

# **Historical Analysis of Institutions and Organizations: The Case of the Brazilian Electricity Sector**

Guilherme Signorini<sup>1</sup>

H. Christopher Peterson

Scholars have argued that the New Institutional Economics (NIE) has not yet provided causal explanations on how long institutions persist or why and how they suffer dramatic changes. Others have stated that evidence is still inconclusive to define a theoretical justification on how changes and development occur. In light of these claimed criticisms, this paper focuses on the institutions of the electricity sector in Brazil, aiming to heighten the body of empirical research in NIE and produce satisfactory explanations that motivate theory refinement. Based on a qualitative approach, we find that the drivers of the first institutional change in Brazil's electricity sector were related to initiatives of market protection and domestic industrial support. For the second institutional change, economic recession (country at stage of bankruptcy, debt crisis, and high inflation rates) and reliability of utility services were the driving factors. We hope this study consistently systematizes historical facts and helps create grounds for our understanding of institutional evolution and economic growth.

Keywords: power market, utilities, regulation, intervention, Brazil

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<sup>1</sup> Corresponding author: Ph.D. student, Department of Agricultural, Food, and Resource Economics (AFRE), Michigan State University, 458 W. Circle Dr., room 200 Cook Hall, East Lansing, MI 48824, [signorin@msu.edu](mailto:signorin@msu.edu).

## Introduction

The New Institutional Economics (NIE) literature has lately paid great attention to understanding how institutions change and how they cause economic growth. Successful changes are interpreted by theorists as those able to foster sustained growth and social progress in countries or specific industries within economies. It is further claimed that economic development only happens if: (i) institutions support exchange by lowering transaction costs and encouraging trust, and (ii) institutions influence the state to protect private property and persons rather than expropriate and subjugate them (Shirley, 2005).

Seminal papers written by the Nobel Laureate Douglass North have shed some light on these social phenomena. North (1990; 1994; 2005) defines institutions as ‘humanly devised constraints that shape human interaction’ (1990 p.3); and explains that institutions are continuously changing at the margin, without affecting the core of cultural aspects or the set of beliefs intrinsic to an economic sector or country.

More specifically, marginal institutional change and economic development integrate a never ending cycle: a small adjustment in institutions generates new opportunities for economic agents to refine business strategies; once the refined set of strategies is implemented, economic agents force a new round of institutional adjustment; if institutions are aligned with the two conditions posed above, social development takes place as economic agents perform activities in a more efficient manner (decreased transaction costs) and are incentivized to produce and innovate (protected intellectual property, for instance).

Despite the great acceptance on North’s view, scholars have argued that the NIE has not yet provided causal explanations on *how long* institutions persist or *why* and *how* they suffer dramatic changes (Arrow, 1999; Ménard & Shirley, 2005). Besides, Shirley (2005, p. 631) states

that few empirical ‘studies have attempted to grapple with the messy details of real institutional change’; and therefore, evidence is still inconclusive to define a theoretical justification on how changes and development occur (Jütting, 2003). In light of these claimed criticisms, this paper focuses on the institutions of the electricity sector in Brazil, aiming to heighten the body of empirical research in NIE and produce satisfactory explanations that motivate theory refinement.

The Brazilian electricity sector provides a particularly interesting case for three reasons: (i) in less than a century, the sector experienced two dramatic institutional changes – the first towards centralization and the second towards market economy (Baer, 2008; Leite, 2009); (ii) the second major change was conducted through the national privatization program (1995-2001) and the electricity sector reform (1995-1998), which re-structured the entire institutional framework (Feldman, 1998; Ferreira, 2000; Pinheiro & Giambiagi, 2000); and (iii) the latter reformulation of institutions along with some financial support has created incentives for production and consumption of renewable electricity (Almeida, 2005; Castro et al., 2008; Fava Neves & Conejero, 2009), which can be analyzed as economic growth and progress in environmental protection.

Put differently, the case characterizes a rich setting for reviewing *why* and *how* formal institutions of electricity were fundamentally redefined twice (Leite, 2009). This paper therefore focuses on the historical facts that led the government, in the first moment, to take control over utilities of generation and distribution; and in a second moment, to restructure the institutional environment with incentive-driven policies. Based on a qualitative approach, our objective is to provide compelling empirical evidence for *why* dramatic institutional changes occur and *how* these changes influence development.

The remainder of the paper is organized as follows. Section 2 introduces the analytical methodology and data. Section 3 reviews the empirical literature in institutions and institutional change. Section 4 analyzes the historical evolution of institutions governing the Brazilian electricity sector. Section 5 discusses about the implications of the second major institutional change. Section 6 summarizes the findings, recognizes limitations, and suggests future research in the field.

## 2. Analytical Methodology and Data

This paper uses case study (Yin, 2009) as the research methodology to evaluate the institutional evolution of electricity and its implications. There are, at least, two strong arguments for using case studies rather than alternative methodologies when the purpose is to analyze institutions. First, measurement errors and reverse causality problems are likely to emerge if econometrics models are implemented (Aron, 2000). The reason is twofold: (i) institutions are not exogenous to the development process and the use of instrumental variables has proven to be a difficult task (Jütting, 2003); (ii) institutions and reforms are path dependent and causality often runs both ways simultaneously. Second, case studies are capable of providing causal explanations to entangled real-life occurrences without having to rely on the notion of *ceteris paribus*. In other words, case study is appropriate if one is willing to maintain the holistic and meaningful characteristics of real-life events without controlling related and interesting variables.

