THE LEVEL OF LEVERAGE AS A CONDITION FOR THE REGULATORY CAPTURE PROCESS IN PUBLIC UTILITY SECTORS

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▪ Received: 01/03/2023 ▪▪ Approved: 12/19/2023

ABSTRACT

The aim is to investigate whether the level of leverage conditions the regulatory capture process in public utility sectors in Brazil. From a capture perspective, regulation can be captured by the regulated and some aspects of the company, such as leverage can be used by the regulated to pressure the regulator for regulatory decisions favorable to their interests. The sample consisted of companies regulated by price, belonging to the sectors of sanitation, piped natural gas and electricity, in the period from 2007 to 2019. The variables used were: abnormal return (dependent), tariff change, leverage, (independent) and ownership, economic growth, size and sector (controls). The results suggest that the level of leverage, strategically used by the regulated, can enable regulatory decisions that are more favorable to the interests of companies. It was observed that the capture is not generalized, because the tariff change does not explain the abnormal return in an isolated way, but an indicator such as leverage can lead to the capture of the regulatory process.

Keywords: Regulatory process. Leverage. Abnormal return. Public utility.

O NÍVEL DE ALAVANCAGEM COMO CONDICIONANTE DO PROCESSO DE CAPTURA REGULATÓRIA EM SETORES DE UTILIDADE PÚBLICA

RESUMO

O objetivo consiste em investigar se o nível de alavancagem condiciona o processo de captura regulatório, em setores de utilidade pública no Brasil. O captura regulatória ocorre quando os agentes regulados influenciam o órgão regulador para obterem vantagens em suas decisões. Nesse contexto, alguns aspectos da empresa, como o grau de alavancagem, podem ser utilizados como

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instrumentos de pressão sobre o regulador, visando favorecer seus interesses particulares. A amostra foi composta por empresas reguladas por preço, pertencentes aos setores de saneamento, gás natural canalizado e energia elétrica, operando no Brasil, de 2007 a 2019. As variáveis utilizadas foram: retorno anormal (dependente), mudança tarifária, alavancagem (independentes) e propriedade, crescimento econômico, tamanho e setor. Os resultados sugerem que o nível de alavancagem, usado de forma estratégica pelo regulado, pode possibilitar decisões regulatórias mais favoráveis aos interesses das empresas. Observou-se que a captura não é generalizada, porque a mudança tarifária não explica o retorno anormal de forma isolada, mas indica como a alavancagem pode conduzir a captura do processo regulatório, por meio da mudança tarifária.

Palavras-chave: Processo regulatório. Alavancagem. Retorno anormal. Utilidade pública.

1 INTRODUCTION

Economic regulation aims to balance relations between agents, consumers and producers, in accordance with the legislation that established sectoral economic regulatory agents in Brazil. The regulation of monopolistic markets, through sectoral economic regulatory agencies, was the means found by the State to facilitate, among other aspects, the correction of market failures. In this sense, regulatory agencies were established in several economic sectors, including: electricity, water and sanitation and piped natural gas, sectors that are the object of analysis of this study and, naturally, constitute agents that are part of the Brazilian regulatory system.

In order to alleviate monopoly power related to public services, market regulation is considered a protection strategy that defends consumers against a monopolist (Martin, Vázquez, Hallack, & Brignole, 2019). According to Laffont and Tirole (1991), the main objective of a regulatory system is to protect consumers from the abuse of economic power and to provide regulated agents with protection against arbitrary political actions. Within the system, the regulatory process imposes some attributions on regulators, such as controlling the quality of service provision and issuing standards, in addition to ensuring the economic and financial balance of the sector with regard to tariff moderation, that is, the minimum tariff to be charged to consumers.

Tariff moderation involves determining, reviewing, and readjusting the minimum tariff to be charged to consumers, requiring authorization from the regulatory agent to be charged, which implies increasing the price of the service. In theory, the permitted regulated price must, at the same time, provide a fair return to investors for the risks of the activity they finance, and not allow consumers to be exploited, especially due to the characteristic of a natural monopoly, when there are few suppliers of a given service.

In practice, the regulatory process, which seeks to reconcile the interests of the parties involved, which are usually conflicting interests, is often a difficult exercise to carry out. The regulator must ensure the economic and financial balance of companies in the sector, seeking to maintain alignment between the company's return and its cost of capital and, at the same time, social well-being

(via affordable tariffs). It is important to note that a rate of return that is much higher than the cost of capital inappropriately penalizes consumers, while a rate of return below the cost of capital inappropriately discourages additional investment (Sirtaine, Pinglo, Guasch, & Foster, 2005), which may compromise the provision of the service. In this study, the abnormal return consists of the distance between the return on capital (ROIC) and the weighted average cost of capital (WACC).

Regulatory agencies, as regulatory bodies linked to the State and with institutional powers, must ensure the balance of interests between the parties and be exempt from capture of the regulatory process by the regulated agents. However, regulated companies, due to the distributive attributes of regulation, should not behave passively in the regulatory process, and it is expected that they will seek ways to capture the regulatory process to obtain greater returns (Savoia, Securato, Bergmann, & Silva, 2019).

The active behavior of regulated companies can be based on the idea of economic rationality, in which managers of regulated companies are maximizers of the companies' profitability and, with this function, will seek ways to increase returns; returns are dependent on the administered price and the reviews and adjustments of these prices; and, in the regulatory process, regulators have the power to determine, review, and readjust administered prices. The combination of these characteristics is a likely motivation for regulated companies to seek ways to capture the regulatory process, through the administered price (tariff change).

Regulation, from a normative perspective, should be provided in response to public demand for the correction of inefficient or unequal market practices (Stigler, 1971), from the perspective of public interest. On the other hand, from the capture perspective, regulation tends to favor producers (regulated), economically stronger agents, who capture regulation as a way of protecting their interests; and in the theory of interest groups, the group that manages to exert greater pressure on the regulator will have its interests met in the regulatory process.

Due to the existence of conflicts over the results of regulation that maximize the individual interests of the parties: consumers will tend to pressure the regulator for lower tariffs and higher quality of services; and companies will seek larger tariff adjustments from the regulator, which absorb costs and increase their returns. In view of this, some characteristics may have potential influence, moderating the relationship between the outcome of the regulatory process (tariff change) and the profitability (abnormal return) of regulated companies, such as the level of leverage, which is measured based on accounting concepts.

