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APPLICATION OF THE GORDON-SHAPIRO VALUATION MODEL FOR DIVIDEND COMPANIES LISTED ON THE POLISH AND AMERICAN STOCK EXCHANGES FOR THE PERIOD 2017-2023

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Purpose: The purpose of this article is to reveal, how issuers, that are components of the WIG and S&P500 indices, paid dividends in 2017-2023, and to evaluate the effectiveness of investing in selected dividend-paying companies using the single-stage Gordon-Shapiro model.
Design/methodology/approach: The article analyzes each of the 30 dividend companies included in the WIG and S&P500 indices, that had the largest market capitalization at the end of 2017. The authors used comparative-descriptive methods and statistical data analysis to examine the differences between selected Polish and U.S. dividend-paying companies in 2017-2023. Stock valuation using the classical form of the Gordon-Shapiro model used the R^2 coefficient of determination and linear regression.
Findings: The results of empirical studies comparing Polish and U.S. dividend companies confirmed, that the latter are characterized by greater stability and systematically transfer profits to stockholders. Moreover, if, during the period under review, Polish companies paid dividends characterized by a higher rate of change, this was, at the same time, accompanied by a higher volatility of payments. In addition, the application of the classical Gordon-Shapiro model to stock valuation has proved problematic in both markets, due to the model's overly stringent assumptions, which are difficult to meet in practice. In the Polish market, no valuation according to the model could be carried out, while in the U.S., a valuation was carried out only for 9 out of 24 companies, but even then, there were significant discrepancies between the model valuation and the market valuation.
Research limitations/implications: Some limitations of the research should be noted, especially with regard to the number of dividend companies analyzed and the time range of the analyses. The authors plan to expand the study in the future to include a broader dataset, allowing for more comprehensive recommendations for investors on choosing companies and listing markets.
Practical implications: Expanding knowledge in building investment portfolios, that include dividend companies, and evaluating investment efficiency using the Gordon-Shapiro model. In addition, knowledge of the dividend payment policies of companies listed on various stock exchanges is very important for both investors and investment fund managements, as this allows them to make better investment decisions, as to where to make efficient equity investments.

Social implications: Among the article's social implications, the most important seems to be a possible change in investors' attitudes toward dividend companies and an increase in their knowledge of valuation using the Gordon-Shapiro model.
Originality/value: The article undertakes a stock valuation using the Gordon-Shapiro Dividend Discount Model for the period 2017-2023. In addition, investments in dividend stocks in the Polish and U.S. markets were compared, taking into account the companies with the largest market capitalization from the WIG and S&P500 indices.
Keywords: dividend-paying company, Dividend Discount Models, Gordon-Shapiro model, stock valuation.
Category of the paper: Research paper.

1. Introduction

The transfer of the value generated by the company to investors is of significant importance, especially from the point of view of theories on corporate value management (R. Litzenberger, K. Ramaswamy, M. Miller, F. Modigliani, M. Gordon, J. Lintner). The primary method of sharing value with stockholders is the payment of dividends. The method of distribution of financial results and changes in the amount of dividends paid perform an important informational function in the issuer's opinion. Therefore, the announcement of the dividend policy and its execution should be included among the basic tasks in the process of company management, which significantly affect the stock price (studies in this regard have been conducted by, among others: S. Desmukh, A.M. Goel and K.M. Howe, P. Asquith and D.W. Mullins Jr, M. Lichtenfeld, H. Rubin and C. Spaht II, M. Skousen) and changes in attitudes of capital market investors (research results published, among others, by P. Asquith and D.W. Mullins Jr, M. Baker and J. Wurgler, P., J.R. Woolridge and C. Ghosh, as well as D.J. Skinner and E.F. Soltes).

One of the most important elements of evaluating and selecting stocks of listed companies for an investment portfolio is to perform their current valuation. In the case of dividend companies, the most popular and widely used stock valuation methods are dividend discount models (considerations in this regard were conducted, among others, by J.B. Williams, M.J. Gordon, E. Shapiro, S.E. Guild, B.G. Malkiel, C.C. Holt, E.F. Brigham, J.L. Pappas, N. Molodovsky, C. May, S. Chottiner, R.J. Fuller and C.-C. Hsia). Discount models are mainly based on dividend analysis, since, as J.B. Williams (1956, pp. 3-4) pointed out, "the longer a purchaser holds a stock or bond, the more important are the dividends or interest received, and the less important is the price achieved at the time of sale". Therefore, the effect of the discount selling price in a long-term investment on the intrinsic value of the stock is small ($\lim_{n\to\infty} \frac{P_n}{(1+r)^n} = 0$) – the discounting process and the significant number of years contribute to this. This article assumes, that the stock of dividend companies purchased by investors will not be sold, and will be valued using the Gordon-Shapiro model.

The purpose of the article is to reveal, on the one hand, how issuers, that are components of the WIG and S&P500 indices, paid dividends in 2017-2023 (whether they were characterized by positive dynamics of change and the level of volatility of dividends paid) and, on the other hand, to assess the effectiveness of investing in selected dividend-paying companies using the single-stage Gordon-Shapiro model.

The research carried out refers, with its scope, to companies in the WIG and S&P500 indices, that paid dividends in the 2017-2023 period (changes for the 2018-2023 period), with the possibility of not paying dividends once, due to the SARS-CoV-2 pandemic. The calculations were made in MS Excel software.

2. Literature review and research hypotheses development

P. Asquith and D.W. Mullins Jr. (Asquith, Mullins, 1983) indicate that, when investing in dividend companies, it is important for investors, that the issuer pays dividends with a positive growth rate on a continuous basis. On the other hand, A. Cwynar and W. Cwynar (Cwynar, Cwynar, 2007) and M. Kowerski (Kowerski, 2011) point out, that the investor's income, in the form of expected dividends, is more important than the expected gain from the sale of stock, because the dividend is certain, while the possible gains from an increase in the stock price are uncertain. Therefore, one of the basic criteria for investing in stock of public companies should be the systematic distribution of financial results to stockholders. Studies conducted by H. Rubin and C. Spaht II (Rubin, Spaht, 2011, pp. 11-19), A. Williams and M. Miller (Williams, Miller, 2013, pp. 58-69), as well as K.P. Fuller and M.A. Goldstein (Fuller, Goldstein, 2011, pp. 457-473) confirm the legitimacy of such investments. The mere fact of paying dividends has consequences for both the company itself and stockholders. Therefore, the dividends paid by issuers, in light of the theory and the research conducted, on the one hand, remain in relation to the value of the company (dividends determine the value of the company) and, on the other hand, depending on the dividend payment strategy adopted, affect the behavior of capital market investors (the dividend policy adopted determines the behavior of investors). Three theories of the determination of a company's value by the level of dividends paid are characterized in the literature. The conservative (pro-dividend) group assumes, that the value of the company will be maximized by a high rate of dividend payments (M. Gordon and J. Lintner). It is assumed, that dividends have always been and continue to be the most desirable form of receiving income from capital invested in stock, as the payment itself is certain, while capital gains are uncertain. Different beliefs are represented by R. Litzenberger and K. Ramaswamy, as representatives of the radical (anti-dividend) group, who recognize, that an increase in dividend payments reduces the value of the company, since stockholders attach considerable importance to taxes. For this reason, investors will prefer capital gains until

the taxation of profits from the sale of stock is lower than the level of taxation on dividends paid. On the other hand, the middle group (represented by M. Miller and F. Modigliani), called neutral, assumes that the dividend policy has no effect on either the stock price or the entity's cost of capital.