Case study corresponds to a research methodology that provides guidance for rigorous data collection, presentation and analysis. As Yin (2009) suggests, case study fits best for

qualitative analysis if: (i) research focuses on *why* and *how* questions, (ii) researcher is interested in contemporary context, and (iii) investigator has no control over the set of events analyzed. The author adds that case studies are appropriate for situations in which multiple sources of evidence and prior theoretical propositions are considered to guide data collection and analysis.

This paper matches the three conditions mentioned. From an outside perspective, it reviews *why* and *how* Brazil implemented two institutional reforms in the electricity sector in less than a century. Following the inductive approach, we suggest that adding other case studies to this historical analysis might enhance our ability to refine existing theoretical models that attempt to predict how institutions evolve.

Data collection was based on two sources: (i) extensive literature review; and (ii) key informant interviews. Two authoritative studies (Baer, 2008; Leite, 2009) provide the foundations of the historical background. For more recent years, additional sources were included in the literature review as they provide important descriptions to the sequence of facts analyzed (Feldman, 1997; 1998; Ferreira, 2000; Pinheiro & Giambiagi, 2000). The current regulation governing transactions between utilities of generation and utilities of distribution and between utilities and independent consumers was collected from publications and websites of related political bodies (i.e. Ministry of Mines and Energy, ANEEL, CCEE, and ONS).

Primary data was also collected from a series of structured interviews conducted between May 25<sup>th</sup> and July 16<sup>th</sup> of 2010. The interviews were conducted with sector experts who represent a range of interests. In total, we interviewed fifteen people: seven decision makers at utilities; five members of consulting companies/market facilitators; one project manager from a design-building company; one member of CCEE (coordinating agency of the wholesale market

of power, in Portuguese); and one member of ONS (National System Operator). The following section reviews empirical studies that look at institutions and institutional changes.

### 3. Literature Review

Several studies have attempted to provide plausible explanations to what factors drive institutional reforms that in turn set the arena for economic progress (La Porta et al. 1997; 1998; 1999; Nugent & Robinson, 2002; Greif, 1994; Bardhan, 2000; Rodrik, 2000; Keefer & Vlaicu, 2004).

La Porta et al. (1997, 1998) confirms that formal institutions matter for the economic growth of a country. The authors compared the effect of the legal environment on the size and efficiency of capital markets across countries. Among other results, the authors conclude that common law countries are better equipped to protect financiers against expropriation by entrepreneurs. French-civil-law countries have the least developed capital markets as the legal system is not very efficient in safeguarding property rights. German- and Scandinavian-civil-law countries fall in the middle.

In another study La Porta et al. (1999) assesses the effect of several factors on quality of public institutions. The authors found statistically significant relationships between wealth, ethno-linguistic homogeneity, legal origin, and religion (control variables); and quality of institutions (response variable). To mention, wealthier, ethno-linguistically homogeneous, common-law, and predominantly protestant countries have better institutions in the sense of promoting economic development. In the paper, however, the authors do not address or even recognize that reverse causality might have been a methodological problem.

Focusing on the coffee industry in Latin-American countries, Nugent & Robinson (2001) use historical evidence to compare institutional evolution across countries. The authors review the institutions of the coffee industry in Costa Rica, Guatemala, El Salvador, Colombia, Brazil, and Venezuela; and based on a qualitative approach, conclude that the differences in institutional evolution observed in those countries are critically linked to the legal environment, geographic characteristics, and technology.

Grief (1994) conducts a comparative historical analysis of the relations between culture and institutional evolution. Specifically, the author compares how the Maghribis and the Genoese responded to the same organizational problem (i.e. alteration in the merchant-agent game due to expansion of their trade to areas previously inaccessible to them). While the former society adopted a collectivist system, the latter adopted an individualist system; which resembles that of contemporary developing countries and that of developed countries, respectively. The paper concludes that historical trajectories of institutions and economic growth are path dependent, and for that reason, studies addressing institutional change must understand the interrelations between culture, the organization of society, and economic growth.

Bardhan (2000) also finds evidence that institutions and strategies adopted by economic agents are path dependent. The author however suggests that the underlying reasons may differ from those pointed by Grief (1994). Focusing on the case of underdeveloped countries the author suggests that the institutional arrangement of a society is often the outcome of strategic distributive conflicts among different social groups. He argues that the distribution of power and power over resources may sometimes affect the way institutions are reformed, and consequently influence the way social progress occurs.

Rodrik (2000) emphasizes that there is no blueprint of an institutional design as countries with similar endowments can have different institutional evolution. The author recognizes that part of the reason is associated with path dependence; and adds that participation in the political system can also affect the way institutions evolve. The paper provides a range of evidence indicating that participatory democracies tend to have more predictable and stable institutional evolution, driving societies to higher quality growth.

Focusing exclusively in democratic countries, Keefer & Vlaicu (2004) question why some democracies perform better than others in the sense of obtaining faster and more stable economic growth. Based on a politics model, the paper concludes that the presence or absence of credible political competitors causes striking differences of institutional evolution.

