Regulatory trade-off between encouraging the improvement of technical quality and recognition of operating and capital costs on the distribution network operators in Brazil

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ABSTRACT

This paper takes the regulatory impact evaluation of the incentive mechanism to improve the technical quality of electricity distributors in Brazil. The methodology proposed by the Brazilian regulatory agency (ANEEL) follows the concept of the mechanism RPI - X know by subtracting the productivity gains in the annual tariff adjustments. Inside the X factor the regulator has created a mechanism that increases the tariff recognition of companies that can improve the quality of service. However, this mechanism does not have an empirical model that corroborates the estimated results and set in a discretionary manner the limits of incentive structure. In this paper we have created an empirical model that confronts the estimated elasticity percentage to increase (or decrease) recognition of costs following a panel fixed effects model. In this statistical model it is possible confront the magnitude of the trade-off in the structure of regulatory incentives linked to the amount of reconnaissance of operation and capital costs. The results indicate that in some underlying criteria the tariff recognition is insufficient to offset the increased costs that ensure the improvement of technical quality in both perspectives: punishment and incentive recognition for operate with better practices, especially in some immature concession areas.

KEYWORDS: Regulation, Technical quality, Benchmarking, OPEX, CAPEX.

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1. INTRODUCTION

Since the third periodic cycle revisions of the electricity distribution companies in Brazil, the firms can obtain tariff gains case deliver a better quality of service to their customers. The regulatory incentive mechanism adopted is dynamic, ie, greater variations of quality indicators between two consecutive years will be higher tariff appropriation in the next year.

The current regulation does not provide a model that the incentive level for the quality gains is empirically estimated. The applied results are derived from assumptions "*ad-hoc*" limited by the maximum percentage of recognition of +/- 2% per year. The importance of studying this mechanism comes from the fact that the strength of regulatory incentive may be underestimated in two cases: **A)** the punishment for sell a low quality service, and, **B)** the reward for improving services. Both can't express the degree of aversion of society to low-quality services.

Unfortunately this paper will only be considered the company's vision in terms of costs incurred to improve the technical quality of the services. An alternative treatment would add to this approach the vision of consumers against the cost of energy deficit. We don't treat this approach on this paper, however is an important perspective for future studies. The hypothesis to be measure in this paper it will then: "*The mechanism of incentives to improve the technical quality in Brazil corresponds to the opportunity cost of improving the quality of services?*"

To answer the question above, we made a regression analysis with panel data, considering two methodologies: **A)** The first it is a dynamic panel fixed effects as proposed by ARELLANO and BOND (1991). We have the intention to address the problem of inertia in trajectory of reducing costs and connect the estimated incentive to reduce them. With this approach is expected to obtain statistical significance between the incentive to improve the quality and the cost trajectories. This case demonstrated insignificant statistical results. **B)** A second model evaluated removed the autoregressive term and treat the variation of costs responds only with shocks in the panel variables. This model considers the "ceteris paribus" vision only on the quality indicators. This approach proved to be statistical significant. Both models were estimated considering two stages, where the effects of other variables that affect the costs were treated assuming be exogenous. The estimated models, therefore, restricted the quality information when separated. The Premise is not a very strong information that will be compound for a weighted index.

"The results indicate that the regulatory incentive to improve the technical quality of supply energy is undersized in Brazil". Besides this introduction the article is divided into the following sections: **2** – Brazilian model; **3** – Incentive mechanism to improve the quality; **4** – Methodology; **5** – Results; **6** – Conclusions **7** – Conflicts of interest; and **8** – Bibliography.

2. BRASILIAN MODEL

The regulatory and institutional framework of the Brazilian market is based on providing non verticalized services which generation costs and freight costs – transmission and distribution – are separated. The latter two characterized by regulated natural monopolies. On the portion of the distribution revenue acts the incentive mechanism to improve the quality[2].

