

Anticompetitive conduct in auctions of electricity in Brazil

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Abstract:

This paper analyzes the auction for electric energy from new power generation projects where Petrobras participated as the sole shareholder and operator of a thermoelectric gas generator enterprise. The participation of Petrobras, a state controlled company, in the auction generated anticompetitive effects since Petrobras is the only company in Brazil, able to supply natural gas to qualified competitors who did not have own production and transportation of gas as the cost of gas is the main variable cost of thermal power plants. This undermines the efficiency of the bidding in allocating the rights of energy marketing to more efficient generators. Using information provided by competitors in the qualification process for the bidding, our study suggests that Petrobras has adopted a discriminatory strategy in the supply of natural gas for thermoelectric enterprises that were participating in the bidding. Furthermore, our findings indicate that a company's access to a supply of natural gas affects its chance of winning the auction, corroborating our aforementioned expectations.

Keywords: Electricity market, auctions, regulation, vertical integration.

JEL: D44, L42, L94

1. Introduction

Setting the institutional stage

There are two distinct categories of energy wholesale markets in Brazil: the Regulated Contracting Environment (RCE) in which the purchase of energy is based on public auctions to supply "captive consumers" and the Free Contracting Environment (FCE).

On the free market (about 25% of the Brazilian energy), the commercialization of energy are either held in bilateral negotiations, or in private tenders promoted by buyers and sellers, and prices thereby reflect the bilateral and the structural conditions of the market.

In the regulated contracting environment, distribution companies buy their projected energy needs to meet the consumers' need within their concession area through auctions, regulated by the National Electric Energy Agency (Aneel) and designed by the

the Ministry of Mines and Energy (MME). The acquisitions are made at the generating plants through “Contracts of Energy Quantity or Contracts of Energy Availability”¹.

The determination of the required amount of electricity by the regulated system as a whole in these regulated auctions is based on the estimation of demand, individually computed by the distribution companies. According to current regulation, the distributors must contract 100% of its energy necessities and have the right to pass the costs of the commitments in the auction on to consumers. The winner is the company that offers the lowest tariff per energy unit (R\$/MWh).

The projected date of energy delivery and the duration of the contract primarily characterize energy auction terms. For example, a contract, stipulating the delivery of energy in the following year of the auction is called A-1 (“A minus 1”) auction. An A-1 auction usually has duration between 3 and 15 year. Similarly, an auction focusing on the delivery of energy in three (five) years is called an A-3 (A-5) auction and tends to have duration between 15 and 35 years. MME is responsible for designing the guidelines and structure of the auctions, as well as the definition of which projects can compete and supply energy to the distributors.

The facts behind the competition issue

Since 1998 several purchase auctions of energy under the regulatory environment were promoted by the Brazilian government. On August 17th, 2011, a new A-3 Auction was held for the purchase of energy from newly generated projects represented by hydroelectric, wind, biomass and natural gas plants. In this auction, Petrobras participated for the first time as the sole shareholder of a new project. Until then, the state controlled enterprise (SCE) had only participated as a minority shareholder in projects led by other companies.

Petrobras participated on the bid as plant operator through “UTE Baixada Fluminense”. At the same time, Petrobras kept its position as the sole supplier of natural gas to all other qualified competitors which did not have its own production and transportation structure of gas, and which competed with Petrobras for the concession of the thermal power plants. Given that the cost of gas represents a considerable amount of expenses for these plans, the permission for Petrobras to participate in the auction as a project operator raised concerns among Petrobras’s competitors regarding potential distortions on the competition process and outcome.

The issue addressed by this paper

This paper (i) addresses the competition issue brought by vertical integrated state-controlled companies, which compete with non-integrated private companies in downstream markets, and (ii) studies the potential consequences for efficiency of energy

¹ The first type of contract refers to bilateral agreements in which the supplier agrees to provide a certain amount of energy and assumes the risk due to hydrological conditions, low reservoir levels (hydroelectric) or changes in fuel price (thermal generation). The second type refers to a contract in which the generating plant is committed to provide a certain capacity to the RCE but the variable cost to dispatch are assumed by the distributor.

markets. Our analysis was made considering the bidding as a competition where competitors have the same vertical integrated state-controlled supplier, as it is the unique viable option for them. Thus, the supplier is at the same time a privileged rival.

Several anticompetitive strategies can be articulated by vertically integrated companies that provide inputs to their opponents. Among them we highlight: (i) price/service discrimination; (ii) margin squeeze; and (iii) refusal to deal.

The abuses of market power may cause several inefficiencies in both thermoelectric generation and the composition of Brazil's electricity matrix, potentially raising the cost of supplying electricity to final consumers. Our main point is that the participation of a quasi-monopolist and state-controlled company in downstream markets may result in crowding out of private investment and in lower efficiency levels.

2. The Brazilian energy matrix and the participation of Petrobras

The Brazilian energy matrix by generating source is represented in Table 1. According to the data provided by Aneel in July, 2011, approximately 66% of the installed capacity for electricity generation available is provided by hydroelectric plants. The second largest share is given by gas thermoelectric plants, which account for approximately 10%. The remaining 23% include thermoelectric plants based on other fuel (including nuclear plants), wind and electricity imported from neighbor countries.