In sum legal origin (La Porta et al., 1997; 1998; 1999; and Nugent & Robinson, 2001), wealth (La Porta et al., 1999), ethno-linguistic characteristics (La Porta et al., 1999), religion (La Porta et al., 1999), geographic characteristics and technology (Nugent & Robinson, 2001), past strategic decisions and culture (Grief, 1994), distribution of power and power over resources (Bardhan, 2000), and political systems (Rodrik, 2000; Keefer & Vlaicu, 2004) are factors that influence institutions and the way institutions evolve.

Nevertheless, a general explanation about what drives successful institutional reforms and consequent economic growth is still missing. Shirley (2005 p.634) adds that deeper analysis of institutions within developing countries is necessary. Next section focuses on the institutions and institutional evolution of the electricity sector in Brazil.



#### 4. Institutions of Electricity in Brazil

The evolution of Brazil's electricity sector is marked by a historical lack of consensus among governments about long-term economic policy. For over five decades (1934-1989), the government's involvement in the electricity sector prevailed and then started decreasing as the Constitution of 1988 was promulgated. With the new Constitution, a range of neoliberal policies were adopted including privatization of state-owned enterprises and reform of economic sectors.

In face with severe international debts and high inflation rates Brazil fell into recession between 1982 and 1984 (Baer, 2008). The plan of privatizing state-owned companies was seen as crucial for the raise of a long-term sustainable economy (Pineiro & Giambiagi, 2000). Privatization alone, however, would not fulfill the major goal of recovering the Brazilian economy. In parallel to the privatization program, several economic sectors in which the government was present as player (e.g. electricity, telecommunications, railroads, highways, petrochemicals, steel, fertilizer) had institutions restructured in order to effectively meet the directives of the new Constitution.

The reformulation of institutions of electricity in specific was not an easy task for the reasons highlighted by Spiller & Tommasi (2005)<sup>2</sup>. Not to mention, decision makers had the additional challenge of designing incentives for new enterprises of power generation to enter the field given that the major player (Brazil's government) was in process of privatizing its assets. In a parsimonious fashion, rule makers defined categories for utilities of generation and for final consumers of electricity, organized the marketplace as a dual-channel market, established

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<sup>2</sup> Three features define utilities of electricity included: (i) technologies are characterized by large specific, sunk, investments; (ii) technologies are characterized by economies of scale; (iii) products are massively consumed. The authors argue that these features are always source of controversy when institutions are to be implemented or modified (Spiller & Tommasi, 2005 p.518).

regulatory agencies, and provided autonomy for those agencies to formulate enforcement rules. Almeida (2005) suggests that the ultimate objectives of the Electricity Sector Reform (ESR) were to create a competitive wholesale market of power and to regulate transmission and distribution services<sup>3</sup>. Almeida's suggestion in fact matches almost perfectly to the analysis carried out in Joskow (1996).

The following sections review in-depth how the government became a player after the 1929 Great Depression, how it retired from the role of player more than six decades after; and how the institutional environment evolved to its current structure. The specific objectives here are to use Brazil's electricity sector as a case study to review the historical trajectory of institutional change and to fill what Shirley (2005) defines as a gap in the literature.

#### 4.1. Background

The negative effects of the 1929 Great Depression led occidental countries to adopt initiatives of market protection and domestic industrial support. Brazil was not an exception. State intervention in the electricity sector began with the Water Code (1934) which empowered Brazil's government to set electricity rates (Pompeu, 2006). The reason for this control was the fact that electricity rates had been partly indexed to international gold prices and partly to the domestic currency (Baer, 2008). As the Great Depression caused high volatility of gold prices and undervaluation of the Brazilian currency, power rates could easily go up and consequently bring electricity consumption down. Low electricity consumption in turn could adversely affect

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<sup>3</sup> Joskow (1996) refers to transmission and distribution services as 'wire' services. The same terminology is adopted from here on.

domestic production, which was one of the government priorities at that time to overcome the global depression.

Controlled rates of electricity were considered to be of national interest until the 1950s. For over three decades the government set relatively low rates as a mechanism of subsidy to industrial development. From one side, the rates policy (along with other policies created in the 50s) indeed stimulated industrial development and economic growth (Baer, 2008 p.66). From the other however, it repelled private enterprises of power generation and distribution that were operating in the country. In other words, the government's control over electricity prices limited private power generating firms and distribution utilities (mainly foreign<sup>4</sup>) from reaching adequate rates of return on investments (ROI) which in turn led them to leave the country. In face with a growing electricity demand (associated with the supported industrial development) the state had no other alternative but to gradually enter the fields of power generation and distribution.

Only two decades later, the state dominated the sector. In 1962, private companies accounted for 64% of the power generating capacity; in 1977 this proportion was reduced to less than 20%; and in 1982 almost all generation was run by state-dominated enterprises (Leite, 2009). Ferreira (2000) contends that the centralized model was justified not only to be consistent with government programs of economic growth but also to permit high levels of technical efficiency in a hydropower-dominated system. It is noteworthy to mention that the three largest operating dams in the country (Itaipu, Tucuruí, and Ilha Solteira, respectively) were built between 1967 and 1975 with government's financial resources.

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<sup>4</sup> Brazilian Traction Light & Power Co. and American & Foreign Power Co. (Canadian and American companies, respectively) owned 70% of the capacity of generation in the country at that time (Leite, 2009).