The regulatory model in Brazil turns the operating conditions of the electricity distributors – provision of infrastructure and quality – in "*drivers*" of costs and simulates the competitive market by techniques of "*benchmarking*". For this the annual adjustment mechanism of tariffs in the regulated distribution market is affected by the performance of companies. The Brazilian mechanism is also one of the most common among regulators in other countries and is the evaluated joint an inflation index adjustment. The X – factor adjusts the retail tariffs annually[3] and this factor is described by

$$X = P_d + T + Q \qquad \mathbf{1}$$

As is known in microeconomic theory, the managerial process in competitive markets is different from that which should be adopted in markets without competition – monopolies – as the interaction of agents becomes not necessarily cooperative. The mechanism of **equation 1** affects competition in the Brazilian electricity sector and the companies start to compete with each other seeking higher tariff margin gains.

The X – factor impose compulsory the sharing of productivity on the regulated tariff simulating the competitive market. It's magnitude depends on the three factors above on **equation 1** that capture different cost drivers: **a) Pd component** – or distribution productivity – is responsible for the sharing of productivity gains on the scale or growth of the concession area, this tends to be positive, ie, it's commonly one tariff reducer; **b) The T component** – or trajectory of operating costs – is responsible for the equalization of operating processes of distribution, identify and apply penalties for not achieving the best operation practices. This component tends to be positive for inefficient firms, also resulting in reduction of tariffs; **c) The Q component** – is responsible for regulatory incentive to improve the quality of service. It tends to be negative for companies that gain efficiency in quality, implicated rate increase when the quality improves, though it may have an impact on rising costs, causing "*trade -off*" especially with T component.

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[2] This portion is known as "portion B" comprises the operation and maintenance costs, and return on investments in distribution systems.

[3] The new indicator that adjusts the tariffs in Brazil is the IPCA - national price index broad consumer - calculated by the Brazilian Institute of Geography and Statistics. Its adoption will take place from 2016 at concessioners to renew their contracts. Before the adjustment was made by the IGP-M – general price index of markets.

In competitive markets when the productivity of a business increase this business is more likely to be successful over time. It can be seen from this that the establishment of regulatory conditions through the "benchmarking" means the removal of a significant degree of comfort to business managers and enforce then act searching better practices.

3. INCENTIVE MECANISM TO IMPROVE THE QUALITY

The mechanism to incentive the improvement of the energy quality in Brazil is applied in the calculation of X – factor according to the sub module 2.5 of PRORET[4]. The component responsible for tariff recognition of improvements in quality of service is described by X_Q factor – or simply Q – where improvements or deteriorations in the quality of service provided to consumers is captured as an increase or reduction of tariffs respectively. For a more detailed description of this mechanism the main references are the technical notes number 67/2015 – SRM / SGT / SRD / ANEEL and number 404/2014 – SRE / ANEEL[5].

Generally speaking the incentive mechanism for quality improvement to distribution system operators with more than 60.000 consumer units[6] is divided into two components:

A. The incentive component improving the Q_T (technical quality), and,

B. The incentive component improved Q_C (commercial quality).

At where:

$$Q = 0{,}70 \times Q_T + 0{,}30 \times Q_C \qquad \mathbf{2}$$

And

$$Q_T = 0{,}50 \times Q_{DEC} + 0{,}20 \times Q_{FEC} \qquad \mathbf{3}$$

$$Q_C = 0{,}10 \times Q_{FER} + 0{,}10 \times Q_{IASC} + 0{,}04 \times Q_{INS} + 0{,}03 \times Q_{IAb} + 0{,}03 \times Q_{ICO} \qquad \mathbf{4}$$

The classification of indicators above is show that, by

[4] Tariff Regulation Procedures, available at: http://www.aneel.gov.br/area.cfm?idArea=702. Only in Portuguese, accessed in14-12-2015.

[5] Avaible at; http://www.aneel.gov.br/, Informações Técnicas > Audiências / Consultas > Audiências Públicas > Audiência Ano 2014 – (Finalizado o período de contribuição em 2015) > Audiência 023/2014, resultados da primeira e segunda fases.

[6] Small distributors have more flexible treatment where the implementation of "Call-centers" and it's optional according to the Art. 184 da REN nº 414/2010.