Regulated companies generally have a high and persistent level of leverage, compared to the level of leverage in most economic sectors. Bortolotti, Cambini, Rondi and Spiegel (2011) and Cambini and Rondi (2011) suggest that regulated companies strategically exploit the level of leverage to obtain better economic results through the regulatory process. In this sense, it is possible that financial leverage is used as a moderator, which pressures the regulator for higher administered prices and, consequently, can lead to greater economic returns for the company.

The abnormal economic return of price-regulated companies partly reflects the performance of the regulator's decisions, which may be biased towards the interests of the regulated companies, from the perspective of regulatory capture and interest groups. When the tariff price is overestimated, the result of the price change (determination, review and readjustment) represents an advantage to the regulated companies (Tapia, 2012) and signals signs of regulatory capture, in which the regulated companies exploit the dynamics of the regulatory process to obtain higher abnormal returns. Overestimation implies higher tariff changes, which will be absorbed by consumers and will represent a distancing from the regulator's commitment to tariff affordability.

In view of the contextualization conducted so far, this paper intends to answer the following research question**: what is the effect of the level of leverage on the relationship between tariff change and abnormal return in a public utility company in Brazil?** The objective is to investigate whether the level of leverage conditions the process of regulatory capture in public utility sectors in Brazil.

In the regulatory process, the regulator's decisions can be criticized by society, especially when the decisions involve increasing the administered price. As a result, the legitimacy of the agency's decisions is questioned, suggesting that the regulator has been making decisions that are biased towards the interests of companies. Empirically, based on scientific evidence, this argument is not found in the literature, considering the relationship between the change in the administered price and the abnormal return, and this relationship is conditioned (moderated) by the level of leverage.

Economic regulation is necessary in natural monopoly sectors. Despite the existing literature, there is no consensus on whether consumers benefit from the dynamics of the regulatory process (Sarkar, 2016) and the extent of this benefit. In the particular case of the public utility, water and sanitation, and piped natural gas sectors, these sectors have been impacted by the approval and discussion of new legal frameworks. Therefore, the empirical results provide information to future private investors (sanitation and gas sectors) on the relationship between the decisions taken in the regulatory process and the return on investments made by companies in these sectors.

In order to achieve the specificity of this study, some delimitations were inserted: a) the attributions of regulatory agencies involve other actions in addition to the regulation of administered prices (tariff changes). However, in the decisions taken in the regulatory process, only the determination, review, and adjustment of tariffs were considered. It is important to note that consumer welfare is a broad concept and involves several aspects, such as: quality of service provided, universalization, price charged for the service, among others. However, this study was limited to consumer welfare based on the dimension of increase or reduction of the tariff price; b) economic regulation occurs in several branches of economic activities, but it is in the sectors of electric power (distribution), sanitation and piped natural gas that price changes require regulatory decisions; c) the outcome of the regulatory process is not a settled issue. In this regard, based on the literature, this study only considered the level of leverage as a condition.

2 LITERATURE REVIEW

2.1 Regulatory theories

Regulatory theory focuses on three approaches: public interest theory, capture theory, and interest group theory.

Economic regulation consists of government intervention in the market. One assumption is that economic markets are extremely fragile and likely to operate very inefficiently (or unequally) if left alone (Posner, 1974). Public interest theory posits how government intervention in the economy through regulation should work. The agents involved in the regulatory process (politicians/regulators) should act to promote the vision of the public interest or need (Levine & Forrence, 1990). From this perspective, regulation is the necessary exercise of collective power, through government, to correct market failures and protect the public from harms such as: monopolistic behavior, destructive competition, abuse of private economic power, or the effects of externalities.

Stigler (1971) challenged the idea that regulation arises only to serve the public interest, and demonstrated that important political advantages held by companies can contribute to the capture of the regulatory process by the regulated industry. Regulation is a product that, like any other, is produced in a market and can be purchased from the government "market" by companies to serve their private interests (Stigler, 1971).

For Potter, Olejarski and Pfister (2014), capture exists when a regulatory agency uses its power to benefit the regulated industry rather than in the public interest. Regulators that consistently favor the industry, even agencies with a dual purpose of promoting an industry and protecting the public, fail to serve this sense of public interest. In other words, since the typical private interest of a regulated industry is to avoid strict regulations (Shapiro, 2012), an agency that consistently serves this private interest is not supporting the public interest (Rex, 2018). Regulated companies have incentives to capture regulation because they know that decisions made by the regulator potentially have significant impacts on the industry and, consequently, on the company's results.

According to Mitnick (1980) cited by Walkern (1987), there are at least five ways in which a regulated entity or industry can capture a regulatory body. Capture is said to occur:

(a) whether the interest of the regulated party controls the regulation and the regulatory agency; (b) whether the regulated parties are able to coordinate the activities of the regulatory body with their activities so that their private interest is satisfied; (c) whether the regulated party is able to neutralize or ensure non-performance (or mediocre performance) by the regulatory body; (d) whether, in a subtle process of interaction with the regulators, the regulated party is able (perhaps not even deliberately) to co-opt the regulators to see situations from its own perspective and thus give them the regulation they desire; or (e) whether, quite independently of the formal or conscious desires of the regulators or the regulated parties, the basic structure of the reward system does not lead to regulators who are inept at the interests of the regulated party.

Capture theory singles out a specific interest group (regulated firms) as predominant in influencing regulation and predicts a regular sequence. Interest group theory, in contrast, assumes that groups will form to protect specific economic interests. Different groups, with incompatible or mutually exclusive interests and objectives, are often seen as in conflict with each other and pressure the government or other regulators to create legislation that benefits them economically (at the expense of the other) (Deegan & Unerman, 2011). The group that can exert greater relative pressure than the other interest groups will probably obtain the regulation that meets their demands (Cardoso, Saravia, Tenório, & Silva, 2009).

The pressure from each group reduces the influence of the other group and, in this way, partially or fully offsets the effect of the pressure from the other group (Becker, 1983). From this analogy, it is possible to see regulation as a pendulum, subject to different pressures, for example: consumers can pressure the regulator for price protection (lower tariffs) and producers (regulated companies) pressure the regulator for tariff protection (higher tariffs). From the perspective of interest groups, regulators will act to transfer wealth from individuals with low levels of regulatory influence to agents with high levels of regulatory influence, with the ability to co-opt the regulator to have their demands met.

