



Institutional Environment 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. The main characteristics of the BEI are: almost 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 vertical integration.

Keywords: Brazilian Electricity Industry, Transaction Costs Economics, Vertical Integration

JEL Classifications: D23, L94

1. INTRODUCTION

The discussion about market deregulation has been the object of many important scientific research after the deregulation and/or privatization of networks industries around the world. The introduction of competition and market mechanisms are the main characteristics of the models implanted in the electricity industry in many countries. The unbundling of firms that has assets in more than one segment (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).

So the main goal of this paper is to evaluate, using Transaction Costs, the reason why firms of the Brazilian Electricity Industry (BEI) use contracts to integrate vertically, i.e, buying and selling electricity to/from firms of the same group.

2. BACKGROUND

In general, the solution to unbundling is not easy (Hart and Moore, 1990; Hart, 1995; Whinston, 2002; Joskow, 2010). Some characteristics of the electricity industry make unbundling even

more complex. These characteristics are asset specificity, externalities; uncertainty; vulnerability to hold up; the access to essential facilities, and the potential efficiency gains that can be achieved through coordination (hierarchy or market) as in Coase (1937), Williamson (1971, 1975, 1979, 1996 and 2005), Joskow (2003b and 2010).

The main point of the literature about unbundling is the definition of the determinants of coordination through market or hierarchy (Joskow, 1988; 1991; Santana and Oliveira, 1998; Whinston, 2002). 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 this governance structure would assure the optimal adaptability of the firm to changes in the conditions of supply and demand. One important aspect of transaction costs economics is that it focus not only on the two extremes of governance (hierarchy or market), but also focus on hybrids forms and long run contracts (Dixit, 2004; 2006; Williamson, 1979; 1996).

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-post performance of the firms are the most relevant variables according to the two theoretical tools used in this paper. It is important to notice that the transaction costs economics focus especially on the ex-post performance of the bilateral transaction and, also, its ex-ante effects.

As contracts are by definition incomplete, when bilateral transactions include specific investments, the power of bargain of one of the parts (due to information asymmetry, adverse selection (Laffont and Tirole, 1999; 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 the owner of a firm to create tools that influence the performance or the conduct of a firm. In a situation where transaction costs are positive, it is enough that the government has the power (authority) to reallocate residual rights, which is exactly the case of the electricity industry.

Gibbons (2004) 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.

In practice, when there's a transition period from regulation to deregulation, information performs 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.

In a period of transition, when uncertainty is higher, transaction costs tend to be more relevant, because more resources are allocated to identify relevant variables and specify mechanisms to monitor contracts (North, 1990; Delmas and Tokat, 2003). The institutional environment is as described 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). The motivation and endeavor of the players are determined by their perceptions, which depend on their degree of information (Dixit, 2006).

Schnaider et al. (2018) identified three types of uncertainty: market, technological and performance assessment uncertainties. Institutional environment is another aspect with great influence on governance structures (Niesten et al., 2017). For Ménard (2014), regulation and competition authorities have a direct impact, however, we still do not understand the mechanisms through which institutions shape and alter the organizational arrangements. It is possible to estimate that an adequate regulatory design has institutional safeguards to prevent opportunistic behavior and tries to balance the trade-off between commitment (limiting governmental opportunism) and flexibility (Ghosh and Kayhuria, 2015).

The irreversibility of investments due to asset specificity creates regulatory risks and uncertainties. Electricity markets can develop only when contracts are credible, complete, and have low opportunism risks (Ghosh and Kayhuria, 2015). The frequency of transactions and uncertainty are the other attributes in Williamson's framework. As electricity is a good that is generated and consumed continuously, the transaction frequency is continuous (Signorini et al., 2015). The uncertainty generally lowers investment, both in the short- and long-run.

For Erdogdu (2013), the success or failure of an electricity market depends on whether a strong legal system clearly defined property rights and if the control structures for enforcing legislation and contracting arrangements exist.