Indicator	Definition	Regulamentation
DEC	Equivalent duration of interruptions per unit consumer (in hours).	Module 8 of PRODIST[7]
FEC	Equivalent frequency of interruptions per unit consumer (in times).	Module 8 of PRODIST[7]
FER	Equivalent frequency of reclamation for each 1000 consumers.	REN nº 574/2012
IASC	ANEEL index of consumer satisfaction. Results on the degree of consumer satisfaction with the service provided.	-
INS	Reflects the answered calls in call-center on respect for calls received less abandoned.	REN nº 414/2010
IAb	Reflects the list of dropped calls on incoming.	REN nº 414/2010
ICO	Reflects the ratio of busy calls.	REN nº 414/2010

The incentive mechanism for each "driver" of quality has the same quantitative basis. But to make an evaluation of a new incentive mechanism we are limited by available historical data for the treatment of the technical component (Q_T). The commercial component (Q_C) will not be considered on this paper for to two reasons: **1** – have recent regulation, and; **2** – the absence of data for statistical analysis. Anyway, the study of only the technical component corresponds for 70% weight in the estimation of Q component of X – factor.

The regulatory incentive mechanism in the tariff for to improve the DEC (in other words reduce the indicator) – and therefore the FEC – is given as follows in Brazil:

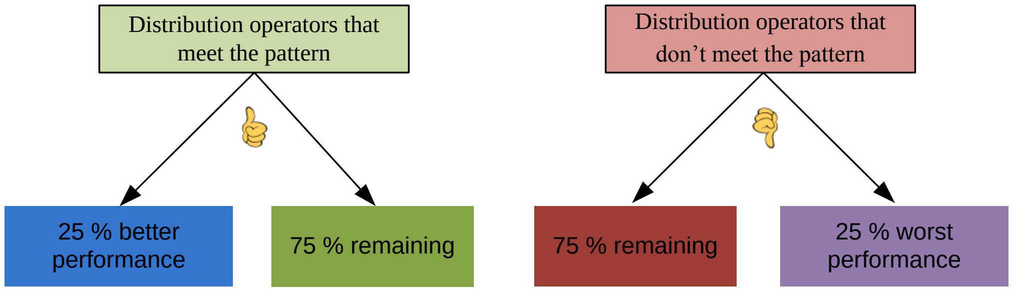
1. The global indicators[8] are computed from adjusting for electrical assembly[9]:
2. After identifying the quality indicators set by electrical assembly we building the individual goals by clustering method using the distance function of the Euclidean technique, where the benchmarks are defined by clusters of 50 to 100 sets from the second decile of box-plot dispersion of comparable values.
3. The individual limits leading to overall limits for distributors where the quality goals that define the pattern of service that being delivered to consumers and are constructed by the weighted sum of the individual indicators.
4. The distributors are separated in large (market ≥ 1 TWh / year) and small companies.

[7] Distribution Procedures, available at em: http://www.aneel.gov.br/area.cfm?idArea=82. Only in Portuguese. Access in 10-12-2015.

[8] The indicator do not consider faults of energy in the transmission system, is the weight sum for each assembly.

[9] The electrical assembly is compound for the electric extensions of a determined electric substation and can include one, many, or only parts of cities.

5. The distributors are divided into two groups in year of analysis: **i** – companies that meet the pattern, i.e. manage to overcome the specific quality goals in item 3, and; **ii** – companies that don´t meet the pattern:



6. Given the two groups of item 4, the distributors are ranked from best to worst effective performance, and classified in sub-groups (Blue, Green, Red and Purple) performance where relationships incentive will be more or less restrictive according to the position of companies in the performance scale compared.
7. Is computed the percentage change between $t-1$ and $t-2$ – two years preceding the year of evaluation – of DEC (Δ% DEC) and FEC (Δ% FEC), for each distributor on the case of technical indicators.
8. The calculated value of the percentage change in the index: $\Delta I\% = (IND_t / IND_{t-1}) - 1$, is applied in the next equations:

Meet the pattern?	Class of performance	Band of variation (DEC or FEC)	Curve Q(ΔI%) in (%)
Yes	25% better	ΔI% ≤ - 25%	$Q(\Delta I\%) = -2{,}0000$
		-25% < ΔI% < 5%	$Q(\Delta I\%) = 0{,}0667 \cdot \Delta I\% - 0{,}333$
		5% < ΔI% < 20%	$Q(\Delta I\%) = 0{,}0267 \cdot \Delta I\% - 0{,}133$
		ΔI% ≥ - 25%	$Q(\Delta I\%) = 0{,}4000$
Yes	75% remaining	ΔI% ≤ - 25%	$Q(\Delta I\%) = -1{,}3000$
		-25% < ΔI% < 5%	$Q(\Delta I\%) = 0{,}0520 \cdot \Delta I\%$
		5% < ΔI% < 20%	$Q(\Delta I\%) = 0{,}0600 \cdot \Delta I\%$
		ΔI% ≥ - 25%	$Q(\Delta I\%) = 1{,}2000$
No	75% remaining	ΔI% ≤ - 25%	$Q(\Delta I\%) = -0{,}9000$
		-25% < ΔI% < 5%	$Q(\Delta I\%) = 0{,}0450 \cdot \Delta I\% - 0{,}225$
		5% < ΔI% < 20%	$Q(\Delta I\%) = 0{,}0640 \cdot \Delta I\% - 0{,}320$
		ΔI% ≥ - 25%	$Q(\Delta I\%) = 1{,}6000$
No	25% worst	ΔI% ≤ - 25%	$Q(\Delta I\%) = -0{,}5000$
		-25% < ΔI% < 5%	$Q(\Delta I\%) = 0{,}0333 \cdot \Delta I\% - 0{,}333$
		5% < ΔI% < 20%	$Q(\Delta I\%) = 0{,}0667 \cdot \Delta I\% - 0{,}667$
		ΔI% ≥ - 25%	$Q(\Delta I\%) = 2{,}0000$

Finally the values calculated in item 8[10] are replaced in **equations 2, 3 and 4**, and applied directly to the X factor on every revenue portion B of the distributors, leading to higher tariff or lower level that reflects the quality performance.

4. METHODOLOGY

4.1. Theoretical discussion

The quality of the optimal level adjustment mechanism is based on many factors that are directly or indirectly on the management of companies. Among the items that most affect the continuity of energy supply are: **i)** exogenous factors related to weather – lightning, rain and wind – **ii)** building pattern of networks, **iii)** the incidence of the practice (still common) of power theft **iv)** the cost of tariffs, which can increase the level of default by consumers, **v)** the conflicting mechanisms of regulatory incentives, especially the requirement to reduce operating costs in companies with low quality. This last is the object of study of this paper.

The first item mentioned relates to stochastic events of atmospheric nature there are uncontrollable and unmanageable and generate considerable costs in terms of quality. Added to this perception the constructive pattern of networks and the degree of depreciation of assets, increases the system vulnerability. The power theft reduces the operating capacity of enterprises, leading instability in the supplier. Such factors are condensed on the ability that the concessionary need to have evaluated the capability to pay of their consumer units. In the Brazilian case – particular for some concessions that have socially vulnerable areas – there can be no large proportion of commitment of family income in payment of bills, because which presses the increase in energy theft and default.

On this paper we estimate of empirical reliably relations that indicate the best possible way what the average elasticity for the Brazilian market adjustments that converge in the improvement of quality of service in terms of costs. In a general way these adjustments has the tendency to evidence part of the information needed so that can identify an optimal level of quality.

From the figure below you can see two behaviors based on the amount of quality indicator. The first described the red line shows the company's vision, where the indicator increases – lower quality – lower costs are expended to maintain the service delivery infrastructure. However the

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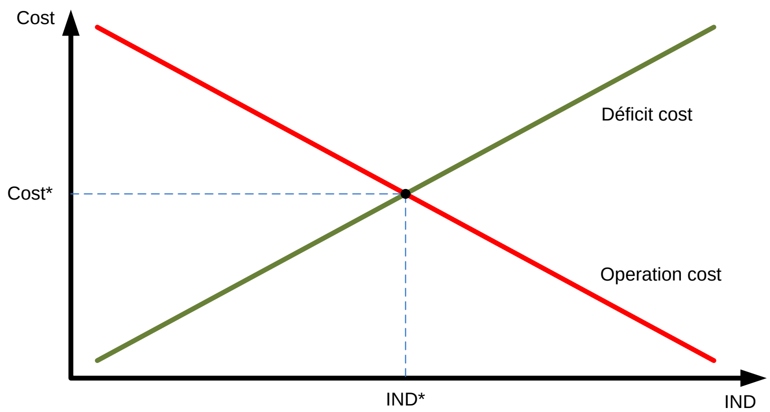
[10] Available at: http://www.aneel.gov.br/arquivos/PDF/Proret_Subm%C3%B3dulo%202.5_V2.pdf. 2.5 module of PRORET, access in 10-12-15.

consumer view is evidenced by the green equation, where the higher the quality – smaller indicator – more costly it becomes to deliver the service. In this case the energy deficit causes economic losses to consumers.



