

Assessing the Brazilian Electric Sector's Financial Monitoring Milestone

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Abstract—The Brazilian energy sector adopted a new regulation system in 2015 due to a system collapse threat. The system was changed to contractually incorporate firms' economic-financial monitoring. This paper aims to assess the progress of this monitoring model toward achieving its goals. Thus, we proceed with a triangulation with three analyses. First, we analyse the literature to indicate if the economic-financial monitoring shows a hybrid form of adoption as suggested by the literature as the most suitable towards achieving regulatory goals. Second, we verify the perception of the economic-financial monitoring efficiency by the regulatory agency. Third, we evaluate the behaviour of some financial indicators before and after the new regulation. Our results show that, first, the economic-financial monitoring adopts a hybrid form which may drive better monitoring. Second, the perception of the regulator regarding efficiency of the financial monitoring model is favourable. Third, our results show that the sector leverage and profitability variances were significantly reduced after the implementation of financial monitoring which indicates less Asymmetric Information and consequently, better monitoring. In general, our results indicate some uncertainty reduction and more uniform behaviour of the entire sector after adopting an economic-financial monitoring system.

Index Terms—Electric sector, financial monitoring, financial indicators, energy regulations.

I. INTRODUCTION

The energy sector policymakers in most countries have similar goals: a near-universal availability of service, affordable prices, and an acceptable service quality [1], [2]. Many nations in the last three decades have initiated regulatory reform movements that encompass privatization, liberalization, and deregulation [3]-[5]. To face the challenges associated with this new arrangement, and in pair with the regulatory reform, the regulation design models for natural monopolies have migrated from cost-of-service or rate-of-return designs to incentive models [6]-[9].

Brazil adopted the price-cap model in the 1990s. In 2015, due to a system-wide threat of financial collapse, the regulation of the electricity distribution sector was changed to contractually incorporate monitoring firms' economic-financial health in a movement named

economic-financial sustainability. Since then, the National Electric Energy Agency (ANEEL) has established a complex financial and operational indicators framework to use as contractual parameter during, and at the end of the concession interval for renewal purposes (financial covenants). Formally, the Agency is “focused on a more preventive action, which avoids the risk of degradation of the regulated service” [10], [11].

Because Brazil is a Developing Country (DC) that recently adopted a more sophisticated hybrid regulatory model, this paper aims to assess this monitoring model's progress toward achieving its goals of controlling the country's financial health by proceeding with a triangulation analysis which minimizes bias and may improve an investigation's validity. Triangulation is often achieved through the assembly of multiple sources of data and methods [12], [13]. To assemble the recommended multiple sources for a stronger substantiation of our constructs and hypotheses we: (1) compare the Brazilian monitoring form to the literature to figure out if the regulatory model in Brazil is the most recommendable for monitoring firms, (2) verify the perceived efficiency of the monitoring model by the regulatory agency, and (3) evaluate the behavior of some financial indicators before and after the new regulation was instated to ensure that the monitoring process is improving towards its goals.

To achieve our first goal, we gather the literature regarding regulation adoption forms. In many studies, the literature suggests the adoption of a hybrid form of regulation [14]-[17] believe that monitoring a firm's private information, even imperfectly, may ensure the ideal “full-information performance level.” However, they also assert that a “complete synthesis of this broader array of problems awaits further research” [18]. Then, we conclude that the Brazilian Electric Sector Monitoring follows the most appropriate model of regulation. Monitoring private information may be a problem mostly for DCs where the regulator's capacity is weak [19]. However, this seems not to be the case for Brazil's ANEEL. Furthermore, although an international consensus about the difficulties of enforcement performance exists, the theory of regulation had paid little attention to DCs [4].

To achieve our second goal, we interview a focus group of agents from the ANEEL's Superintendence of Economic and Financial Supervision (SFF) to verify the perceived efficiency of the monitoring model by the regulatory agency. The analysis of the interviews shows that the perception of the financial monitoring model is more favorable after the implementation of the new monitoring system in 2015.

