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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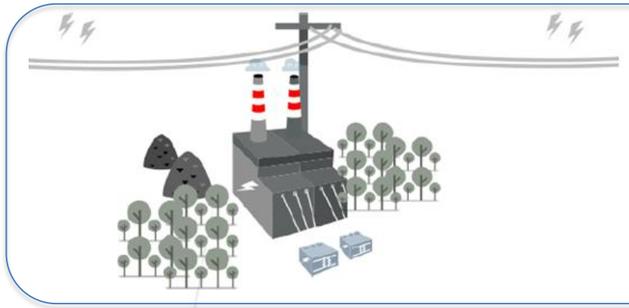
01 Brazilian distribution market

A great challenge for a very diversified country

In 2015 the electric energy generation market had 4.048 companies, with an installed capacity of 136 GW. 74 % of capacity come from renewable sources mainly hydro.



Brazil has the largest integrated transmission system centrally operated in the world (126 X 10^3 Km)! “The national interconnected system” contributes to optimize the energy dispatch considering the cascade effect of the hydro power.

The distribution system has 3,5 million kilometers. That’s sufficient to give 875 turns on the earth equator line. The electric distribution services supply energy to 99,9 % of Brazilian houses.

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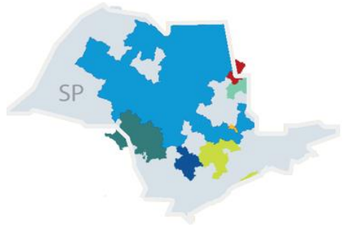
01 Brazilian distribution market

And!

The Brazilian market is very heterogeneous! Regional differences are also extremely high! For instance:

State of S.Paulo (southeast Region):



The yellow region in the State of São Paulo State has 1,6 million consumers, with a market of 16 TWh and US$ 0,7 billion of revenue on his 6,2 thousand Km^2 concession area. This area is one of the most dynamic economic regions of Brazil. The DISCO that operated in this area presents a ***very high quality standard***.

State of Amazonas (North Region):

The red area is the Amazonas Brazilian State, and one of the largest State of Brazil. The electric company that operates in this area has 700 thousand consumers, with market of 6 TWh, and US$ 0,4 billion of revenue on his 560 thousand Km^2 concession area. Due mainly to social economic factors it presents low level of quality standards.

02 Iberian capital invested in Brazil

There’s a high Iberian investment in the Electric Distribution Brazilian market

EDP Escelsa is the largest distributor in Espirito Santo State. It has 1,38 million consumers, with an energy market of 10 TWh.
EDP Bandeirante is 4th largest distributor in São Paulo State. It has 1,73 million consumers, with an energy market of 16 TWh.

Elektro is a 3th largest distributor in São Paulo State, and is directly controlled by Iberdrola. It has 2,5 million consumers, with an energy market of 13 TWh. Elektro is for 2nd year the Better Company of Brazil, for work!

Iberdrola also have 39% share of Neoenergia Group. Neoenergia is the 4th largest distribution group in Brazil. Combined the three DISCOs they have 10,5 million consumers, with a market of 37 TWh.

The Endesa, now incorporated in Brazil by Italian Enel, has two concessions with 5,7 million consumers and a market of 23 TWh.

