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Frequency of dividend payment among electricity sector firms in Brazil, USA and Germany

Alexandre Rodrigues da Silva

Abstract
The aim of this work is to analyze, through the annual amount of dividend payments from companies in the electricity sector in Brazil, the United States and Germany, the possible influence of its institutional rules on dividend policy and also on asset prices through the frequency of dividend payments. Methodology: data on dividend payments and daily value of shares of companies in the electricity sector in Brazil, the United States and Germany, respectively traded on the São Paulo, New York and Frankfurt stock exchanges, were collected. The period from January 1, 2000 to December 31, 2022 was covered. Results: Brazilian and German companies concentrate dividend payments on fewer annual dates than US companies. The findings found may be related to the legal framework based on common law and which, according to LaPorta (2000), is used as a form of greater protection for minority shareholders.
Keywords: Dividend policy. Electrical sector. Concentration of dividends

1. INTRODUCTION

According to Ferris et al (2010), although dividend policy is one of the most intensely studied areas of corporate finance, the issue of how frequently the firm should make dividend payments to its shareholders remains unexplored. The previous literature in corporate payout policy examines the decision to pay or not to pay dividends (Fama; French, 2001; DeAngelo et al, 2004; Baker; Wurgler, 2004a, b), how much to pay (Rozeff, 1982; Miller; Rock, 1985), or how to pay – repurchases versus dividends (Stephens; Weisbach, 1998; Jagannathan et al, 2000). But no study examines how frequently the firm should pay dividends once the decision to pay has been made.

Ferris et al (2010) also explain that one might argue that once the level of payout is decided, the frequency of payment is only of secondary importance and that reporting conventions or other regulatory guidelines might determine the dividend payment schedule. Such an argument, however, ignores the higher utility derived by investors from receiving more frequent payments implied by the prospect theory of Kahneman and Tversky (1979) and Thaler's (1980) mental accounting. These theoretical developments jointly imply important

predictions regarding the frequency with which investors prefer to receive dividends. Prospect theory contends that the utility function of investors is concave over the domain of gains. Thaler (1980) subsequently describes the process of mental accounting by which investors evaluate their gains separately from their losses, and thereby increase their overall utility. These arguments suggest that an investor receives a higher level of utility from a sequence of smaller discrete payments than a single aggregate payment.

The aim of this work is to analyze, through the annual amount of dividend payments from companies in the electricity sector in Brazil, the United States and Germany, the possible influence of its institutional rules on dividend policy and also on asset prices through the frequency of dividend payments.

The article is divided as follows: this introduction, the theoretical framework, where the themes of dividend taxation and dividend policy in the electricity sector are explored in depth and the hypotheses to be tested are formulated. The methodology and results follow, where the statistical analysis of the collected data and its discussion in light of the literature are demonstrated. The article ends with final considerations, where the results achieved and perspectives for future work are reviewed.

2. THEORETICAL REFERENCE

The theory of Kahneman and Tversky (1979) and the models of Barberis and Thaler (2003) and Barberis and Huang (2001) show that a greater frequency of payments increases the investor's total utility. The separate valuation by investors of individual gains over a concave utility function influences how a stream of dividend payments will be valued. More specifically, it suggests that the frequency with which dividends are paid will positively effect an investor's valuation of a total dividend distribution. Consider the discussed by Barberis and Thaler (2003) whereby a firm pays a $2 annual dividend and a $8 capital gain. If the firm elects to pay that dividend in the form of $0.50 per quarter, the investor now has four individual dividends to evaluate rather than one. Because of the concavity of his utility function, these four dividends will provide the investor with a total greater utility than one annual dividend of $2 in spite of their identical total dollar amount. To the extent that dividends are paid more frequently, investors are able to code each individual dividend as a separate gain, resulting in a higher level of total utility than if the dividend was paid at once and viewed as a solitary gain. Hence, the choice of payment frequency determines the amount of utility an investor receives from a given payout level.

Ferris et al (2010) also found a positive relationship between payment frequency and the market value/book value ratio, which was interpreted as evidence that payment frequency has implications for company value. These arguments suggest that an investor receives a higher level of utility from a sequence of small payments than from a single aggregate payment. Ferris et al (2010) found significant intersectoral variability in the frequency of dividend payments, but excluded from their study those firms operating in the regulated industries of financials, utilities, and real estate. Another factor may be the legal regime in which the dividend-paying company is inserted and the nature of the legal protections for minority shareholders. LaPorta et al (2000), for example, found that companies in countries with strong investor protection pay more dividends than those in less favorable regimes, a finding also reported by Ferris et al (2010), who found a pronounced difference in the frequency of dividend payments in relation to the legal regime. They found that those shareholders who invested in companies based in countries with a common law legal system

receive their dividends, on average, twice as often as those based in countries with civil law. The authors conclude from our analysis that there are effects beyond that identified in prospect theory and mental accounting that influence the frequency with which dividends are paid. They observed, for instance, that there is an important distinction between legal regimen, with shareholders in common law countries receiving their dividends twice as frequently as their civil law counterparts.

