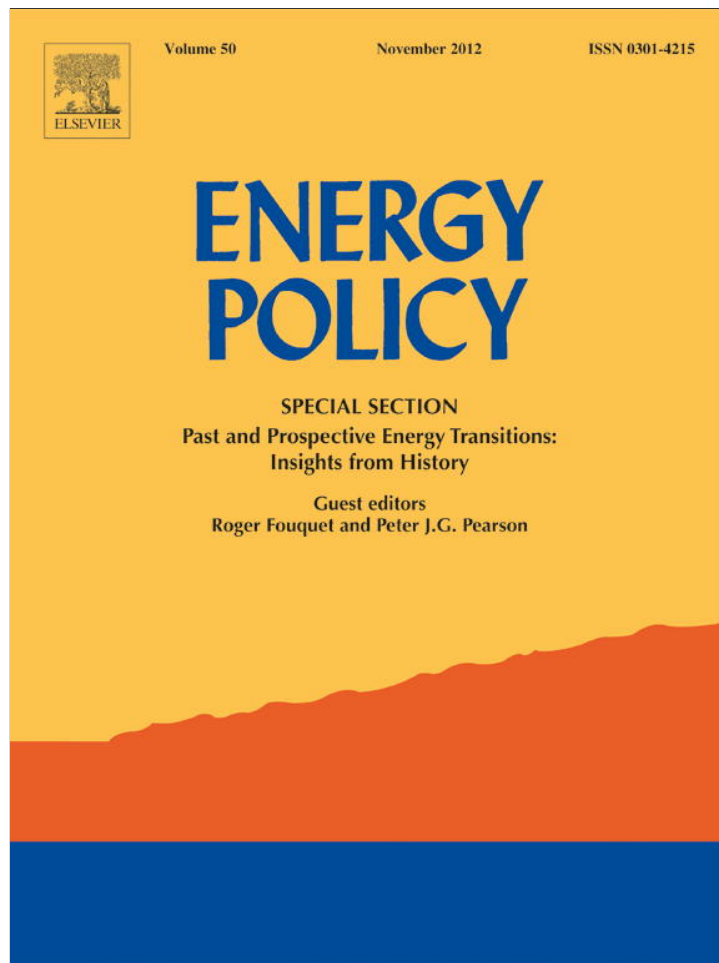


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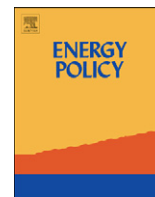


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The development of the natural gas transportation network in Brazil: Recent changes to the gas law and its role in co-ordinating new investments

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HIGHLIGHTS

- ▶ Natural gas transportation investment requires some coordination mechanisms.
- ▶ The 9,478 Act was not capable to incentive the new player entrance.
- ▶ Brazilian natural gas industry is strongly concentrated in Petrobras hands.
- ▶ The new Brazilian legal framework aims to reduce transaction costs in gas industry.
- ▶ The industrial structure of the gas sector discourages the entrance of new investors.

ARTICLE INFO

Article history:

Received 1 March 2011

Accepted 31 July 2012

Available online 18 August 2012

Keywords:

Natural gas

Regulation

Investment in pipelines

ABSTRACT

In Brazil, the consensus that natural gas regulation has failed to attract investments, especially from private companies, culminated in a new law for the natural gas sector, passed in March 2009 (Law No. 11,909). The most significant change this new law introduced was the new governmental role in co-ordinating investments in the transportation sector. The Brazilian government has had to plan pipeline networks, estimate the size of demand for transportation and organise bidding to select investors for new pipeline projects. Although the law has established a clear regulatory framework for the midstream sector, providing stability and the legal certainty necessary for long-term investments in assets with high specificity, it has not been able to fill all of the gaps that remain under Law 9,478. In this sense, besides the challenges related to effective implementation of the regulatory attributes defined in Law 11,909, the absence of certain issues prevents the modified legal structure from encouraging the entry of new players in the transportation sector. This paper has identified, according to the neo-institutional view, the mechanisms of co-ordination introduced by the new law and the limitations of the new regulatory framework.