Although the regulatory process may sometimes favor consumers and sometimes producers, depending on the relative strength of their desires and their relative capabilities to marshal resources, its outcomes are never undesirable (Taggart, 1985). Of particular interest to this study, Peltzman (1976) infers one such set of fluctuating but nonetheless intentional outcomes from his model, in which regulation will tend to be more strongly oriented toward consumer protection in booms and toward producer protection in busts. It is in this sense that more leveraged firms, exposed to greater financial risk, will be able to pressure the regulator for regulation favorable to their interests.

2.2 Regulatory process

Regulation is understood as the deliberate action to define criteria and operating conditions for economic and social activities, in order to align private interest with public interest (Cunha, 2016). Economic regulation refers to restrictions on prices, quantity, and entry and exit conditions for specific sectors, such as ANEEL regulations.

Regulatory agents must use their regulatory intervention capacity to balance divergent interests by using their moderating power over the relationship between companies and consumers of services. In the regulatory process, determining the tariff to be charged to consumers is one of the main points of divergence, and directly impacts the abnormal return of companies and the moderateness of tariffs (definition of the minimum tariff required to be charged to the consumer).

Natural monopoly is the reality in some sectors, consequently, prices require some regulation. The objective of the regulator in these processes is to determine fair tariffs for consumers and concessionaires, at a level close to the prices that would be found in a competitive market (Brandão et al., 2021). The definition of tariff prices involves several variables, but the purpose should be to balance the

fair price charged to consumers and the normal return of the company, which ensures the maintenance, expansion and improvement of the quality of services. Regulators must protect consumers from abusive prices and, at the same time, ensure that investors have incentives to invest and maintain service production facilities (Rocha, Camacho, & Braganca, 2007; Sarkar, 2016).

The result of price regulation, in a scenario free from bias and pressure from interest groups, establishes a balance between consumer interests and investor interests. The balance must provide for a synergy between the administered price and capital costs throughout the tariff change interval, in order to reconcile the economic and financial balance of companies with tariff affordability. However, considering that company managers seek to maximize their profitability, it is expected that regulated agents will not behave passively within the regulatory process, but will explore ways to co-opt the process to serve their interests.

2.3 Basis of the research hypothesis

Based on the differences in the capital structure between regulated and non-regulated companies, some studies have emerged on the capital structure of regulated companies. The price-influence effect advocated by (Taggart, 1981) indicates that the effect is specific to companies operating in regulated sectors and depends on the company's ability to exploit the regulatory process to its advantage, based on the use of the capital structure. The main purpose of Taggart's (1985) article referred to predictions about changes in the capital structure that result from the change to a regulated environment, considering the public interest theory, the theory of interest groups and imperfect monitoring.

Taggart (1985), when interacting regulatory theories with capital structure theories, regarding the relationship between price, profit and leverage, argues that:

a) according to the trade-off theory, agents can exploit the capacity of debts to achieve objectives strategically. In this sense, the effect of financing on public interest regulation depends on its impact on the costs associated with debt. If these costs vary directly with the concessionaire's profits, public interest regulation will reduce the company's ability to take on debt (leverage) (Taggart, 1985).

b) from the perspective of interest groups, price and profit may increase due to the regulated company's ability to exploit the leverage level to its advantage. Similarly, in imperfect monitoring, in which the company is able to manipulate the regulatory process to its advantage, due to aspects of information asymmetry, price and profit may increase due to the company's ability to take on debt (Taggart, 1985).

The rationale is that regulated firms may issue debt to induce regulators to set a relatively high price in order to minimize the risk of the firm experiencing financial distress (Cambini & Spiegel, 2012; Spiegel, 1994; Spiegel & Spulber, 1994). When the firm is more leveraged, a sufficiently negative cost shift can result in a costly financial distress. The regulator therefore faces a trade-off between setting a low price that benefits consumers and a high price that minimizes the likelihood of financial distress (Cambini & Spiegel, 2016). Although evidence has shown that

regulation results in higher leverage, the risk of bankruptcy decreases (Sarkar, 2016), in part due to industry aspects such as low or no competition.

According to the model of Dasgupta and Nanda (1993), firms may be able to use debt to increase their bargaining power vis-à-vis consumers. An important prediction of the model is that firms in more hostile regulatory environments would tend to rely more heavily on debt financing. This is contrary to the view that stricter regulatory environments are associated with lower profits for regulated firms, and therefore they would choose to carry less debt in order to reduce the expected costs of bankruptcy. The authors empirically tested this model in electric utilities in the United States for the sample period 1972-1983, and found that the findings point to the strategic use of debt, since the greater use of debt in more hostile environments suggests that firms may use the proportion of debt to combat regulatory hostility.

Some studies have investigated the interaction between leverage and the price administered by the regulator, and have found evidence that the level of leverage has an effect on the regulatory tariff (Bortolotti et al., 2011; Cambini & Rondi, 2011; Cambini & Spiegel, 2016; Dasgupta & Nanda, 1993; Klein, Phillips, & Shiu, 2002). Public utilities have the highest debt levels (Campos & Lamounier, 2022). Firms subject to price regulation have higher leverage – a result that remains consistent using two different measures of leverage and several measures of regulatory stringency (Klein et al., 2002). Klein, Phillips, and Shiu (2002) and Spiegel and Spulber (1994) argue that the lack of equity in the company mitigates the regulator's opportunism to reduce the tariff price, and increases the regulator's commitment by allowing structures with higher tariffs.

In addition, unlike companies in unregulated and competitive industries with a low concentration index, abnormal returns increase with leverage in concessionaires (regulated industries) (Muradoğlu & Sivaprasad, 2012). Based on the previous discussions, the objective of companies guided by the concept of profitability (abnormal return); the abnormal return of these regulated companies is affected by the tariff change in the regulatory process; and that the tariff change can be influenced (moderated) by the level of leverage. In view of this, the hypothesis argues that: the level of leverage is a conditioner of the positive relationship between tariff changes and abnormal returns of regulated companies.

3 METHODOLOGICAL PROCEDURES

3.1 Sample and variables

The sample consisted of sectors with monopolistic characteristics, regulated by administered prices, namely: water and sanitation, piped natural gas, and electricity. The choice of the 2007 to 2019 range was made considering the availability of data, so that when regressing in time, the unavailability of data increases. Regarding data collection, companies with negative equity were excluded, since discontinuity implies differentiated accounting treatment and, therefore, these companies are not comparable with the others.

