Transaction costs economics, property rights, and the strategies of the firms of the Brazilian Electricity Industry

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Abstract

The main goal of this paper is to analyze how the evolution of the institutional environment of the Brazilian Electricity Industry (BEI) has influenced the strategies of the firms. To do so, we use two theoretical tools: the transaction costs economics and the theory of property right, as developed by Coase (1937). The main characteristics of the BEI are: 90% the electricity is generated from hydroelectric plants; central coordination is required to minimize costs, optimize the operation of the system and mitigate risks; hybrid governance structure, where private firms compete with public owned firms; specific assets and a complex and uncertain business environment. Since 1996, the BEI has faced two distinct reforms. The first, more market oriented, was characterized by the privatization of 80% of distribution firms and 20% of generation assets. But in 2001 Brazil faced its worse electricity crisis in history, so the new government in 2003 proposed a new model for the BEI. This model re-established the role of the government as a planner and tried to create a more competitive market through auctions. We analyze the long term contracts to buy energy and new investments in generation in the BEI. We show that in Brazil there were risks of gaming and it is difficult to allocate the residual rights perfectly and this has an influence in the fact that firms are buying electricity from firms of the same economic group. We conclude that the industry characteristics, the evolution of its governance structure and the transition between institutional models lead to an elevated potential for *ex-post* bargain. We also find that firms with real control have more competitive advantage than firms that have formal control, and this leads firms to self-dealing or to vertically integrate using contracts to sell and/or buy energy.

Keywords: Brazilian Electricity Industry – Transaction costs economics – Property right theory

1. Introduction

The discussion about market deregulation has been the object of many important papers, in the last 15 years, especially after the deregulation and/or privatization of networks industries around the world. The introduction of competition, especially in wholesale generation market, is the main characteristic of the models implanted in the electricity industry in many countries. The unbundling of firms that work in more than one section (generation, transmission, distribution and retail) is one essential condition established in the design of the models implanted in countries such as England, Norway, Sweden, Denmark, Finland and Argentina. Transmission and distribution remain as natural monopolies, as free access of generators and retailers is a key factor to introduce competition in the electricity industry. Besides, the obligation to unbundled would be an interesting way to, at least,

minimize the cross subsidies by the incumbent and reduce the costs of captive consumers (Joskow, 2003a).

It is known that in four markets (Spain, New York, Texas and PJM) the model implanted did not require unbundling (Kühn and Machado, 2003; Hortacsu and Puller, 2003; Mansur, 2003; Saravia, 2003), but the results were still good, especially concerning the spot price. In the countries mentioned above, though they were successful in moving towards competition, the micro and macroeconomic efficiency were not achieved. England and the Nordic countries have experienced more positive effects of competition than Argentina (Newbery, 2002; Joskow, 2003c). In Brazil, unbundling became compulsory only after 1998, and we are not able to evaluate its effects. But analyzing the prices of the buy/sell contracts between firms of the same economic group (Losekan, 2003; Von der Fehr and Wollak, 2003) and the new model implanted in 2004, we can say that the positive effects for the consumers are far from being achieved (MME, 2003a and 2003b).

So the main goal of this paper is to evaluate, using the transaction costs economics (as in Coase, Williamson, Dixit, Joskow and others) and the property right theory (as in Grossman, Hart, Moore and others), the reasons why the firms of the Brazilian Electricity Industry (BEI) used contracts to integrate vertically, i.e, buying and selling electricity to/from firms of the same group. We analyze long run contracts and investments in generation plants. In other words, we show that the opportunism risk and the difficult to efficiently allocate residual rights have stimulated firms to adopt as strategy the bundled contracts.

2. Theoretical background

In general, the solution to unbundling is not trivial (Hart, 1995; Whinston, 2002; Joskow, 2003b). Some characteristics of the electricity industry make it even more complex. Among these characteristics, we quote: asset specificity, extenalities; uncertainty; vulnerability to hold up; the access to essential facilities, and the potential efficiency gains that can be achieved through coordination (hierarchy or market)[1].

In many cases, the financial rate of return of investments, in any part of the industry, can be strongly influenced by different types of risk, especially regulatory risk and commercial risk. In this case, it is clear the ambiguity between who has the formal authority (contractors) and real authority (government or the regulator), as in a typical problem to identify who has control over residual rights in a transaction (Aghion and Tirole, 1997; Aghion et al., 2003). So, it is a situation that can be discussed using transaction costs economics or incomplete contracts as in Williamson (1971; 1975;1985; 1996), or the theory of property rights[2], as in Grossman and Hart (1996), and Moore (1990).