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1. Introduction

According to Costa (2003), although Law No. 9,478 has defined a draft of the regulatory framework of the oil and natural gas industry, it has not effectively introduced competition into the natural gas upstream segment, let alone promoted expansion of private investment in infrastructure, such as the case of the transportation segment. In fact, the control of this infrastructure by a single agent; Petrobras, and the reduced participation of natural gas in Brazilian energy consumption bring great risks to new investments in exploration and production, thereby limiting competition in the natural gas industry. What explains Petrobras' monopoly in the natural gas segment? Will the new gas Law (Law

11,909) be able to stimulate the entry of new players in the transportation segment? These are some questions that this paper will attempt to answer.

The entry of new players in the activity of natural gas transportation may occur in two ways. First, by the ingress of a new private player in the transportation segment through investments in new pipelines. In this case, the high risks associated with investments in natural gas transportation assets require regulatory and institutional guarantees for new potential investors. As will be shown later on, the greater the level of vertical integration of the incumbent company, the greater the risks for new investors.

Second; new players could operate by means of accessing the already existing transport infrastructure. In this case, the mechanisms of primary capacity allocation and the definition of the rules of access for third parties are shown to be a determining factor for the entry of new players. These rules are also demonstrated to be

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essential to making investments viable in new pipelines as they stimulate or discourage primary contracting capacity by the initial carriers.

In both cases, Law 9,478 was shown to be incapable of stimulating the entry of new players in the transport segment. This fact became evident by the reduction in the volume of private investments as well as conflicts existing between Petrobras and some private agents (BG and ENERSIL) for the right of access to the Brazil–Bolivia gas-pipeline.¹

According to the Brazilian Petroleum Agency (ANP, 2004), Law 9,478 has limitations that bring serious co-ordination problems among players in the natural gas transport sector. For the agency, the lack of regulatory mechanisms that allow these problems to be resolved increases risk and creates difficulties for the entry of new investments in transport assets.

It was the consensus that Law 9,478 had failed to stimulate competition that brought about the development of Law 11,909, passed in March 2009, after a long political negotiation between Petrobras and the other players of the Brazilian natural gas industry (Sobreira et al., 2009). This new act has not affected the upstream sector, which remains regulated by Law 9,478 of 1997, or the distribution sector, which is regulated by state governments.² The most significant change brought by the new Law has been the new regulatory framework of the transport sector and the new government role in co-ordinating investments in new pipeline projects.

The new regulatory structure created by Law 11,909 was sought to set up new instruments capable of stimulating and guaranteeing co-ordination among the different players of the natural gas industry, thereby reducing the risks to investment. Nevertheless, although the development of mechanisms of regulatory co-ordination are necessary to reduce risk in economic sectors that are characterized by high assets specificity and high costs, it is not sufficient to guarantee the entry of new players, whose stimulus in some cases, would demand changes in the manner of organising the industry.

Thus, although the new gas Law has contributed to the development of regulatory co-ordination mechanisms among players, Petrobras' cross-participation in all sectors prevents the entrance of other potential investors in the transport sector. Comparing the Brazilian case with the North-American and Spanish models, one realises that the industrial structure, inherited from the state monopoly, is the main entry barrier to new players, especially in the transport sector. Thus, although Law 11,909 has contributed to the reduction of transaction costs, the industry's market design prevents the entry of new players in the industry.

This paper highlights the evolution of the institutional framework of the Brazilian natural gas industry. In particular, it analyses how the new institutional and economic co-ordination mechanisms can reduce risk for public and private investors and why these mechanisms are not sufficient to promote new private

investment. To better analyze the above issues, this paper was divided into five sections besides this introduction and the conclusion.