The unbalanced sample consisted of 110 companies, 21 of which were piped natural gas, 27 of water and sanitation (sanitation), and 62 of electricity. After the data collection process, the sample was distributed as shown in Figure 1.

Regulator	**State**		**ANEEL**	**Total**
Sector	Natural gas	Sanitation	Electric energy	3
Number of companies	21	27	62	110
All Observations	273	340	806	1,419
(–)Companies/year without data	(63)	(50)	(180)	(293)
(=) Companies/year with data	210	290	626	1,126
(–) Companies/year with negative equity	0	(20)	(63)	(83)
(=) Companies/year with positive net worth	210	270	563	1,043
Observation with return less than or equal to the weighted average cost of capital	75	220	229	524
Observation with return higher than the weighted average cost of capital	135	50	334	519
Annual average of companies after exclusions	17	21	44	82

Figure 1 – Sample by sector and year, from 2007 to 2019
Source: Own elaboration.

Since most companies are privately held, a structured database was not used to collect all the data. Financial and operational data were collected from the company's or regulatory agency's website; data was also requested based on the Access to Information Act or from government agencies' websites between August 2020 and March 2021. Market data, sector beta, was collected from the Economatica® database. Economic growth data, gross domestic product (GDP) growth, was collected from the Brazilian Institute of Geography and Statistics (IBGE) website.

Data from the water and sanitation sector was collected from the companies' websites, in environments such as: financial statements, financial reports, annual reports, financial statements or investor relations. In these environments, financial data was collected, such as: total assets, investments, net equity, debts, revenues, costs, operating expenses, operating income, financial expenses and net income.

Data on companies in the electric power sector were collected from ANEEL's website, in the Economic and Financial Oversight environment. In this environment, financial and operational data from companies were collected in financial reports prepared in accordance with current Brazilian Accounting Standards and in annual reports. Data on companies in the piped natural gas sector were initially collected from the companies' websites. If any data were not available, this was requested via the Access to Information Act (LAI).

Data collection regarding tariff changes (reviews or adjustments) was carried out in several environments: company websites, regulator websites, and company annual reports. Some companies did not have all the data necessary

for the research regarding tariff changes available. In these cases, the data were requested via the Access to Information Act (for the three sectors).

The three main variables of the research are tariff changes (independent), abnormal returns (dependent), and leverage levels (moderator):

a) Theoretical models vary immensely, but the possibilities for measuring influence and capture are more restricted (Lima & Fonseca, 2021). Among those that are willing to empirically identify capture, the most frequent measurement strategies in the literature are: corruption measures; campaign financing tracking; and trajectory mapping (mapping the trajectories of leaders to assess the "revolving door" phenomenon (Dal Bó, 2006). However, one of the main points of conflict, in the search for a balance of interests between regulated companies and service consumers, is the change in tariffs.

Tariff changes can be considered the most direct representation of the transfer of consumer resources to the regulated company, as a result of a regulatory decision. The regulatory agent assumes the role of arbitrator to balance the relationship between the consumer and the regulated company, and should essentially seek an appropriate tariff level to ensure the economic and financial balance of the companies and, at the same time, tariff moderation (definition of the minimum necessary tariff). Therefore, periodic tariff review (RTP) or annual tariff adjustment (RTA) are the products of regulation and mechanisms that moderate the relationship between the consumer and service concession companies.

The indicator of regulatory capture was modeled by the proxy periodic tariff review of company i at time t (RTP_{it}) or annual tariff adjustment of company i at time t (RTA_{it}), controlled by the average periodic tariff review price of sector s at time t (RTP_{st}) or by the average annual tariff adjustment price of sector s at time t (RTA_{st}). The review or adjustment of the company and the sector converge to the abbreviations Tar_{it} and Tar_{st}, respectively. The result of this moderation was called $Tariff_{it}$, which is the tariff change of company i at time t, adjusted by the average tariff change of sector s at time t, as shown in Figure 2; and also, for the purposes of estimating the econometric models, it was called Tariff.

Another characteristic identified in the three sectors was the tariff change period, which occurs in different months within the year, but the financial, market and operational data follow the calendar year. To correct this mismatch, the tariff change was controlled by the number of days in the year before and after the tariff change, based on the annual period. For example, the Basic Sanitation Company of the State of São Paulo (Sabesp), on July 9, 2018, increased the tariff by 3.51%, and on May 11, 2019, adjusted the tariff by 4.72%. The tariff change for company i (in this case, i is Sabesp) attributed to the 2019 period was obtained as follows: the tariff change in t-1 divided by 365 days, multiplied by the number of days in t (in this case, t is the year 2019) before the tariff change [(3.51% / 365) * 130], called $TARIF_{it-1}$; plus the tariff change in t divided by 365 days, multiplied by the number of days in t after the tariff change [(4.72% / 365) * 235], called $TARIF_{it}$. Therefore, the adjusted price of the tariff change at Sabesp, attributed to the 2019 period, was 4.29%, called Tar_{it}, as can be seen in Figure 2.

b) According to Sirtaine et al. (2005) and Brandão et al. (2021), an appropriate regulatory practice should align the company's rate of return with the

cost of capital in the medium term. An excessive rate of return penalizes consumers, while a low rate of return discourages investments. According to Santos (2006), to measure how much value has been added to shareholders' equity, it is necessary to establish a direct relationship between the invested capital and the spread (ROIC and WACC). As a rule, investments will create value for their owners whenever they generate ROIC higher than WACC. Otherwise, they will destroy value, reducing the owners' wealth, since the return generated is insufficient to meet investors' expectations in the face of similar risks (Santos, 2006).

In this research, the abnormal return (Ret) corresponds to the distance between the rate of return on invested capital and the weighted average cost of capital for the observation period (t). The return of companies consisted of the return on invested capital (ROIC). The return was controlled by the weighted average cost of capital (WACC). The WACC was used with a threshold of return on capital greater or less than the weighted average cost of capital, since the WACC represents the return expected by investors. The variable Ret refers to the return on total capital that is abnormal in relation to the weighted average cost of capital, that is, the creation of value. In this study, Ret is called the abnormal return, which represents the return on capital that is greater or less than the weighted average cost of capital, during the observation period (t).