D'Souza et al (2015) investigated changes in the dividend policies of electric utilities after the beginning of deregulation of the sector in the United States in the 1980s. Consistent with the clientele effect theory, the authors found that utilities continued to pay high dividends after deregulation. Under a regulated regime, they found no systematic pattern of associations between dividend changes and abnormal returns or future earnings changes. After deregulation, however, they found that, consistent with previous work on unregulated companies, the increase (decrease) of dividends is seen by the market as good (bad) news. When D'Souza et al (2015) examined earnings after changes in dividends, they found no evidence in favor of the dividend signaling theory. The authors found that electric utilities maintain their dividend levels even when their profitability falls. These results are interpreted as being consistent with the clientele effect.

With the aim of evaluating the occurrence of high dividend payments (greater than 5%) on a single date in the Brazilian electricity sector, as well as seeking a relationship with ownership concentration and frequency of dividend payments, Silva (2019) selected share prices and dividend payments on their respective dates during the period from January 1, 2010 to December 31, 2015. The author defined the concentrated payment as once a year and diluted as equal to or greater than two annual payments. The shares were separated into different groups: the first covered the shares present in the IBOVESPA index of companies in the electricity sector, from 2010 to 2015 (IEE group). The second group, that of shares present in the Bovespa index (IBOV group, excluding shares in the electricity sector. In the same way as in the previous group, actions from the years 2010 to 2015 were included (even those that were present in only one of these years).

Silva (2019) concluded that: 1) IEE concentrates dividends (lower payment frequency), which can be explained by Ferris et al (2009) in relation to the volatility of companies' operating earnings. In the case of the electricity sector, as it has more constant cash flows, there is no need for more frequent dividend payments during the year. Such results could also be explained according to the work of Armitage (2012), which demonstrates that there is a demand for dividends from companies of a certain type, mainly from mature companies that normally have large cash flows, as in the life cycle theory. The evidence shown in the work in relation to life cycle theory and that demand clearly exists even when the motivation for the demand is not the reduction of agency costs. 2) Despite the lower payment frequency, IEE's dividend yield is higher than IBOV; 3) Large dividends (yields greater than 5%) are more frequent in the IEE than in the IBOV group, and this effect is not linked to differences in the dilution of more frequent dividend payments during the year. 4) Even without the large dividends, IEE pays a higher Yield than IBOV. 5) Large dividends concentrate most of IEE's yield in relation to the IBOV group. 6) Yield of the IEE group without large dividends is the same as the IBOV group, that is, the target for arbitrage is large dividends (mainly with a single annual payment); 7) The ownership structure can make a difference: companies with public control pay large dividends more frequently than others. Companies with centralized private control

pay large dividends more frequently than companies with dispersed private control. Public IEE and pulverized IEE pay more than public IBOV and pulverized IBOV. There is no difference between centralized IEE and IBOV. IBOV of private and concentrated capital pays large yields as IEE of private and concentrated capital, which is in line with Farinha (2003), Johnson (2017) and Bohren and Odegaard (2001).

The author also concludes IEE has a lower payment frequency: 89% of cases with 1 or 2 payments per year. IBOV: 60% with 1 or 2 payments per year ($p = 0.001$). Despite the lower payment frequency, IEE's dividend yield is higher than IBOV ($p < 0.000001$). The effect of large dividends is not due to greater dilution of the yield in many payments. Despite the percentage difference between the groups, the findings were not statistically significant. In other words, IEE does not pay large dividends at the expense of fewer diluted dividends. Even after excluding large dividends from the analysis, the IEE group pays a higher Yield than IBOV.

Silva and Kirch (2020), in order to investigate if companies in the electricity sector that pay dividends irregularly lead to lower share prices, as they transmit uncertainty to the market by not effectively resolving the agency conflict, present mainly in utilities. Another hypothesis studied was if companies in the electricity sector that concentrate the payment of dividends pay higher yield than those that pay on several dates a year, similar the study of Silva (2019), who demonstrated this occurrence of higher yield in companies in the sector concentrating dividend payments in relation to companies listed on the BOVESPA.

