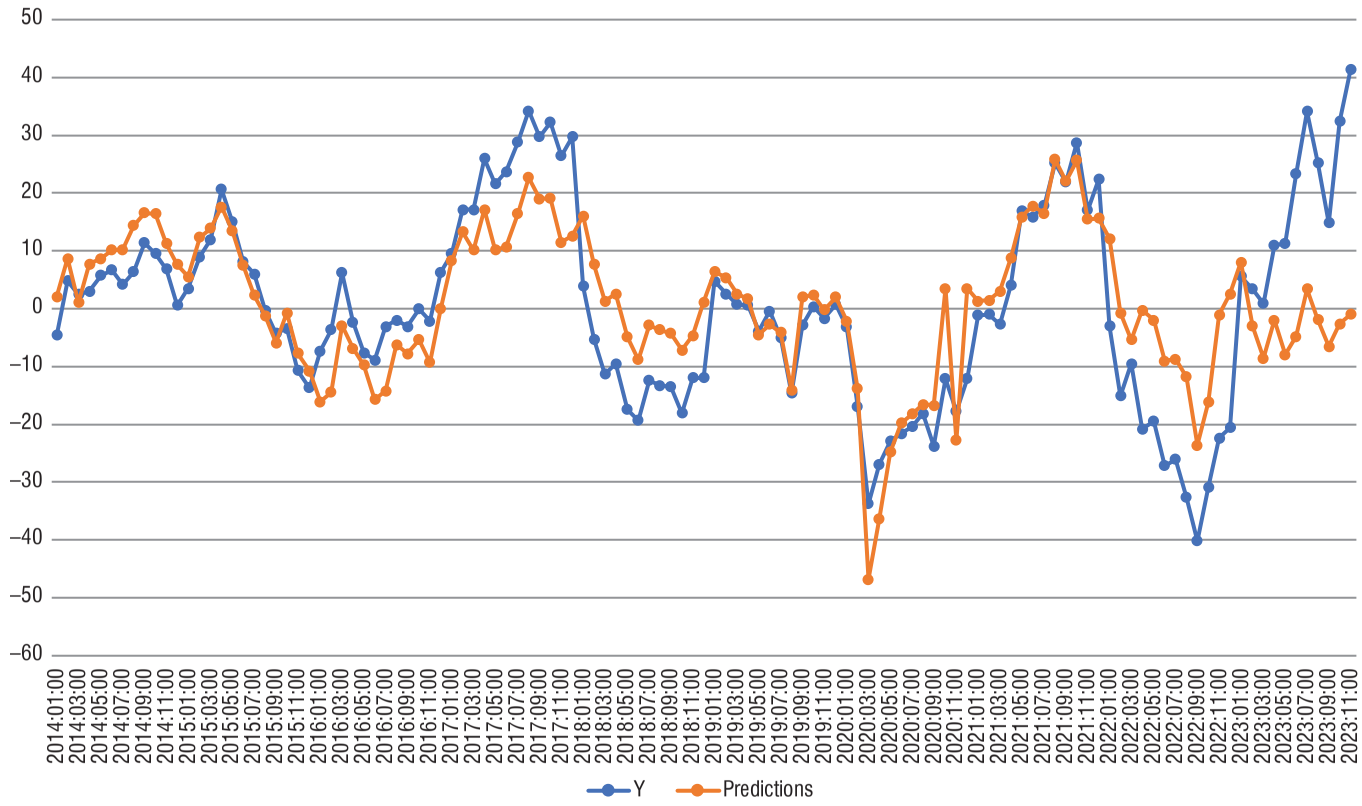
The correlation analysis between the two variables x_3 and x_5 clearly indicates that the variable x_5 is quite strongly correlated with the variable Y. The sample size of n=119, coupled with the p-values calculated for each variable, confirms that the coefficient of variation and especially the CW/K ratio have a positive effect on the stability of the WIG-ESG index quotations.

In the estimated econometric model, the p-value is within the level of 0.0015 (x_3) and <0.0001 (x_5), while R^2 0.54. In the process of estimating the model, the authors carried out selected tests to evaluate the estimated model, as presented above. The present test results confirmed the fact that the built model is a linear model characterized by correct specification (RESET test for specification). Heteroskedasticity of the residuals is not present. The statistical error has a normal distribution, autocorrelation is also absent. Besides, the results of the CUSUM test for parameter stability confirmed the lack of change in the parameters used for the model.