Table 1 – Brazil's energy matrix

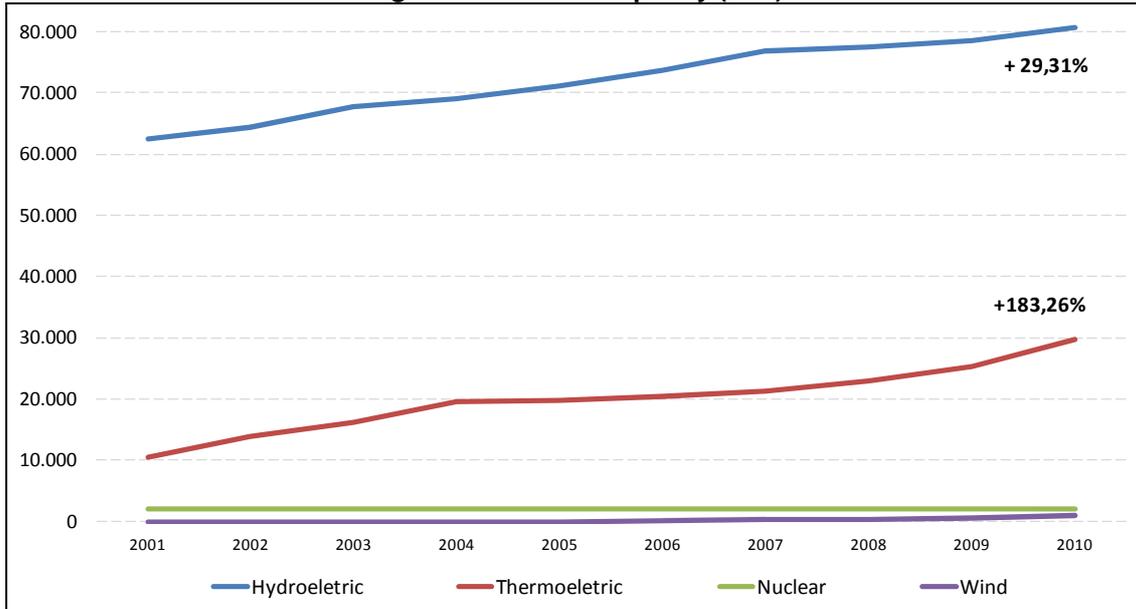
Type	Insttaled capacity			Total			
	# of Plants	kW	%	# of Plants	kW	%	
Hydroelectric	927	81.461.730	66,29	927	81.461.730	66,29	
Thermoeletric Gás	Natural	99	11.404.088	9,28	137	13.193.271	10,74
	Process	38	1.789.183	1,46			
Thermoeletric Oil	Diesel	872	3.880.082	3,16	902	6.675.209	5,43
	Residual Oil	30	2.795.127	2,27			
Thermoeletric Biomass	Bagasse (Sugarcane)	337	6.656.956	5,42	412	8.351.331	6,80
	Black Liquor	14	1.245.198	1,01			
	Wood	41	359.527	0,29			
	Biogas	14	70.742	0,06			
	Rice Husk	6	18.908	0,02			
Thermoeletric Nuclear	2	2.007.000	1,63	2	2.007.000	1,63	
Thermoeletric Coal and Minerals	10	1.944.054	1,58	10	1.944.054	1,58	
Wind	56	1.081.542	0,88	56	1.081.542	0,88	
Imports	Paraguai		5.650.000	4,60		8.170.000	6,65
	Argentina		2.250.000	1,83			
	Venezuela		200.000	0,16			
	Uruguai		70.000	0,06			
TOTAL	2.446	122.884.137	100	2.446	122.884.137	100	

Operating plants (Date: 07/2011)

Source: National Electric Energy Agency (Aneel)

The participation of thermoelectric plants in the electricity matrix has grown significantly in recent years because the government promoted energy diversification of the national matrix in order to reduce the dependence on hydropower. While total energy generation capacity of the country grew by 51.35% in the last decade, installed capacity of power plans of thermoelectric power plans in Brazil grew by 183.26% during that period. In comparison, energy generated by hydroelectric power plants grew only by 29.31%, during the last 10 years (Figure 1).

Figure 1: Installed capacity (MW)



Source: National Electric Energy Agency (Aneel).

Thermal generation is relevant to the country and recognized as complementary to the hydropower plants, being central to ensure the meeting of demand, even in adverse hydrological conditions.

Various fuels are used in thermolectric generation, such as most common fossil fuels (about 67% of the national thermolectric capacity, Table 2). The reliance on natural gas has increased worldwide and this pattern is not different in Brazil and today already represents 37.8% of the fuels used. The advances in technology of jet turbines and combined cycle increased the thermodynamic efficiency of natural gas plants significantly, thereby making them a competitive option. These advantages are reinforced by considerable discoveries of new natural gas reserves in various regions of the country in recent years, and the fact that gas plants are cleaner (less polluting) than other thermolectric plants, for instance plants based on oil.

Table 2 - Class of fuels used by power plants in Brazil

Fuel	Quantity	Power (kW)	%
Black Liquor	14	1.245.198	4,13
Wood Waste	36	302.627	1,00
Elephant Grass	2	31.700	0,11
Biogas	14	70.742	0,23
Bagasse (Sugarcane)	337	6.656.956	22,07
Palm oil	2	4.350	0,01
Vegetabel Coal	3	25.200	0,08
Rice Husk	6	18.908	0,06
Total Biomass	414	8.355.681	27,70
Ultraviscous Oils	1	131.000	0,43
Natural Gas	99	11.404.088	37,80
Diesel	872	3.880.082	12,86
Refinery Gas	8	305.000	1,01
Fuel Oil	29	2.664.127	8,83
Mineral Coal	10	1.944.054	6,44
Total Fossil Fuels	1.019	20.328.351	67,38
Sulphue	5	56.688	0,19
Furnace Gas	14	299.555	0,99
Process Gas	8	638.420	2,12
Efluent Gasses	2	211.320	0,70
Steel Mills Gas	1	278.200	0,92
Total Others	30	1.484.183	4,92
TOTAL	1.463	30.168.215	100

Capacity in operation (Date: 07/2011)

Source: National Electric Energy Agency (Aneel).

(State-owned) Petrobras is the main operator of thermoelectric plants in Brazil. It appears in the ranking of agents with greater generating capacity in the country as (1) the leader among natural gas plants, (2) the leader of all thermoelectric plants, and (3) the eighth among all players in the sector, even also considering hydroelectric power plants.² According to Aneel, from the 11,404,088 kW from thermal power plants operating on natural gas in the national energy matrix, 68% (or 7,719,588 kW) are produced solely by Petrobras. This high participation rate is the result of several acquisitions of thermoelectric plants that Petrobras made in recent years. Besides being the largest operator of thermoelectric gas plants in Brazil, Petrobras also has a significant market power in all links of the chain of natural gas in the country.