Section 2 identifies the investment characteristics of the natural gas transport sector from a neo-institutional view. In this section, we can note how the high transaction costs inherent to the transportation of natural gas require a regulatory framework that is different from that required by other sectors. In Section 3, we will analyze the market design of the Brazilian natural gas transport sector. In this section we will highlight Petrobras' dominance and the industry's vertical integration. In Section 4, we will show the difficulties that are imposed by Law 11,909 by the market structure of the natural gas industry in Brazil. Section 5 identifies in some international experiences, institutional and regulatory mechanisms that permit dealing with the problems of a monopolized and vertically integrated market structure. Section 6 presents the lessons of international market analysis. Finally, we present the main conclusions of this paper.

2. Characteristics of investment in the natural gas transport network: through a neo-institutional lens

According to ANP (2004), the main weakness of Law 9,478 was that it did not deal with the co-ordination problems stemming from the process of liberalization and decentralization of the natural gas industry in Brazil. Therefore, the aim of Law no. 11,909 was to create mechanisms of regulatory co-ordination capable of reducing the perception of risk to private players and stimulating investments in the transport segment.

A co-ordination mechanism is any structure that induces the agents to cooperate tacitly or by law enforcement. Its effect must perpetuate itself over time, as the agents are always considering the opportunity costs of their co-operation.³ The concept of co-ordination goes beyond the economy. It is important for the establishment of any enduring social relationship. A nation's legal system, traditions, customs and contracts are examples of co-ordination mechanisms in which relations between individuals are limited by rules established by consensus or by the federal government's power of enforcement.

According to economic literature (Williamson, 1985; Ruester, 2010; Rious, 2007; Perrot, 1995; Makhholm, 2009; Glachant and Brousseau, 2002), in industries characterized by network segments, contracts have proven to be not very effective co-ordination mechanisms. In this type of industry, the costs associated with the re-definition of contractual relations – transaction costs – have proven to be excessively high, thus raising the risk to investment. In this sense, the aim of the regulator is to create alternative co-ordination mechanisms that are complementary to private contracts that reduce transaction costs and consequently, the risks.

For Almeida and Pinto (2009) the great advantage of the regulatory framework of the Brazilian natural gas industry, defined by Law 11,909, was the creation of new co-ordination mechanisms that permit the reduction of risk and uncertainty to private investment in the gas transport segment. According to the authors, the new role of the state in co-co-ordinating investments in the transport segment permits a considerable reduction in

¹ After the end of the period of exclusiveness, both companies, BG and ENERSIL, requested access to the idle capacity of the gas-duct Brasil–Bolivia – GASBOL. However, in spite of the free access included under 9,478, the lack of clear regulations permitted Petrobras, the only carrier of the duct, to prevent access by the aforementioned requesters. The conflict of interests was arbitrated by ANP, which ruled that the right of access to the duct by BG and ENERSIL was legitimate, thereby forcing TBG (GASBOL operator) to concede access to its transport infrastructure.

² The 1988 Brazilian Federal Constitution (Article 25, Section 2°) grants the states the responsibility for regulating the distribution of natural gas. Each state is empowered to regulate this sector, regardless of federal laws. With the exception of Rio de Janeiro, São Paulo, Espírito Santo and Maranhão, no other states have opened up their markets to competition – only the local distribution company may sell gas to end consumers.

³ Moreover, we can apply Game Theory: as explains Varian (1992), there is no advantage to cooperating on the next to the last move, as long as both players believe that the other player will not cooperate on the final move. To make co-operation the strategy chosen by both players, we should have any guarantee or assurance that the two players will cooperate in all periods. It is here that the mechanisms of co-operation show their importance.

transaction costs and consequently it reduce also the investment uncertainty, which would stimulate private investment.

In order to reassess the effects of Law 11,909 on the transaction costs and consequently on the investment risks in new pipelines, identified by Almeida and Pinto (2009), this paper adopts, as a theoretical framework, the theory of transaction costs.