The authors collected the stock prices and dividend payments of shares in the electricity sector listed on the São Paulo Stock Exchange (B3) from January 1, 2009 to December 31, 2018. Dividend payments were grouped within their respective year of payment; when multiple payments occurred within a year, their yield was added up. Dividend payments made in a single period of the year allocated the share in that specific year to the group of concentrated payers. The asset with several payments during the year was included in the group of diluted payers. Each year in which a dividend was paid featured a year 0, or index year. The share price on the dividend payment day in the concentrated group was also recorded and also became an index year. In the group of several payments per year (diluted), an arithmetic average of the share prices on the respective payment dates was made. Based on year 0, the variation in prices and yield was calculated for successive years 1, 2 and 3. The concentrated and diluted groups in their respective years were compared using the Student's t test with significance level established at 0.1 to assess possible discrepancies. The persistence of the pattern of dividend payments (either concentrated or diluted) in years 1, 2 and 3 was tested as well as the variation of prices and yield in years 1, 2 and 3 between rigid payers (those who did not change their annual payment amount) and flexible payers, whose payments varied between concentrates, (once a year) and diluted (above an annual payment).

Silva and Kirch (2020) conclude that: 1. The yield of companies that pay dividends on several dates in the year is higher than the yield of companies that pay dividends only once a year, showing that within the electric sector, the behavior of companies when compared to each other is different. This finding offers a different standpoint in comparison to an intersectoral assessment, as shown by Silva (2019). 2. Companies that concentrate the payment of dividends once a year obtain greater capital gain than companies that pay dividends on several dates in the year. 3. Companies show a tendency to maintain their payment frequencies, both in those that concentrate and in those that pay on several dates per year. 4. Companies that maintain multiple dividend payments per year have a higher yield

than companies with inconsistent dividend payments (ranging from 1 or more payments). The same, however, did not occur in the comparison between the group of dividend payments on a single date and the group of inconstant payments. These findings show the importance of regular dividend payments, especially in relation to yield. 5. Although differences were found between the yield of companies whose payments were regular in relation to the companies with irregular yield payment, there were, however, no differences in the price variation between both groups, which shows that neither the yield nor the irregularity of payments interfered with the share price.

Given the above, the following hypotheses were formulated:

H_{A1}: countries have differences in the frequency of dividend payments, concentrating or diluting according to LaPorta (2000).

H_{B1}: there are differences in the amount of dividends paid and share price variation between concentrated and diluted payments, according to Silva (2019) and Silva and Kirch (2020).

3. METHODOLOGY

From the Yahoo Finance website (YAHOO FINANCE, 2023), data was collected on dividend payments and daily values of shares of companies in the electricity sector in Brazil, the United States and Germany, respectively traded on the São Paulo, New York and Frankfurt. The values corresponded to the closing of the daily trading session. The period from January 1, 2000 to December 31, 2022 was covered. Furthermore, data analysis also included data on the GDP of the countries under study and the main indexes of each exchange: in Brazil, the Ibovespa, in USA, the S&P500 and in Germany, the GDAXI.

To test the hypotheses, the collected data were converted as follows: dividends were converted into yield, annual yield variation (hereinafter D_yield), dividend payment (div), represented in Reais, US Dollars or Euros (respectively for the groups of Brazil, USA and Germany), annual variation in dividend payments (hereinafter D_div) and the first yield difference between D1 and D0 (hereinafter yi_d1-d0).

The prices were converted into annual price variation, where the closing value of the asset on the last day of the year was collected in relation to the previous year's value (hereinafter D_price) and also through the difference between D_price and the annual variation of the stock index. respective country (hereinafter PR_SP). Companies where there was only one year of data were excluded, which would make the conversion to the variables described above unfeasible.

The sample was also divided into two groups: the group of concentrated payments, where 1 or 2 dividend payments were made during the year. The second group, that of diluted payments, consisted of companies-years whose dividend payments were equal to or greater than three payments. Years in which there were no payments were excluded for a separate analysis.

The data was analyzed using the chi-square test to test HA between the three countries and the Student's t test to test HB for the variables related to dividend payments. The level of statistical significance was set at 0.1.

4. RESULTS AND DISCUSSIONS

On the São Paulo stock exchange (B3), 17 companies were found, for a total of 184 company-years. The stock exchange From the New York Stock Exchange, 35 companies were found, but Eletrobras was discarded, as it is a company already traded on B3. Thus, through 34 companies, there were a total of 651 company-years. On the Frankfurt Stock Exchange, 3 publicly traded companies were found, representing 69 company-years.

The amount of dividend payments as well as the proportions between concentration or dilution of these is shown in table 1. It is evident that the three countries had similar percentages of dividend payments (ranging between 88.6 and 93.4%). However, the amount of concentration of dividend payments in Germany (98.4%) and the dilution of payments in the USA (91.4% of payments were diluted) is also demonstrated. The analysis between countries, using the chi-square test, is in table 2. Brazilian companies concentrate the payment of dividends more than companies in the USA and Germany, while Germany concentrates payments more than the USA, in accordance with hypothesis H_{A1}. This finding that the USA dilutes dividend payments more is in line with LaPorta (2000), who demonstrated that in countries where the legal regime of common law predominates, companies pay dividends much more frequently than those included in civil law, such as Brazil and Germany.