In the final stage of the econometric model estimation process, the authors additionally conducted a forecasting process as well. The data are presented in Figure 2.

The results of the forecasts carried out confirmed the fact that, as a result of the increase in the stock market capitalization of the companies included in the WIG-ESG index in relation to their equity, in the prevailing period the predictive values describing the dependent variable Y were higher than the base data used to estimate the econometric model. The above statement is also confirmed by calculations of statistics based on the presented predictions.

Figure 2. Forecasts for 95% confidence intervals, t(116, 0.025) = 1.981. Forecast evaluation statistics using 119 observations



Calculations based on the projections in the chart:
Mean Error = 5.4336e-015
Root Mean Squared Error = 11.397
Mean Absolute Error = 8.3705
Mean Percentage Error = −60.869
Mean Absolute Percentage Error = 181.23
Theil's U2 = 2.6119
Bias proportion, UM = 0
Regression proportion, UR = 0
Disturbance proportion, UD = 1

Source: own elaboration.

Summary

The article devoted to the problems relating to the continuous changes in the quotations of the WIG-ESG index made not always in favour of the sixty joint-stock companies included in it adds value in the sense of explaining the key role of the assumptions of the ESG concept in the process of making investments in the stock market. In order to study what most influences the possibility of reducing the fluctuation of quotations, variables were extracted to build an econometric model:

- dependent variable Y indicating changes in the current year YTD (% EUR);
- independent variable x_1 determining the correlation coefficient;
- independent variable x_2 determining Beta coefficient;
- independent variable x_3 determining the coefficient of variation;
- independent variable x_4 determining the P/E ratio;
- independent variable x_5 determining the P/BV ratio;
- independent variable x_6 specifying the dividend rate (%).

As a result of parameter estimation, the authors obtained results confirming unequivocally that it is not so much the coefficient of variation, but the CW/K ratio that most strongly influences the stabilization of continuous changes in the quotations of the WIG-ESG index. This means that the stock market value of the listed companies included in the analyzed index equal to the product of the current share price and the number of shares of these companies in relation to the value of their equity is able to influence most the decisions made by potential investors as to how to steer the company in such a way so that, in the process of their business activities, they are guided not only by the highest business standards, but, above all, by social, labour, ethical ones and, consequently, related to reducing the negative impact on the environment, in an effort to move in the direction of sustainable development in the broadest sense.

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Appendix

Table 1. Monthly baseline data for the period 01.2014–11.2023 used to build the econometric model

Period	Y (Change in current year YTD (% EUR)	x1 (Correlation coefficient)	x2 (Beta coefficient)	x3 (Coefficient of variation)	x4 (P/E ratio)	x5 (P/BV ratio)	x6 (Dividend yield (%)
January 2014	–4.6	0.9	0.93	16.3	12	1.11	4.8
February 2014	4.82	1	0.95	17.1	13.1	1.2	4.4
March 2014	2.44	1	0.99	26	13.6	1.16	4.5
April 2014	3.04	0.9	0.85	12.8	13.5	1.16	4.5
May 2014	5.73	0.8	0.76	10.9	14.6	1.16	4.8
June 2014	6.67	0.9	0.85	11.1	15.1	1.18	4.8
July 2014	4.15	0.8	0.89	11	19.9	1.18	4.6
August 2014	6.35	0.9	0.87	13.4	20.1	1.25	4.5
September 2014	11.39	0.9	0.87	13.7	20.8	1.28	4.1
October 2014	9.52	0.9	0.91	12.6	21.4	1.27	4.1
November 2014	6.85	0.8	0.85	10.4	21.6	1.19	4.2
December 2014	0.55	0.9	0.92	13	20	1.16	4.4
January 2015	3.48	1	0.92	20.2	21.3	1.18	4.3
February 2015	8.95	0.8	0.79	11.4	22.2	1.21	4.2
March 2015	11.92	0.9	0.97	11.4	24.3	1.23	4.1
April 2015	20.65	0.9	0.91	11.8	23.6	1.28	3.6
May 2015	14.97	0.9	0.83	10.7	21.7	1.22	3.5