According to neo-institutional theory, transaction costs are a problem because of the incompleteness of long-term contracts and the specificity of assets. According to Arrow and Debreu (1954), a complete contract includes every response for any future circumstances. In other words, a complete contract includes stipulations for every possible circumstance (Hart and Moore, 1998; Saussier, 1997; Masten, 2000). As such, these contracts will never be revised. For Williamson (1985, 1996), a contract is incomplete if it cannot anticipate all appropriate actions for all future events. Thus, incomplete contracts only define appropriate behavior for a short list of situations. For this reason, Williamson states that contracts must explain not only the devices *ex ante* but also the governance structure needed to ensure proper implementation of contracts *ex post*.

The neo-institutional theory's explanation to contract "incompleteness" lies in the behavioral assumptions of bounded rationality and information asymmetry. That is, once the players do not possess the same level of information and their capacity to process the available information is limited, the elaboration of complete contracts becomes impossible.

However, in many industry sectors, contracts are sufficient to induce co-operation among individuals, even if they are incomplete. In other words, for transactions in which asset specificity is low and transaction frequency is high, co-operation between economic agents can be easily and quickly restored. For example, if we consider an activity for which there are no high asset specificities; if a supplier reduces the quality of the product *ex post* in order to reduce its costs and thereby increase its profit, the buyer can easily cancel the contract with this supplier and make another contract with a new seller without incurring relevant costs.

However, in industries with high asset specificity and lower frequency of transactions,⁴ the incompleteness of contracts prevents their functioning as a co-ordination mechanism. That is, the greater the assets' specificity, the more difficult it is to redefine a co-operative relationship once the original relationship is broken. The contract "incompleteness" encourages a dispute for a quasi-rent⁵ appropriation, which explains opportunistic behavior. The threat of opportunistic behavior explains the high transaction costs for natural gas transportation and thus explains the high risk of new investments in pipelines.

Following Williamson (1996), we can identify three different kinds of asset specificity in the natural gas transportation sector: dedicated assets, geographical specificity and time specificity.

Natural gas pipelines are sets of ducts, valves and compression stations that cannot be redeployed for other purposes than the transportation of gas in a specific region, at least not without expensive investments. The difficulty of rearranging the infrastructure for other uses and the important economies of scale imply that in 'immature' markets the remuneration of the transport investment is frequently dependent on a small number of players. This means that the transport infrastructures are often assets dedicated to one or to a small number of possible

transactions. Once the number of interconnections and carriers increase, the dependence on the transport company is reduced.

The geographical (site) specificity is a consequence of pipeline immobility: once the investment in the gas transportation network is made, it becomes almost impossible to displace the infrastructure.⁶ The removal of the ducts, valves and pressure stations to another site is very expensive, and thus, most of the time, there are no economic gains to be made in demolishing the infrastructure, even if it is not utilised. Therefore, the networks are actually a sequence of investment-adding infrastructures (Glachant and Hallack, 2010). The site specificity explains the geographical interdependence between the transport companies and the other players that can physically access the facilities. Nevertheless, the network development and increase in the number of interconnections contribute to decreasing site specificity because more players, located in different areas, can have physical access to the infrastructure (Glachant and Brousseau, 2002).

The time specificity stems from the need to synchronise investments at different stages of the production line. Rious (2007) shows that in the electricity industry, the *ex post* decision to invest in a new generation plant is conditioned by the *ex ante* decision to invest in transmission. On the other hand, the *ex ante* decision to invest in transportation is constrained by the need for investment in generation. This simultaneity of investment decisions across different sectors can be explained by the high costs of electricity storage.