Table 1 – Payment and concentration of dividends in the three countries

	Dividends paid (%)	Concentrated dividends (%)[1]	Total (%)
Brazil	163 (88.6)	113 (69.3)	184 (100)
USA	608 (93.4)	52 (8.6)	651 (100)
Germany	63 (91.3)	62 (98.4)	69 (100)

[1]In relation to dividends paid;
Source: survey data

Table 2 - Chi-square test between countries regarding dividend concentration

Países	
Brazil vs USA	Brazil concentrates the payment of dividends at a frequency 8 times higher than the USA *
Brazil vs Germany	Germany concentrates the payment of dividends at a frequency 42% higher than Brazil*
USA vs Germany	Germany concentrates dividend payments at a frequency 11.4 times higher than the USA *

*p<0.001
Source: survey data

Tables 3 to 14 provide descriptive statistics. In order, from tables 3 to 6 are the data referring to Brazil, respectively, in ascending order: table 3 with concentrated dividend events, table 4, diluted dividends, table 5 both aggregated as dividends paid and table 6 with the events in which there was no payment of dividends. Furthermore, each of the variables under study (yield, d_yield, div, d_div, Yi_d_1_d_0, d_preco and Pr-sp) are their respective mean, standard error, 90% confidence interval, minimum value, 25th percentile, median, percentile 75 and maximum value. Tables 7 to 10 refer to the USA, while the rest refer to results from Germany, in the same order as the previous ones.

The wide variation in yield (d_yield) and variation in dividends (d_div) in the Brazil group stands out, both in those whose payments are concentrated and in those diluted, being even greater in the former. This would show a component of uncertainty in the payment of dividends, even though it is a sector that traditionally pays high dividends (RODRIGUES et al, 2016).

Table 3 – Brazilian shares with concentrated dividend payments (n = 113)

	Mean ± standard error	CI (90%)	minimum	pc 25	median	pc 75	maximum
yield	0.049 ± 0.004	0.042; 0.056	0.0004	0.018	0.036	0.068	0.206
d_yield	68.55 ± 62.74	-35.47; 172.57	-1	-0.537	-0.25	0.621	7089.66
div	1.544 ± 0.328	1.000; 2.088	0.000006	0.39	0.886	1.524	28.86
d_div	47.72 ± 43.49	-24.386; 119.83	-1	-0.556	-0.159	0.75	4914.25
yi_d1-d0	-0.007 ± 0.005	-0.015; 0.001	0.0004	-0.032	-0.0002	0.02	0.107

D_preco	0.082 ± 0.035	0.024; 0.140	-0.803	-0.097	0.054	0.219	2.334
Pr-sp	0.024 ± 0.036	-0.036; 0.084	-0.682	-0.196	-0.0007	0.199	2.46

Abbreviations: pc 25: 25th percentile; pc 75: 75th percentile; D_yield: annual yield variation; Div: dividends paid (in Reais); D_Div: annual variation in dividends paid; Yi_D_1-D_0: annual difference between yields; D_price: annual variation in share price; PR_SP: difference between the annual variation in the share price and the respective stock exchange index for the respective year.

Source: survey data

Table 4 – Brazilian shares with diluted dividend payments (n = 50)

	Mean ± standard error	CI (90%)	minimum	pc 25	median	pc 75	maximum
yield	0.116 ± 0.012	0.096; 0.136	0.043	0.07	0.1	0.132	0.548
d_yield	3.96 ± 2.458	-0.162; 8.082	-0.894	-0.014	0.242	1.601	121.11
div	2.254 ± 0.222	1.882; 2.626	0.13	1.203	2.08	2.845	8.722
d_div	2.961 ± 1.66	0.177; 5.745	-0.827	-0.15	0.335	1.125	78.76
yi_d1-d0	0.026 ± 0.016	-0.001; 0.053	-0.49	-0.0002	0.022	0.079	0.342
D_preco	0.067 ± 0.041	-0.002; 0.136	-0.776	-0.081	0.025	0.165	1.207
Pr-sp	0.003 ± 0.037	-0.059; 0.065	-0.805	-0.147	0.051	0.144	0.888

Abbreviations: pc 25: 25th percentile; pc 75: 75th percentile; D_yield: annual yield variation; Div: dividends paid (in Reais); D_Div: annual variation in dividends paid; Yi_D_1-D_0: annual difference between yields; D_price: annual variation in share price; PR_SP: difference between the annual variation in the share price and the respective stock exchange index for the respective year.