2.1 The chain of natural gas and the participation of Petrobras

The natural gas sector has some peculiarities that make its dynamics quite different from the ones observed in the chain of other fossil fuels. The distinction is mainly due to high costs of transportation and storage. In certain circumstances, the shipping cost of gas may represent about 50% of its final price, whereas in case of the oil, the percentage

² Source: Aneel.

varies between 5% and 10%. Furthermore, there are high economies of scale and the infrastructure (ducts) necessary for the transportation and distribution of the natural gas is very idiosyncratic and thus cannot be used for other purposes.

Another significant difference is that there is virtually no global market for gas: according to the National Petroleum Agency (ANP), about 85% of gas consumption is produced locally. Therefore, unlike other fossil fuels, it is not an international commodity.³

A complex chain that connects the producer and processing plants through the transmission system is a characteristic of the gas industry. Each link of this chain corresponds to a business relationship with different characteristics, but all links are dependent among themselves. The economic viability for the extraction of gas and its infrastructure for transportation depend on large irreversible investments, common to the emergence of strong long-term relationships between companies in this sector. These are reflected in the “take-or-pay⁴” or “ship-or-pay⁵” contracts, or in vertical integration.

One of the main features of the gas chain is that it is very capital-intensive (and of high asset specificity), requiring high initial investments in production, transportation, storage and distribution, even when compared to the oil chain. This is primarily due to three main factors: (a) as gas density is lower than oil, it is necessary to obtain a greater volume for the same energy content and, moreover, as natural gas is found in the gaseous state, it requires its own infrastructure, causing high shipping and storage costs; (b) different from oil, a gas extraction plant has no commercial value if the necessary infrastructure to transport the production to the consumer market is not built, and (c) a significant portion of natural gas is a byproduct obtained in the oil production (“associated gas”), implying a production rate that is independent of its demand.

Together, these features make supply of gas inflexible, which often causes natural gas suppliers to impose restrictions on the “take-or-pay” and “ship-or-pay” to customers.

³ Moreover, given the difficulties in selling small volumes of the product or the discoveries in remote regions, there is a large supply of gas that is not yet commercially exploited. The exception is the liquefied natural gas that can be transported and stored better, but it involves an additional cost of liquefaction and regasification.

⁴ The supply contract impose clauses called “take-or-pay” (“use-or-pay”) in which the generator is required to purchase a minimum amount of gas. More precisely, the clauses that restrict the fuel contract management establish that: (a) ToP monthly → the plant is required to purchase a monthly amount of gas corresponding to X% of the amount of fuel available for a given month, or (b) ToP annual → as a complement to the ToP monthly clause, the plant is required to purchase an annual amount of gas corresponding to Y% of the amount of fuel available for one year.

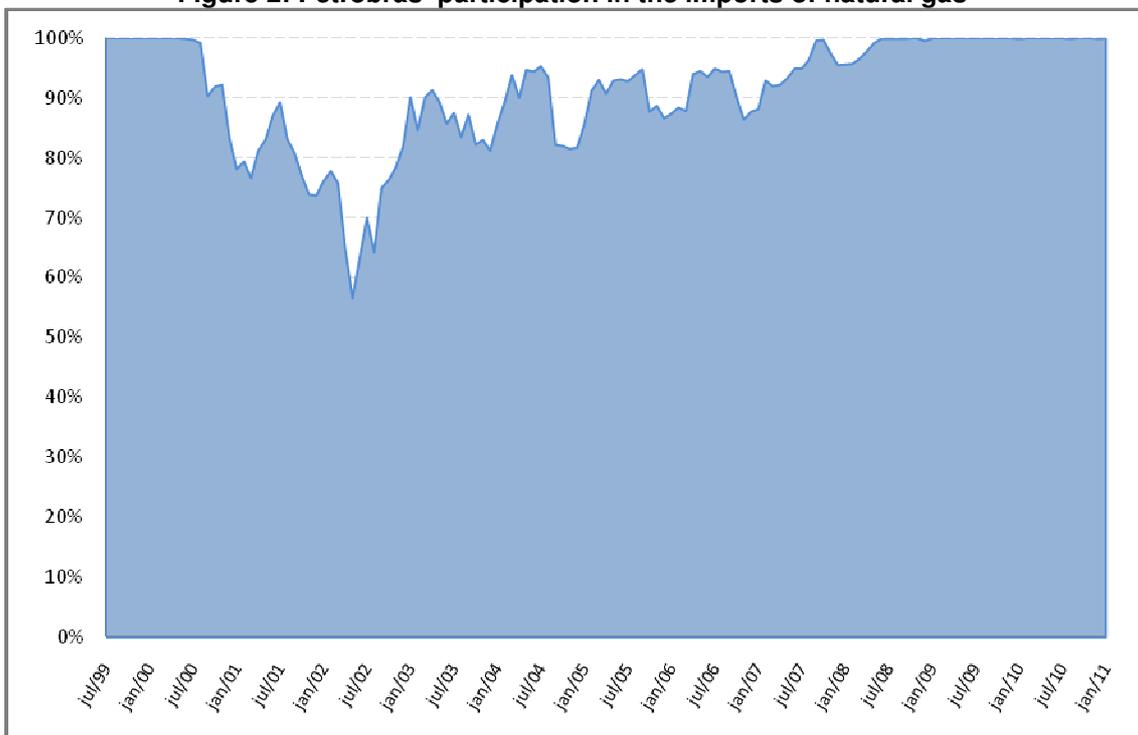
⁵ Minimum levels of payment are imposed on the plant for the use of the pipeline. The plant must pay monthly Z% of the cost of the gas transportation contract for the month, regardless of whether or not the gas passes through the pipeline. That is, it does not matter if plant decides to consume or store the gas; the generator will make a minimum monthly payment for the availability of the infrastructure for transportation. Different from the “take or pay”, the payment of the “ship or pay” does not generate a future credit if the gas is not consumed. In this case, the “ship or pay” can be seen merely as a fixed cost.

Until 1995, the market was only represented by Petrobras, which was a vertically-integrated state-owned company. Since then, Constitutional Amendments No. 5 and No. 9 transferred gas exploitation to state governments either by direct exploitation or through concession of local services of piped gas. This allowed entry of private companies in the power generation business and in the import, export and transportation of natural gas.