The main point of the papers about unbundling, whether theoretically or in practice, is the definition of the determinants of coordination through market or hierarchy (Joskow, 1988 and 1991; Santana and Oliveira, 1998; Whinston, 2002; Losekan, 2003). In this sense, the boundaries of the firm would be function of the governance structure (Holmström and Roberts, 1998; Williamson, 2002, and 2005), especially when we consider that this governance structure would assure the optimal adaptability of the firm to changes in the conditions of supply and demand. One important aspect of

[1] As in Williamson (1979, 1996 and 2005) and Joskow (2003b).

[2] For some authors (North, 1991; Mcafee and Schawrtz (1994); and Holmströn and Roberts (1998) the property rights theory is one field of transaction costs economics, though this is not an opinion shared by everyone (Hart, 1995; Whinston, 2001 and 2002; Gibbons, 2004).

transaction costs economics and the theory of property rights, opposite to traditional theories on vertical integration, is that they focus not only the two extremes of governance (hierarchy or market), but also focus on hybrids forms and long run contracts[3].

Incomplete contracts, also including regulatory contracts (Sidak and Spulber, 1998), transactions including specific assets (downstream and upstream) and their effects on the performance of the ex-ante level of investments and ex-posts performance of the firms are the most relevant variables according to the two theoretical tools used in this paper. In fact, as it is in Grossman and Hart (1986), Aghion and Bolton (1992), Maskin and Tirole (1999), Whinston (2001 and 2002), Baker and Hubbard (2001), and Joskow (2003b), the property right theory focus on the effects on the ex-ante investments, because it assumes the efficiency of ex-post bargain, i.e, the residual rights are always allocated in a efficient way. It is important to notice that the transaction costs economics focus especially the ex-post performance of the bilateral transaction and, also, its ex-ante effects.

As contracts are incomplete, when the bilateral transaction includes specific investments, the bargain power of one of the parts (due to information asymmetry, adverse selection (Laffont and Tirole, 1998; Stadler and Castrillo, 1997) or to opportunism (Grossman and Hart, 1986; Hart, 1995; Joskow, 1991 and 2003b)) is a determinant of the ex-ante and ex-post inefficiency, reducing the level of investment, in the first case, and increasing total transaction costs, in the second case. In many cases, one agent, the government, can perform more than one role in a governance structure (e.g., shareholder and controller of firms and planner of the institutional model), which can lead to a strong power in negotiating ex-post residual rights. As Hart (2002) states, the government doesn't need to be owner of a firm to create tools that influence on the performance or the conduct of a firm. In an environment of incomplete contracts, it is enough that the government has power (authority) to reallocate residual rights, which is the case of industries that are under regulatory contracts.

In a restructured industry, this source of inefficiency is even clearer. The uncertainty from changes in the institutional environment, the need to make tests during the reforming period and the long period of time to put a new design model into action (Levy e Spiller, 1994; Delmas e Tokat, 2003) increases contractual uncertainty, and make it difficult to allocate residual right, especially when there's a dichotomy between formal and real authority. Gibbons (2004, p.11) states that transaction costs economics also deal with the adaptation of the firm to the institutional environment and, under these circumstances, it discusses if vertical integration is or is not the optimal way to make adaptive sequential decisions easier, especially in situations where uncertainty can be minimized.

The transaction costs economics and the theory of property rights is important tools to analyze this kind of problem. In practice, when there's a transition period from regulation to deregulation, information has a key role. However, it is known that the cost of information is essential to evaluate the costs to identify the relevant decision variables and create mechanism to monitor contracts. These are the components of transaction costs (Williamson, 1985; North, 1990).

In a period of transition, when uncertainty is higher, transaction costs tend to be more relevant, because more resources are allocate to identify relevant variables and specify mechanisms to monitor contracts (North, 1990; Delmas and Tokat, 2003). If the institutional environment is as in North (1990); i.e., taking into consideration the 'rules of the game', how well institutions solve the problems of coordination and production is determined by the motivation of the players, the complexity of the environment and the ability of the players to decipher and order the environment (North, 1990, p.34).

[3] See Dixit (2004 and 2006) and Williamson (1979 and 1996).

The motivation and endeavor of the players are determined by their perceptions, which depend on their degree of information (Dixit, 2006, p.4)

It is also important to notice that hierarchy between rules and contracts, which vary from one country to another, can determine the level of residual rights that must be allocated ex-post (North, 1990).