Source: survey data

Table 5 – Brazilian shares that paid dividends (n = 163)

	Mean ± standard error	CI (90%)	minimum	pc 25	median	pc 75	maximum
yield	0.07 ± 0.005	0.062; 0.078	0.0004	0.026	0.057	0.101	0.548
d_yield	48.15 ± 43.49	-23.39; 119.691	-1	-0.467	0.069	0.736	7089.66
div	1.761 ± 0.238	1.369; 2.153	0.000006	0.486	1.062	2.08	28.86
d_div	33.59 ± 30.15	-16; 83.187	-1	-0.457	0.067	0.843	4914.25
yi_d1-d0	0.003 ± 0.006	-0.007; 0.013	-0.49	-0.025	0.007	0.03	0.342
D_preco	0.077 ± 0.027	0.033; 0.121	-0.803	-0.094	0.045	0.205	2.334
Pr-sp	0.018 ± 0.027	-0.026; 0.062	-0.805	-0.191	0.011	0.182	2.456

Abbreviations: pc 25: 25th percentile; pc 75: 75th percentile; D_yield: annual yield variation; Div: dividends paid (in Reais); D_Div: annual variation in dividends paid; Yi_D_1-D_0: annual difference between yields; D_price: annual variation in share price; PR_SP: difference between the annual variation in the share price and the respective stock exchange index for the respective year.

Source: survey data

Table 6 – Brazilian shares that did not pay dividends (n = 21)

	Mean ± standard error	CI (90%)	minimum	pc 25	median	pc 75	maximum
yield	0 ± 0	0;0	0	0	0	0	0
d_yield	-1 ± 0.10	-1,172; - 0.828	-1	-1	-1	-1	-1
div	0 ± 0	0;0	0	0	0	0	0
d_div	-1 ± 0.105	-1.181; -0.819	-1	-1	-1	-1	-1
yi_d1-d0	-0.013 ± 0.007	-0.025; -0.001	-0.131	-0.005	0	0	0
D_preco	-0.047 ± 0.12	-0.253; -0.16	-0.694	-0.416	-0.046	0.148	1.741
Pr-sp	-0.218 ± 0.118	-0.421; -0.015	-1.029	-0.55	-0.207	-0.035	1.422

Abbreviations: pc 25: 25th percentile; pc 75: 75th percentile; D_yield: annual yield variation; Div: dividends paid (in Reais); D_Div: annual variation in dividends paid; Yi_D_1-D_0: annual difference between yields; D_price: annual variation in share price; PR_SP: difference between the annual variation in the share price and the respective stock exchange index for the respective year.

Source: survey data

Table 7 – USA stocks with concentrated dividend payments (n = 32)

	Mean ± standard error	CI (90%)	minimum	pc 25	median	pc 75	maximum
yield	0.042 ± 0.003	0.037; 0.047	0.007	0.029	0.045	0.053	0.074
d_yield	0.09 ± 0.104	-0.086; 0.266	-0.776	-0.1	0.003	0.194	2.958
div	1.707 ± 0.281	1.23; 2.184	0	0.113	1.664	3.254	3.801
d_div	0.423 ± 0.262	-0.022; 0.868	-0.717	-0.091	0.004	0.094	6.821
yi_d1-d0	-0.003 ± 0.004	-0.01; 0.004	-0.118	-0.005	0.001	0.009	0.029
D_preco	0.035 ± 0.06	-0.067; 0.137	-0.535	-0.167	-0.034	0.223	0.941
Pr-sp	-0.045 ± 0.068	-0.16; 0.07	-0.804	-0.26	-0.037	0.064	1.136

Abbreviations: pc 25: 25th percentile; pc 75: 75th percentile; D_yield: annual yield variation; Div: dividends paid (in US Dollars); D_Div: annual variation in dividends paid; Yi_D_1-D_0: annual difference between yields; D_price: annual variation in share price; PR_SP: difference between the annual variation in the share price and the respective stock exchange index for the respective year.

Source: survey data

Table 8 – USA stocks with diluted dividend payments (n = 576)

	Mean ± standard error	CI (90%)	minimum	pc 25	median	pc 75	maximum
yield	0.043 ± .0008	0.042; 0.044	-1	0	0.04	0.069	2.813
d_yield	0.007 ± 0.01	-0.01; 0.024	-1	-0.101	-0.025	0.07	2.564
div	1.66 ± 0.037	1.599; 1.721	0	1.054	1.523	2.156	6.579
d_div	0.04 ± 0.007	0.029; 0.052	-1	0	0.04	0.069	2.813
yi_d1-d0	0.0002 ± 0.0006	0.001; 0.003	-0.074	-0.004	-0.001	0.003	0.151
D_preco	0.065 ± 0.009	0.05; 0.08	-0.62	-0.045	0.069	0.18	1.045
Pr-sp	0.0001 ± 0.009	-0.015; 0.015	-0.831	-0.139	-0.015	0.113	1.051

Abbreviations: pc 25: 25th percentile; pc 75: 75th percentile; D_yield: annual yield variation; Div: dividends paid (in US Dollars); D_Div: annual variation in dividends paid; Yi_D_1-D_0: annual difference between yields; D_price: annual variation in share price; PR_SP: difference between the annual variation in the share price and the respective stock exchange index for the respective year.