In other words, there is a relationship of mutual dependence. The co-ordination between actors is vital to investment decisions on both sides. In the natural gas sector, even if the storage is less costly than in the electricity industry, it is still too costly in the long term. Therefore, there is the same need for the co-ordination of investment decisions in infrastructure and gas production. New technologies, such as LNG (liquefied natural gas) and CCGT (combined cycle gas turbine), reduce part of the site and time specificities since they reduce storage costs and increase geographical mobility (Colomer, 2009).

Asset specificities show the high physical and contractual interdependence between the various players of the natural gas chain. This dependence is much more important in the natural gas transportation sector since it is characterized by huge sunk costs. According to Estrada et al. (1995), the inflexibility of natural gas transportation through pipeline networks is one of the causes of the high investment risk in natural gas pipelines, especially in a less developed industry.

These characteristics explain the high transaction cost and, consequently, the high level of risk to investors. Therefore, the development of the natural gas industry depends on the adoption of other co-ordination mechanisms besides private contracts to reduce risks to investment.

Co-ordination among different industry actors reduces risks to investment because it lowers incentives for opportunistic behavior. In this way, the development of co-ordination mechanisms is essential to stimulating investment in industries with high transaction costs.

The integration of different sectors into a single company can be understood as a co-ordination mechanism or a governance structure since the maximization of company profit induces co-ordination between the firm's different departments. However, this interpretation can obscure certain types of problems that may occur within a vertically integrated structure. Even within these structures, there may be disputes between departments of a

⁴ Being the frequency of relation the number of times that the contract is negotiated, as defined by Ruester (2010).

⁵ Quasi-rent can be defined as the difference between the economic value of the same asset employed either by an asset specificity transaction or not. The asset specificity investment generates a possibility of a bigger surplus as a counterpart to the greater interdependency between players.

⁶ The displacement of some network pieces can happen in some rare cases, but it is a costly process and atypical.

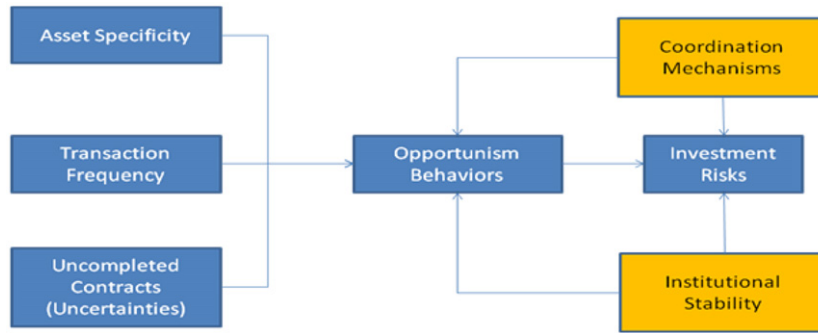


Fig. 1. Investment risks.
Source: Author's elaboration.

firm which can undermine co-operation within the company, thereby duplicating costs and reducing productivity. Even within these structures, it is necessary to develop managerial co-ordination mechanisms.

A second mechanism stems from the coercive power of the state. The establishment of regulatory structures has the potential to induce co-operation between players by setting rules as well as legal and economic constraints. Furthermore, state planning has the potential to reduce uncertainty in relation to the evolution of investments in sectors with high physical and temporal complementarities. Not only should co-operation among the private agents be fostered, but co-operation between the public and the private sector must also be encouraged. Constant changes in government behavior increase the uncertainties and risks to investment.

However, co-ordination mechanisms should be viewed as structures that foster co-operation and enhance mutual trust between agents. When the economic policies of the State generate a new source of uncertainty, they do not work as a co-ordination mechanism and are therefore not justified. The main objective of the State as a regulator is to induce co-operation between individuals when the co-ordination structure of the market is unable to do so. As Berg (2000) states, regulation involves the establishment of rules that provide value to consumers and suppliers in such a way that they maintain incentives for the firm to create value, while promoting political legitimacy in the eyes of consumers and other stakeholders.