Regarding the strategies used by issuers to pay dividends, a review of the literature in this area reveals not only the diversity of approaches, but also the complexity of their application, since, depending on the strategy adopted, more or less consideration is given to factors, that affect future dividends (Brigham, Houston, 2015, p. 204; Brealey, Myers, 2003, p. 438; Baker et al., 2002; Duraj, 2002, p. 93; Benninga, Sarig, 2000, p. 285; Baker, Powell, Veit, 2002; Wilimowska, Wilimowski, 2001, pp. 452-453). Among the most important are:

- stable dividend payout ratio strategy – the company pays out a fixed percentage of its profits in the form of dividends,
- stable dividend strategy – the company pays a dividend, that is constant over time, thus avoiding changing it over short periods,
- surplus (so-called residual) dividend strategy – dividends are paid from the amount remaining after implementation of all approved projects,
- strategy of paying out the total profit – a strategy, that is difficult for the company to execute in the long term, due to the continuous transfer of high amounts without taking into account the development needs of the entity,
- a compromise strategy of a fixed dividend amount and an irregular additional one, depending on the company's current earnings,
- zero dividend strategy – the company does not pay dividends.

Taking into account the mentioned theories of the determination of the company's value by the level of dividends paid, as well as strategies for its payment, one can find proposals in the literature, that may provide some solution to the above controversies and dilemmas. One of them is the target payout ratio proposed by A. Damodaran (Cwynar, Cwynar, 2007, p. 213; Damodaran, 2007, p. 1017; Szablewski, Tuzimek, 2007, p. 51). The author assumes, that the company should set a target and valid long-term payout ratio. Adjustments, if any, can be made by paying additional dividends or using buy-back, and the analysis of dividend policy should consist of the following steps:

1. Indicating what kind of net cash flow the company has generated in the past and the level of cash transfer to stockholders (dividend payments and buy-back).
2. Evaluating the results of ongoing investment projects, as measured by the ratio of return on equity and total invested capital to the cost of capital and weighted average cost of capital (WACC).
3. Determining what new investment projects the entity is planning from the point of view of creating stockholder value.
4. Deciding on:

a. limiting dividend payments when the company has made sound investment choices in the past and has favorable investment projects for the future,
b. paying dividends when the company has made wrong investment choices in the past and there are no effective investment projects.

Other ways of determining the dividend payout ratio can also be seen in the literature. Depending on the approach, indicators relating to FCFE (Cwynar, Cwynar, 2007, p. 214), net profit (Brigham, Houston, 2005, p. 207) or investment estimate budget and retained earnings are adopted (Wilimowska, Wilimowski, 2001, p. 463). Particularly interesting is the proposal presented by E.F. Brigham and J.F. Houston (Brigham, Houston, 2005, pp. 203-204) for the residual dividend policy, which the authors believe should be a function of four variables: investors' preference for choosing between dividends received and capital gains, the entity's investment capabilities, the target capital structure, and the availability of external capital. In contrast, J. Lintner's model (Brealey, Myers, 2003, p. 579) suggests, that dividends depend, in part, on a company's current profits and, in part, also on dividends paid in the previous year. In light of the mentioned theories related to the issue of the impact of the amount of dividends paid on the value of the company and on the behavior of investors, dividend discount models seem particularly relevant and interesting.

The first attempts to value stocks using Dividend Discount Models (*DDM*) took place as early as the beginning of the 20th century, although it wasn't until half a century later, that they gained popularity among investors, who began to develop and apply them en masse. Discount models of stock valuation are based on the analysis of dividends, which are the basis for assessing the effectiveness of the investment for the investor from holding stock (Pera, Buła, Mitrenga, 2014, p. 71).

In the stock valuation process, an investor's primary goal is to determine the current price of a stock at a given point in time by determining its intrinsic value (IV). As defined by S.E. Guild (1931, p. 43), the intrinsic value of a stock is the sum of the discount payments we expect to receive in the future. In view of this, the purchaser of the stock is entitled to the benefits of its sale, as well as the profits in the form of dividends from holding it, which, simplifying, can be written using the formula:

$$IV_0 = \sum_{t=1}^{n} \frac{DIV_t}{(1+r)^t} + \frac{P_n}{(1+r)^n},$$

where:

IV_0 – the intrinsic value of the stock at the current time,

DIV_t – dividend per stock paid at the end of year t,

P_n – stock sales price,

r – required rate of return on stocks, taking into account three elements, i.e. the real rate of return, expected inflation and risk.

If the purchaser of stock does not intend to sell it, the value of the stock is determined solely by the stream of dividends received (Zarzecki, 1999, p. 98).

The literature distinguishes several versions of dividend discount models, namely the constant dividend value model and the logistic dividend growth model (Williams, 1956, pp. 77-80, 89-96), the finite dividend model and the constant dividend growth rate model – otherwise known as the Gordon-Shapiro model – (Gordon, 1962; Gordon, Shapiro, 1956, pp. 102-110), two-stage models (Guild, 1931, pp. 66-84, 265-273; Malkiel, 1963, pp. 1004-1031; Holt, 1962, pp. 465-475; Brigham, Pappas, 1966, p. 158; Fuller, Hsia, 1984, p. 51), three-stage models (Molodovsky, May, Chottiner, pp. 104-123), as well as bimodal models (Fernandez, 2002, p. 118 et seq.; Hurley, Johnson, 1994, pp. 5-54). In this article, research was conducted for the oldest and the most widely used model in developed markets, the Gordon-Shapiro model. Figure 1 shows several scenarios for the development of future dividends for PZU under the aforementioned models.