Source: survey data

Table 9 – USA stocks that paid dividends (n = 608)

	Mean ± standard error	CI (90%)	minimum	pc 25	median	pc 75	maximum
yield	0.043 ± 0.001	0.041;0.045	0	0.033	0.04	0.048	0.179
d_yield	0.011 ± 0.01	-0.006; 0.028	-1	-0.101	-0.023	0.071	2.958
div	1.665 ± 0.038	1.6;1.73	0	1.023	1.523	2.2	6.579
d_div	0.057 ± 0.015	0.031;0.083	-1	0	0.04	0.07	6.821
yi_d1-d0	7.43946E-05 ± 0.0006	-0.001; 0.001	-0.118	-0.004	-0.001	0.003	0.151
D_preco	0.063 ± 0.009	0.048; 0.078	-0.62	-0.053	0.068	0.181	1.045
Pr-sp	-0.002 ± 0.009	-0.017; 0.013	-0.831	-0.141	-0.0152	0.112	1.136

Abbreviations: pc 25: 25th percentile; pc 75: 75th percentile; D_yield: annual yield variation; Div: dividends paid (in US Dollars); D_Div: annual variation in dividends paid; Yi_D_1-D_0: annual difference between yields; D_price: annual variation in share price; PR_SP: difference between the annual variation in the share price and the respective stock exchange index for the respective year.

Source: survey data

Table 10 – USA stocks that did not pay dividends (n = 43)

	Mean ± standard error	CI (90%)	minimum	pc 25	median	pc 75	maximum
yield	0 ± 0	0;0	0	0	0	0	0
d_yield	-1 ± 0.053	-1.088; -0.911	-1	-1	-1	-1	-1

div	0 ± 0	0;0	0	0	0	0	0
d_div	-1 ± 0.05	-1,683; -0.917	-1	-1	-1	-1	-1
yi_d1-d0	-0.007 ± 0.003	-0.012; -0.002	-0.075	0	0	0	0
D_preco	0.111 ± 0.077	-0.017; 0.239	-0.818	-0.193	0.093	0.33	1.595
Pr-sp	0.026 ± 0.073	-0.095; 0.147	-1.057	-0.229	0.015	0.25	1.3

Abbreviations: pc 25: 25th percentile; pc 75: 75th percentile; D_yield: annual yield variation; Div: dividends paid (in US Dollars); D_Div: annual variation in dividends paid; Yi_D_1-D_0: annual difference between yields; D_price: annual variation in share price; PR_SP: difference between the annual variation in the share price and the respective stock exchange index for the respective year.
Source: survey data

Table 11 – German shares with concentrated dividend payments (n = 62)

	Mean ± standard error	CI (90%)	minimum	pc 25	median	pc 75	maximum
yield	0.038 ± 0.003	0.033; 0.043	0.002	0.025	0.034	0.05	0.093
d_yield	0.178 ± 0.124	-0.029; 0.385	-0.767	-0.177	0.013	0.294	7.144
div	1.095 ± 0.11	0.911; 1.279	0.1	0.558	0.85	1.475	3.948
d_div	0.236 ± 0.192	-0.084; 0.556	-0.87	-0.192	0	0.169	11.5
yi_d1-d0	0.001 ± 0.002	-0.002; 0.004	-0.055	-0.008	0.0006	0.015	0.051
D_preco	0.025 ± 0.035	-0.033; 0.083	-0.543	-0.172	0.023	0.203	0.729
Pr-sp	-0.042 ± 0.032	-0.095; 0.011	-0.639	-0.172	-0.027	0.187	0.475

Abbreviations: pc 25: 25th percentile; pc 75: 75th percentile; D_yield: annual yield variation; Div: dividends paid (in Euros); D_Div: annual variation in dividends paid; Yi_D_1-D_0: annual difference between yields; D_price: annual variation in share price; PR_SP: difference between the annual variation in the share price and the respective stock exchange index for the respective year.
Source: survey data

Table 12 – German shares with diluted dividend payments (n = 1)

	D_preco	yield	d_yield	div	d_div	yi_d1-d0	Pr-sp
Mean	0.264	0.082	1.519	2.4	2.429	0.049	0.229

Abbreviations: pc 25: 25th percentile; pc 75: 75th percentile; D_yield: annual yield variation; Div: dividends paid (in Euros); D_Div: annual variation in dividends paid; Yi_D_1-D_0: annual difference between yields; D_price: annual variation in share price; PR_SP: difference between the annual variation in the share price and the respective stock exchange index for the respective year.
Source: survey data

Table 13 – German shares with dividend payments (n = 63)