Despite the removal of Petrobras’s legal monopoly, its quasi monopoly position is still in effect in production and transportation. The company controls most of the concessions of existing fields and of the total gas transportation infrastructure (pipelines) between exploration fields and consumer markets.⁶ Petrobras also holds 51% on TBG, the company responsible for the pipelines between Brazil and Bolivia. Furthermore, it is the only company operating in both exploration and transportation of natural gas to the market, either alone or in partnership with the private sector (like the case of the Bolivia / Brazil), and has strong (shareholdings?) participation in various final distribution companies.

Even when we include the import of gas in the chain, the market share of Petrobras is not yet diluted. Figure 2 shows its participation in the imports of natural gas over the last decade.

Figure 2: Petrobras’ participation in the imports of natural gas



Source: ANP (National Petroleum Agency).

According to data provided by ANP, since the beginning of 2007, the participation in the import of gas is not less than 90%. For the last two years the share has always been above 99.8%, indicating that import do not provide an effective contestability, because

⁶ For instance, the gas transportation to the “city gates” is made by Transpetro, Petrobras’ subsidiary/

Petrobras also dominates the required infrastructure market to imported gas (international pipelines, port terminals, regasification facilities of LNG (Liquefied Natural Gas))⁷. Moreover, even if a company decides to import natural gas and owns the required infrastructure, it still depends on the infrastructure provided and owned by Petrobras to transport gas from the port to the consumer.

All these aspects indicate that Petrobras has a high market power in producing and importing natural gas, as well as the monopoly on the transport infrastructure. This scenario can negatively affect the competition in the auctions of thermoelectric power, given that Petrobras is one of the competitors in the thermoelectric gas segment.

3. The competition issue

The energy generation sector is capital intensive and involves high sunk costs. Therefore, the risks and costs to fund and facilitate a new investment are significantly reduced by the adoption of long-term contracts. The solution adopted in Brazil to facilitate and attract the private sector to these projects is to hold periodic auctions of future energy provision to meet the growing number of consumers.

The auctions for the commercialization of energy from new generating projects, such as the A-3 Auction that occurred on August, 17th, 2011, are crucial to the creation of a structure that favors competition as an instrument to promote low tariffs. In a classical setting of perfect competition, suppliers compete in the market for the demand of goods and services, especially by price competition. This competitive dynamic allows market participants to purchase products at the lowest prices, favoring the most efficient suppliers – the one with the lowest production costs. Given the specific investments required for the production of electricity, it is necessary to establish commitments through long term supply contracts between parties, often in the format of “take or pay” contracts. This feature implies that competition among generation plants occurs only during the investment decision and not over the lifetime of the project. In this sense, energy auctions play a key role by making potential suppliers competing for the market rather than in the market. This is facilitated by that fact that long term supplying contracts are signed under competitive prices, and winner projects acquire the right to sell their product in the market ex-ante for up to 30 years!

On the other hand, if the auction is not efficient in allocating the right to sell the electricity generated, the supplying contract will be signed on bases that do not reflect the competition conditions initially idealized. That is, as there is no competition in the market, the competition for the market via the auction would ensure the lowest cost for costumers. Otherwise, even small distortions of competition for the market can result in

⁷ The import of gas requires that importers have the required installations and logistics for the gasification of the gas in order to make it available to the consumers. Imported gas arrives in Brazil on ships in the form of liquefied gas and its gasification is carried out on the port by ships exclusively prepared for it.

large losses to the society in the long run. The contract would be more costly for costumers for the lifetime of the project.

In this sense, the participation of Petrobras in the auctions of new power generation projects may have the effect of undermining the efficiency of these bids, preventing the rights of commercialization are effectively assigned to more efficient generators.

This case analysis must always be made by taking into consideration that this is a competition where auction participants have the same supplier, but this supplier, besides being the only viable option for these competitors, is a vertically integrated downstream firm, which becomes a privileged rival. If the vertically integrated competitor is able to get rid of non-integrated rivals, the competitive outcome will not result in the downstream stage.

3.1 Economic rationale for anticompetitive conduct adopted by a vertically integrated competitor

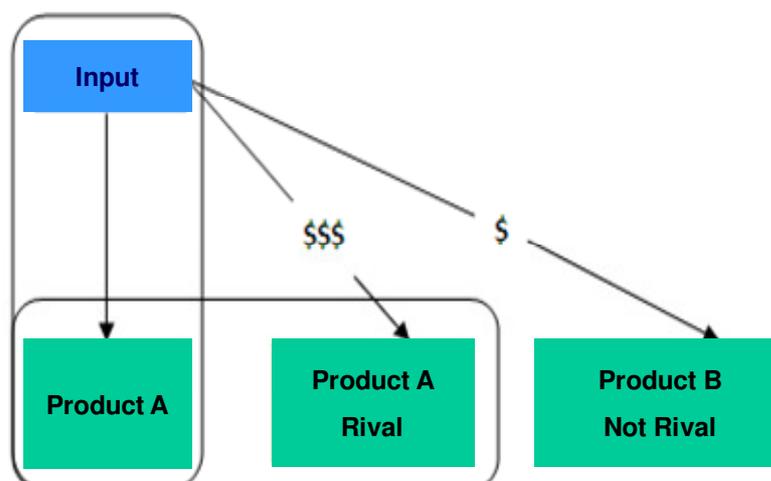
The first question that may arise in the reasoning of this theme refers to the economic rationale that would undermine a company's rivals, which are also in this case its clients. Why would an upstream dominant company, in the production stage of a raw material, have incentives to cause damage to its customer, thereby reducing sales to non-integrated companies?

If the downstream firms act in different relevant markets, losses of the integrated upstream company due to failing to adequately serve its customers are not compensated by gains obtained by the integrated downstream companies. Thus, there are no incentives for the upstream companies to jeopardize its client base. On the other hand, if they compete in the same relevant market, the vertically integrated company will have greater incentives for not supplying an adequate service to its competitors, given that it will result in a transfer of demand from its rivals to the upstream company. This then compensates for the loss of supply with a larger profit from the integrated company.

The integrated company may have incentives to eliminate the downstream competitors with the intention to increase entry barriers in the upstream market. It would happen because, if the integrated company has significant part of the downstream market, a potential entrant in the upstream market could be discouraged from competition when analyzing that its potential consumers are integrated with competitors.