Variable	Metrics		Base Authors
Abnormal return *(Ret)*	ROIC	$ROIC = \frac{EBIT(1 - tax\ rate)}{(Loans, financing, debentures + Equity)}$	Santos, (2006), Sirtaine et al. (2005)
	WACC	$WACC = \left[Ke.\frac{E}{E+D}\right] + \left[Kd\ .(1 - tax\ rate).\frac{D}{E+D}\right]$	
	$Ret = \frac{ROIC}{WACC}$		
Tariff change *(Tariff)*	$Tar_{it} = TARIF_{it-1} + TARIF_{it}$		
	$Tariff_{it} = \frac{Tar_{it}}{Tar_{st}}$		
Leverage (*Lev)*	$Lev = \frac{Onerous\ Liability}{Total\ Assets}$ Onerous liabilities (loans, financing and debentures, in the short and long term) and total assets.		Albanez e Valle (2009), Machado, Medeiros e Eid Júnior (2010).
Property *(Pro)*	It consists of a dummy attribute assigning 1 (one) to the privately owned company and 0 (zero) otherwise. If private investors have more than 50% of the voting shares, the characteristic of a privately owned company was assigned.		Dewenter e Malatesta (2001), Romano e Guerrini, (2014).
Economic growth *(Gdp)*	Gross domestic product, measured by the annual percentage growth of the country's GDP.		Macher e Mayo (2012), Reynaud e Thomas (2013).
Size (*Tam/Inv*)	Natural logarithm of operating investments (fixed and intangible assets).		Guerrini, Romano e Campedelli (2011), Pamplona,

		Mazzuco e Silva (2019).
Sector of activity (*Sector)*	Economic sector in which the company operates, measured by dummy.	Macher e Mayo (2012).

Legend: EBIT = earnings before interest and taxes. D = total volume of third-party capital at book value; E = total volume of equity at book value; E + D = total volume of capital; Ke = industry cost of equity (annual percentage); Kd = company cost of equity (annual percentage); and Tax = corporate income tax rate of 34%. The company and industry review or adjustment converge to the abbreviations Tar_{it} and Tar_{st}, respectively. TARIF refers to the annual tariff adjustment or review weighted by the number of days the tariff was in effect in the period.

Figure 2 – Model variables and variable metrics
Source: prepared by the author, based on references.

The WACC (and the CAPM - Capital Asset Pricing Model) has become the methodology of choice for major regulatory agencies worldwide (Savoia et al., 2019). In cases where the company's shares are not traded on a stock exchange, betas from shares of comparable companies can be used (Sanvicente, 2012). Considering that most of the companies included in the research do not have shares traded on a stock exchange, it was decided to use the calculation of the cost of equity (Ke) based on the comparable beta methodology. This methodology was operationalized with the average unlevered beta of the sector and subsequently relevered with the financial data of the sample company. In this case, the comparable beta was the average periodic beta of the sector. The cost of third-party capital (Kd) consisted of the ratio between the debt burden and the sum of onerous liabilities, loans, financing and debentures, short and long term.

c) The Lev indicator refers to the strategic use of debt through the company's management's preference for financing its activities with third-party capital; and this indicator was obtained by dividing the onerous liabilities, which consist of loans, financing and debentures, in the short and long term, by the total assets (amount of investments), as per the information in Figure 2.

To control the effect of tariff changes on companies' abnormal returns, capital ownership (Pro), company size (Size), economic growth (Gdp) and the company's economic sector of operation (Sector) were used, as described in Figure 2.

3.2 Econometric models and analysis of hypotheses

The model investigated the relationship between the abnormal return and the change in the tariffs of the most leveraged companies. The research hypothesis is analyzed using Equation 1.

$$Ret_{it} = \alpha + \beta_1 Tariff_{it} + \beta_2 Lev_{it} + \beta_3 Tariff_{it} * Lev_{it} + \sum_{c=1}^{3} \phi Controls + \sum_{i=2}^{3} Sector + \varepsilon_{it}$$

Equation (1)

Where: Ret_{it} = abnormal return of firm i at time t; $Tariff_{it}$ = tariff change of firm i at time t; Lev_{it} = leverage of firm i at time t; $Tariff_{it} * Lev_{it}$ = interaction

between the variable $Tariff_{it}$ and the variable Lev_{it} of firm i at time t; Controls: Pro_{it} = ownership of firm i at time t; Gdp_t = growth of the country's gross domestic product (in %) at time t; $Size_{it}$ = investment in operating assets of firm i at time t; $\sum Sector_i$ = economic sector in which firm i operates; and ε_{it} = error term of company i at time t. The coefficient of the variable Tariff interacted with Lev (β_3) is expected to be positive and significant (the relationship between tariff change and abnormal return differs depending on the level of leverage).

Initially, the model was estimated in an unbalanced panel with random effects (generalized least squares method (GLS)). Subsequently, sensitivity to endogeneity was performed using the GMM-SYS estimator with all observations. The GMM-SYS estimator is particularly useful when the researcher does not have instrumental variables external to the model and/or quasi-experimental contexts (Barros; Bergmann; Castro; Silveira, 2020), to control simultaneity, for example.

Models using the GMM-SYS estimator are composed of variables considered endogenous and exogenous. The exogenous variables were used as controls and serve to instrument the equation at the level, and the endogenous variables were instrumented by their lags. The variables Tariff, Pro, Gdp and Sector were treated as exogenous, while the variables Lev and Size (Ati and Inv) were treated as endogenous. The variable Pro measures the identity of the owner of the capital and the entity (company) represents the private agent that received the capital, for this reason Pro was treated in the model as exogenous.

4 ANALYSIS AND INTERPRETATION OF RESULTS

4.1 Descriptive presentation of data

Table 1 shows the descriptive statistics of the variables, such as: mean, median, standard deviation, maximum and minimum values of each variable, and the number of observations.

The dependent variable Ret, resulting from the division of ROIC by WACC, in the descriptive statistics of Table 1, was divided into two groups: companies with Ret greater than 1 (ROIC>WACC) and companies with Ret less than or equal to 1 (ROIC≤WACC). The variables (Ret, Tariff, Tariff*Lev and Tar) of the two groups were subjected to the Wilcoxon test. The results indicate the existence of statistically significant differences between the two groups in the variables Ret, Lev, Tariff*Lev and Tar.