3. Incomplete contracts, transaction costs and residual rights: some evidence

3.1 Consequences of the characteristic of the industry

In general, the electricity industry can be organized in four basic models (Hunt and Shuttleworth, 1996): (i) monopoly, where firms are under governmental control are vertically integrated; (ii) single buyer, or purchase agency, chooses from a number of different producers, to encourage competition in generation; (iii) wholesale competition, where distribution companies choose their supplier; (iv) retail competition, where all costumers can choose their supplier. In Brazil, the model implanted in 1998 is a mix of wholesale and retail competition (especially the former). In the latter, only a few consumers can choose their supplier.

In many countries that went trough the restructuring process, since the beginning of the year 2000, there's a movement towards a change in conception, even in the cases where restructuring has succeeded. In countries adopted the wholesale competition model, the focus of studies is choosing the best auction model and the analysis of market power (Fabra et al., 2002; Borenstein, et al. 2002; Newberry and McDaniel, 2003; Evans and Green, 2003; Cramton, 2003a and 2003b), as in England and California. They also focus on the contents of long run bilateral contracts.

Rethinking the restructuring process is a consequence of works that showed vulnerabilities in auctions (Federico and Rahman, 2001; Fabra et al., 2002; Newberry and McDaniel, 2003) and other structural problems, as the role of long run bilateral contracts (Newberry, 1998; Wilson, 1998; Green, 2001; Wolak, 2003). In USA and Brazil, these papers were determined by crisis in supply in 2000 and 2001, respectively. In Brazil, where the restructuring process began in 1998, the discussion of a new model has been strengthened with the new Federal Government after 2003. In 2004, the Brazilian government implanted a new institutional model for the electricity industry, which was quite different from the model designed and implanted in 1998.

In Brazil, generators don't make price bids, unless flexible thermo plants[4]. This happens because in Brazil 90% of electricity is generated in hydroelectric plants (80% of installed capacity). Due to this, to serve demand at minimum cost and with reliability, the dispatch is coordinated by the system operator and prices are determined by the dispatcher, i.e., prices are the short run marginal costs. So, as a System Operator is essential to the Brazilian Electricity Industry, it has been created a mechanism to mitigate hydrological risks to make it possible to separate commercial and technical operation.

One of the most important things in developing a new market design is to create incentives to new private investments in capacity (generation, transmission and distribution). So, the way bilateral contracts are written are a key factor to success in restructuring. The regulatory arrangement in Brazil has two types of incentives: (ii) distribution companies and retailers must supply, according to long run (more than six months) bilateral contracts, 100% of their market; (ii) generators must guarantee 100%

[4] Flexible thermo plants are plants that are dispatched according to their marginal costs, i.e., to their price bids.

of electricity, with their own production or buying in the spot market, according to their contracts. There's a severe penalty for firms that fail in any of the cases.

Some of the characteristic of the Brazilian electricity industry make the modeling process even more complex. In the case of Brazil, the predominance of hydroelectric plants (specific asset) and the complexity and uncertainty in production and in supply and demand equilibrium were determinants of the non-bidding in the spot market. To deal with these problems, in 1998 was created a tool to mitigate hydrological risks, in order to protect hydroelectric plants against spot price volatility. This tool is called Energy Reallocation Mechanism (MRE) and includes a set of algebraic rules to transfer electricity to/from hydroelectric plants (*Hydroelectric Club*). The price (P_T) for theses transferences equals 1/3 of the minimum spot price (P_S)[5].

To be a part of MRE, a generator must have a certification of secured energy[6] (E_A), which is calculated by the System Operator and approved by the Brazilian Electricity Regulatory Agency (ANEEL). So, the revenue of a generator unit is not directly linked to its actual production, but to its long run contracts and certifications of E_A. If, in a certain week, the allocated energy (EL) for the generator 'i' is smaller than its certification E_A, the generator 'i' will receive the difference (C) through MRE, in a way that $Ci= [E_L-E_A]P_T$. It is important to notice that the secured energy of the system is equal to the sum of the certifications, i.e., if a generator is producing more energy, another is producing less in the same quantity.

When the power produced by hydroelectric plants (T_{EH}) is higher than the secured energy (E_A), the difference ($T_{EH} - E_A$) is distributed accordingly to the allocated energy of each unit, priced by the spot price. So, one generator can, even producing exactly as its certificate, receive a credit of energy to sell. On the other hand, if the market can only be supplied with the addition of thermal plants, each MRE generator will pay to these thermal plants $Ps(E_A - T_{EH})$. So, when hydroelectric plants are not able to supply the market, Ps increases.