In these scenarios, the result of strategic interaction among agents tends to lead the supplier to fix the price of inputs for companies that compete with the integrated company at a level above the optimal value that it charges similar companies that compete in other markets.

Figure 3: The logic of action of a vertically integrated firm



The case of this paper clearly shows a situation in which an integrated downstream firm (thermoelectric Petrobras) directly competes with other companies (other thermoelectric plants that are not vertically integrated) that get its input from an integrated supplier (Petrobras).

3.2 Anticompetitive strategies of a vertically integrated competitor

Several anticompetitive strategies can be articulated by vertically integrated companies responsible for the provision of inputs to their competitors. The antitrust literature summarizes these strategies into three categories:

- ✓ Price or service discrimination;
- ✓ Margin squeeze;
- ✓ Refusal to sell or supply to the rivals (*refusal to deal*).

Price or service discrimination

The discrimination in the provision (price or service condition) for an integrated downstream firm relative to its rivals is the most basic anti-competitive practice that a competitor can use to benefit from its position in the supply chain.

Specifically with regard to the electricity sector, a document prepared by the regulatory energy agency of the U.S. *Federal Energy Regulatory Commission* (FERC) - with comments from the *Federal Trade Commission* (FTC) - presents types of discrimination, companies in the sector use to encourage downstream members to the detriment of competitors. According to the FERC, a potential source of discrimination occurs with the sale or provision of services on preferential terms for the integrated company to the detriment of non-integrated firms. This classic type of discrimination can be achieved, for example, by selling supplies to the integrated company at a lower price than what is offered to other participants in the downstream market. Thus, the dominant company subsidizes its company in the downstream market via the provision

of inputs and overpricing the supplier's other customers. This strategy has the effect of increasing profits of a vertically integrated group, putting its rivals at a worse position.

Margin squeeze

Another anticompetitive strategy that can be adopted by companies like Petrobras is the margin squeeze strategy. This practice is also mentioned by the *Federal Energy Regulatory Commission* (FERC) in its report.⁸

In this case, the supplier "inflates" the prices of inputs for all competitors in the downstream market. On one hand, this practice does not characterize a classical discrimination, since the integrated company will also pay more for the input, on the other hand, the gains from the increased profitability on the upstream market more than offset losses incurred by its downstream firm. Furthermore, the integrated downstream firm can withstand lower operational margins and the eventual exit from its competitors allows it to increase market share, which, in the future, may give rise to greater profitability in the upstream market.

Refusal to deal

A vertically integrated company may also refuse to provide the necessary inputs for the downstream competitors. Such strategy is similar to a discrimination in which the selling price charged by the input is infinite.

In the present case, the vertical integration can create an incentive for Petrobras to stop sharing the infrastructure, which is essential for the operation of other thermoelectric gas plants. This conduct harms competition in the sector to the extent that non-integrated rivals face the impossibility of obtaining a contract for the supply of fuel - a necessary condition to be technically qualified to participate in the auction.

3.3 Incentives for state-controlled enterprise (SCE) to adopt anticompetitive practices

Are there incentives for such anti-competitive practices that could be adopted by a SCE like Petrobras? If it does not maximize profit, could its behavior be different and more lenient with non-integrated rivals? The literature indicates that the incentive structure confronted by SCE can give rise to anticompetitive behavior as much as for private companies.

According to Sappington and Sidak (2003)⁹, because a state-owned or -controlled company may not maximize profit, one might suppose (at first) that it less aggressive towards its competitors. But the authors show that, by contrast, state-owned companies have stronger incentives to adopt a behavior that negatively affect its rivals. Moreover, these incentives are greater, the more they move away from the goal of maximizing profits. These behaviors include pricing below cost, raising rival's cost, and raising

⁸ See footnote 8.

⁹ Sappington, D. E. M.; Sidak, J. G. *Incentives for anticompetitive behavior by public enterprises*. Review of Industrial Organization, Vol. 22, pp. 183-206, 2003.

barriers to entry to prevent the participation of new competitors. According to the authors, the incentives to act aggressively can be created by the objectives of the government policy that induce the SCEs to seek expansion of its activities as a management goal.

In the same line, Pinheiro and Giambiagi (1992)¹⁰ argue that SCEs have commercial and public policy goals that may have a negative impact on the economic efficiency, because these companies are not necessarily driven by profit maximization, but by the growth of the company and the necessity to maximize the size of its operations.

Therefore, the economic rationale for the SCEs to adopt strategies to close the market is more feasible than for private companies. Rather than expanding their operations, private companies maximize profits, which is not necessarily achieved by extending the company's activities in the economy. In the case of the SCEs, the expansion of its activities is desired, even at the expense of profitability.¹¹

3.4 "Double marginalization" argument is not reasonable

An argument that could arise in favor of Petrobras would be that verticalization of the SCE eliminates the "double marginalization" of links in the gas supply chain and in the power generation, once it forms a single integrated company (Petrobras) in both of these segments. From this perspective, the elimination of "double marginalization" would reduce the load of the electricity supply chain, thereby reducing the tariff paid by the final consumer.

However, this argument is fallacious. The energy auctions ensure fierce competition for the market, approaching the characteristics of perfect competition. As previously mentioned, an auction of market dispute has the effect of reflecting the same conditions of a competitive market. Hence, a power plant that wins the auction will not enjoy any monopolistic gain. Rather, its economic profit tends to zero and its gain will only reflect the return of capital and other costs.

Therefore, the gas suppliers' integration with a thermal gas plant does not have the potential to provide gains to consumers via elimination of a monopolistic margin in the generating market, because the auction process eliminated the monopolistic margin in advance. However, as the only supplier can "regulate" the downstream cost of non-integrated companies, he will be able to win the auction even if he is less efficient downstream.

¹⁰ Pinheiro, A. C.; Giambiagi, F. As empresas estatais e o programa de privatização do governo Collor. **Pesquisa e Planejamento Econômico**. V. 22, n. 2, pp 241-288, 1992.