The dynamic equilibrium between the perception of quality by consumers – cost of the deficit – and the actual cost of providing a more reliable service – operating cost – define on the middle an optimal value for the cost for a given concession area.

Generally speaking the red equation can be estimated – and it is about her the study of this article – from operating data of the distribution companies in Brazil. The green equation has set more complex because it depends on the consumer market expectations, energy demand growth and any "*trade-offs*" involving increase in operating costs, the cost of welfare, opportunity or the production of products and services that depend on electricity as irreplaceable input.

The simple model presented above shows the importance of following premise: "*There is a theoretical limit of the operating cost of a concession and the level of quality required by its consumer market*." On this limit none improvement in the quality of service may be appropriate by the concessionaire or by their consumers, causing economic loses and allocative irrationality. The most important restriction of the trajectory for the correlation between cost and quality is the valuation that the consumer units have for the level of quality that are willing to pay.

4.2. Empirical adjustment

Dealt with issues that related to the identification of the efficient cost level compared to quality, it is necessary to indicate how the cost equations and deficit cost can be calculated. Two adjustment assumptions were used on this paper. One considers the inertial effect of other adjustment policies on the level of costs that affect the quality indicators, ie, it was assumed that the cost depends on the cost today a step forward. The second alternative considers only the contemporary impact of quality indicators on the level of cost.

The deficit cost equation – the view of consumers – have relatively complex estimation and the time has not yet formed a consolidated view of how such a relationship could be estimated, considering the specificities of each concession in Brazil. Some ideas already exist to promote this adjustment as estimate, using as a proxy GDP growth, compared to the variation of global indicators for concession. These studies are a continuation of this work, in which it is expected to give more robustness to the analyzes presented.

The cost equation award for quality can be estimated from operational indicators of distribution concessions in Brazil. It was decided to adjust the model containing the inertia parameter using the technique proposed by Arellano and Bond (1991), where the major references on the construction of mathematical assumptions of analysis can be obtained.

According to GREENE (2008), TRIVEDI and CAMERON (2010) the model proposed by ARELLANO and BOND (1991) can be described by the following equations:

$$\begin{aligned} y_{i,t} &= \mathbf{x_{i,t}}\boldsymbol{\beta} + \delta y_{i,t-1} + c_i + \varepsilon_{i,t} \\ &= \mathbf{w_{i,t}}\boldsymbol{\theta} + a_i + \varepsilon_{i,t} \end{aligned} \qquad \mathbf{5}$$

In equation 5 it notes where two equivalent formulations $\mathbf{w_{i,t}}$ presents part of the information contained by $y_{i,t-1}$. In general the dynamic autoregressive term – of interest – is correlated with the error term, said that the estimators of fixed effects, which depend on second WOOLDRIDGE (2006) by the transformation of fixed effects will be inconsistent. Thus the model:

$$y_{i,t} - y_{i,t-1} = (\mathbf{x_{i,t}} - \mathbf{x_{i,t-1}})\boldsymbol{\beta} + \delta(y_{i,t-1} - y_{i,t-2}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \qquad \mathbf{6}$$

Becomes inestimable. Since:

$$E(\varepsilon_{i,t}|\mathbf{x}_{i,t}\boldsymbol{\beta}) \neq 0 \qquad \mathbf{7}$$

The solution to this problem has been given by applying the generalized moment estimator proposed by HANSEN (1982), where $\mathbf{w_{i,t}}$ capture the effect of $y_{i,t-1}$, leading to consistent estimator. The OLS estimator is biased in this case because: **i)** the fixed effects should not be equal for all companies; **ii)** the explanatory variables are not exogenous especially $y_{i,t-1}$ – there is a direct correlation relationship between costs and quality; and **iii)** the OLS does not allow for serial correlation in the error term; It's precisely to correct this autocorrelation which are included the lagged instruments.