02 The Energisa Group

Areas Energisa Group operates in

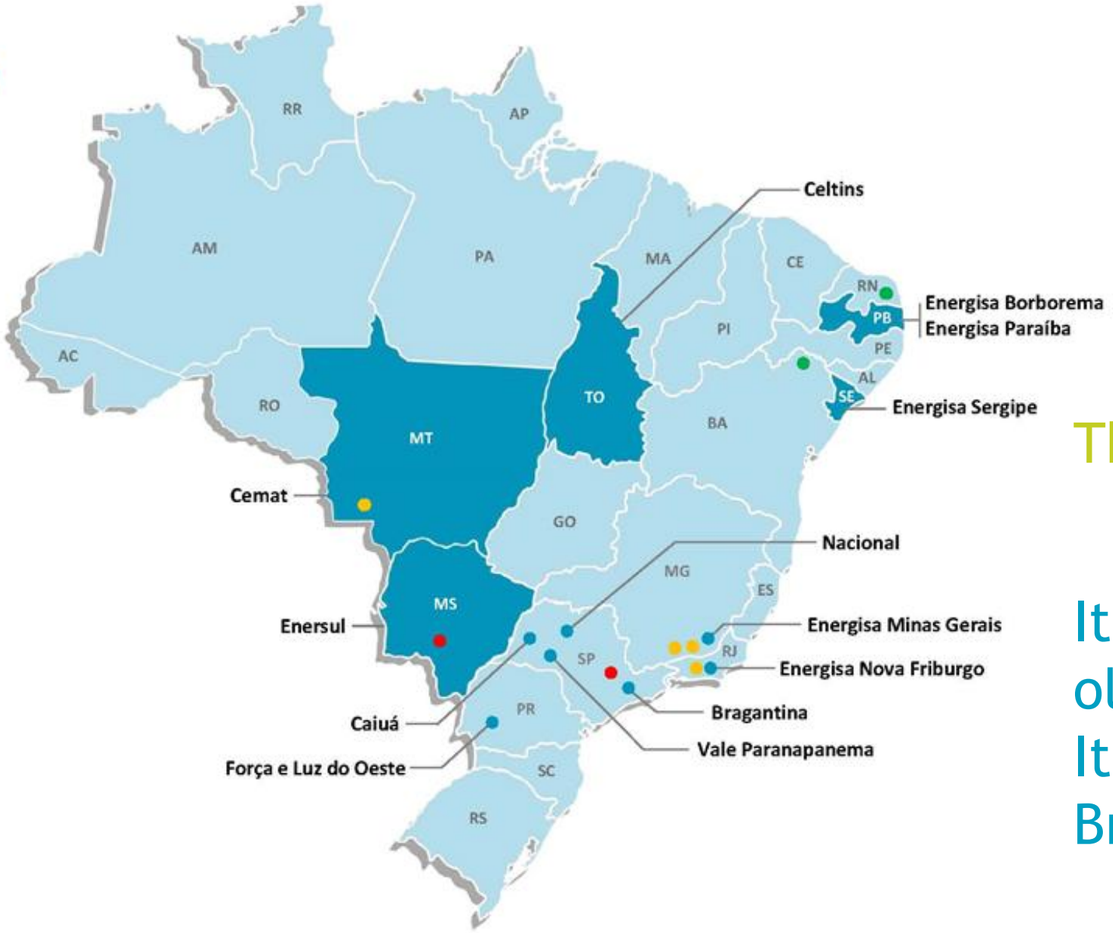
- ✓ 13 energy distribution concessions across Brazil

788
municipalities served

6.2 million
clients

16.0 million
people served
(8.2% Brazil)

1,630,000 Km²
Total area covered



The Energisa Group:

It is a 100% Brazilian Company! The oldest one in the Distribution sector. It has 111 years. It is the 5th largest Brazilian distribution group.

03 Regulation of technical quality in Brazil

How our regulator (ANEEL) think?

Incentive mechanism:

Brazilian market has 63 distributors, and they are compared by benchmarking techniques. All of them compete for better tariffs. Quality indicators affect directly the amount of recognition.

$$X = P_d + T + Q$$

The Brazilian mechanism incentive is an **RPI - X** procedure. Basically we recalculate the productivity share compounds in events called tariffs revisions, and apply the X factor on the annual tariff adjustments.

How operate the Q component?

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

How operate the Q_T component?

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

03 Regulation of technical quality in Brazil

How our regulator (ANEEL) think?

Indicator	Definition	Regulamentation
DEC	Equivalent duration of interruptions per unit consumer (in hours).	Module 8 of PRODIST
FEC	Equivalent frequency of interruptions per unit consumer (in times).	Module 8 of PRODIST

1st Question: **How DEC and FEC indicators affect the Q_T factor?**

There are calculated the percentage variation of both indicators:

$$\Delta I(\%) = \frac{I_{t-1}}{I_{t-2}} - 1$$

If this variation is positive – *worst quality* – the tariff adjustments reduces the tax appropriation by the companies (taxes fallen). And if this variation is negative the taxes increase.

2nd Question: **And what's the problem?**

The problem is that: "The appropriation of this benefice don't are empirically estimated, and don't treat the trade offs between the costs incurred"

03 Regulation of technical quality in Brazil

How can we calculate the Q factor?

1st step

- The targets of individual assembly are building for clustering method by dynamic Euclidian method.
- The 2nd decil is the individual target for each assembly and the global target is defined by the weighed sum of individual targets with reference on number of consumers.

2nd step

- The distributors are separated in large (market ≥ 1 TWh/year) and small (market < 1 TWh/year).
- After the distributors are separated in: I – Companies that meet the pattern; II – Don't meet the pattern.

3rd step

- The distributors are ranked in order to performance of quality. It's important to segregate the best practices.

4th step

- Is computed ΔI(%) of each indicator (technical and commercial) and applied in the **reference equations**.

5th step

- Is computed the Q factor by the sum of each indicator.