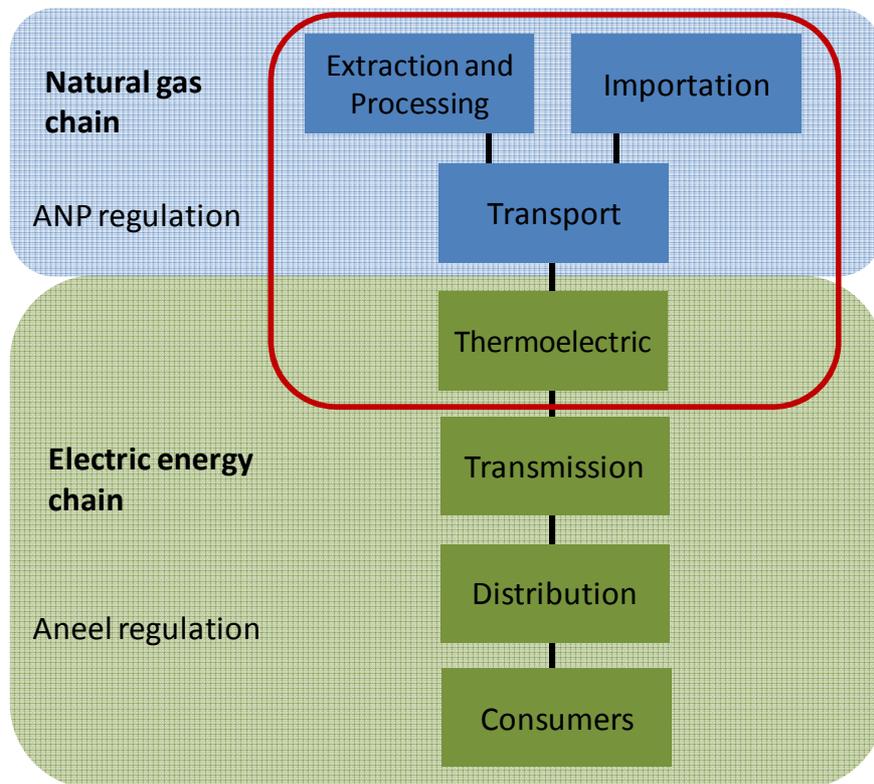
¹¹ Petrobras is certainly not a different example of SOE, considering the statement of its own president, Jose Sergio Gabrielli, to the newspaper O Estado de Sao Paulo (August, 17, 2011), stating that all of Petrobras' strategic decisions - from fuel prices, sales to other countries or exploitation of reserves - are political decisions.

3.5 The risk of a regulatory evasion

In addition to anticompetitive effects, the participation of Petrobras in selling auctions of thermoelectric power as an upstream gas supplier and as a downstream competitor can generate other undesirable consequence. Because it controls the entire chain of natural gas the verticalization of Petrobras on the thermoelectric power generation market creates difficulties for regulatory agencies to obtain information about the commercial conditions adopted due to the lack of transparency and absence of contracts between companies of the group.

The vertically integrated company, represented by the red (Figure 4), works integrated over two chains with distinct regulators, weakening the regulatory ability of both, and generating a phenomenon, known in the economic literature as the regulatory evasion.

Figure 4: The risk of regulatory evasion by the vertical integration of two distinct chains



The absence of a proper distinction of the financial and accounting operations between the integrated operations into every link in the chain and the lack of formal contracts and well-established commercial conditions governing the relationship of vertically integrated companies have the effect of undermining the role of the regulator.

Thus, Aneel cannot regulate the sector efficiently by, for example, preventing discriminatory practices by downstream-integrated company. If Aneel cannot see available space to transport gas, it thus cannot enforce that downstream-integrated company takes a rival's gas.

According to the OECD's¹² report on structural separation in regulated industries, the regulated and vertically integrated firm has strong incentives to evade regulation and restrict competition in complementary activities. This is because a set of activities (non-competitive and competitive) is less regulated than a non-competitive activity alone. In this case, the regulated firm could recover monopolistic rents, which would be lost by regulation, and enter the competitive market by restricting or hindering access of potential rivals.

Besides the issues of competition, the asymmetry of information faced by regulators on the internal relations of the vertically integrated companies can bring harm to final consumers by preventing them to take corrective or prudential measures in a timely manner.

4. The abuse of market power

Whatever the theoretical rationale for the abuse of market power, discriminatory strategies were observed in the A-3 Auction held on August, 17th, 2011 in Brazil.

Discrimination in the provision of natural gas became explicit before the auction when MME published a list of thermoelectric plants eligible to participate in the auction with its respective "Inflexibility and Physical collaterals"¹³.

During the qualification process for the auction, Petrobras declared "zero inflexibility" of its thermoelectric plant. Nevertheless, it demanded - as a supplier of fuel - an inflexibility of 30% to 70% of the other participants of the auction. This is problematic as the other participants' thermoelectric business depends on Petrobras's supply of gas.

Table 3 lists the respective rates of inflexibility of the ten thermoelectric plants authorized by the Energy Research Company (EPE) to participate in the auction on August, 17th, 2011¹⁴.

From this list, only MPX Energia S.A. (UTE Maranhão I, II e III) did not require a gas supply contract with Petrobras, because they belong to a group ("OGX Gas and Petroleum"), which owns proprietary natural gas extraction fields in the state of Maranhão. All others, however, for not being vertically integrated, relied on Petrobras for the supply of natural gas needed to the operation of their plants. Importantly, OGX – MPX's supplier – could not be a supplier for other thermoelectric plants since there is no infrastructure for the transportation of gas from Maranhão to other consumer markets.

¹² Structural separation in Regulated Industries – Report by the Secretariat, Directorate for Financial, Fiscal and Enterprise Affairs, Committee on Competition Law and Policy (2001) – OECD.

¹³ Ordinance No. 28 – August, 1st, 2011, published in the Official Gazette on August, 2nd, 2011.

¹⁴ Press Release issued by EPE on August, 8th, 2011. The list of the ten projects was obtained by crossing the information contained in table "Reserve Auctions A-3/2011 - Summary of the qualification (by federal unit)" of the referred report with its information on Ordinance No. 28 of MME.