Regarding to our third goal, we analyze the values of leverage and profitability variances to evaluate Asymmetric

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Information (AI) which may explain efficiency of the monitoring model. Our results show that sector leverage and profitability variances were significantly reduced after the implementation of financial monitoring which indicates less information asymmetry and consequently, better monitoring.

In sum, this study expects to contribute to the National Agency with our assessment of a newly designed hybrid regulatory incentive model that is in its first renewal cycle. The case description may be useful for other developing countries that may decide to launch a new incentive or a different hybrid model. Finally, the research serves as empirical evidence for some economic theories about natural monopoly as we will see in the next sections.

II. LITERATURE REVIEW OF THE MONITORING SECTOR INFORMATION

The electric power segment has natural monopoly characteristics—a single firm supplies services in the relevant market rather than two or more competing firms. Natural monopolies are thought to have many economic performance issues such as excessively high prices, production inefficiencies, costly duplication of facilities, poor service quality, and potentially undesirable distributional impacts [17].

In an effort to solve these issues, for more than a hundred years economists have refined and evolved the knowledge on natural monopolies. This work first resulted in more substantial institutional infrastructure (and a high regulatory cost) such as increased staff at agencies, regulation, and enforcement [20], [21]. Subsequently, in the 1970s, industries participated in a deregulation movement based on the theory that where unregulated competition replaces the rate-of-return (ROR) or cost-of-service (COS) regulation, firms would eliminate inefficiencies caused by overcapitalized plants and operations. This is known as the Averch–Johnson capital using bias effect [1], [22].

The rationale behind the monopolist behavior under artificial regulatory constraints is quite simple: “The closer the ‘fair rate of return’ is to the true cost of capital, the greater the quantity of capital the firm will want to use” [23]. Thus, the quality will only improve if it is capital-using [2]. Because prices are set to assure a return on investment, the utilities have little incentive to minimize costs, since any reduction would cause prices to decrease [24], [25].

Therefore, starting in the 1980s, performance-based regulation (PBR) and quality standards replaced rate-of-return regulation in many countries [26]. Performance-based research includes multiple metrics such as energy and demand savings, customer service quality, lower costs, and a more rational allocation of risks and rewards [8], [27].

The regulatory design challenge includes ensuring an adequate industry structure (monopoly or competitive), regulatory framework (regulation, centralized, and information systems), and contract designs (price cap or rate of return), depending on the capacity of the agency [19]. Policy instruments for setting and designing regulations are cyclic and continuously revisited [28]. While almost every mechanism presented has its shortcomings and pitfalls, the

central interest of this study is the solution to the Asymmetric Information (AI) problem [29]-[31]. [32] presents an extensive review of the AI problem “where the firm is endowed with privileged knowledge of some relevant aspect of the regulatory environment.” According to the literature, the problem is bifold, encompassing both operational costs (variable and fixed), and consumers’ demand for a firm’s private information [18]. The standard regulatory problem is well known. It occurs when the firm’s induced performance varies with the realization of its private information. This happens up to the (ideal) full information performance level with no rent-seeking, which is “the firm’s equilibrium marginal cost of production in that state” [18], [33].

Developing countries suffer more from asymmetry because (1) their regulators are generally short of financial and human resources, (2) their auditing systems are underdeveloped, and (3) their judiciary is inexperienced [19], [34]. In sum, implementation depends very much on a particular regulator, who may be biased, co-opted, or lack resources [16]. Regulatory monitoring should be capable of limiting the private operator’s leverage and reducing its exposure to risk [35]. In the second half of the 1990s, the Brazilian government implemented the transition of the cost of service model to a price-cap model. This was intended to reduce the problems of asymmetric information, encourage companies increase their efficiency levels, generate new investment, and simplify the pricing structure [11].

In 2012, the REDE group, one of the country’s largest conglomerates with nine distributors under its control collapsed, putting the Brazilian electric system at risk. Auditors took over the business, assigned by ANEEL, until 2014, when the new owner ENERGISA took over. Before the intervention, REDE had liabilities totalling six times its cash generation, compromising its investment capacity and conversely its service quality [36]-[38].