Without this, $y_{i,t-1}$ the set of independent variables included in the model $\mathbf{x_{i,t}}$ is "*all information*" necessary for the estimation of $y_{i,t}$, in this way, any change of dependent variable is expressed by the impact of "*new*" information. So it is observed that the effect of temporal correlation in costs can be "*removed*" from the model so as to subtract only the effect of endogenous variables without temporal correlation. However a most suitable inference process can be built with the exclusion of "*inertial*" term. In this case the $y_{i,t-1}$ may be included as exogenous, if the model is not significant, and a model including only the relationship between the costs and the quality indicator can be estimated by least squares two stages with safety. According to GREENE (2008) the specification of this model would be:

$$\begin{aligned} y_{i,t} &= \mathbf{x_{i,t}\beta} + \boldsymbol{\alpha}\mathbf{h_{i,t}} + \varepsilon_{i,t} \\ &= \mathbf{x_{i,t}\beta} + a_i + \varepsilon_{i,t} \end{aligned} \qquad \mathbf{8}$$

Where it is noted that $y_{i,t}$ does not depend on lagged cost $y_{i,t-1}$. In this case there is no "*inertia*" in $y_{i,t}$. The effects of unknown variables not included $\mathbf{h_{i,t}} = a'_i - \boldsymbol{\gamma}\mathbf{z_{i,t}}$ are treated exogenously.

5. RESULTS

The estimation results of the two models for the DEC and FEC have been calculated from the data of public audience 023/2014 organized by the National Electric Energy Agency[11] (ANEEL). The number of data set consists only of CAPEX values of the second cycle of periodic revisions of power distributors extrapolated to the year 2012 for the third cycle results. Thus the data used in the sample represent a balanced panel from 2005 to 2012, to amount of 61 (of 63) Brazilian power distributors, totaling a sample of 488 observations.

The estimated models take into account the behavior of costs according to the DEC assumption is correlated with TOTEX and the FEC is correlated only with the CAPEX, given the particular nature of each indicator. The DEC depends on the investments and so much of the OPEX, just watch with the duration of interruptions is strongly related to the time spent for repair of power outages, and the FEC is particularly dependent on investments so not be affected by OPEX.

The set of considered instruments included the following variables: Market weighted revenue for each voltage level, kilometers of total network, number of users, FEC performed (DEC performed when the setting involve FEC), a dummy equal to 1 if the FEC performed is lower than the target FEC (or equal to 1 is performed DEC is less than the target DEC, in the case of setting involve FEC). The summary of the adopted models are as follows:

[11] See:

http://www.aneel.gov.br/aplicacoes/audiencia/dspListaDetalhe.cfm?attAnoAud=2014&attIdeFasAud=938&id_area=13&attAnoFasAud=2015 – acessed at 12-12-2015.

i. **Relation between the DEC and the TOTEX:**

$$\ln(TOTEX)_{i,t} = \mathbf{x}_{i,t}\boldsymbol{\beta_1} + \mathbf{z}_{i,t}\boldsymbol{\beta_2} + \nu_i + \epsilon_i \qquad \mathbf{9}$$

$$\ln(TOTEX)_{i,t} = \boldsymbol{\beta_0}\ln(TOTEX)_{i,t-1} + \mathbf{x}_{i,t}\boldsymbol{\beta_1} + \mathbf{z}_{i,t}\boldsymbol{\beta_2} + \nu_i + \epsilon_i \qquad \mathbf{10}$$

where:

$$\mathbf{x}_{i,t}\boldsymbol{\beta_1} = [\ln(DEC_a) \quad LIM_D] \cdot \begin{bmatrix} \beta_{11} \\ \beta_{12} \end{bmatrix} \qquad \mathbf{11}$$

$$\boldsymbol{z}_{i,t-p}\boldsymbol{\beta_1} = [MP_t \quad REDE_t \quad CONS_t \quad \ln(FEC_a)_t \quad LIM_{F_t}] \cdot \begin{bmatrix} \beta_{21_p} \\ \beta_{22_p} \\ \beta_{23_p} \\ \beta_{24_p} \\ \beta_{25_p} \end{bmatrix} \qquad \mathbf{12}$$