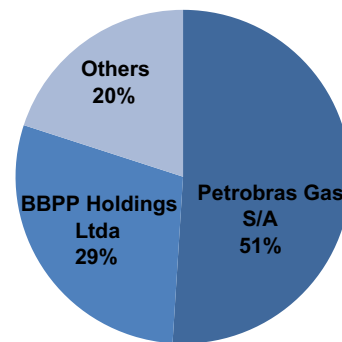
Fig. 1 shows the causes of high transaction costs and the importance of co-ordination mechanisms to mitigate these types of costs.

3. The Brazilian natural gas industry

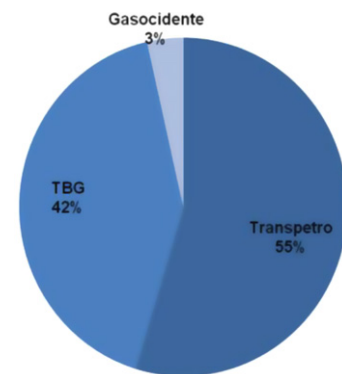
The main objective of Law 9,478 is to begin the process of liberalization and decentralization of the oil and natural gas industry in Brazil. This Law aims to promoting free competition and stimulating private investments in all segments of oil and natural gas industry. However, in the case of natural gas, these aims have been advanced very little.

Besides the opening up of Petrobras' capital, the main change brought by law 9,478 was the separation of transportation from the other activities of the natural gas productive chain. Thus, the same Law forced Petrobras to constitute a subsidiary exclusively for operating and constructing its natural gas transportation ducts (BRAZIL, 1997, Article 65). It is forbidden for the transporter to act as producer, importer, carrier, or trader.

This separation of the productive chain of natural gas presents a merely legal aspect however. No restriction is made on the cross-participation between the agents of the natural gas segment or regarding shareholding control of a transportation company by



Graph 1. TBG share holds.
Source: TBG (2009).

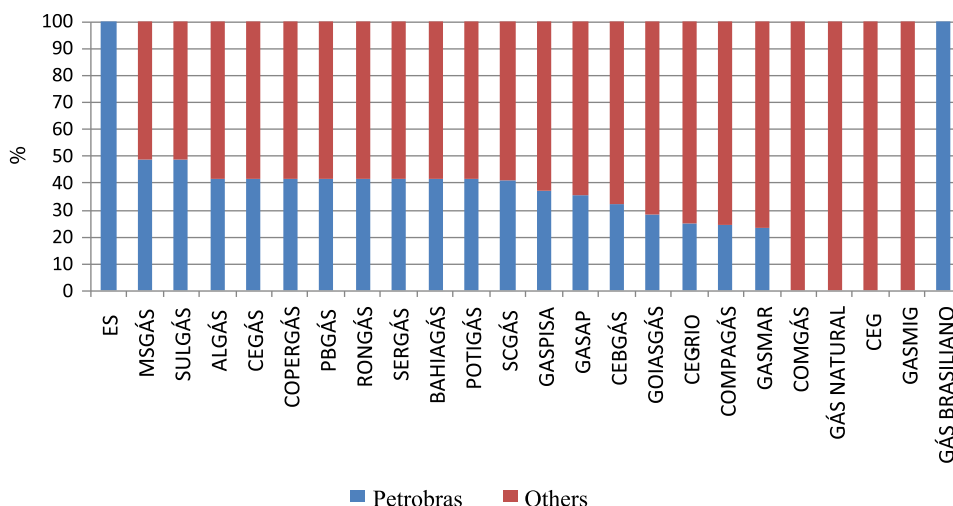


Graph 2. Brazil: Natural Gas Pipelines Extension (2009).
Source: TRANSPETRO (2009), TBG (2009) and ANP (2009).