During the 70s and 80s three economy shocks associated with a sequence of poor financial strategies pushed Brazil into recession times with serious inflationary problems<sup>5</sup>. Government leaders believed that a large scale import substitution program (financed with international loans) was the best alternative to fight the first oil shock of 1973. The substitution program was set under the assumption that loans would be paid back as soon as the stimulated production was in place, declining imports and increasing exports. The reality, however, was not so: the second oil shock of 1979 and the interest rate shock of 1982 turned down international demand for Brazilian products and aggravated debts contracted few years earlier.

Storming debts and high inflation rates forced Brazil's government to venture its last attempt to overcome the inevitable crisis. Public enterprises, the last stable segment of the Brazilian economy, were used as tools of macroeconomic policies. Specifically, production of public enterprises (electricity, telephone services, iron, and steel) were used as instrument to control inflation. Companies were forced to borrow more on international markets than they needed in order to provide the government a continuous inflow of foreign exchange needed to cope with a deteriorating balance of payments (Werneck, 1987). Baer (2008) points out that, as result of those policies, the average electricity rate decreased by 40% between 1979 and 1984.

Economy shocks along with bad financial strategies left Brazil in a bankrupt state<sup>6</sup>. Regarding the electricity sector, the forced debt accumulation placed generating firms and distribution utilities in unsustainable financial situations. Moreover, increasing demand of power and frozen supply caused severe power shortages in the mid 1990s.

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<sup>5</sup> The country contracted numerous international loans in the 70s to finance construction and to overcome the crisis imposed by the first oil shock of 1973. Loans, however, were contracted based on flexible interest rates which were sharply increased in 1982 (triggered by the Volcker's policy in the US).

<sup>6</sup> Brazil required IMF (International Monetary Fund) assistance in December 1982. The austerity program continued between 1983 and 1984.

With the liberal directives of the new Constitution, privatization of state-owned enterprises and reform of several economic segments were given high priority to overcome the debt crisis and better match supply and demand of power. The positive effects of such initiatives were, however, only seen after 2001.

#### 4.2. National Privatization Program (1995-2001): First Tool of Institutional Change

The National Privatization Program (NPP) was one of the government initiatives launched to modernize the Brazilian economy through a general liberalization process. 'Privatization was seen as a safety net or bridge to stability, affording the country some leeway for resolving its two main disequilibria, the current account and fiscal deficits' (Pineiro & Giambiagi, 2000). Public enterprises of electricity, telecommunication, railroads, highways, petrochemicals, steel, fertilizer, as well as an aircraft manufacturing firm and a computer firm were all in the government's privatization list. The privatization process generated \$93.4 billion in revenues and the electricity sector alone accounted for 31.8% (\$29.7 billion) of the total (Coelho, 2000).

Privatization was conducted differently depending upon the economic sector. Law 8,031 of 1990 established formal procedures for the privatization process of every sector where public enterprises existed. This law introduced legal structures not only for private acquisition of existing enterprises but also for the establishment of a variety of new private firms (Feldman, 1997), including investments in power distribution grids and transmission network.

Five years later, law 8,987 provided general rules for the process of contracting private companies to operate public assets. In the electricity sector, privatization of generation facilities,

transmission grids, and utilities of distribution occurred through the settlement of long-term concession contracts between the government and private firms. This law also specified the rights and obligations of concessionaries.

Concession contracts of electricity enterprises were publicly auctioned between 1995 and 2000. The NPP privatized a total of 23 state-owned firms. There was, however, a clear improvement on specifying contracts over time (Ferreira, 2000). As contracts were individually drafted for every public enterprise being conceded, clauses were better specified as the regulatory reform proceeded (Pinheiro & Giambiagi, 2000). In other words, because concession of state-owned electricity facilities and the restructure of formal institutions were happening simultaneously, contracts drafted at the end of the five-year period were better specified than those written at the beginning of the privatization program.

Concurrent policymaking decisions caused reluctance among potential auction bidders. Leite (2009) suggests that there was a lack of interest in public auctions because during early stages of the electricity sector reform high levels of market uncertainty intimidated buyers: ‘auctions began before the complete definition of market regulations’ (p.54). For Feldman (1997) Brazil was experiencing a paradox of simultaneous growth, represented by the necessary privatization; and inertia, associated with the lack of interest and market uncertainty.

The close relation between the National Privatization Program and the Electricity Sector Reform seems to cause confusion even among energy economists and policy makers. While Ferreira (2000) associates the three formal laws (8,031; 8,937; 9,074) with the Privatization Program, Feldman (1997) relates the first two laws with the same program and the third with the Electricity Sector Reform. Either way, it is noteworthy to observe the close relation between these programs. Regulations of the electricity sector were written taking into consideration

definitions made through the laws associated with the NPP. Likewise, concession contracts were drafted based on the specific regulations as they were defined through the Electricity Sector Reform.

#### 4.3. Electricity Sector Reform (1995-1998): Second Tool of Institutional Change

The Electricity Sector Reform (ESR) and post amendments established a market that was, until then, missing. Until 1995 market competition was not observed and all categories of electricity consumers could only accept products and services offered by local utilities of distribution, all government-dominated. Rights and obligations of players, market regulations and mechanisms of enforcement were crafted from scratch. Incentives not only to generators but also to consumers of renewable electricity were created to diversify the electricity supply mix and to motivate entry of new power generating firms.