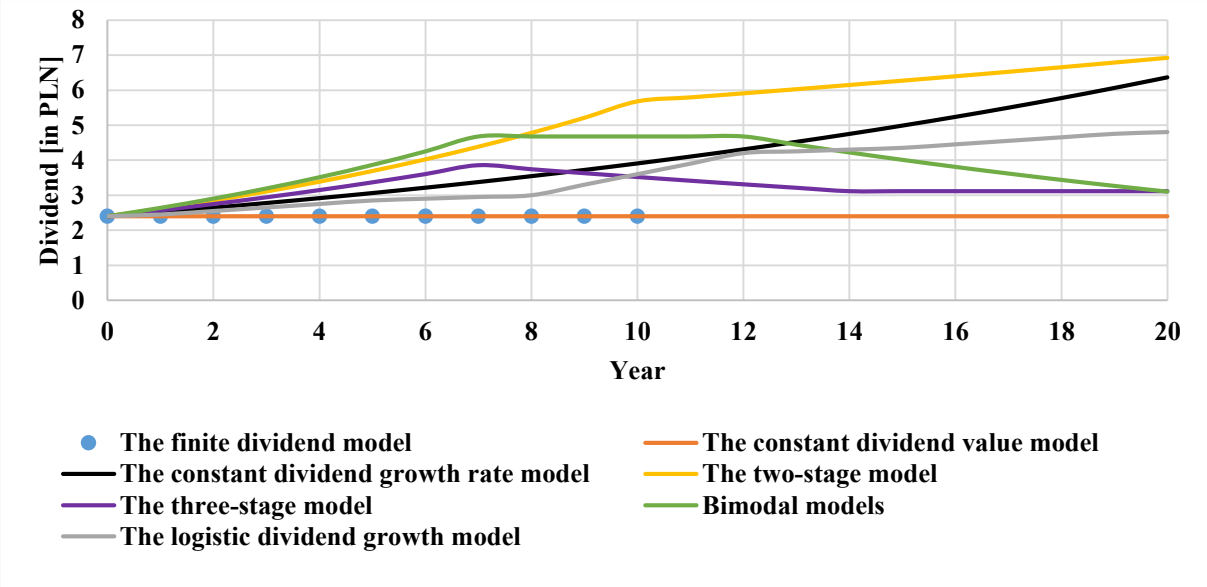

Figure 1. Scenarios of future dividends for PZU company, according to different dividend discount models.

Source: Own study.

The constant dividend growth rate model is used to determine the relevant stock price at a given point in time (IV), and then compare it to the market price (P_0). Taking into account the relationship between the current market price of a stock and its intrinsic value, the stock was divided into: undervalued stocks ($P_0<IV$), overvalued stocks ($P_0>IV$) and properly valued stocks ($P_0=IV$). If the current stock price is determined solely by the level of future dividends (ref. $DIV=DIV_1=DIV_2=...=DIV_\infty$) and the required rate of return, the aforementioned fixed dividend model should be considered (Williams, 1956, pp. 76-77):

$$P_0 = \sum_{t=1}^{\infty} \frac{DIV}{(1+r)^t} = \frac{DIV}{r},$$

where DIV – expected dividends.

The Gordon-Shapiro model takes into account the fact, that profitable companies reinvesting retained earnings can pay higher dividends in the future than before. Thus, Gordon's model is based on two basic assumptions:

1. Dividends are paid every year (indefinitely).
2. The dividend paid to the company's stockholders is growing at a constant rate over time, which means that:

$$DIV_t = DIV_{t-1}(1 + g_t) ,$$

where g – dividend growth rate in year t.

In practice, a serious problem is the proper determination of the g parameter. Citing J.B. Williams and assuming, that the return on assets, income tax rate, cost of debt, profit retention ratio and financing structure are unchanged, g can be written as (K. Jajuga, T. Jajuga, 2015, p. 161):

$$g = ROE \cdot f ,$$

where:
ROE – return on equity,
f – retention rate (*RR*), calculated as the quotient of retained earnings and net income.

The literature often emphasizes, that dividend growth rates in developed markets are in the range of 5-8% per year. This is because the Gordon-Shapiro model applies primarily to companies in a mature growth phase, where the growth of their dividends is expected to be linked to the growth rate of GDP (real + inflation) (Brigham, Houston, 2015, p. 381).

Assuming, following J.B. Williams (1956, pp. 128-135), that the dividend growth rate is constant at g and, at the same time, is lower than the cost of equity, i.e. $g < r$, the value of stock can be estimated as follows (Panfil, Szablewski, 2006, pp. 300-302):

$$P_0 = \sum_{t=1}^{\infty} \frac{DIV_0(1+g)^t}{(1+r)^t} = \frac{DIV_0(1+g)}{r-g} = \frac{DIV_1}{r-g} .$$

The Gordon-Shapiro model can also be used to estimate the required rate of return based on the current market price of stock:

$$r = \frac{DIV_0\,(1+g)}{P_0} + g = \frac{DIV_1}{P_0} + g .$$

It should be noted, that the constant dividend growth model does not examine the relationship between dividends and stock value. Although the studies of M.J. Gordon (1959, pp. 99-105) and J. Lintner (1956, pp. 49-95) referred to the analysis of market data and allowed the formulation of the hypothesis of a positive relationship between dividends and stock prices (the "bird in the hand" theory).

Based on the literature review and the identified research gaps, the following research hypotheses were defined:

H_1: The average rate of change in dividends paid by dividend companies included in the WIG index is higher than the same measure characterizing companies that are components of the S&P500 index.

H_2: The standard deviation of the rate of change of dividends is lower for U.S. dividend companies than for dividend companies in the WIG index.

H_3: The use of the classical form of the Gordon-Shapiro model for stock valuation does not allow a reliable assessment and proper selection of listed companies for an investment portfolio.

A description of the research sample and research methodology is included in the next section of the paper.

3. Sample selection and methodology

For the purpose of conducting the research, the research sample was selected so as to provide, on the one hand, the broadest possible view of the issue at hand (the issues discussed concern only dividend companies) and, on the other hand, it should take into account the possibilities in terms of data availability and quality. Therefore, the authors decided to compare two markets that, from the point of view of the history of dividend payments by listed issuers, are significantly different. In the first stage of the research, the authors set themselves the goal of comparing the U.S. market, which is particularly developed in terms of dividend payment traditions, with the Polish capital market, the selected dividend companies of which are trying to emulate the best global practices in terms of transferring a portion of profit to stockholders. For this purpose, when analyzing the Polish market, the 30 largest companies included in the WIG index were taken into account. Similarly, analyses of the U.S. market were based on 30 entities from the S&P500 index (this was the first criterion for selecting companies). In both cases, these were the companies with the largest market capitalization at the end of 2017. Companies classified in the study, that are components of the WIG index, are Alior, Amrest, Assecopol, BgzBnpp, Budimex, BzWbk (now as Santander), Ccc, Cyfrplsat, Enea, Energa, Eurocash, GrupaAzoty, Handlowy, Ingbsk, Kghm, Lotos, Lpp, Mbank, Millenium, OrangePl, Pekao, Pge, Pgnig, PknOrlen, PkoBp, Pulawy, Pzu, Synthos, TauronPe and Żywiec. In turn, the selected issuers from the S&P500 index are Alphabet Inc. Class A, Alphabet Inc. Class C, Amazon.com Inc., Apple Inc., AT&T Inc., Bank of America Corporation, Berkshire Hathaway Inc. Class B, Chevron Corporation, Cisco Systems Inc., Coca-Cola Company, Comcast Corporation Class A, Exxon Mobil Corporation, Facebook Inc. Class A, General Electric Company, Home Depot Inc., Intel Corporation, Johnson & Johnson, JPMorgan Chase

& Co., Merck & Co. Inc., Microsoft Corporation, Oracle, PepsiCo Inc., Pfizer Inc., Philip Morris International Inc., Procter & Gamble Company, Verizon Communications Inc., Visa Inc. Class A, Wal Mart, Walt Disney Company and Wells Fargo & Company.