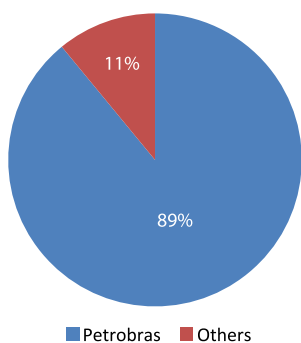
a producer, importer or trader. This becomes evident when one analyzes the shareholding structure of the transportation company Brasil Bolivia – TBG.

Graph 1 shows that 51% of TBG's shares belong to Petrobras Gas – Gaspetro, a wholly-owned subsidiary of Petrobras. The control of the network by Petrobras becomes even clearer when we analyze the participation of Transpetro – a wholly-owned subsidiary of Petrobras – in the Brazilian transport sector. Graph 2 shows that 55% of the pipeline network (distribution network is not included) in Brazil is operated by Transpetro, while 42% is operated by TBG.

The organizational structure of the gas industry in Brazil does not include any rule that separates the right of property over the transportation capacity from the right of property over the commodity. The carriers may be the owners of their own gas and also act as traders. Thus, 100% of the transport capacity of the Brazil–Bolivia



Graph 3. Brazil: Natural Gas Distribution (2011).
Source: ABEGAS (2009).



Graph 4. Brazil: Gas Production (April 2012).
Source: ANP (2012).

pipeline and the Transpetro pipelines are contracted by Petrobras itself. In other words, the company acts as a trader and carrier of its own gas and, in some cases, of the gas of other producing companies that do not have access to transport infrastructure.

Another characteristic of the industrial organization of the natural gas market is the participation of Petrobras in the distribution segment. Of the 24 distribution companies operating in 2011, Petrobras holds stakes in 20 (Graph 3).

The control of transportation and distribution infrastructure by Petrobras has direct impacts on upstream. The company represents around 90% (Graph 4) of national natural gas production and around 100% of the importation of fuel in Brazil, as Graph 4 shows.

Petrobras controls the 38 units of natural gas treatment – (UPGN) – and the two plants of re-gasification that exist in Brazil. And, with the exception of the transport segment, third-party-access is not obligatory, which permits even greater control by Petrobras over the Brazilian gas industry. The above data shows that Petrobras has a large share in all segments of the natural gas industry, from the exploration to the final consumer – a segment in which it has been increasing its stake through the construction of thermoelectric power stations and fertilizer manufacturing plants.

As will be shown in the following section, the market design of the natural gas industry in Brazil, characterized by a “*de facto*” Petrobras monopoly, creates important barriers to the entry of new players in all of the links of the productive chain and particularly in the transport segment. The next section will show that in spite of the reduction in transaction costs provided by Law

11,909, the industrial structure in force inhibits private investment and competition in the transport sector.

4. The difficulties imposed by the market structure on Law 11,909

This section will analyze the evolution of the regulatory framework of the Brazilian natural gas industry and the difficulties imposed by maintaining the Market structure controlled by Petrobras. In Section 4.1, the regulatory framework defined by law 9,478 will be presented. In Section 4.2, the main regulatory changes brought by law 11,909 will be highlighted. Section 4.3 analyzes the contribution of the new regulatory milestone in reducing transaction costs and consequently incentives to investments. Finally, Section 4.4 will analyze the main barriers imposed by the Market structure on the risks of investment and on the competitiveness of the natural gas sector.

4.1. Regulatory framework defined by law 9,478

The institutional evolution of Brazil’s gas industry has been characterized by the search for new co-ordination mechanisms and ways to reduce investment uncertainty. The constitutional reform of 1995 was the first step towards a liberalized market. Constitutional amendment No. 9 states that the activities for which the Brazilian State has an exploration monopoly can be carried out by private or state companies.

In 1997, the 9,478 Act ended Petrobras’ monopoly over the petroleum and gas industries by implementing constitutional amendment No. 9 (BRAZIL (1997, Article 23). The market was opened to new investors, natural gas prices were deregulated, and new institutions were created to regulate the sector. The 9,478 Act created the National Council of Energy Policy (CNPE) and the National Agency for Oil and Gas (ANP).