The Public Service law (law 9,074 of 1995) introduced the guidelines for free market competition in the electricity sector (Feldman, 1997). It formally defined electricity buyers and sellers, and their rights and obligations. Specifically, this law formalized the entity of Independent Power Producers (IPPs) just as the Public Utility Regulatory Policies Act did in 1978 in the United States. In addition, that law validated the entity of Independent Consumers (ICs) who can obtain 'wire' service from the local distributor and purchase power supplies directly from IPPs.

A questionable measure formalized through law 9,074 was that companies of generation, transmission, and distribution should be functionally separated or completely restructured through vertical divestiture. The measure partly meets the approach mentioned by Joskow (1996

p.361) to resolve coordination problems associated with abusive pricing strategies that could otherwise arise. Liberal economists, on the other hand, would argue that it prevents economic players from adopting the governance strategy that best matches the underlying attributes of transactions. Feldman (1997) suggests that the reason for this measure came from past experiences of other Latin American countries: ‘a combination of reform and unbundling has resulted in a third more closing and twice as much megawatt production, as opposed to cases where the reform has not been accompanied by unbundling’ (p. 5). Ferreira (2000) in turn relates the measure to the situation of four state-owned companies: ‘CESP, CEMIG, COPEL, and CEEE were not only responsible for 34.7% of the generation capacity in 1995 but also owned the largest assets of distribution across the country’ (p.207). As the country did not intend to concede operation rights along with monopoly power to concessionaries, these four state-owned companies had their assets divided among 15 smaller companies. Some of them are still controlled by a single holding but organized under different subsidiaries (Key informant interviews, 2010).

Regulations and enforcement mechanisms were indirectly introduced with the promulgation of law 9,427 in 1996 which formalized the creation of the Electricity Regulatory Agency (ANEEL, in Portuguese). ANEEL is an autonomous regulatory agency responsible for overseeing the electricity sector and for enforcing quality protocols over generation firms, transmission utilities and distribution utilities.

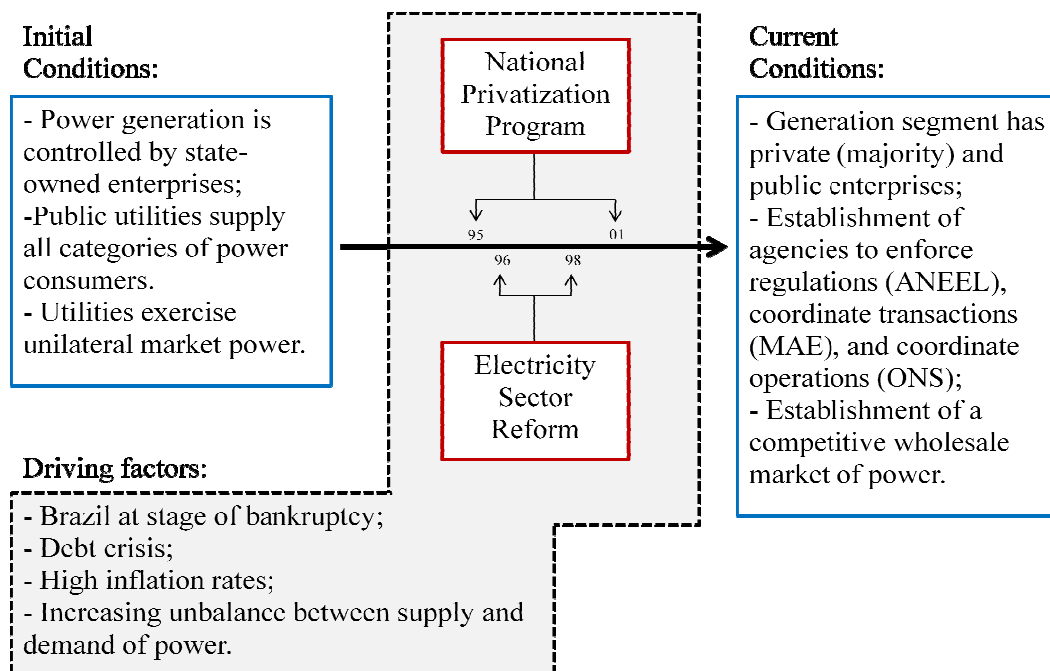
Law 9,427 also defined the entity of special consumers (SCs), a sub-category of ICs who are authorized to trade renewable electricity (e.g. small hydro, biomass, solar, and wind-based) directly with IPPs and to obtain ‘wire’ services from the local utility of distribution. This definition marks the beginning of the renewable electricity segment, the fastest-growing segment



within Brazil's electricity sector (Castro et al., 2008; Fava Neves & Conejero, 2009). Captive consumers are also defined under this law as final consumers of power who must accept prices and conditions offered by local distributors.

The law 9,648 promulgated in 1998 established two other political bodies and introduced the first incentive to SCs. First, it formally established the Wholesale Electricity Agency (MAE, in Portuguese), an organization responsible for assisting wholesale transactions among players (i.e. utilities of generation, IPPs, utilities of distribution, ICs, and SCs). Second, the law assigned the task of coordinating network operations to the National System Operator (ONS, in Portuguese). Finally, it introduced the first incentive for SCs of power: a 50% discount in 'wire' service rates. Figure 1 summarizes the conditions before and after the NPP and ESR; and what factors led Brazil to adopt these tools of institutional change.