For the purposes of the research, dividend companies were classified as those, that paid dividends continuously for the period 2017-2022 during 2018-2023 (this was the second criterion for selecting companies, and it was not influenced by whether dividends in a given year were paid on a one-time basis or, as in the case of the U.S. market, more frequently, as even quarterly). In addition, the study took into account the occurrence of the SARS-CoV2 pandemic during the period analyzed, which negatively affected the continuity of dividend payments. Therefore, consideration was given to the possibility of suspending dividend payments for a maximum of 1 year of the study's time range. For the selected companies, data on dividends paid, as well as stock price levels, were downloaded from stooq.pl and investing.com.

In the second stage of the research on stock valuation using the Gordon-Shapiro model, an important element was the determination of the expected dividend growth rate (g) and the rate of return attributable to the investor (r). Theoretically, dividend growth rates are assumed to be in the range of 5% in developed financial markets. In this study, the real dividend growth rate calculated on the basis of historical data (calculated year-on-year) was taken as the g value. In turn, according to one of the market efficiency hypotheses (Fama, 1970, pp. 384-417; 1991, pp. 1575-1617), an investor also expects an appropriate premium for the risk incurred. It is, therefore, necessary to consider, to what alternative investments an investor today relates the risks present in the stock market. At this stage of the research, the rate of return was set at 10% higher than 10-year Treasury bonds can generate. As of 01.01.2023, the interest rate on EDO0133 Polish bonds was 7.25%, so r was assumed at 7.98%. In contrast, the interest rate in the U.S. market was at 3.79%, so 4.17% was assumed. During the period under review, the geometric mean return for the entire Polish stock market for the period 2017-2023, i.e. the geometric mean return of the WIG index (r_{gWIG}), could not be taken as a point of reference, as it was negative (r_{gWIG} = -23.39%), due to the occurrence of the COVID-19 pandemic and the war caused by Russia's aggression against Ukraine in 2022. In contrast, the geometric mean for the U.S. stock market (S&P 500 index) was 11.19%.

A practical stock valuation using the classical form of the Gordon-Shapiro model used the R^2 coefficient of determination and linear regression, which was used to test, whether the dividends paid by each listed company were statistically at a similar level, which allows the Gordon model to be used with a constant dividend value.

The results of the research conducted are presented in the following point.

4. Analysis of the application of the Gordon-Shapiro valuation model for Polish and American dividend companies

In the analyzed period 2017-2023, there is a wide variation among the analyzed markets, not only in the number of dividend companies, but more importantly in the systematics of dividend payments. Of the 30 largest companies in the Polish market, only 4 paid dividends without a break (13.33% of the 30 issuers analyzed), and 5 issuers paid dividends with one break period (16.67%). For the U.S. market, as many as 80% of companies paid dividends continuously (Table 1).

Table 1.
Frequency structure of dividend payments by Polish and U.S. companies in 2017-2023 (%)

Percentage of companies that paid dividends	WIG	S&P500
0 years	20.00%	16.67%
1 year	10.00%	0.00%
2 years	10.00%	0.00%
3 years	6.67%	3.33%
4 years	6.67%	0.00%
5 years	16.67%	0.00%
6 years	16.67%	0.00%
7 years	13.33%	80.00%

Source: Own study.

It is also worth noting, that, already at the initial stage of the research, a significant variation is outlined between the companies in the WIG and S&P500 indices. Of the 30 largest U.S. companies selected, only 16.67% paid no dividends at all and 3.33% paid dividends for 3 years. Much greater variation in the systematics of dividend payments can be observed in the Polish market, since as many as 20% of the 30 companies analyzed did not pay dividends during the period. In addition, 10% of entities paid dividends in only 1 year or for 2 years, 6.67% paid dividends for 3 or 4 years, and a total of 33.33% of companies paid dividends for 5 or 6 years (Figure 2).

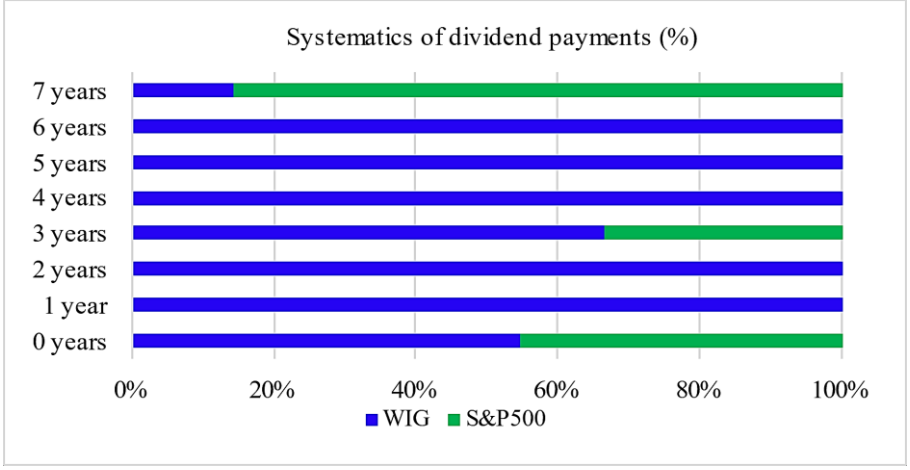

Figure 2. Systematics of dividend payments in the years 2017-2023 (%).

Source: Own study.

Following the formulated methodology of the next stage of the research, Assecopol, Budimex, BzWbk (now as Santander), Handlowy, Lpp, Pekao, PknOrlen, Pzu and Żywiec were considered dividend companies from the WIG index. In turn, the selected dividend issuers from the S&P500 index are Apple Inc., AT&T Inc., Bank of America Corporation, Chevron Corporation, Cisco Systems Inc., Coca-Cola Company, Comcast Corporation Class A, Exxon Mobil Corporation, General Electric Company, Home Depot Inc., Intel Corporation, Johnson & Johnson, JPMorgan Chase & Co., Merck & Co. Inc., Microsoft Corporation, Oracle, PepsiCo Inc., Pfizer Inc., Philip Morris International Inc., Procter & Gamble Company, Verizon Communications Inc., Visa Inc. Class A, WalMart and Wells Fargo & Company.

If the selected companies can be considered representative of dividend companies listed on the Polish and American stock exchanges, then from the point of view of the rate of change of dividend payments, the former can be pointed out to be more attractive. They are characterized by higher average changes in payouts between 2021 and 2023, as well as an increasing trend line (Figure 3).