	Mean ± standard error	CI (90%)	minimum	pc 25	median	pc 75	maximum
yield	0.038 ± 0.003	0.033; 0.043	0.002	0.025	0.034	0.05	0.093
d_yield	0.202 ± 0.121	-0.0002; 0.404	-0.767	-0.163	0.018	0.302	7.144
div	1.116 ± 0.11	-0.068; 0.3	0.1	0.567	0.85	1.497	3.948
d_div	0.274 ± 0.192	-0.047; 0.595	-0.87	-0.188	0	0.176	11.5
yi_d1-d0	0.002 ± 0.003	-0.003; 0.007	-0.055	-0.008	0.0008	0.018	0.05
D_preco	0.029 ± 0.034	-0.028; 0.086	-0.543	-0.168	0.025	0.228	0.729
Pr-sp	-0.037 ± 0.031	-0.089; 0.015	-0.639	-0.167	-0.026	0.187	0.475

Abbreviations: pc 25: 25th percentile; pc 75: 75th percentile; D_yield: annual yield variation; Div: dividends paid (in Euros); D_Div: annual variation in dividends paid; Yi_D_1-D_0: annual difference between yields; D_price: annual variation in share price; PR_SP: difference between the annual variation in the share price and the respective stock exchange index for the respective year.
Source: survey data

Table 14 – German shares that did not pay dividends (n = 6)

	Mean ± standard error	CI (90%)	minimum	pc 25	median	pc 75	maximum
yield	0 ± 0	0; 0	0	0	0	0	0
d_yield	-1 ± 0.224	-1.435; -0.565	-1	-1	-1	-1	-1
div	0	0; 0	0	0	0	0	0
d_div	-1 ± 0.224	-.0,435; -0.565	-1	-1	-1	-1	-1
yi_d1-d0	-0.014 ± 0.004	-0.022; -0.006	-0.024	-0.021	-0.015	-0.008	0
D_preco	0.287 ± 0.09	0.112; 0.462	0.01	0.179	0.338	0.445	0.461
Pr-sp	0.255 ± 0.06	0.138-;0.372	0.162	0.197	0.261	0.32	0.336

Abbreviations: pc 25: 25th percentile; pc 75: 75th percentile; D_yield: annual yield variation; Div: dividends paid (in Euros); D_Div: annual variation in dividends paid; Yi_D_1-D_0: annual difference between yields; D_price: annual variation in share price; PR_SP: difference between the annual variation in the share price and the respective stock exchange index for the respective year.

Source: survey data

The analysis using the Student's t test between companies that concentrate dividends and those that dilute them are shown in table 15. In the group of Brazilian companies, there were only significant differences between yield and annual difference between yields, where, in both cases, the payment was higher among the diluted ones, similar to Silva and Kirch (2020). In the USA group, there was only a difference in dividends, where concentrates paid more, which is in line with hypothesis H_{B1}. There was no difference in terms of price variation in any of the groups. It was not possible to analyze the group from Germany due to the low sample of diluted payments.

Table 15 - Concentrated vs diluted Student t-test

	Brazil	USA	Germany
yield	** higher among diluted ones	NS	NA
d_yield	NS	NS	NA
div	NS	NS	NA
d_div	NS	** greater growth among concentrates	NA
yi_d1-d0	** higher among diluted ones	NS	NA
D_preco	NS	NS	NA
Pr-sp	NS	NS	NA

Abbreviations: D_yield: annual yield variation; Div: dividends paid (in Euros); D_Div: annual variation in dividends paid; Yi_D_1-D_0: annual difference between yields; *: $p < 0.1$; **: $p < 0.01$; NS: non-significant difference. NA: not avaiable; D_price: annual variation in share price; PR_SP: difference between the annual variation of the share and the index of the respective stock exchange for the respective year.

Source: survey data

Table 16 shows the results of the Student's t test carried out between the shares that paid dividends and those that did not. In the Brazilian group, the yield, dividend and price variation corrected by the variation in the IBOVESPA index were statistically higher in the group that paid dividends. There was no difference in relation to asset price variation, yield variation, dividend variation and annual difference between yields. These last three are due to the fact that Brazilian companies are irregular in their dividend payments, with years with dividend payments interspersed with the absence of dividend payments. In the USA group, only in the price variation and in the variation in the yield corrected by the S&P500 index were there no significant differences. In other attributes, shares that paid dividends were superior. In the German group, in turn, it was the only one among the three where there was a difference in relation to price variation, where the group that did not pay dividends had

greater appreciation. The shares that paid dividends had a higher yield, yield variation and dividends than the non-paid group.