Thermal plants can't benefit from this mechanism. As the electricity they produce is dispatched by minimum costs and they complement the electricity from hydroelectric plants, their bilateral contracts are backed up by the spot market ($Ps > P_T$). It is clear that there's an incentive for hydroelectric plants, because the short run marginal costs of hydroelectric plants are smaller than those from thermal plants. Besides that, hydroelectric generators can exchange electricity credits through MRE. These characteristics are barriers to entry of new power plants (thermal, nuclear, etc.). But, thermal plants are very important to the system, because hydroelectric plants can't supply the whole system anymore. As thermal costs are higher, thermal plants don't have competitive advantage, especially in long run contracts (Von der Fehr and Wollak, 2003).

Actually, the long run marginal cost (investments, fuel, and maintenance) of a thermal plant is higher than the hydroelectric plant's marginal cost. Until recently, ANEEL limited the increase in the costs of buying energy, for distributors, using a mechanism called Normative Value (VN). This mechanism purpose was to connect a specific source of electricity with its own cost. And, in order to stimulate new investments in thermal plants, the government freed limit of self-dealing of transactions from thermal plants. As these plants are necessary to supply the market, so the market's long run marginal cost is the very cost of thermal plants, as it was proved in the recent auctions. So, the

[5] In Brazil, the spot price or P_{LD} varies from US$ 7,50 to US$ 240,00.

[6] Secured energy is the power that can be produced by a hydro unit, in a certain level of risk and configuration of the system.

liberalization of the limit of self-dealing was not necessary and causes a reduction in social welfare, which was a fail in regulation.

As distributors were free to choose from which company they wanted to buy electricity, rationally, they would choose to buy from lower costs generators. This stimulated thermal generators to sell electricity, preferably, to distributors of the same economic group[7]. In other words, the characteristics of the industry, especially complexity and uncertainty of transactions, the way that risks are allocated between suppliers and flaws in regulation lead to vertical integration as a strategy (Joskow, 1988 and 1991; Newberry, 1998), through long run contracts.

Important to notice a case in which real authority prevailed over formal authority. When the whole system needs electricity from thermal plants to supply the load it's because the strategy of system operator is to save water immediately, to avoid a rationing in the future. Or because the system is already under rationing, i.e., even the thermal plants can't supply the load. In both cases, thermal generators would have monopoly power, and would receive a very high price for electricity, for example, the maximum spot price, as buy/sell contracts and regulatory contract give them formal authority). If this happens, the hydroelectric generators costs to buy electricity at the spot market would increase a lot, and some of them could have serious financial trouble. More, this increase in costs would eventually result in an increase in market price, and the government would try to decrease prices – this is the real authority as in Hart (1995) and, especially, in Hart (2002).

Under these circumstances, as contracts are incomplete, there's room for ex-post bargain, i.e., after the contract is written (Williamson, 1985; Hart, 1995; Joskow, 2003b). In the case of thermal plants, the government's discretionary power would influence the performance of the firms. That's because the market rule that states that a thermal plant can sell electricity at the declared price and the fact that hydroelectric plants can be exposed to spot prices can fail, as it already happened in the 2001 rationing (Von der Fehr and Wollak, 2003; MME, 2002). In this case, due to incomplete contracts, the government exercises it's real authority in hierarchy, by interfering in the allocation of residual rights, as in Levy and Spiller (1994) and Hart (2002).

So, thermal plants face two distinct situations: (a) their prices are higher; (b) if they choose to sell only at the spot market, they would not produce electricity for a long period of time. There are two important consequences: first, thermal plants were nearly obligated to write contracts with distribution companies of the same economic group (vertical integration through contracts) – strategy adopted by the groups ENDESA, Iberdrola, AES, Light and Cataguazes-Leopoldina. Second, if there are no thermal plants available to contract, that can lead to under investments and could harm the system's reliability[8].

Some hydroelectric plants wrote contracts to sell energy to distributors of the same economic group. This strategy is explained by the fact that when the sum of certificates of assured energy from hydroelectric plants is smaller than the load, hydroelectric plants face the risk of exposure to the spot price, which is very volatile. As the spot price equals the marginal cost of the thermal plants, hydroelectric generators could face very serious financial trouble. To solve this problem, contracts should have a term stating that, in the presence of rationing or a dry season, the contract would be reduced proportionally. Though distributors would not accept such a term, because, in their opinion, this would be a problem of the generator (supplier) and this would require the intervention of the

[7] Important and formal details of the competitiveness of thermal plants in Brazil are in Moreira et al. (2004).
[8] As in Von der Fehr and Wollak (2003).

government. The government would resist declaring a rationing period, as we saw in the near past in Brazil. As North (1990) states, history matters. So hydroelectric generators tend to sell energy to distributors of the same economic group (MME, 2002; Von der Fehr and Wollak, 2003). This strategy was adopted by Brazilian firms, such as Votorantin and Rede, by Eletricidade de Portugal (EDP) and by a large number of self-dealing firms.