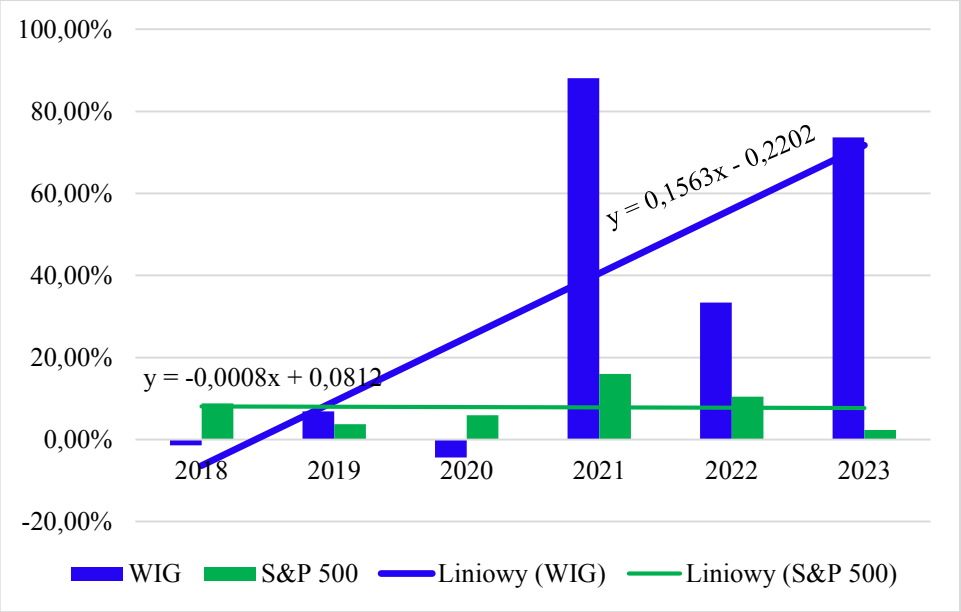

Figure 3. Trend line of the average rate of change of dividends for the period 2018-2023.
Source: Own study.

However, referring to selected statistics characterizing both groups of companies from the point of view of a capital market investor, the advantage of dividend companies from the S&P500 index becomes apparent. Not only are they characterized by a lower standard deviation of the average rate of change of dividends, but also there was no negative average rate of change and no negative median rate of change of dividends in each of the analyzed periods. Which is something different from Polish listed issuers (Table 2).

Table 2.
Selected statistics characterizing Polish and U.S. companies in 2018-2023 (%)

Groups of dividend companies	Measure	2018	2019	2020	2021	2022	2023
WIG	Average dividend change rate	-1.41%	6.86%	-4.39%	88.09%	33.35%	73.63%
	Standard deviation of the dividend change rate	29.05%	68.40%	80.96%	118.59%	112.81%	143.84%
	Median dividend change rate	-4.49%	5.68%	-27.62%	34.21%	0.00%	24.88%
S&P 500	Average dividend change rate	8.83%	3.77%	5.90%	15.96%	10.41%	2.30%
	Standard deviation of the dividend change rate	18.05%	22.84%	14.82%	72.27%	23.26%	14.30%
	Median dividend change rate	6.56%	6.06%	5.51%	5.43%	6.18%	4.47%

Source: Own study.

Dividend companies, that are components of the S&P500 index, were characterized by greater stability in payouts (lower average rate of dividend change and median rate of change), while having a lower standard deviation in each of the analyzed years from the 2018-2023 range. Moreover, over the period under review, Polish dividend companies were characterized by an upward trend in the standard deviation of the rate of dividend changes with a relatively stable trend for U.S. companies (Figure 4).

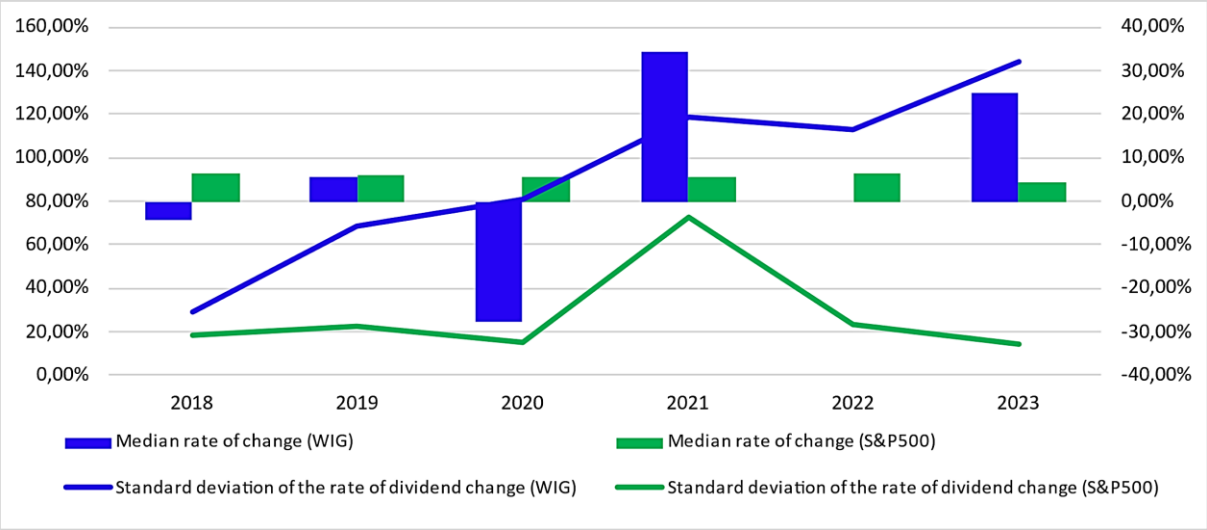

Figure 4. Standard deviation (left scale) and median (right scale) of the average rate of dividend change for the 2018-2023 period.

Source: Own study.

A summary of the first stage of the study is presented in Table 3. The calculations therein show that, if investors are counting on a higher average rate of dividend changes by Polish dividend companies (20.05 pp. higher), this will be associated with a higher average standard deviation of the rate of dividend changes by as much as 16.57 pp. This relationship is also confirmed by comparing for both groups of companies the average median rate of dividend

changes. For dividend companies in the WIG index, it is 17.43% and 5.86% for U.S. dividend issuers.

Table 3.
Average statistics characterizing Polish and U.S. companies in 2018-2023 (%)

Groups of dividend companies	Measure	For the period 2018-2023
WIG	Average dividend change rate	27.91%
	Standard deviation of the dividend change rate	25.97%
	Median dividend change rate	17.43%
S&P 500	Average dividend change rate	7.86%
	Standard deviation of the dividend change rate	9.40%
	Median dividend change rate	5.86%

Source: Own study.

In the next step, dividends paid were analyzed for valuation using the Gordon-Shapiro model. The first assumption is that companies pay non-zero dividends on a regular basis, while the second is that they should follow an exponential function (the dividend growth rate – *g* parameter – is and will always remain constant).