3. VERTICAL INTEGRATION: EVIDENCES AND DISCUSSION FROM THE BEI

3.1. Governance Structure

The main characteristic of the BEI is the predominance of hierarchy as a governance structure. Until the 1990's, Eletrobras was on the top of the hierarchy. It was a State-owned 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. 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 and Oliveira, 1999). The Brazilian energy mix is diversified, with varied sources of energy generation (hydraulic,

biomass, wind, photovoltaic and others), with smaller projects alongside larger, being distributed in the various geographic regions of the country (Silva et al., 2013; Vahl et al., 2013; Ferreira, et al. 2015), and increased private sector participation (Rego and Parente, 2013).

The BEI has faced in the previous decades two important institutional reforms. In 1996, the BEI was restructured for the 1st time and the main purpose of this restructuring reform was to introduce competition and enhance investments in the industry. Nearly 80% of the distribution companies and 20% of the generation companies were privatized. Some companies remained state-owned and two (CEMIG and COPEL) remained vertically integrated. The 2001 supply crisis made clear that investments, both private and public, in electricity had decreased. After 2003, the government designed a new model for the BPS that strengthen the role of the State in the industry.

Though these reforms tried to introduce competition in generation, it is possible to say that the BEI is far from being a competitive market. As Araujo et al. (2008) state, in a hydroelectrical system, like in Brazil, coordination is more important than competition in energy markets.

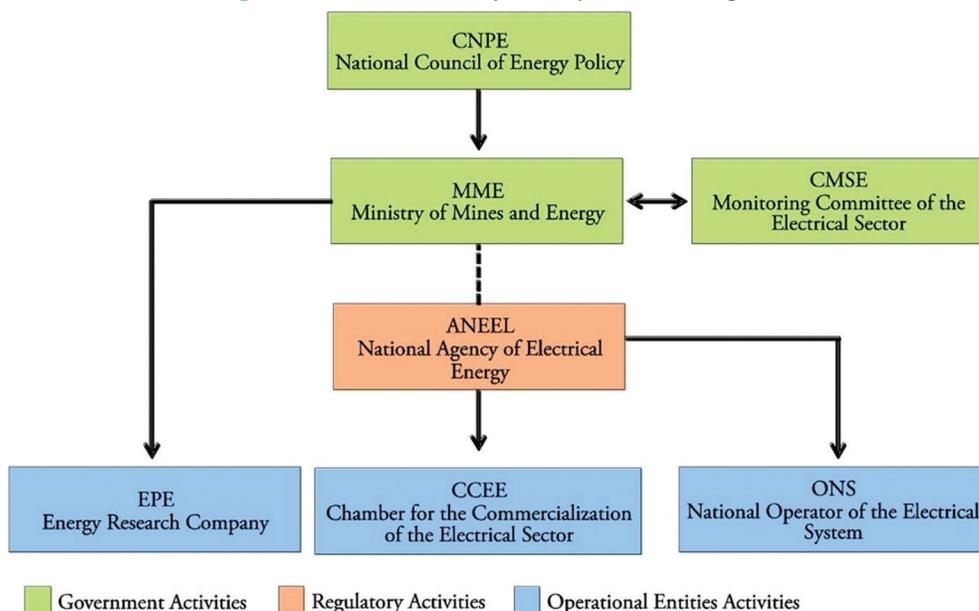
The most important features of short-term Brazilian market are: existence of two market operators, with distinct functions. On one hand, the physical system operator, the National System Operator (ONS), is responsible for the coordination and control of the operation of installations for the generation and transmission of electric energy in the national interconnected System, under the supervision and regulation of the National Electric Energy Agency (ANEEL). On the other hand, the electric energy trading Chamber (CCEE) is responsible for transactions of purchase and sale of energy. Figure 1 shows the BEI institutional agents. It's important to notice the key role of the Government as the main planner of the industry.

From April 2004 on, in this 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 MME 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, it is possible to 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 indicates 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 (Delmas and Tokat, 2003).