ii. **Relation between the FEC and the CAPEX:**

$$\ln(CAPEX)_{i,t} = \boldsymbol{x}_{i,t}\boldsymbol{\beta_1} + \mathbf{z}_{i,t-p}\boldsymbol{\beta_2} + \nu_i + \epsilon_i \qquad \mathbf{13}$$

$$\ln(CAPEX)_{i,t} = \boldsymbol{\beta_0}\ln(CAPEX)_{i,t-1} + \mathbf{x}_{i,t}\boldsymbol{\beta_1} + \mathbf{z}_{i,t-p}\boldsymbol{\beta_2} + \nu_i + \epsilon_i \qquad \mathbf{14}$$

Where:

$$\boldsymbol{x}_{i,t}\boldsymbol{\beta_1} = [\ln(FEC_a) \quad LIM_F] \cdot \begin{bmatrix} \beta_{11} \\ \beta_{12} \end{bmatrix} \qquad \mathbf{15}$$

$$\boldsymbol{z}_{i,t-p}\boldsymbol{\beta_1} = \left[MP_{t-p} \quad REDE_{t-p} \quad CONS_{t-p} \quad \ln(DEC_a)_{t-p} \quad LIM_{D_{t-p}}\right] \cdot \begin{bmatrix} \beta_{21_p} \\ \beta_{22_p} \\ \beta_{23_p} \\ \beta_{24_p} \\ \beta_{25_p} \end{bmatrix} \qquad \mathbf{16}$$

9 and 13 models are simple panel models, since models 10 and 14 assumes the dynamic argument proposed by ARELLANO and BOND (1991), where the number of lags was chosen in this case to be p = 2. Observing these equations, the expected signal to β_1 coefficient is negative, i.e., if the DEC (FEC) increases costs should fall, revealing a negative substitution ratio.

The $\mathbf{z}_{i,t}\boldsymbol{\beta}_{\mathbf{2}} = \boldsymbol{\alpha}$ is an intercept term, can have any signal. If negative, it indicates that business costs that reach the targets are on average – X % lower than those who do not reach the goal, revealing that the best quality practices are linked to the best costs practices. If the signal is positive, it indicates that those with better quality on average operating at a higher cost than the average, and for this group the average cost is higher. Thus the results are:

Model	**DEC**		**FEC**	
Est.	Model (9)	Model (10)	Model (13)	Model (14)
L1.TOTEX	0,790*** (0,040)			
L1.CAPEX			0,911*** (0,013)	
ln(DEC)	0,028 (0,026)	-0,342*** (0,065)		
ln(FEC)			0,035*** (0,010)	-0,460*** (0,125)
lim.DEC	0,011 (0,019)	-0,483*** (0,089)		
lim.FEC			-0,020* (0,010)	-0,743*** (0,199)
Cte	2,428*** (0,504)	13,033*** (0,220)	0,929*** (0,157)	12,539*** (0,459)
Prob > F	-	0,000	-	0,000

The above results indicate that the models 10 and 14 on both DEC and for FEC are not significant. That said it is observed that when treated together the term of inertia and quality indicators lack statistical significance. Therefore it is not possible to estimate the elasticity of costs when applying a dynamic model, implying that the trajectory of reducing costs and improving quality indicators not jointly explain the cost level of Brazilian concessions.

One possibility that can't explain the significance of the dynamic model is the lack of observations over time. Then it could be biased by the lack of degrees of freedom. Another important assumption is to assume that there is no correlation between cost reduction and quality improvement trajectories. In this case it would be characterized a significant statistical "*trade-off*" between adjustment strategies that can result in the deterioration of the performance indicators of the regulated businesses.

By comparison models without dynamic terms have great significance. Thus, considering the effect of improving the quality of the costs it is noted that the signs of the estimators are correct and that from them it is possible to estimate the elasticity of substitution between costs and improving quality indicators, without however correlate this impact with cost trajectories. Thus the assumptions of the analyzes that follow are based on the assumption that costs are related to the quality only, regardless of the effects of the derived cost savings from implementation of other components of the X – factor, especially the T component that affects OPEX causing effects on the estimates of the adjustments relative to DEC.