The study highlighted the shortcomings of the classical form of the Gordon-Shapiro model in the Polish market. 5 of the 9 WIG index companies examined did not pay dividends in each period, while for none of the 4 companies regularly paying dividends was it possible to determine a constant dividend growth rate. This means, that in no case did the exponential model fit the dividends paid by the companies well – see Figure 5. Failure to meet at least one of the basic assumptions of the classical dividend form of the Gordon model prevents the model from being used in practice. Therefore, in addition, a simple statistical analysis was referred to, abandoning complete adherence to the restrictive assumptions of the Gordon model, and a basic measure of the quality of model fit, the so-called coefficient of determination (R^2), was introduced into the analysis. The coefficient of determination indicates what proportion of the variation in the dependent variable (to what extent) was explained by the selected model. The R^2 coefficient takes values in the [0;1] interval, and uses the least squares method to estimate parameters. The model is best fit when $R^2 \geq 0.90$. In this context, the best-fit dividends, in terms of coefficient of determination, were those of Assecopol, with $R^2 = 0.7636$, while only a linear fit was possible for Santander, with $R^2 = 0.7081$. As a result, it was impossible to apply the classical form of the Gordon-Shapiro model to stock valuation for companies in the WIG index.

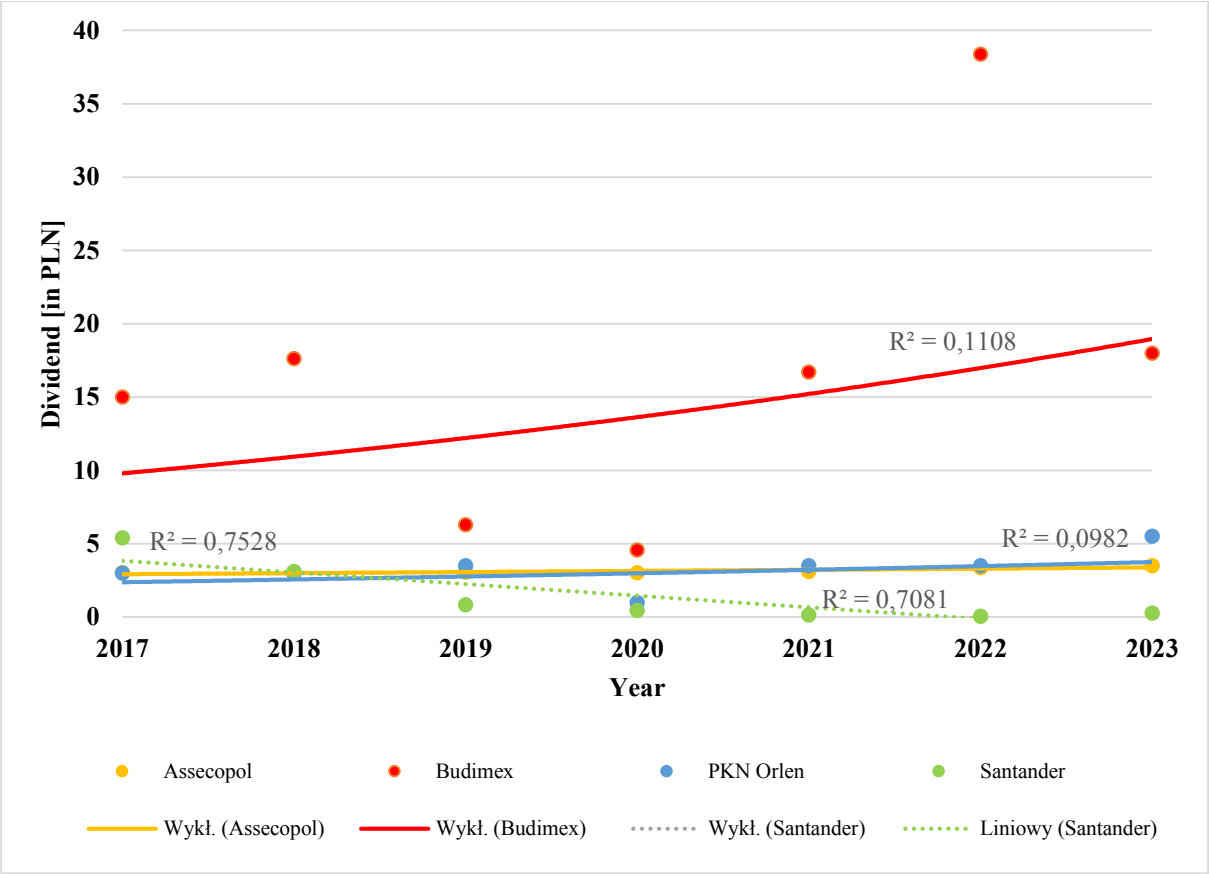

Figure 5. Dividends paid by Assecopol, Budimex, PKN Orlen and Santander in 2018-2023.
Source: Own study.

Rigorous application of the assumptions of the classical form of Gordon's model allows the model to be applied in practice for only two companies in the U.S. market, namely Verizon Communications and Walmart, whose dividend growth rate from 2017 to 2023 was 2%. For this reason, as in the case of the Polish stock market, the coefficient of determination (R^2) was used. Based on the observations, it was noted that for 13 companies, i.e. BAC, CVX, HD, JNJ, KO, MRK, MSFT, ORCL, PFE, PG, WMT, VZ, V, the coefficient of determination was higher than 0.9, which indicates a very good fit of dividends paid to the exponential model. The highest score, i.e. $R^2 = 0.99$, was achieved by Chevron, Johnson & Johnson, Microsoft, Verizon Communications, Visa and Walmart. This means that, although the dividends paid by these companies do not meet the Gordon model's second assumption of constant dividend growth (except for VZ and WMT), they are close to its execution. In the case of companies: CSCO, JPM, PEP, XOM, the coefficient of determination indicates a good fit of dividends to the model, that is $0.80 \leq R^2 < 0.90$. A satisfactory fit was observed for Comcast Corporation and Philip Morris, i.e. $0.60 \leq R^2 < 0.80$. In other cases, the fit was poor or unsatisfactory – $R^2 < 0.60$. Figure 6 presents the development of dividends paid by Microsoft with the exponential model fitted thereto (dividends are marked in blue, while the exponential function is shown as a solid blue line), and compares them with various theoretical variants of dividends

determined according to the Gordon model (dividends are marked in red, green and yellow, respectively, depending on the level of *g* adopted, while exponential functions are shown using a dashed line). For each of the theoretical variants, the coefficient of determination is 1.