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 since 2003 under direct control of the MME, which is the controller of a large part of electricity supply. This situation,

Figure 1: Brazilian electricity industry institutional agents



Source: (MME, 2013)

Table 1: Holdings in the Brazilian electricity sector

Holding	2017				
	Companies	Generation	Transmission	Distribution	Trader
Companhia Brasileira de Energia CEMIG	AES Tietê, AES Uruguaiana			Eletropaulo Metropolitana	CEB
	CEMIG, UTE Barreiro, UTE Ipatinga, Cogeração S.A.	Transleste S.A., Centrooeste Minas, ETEP, ENTE, ERTE, EATE		CEMIG	CEMIG Trading S.A.
CTG Brasil	Duke Energy Brasil CTG Brasil Triunfo Ilha				CTG
ENERGISA	UTE-JF, Zona da Mata Geração			CFLCL, CENF, Energipe, CELB, SAELPA	Cat-Leo
NEONERGIA	Rio PCH, Termope, afluente, UHE Baguari, Termoçu, Itapebi, Goiás Sul			COELBA, CELPE, COSERN	NC Energia
COPEL REDE	17 UHE, 1 UTE Tangará Energia, Juruena Energia, Rede Lajeado S.A.	Copel Transmissão		Copel Distribuição CAIUA, CELPA, CEMAT, CELTINS, CFLO, CNEE, EEB, EDE VP	Copel comercialização REDECOM
ENERGIAS DO BRASIL VBC/CPFL Energia SA	Energest, EDP Lajeado, Enerpeixe, Enernova CPFL Geração			Bandeirante, Escelsa, Enersul	ENERTRADE
ELETROBRÁS	Furnas, Eletronuclear, CHESF, CGTEE, Eletronorte	Eletrósul, Eletronorte, CHESF		CPFL Piratininga, RGE	CPFL Brasil Comercialização S.A.
State Grid Brazil Holding (SGBH)		Belo Monte Transmissora, Luziânia Transmissora, Paranaíba T.E.,		ETE, ETIM, ITE, PPTE, SIMTE,	

Source: SÉRIES Econômico Financeira das Empresas do Setor Elétrico. 2011 and website of the firms. And ANEEL (www.aneel.gov.br)

paradoxically, is more transparent than in the previous model, and allows firms to correctly calculate the costs of a new project.

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 contracting. 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.

One important issue arises, however, when one considers the increasing numbers of firms structured as holdings subordinated to a single controller. In the institutional model of the BEI, firms were compulsory unbundled. However, neither the law nor the regulator place no restriction in terms of market share on firms structured as holdings. In this regard, the law – i.e. the electricity sector and antitrust regulatory agencies – assume in fact that a holding plays a neutral role. That interpretation is mistaken and if not recognized and corrected can lead to firms of the holding type gaining considerable market power.

The market power stems not just from the holding's financial capacity, which lead to greater leverage. It also enjoys

greater competitive advantage in terms of market knowledge, especially in the regulated market, because generators will tend to write contracts with firms of the same economics group. This fact points to an information asymmetry that, in practice, acts as a barrier to entry. The competitive advantage consists in the opportunity to capture the distributor's customers with the potential to enter the free contract market. Thus the regulatory agency's role, which ultimately is to eliminate the power that the natural monopoly structure gives the distributor, is surmounted by the bundled operation of the holding. This argument gives grounds for saying that the larger the distributor's market, and the larger the influence of industrial consumption, the greater will be the potential for it to bring billing gains into the holding by creating barriers to entry. Thus, according to the line of reasoning presented here, there is a strong likelihood of a process of full re-bundling taking place through contracts.

Table 1 shows the firms structured into holdings in Brazil. The firms showed in the table are responsible for, approximately, 85% of generation and 70% of distribution capacities in the Brazilian system. The main tendency is for a generator company to integrate with a trader. Shortly after the rationing period, the spot price was very low. In this sense, the free market became more attractive for free consumers. So, generators companies created their own traders to attract free consumers to have contracts with one – or more than one – generator of the group.