Considering the dependent variable Ret, it is expected that the higher the ROIC in relation to the WACC, the higher the abnormal return; and when the variable Ret is equal to 1, it means that the return on invested capital is equal to the weighted average cost of capital. In Table 1, Ret has a mean of 1.0963 and a median of 1.004, which indicates that, on average, companies are able to obtain a return greater than the cost of capital. The standard deviation of 1.6769 and the dispersion in the range of -6.02 and 8.56 reveal that some companies have a negative return, while others can have a return eight times greater than the weighted average cost of capital.

Table 1
Descriptive statistics of variables: all observations

Continuous variables	Observations	Mean	Median	Standard deviation	Minimum	Maximum	Wilcoxon Test
Ret	1,037	1.0963	1.004	1.6769	-6.02	8.56	19.68 (0.000)
Tariff	1,021	0.9358	0.968	2.4967	-9.49	9.65	1.43 (0.1519)
Lev	1,039	0.2130	0.184	0.1831	0	0.82	6.46 (0.000)
Tariff*Lev	1,019	0.1934	0.123	0.7747	-4.64	5.18	2.14 (0.0318)
Gdp	1,043	1.5629	1.14	3.1061	-3.55	7.53	-
Ati (Size)	1,028	8.8790	9.087	1.0561	4.19	12.45	-
Inv (Size)	1,035	8.4722	8.799	1.1283	1.72	10.53	-
Tar	1,024	7.5540	6.531	9.3791	-25.02	58.25	-3.043 (0.002)
Binary variable							**Percentage**
Pro (private propriety)							52.49%
Pro (public property)							47.51%

Legend: abnormal return (Ret); tariff change (Tariff); leverage (Lev); ownership (Pro); economic growth (Gdp); asset size (Ati); investment size (Inv); and tariff before adjustment for annual industry average (Tar).
Source: Prepared by the authors.

One of the main independent variables analyzed is the tariff change, obtained by weighting the company's tariff change by the average annual tariff change of the sector, from the perspective that the higher its value, the greater the change in the company's tariff in relation to that of the sector. Considering Table 1, the values of the Tariff variable have a mean of 0.9358 and a median of 0.968, indicating that, on average, companies have tariff changes that are smaller than the average change value in the sector; and half of the companies experience tariff changes that are smaller than the average value in the sector. The dispersion found is from -9.49 to 9.65, with a standard deviation of 2.4967, and was treated by the winsorization technique of 1.5% at each extremity.

The financial leverage of companies is used as an interacted variable, according to the econometric models (Equations 1), from the perspective that the higher the value of the indicator, the higher the company's leverage. According to Table 1, leverage has an average value of 0.2130 and a median of 0.184. The values considered low may be due to the fact that some companies in the piped natural gas sector had low onerous liabilities or no one. The leverage level data range from 0 to 0.82, with a standard deviation of 0.1831, and were treated by the winsorization technique at 0.86% at each end with outliers. According to the descriptive statistics of Gallardo and Teixeira (2023), with energy and sanitation companies in the period 2004 to 2016, the general debt, on average, was 0.3, standard deviation of 0.19 and range from 0 to 0.846.

4.2 Relationship between abnormal return, tariff change and leverage

The analysis of this relationship is based on the assumption that the level of leverage can be a determining factor of the positive relationship between tariff changes and abnormal returns of regulated companies. Therefore, the analysis of the data presented in Tables 2 and 3 focuses mainly on the coefficient β3, which indicates whether the relationship between tariff change and abnormal return has no difference due to the level of leverage or whether there is a significant difference.

The model was estimated using an unbalanced panel with random effects, with sector control. Table 2 presents the results of the estimated model, the assumptions and the specification tests. The estimation of the random effects model, generalized least squares method (GLS) was considered valid for the analysis of the hypothesis using Wald's chi-square. The random effects panel was estimated with the response variable Ret, the predictor variables Tariff, Wing and Tariff*Wing and three control variables (Pro, Gdp and Size), in addition to control by economic sector. It is worth noting that the Tariff and Wing variables were standardized in z-score before being multiplied, as suggested by Dawson (2014), when dealing with non-binary variables.

To better understand the effect, the moderating variable was divided into three parts, adopting the cutoff points: 16% lower, 64% median and 84% upper (HAYES, 2018). In Table 2, at the 64th percentile, the coefficient of the Tariff variable is insignificant with the Ret variable; the coefficient of the Tariff variable is negative and significant, at the 1% level, with the Ret variable; and the Tariff*Lev variable presents a positive and significant coefficient, at the 1% level, with the Ret variable. At the 84th percentile, the Tariff*Lev variable presents a positive and significant coefficient, at the 5% level, with the Ret variable. As for the control variable Gdp, the coefficients present positive significance with the Ret variable; while the coefficients of the variables Size, at the 64th and 84th percentiles, and Pro, at the 16th and 84th percentiles, are not significant with the Ret variable. Also in Table 2, at the 64th percentile, the coefficient of the Pro variable was significant and positive at the 1% level.

In the analysis of the estimation of the 64th and 84th percentiles, as observed in table 2, the coefficient (β3), resulting from the interaction between Tariff and Lev, presents a positive and statistically significant effect, indicating the presence of positive moderation of Lev, that is, there is a significant difference in the relationship between tariff change and abnormal return due to the level of leverage.

Still in Table 2 (64th percentile and 84th percentile of Lev), the positive and significant coefficients (β_3 = 0.0957 and β_3 = 0.4290) indicate that the interaction between Tariff and Lev has a statistically significant effect, indicating the presence of positive moderation of the leverage level in the group of companies with medium and high leverage. Therefore, based on these results, despite the hypothesis, it is not possible to reject the hypothesis that the leverage level is a conditioning factor of the positive relationship between tariff changes and abnormal returns of regulated companies.