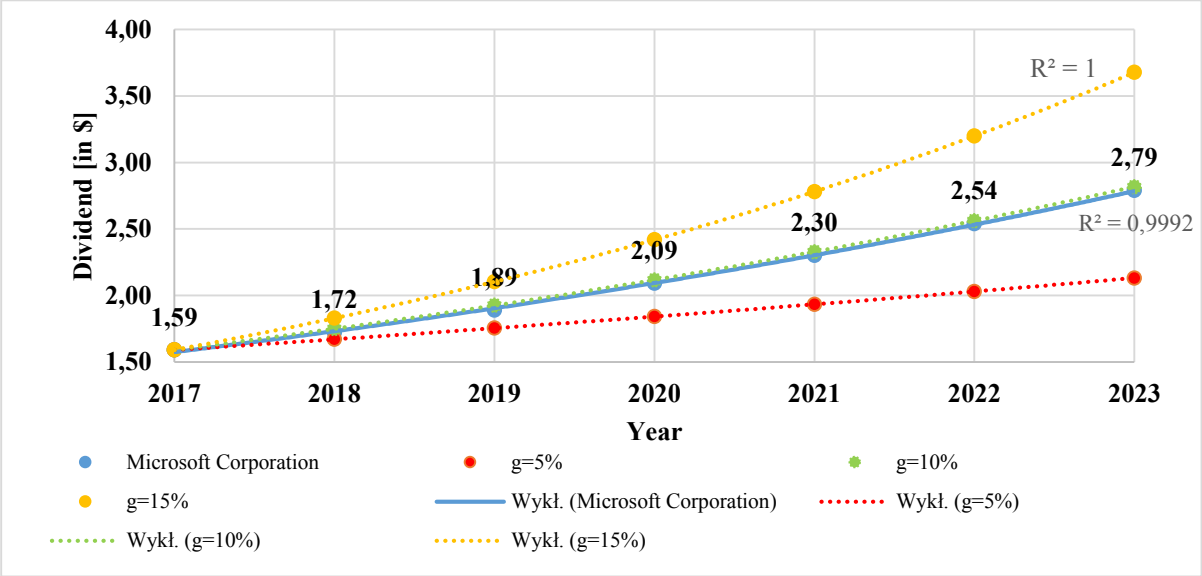

Figure 6. Dividend paid by Microsoft vs. dividend formation according to Gordon's model for $g = 5\%$, 10% and 15%.

Source: Own study.

For S&P500 companies with a coefficient of determination above 0.9, stock valuations were made using the Gordon-Shapiro model, assuming a dividend growth rate equal to the average rate of change of dividends in 2017-2023 – Table 4. The theoretical price was then compared with the market price as of 29.12.2023, and a signal was determined as to whether buy (K) or sell (S) stocks, if held. Finally, the K and S signals were verified by checking the behavior of the price of each stock at the end of June 2024.

The research showed that only for 9 companies (of which 3 in the two adopted variants for the *r* parameter) was it possible to value stocks according to the assumptions of the Gordon-Shapiro model. Interestingly, there was a buy signal in the valuation of KO, VZ and WMT stock, which was verified correctly by taking into account the stock market price of these stocks on 28.06.2024, when the investor accepted a rate of return 0.1 higher than that given by 10-year Treasury bonds. For most companies, only valuation under the second option was possible, where *r* was greater than *g* and estimated as the geometric mean return of the S&P500 index for the period 2017-2023. For all 9 companies, a sell signal was received for the stock, while only for JNJ and PFE did the forecast prove accurate, as the stock price on 28.06.2024 was lower than the price on the decision date, i.e., 29.12.2023. For the remaining companies, the valuation was not possible, as they did not meet the model's assumption of $r>g$. In summary, it can be concluded, that the discrepancies between the model valuation and the market prices of individual stocks are significant, which indicates the impossibility of making a correct stock valuation using the classical form of the Gordon-Shapiro model in practice.

Table 4.
Stock valuation according to the Gordon-Shapiro model and verification of the forecast for S&P500 index companies

Index	Company symbol	Stock valuation according to the Gordon-Shapiro model as of 29.12.2023 [in $] assuming:			Stock market closing price on 29.12.2023 [in $]	Buy [K]/ Sell [S] signal as of 29.12.2023		Forecast verification - stock market closing price on 28.06.2024 [in $]
		g [in %]	*10-year Treasury bonds* + *premium* r_{US}=4.17% [1]	*S&P500 index* + *premium* $r_{gS\&P500}$=11.19% [2]		[1]	[2]	
S&P500	BAC	16%	$r < g$	$r < g$	33.67	-	-	-
	CVX	6%	$r < g$	117.68	149.16	-	S	156.42
	HD	16%	$r < g$	$r < g$	346.55	-	-	-
	JNJ	6%	$r < g$	95.32	156.74	-	S	146.16
	KO	4%	408.29	25.48	58.93	K	S	63.65
	MRK	8%	$r < g$	94.22	109.02	-	S	123.80
	MSFT	10%	$r < g$	224.95	376.04	-	S	446.95
	ORCL	14%	$r < g$	$r < g$	105.43	-	-	-
	PFE	4.23%	$r < g$	24.56	28.79	-	S	27.98
	PG	5%	$r < g$	67.13	146.54	-	S	164.92
	V	18%	$r < g$	$r < g$	260.35	-	-	-
	VZ	2%	125.96	29.26	37.70	K	S	41.24
	WMT	2%	101.03	24.92	52.55	K	S	67.71

Source: Own study.

The absence among the companies in the WIG index of those that regularly pay dividends with a constant rate of growth inspired the authors to try to check, whether the dividends paid by the companies were not at a similar level (constant) during the period under research, which would make it possible to omit the g value from the calculations ($g = 0$). For this purpose, a statistical method was used to test the significance of the regression parameters of individual companies.

The significance level was assumed to be $\alpha = 0.05$. The significance of the individual regression parameters (β_i) was then evaluated to see, if changes in the explanatory variable x somehow explain variation in the dependent variable y. Hence, the following hypotheses of significance of the directional coefficient were tested:

$$H_0: \beta_i = 0,$$

$$H_1: \beta_i \neq 0,$$

where:

H_0 – Hypothesis H_0 means that the directional coefficient is 0,

H_1 – Hypothesis H_1 means that the directional coefficient is different than 0,

β_i – beta regression parameter, understood as the rate of change of the dividend.

The zero beta (hypothesis H_0 positively verified) implies the relative constancy of the price over time, which is derived from the constant level of dividends over time. A positive beta means a rising stock price over time, by definition resulting from rising dividends. By the same logic, negative beta in this view means declining dividends over time.

The test was then based on:

$$t = \frac{\hat{\beta}_i}{s\left(\hat{\beta}_i\right)},$$

where:

$\hat{\beta}_i$ – is the estimator of the regression parameter β_i,

$s\left(\hat{\beta}_i\right)$ – is an estimate of the estimator error $\hat{\beta}_i$.

The critical area of the test depends on the hypotheses adopted and was determined using a Student's t-distribution. Table 5 summarizes the results for companies in the WIG and S&P500 indices.