Table 16 - Paid versus unpaid Student t-test

	Brazil	USA	Germany
D_preco	NS	NS	* price increased more in the unpaid group
yield	** highest among paid	** highest among paid	** highest among paid
d_yield	NS	** highest among paid	* highest among paid
div	** highest among paid	** highest among paid	** highest among paid
d_div	NS	** highest among paid	NS
yi_d1-d0	NS	** highest among paid	NS
Pr-sp	** highest among paid	NS	NS

Abbreviations: pc 25: 25th percentile; pc 75: 75th percentile; D_yield: annual yield variation; Div: dividends paid; D_Div: annual variation in dividends paid; Yi_D_1-D_0: annual difference between yields; *: $p < 0.1$; **: $p < 0.01$; NS: non-significant difference; D_price: annual variation in share price; PR_SP: difference between the annual variation of the share and the index of the respective stock exchange for the respective year.

Source: survey data

Table 17 shows the results of the statistical analysis, using the Student's t test, between the different countries regarding the concentration or dilution of dividend payments, in addition to the analysis of companies that did not pay dividends.

Among dividend payers concentrated on a maximum of two payment dates in the year, there were no differences between countries regarding variables related to dividends and price. Again, we return to the issue discussed above regarding the high variability of d_yield and d_div, which could even lead to less confidence in the sector and, therefore, a lower appreciation of its assets. However, when compared with price developments in the USA and Germany, no statistically significant differences were found.In the group of payments diluted on more than two dates per year, the yield was higher in Brazilian companies compared to American companies. In turn, the group of American companies showed greater growth in the value of shares compared to the Brazilian group, a fact that disappeared when discounting the variation in the annual index of their respective exchanges. Even so, it can be conjectured that greater regularity and annual amounts of payments could lead to greater demand for this type of asset in the USA and, thus, an increase in its value, compatible with the phenomenon of catering dividends (ARMITAGE, 2012), the same cannot be applied to the Brazilian group, where even with a higher yield among companies with the highest annual number of dividend payments, there was no difference with the group with fewer payments in terms of the appreciation of their shares.

Given the low sample size, no comparison with the group of companies in Germany was possible. Still in the same table, when evaluating together only the events that paid dividends, it was statistically demonstrated that Brazil had a higher yield than the USA and Germany. Furthermore, the Germany group had lower dividends than the Brazil and USA groups. It is evident that different monetary units are being compared here for shares of different values. Finally, when evaluating the events that did not pay dividends, the only statistically significant finding was an increase in the value of German shares in relation to those of the American group after correction by the indices of two respective stock exchanges, which is in line with the results shown in table 16.

Table 17 – Student t test among countries

	yield	d_yield	div	d_div	yi_d_1-d_0	D_preco	Pr-sp
concentrated							
Brazil vs USA	NS	NS	NS	NS	NS	NS	NS
Brazil vs Germany	NS	NS	NS	NS	NS	NS	NS
USA vs Germany	NS	NS	NS	NS	NS	NS	NS
diluted							
Brazil vs USA	Higher in Brazil*	NS	Higher in Brazil*, em unidades monetárias	NS	NS	Higher in USA*	NS
Brazil vs Germany	NA	NA	NA	NA	NA	NA	NA
USA vs Germany	NA	NA	NA	NA	NA	NA	NA
paid							
Brazil vs USA	Higher in Brazil *	NS	NS	NS	NS	NS	NS
Brazil vs Germany	Higher in Brazil *	NS	Higher in Brazil *	NS	NS	NS	NS
USA vs Germany	NS	NS	Higher in USA *	NS	NS	NS	NS
unpaid							
Brazil vs USA	NS	NS	NS	NS	NS	NS	NS
Brazil vs Germany	NS	NS	NS	NS	NS	NS	NS
USA vs Germany	NS	NS	NS	NS	NS	NS	Higher in Germany*

Abbreviations: pc 25: 25th percentile; pc 75: 75th percentile; D_yield: annual yield variation; Div: dividends paid; D_Div: annual variation in dividends paid; Yi_D_1-D_0: annual difference between yields; D_price: annual variation in share price; PR_SP: difference between the annual variation of the share and the index of the respective stock exchange for the respective year; *: $p < 0.1$; NS: non-significant difference; NA: not avaiable.
Source: survey data

5. FINAL CONSIDERATIONS

This study aimed to look for differences in the policy of payment of share dividends in companies in the electricity sector in Brazil, the United States and Germany given that their tax legislation on the subject is different from each other. The findings of greater dilution of dividend payments in the USA may be related to the legal framework based on common law and which, according to LaPorta et al (2000) and Ferris et al (2010), is used as a form of greater protection for minority shareholders. Armitage's (2012) theory of catering dividends was also able to justify some differences found between countries, such as the greater appreciation of assets in the USA compared to Brazil in terms of dividends with diluted payments.

Future perspectives include the study of other countries, especially those where the legislation on dividend taxation is different from that demonstrated by the countries described in this work. Furthermore, other aspects such as concentration of dividend payments and share splits can be very promising topics of study.

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