Table 3 – Inflexibility rate of thermoelectric plants in the auction held on 02/211 (A-3)

Plant	Company	Location	Inflexibility		Power		Physical collateral	
			MW-med	%	MW	MW-med	%	
Baixada Fluminense	Petróleo Brasileiro S.A. - Petrobras	RJ	0,0	0,0%	530,0	430,2	81,2%	
Linhares III	Linhares Energia Ltda.	ES	16,8	30,0%	56,1	36,7	65,5%	
Global VI	Global Partic em Energia S.A.	BA	98,2	30,0%	327,1	237,1	72,5%	
Queimados 3	Genpower Termoelétricas e Part S.A.	RJ	291,4	50,0%	582,8	506,2	86,9%	
Maranhão II	MPX Energia S.A.	MA	241,6	48,4%	499,2	470,7	94,3%	
Maranhão III	MPX Energia S.A.	MA	241,6	48,4%	499,2	470,7	94,3%	
Maranhão I	MPX Energia S.A.	MA	100,0	48,8%	205,1	187,8	91,6%	
Resende	Omega Engenharia e Assessoria Ltda.	RJ	330,3	65,9%	501,5	446,7	89,1%	
Paracambi	Usina Termelétrica Paracambi Ltda	RJ	422,8	69,6%	607,8	551,9	90,8%	
Araraquara	ARS Energia Ltda.	SP	405,8	70,0%	579,4	526,2	90,8%	

Source: MME and EPE(?). Elaborated by: Tendências.

Through a "take-or-pay" contract for fuel supply, Petrobras demanded from potential plants that would compete in the auction an inflexibility rate equal to or greater than 30% (Table 3). This means that the thermoelectric plant is obliged to consume annually at least 30% of the contracted quantity. Consequently, this creates considerable inflexibility in the generating plant that, *coeteris paribus*, reduces its competitiveness in the auction

Petrobras did not adopt this same condition in relation to its thermoelectric plant in the state of Rio de Janeiro (UTE Baixada Fluminense), according to information provided by the company to MME during the process of technical qualification for the auction¹⁵. This made the UTE Baixada Fluminense a fully flexible plant - that is, it would only have to pay for gas that is actually used in the generation and sale of electric energy. This places it in a noticeable advantageous position over its rivals.

Even other plants located in the state of Rio de Janeiro – recognized as a region with high natural gas production and in the same location as Petrobras's UTE Baixada Fluminense – failed to enter into supply contracts under the same conditions of Petrobras (see inflexibility rate of UTE Queimados 3, UTE Resende e UTE Paracambi).

The imposition of inflexibility rates restricts the optimal operation of the plant, which has the effect of reducing the value to meet the electrical system.

In the energy auctions, the thermoelectric plants present their Variable Cost per Unit in the qualification process and compete in the auction with decreasing bids based on the Fixed Revenue to which they are willing to build and operate the plant, considering the payment of the Variable Cost per Unit declared for each megawatt of energy generated.

¹⁵ This information became public on February, 8th, 2011, through Decree No. 28 of the Secretariat of Energy Planning and Development of the Ministry of Mines and Energy.

At the auction, the Revenue bids are converted into a Cost Benefit Index (CBI), which is the average cost of energy expected to be generated at the plant, given its use rate. The expected value (EV) of the total cost of a project includes the cost of investment during the construction and fixed costs of operation and maintenance, plus the expected value of operational costs and the expected value of short-term (ST) economic costs. Thus the CBI (measured in R\$/MWh) of each generating company is defined as the ratio between the total cost of and its energy benefits (Physical collateral)¹⁶:

$$CBI = \frac{\text{Fixed Costs} + EV(\text{Operational Cost}) + EV(\text{ST Economic Cost})}{\text{Physical Collateral}}$$

The Physical collateral of a thermoelectric plant refers to the maximum amount of its generating capacity that the plant can sell at the auction.

Once index values are calculated for each project, the decision criterion for winners lists the projects in ascending order (from the lowest to the highest CBI value).

An increase in the inflexibility rate implies greater physical collateral, raising the denominator of the equation above and contributing to the reduction to the CBI (the lower the CBI, the more competitive the plant is). On the other hand, this makes the plant more competitive if a raise of Fixed Cost associated with greater inflexibility – the numerator of the formula – impacts the CBI less than the effect of the raise on the physical collateral. Thus, a flexible thermoelectric plant can be optimized to obtain the best CBI given its cost structure (represented by its Fixed Income and its Variable Cost per Unit). Plants with inflexibility must be operated in a more restricted way, which may imply a greater CBI.

In this scenario, the probability that the auction will be won by a more flexible project increases even if the plant is economically less efficient than those of other operators upon which greater inflexibility is imposed. That is, it is possible that the auction is won not by the most efficient generating company (the main objective of the auction by Aneel), but by a firm that, although inefficient, has a greater CBI due to the flexible supply of gas that it holds.

Even if the price of gas supplied by Petrobras is the same for all plants, the fact that other competitors do not have the choice of a fully flexible supply at their disposal - as it was the option adopted by Petrobras's UTE Baixada Fluminense – characterizes the discrimination of the upstream supplier as recognized by the Federal Energy Regulatory Commission¹⁷.

One would expect that the supplier was willing to provide natural gas more flexibly at a higher price. Then, it would be natural that Petrobras entered the auction with a Variable Cost per Unit higher than the variable costs of its competitors. This is because the price

¹⁶ See technical note: Cost Benefit Index (CBI) of Thermal Power Generation Projects: Methodology. Buying auctions of Electricity Projects from New Generating plants A-3/2011. Prepared by the Energy Research Company (EPE) and available in <http://www.epe.gov.br> (accessed 08/19/2011).

¹⁷ See footnote 8.

it pays for its natural gas should be higher due to the total flexibility it holds¹⁸. But data presented by Petrobras to MME shows that the cost of gas for its thermoelectric plant is the lowest among all its competitors. That is, Petrobras did not just discriminate on the inflexibility rate for the gas supply but also discriminated the price charged for gas between its thermoelectric plants and other competitors by violating the relation price-inflexibility offered to other plants.