Holdings show their market power in two ways: First, in financial terms they can cross-subsidize controlled firms. Secondly, they have a larger competitive advantage derived from the knowledge of the market, specially their geographical area, which is concession from public authorities. In this case, especially when a distributor company is part of the group, there's a significant information asymmetry, which, in turn, act as a barrier to entry. So, our hypothesis is that holdings use their market power to attract free consumers through their distributor company.

Therefore, the regulatory Agency faces a significant challenge in order to minimize the market power of large firms. So, we argue that, in this case, the larger the market and the number of industrial plants in the geographical area, the greater the possibility for the holding company to internalize gains from this strategy.

This process could lead to even greater growth of the short-term market, given the larger number of free consumers. This growth would tend to raise the average rate charged to captive consumers, because the tariffs include certain costs, such as the Energy Development Account (*Conta de Desenvolvimento Energético*, CDE) and the pro-rata cost of power from Itaipu. If more captive consumers become free, this account will have to be shared among a smaller number of regulated consumers, thus increasing their rates. On the other hand, the groups structured into holdings will come to command greater market power, which will hinder the regulatory agency's activities in the future.

4. CONCLUDING REMARKS

According to the previous analysis, it is possible to 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 structure themselves as holding firms. 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 these strategies. The rule created by the government to restrain 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.

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. The strategy used by firms to minimize

this was vertical integration, via contracts, as it is predicted in Transaction Costs Theory, in Williamson.

REFERENCES

- Araujo, J.L.R., Costa, A.M.A., Correa, T., Melo, E. (2008), Energy contracting in Brazil and electricity prices. *International Journal of Energy Sector Management*, 2(1), 36-51.
- Coase, R. (1937), The nature of the firm. *Economica*, 4, 386-405.
- Delmas, M., Tokat, Y. (2003), *Deregulation Process, Governance Structures and Efficiency: The U.S. Electricity Utility Sector*, Energy Policy and Economics Paper 004. California: University of California Energy Institute.
- Dixit, A.K. (2004), *Lawlessness and Economics: Alternative Modes of Governance*. New Jersey: Princeton University Press.
- Dixit, A.K. (2006), *Economic Governance*. Department of Economics (Working Paper). New Jersey: Princeton University.
- Erdogdu, E. (2013), A cross-country analysis of electricity market reforms : Potential contribution of new institutional economics. *Energy Economics*, 39, 239-251.
- Ferreira, P.G.C., Oliveira, F.L.C., Souza, R.C. (2015), The stochastic effects on the Brazilian electrical sector. *Energy Economics*, 49, 328-335.
- Gibbons, R. (2004), *Four Formal (Ized) Theories of the Firm*, Working Paper. Cambridge: MIT, Department Economics.
- Grossman, S.J., Hart, O. (1986), The costs and benefits of ownership: A theory of vertical and lateral integration. *Journal of Political Economy*, 94(4), 691-719.
- Hart, O. (1995), *Firms, Contracts, and Financial Structure*. Oxford, England: Oxford University Press.
- Hart, O. (2002), *Incomplete Contracts and Public Ownership: Remarks, and an Application to Public-private Partnerships*, Discussion Paper. Massachusetts: Department of Economics of the Harvard University.
- Hart, O., Moore, J. (1990), Property rights and the nature of the firm. *Journal of Political Economy*, 98(6), 1119-1158.
- Holmström, B., Roberts, J. (1998), The boundaries of the firm revisited. *Journal of Economic Perspectives*, 12(4), 73-94.
- Joskow, P.L. (1988), Asset specificity and the structure of vertical relationships: Empirical evidence. *Journal of Law, Economics and Organization*, 4, 95-117.
- Joskow, P.L. (1991), The role of transactions cost economics in antitrust and public utility regulatory policies. *Journal of Law, Economics and Organization*, 7, 53-83.
- Joskow, P.L. (2003a), *The Difficult Transition to Competitive Electricity Markets in the U.S*, Working Paper. United States: MIT, Department of Economics.
- Joskow, P.L. (2003b), *Vertical integration*. In: *Handbook of New Institutional Economics*. Netherlands: Kluwer.
- Joskow, P.L. (2010), *Vertical integration*. Symposium in Honor of Oliver Williamson, *Antitrust Bulletin*, 55(3), 545-586.
- Laffont, J.J., Tirole, J. (1999), *A theory of incentives in procurement and regulation*. Cambridge, Massachusetts: The MIT Press.
- Ménard, C. (2014), *Embedding organizational arrangements : Towards a general model*. *Journal of Institutional Economics*, 10(4), 567-589.
- MME. (2013), *Modelo Institucional do Setor Elétrico*. Brasil: Ministério de Minas e Energia.
- Nielsen, E., Jolink, A., Jabbour, A.B., Chappin, M., Lozano, R. (2017), Sustainable collaboration: The impact of governance and institutions on sustainable performance. *Journal of Cleaner Production*, 155(2), 1-6.
- North, D.C. (1990), *Institutions, Institutional Change and Economic Performance*. Cambridge, England: Cambridge University Press.
- Rego, E.E., Parente, V. (2013), *Brazilian experience in electricity auctions: Comparing outcomes from new and old energy auctions as well as*