Figure 1: Summary of Conditions and Driving Factors of Institutional Change



Source: Designed by the authors, 2011

#### 4.4. Later Institutional Changes

Out of the ESR scope, a set of major changes were still promulgated to formalize the specification of players and the new market design. Minor adjustments also took place after the conclusion of the ESR in order to stimulate new entry, especially in the segment of renewable electricity.

In 2000, an amendment of law 9,074 decreased the minimum load (capacity installed) required for independent consumers to trade directly with IPPs. Since then, ICs that have load of 3MW or higher have been authorized to negotiate and buy electricity from IPPs regardless of the input used for generation. Medium-sized firms and hospitals, for instance, are compatible with these requirements and trade directly with IPPs.

Under the same amendment, the entity of SCs had specifications formalized: SCs are final consumers with load of 500 kW or more who are allowed to trade directly with IPPs as long as the input used to generate power is renewable. Shopping malls, galleries, and museums for instance can easily meet these technical requirements and be categorized as special consumers. Final consumers with load equal or less than 500kW (e.g. households, small-sized firms) are considered captive and must be supplied by local utilities. The law also determines that ICs and SCs are allowed to accept prices and conditions offered by utilities of distribution rather than trading power themselves. Table 1 summarizes the definition of the economic agents in Brazil's electricity sector.

Table 1: Categories of Economic Agents in Brazil's Electricity Sector

<b>Economic Agents</b>	<b>Description</b>
- Utilities of generation	Concessionaries, private-owned, or government-owned firms responsible for generating power as determined by ONS.
- IPPs	Independent Power Producers. Private or public enterprises.
- Utilities of distribution	Concessionaires or government-owned firms responsible for providing services of distribution to captive consumers within a specific geographical region.
- Independent consumers (ICs)	Final-users with load of 3MW or more authorized by law to trade directly with IPPs.
- Special consumers (SCs)	Final-users with load of 500kW or more authorized to trade with IPPs based on renewable sources.
- Transmission utilities	Concessionaries and private companies responsible for transporting high voltage power from generating plants to utility-managed substations.
- Captive consumers	Final-users of electricity with load less than 500kW; Final-users with higher load who deliberately want to be provided by distribution utilities.

With the definition of economic agents in place, an additional rule was still necessary to complete the reformulation of institutions governing the electricity sector. The regulation 5,163 of 2004 played this role and formalized the marketplace as it currently is. The regulation has designed a dual-channel market in which utilities of distribution are enforced to purchase power through auctions, and the resulting mode of governance must be specification contract<sup>7</sup>. The same regulation has allowed ICs and SCs to coordinate transactions under a free channel using any governance strategy except spot markets. Also in 2004, CCEE (Chamber of Electrical Energy Commercialization) replaced MAE<sup>8</sup> with the mission of coordinating the dual-channel market defined through regulation 5,163.

Figure 2 below summarizes the organization of both regulated and free channels. It highlights transactions (green arrows) between generating firms, utilities of distribution, and

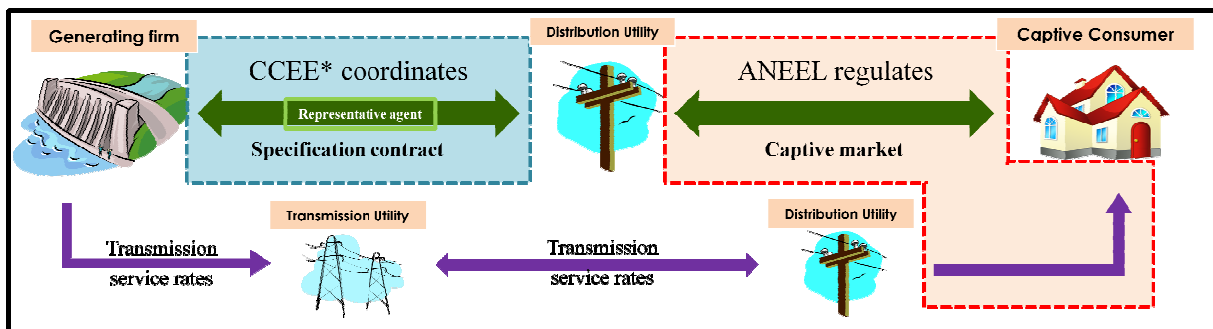
<sup>7</sup> Other governance strategies are allowed but limited to small shares of their load.

<sup>8</sup> Promulgated through law 10,848 of 2004.

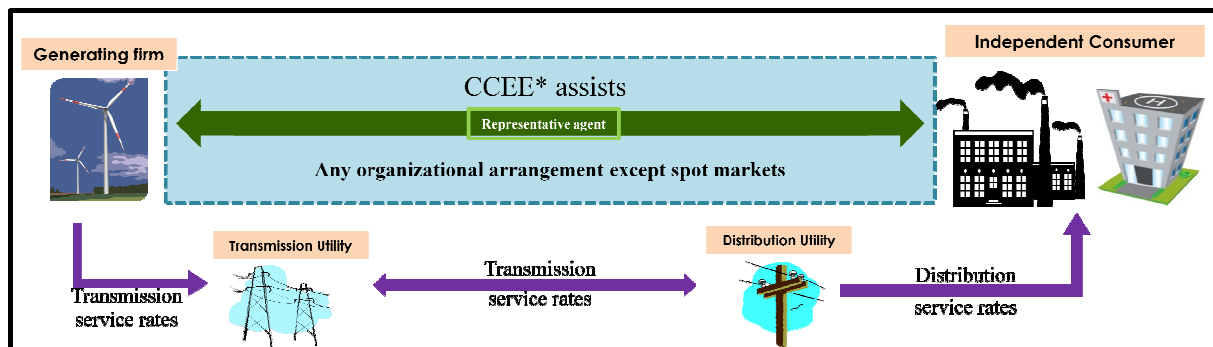
consumers of electricity. Blue-shaded boxes represent wholesale markets whereas the red-shaded box corresponds to captive markets. Purple arrows represent the flow of electricity.