In the case of hydroelectric units, incomplete contracts lead to an increase in transaction costs, due to asset specificity, complexity and uncertainty in transactions (Williamson, 1979 & 1985). This occur because incomplete contracts give conditions for the control of residual rights, which ex-pos control could affect in a negative way the performance of the agents. Actually, asset specificity, complexity and uncertainty in the production process and demand and supply equilibrium are the determinants of the contractual relations established in the electricity industry. Due to the factors mentioned, contracts can't be written in a way that, ex-ante, they can protect agents against ex-post opportunism. This leads to a microeconomic inefficiency, as difficulties in negotiating contracts implies delays in building new plants and under-investments, as in Grossman and Hart (1996), Hart (1995) and Joskow (1991 and 2003b).

3.2 Governance Structure

The main characteristic of the BEI is the predominance of hierarchy as a governance structure[9]. Until the 1990's, Eletrobras was on the top of the hierarchy. It was a holding, controlling nearly 90% of supply and was responsible for planning and operating the whole system. This governance structure was created in the 1950's, when the system was State-owned. The governance structure became more important in the 1970's, when efficiency gains from the interconnection of the system and economic growth resulted in a virtuous cycle, with decreasing short and long run marginal costs. And, the increase in demand was linked to the increase in supply. This was consequence of the centralized coordination of the operation and growth of the electric system (Santana e Oliveira, 1988 and 1999).

In the model implanted in Brazil after 1998, the regulation role is performed by the Brazilian Electricity Regulatory Agency (ANEEL). When the agency was created there was not a clear institutional rule, which was established only two years later. Until present time, it's possible to notice some problems in Brazil, especially concerning planning. This is now a role for the Mines and Energy Minister (MME). Nowadays, all electricity in Brazil is traded in the Electricity Trade Chamber (CCEE), i.e., the spot market. But, the electricity that is not sold through contracts is traded at the spot price. So, the distributor is exposed to the spot price at the same time as contracts surplus are sold at the spot price. CCEE has five directors. Two of them are indicated by generators, other two by distributors, retailers and exporters and one by MME. MME also indicates the CEO.

From March 2004, generators sell energy to distributors only at the regulated contract environment (ACR). But, they can compete with distributors and retailers to sell electricity to free consumers. This is the free contract environment (ACL). The system is operated and coordinated by the National System Operator (ONS), which is a private institution. The shareholders are the generator, transmission, distribution and retail firms. ONS has five directors, and three of them are nominated by MME.

[9] The definition of governance structure is in Williamson (1979 and 2005), and governance structure in this case is the environment where transactions take place. In many case, this definition is similar to what North (1990) calls institutional environment.

So, the governance structure from 1998 to march 2004 could be described as hybrid (Santana and Oliveira, 1998 and 1999; Losekan, 2003), partially hierarchy (centralized operation) and partially market, especially on long run contracts. But, the roles of the MME, ANEEL, and the spot market (former MAE; now CCEE) were not clear. Especially, concerning buy/sell contracts (penalties, monitoring, and measurement). The internal structure of ONS and MAE was characterized by conflicts (GCE, 2001). These conflicts harmed the performance of the market.

The institutional role of the MME wasn't clear as well, but as a large number of firms remained state-owned and the MME had formal authority to make changes in the model, it was clear for private firms that the government had a large ex-post bargain power. From April 2004 on, in the new governance structure, MME has four important roles: (a) has the power to authorize new concessions and permissions; (b) coordinates, through the Electricity Planning Company (EPE), the planning of expansion of the system; (c) coordinates the Monitoring Committee of the Electricity Sector (CMSE), which is responsible to define rules to maintain supply and demand equilibrium; and (d) coordinates the National Energy Policy Council, which is an institution that advises the President concerning energy policy. Therefore, the new model made the role of the MEE clearer. Besides, the most part of contracts and transactions are done under regulation control, the environment of free contracting remains with no price bids, so it can be concluded that the governance structure is more hierarchy than market. Due to its strategic role, we conclude that the MME is the coordinator of the hierarchy.

The recent changes in the institutional environment can illustrate the perspective of an increase in transaction costs, according to the perception of the agents. Generally, these changes indicate that the expansion planning is centralized, the decrease in free contracting environment creates a tendency to conflict between institutional and firms purposes and concentrate a bigger part of decision in the hands of the government; which create room to pressures that could affect the allocation of residual rights of contracts. This could indicate what Williamson (1979) and Grossman and hart (1986) call contractual relationship characterized by inefficient conduct and results, because the ex-post residual rights to be allocated would be expressive. Clearly, this reflects in a relevant way in the transaction costs, but in a more transparent way than during the previous model.