To compare the empirical estimates to the results of the amounts recognized by ANEEL, it takes the average participation of the CAPEX on the distributors in Brazil, weighted by TOTEX between 2005 and 2012 amounting to 47.5%. On this case the elasticities for the estimators of the FEC will be multiplied by this term to reflect the impact of CAPEX on total costs. Comparisons were made with models 9 and 13:

			DEC			
Variation	Q ANEEL - Blue	Q ANEEL - Green	Q ANEEL - Red	Q ANEEL - Purple	Model don’t meet the pattern	Model meet the pattern
-20%	-1,67	-1,04	-0,90	-1,00	-6,85	-7,33
-15%	-1,33	-0,78	-0,68	-0,83	-5,13	-5,62
-10%	-1,00	-0,52	-0,45	-0,67	-3,42	-3,91
-5%	-0,67	-0,26	-0,23	-0,50	-1,71	-2,19
0%	-0,33	0,00	0,00	-0,33	0,00	-0,48
5%	0,00	0,26	0,23	-0,17	1,71	1,23
10%	0,13	0,60	0,64	0,00	3,42	2,94
15%	0,27	0,90	0,96	0,33	5,13	4,65
20%	0,40	1,20	1,28	0,67	6,85	6,36

			FEC			
Variation	Q ANEEL - Blue	Q ANEEL - Green	Q ANEEL - Red	Q ANEEL - Purple	Model don’t meet the pattern	Model meet the pattern
-20%	-1,67	-1,04	-0,90	-1,00	-4,37	-5,12
-15%	-1,33	-0,78	-0,68	-0,83	-3,28	-4,02
-10%	-1,00	-0,52	-0,45	-0,67	-2,19	-2,93
-5%	-0,67	-0,26	-0,23	-0,50	-1,09	-1,84
0%	-0,33	0,00	0,00	-0,33	0,00	-0,74
5%	0,00	0,26	0,23	-0,17	1,09	0,35
10%	0,13	0,60	0,64	0,00	2,19	1,44
15%	0,27	0,90	0,96	0,33	3,28	2,54
20%	0,40	1,20	1,28	0,67	4,37	3,63

In the tables above we see that the models estimated by ANEEL recognized – under the analysis of assumptions adopted without the inertial term – *less costs than would be appropriate for the improvement of quality indicators*.

Nevertheless it is noted that both, the empirical reward, and the punishment for breaches of the quality goals are greatly increased. For the most feasible performances between -5% and 5% strong differences are noted. *It is believed in this case that the regulatory incentive is undersized*.

6. CONCLUSIONS

This paper demonstrated that the regulatory incentive to improve the quality of service provided by power distribution utilities in Brazil can be changed in order to provide greater penalties or incentives to improve the quality of service.

The principle of regulatory parsimony can make little regulatory feasible volatilities estimated empirically, when it applies the tariff recognition of companies, either by volatility in tariffs factors, whether the eventual extraction of the tariff increases for tariff setting methodologies.

It is noteworthy that the proposed results are not limited to the treatment of other regulatory incentives involving a reduction in operating costs, which are ultimately important sources of "*trade-offs*" particularly in the case of DEC.

It is characterized unless the restrictions of statistically significant model used to analyze the regulatory incentive introduced in Brazil to improve quality indicators is not enough to "*offset*" the expenses incurred by the distributors in improving the technical quality indicators in the short term.

In the long run it is important to point it out that the regulatory incentive to improve the quality must tend to be zero, "backed the operational characteristics of the companies and exogenous factors that affect the quality such as the weather." This is important as there are operators that can serve as a reference for others in more mature concession areas. The concessions tend dynamically become saturated when its quality index going to stationary state.

Thus the benchmark of quality is not actually bad, but it needs to capture the short-term needs of the less mature concession areas, especially where there is still much work to be done for yours difficulties. The economic and financial balance of concessions can't be threatened by performance awards that do not face the same short-term improvement challenges.

7. CONFLICTS OF INTEREST

The opinions described on this academic work don't represent the institutional view of ENERGISA Group, shareholders, managers and controllers.

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