Figure 2: The Dual-Channel Market of Power

▪ **Regulated Channel:**



▪ **Free Channel:**



Source: Designed by the authors, 2011

Minor institutional adjustments were implemented thereafter in order to stimulate production and consumption of renewable electricity. The ANEEL regulation 281 expanded the discount in ‘wire’ service rates to IPPs: similar to SCs, utilities of generation based on renewable sources that were established before 2004 receive a full exception in the service rate. The law 10,438 of 2002 expanded the stimulus even further and partially released renewables-based IPPs established after 2004 from paying the whole ‘wire’ service rate. Still, the law 9,991 of 2000

eliminated the R&D tax that biomass-, wind-, and small scale hydro-based generating firms had to pay.

Between 2002 and 2003 a national scale program took place to promote production of renewable electricity and solve the historical imbalance of supply and demand of power (that date from mid 1990s). The National Program of Incentives for Alternative Electricity Sources (*Proinfa*, in Portuguese) supported the construction of 63 small hydropower mills, 52 windmills, and 27 biomass-based generators with a total of 3,299MW (2.7% of the current capacity of generation). Financial and marketing advantages were given to Proinfa investors: (i) financial support of up to 70% of the total investment cost; (ii) reduced interest rates; (iii) acquisition of production guaranteed; and (iv) minimum price guarantee for the following 20 years. With the end of Proinfa in 2003, the Brazilian Development Bank (BNDES, in Portuguese) created a new line of credit that has provided similar benefits, except for the acquisition and minimum prices guarantee.

Table 2 summarizes the laws and amendments related to the redefinition of formal institutions governing the electricity sector in Brazil. In the following section, we discuss about the positive and negative aspects of the latter institutional reform.

Table 2: Laws and amendments related to the formal institutions of electricity in Brazil

<b>Law/Rule</b>	<b>Year</b>	<b>Details</b>
8,031	1990	- National Privatization Plan (NPP).
8,987	1995	- Rights and Obligations of conceded companies.
9,074	1995	- Definition of independent power producer (IPP); - Definition of independent consumers (IC); - Unbundling of generation, transmission and distribution segments.
9,427	1996	- Establishment of ANEEL; - Definition of special consumers.
9,648	1998	- Establishment of Wholesale Electricity Market (MAE); - Definition of ONS functions; - Creation of 50% discount in 'wire' rates for special consumers.
ANEEL 264	1998	- Independent consumers and special consumers may deliberately accept conditions imposed by distribution utilities and stay under captive markets.
ANEEL 281	1999	- Removal of 'wire' rates charged from IPPs based on alternative sources that become operational before 2004.
Amendment of law 9,074	2000	- Redefinition of independent consumers.
9,991	2000	- Elimination of R&D tax from biomass, wind, and small hydropower based firms.
10,438	2002	- Launch of <i>Proinfa</i> ; - Extension of the 50% discount on 'wire' rates to IPPs based on alternative sources that become operational after 2004.
10,847	2004	- Establishment of Electricity Research Company (EPE).
10,848	2004	- Establishment of CCEE.
Reg. 5,163	2004	- Definition of the current market design: creation of the regulated contracting channel, free contracting channel, and imbalance market.

Source: CCEE website (2011)

## 5. Implications of the Institutional Change

The NPP, ESR and later adjustments have intensively modified the industry structure as well as the opportunity set for economic agents. For instance, incentives (i.e. discounts in ‘wire’ service and R&D rates, and *Proinfa*) have stimulated the entry of numerous generating plants. As of 2012, there are 387 small hydropower plants, 41 biomass-based plants, and 56 windmills in operation that were not generating power before the institutional change. These power plants are mostly classified as IPPs (independent power producers) and participate with approximately 13% of the total capacity of generation in the country.

As result of the institutional reform, the entry of renewable electricity generators has not only diversified the energy mix but also decreased oil dependence for electricity production in the country (Castro et al., 2008). Previously, large scale hydropower plants dominated the segment with more than 80% of the generation capacity. As of 2012, there are 178 large scale hydropower plants in operation that account for approximately 67% of the total capacity installed (ANEEL, 2012). Besides, numbers indicate that diesel fuel-fired plants represent no more than 3% of the country’s power supply.

Incentives along with the dual-market design also motivated the entry of independent consumers. There are approximately 587 ICs and 967 SCs trading electricity through the free channel with demand of 982 TWh and 134 TWh per year, respectively (CCEE, 2013). It is noteworthy to remember that this segment of consumers was inexistent before 1995, and the only alternative available for final consumers of electricity was to accept prices and services offered by local utilities of distribution.