Excluding activities such as regulation and mediation, the institutions that decide about the strategies of the industry (concession, planning, contracting, operation, monitoring, and supply and demand adjustments) are now under direct control of the MME, which is the controller of a large part of electricity supply. This situation, paradoxically, is more transparent than in the previous model, and allows firms to correctly calculate the costs of a new project. According to Grossman, Hart and Moore's theory it is like almost all residual right could be reallocated by the one who exercises the coordination or the one who has the real authority in the hierarchy.

Even if the government doesn't want to exercise this authority, just the possibility that these residual rights could be, through ex-post bargain, allocated to one of the parts involved is enough to influence investments ex-ante performance and ex-post performance of firms. This situation creates an increase in transaction costs. The tendency of the transaction costs will be influenced directly by the conduct of the organizations coordinated by the government during this transition period. Due to the residual rights that must be allocated ex-post, the transactions costs tend to be high in the beginning.

In a governance structure like this, the strategy to minimize the effects of ex-post bargain is to make transactions within the same group, i.e., vertical integration trough contracts, as in Williamson (1979, 1985 and 2000) and Joskow (1988 and 2003b). This strategy minimizes ex-post bargain by the real authority. A very important detail about the new model for the BEI is that every distributor must

buy electricity by means of auctions, which are coordinated by ANEEL. And, a distributor can no longer be a shareholder of a generator, which refrains vertical integration through contracts. As vertical integration is a natural path in the industry, the restriction to this strategy could have harmful effects on investments.

3.3 Transition from hierarchy to market

The transition period is analyzed from three important aspects: (i) the effects of the changes in the way electricity is traded; (ii) the influence of the rationing period in the allocation of residual rights; and (iii) the creation of the Normative Value (VN). There are no doubts about the effects of the transition from a regulated environment to a market in transaction costs (Levy and Spiller, 1994; Delmas and Tokat, 2003). In Brazil, the first change in the model was in 1998 (free trade) and another one is occurring since march 2004. The second reform gave force to hierarchy instead of market.

In 1998, the Law n° 9.648/98, established that electricity transactions among firms should be the result of free negotiation, especially in long run bilateral contracts. Besides, this same Law defined a four year period for the transition from regulated contract to free negotiation. So, from 2003 the regulated contracts (in Brazil called initial contracts) would be deregulated in 25% a year, so the electricity transactions should be totally free in 2006. So, the terms of transition were defined in the Law concerning the new model. The same Law predicted that, in order to minimize the effects of occasional increases in the wholesale price of electricity, ANEEL should establish rules that limited the effects of the increase in prices to final consumers. This is the main purpose of the Normative Value (VN), which indicates to investors the value of transferring to retail price the costs according to different sources of electricity.

The transition of contracts had three main assumptions: (i) the change to a more market oriented structure could not cause a significant increase in the price paid by final consumers; (ii) generation and distribution assets should be completely privatized; and (iii) prices in contracts between state-owned generators and distributors were no up-to-date (Araujo, 2002; Von der Fehr and Wollak, 2003).

Two important things happened during the transition period: (1) due to political pressures and a not favorable international financial scenario, the federal government privatized only one generator company; and (2) in 2001, Brazil faced its worse electricity supply crisis that forced the regions Southeast, Mid-west, North and Northeast to reduce consumption in 20%. The fact that 2/3 of generation firms remained under Federal control created an uncertain environment. And more, with free contracting, federal generators had a huge market power.

The Law n° 9.648/98 stated that new energy (energy that would be produced by new power plants) and old energy (energy that was not under contract from incumbents) should be traded under free negotiation. But, the Law didn't mention the electricity that was not contracted and was being sold by federal generators[10]. There were rules (not specific to the electricity industry) that forbidden or restrained free negotiation for federal firms, which was understood as regulatory gap (Santana, 2004). And, smaller prices of old energy firms that must be sold in the market dislocated the installation of new firms.

[10] The term 'old energy' is quite common in Brazilian Electricity Industry and refers to the electricity that is produced by plants that are paid-off. Their average costs are, usually, smaller than the costs of new plants. For example, the average price of old energy is US$ 34.00/MWh, while the average price for new energy is US$ 62,00/MWh (prices in December 2006).