Table 5.
Test of significance of the regression parameters of the WIG and S&P500 index companies for the period 2017-2023

Index	Symbol	|t|	t_α	Hypothesis accepted/rejected
WIG	**ACP**	3.8477	0.9621	H_0 rejected
	BDX	1.0527	0.9621	H_0 rejected
	SPL	-3.4828	0.9621	H_0 rejected
	BHW	0.8583	0.9621	No grounds for H_0 rejection
	LPP	3.3138	0.9621	H_0 rejected
	PEO	-1.3893	0.9621	H_0 rejected
	PKN	1.2822	0.9621	H_0 rejected
	PZU	0.4012	0.9621	No grounds for H_0 rejection
	ZWC	-1.9781	0.9621	H_0 rejected
S&P500	**AAPL**	-3.1851	0.9621	H_0 rejected
	T	-1.0938	0.9621	H_0 rejected
	BAC	13.3111	0.9621	H_0 rejected
	CVX	20.9581	0.9621	H_0 rejected
	CSCO	7.3807	0.9621	H_0 rejected
	KO	15.6628	0.9621	H_0 rejected
	CMCSA	2.6791	0.9621	H_0 rejected
	XOM	6.8853	0.9621	H_0 rejected
	GE	-0.9614	0.9621	No grounds for H_0 rejection
	HD	23.4951	0.9621	H_0 rejected
	INTC	-0.2673	0.9621	No grounds for H_0 rejection
	JNJ	61.3572	0.9621	H_0 rejected
	JPM	6.6798	0.9621	H_0 rejected
	MRK	23.1384	0.9621	H_0 rejected
	MSFT	22.3651	0.9621	H_0 rejected
	ORCL	11.1148	0.9621	H_0 rejected
	PEP	4.2645	0.9621	H_0 rejected
	PFE	13.0236	0.9621	H_0 rejected
	PM	2.9301	0.9621	H_0 rejected
	PG	14.9244	0.9621	H_0 rejected
	VZ	1.28E+15	0.9621	H_0 rejected
	V	18.0284	0.9621	H_0 rejected
	WMT	1.45E+15	0.9621	H_0 rejected
	WFC	-1.5332	0.9621	H_0 rejected

Source: Own study.

Based on the results presented in Table 5 for the 4 companies in the WIG and S&P500 indices, i.e. BHW, PZU, GE and INTC, it was observed, that there were no grounds for rejecting the H_0 hypothesis, as $|t| < t_\alpha$. This means, that it is possible to assume, that the directional coefficient is equal to 0, that is, to assume, that dividends paid during the period under research were similar, constant. Statistically, it is assumed that dividends paid did not change ($g = 0$). In other cases $|t| > t_\alpha$, that is, the hypothesis H_0 should be rejected. It can even be argued, that the size of dividends paid has fluctuated – most of the companies in the WIG and S&P500 indices saw an increase in dividends paid between 2017 and 2023.

The results obtained confirm, that companies in the WIG index pay dividends in an unpredictable and diverse manner, without sticking to a strict dividend policy, while in the case of U.S. companies, dividends were increasing. Therefore, it is necessary to hypothesize, that the dividends paid by the companies under research change over time, except that no pattern can be clearly identified as to how they change.

Complementing the above considerations, the intrinsic value of stocks of companies, for which it was assumed that the dividend statistically did not change, was calculated. The stock valuation according to Gordon's model was compared with the market price of the stock as of 29.12.2023, and then buy or sell signals were evaluated based on verification on 28.06.2024 – Table 6.

Table 6.
Stock valuation according to Gordon's model and verification of the forecast for companies in the WIG and S&P500 indices meeting the H_0 hypothesis

Index	Company symbol	Stock valuation according to the Gordon-Shapiro model as of 29.12.2023 [in PLN/$] for the 2023 dividend assuming:		Stock market closing price on 29.12.2023 [in PLN/$]	Buy [K]/ Sell [S] signal as of 29.12.2023		Forecast verification - stock market closing price [in PLN/$] on 28.06.2024
		10-year Treasury bonds + premium r_{PL}=7.98%; r_{US}=4.17% [1]	*S&P500 index + premium* $r_{gS\&P500}$=11.19% [2]		[1]	[2]	
WIG	BHW	112.78	-	101.40	K	-	97.80
	PZU	30.08	-	47.27	S	-	51.54
S&P500	GE	5.76	2.14	101.86	S	S	158.97
	INTC	17.75	6.61	50.25	S	S	30.97

Source: Own study.

Table 6 shows that PZU, GE and INTC were overvalued, regardless of the investor's assumed expected rate of return, while BHW was undervalued. The valuation of GE stocks at the levels of $5.76 [1] or $2.14 [2] with a market price of $101.86 as of 29.12.2023 looks the least likely. Moreover, the analysis showed that 2 out of 5 generated sell signals (which is 33.33%) were correct, which means that the investor would not suffer a loss. In contrast, the other 3 signals were wrong and the investor would not have made a profit.

5. Discussion and conclusions

The obtained results of the research on the comparison of Polish and American dividend companies confirm the existing practices of the latter in terms of the stability of dividend payments and the number of companies systematically transferring profits to stockholders. The largest companies, that are components of the WIG index, do not show as much concentration of dividend payment systematics as the companies in the S&P500 index, which were characterized by a lower diversity of dividend breaks between 2017 and 2023. The considerations presented and the research performed also made it possible to conclude, that Polish dividend companies, if they actually paid dividends characterized by higher dynamics of change, were, at the same time, burdened with higher variability of payments.

On the other hand, studies of stock valuation using the classical form of the Gordon-Shapiro model in the Polish and U.S. markets have shown shortcomings regarding the model's overly demanding assumptions, which are difficult for dividend companies to meet in practice. Accordingly, for no company in the Polish market was it possible to value stock according to the constant dividend growth rate model. Companies from the U.S. stock market performed much better, although it was possible to make a practical valuation for only 9 of the 24 companies, with only 2 companies having a fixed dividend growth rate, and 7 estimated as an average growth rate from 2017-2023. Unfortunately, the discrepancies that occurred between the model valuation of stocks and their stock market prices were significant, suggesting the impossibility of correctly valuing stocks in practice using the classical form of the Gordon-Shapiro model in the U.S. market as well.

Based on the conducted research, the adopted research hypotheses were verified, and on this basis, it was concluded that:

H_1: The average rate of change in dividends paid by dividend companies included in the WIG index is actually higher than the average rate of change in dividends paid by issuers that are components of the S&P500 index.

H_2: The standard deviation of the rate of change of dividends is significantly lower for U.S. dividend companies than for dividend companies in the WIG index.

H_3: The use of the classical form of the Gordon-Shapiro model for stock valuation actually in practice does not allow for a reliable assessment and proper selection of listed companies for an investment portfolio in both the Polish and U.S. markets.

However, it should be noted, that there is a certain insufficiency in the research conducted regarding the set of dividend companies analyzed (especially for companies in the WIG index) and the time range of the analyses. The authors intend to conduct extended analyses of the issues raised in the article in the future with a more extensive dataset. It is also worth pointing out that, given the capitalization of the companies under research, the conclusions presented can be important recommendations for investors regarding the choice of companies, as well as the markets, on which they are listed.

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