cont. Table 1

Period	Y (Change in current year YTD (% EUR)	x1 (Correlation coefficient)	x2 (Beta coefficient)	x3 (Coefficient of variation)	x4 (P/E ratio)	x5 (P/BV ratio)	x6 (Dividend yield (%)
June 2015	8.12	0.9	0.9	13.2	20.7	1.16	3.7
July 2015	5.96	1	0.9	17.3	13.6	1.12	4
August 2015	–0.31	0.9	0.92	21.3	13.1	1.1	4.1
September 2015	–4.24	1	1	25.9	20.3	1.07	4
October 2015	–3.41	0.9	0.97	17.2	20.8	1.08	3.9
November 2015	–10.72	0.9	1.07	15.6	20.4	0.98	4.2
December 2015	–13.72	0.9	0.9	20.1	18.1	0.97	4.4
January 2016	–7.34	1	0.96	26	16.1	0.94	4.5
February 2016	–3.67	1	0.98	24.4	16.4	0.95	4.4
March 2016	6.21	0.9	1.02	20	88.8	1.07	4.1
April 2016	–2.29	1	0.91	17	93.7	1	4.9
May 2016	–7.67	0.9	0.86	13.6	1751.7	0.94	5.2
June 2016	–8.87	1	1.01	23.7	1738	0.93	4.9
July 2016	–3.12	0.9	0.97	23.9	391.6	0.95	4.3
August 2016	–2	0.9	0.85	14.3	60.1	0.99	4.3
September 2016	–3.1	0.9	0.84	12.7	41.2	0.96	3.7
October 2016	–0.07	0.9	0.68	11	34.6	0.98	3.5
November 2016	–2.15	0.9	0.92	17.2	34.4	0.97	3.5
December 2016	6.32	1	0.92	18.7	30.9	1.1	3.7
January 2017	9.52	0.9	0.86	11.7	27.2	1.16	3.5
February 2017	17.12	1	0.9	15.7	33.5	1.25	3.3
March 2017	17.12	1	0.87	17.3	19.1	1.22	3.3
April 2017	25.98	1	0.89	15.8	18.7	1.3	2.8
May 2017	21.57	0.9	0.88	15.7	16.7	1.21	2.8
June 2017	23.74	0.9	0.98	17.6	16.9	1.23	2.7
July 2017	28.78	0.9	0.86	12.5	17.7	1.27	2.6
August 2017	34.18	0.9	0.83	10.9	16.4	1.34	2.5
September 2017	29.73	0.9	0.9	13.6	16	1.31	2.4
October 2017	32.26	0.9	0.91	11.8	15.8	1.3	2.4
November 2017	26.46	0.9	0.87	13.1	13.9	1.21	2.6
December 2017	29.76	0.9	0.88	14	16.1	1.23	2.2
January 2018	3.88	0.9	0.92	14.9	16.8	1.28	2.1
February 2018	–5.28	0.9	0.78	14.5	13.7	1.17	2.3
March 2018	–11.3	0.9	0.77	14.8	10.9	1.09	2.4
April 2018	–9.54	0.9	0.76	15.3	11.2	1.11	2.5
May 2018	–17.42	0.9	0.76	14.7	10.7	1.01	2.7
June 2018	–19.32	0.9	0.94	19.3	10.5	0.99	2.7
July 2018	–12.39	0.9	0.85	16.8	11.1	1.05	2.1
August 2018	–13.31	0.9	0.89	18.4	11.2	1.05	2.1