The determinant factors for the performance of investments and firms were not defined for the transition period[11]. The government should've defined them, due to regulatory gap, but the players could realize that this definition could not be neutral, as the government was shareholder of a large amount of firms. As Williamson (1979 and 1985), North (1990) and Hart (2002) state this situation is as one of the parts (with real control) of the contract could, with lower costs, influence the amount contracted or the performance of the other part, due to its power to ex-post reallocate the residual rights of the contract.

As contracts are incomplete, the (re)allocation of residual rights is a consequence, in this case, of uncertainty regarding rules, the final governance structure of the electricity industry and the conduct of one of the parts (North, 1990), in this case, the government. The transaction costs to mitigate this situation tend to be high and the natural way to minimize them is through vertical integration. This can also explain why during transition the growth in generation capacity was, mainly, done through transactions between firms of the same economic group, both in hydro and thermal units.

The rationing in 2001 and 2002 performed an important role in the behavior of firms. The initial contracts, regarding transactions during the transition period, due to their incompleteness, left a room for ex-post bargain. In those contracts it was not clear the financial arrangements in case of a rationing. But, there was a clause that established an equation to protect sellers in case of a non-favorable hydrological regime[12]. According to this clause the obligation of generators would be reduced in 6%, but the rationing was 20%. Generators should buy electricity in the spot market at R$ 658,00/MWh, while the contracts established the price of R$ 60,00/MWh.

On the other hand, there was another federal rule, applied in the rationing in Northeast in 1987, that stated that if a rationing was declared, the contracts of electricity between generators and distributors would be reduced in the same proportion as the load. In this case, the commitments of the generators would be limited to 80% of the contracts, which would lead generators in comfortable situation. So, for generators it would interesting to maintain the validity of this federal rule and for buyers, the opposite. This dispute was in the hand of the Federal government, by means of the Electricity Crisis Administration Chamber (CGE), which had a huge power during rationing period.

By that time, the roles of MME, ANEEL and ONS were not clear concerning a rationing period and its consequences. This problem was solved only in March 2004 with Law n°10.848/04 that transferred monitoring function to the CMSE.

It was clearly a problem[13] of contract incompleteness and hierarchy between rules and contracts, which, according to North (1990), influenced ex-post allocation of the associated residual rights. The solution was a General Agreement mediated by the government and resulted in the increase in prices was divided by three: the consumers (major part), buyers and sellers.

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[11] An interesting phenomena happened in USA. Due to uncertainty in the transition period from 1996 to 2000 it was noticed a slow in the investments in generation, which is the segment of the industry exposed to competition (Ishii and Yan, 2002).

[12] This caused an ambiguity in interpretation. In Brazil, a rationing is only legal if it is stated by the government. But in a hydrological system, a rationing is the consequence of a non-favorable hydrological regime. This ambiguity in Law and rules explain the incompleteness of contracts and the possibility of ex-post bargain.

[13] According to the Kelman Report (CGE, 2001), there was more electricity contracts than assured energy. In other words, there was more load than supply. This was harmed by the unfavorable hydrological regime. As it is in the report, the language used has induced non-specialists to conclude that there were no reasons that justify immediate corrective strategies (CGE, 2001, p.7).

Even if the solution founded has been a good one, it was clear to investors that the incompleteness of contracts to buy/sell electricity and the lack of clearness in the hierarchy of regulatory rules have increased the amount of residual rights to be allocated (as in Klein et al. 1978; Williamson, 1979; Grossman and Hart, 1986; and North 1990). So, due to the characteristics of the industry and the incomplete contracts, there are a big amount of residual rights to be ex-post allocated. In this case, the bilateral contracts are exposed to inefficient conduct. And, this leads to vertically integrated transactions, in which firms can minimize these effects, because if there's a great amount of residual rights, one of the players can take them, even if this was not an efficient strategy (Hart, 1995; Whinston, 2002; Joskow, 2003b).

The Law n°9.648/98, concerning electricity free negotiation, also stated that ANEEL should establish rules to limit the transfer to final prices of an increase in costs, during the transition period. So, ANEEL created the Normative Value (VN), which indicated to investors the price cap for long run contracts. VN was established, from 1999 until May 2002, according the source of generation (hydroelectric, fuel, gas, small hydro units, others), and since them it is calculated and published referring to the competitive source, in this case, hydroelectric[14]. As the market was growing and didn't have sufficient volume of business to indicate a reference price, this reference was the VN. So, the investments return and decisions were attached to a regulated price.