Subsequently, the bankruptcy law was amended to ensure that ANEEL, rather than the justice department or creditors, would dictate problematic firm’s actions. Furthermore, in 2015, the Agency began to contractually control leverage and monitor distributors’ cash flow [39]. [35] indicated the same preventive actions. Since then, researchers have conducted several financial studies on the energy distribution sector [11], [36], [38], [40], [42].

III. INTERVIEWS ANALYSIS

To assess the regulator’s perceived efficiency of the model in achieving the expected outcomes (objective 2), we recruited a focus group of agents from the ANEEL’s Superintendence of Economic and Financial Supervision (SFF) for a semi-structured two-hour session. The group includes 1 professor, 2 doctoral students and 3 experts from SFF/ANEEL.

We use general guideline questions and analyse recorded information generated during group interactions [43], [44]. The “interview guide” contain five parts: (1) participants profiles, (2) model positioning, (3) monitoring efficiency, (4) monitoring model construction, and (5) understanding of indicators. After transcribing the recordings, we analysed the data using the qualitative content analysis strategy [45]-[47].

Regarding the model description and positioning, the focus group perceived that the Brazilian model is a hybrid because it has had some aspects of price-cap regulation since the 1990s, but in the 2000s, it incorporated some aspects of the benchmark and cost-of-service models. The grantor established the general model parameters before the current regulatory agency configuration.

The opinion of the group on the efficiency of the model was favourable because from 2004 to the present, the electricity tariff only varied from 2% to 3% in nominal terms, which means a half value reduction in real terms [48].

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However, this was a unanimous opinion among the participants. The benefits of the indicators' transparency and publicity are worthy of pursuit. "Some players liked it. Others not so much. Next steps include compliance and enforcement actions and tools related to the monitoring results."

IV. ANALYSIS OF FINANCIAL INDICATORS BACKGROUND

The quality of monitoring depends directly on the quality of financial statements and their comparability or temporal consistency and the cross-sectional uniformity of their accounting information. For domestic purposes, in 2001, ANEEL issued a manual to establish the same chart of accounts, accounting procedures, and disclosure level for the entire electric sector [41]. Brazilian electric sector is now the most uniform and transparent sector in Brazil [49].

However, in 2015, the Agency [50] updated its manual to incorporate regulatory and international topics. In the same year as the international standard adoption (2007), ANEEL decided to improve economic and financial performance monitoring of its concessionaires. ANEEL periodically revise its methodology and produced several reports used to support interventions and enforcement actions toward distributors with unfavourable financial performances [51].

However, in 2015–2017, many contracts would end, and the Ministry delegated to the Agency by force of Decree n. 8461/15 the authority to issue new 30-year concession agreements. This was novel because it went beyond efficiency and quality of service to include the efficiency of the economic-financial management [52].

Henceforth, the regulator selected seven indicators for (1) debt, (2) efficiency, (3) investments, (4) pay-out, (5) profitability, and (6) operations to assess the granted firms' financial performance. We noted that even using the regulatory accounting standards, some formula terms need almost 20 adjustments before producing the value to comply (e.g., PMSO). The seventh indicator refers to the incremental cash flow improvement goals for the first five years after renewal [53]. We draw attention to some aspects of the financial instruments. The values are calculated yearly and are presented for the last four years. All indicators are

published and are available on the regulator's website [54].

To verify the indicator behaviour before and after the new financial monitoring (objective 3) we use the traditional economic, business, and finance event study methodology [55]–[58]. The event window is from 2011 to 2017, the pre-event window is from 2011 to 2014, and the post-event window is from 2015 to 2017. We test the hypothesis that: H1: The pre-event indicator behaviours are different than the post-event indicator.

Our sample is from the Agency's public financial information database available on the ANEEL website. It considered only the energy distribution sector that was composed of 59 firms in 2011 and 51 firms in 2017. Some mergers and acquisitions explain the reduction in the number of firms over time.