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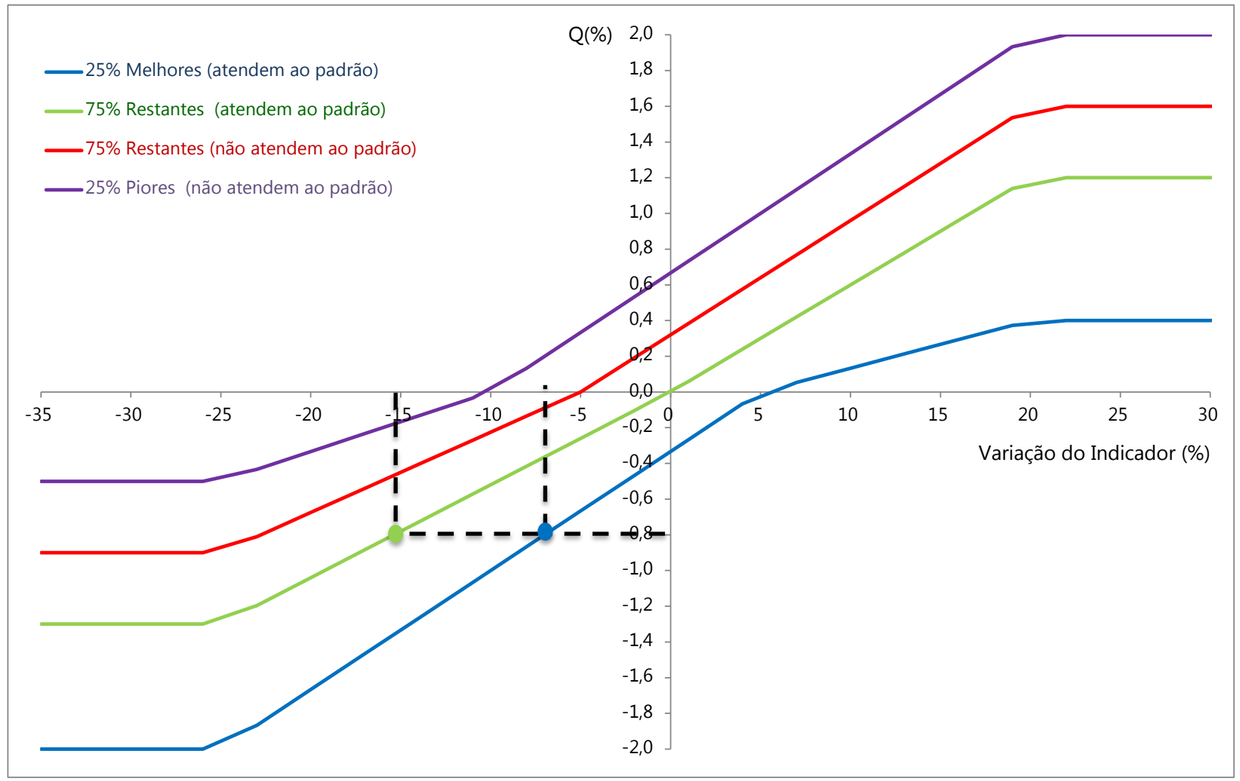
03 Regulation of technical quality in Brazil

Graphic example for DEC:

Imagine Q_{DEC} = -0,8 %

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%	$Q(\Delta I\%) = 2{,}0000$