- the application of the hybrid Anglo-Dutch design. *Energy Policy*, 55, 511-520.
- Santana, E.A., Oliveira, C.A. (1998), A economia dos custos de transação e a reforma na indústria de energia elétrica do Brasil. *Estudos Econômicos*, 29(3), 1-10.
- Santana, E.A., Oliveira, C.A. (1999), Análise da indústria de energia elétrica do Brasil: Abordagem através da economia dos custos de transação. *Pesquisa e Planejamento Econômico*, 29(2), 273-29.
- Schnaider, P.S.B., Ménard, C., Saes, M.S.M. (2018), Heterogeneity of plural forms: A revised transaction cost approach. *Managerial and Decision Economics*, 39(6), 652-663.
- Sidak, J.G., Spulber, D.F. (1998), *Deregulatory Takings and the Regulatory Contract*. London: Cambridge University Press.
- Signorini, G., Ross, R.B., Peterson, H.C. (2015), Historical analysis of institutions and organizations: The case of the Brazilian electricity sector. *Journal of Institutional Economics*, 11(1), 191-212.
- Silva, N.F., Rosa, L.P., Freitas, M.A.V., Pereira, M.G. (2013), Wind energy in Brazil : From the power sector's expansion crisis model to the favorable environment. *Renewable and Sustainable Energy Reviews*, 22, 686-697.
- Stadler, I.M., Castrillo, D.P. (1997), *An Introduction to the Economics Information: Incentives et Contracts*. Oxford, England: Oxford Press.
- Vahl, F.P., Rütther, R., Filho, C. (2013), The influence of distributed generation penetration levels on energy markets. *Energy Policy*, 62, 226-235.
- Whinston, M.D. (2002), *On the Transaction Cost Determinants of Vertical Integration*, Working Paper, Department of Economics. Illinois: Northwestern University.
- Williamson, O. (1971), The vertical integration of production: Market failure considerations. *The American Economic Review*, 61, 112-123.
- Williamson, O. (1975), *Markets and Hierarchies: Analysis and Antitrust Implications*. New York: Free Press.
- Williamson, O. (1979), Transaction-cost economics: The governance of contractual relations, *The Journal of Law and Economics*, 22(2), 239-261.
- Williamson, O. (1985), *The Economic Institutions of Capitalism*. New York: Free Press.
- Williamson, O. (1996), *The Mechanism of Governance*. Oxford: Oxford University Press.
- Williamson, O. (2002), The theory of the firm as governance structure: from choice of contract. *Journal of Economic Perspectives*, 16(3), 171-195.
- Williamson, O. (2005), The economics of governance. *American Economic Review*, 95, 1-18.