Table 2
Panel estimates with random effects. Estimations were performed at the 16th, 64th and 84th percentiles, as suggested Hayes (2018).

$$Ret_{it} = \alpha + \beta_1 Tariff_{it} + \beta_2 Lev_{it} + \beta_3 Tariff_{it} * Lev_{it} + \sum_{c=1}^{3} \phi Controls + \sum_{i=2}^{3} Sector + \varepsilon_{it}$$

	Percentile 16 de *Lev*		**Percentile 64 de *Lev***		**Percentile 84 de *Lev***	
Variables	***Ret***		***Ret***		***Ret***	
	Coef.	**Sta. z (p-value)**	**Coef.**	**Sta. z (p-value)**	**Coef.**	**Sta. z (p-value)**
Tariff	-0.0911	-1.14 (0.255)	-0.0115	-0.26 (0.792)	0.0772	0.69 (0.490)

Lev	-0.0631	-1.05 (0.295)	-0.1962	-2.60 (0.009)	0.0252	0.15 (0.882)
Lev*Tariff	**-0.0126**	**-0.21(0.833)**	**0.0957**	**2.68 (0.007)**	**0.4290**	**1.91 (0.056)**
Pro	-0.3957	-0.42 (0.671)	0.6604	3.03 (0.002)	0.4789	1.40 (0.163)
Gdp	0.0729	1.63 (0.103)	0.0401	3.41 (0.001)	0.0959	4.44 (0.000)
Size	0.6477	2.77 (0.006)	0.2578	1.34 (0.179)	-0.0023	-0.02 (0.982)
Sector		Yes		Yes		Yes
Intercept	-3.1658	-1.32 (0.187)	-0.1285	-0.06 (0.948)	1.5131	1.49 (0.135)
	Within	**Between**	**Within**	**Between**	**Within**	**Between**
R^2	0.0257	0.2330	0.0418	0.2036	0.2129	0.0100
	Overall 0.1802		**Overall** 0.1868		**Overall** 0.1805	
VIF mean	1.52		1.53		2.01	
Obs.	161		690		163	
Tests	**Coef.**	***p-value***	**Coef.**	***p-value***	**Coef.**	***p-value***
Chow	*14.78*	*0.0000*	*6.93*	*0.0000*	*4.73*	*0.0000*
LM BP	*133.07*	*0.0000*	*57.38*	*0.0000*	*11.06*	*0.0004*
Hausman	*2.05*	*0.8419*	*3.73*	*0.7127*	*13.32*	*0.0206*
Wooldrigde	*26.387*	*0.0001*	*14.354*	*0.0003*	*12.563*	*0.0019*
Wald	*32.94*	*0.0001*	*73.02*	*0.0000*	*31.43*	*0.0001*
White	*22.61*	*0.9774*	*207.81*	*0.0000*	*27.51*	*0.9161*

Legend: $Tariff_{it}$: tariff of firm i at time t, controlled by the average annual tariff of sector s at time t; Lev_{it}: leverage level of firm i at time t; $Tariff_{it} * Lev_{it}$: interaction between the variables $Tariff_{it}$ and Lev_{it}; Pro_{it}: ownership of firm i at time t; $Size_{it}$: natural logarithm of firm i's investments at time t; Gdp_t: economic growth of the country at time t; $Sector_s$: dummy for economic sector s (electricity, water and sanitation, and piped natural gas). The Chow test indicates that the fixed effect model fits better than the pooled model; and the Hausman test, in general, indicates that the random effect model is better than the fixed effect model. The White test and the Wooldridge test, respectively, indicate heteroscedasticity of errors and autocorrelation of residuals, but the estimate of the generalized least squares method (GLS) is robust to these assumptions (Wooldridge, 2014). The average variance inflation factor (VIF) indicates acceptable correlation between the explanatory variables.
Source: Prepared by the authors.

At the 16th percentile of Lev (Table 2), the non-significance of the coefficients β_1, β_2 end β_3 demonstrates that leverage (Lev) and leverage interacted with the tariff change (Tariff*Lev) do not appear to affect the abnormal return of companies in this group. This result suggests that the effect of leverage on the relationship between tariff change and firms' abnormal return may be less intense and, therefore, not significant in less leveraged firms.

In Table 2, the relationship between tariff change and the level of leverage with abnormal return was controlled by capital ownership (Pro), economic growth (Gdp), and size of investments (Size). At the 64th percentile, the results demonstrate that ownership (Pro) and the country's economic growth (Gdp) positively explain the firm's abnormal return. At the 84th percentile, the results suggest that Gdp is positively significant, but Pro is not significant. Therefore, it is observed that the country's economic growth seems to positively explain the abnormal return, but capital ownership positively explains the abnormal return only in the group of firms with median leverage.

The model with all observations (Table 3) was estimated with sensitivity to endogeneity. To control for suspected endogeneity problems (omitted variables or simultaneity problems), the model was estimated using a dynamic panel GMM-

SYS. The panel helps to reduce or eliminate the omitted variables problem (Barros et al., 2020), which can be a source of endogeneity.

The dynamic panel estimation with GMM-SYS explored the dynamic relationships between independent variables and the dependent variable. GMM-SYS was estimated using the lagged dependent variable as the explanatory variable and the lagged values of the explanatory variables as instruments for the current explanatory variables. The regression models were estimated using GMM-SYS using Ret as the dependent variable, predictor variables Tariff, Lev and Tariff*Lev and three control variables (Pro, Gdp and Size). The estimation results are presented in Table 3.

Table 3
Dynamic panel estimation with GMM-SYS with all observations, Equation 1.

Variables	Model I		Model II		Model III	
	Ret (All Obs.)		*Ret* (All Obs.)		*Ret* (All Obs.)	
	Coef.	Sta. z (p-value)	Coef.	Sta. z (p-value)	Coef.	Sta. z (p-value)
Ret$_{t-1}$	0.5003	4.26(0.000)	0.5981	5.83 (0.000)	0.6294	6.55 (0.000)
Tariff	-0.0330	-0.69 (0.493)	-0.0370	-0.66 (0.507)	-0.0347	-0.66 (0.507)
Lev	-0.1585	-1.64 (0.101)	-0.2390	-2.99 (0.003)	-0.1963	-2.72 (0.007)
Tariff*Lev	**0.1567**	**2.00 (0.046)**	**0.1666**	**1.57 (0.117)**	**0.1659**	**1.76 (0.078)**
Pro			0.4643	3.74 (0.000)	0.4663	3.03 (0.002)
Gdp			0.0207	1.85 (0.064)	0.0201	1.85 (0.064)
Size			0.1337	2.01 (0.045)	0.1299	1.88 (0.060)
Sector		Yes		No		Yes
Intercept	0.7838	1.87 (0.062)	-0.9591	-1.60 (0.109)	-0.5997	-0.89 (0.376)
N observations	921		920		920	
N instruments	68		102		104	
Lag	(2 3)		(2 3) (1 2)Size		(2 3) (1 2)Size	
Wald test (*p-value*)	461.84 (0.000)		796.05 (0.000)		870.25 (0.000)	
Arellano/ Bond test – AR1/AR2	0.000 / 0.360		0.000/0.409		0.000 / 0.426	
Hansen/ dif-Hansen test	0.176 / 0.089		0.465/0.237		0.549 / 0.240	

Legend: The chi-square test indicates rejection of the null hypothesis, i.e., there is an association between the variables used in the model. The Hansen test indicates that the null hypothesis cannot be rejected, i.e., it is assumed that there is no over identification of the instruments. In the Arellano and Bond (1991) test, the null hypothesis for first-order serial autocorrelation is rejected, but the second cannot be rejected, i.e., the model presents first-order serial correlation, indicating that the dynamic GMM-SYS model is the most appropriate for the study. Two-step estimation, with robust standard errors (Windmeijer, 2005). The Wald test indicated that the model estimated by GMM-SYS was well specified.
Source: Prepared by the authors.