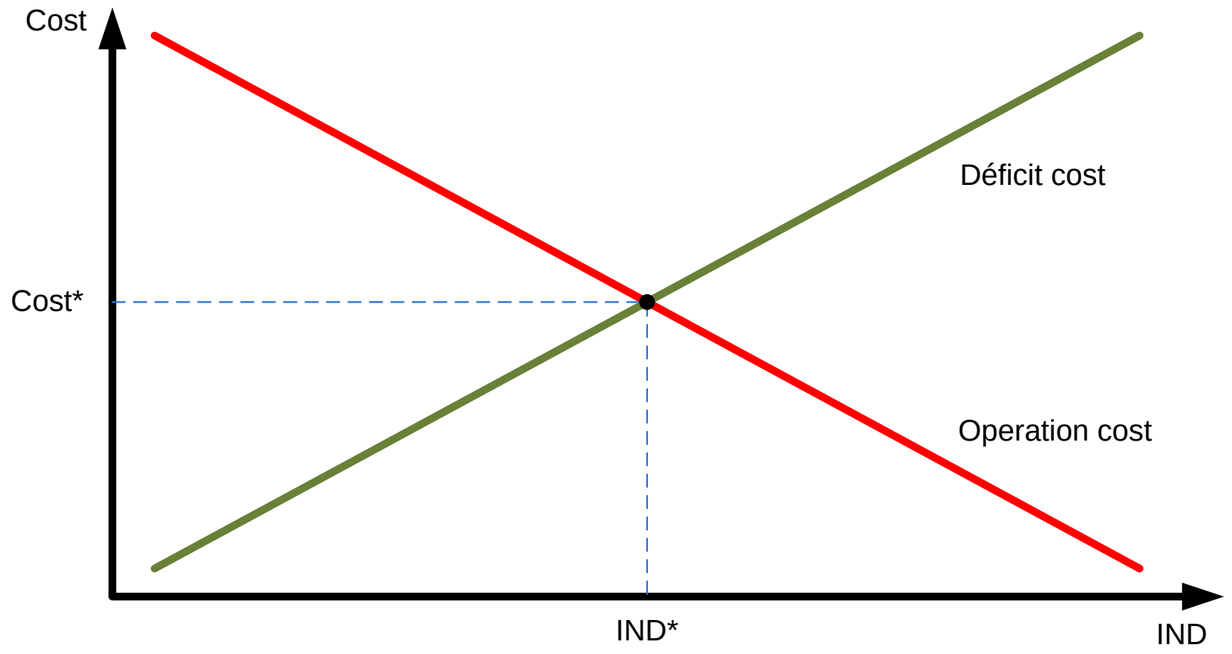


04 Methodology

Theoretical discussion on the quality demand and offer:

3rd Question: **Is the consumer disposed to pay for a better quality?**

"**No!** Different consumers have different valuations of cost! Principally of cost default. For example a steel company have a expensive cost, and it is so different for a farm residential consumer!"



Theoretically we have an optimal level of quality! But the deficit cost is difficult to estimate.

This work treat only about the operation cost because is easy compute the elasticity between the costs and the variation of the indicators if we use a robust statistical model.

04 Methodology

Empirical adjustment equations:

$$y_{i,t} = \mathbf{x_{i,t}}\boldsymbol{\beta} + \delta y_{i,t-1} + c_i + \varepsilon_{i,t}$$
$$= \mathbf{w_{i,t}}\boldsymbol{\theta} + a_i + \varepsilon_{i,t}$$

Arrellano and Bond (1991) estimator of a fixed effects panel autoregressive linear adjustment by GMM technique proposed first by Hansen (1982), because $E(\varepsilon_{i,t}|\mathbf{x_{i,t}}\boldsymbol{\beta}) \neq 0$, when $y_{i,t-1}$ term exists.

Panel estimator of a **fixed effects linear adjustment by GMM technique.** In both models we isolated the effects of another cost drivers. Inside the model we have only quality effects.

$$y_{i,t} = \mathbf{x_{i,t}}\boldsymbol{\beta} + \boldsymbol{\alpha}\mathbf{h_{i,t}} + \varepsilon_{i,t}$$
$$= \mathbf{x_{i,t}}\boldsymbol{\beta} + a_i + \varepsilon_{i,t}$$

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05 Results

Empirical adjustment CAPEX and OPEX computations:

OPEX adjustment:

The adjustment of OPEX is make on the basis of the values informed in “RIT” (trimestral informative of accounting information). Accounting with the principles of MCPSE (manual of accountability of electrical sector). Corresponds of the sum of these sub amounts: **615.03.X.X.X and 615.05.X.X.X.** For: **people, materials, third part services, others operational costs, tributes, insurances and labor lawsuit.** According to annex I to NT 185/2014-SRE/ANEEL.

CAPEX adjustment:

The calculation of CAPEX is given by the sum of the gross return on capital and depreciation in the year **t**, where:

$$REM_i = WAAC_{pré} \times BRR^i_{Líq}$$

$$DEP_i = Tx_{dep} \times BRR^i_{Brut}$$

According to the constant adjustments in Annex II to NT 185/2014-SRE/ANEEL. BRR is the remuneration basis, and computes the sum of all assets immobilized, and is adjusted by “***New value of reposition methodology***”

05 Results

Empirical adjustment of empirical models:

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

05 Results

Impact Q_{DEC} (in % by model 10):

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

05 Results

Impact Q_{FEC} (in % by model 14):

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

06 Conclusions

Impact FEC:

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.

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.

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.

07 Next steps

How we can estimate the deficit cost in Brazil?

The fundamental next step is estimate a more reliable equation to compute the deficit cost **for each concession**.

It’s possible construct a model that’s optimize the quality based on the representative consumer needs and reduces the regulatory trade off.

One possibility is correlate the deficit cost with the GDP variation of each concession, but this perception is still embryonic.

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