The literature recommends the study of two main elements: profitability and leverage. Based on our findings at the focus group experiment, we controlled for the tariff revision year and the public/private characteristics of the distributors. We proceed with a descriptive statistical mean analysis considering both groups (factors) and the time series (tariff revision, $tr + 1$, $tr + 2$, $tr + 3$, $tr + 4$).

Negatives values in the cash flow element (EBITDA) at the capacity to pay debt services indicator were treated like null capacity (CPDS = 0). The fifth section describes each indicator and the outliers' treatment when relevant.

The second part of our analysis concentrates on profitability and leverage. For the profitability analysis, we use the EBITDA on net revenue indicator (EOR). EBITDA is the sector's most used and available indicator of profitability because, in a simplified manner, it surrogates the net cash flow. Using EBITDA is also a convenient method for separating the interest, capital expenditures, and sunk costs from operational results. Table I depicts the statistics.

TABLE I: PUBLIC AND PRIVATE DISTRIBUTORS PROFITABILITY

EOR	PRIVATE		Obs
	Mean	SD	
2011	0.1737	0.0113	49
2012	0.1463	0.0131	49
2013	0.1402	0.0128	49
2014	0.1699	0.0143	49
2015	0.0939	0.0101	49
2016	0.0935	0.0099	49
2017	0.1016	0.0131	41
EOR	PUBLIC		Obs
	Mean	SD	
2011	-0.1092	0.1082	10
2012	-0.0868	0.0758	10
2013	-0.0499	0.0552	10
2014	0.0527	0.0468	10
2015	-0.1707	0.0935	10
2016	-0.281	0.1602	10
2017	-0.0912	0.0604	10

Source: Authors; SD = standard deviation.

First, Table I shows that private and public distributors' EOR figures are significantly different. Seven of ten public firms had negative EBITDA during the entire period. A negative EBITDA means that the company did not generate enough cash to make capital investments (CAPEX), or even to replace the current assets, which indicates a possible service quality degradation. The effects of some periodic tariff revisions in 2013 and 2016 can be seen in 2014 and 2017, respectively, but the benefits rapidly disappear. Public

behaviour changed rapidly, denoting volatility and risk.

Another finding shown in Table I is the difference between both types of results after 2015, a year of regulatory milestones. The result suggests a tariff tightening and a more accurate price-cap determination decreased the opportunities for rent-seeking. We also note the significant negative result seen for public companies after the implementation of the regulatory framework, suggesting that they do not react in the same way to policy incentives. The data in Table II reinforces the tightening and difference.

Table II shows the EOR in the year of regulatory revisions and the subsequent years for all distributors. Some revisions were in 2013 and others in 2014. Most companies have a four-year revision cycle, one has a 3-year cycle, and a few have a 5-year cycle. The default tariff revision period after the renewal of 30-year concession agreements from 2016 forward is 5 years [59]. Thus, it is not possible to infer the ratchet effect on revision period change.

TABLE II: PROFITABILITY PER REVISION PERIOD

PRIVATE			
EOR	Mean	SD	Obs
Revision	0.1286	0.0098	85
Year +1	0.1243	0.0104	65
Year +2	0.1208	0.0116	54
Year +3	0.117	0.0157	47
Year +4	0.1178	0.0089	8
PUBLIC			
EOR	Mean	SD	Obs
Revision	-0.0947	0.0392	19
Year +1	0.0576	0.0312	14
Year +2	-0.1784	0.0934	10
Year +3	-0.2723	0.1618	10
Year +4	0.0616	.	1

Source: Authors; SD = standard deviation.

As shown in Table II, there is no significant difference in the after-revision period for private firms. It is, however, possible to observe in the public firms the beneficial effects of a revision year and the years following it (revision, year +1, year +4). Because some revisions are made in the last quarter of the revision year, many effects can only be seen the following year, dividing variance and muddling the public firms' indicator. These results might bring some concern about the capital structure, financial health, debt, and leverage of the distributors, mostly the public ones. Table II sheds some light on the Brazilian scenario.