During this time, the Brazilian economy was going through a serious crisis, especially concerning exchange rate. And in the year 2000, it was discussed the vulnerability of the BEI, as more than 95% of the load was served by hydroelectric plants. So, the increase in installed capacity should be done with gas plants, which VN was 40% more than a hydroelectric plant. So, in 2000, the government created the Thermal plants Priority Program (PPT), which guaranteed VN for gas plant investors and fuel supply for a period of 20 years. Besides, if a contract to buy electricity was between a distributor and a PPT plant, the distributor would be free of the limit to self-dealing[15]. As PPT plants prices were higher than hydroelectric plants prices, it was clear that PPT plants would sell electricity to firms of the same economic group. In such a system, investments in gas and coal plants would be economic viable only if there was some kind of incentive, like a higher price and the right to pass it through end consumers[16] (Von der Fehr and Wollak, 2003).

In Practice, the incentive created during the transition period defined the conduct of firms. By writing vertical contracts, thermal plants avoided ex-post bargain to allocate residual rights and would no be worried about market competition. Though investments in gas and coal took place, the costs to consumers were higher than would be in a competitive market. That means that if one of the players gets ex-ante the residual rights, the chances of under investments are smaller. But, the way residual rights are allocated can cause distortions in efficiency, which is the essence of the model of Grosman and Hart (1996) and Hart and Moore (1990).

4. Concluding Remarks

[14] Law n°10.848/2004 replaced VN for the Reference Value (VR), calculated from the results of the auctions promoted by ANEEL.
[15] ANEEL limited the transactions among firms of the same economic group at 30%.
[16] In the year 2000, thermal capacity in Brazil was 8% and, nowadays, it is 18%.

According to the previous analysis, we can conclude that the strategy of the firms of the BEI , concerning buying electricity, can be explained by contractual incompleteness. And, because of this, firms tend to minimize the effects of ex-post bargain in allocating residual rights. The characteristics of the BEI (hydroelectric plants respond for more than 80% of supply and centralized coordination – that means a high degree of asset specificity, uncertain and complexity) creates a potential for ex-post allocation of residual rights.

The governance structure gives consistent evidence that the role of the government, with its real authority to propose changes in the rules of the game, can affect ex-ante investments. In this case, a government strategy that lead in the redefinition of residual rights of a contract can be interpreted by the players as the negative effects of ex-post performance of the firms. This happens even if the government doesn't intend to do so, which has been told to society since the new model was established.

Besides, the transition period is characterized by uncertainty that in general increase the scope of residual rights and stimulate inefficient investments, as the case of the plants of the Thermal plants Priority Program (PPT).

The reaction of the firms to these three factors, (characteristics of the BEI, governance structure and transition period) that resulted in the reallocation of residual rights and in higher transaction costs, was vertical integration through contracts. Though this was not an efficient strategy.

The rule created by the government to restrain (stop) vertical integration can stimulate competition, especially, because it minimize cross-subsidies in the BEI. But, players have strong arguments, like their vulnerability to reallocation of residual rights, in favor of vertical integration. This difference in the design of the model and the conduct of firms can result in under investments in generation, at least until players know that contracts are being respected. Besides, the new model is more hierarchy than market oriented, there should be no restriction to vertical integration.

As the BEI can induce a large amount of residual rights to be ex-post bargained, it would be prudent that the contracts to buy/sell electricity should predict some terms to be valid immediately and others to be negotiated in the future. This kind of contract has been modeled, as optimal contract, by Hart and Moore (2004) and it is know as open terms contracts.

As it is difficult to quantify, when the contract is written and signed, some relevant variables (supply and demand conditions, prices, etc.) and anticipate who will exercise real authority, it is better to leave some terms open in the contract. In the rationing period in Brazil, as there were supply surplus and a exchange rate crisis, prices in long-term contracts were very high, exactly as the prices of PPT. If the contract type modeled in Hart and Moore (2004) had been adopted, there would be room for a short-term price and a price negotiation for the long-term. This could equalize bargain power and would make the buying and selling process more efficient.

The theoretical contribution of the paper was that, in opposite to Grossman, Hart and Moore's theory, it's not only the physical ownership of assets that gives control over residual rights. In an environment as the BEI the government exercises an important role in reallocating residual rights among the players. In the BEI it's determinant the power of who has the real authority in coordinating planning and operation process.

In practice, when hierarchy is dominant and coordinates the industry, it is the organization that has the real authority that has control over residual rights, because this organization can determine the use of a specific asset when something not specified in a contract happens.

It's important to emphasize that the theoretical tools used in this paper were adequate to study the conduct of the firms in the BEI from 1998 until march 2004. The possible negative effects of a dispute over residual rights and opportunism increase transaction costs. The strategy used by firms to minimize this was vertical integration, via contracts, as it is predicted in Transaction Costs Theory, in Williamson, and property rights theory, as in Grossman, Hart and Moore.

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