It is possible to verify this by looking at the physical collateral of each firm that participated in the A-3 Auction on August, 17th, 2011. According to EPE, the physical collateral of a thermoelectric is the sum of the variables below:

$$PC = IR + URCI(VCU)$$

Where:

PC is the physical collateral;

IR is the inflexibility rate of the plant, and refers to the quantity of energy generated by the plant, regardless of the marginal price of the system operation;

URCI is the Use of Remaining Capacity Index. Remaining Capacity refers to the capacity of flexible generation of the plant and its use is an index that is estimated by EPE based on a computer program that calculates the projected time in which the plant has variable cost per unit less than operational marginal cost. The *URCI* is then inversely proportional to the Variable Cost per Unit (*VCU*), in which the price of natural gas is the main variable.

Therefore, the physical collateral of a competitor will be greater the greater its inflexibility rate or the lower the supply cost of gas used.

As the inflexibility rate of Thermoelectric Petrobras (UTE Baixada Fluminense) is the lowest amongst all the competitors involved in the A-3 Auction, it is natural to expect that, if there is no considerable price differentiation on the natural gas used, its physical collateral will be one of the lowest. But this is not what one observes in Table 3. Particularly, there are two other plants with lower physical collaterals (UTE Global VI e Linhares III), despite an inflexibility rate of 30%.

Thus, a better way of comparing gas prices paid by plants supplied by Petrobras is to analyze what should be the physical collateral of each thermoelectric if they had a Variable Cost per Unit equal to the thermoelectric Petrobras. In this case, the physical collateral of each plant would be equal to its inflexibility added to the flexible capacity available, assuming the same use rate of the thermoelectric Petrobras. This overcomes one shortcoming of EPE's methodology as EPE provides the apportionment of the demand among all power plants with the same Variable Cost per Unit proportionally to its flexible capacity.

¹⁸ Fuel is the main component of variable costs of a thermoelectric plant.

Given the inflexibility rate of the respective plants, a greater physical collateral means that the URCI must be raised, indicating a decrease in variable cost in relation to the original situation. Table 4 displays the results of this exercise.

Table 4 – Physical collaterals

Plant	Company	Inflexibility		Power MW	Physical collateral (PC)		PC w/ price equal to UTE Petrobras
		MW-med	%		MW-med	%	
Baixada Fluminense	Petróleo Brasileiro S.A. - Petrobras	0,0	0,0%	530,0	430,2	81,2%	81,2%
Linhares III	Linhares Energia Ltda.	16,8	30,0%	56,1	36,7	65,5%	86,8%
Global VI	Global Participações em Energia S.A.	98,2	30,0%	327,1	237,1	72,5%	86,8%
Queimados 3	Genpower Termoeletricas e Part S.A.	291,4	50,0%	582,8	506,2	86,9%	90,6%
Resende	Omega Engenharia e Assessoria Ltda.	330,3	65,9%	501,5	446,7	89,1%	93,6%
Paracambi	Usina Termelétrica Paracambi Ltda	422,8	69,6%	607,8	551,9	90,8%	94,3%
Araraquara	ARS Energia Ltda.	405,8	70,0%	579,4	526,2	90,8%	94,4%

Source: MME e EPE.

The positive change in physical collateral of Petrobras's rivals, assuming the same VCU for other plants, shows that the VCU declared by UTE Baixada Fluminense is lower than for other projects. As the cost of gas represents a significant proportion of the variable cost, it is possible to conclude that Petrobras offered supply contracts of gas to the competitors at a higher price than charged to its plant, indicating price discrimination.

At the end of the auction, the only successful natural gas power plants were thermoelectric Petrobras (UTE Baixada Fluminense) and thermoelectric UTE Maranhão III, which also had its own supply of natural gas. The other six plants, which depended on the supply from Petrobras, did not succeed in the auction.

It is important to highlight the fact that Petrobras' plant has been a marginal plant, that is, the plant with the highest price to be hired in the reverse auction.

Although the abuse of market power by Petrobras is mitigated by competition with other generating sources, its behavior has the potential to cause a number of inefficiencies:

- (1) Less efficient thermal power generation by potentially resulting in the selection of a less efficient thermoelectric;
- (2) Inefficiencies in the electricity supply as it distorts the electrical matrix, reducing the thermal generation vis-à-vis the ideal amount given its costs relative to other sources.

Both inefficiencies have the effect of raising the cost of supplying electricity to final consumers.

The overall result is that a state-controlled company (Petrobras) might also replace private investments in energy in the long-run as only Petrobras's partners have an

incentive to invest in those areas. It is worth remembering that the privatization and liberalization program in Brazil had as objective to attract private capital investments in order to attend the growing demand of infrastructure services, chemical and fuel products, among others. The recent vertical integration strategy adopted by Petrobras can be understood as a retrocession in the Brazilian economic policy towards market mechanisms.

5. Conclusion

Evidence from the energy auction held on August, 17th, 2011 for the purchase of energy from new generation projects (A-3 Auction) suggests that Petrobras used its dominant market position as a natural gas quasi-monopolist supplier to promote its thermoelectric plant at the expense of other competitors that relied on fuel supplied by the Petrobras.

In the auctions held so far, Petrobras participated only as a minority shareholder of thermoelectric plants operated by other companies. However, in the August 17th auction, the SOE signed in to the auction a thermoelectric plant in which its capital share is 100%.

The position of Petrobras as the sole supplier of inputs to its competitors and at the same time, competitor in the auction may bring risks to the competition promoted by the Ministry of Mines and Energy. In practice, Petrobras is already adopting an anticompetitive strategy by discriminating the conditions in the supply of natural gas between its thermoelectric plant and other competitors.

The information provided to EPE by competitors in the auction indicates that Petrobras offered supplying contracts of gas with lower prices and inflexibility rate to its thermoelectric plant (UTE Baixada Fluminense) in relation to the conditions offered to the others.

These practices undermine the competitiveness of rivals and increase the likelihood of victory for Petrobras. Moreover, it is not possible to eliminate the hypothesis that other anticompetitive strategies can be adopted by Petrobras in the future.

The antitrust literature shows that even though Petrobras is a state owned enterprise, it has incentives to adopt anticompetitive strategies and regulatory evasion may be another unintended effect of the resulting verticalization.

For future auctions, one could suggest the creation of mechanisms that prevent Petrobras from discriminating conditions of gas supply, even though this does not eliminate all risk of an anti-competitive conduct.