For understandable reasons, we use the inverse of ANEEL debt indicator. Although the Agency named it a debt indicator, in reality, it measures the firm's capacity to meet their debt services (CPDS). Per example, a 0.40 CPDS means an ability to pay 40% interest on net regulatory debt (NRD) after mandatory regulatory capital expenditures (QRR). Per ANEEL, the indicator value would be 2.50 (1/0.40). Formally: $CPDS = (EBITDA - QRR) / NRD$

From 10 public facilities the observation universe only goes up to four (zero in the 2016 case), and 41 private companies had positive cash flow (EBITDA – QRR). In a negative EBITDA or cash flow case, we drop the observation from the sample, because CPDS = 0. We also drop very low debt firm outliers (11 private firms' observations) (CPDS >2) because there is no limit for CPDS.

After seven years with no CPDS the public distributors have: (a) a complicated debt situation, (b) received a capital

contribution of taxpayers' money, or (c) are eligible for privatization. The options are not mutually exclusive, and a total occurrence (a + b + c) is not rare [36].

It is not possible to infer any trend in indebtedness in the private firm samples, which regarding leverage security, risk, health, and stability, is a good result. Nevertheless, from 2011 to 2017, we noticed a 25% sample reduction. The reduction suggests there are more companies with negative cash flow. The result is consistent with Table III's post 2015 findings.

TABLE III: CAPACITY TO PAY DEBT SERVICES AFTER CAPEX

PRIVATE			
CPDS	Mean	SD	Obs.
2011	0.4066	0.0472	41
2012	0.312	0.0367	40
2013	0.2822	0.0376	36
2014	0.2675	0.0479	39
2015	0.3122	0.0559	35
2016	0.271	0.0585	33
2017	0.2947	0.0466	30
PUBLIC			
CPDS	Mean	SD	Obs.
2011	0.1652	0.0248	3
2012	0.0715	0.045	3
2013	0.0465	0.0221	2
2014	0.1227	0.0558	4
2015	0.226	0.1957	3
2016	ND	.	0
2017	0.0631	0.0175	4

Source: Authors; SD = standard deviation.

Despite the significance of the results, future research could investigate the environmental reasons for such a difference by detaching it from its causes. It would also be desirable to compare more indicators for a better monitoring assessment. In addition, the ratchet effect was not investigated in this work, as we must wait for the new agreement first revision period to compare the four- and five-year revision cycle effects.

V. CONCLUSION

As defined by the literature (objective 1), Brazil's regulatory model was historically a price-cap type. On the regulator perception of financial monitoring (objective 2), a focus group of agents from the ANEEL's Superintendence of Economic and Financial Supervision (SFF) corroborated many of this study findings. Regulators perceived how public and private firms have different sensitivities to regulatory incentives. Interestingly, for the SFF agents, the information is easily constructed. Another interesting finding is the absence of an automatic reaction to any financial event, although interventions are allowed. For the agents, interpreting and acting upon data is the most challenging issue. We see some policy implications and research opportunities here. The regulator's assessment of the efficiency of the financial monitoring model is favorable.

Accordingly, the study's results on evaluating financial indicator behaviour before and after the new regulation was implemented (objective 3) suggests some benefits in monitoring. The indicators analysis reinforces the public-private difference in profitability and risk. Either the private firm returns are significantly higher, or the volatility

between tariff revisions are significantly lower. An unbiased economic analysis would lead to the recommendation of privatization of the electric sector to save taxpayers money and optimize economic resources.

The results after the implementation of monitoring also suggest a tariff tightening and a more accurate price-cap determination, decreasing the opportunity for rent-seeking. Future research controlling exogenous variables would be desirable. ANEEL is increasing and standardizing the contracts tariff revision period from three or four to five years. According to the literature, the increase in the tariff revision time is beneficial for the performance of the electric system. Indicators analysis does not allow any interpretation in this subject, because of the recent revision period change.

AUTHOR CONTRIBUTIONS

A. F. conducted the research; A. B., wrote the paper, downloaded and analysed the data, J. C. conducted the interviews, V. M. and D. V., wrote the paper, and J. Q. wrote, formatted and proceed with the submission of the paper; all authors had approved the final version.

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