Period	Y (Change in current year YTD (% EUR)	x1 (Correlation coefficient)	x2 (Beta coefficient)	x3 (Coefficient of variation)	x4 (P/E ratio)	x5 (P/BV ratio)	x6 (Dividend yield (%)
September 2018	–13.52	0.9	1	19.6	11.1	1.05	2.4
October 2018	–18.05	0.9	0.87	16.1	10.6	0.99	2.5
November 2018	–11.97	0.9	0.77	18.9	11.7	1.04	2.5
December 2018	–11.92	0.9	0.81	19.6	11.2	1.12	2.4
January 2019	4.72	1	0.8	16.9	12	1.17	2.3
February 2019	2.57	0.9	0.86	12.8	11.7	1.13	2.4
March 2019	0.72	0.9	0.99	12.3	11.7	1.09	2.4
April 2019	0.62	1	0.94	12.4	12.2	1.08	2.4
May 2019	–3.92	1	1.04	15.5	12.3	1.02	3
June 2019	–0.4	1	0.94	13.4	12.5	1.03	2.8
July 2019	–5.01	0.9	0.89	10.1	12	0.99	3
August 2019	–14.66	0.9	0.98	17.5	11.1	0.91	3.4
September 2019	–2.87	1	0.85	13.4	12.9	1.09	3.1
October 2019	0.35	1	0.91	14.1	13.1	1.1	3.1
November 2019	–1.71	1	0.85	14.6	13	1.07	3.1
December 2019	0.7	1	0.8	10.3	13	1.07	3.1
January 2020	–3.2	1	0.79	13.9	12.6	1.04	3.2
February 2020	–16.92	1	0.85	15.5	11.1	0.9	3.7
March 2020	–33.77	1	0.93	57.6	9.8	0.75	4.4
April 2020	–26.93	1	0.93	47.5	12.8	0.82	3.8
May 2020	–22.92	1	0.92	29.4	18.4	0.85	2.7
June 2020	–21.59	1	0.92	24.1	21.6	0.88	2
July 2020	–20.4	1	0.96	19.5	20.8	0.87	1.5
August 2020	–18.13	1	0.95	17.7	20.6	0.88	0.9
September 2020	–23.82	1	0.9	16.5	24	0.87	0.9
October 2020	–12.12	0.9	0.96	22.7	33	1.17	0.6
November 2020	–17.73	1	0.99	33	30.2	0.9	0.8
December 2020	–12.12	0.9	0.96	22.7	33	1.17	0.6
January 2021	–1.14	1	0.9	23.9	32.4	1.15	0.6
February 2021	–1	1	0.84	20.5	34.5	1.13	0.6
March 2021	–2.69	1	0.91	17.5	23.7	1.13	0.6
April 2021	4.02	1	0.87	16.9	26.1	1.2	0.6
May 2021	16.91	1	0.88	15.1	22.7	1.28	0.6
June 2021	15.85	1	0.88	11.5	22.3	1.28	0.9
July 2021	17.79	1	0.93	17	24.8	1.3	1.3
August 2021	25.19	1	0.92	10.9	20.1	1.38	1.2
September 2021	21.89	1	0.9	13.6	19.4	1.35	1.9
October 2021	28.72	1	0.85	14.2	17.6	1.4	1.9
November 2021	17.05	1	0.96	14.4	13.7	1.27	2.1

cont. Table 1

Period	Y (Change in current year YTD (% EUR)	x1 (Correlation coefficient)	x2 (Beta coefficient)	x3 (Coefficient of variation)	x4 (P/E ratio)	x5 (P/BV ratio)	x6 (Dividend yield (%)
December 2021	22.39	1	0.88	18.6	14.2	1.3	2
January 2022	–3.06	1	0.89	18	12.8	1.25	2.2
February 2022	–15.12	1	0.93	29.5	10.7	1.16	2.4
March 2022	–9.5	1	0.96	54	9.5	1.26	2.2
April 2022	–20.78	1	0.88	20.9	7.9	1.11	2.6
May 2022	–19.52	1	0.89	21.2	7.2	1.09	2.5
June 2022	–27.17	1	0.92	24.4	6.7	1.02	2.5
July 2022	–26.09	1	0.93	26.9	6.8	1.04	2.8
August 2022	–32.65	1	0.9	23.7	6.1	0.98	3.5
September 2022	–40.14	1	0.9	30.2	5.5	0.87	3.5
October 2022	–30.93	1	0.94	30.8	6.3	0.97	3.1
November 2022	–22.4	1	0.9	22.5	8.3	1.11	2.8
December 2022	–20.55	1	0.89	18.4	8.5	1.13	2.7
January 2023	5.62	1	0.97	18.3	9.1	1.2	2.6
February 2023	3.37	1	0.96	18.7	7.3	1.06	2.6
March 2023	0.86	1	0.93	20.4	7.2	1	2.7
April 2023	10.89	1	0.89	18.2	7.6	1.07	2.2
May 2023	11.34	1	0.91	17.7	7.3	0.99	2.3
June 2023	23.28	1	0.91	23.8	7.8	1.07	1.8
July 2023	34.11	1	0.92	16.7	8.3	1.13	1.7
August 2023	25.19	1	0.88	15	7.6	1.05	2.6
September 2023	14.81	1	0.82	14.8	7.4	0.99	2.9
October 2023	32.4	1	0.92	22.5	8.9	1.09	2.6
November 2023	41.3	1	0.93	22.3	8.8	1.11	2.5

Source: own elaboration based on https://www.gpw.pl/statystyki-gpw#2 [accessed: 26.12.2023].