The positive and significant coefficient (β3 = 0.1659) indicates that the interaction between Tariff and Wing has a statistically significant effect, indicating the presence of positive moderation of leverage. In the model with Sector control, the positive and significant coefficient (β3 = 0.1659) and the insignificant coefficient of β1 suggest that the level of leverage has a positive effect on the relationship between tariff change and abnormal return. In general, the result

indicates non-rejection of the hypothesis, when analyzing the entire sample (All Observations).

In the other variables used in the estimation, the coefficients Pro (0.4663), Gdp (0.0201) and Size (0.1299) present positive and significant coefficients, at the 1%, 10% and 10% levels, respectively. Such evidence suggests that capital ownership, the country's economic growth and the amount of investment in operating assets positively explain the abnormal return, in accordance with the expected results. Regarding capital ownership, Brandão et al. (2021) stated that privately owned companies tend to be more efficient than government-owned companies, and therefore could be more profitable.

According to Table 3, it can be observed that the country's economic growth positively explains the companies' abnormal returns. This was already expected, given that companies operating in network sectors, such as water and sanitation, electricity, and piped natural gas, are sensitive to exogenous factors such as the country's economic growth. When the country's economy grows, an increase in demand for services and an increase in abnormal returns are expected (Reynaud & Thomas, 2013), partly due to economies of scale. In line with this, Soroush, Cambini, Jamasb, and Llorca (2021) also indicated that the different performances in the Italian electricity sector could be linked to macroeconomic factors, such as GDP.

Network sectors are characterized by the need for high investments in operating assets such as fixed assets and intangibles. Since public service infrastructures require substantial resources to be developed (Martin et al., 2019), acquisitions of fixed assets – investments – positively affect companies' returns (Pamplona et al., 2019). In line with the expected result, the positive relationship between the variable Size, measured by the amount of investments in operating assets, and the variable Ret reveals that companies with a greater amount of investments in operating assets obtain higher abnormal returns.

The non-rejection of the hypothesis indicates that the regulatory process, materialized through the change in tariffs, explains the abnormal return (return on invested capital above the cost of capital), when conditioned by the level of leverage. This result is in line with Taggart's (1985) view on the strategic use of the capital structure by the company in the regulatory process, which the author called the price-influence effect; and the understanding of Spiegel (1994, 1996) and Spiegel and Spulber (1994) and Bortolotti et al. (2011). Ryan, Ives and Dunham (2019) discussed that private water companies regulated by Ofwat initially focused on sources of financing, with most companies using debt to finance future investments. Compared to other economic sectors, the electricity sector has higher levels of debt, in part, due to the need for capital to develop projects (Oliveira, Raeder & Marques, 2022).

The results of this study converge with the interaction between political economy theory (interest group theory) and trade-off theory (by proposing that prices and profits increase when firms benefit from increased leverage); and the interaction between imperfect monitoring and trade-off theory. Furthermore, according to the capture perspective, in which regulation can be provided in response to the demands of the regulated agent (Posner, 1974), the findings indicate that price-regulated firms are able to obtain tariff changes that lead to

higher abnormal returns when they are more leveraged. However, in these findings, the significance level ranged from 1% to 10%, depending on the model estimation, even indicating that the moderating effect of leverage is more noticeable in firms with debt close to the median. In general terms, these results are in line with the considerations of Fremeth and Holburn (2012), Mizutani and Nakamura (2017) and Niesten and Jolink (2012).

5 CONCLUSIONS

The research aimed to investigate whether the regulatory process is captured by regulated companies, based on the leverage condition. The research is based on the claim that, in Brazilian monopoly markets, regulated companies use accounting indicators, such as leverage, to capture the regulatory process, achieving a relationship between tariff changes and abnormal returns that is more favorable to the regulated company.

Leverage can be used strategically by regulated companies to pressure the regulator for higher tariff prices, as a way of minimizing financial problems. The findings of this study strengthen the perspective of the strategic use of the leverage level as a means of obtaining greater tariff changes and, consequently, greater abnormal returns. Specifically, the results show that, in regulated companies, there is a positive effect of the leverage level on the relationship between tariff changes and abnormal returns.

The research found evidence that companies obtain greater economic benefits explained by the regulatory process, when conditioned on aspects such as greater leverage. Furthermore, the results show that the process of capture and pressure from interest groups is not homogeneous in all companies, given that the relationship between tariff changes and abnormal returns is conditioned by aspects such as the level of leverage.

The contributions of the evidence from this study are aimed at various audiences interested in the outcome of economic regulation. Thus, the following perspectives of contribution and users are presented: a) for academia, the evidence strengthens the perspective of regulatory capture in the public utility sectors and exposes leverage as a driver of the regulatory co-optation process; b) for society, the results demonstrate how the regulator has made decisions in order to balance the divergent interests between consumers and concessionaires, and that decisions on tariff adjustments/reviews are reflecting on the abnormal returns of companies; and c) for regulators, the results encourage discussion on the importance of using accounting indicators to monitor the implications after the regulatory process, in order to balance the interests of agents acting in a natural monopoly environment.

The limitations are the lack of a consolidated database for regulatory agents, especially in the sanitation and piped natural gas sectors; difficulty in accessing data prior to 2007 that would allow comparisons of results; and the difficulty in accessing data from privately held companies, limiting the research period.

Future research can be developed by exploring the effects of other factors that determine the data capture process. In addition, the implementation of the new regulatory framework for basic sanitation in 2020, which aims to stimulate private investment, and the new legal framework for natural gas in 2021, whose main objective is to formalize an open, dynamic and competitive natural gas market, may encourage further research on their impacts on the dynamics of the regulatory process and on the economic and financial results of current and future companies.

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