Commentators argue, however, that independent consumers might be exposed to additional procurement costs in the free channel as they need to identify counterparties, draft agreements and safeguards, monitor agreement performance, and so on. On the other hand, industry experts reply that ‘incentives not only offset procurement cost but also create marginal benefits for consuming renewable electricity’ (Key informant interviews, 2010).

In this sense the second institutional reform has created opportunities for some consumers to acquire more affordable electricity. By trading directly with power suppliers, independent consumers are able to alleviate unnecessary expenses that would be intrinsic to retail prices otherwise (i.e. margin of the utility and related transaction costs). This interpretation seems to be aligned with the existing NIE theory: economic development happens as institutional reforms lessen transaction costs.

The same might not be true for captive consumers (i.e. those with capacity of consumption of 500 kW or less) who can only accept prices and conditions imposed by local utilities of distribution. Households, a likely type of captive consumer, would be harmed if utilities decided to exercise unilateral market power in their conceded geographical area. To minimize the probability of such harm, the second institutional reform has established enforcement organizations that play pivotal roles in regulating retail prices and services. Specifically, CCEE organizes competitive-oriented auctions through which utilities must acquire the largest share of their aggregate demand; ANEEL estimates profit margins based on retail prices and auction prices; ANEEL compares those margins across all 64 operating utilities in order to ensure that profits fall within a specific range; also, ANEEL imposes operation standards so the service offered to captive consumers has a certain level of quality and reliability. Those regulatory activities, however, generate additional transaction costs that were absent



before the second institutional reform. Although convincingly necessary to balance Brazil's current account and fiscal deficits, the institutional reform of Brazil's electricity sector appears to have aimed economic growth at the expense of captive consumers; interpretation that might not corroborate with NIE theory predictions.

Put differently, the establishment of regulatory organizations (i.e. ANEEL, CCEE, and ONS) might seem appropriate on one hand but not on the other. On the first, regulatory oversight ensures that operations do not constitute reliability risk for the national network; that transactions between generators and utilities are competitive-oriented; and that unilateral market power of utilities is not exercised over captive consumers. On the other, the intensive use of enforcing organizations results in increasing transaction costs. That is true for households and distributors whose tax payments are partially used for covering running costs of regulatory organizations.

Interestingly enough, this latter implication appears to be aligned with structural reforms implemented in several other countries worldwide (Joskow, 1996). It also corroborates with the idea that successful institutions protect citizens against expropriation of rents. But, at the same time, it goes against Mary Shirley's suggestion (2005 p.611): 'to meet the challenge of development countries need an institutional framework that (...) foster exchange by lowering transaction costs'.

That is perhaps one good reason for our inability to define a conclusive theoretical justification on how institutional evolution and economic growth occur. Although the electricity sector in Brazil seems to have evolved positively in the sense of being more reliable, its empirical evidence suggests that a small share of electricity users have incurred reduced transaction costs (i.e. independent consumers, including special consumers) while others have faced additional expenses (i.e. captive consumers).

## 6. Concluding remarks

Numerous case studies have attempted to provide plausible explanations to factors driving institutional reforms. This study indicates a new set of causes and means for institutional change that had not been observed in earlier work. Specifically, economic recession (Brazil at stage of bankruptcy, debt crisis, and high inflation rates) and reliability of utility services were the main factors driving the National Privatization Program and the Electricity Sector Reform, initiatives for the second institutional change. These two initiatives (and related laws) have defined the foundations of Brazil's wholesale market of power and have promoted economic growth (when compared to conditions preceding these initiatives). Hence, this study attempts to fill the research gap suggested by Shirley (2005, p.634): that there are needs for further research of institutions in developing countries including research on what causes changes in norms of beliefs that underlie successful institutional reforms.

Our interpretation also indicates that the institutional evolution of Brazil's electricity sector may have concurrent favorable and unfavorable effects on economic growth. As supported by others (Pinheiro & Giambiagi, 2000), the reforms were important to balance off macroeconomic disequilibria (Pinheiro & Giambiagi, 2000) and to improve network reliability. But the reforms were contentious in the sense that they have created a favorable market design for independent consumers (i.e. with reduced transaction costs) but unfavorable for captive consumers who must incur certain costs that were absent in the first place.

There are, however, a few limitations that we could not overcome. Ideally, one would like to estimate and compare social, economic, and environmental conditions before the institutional change to conditions thereafter. In that way the effects of the institutional change

could be estimated, or at least, correlated to the social-economic growth and progress in environmental protection. As this paper covers a reasonably long time horizon, data has proven to be inexistent or of hard access for such estimation. Specific employment data and GHG emissions data for Brazil's electricity sector, for instance, appear not to be available.

Nevertheless, the analytical results of this paper might be aligned with other empirical studies (such as those reviewed in section 3) in order to identify a pattern of historical facts and changes. Once a pattern is determined, a tentative hypothesis might guide us towards refining the current NIE theory. Grounded theory (Corbin & Strauss, 1990; Strauss & Corbin, 1994) might be used as the analytical framework to help us identify patterns and specific issues not yet considered in theoretical models.

Finally, we would like to add that further advances can only be obtained if we investigators enhance the body of empirical knowledge and consistently systematize historical evidence in order to create grounds for refining well-accepted economic theories. We hope we have succeeded in doing so.

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