The role of CNPE is to approve the main directives of energy policy to be implemented by both the Ministry of Mines and Energy (MME) and by ANP. In turn, ANP is in charge of regulating the entire oil and gas chain, except gas distribution, which is regulated at the state level (BRAZIL, 1988).

The upstream liberalization occurred after the implementation of exploration auctions carried out by ANP. The auctions attracted new companies to the Brazilian upstream oil industry, while

Table 1
Change in the natural gas regulatory framework.
Source: Author's elaboration.

Regulatory attributes	9,478 Law and ANP Ordinances	11,909 Law
Unbundling rules	<i>Legal Separation without cross-holding restriction</i>	<i>Legal Separation without cross-holding restriction</i>
Transportation grant scheme	<i>Authorization</i>	<i>Concession preceded by bid</i>
System operation	<i>Each transport company operates independently its network</i>	<i>Each transport company operates independently its network</i>
Open access	<i>Unregulated. Bilateral Contract</i>	<i>Regulated by ANP</i>
Primary transport capacity allocation	<i>Through open season</i>	<i>Through open season (Public Call)</i>
Capacity secondary market	<i>Although the assignment of capacity from a carriers to another is permitted the sale is prohibited</i>	<i>No reference</i>
Transport services allowed	<i>Firm and interruptible contracts</i>	<i>Firm, interruptible and extraordinary contract</i>
PriceParte inferior do formulário Tax	<i>Freely negotiated but depends on ANP approval, which suggests a methodology for calculating</i>	<i>Regulated by ANP through service cost methodology</i>
Transport capacity contracts	<i>ANP receives the contracts after signing</i>	<i>Regulated: The ANP defines the contract model and has to approve it before it is signed.</i>
New investment in pipe	<i>Depends on market agent initiative</i>	<i>Proposed by MME</i>

natural gas production remains dominated by Petrobras, as we have seen in the last section.

Although symbolically important, the 9,478 Act did not contribute to the expansion of private investment in the natural gas sector, unlike that which occurred in the oil industry. Natural gas is treated by the 9,478 Act as a by-product of oil production. Although the law provides a macro model for market liberalization, it does not provide the necessary tools for the implementation of competition. During this time, private investment incentives, especially in the transport sector, have been very low.

For the natural gas industry, the regulatory framework, defined by the 9,478 Act, is very vague. ANPs capacity to regulate depends exclusively on negotiations and publications of ordinances that do not have the same legal power of enforcement as a law.

Law 9,478 states that the transportation of natural gas has to be carried out under authorization from ANP. Under this model, the investment risk falls entirely on the transport companies. Thus, the few private investments that have been made in the natural gas sector were concentrated in distribution.

4.2. A new regulatory model: law 11,909

In the mid-2000s, the natural gas industry players reached an agreement that the 9,478 Act was not appropriate for promoting competition in the Brazilian natural gas industry (Sobreira et al., 2009). This consensus sparked a lengthy political discussion, which culminated in the approval of a new law for the gas sector in March 2009 (Law No. 11,909). Table 1 shows the main differences between the 11,909 law and the former regulatory model.

Besides the adoption of the concession as a legal regimen in transport activity (BRAZIL, 2009, Article 3), the biggest change brought about by the law 11,909 was the new government role in co-ordinating investments in transportation.

With the new Law, the regimen of authorization⁷ (permit) was substituted by one of concession.⁸ Authorization is a poor legal

system; it lacks the necessary contractual guarantees for investment in assets with high specificity (Di Pietro, 2000). Concession is a more stable legal regimen. It is more appropriate for activities that require high investments in specific assets than the authorization regimen (Leite, 2005).

Any concession in Brazil must have a contract signed by the State and the concessionaire. It specifies previously when, how and where Federal government can intervene. It also includes a tariff methodology that ensures economic and financial equilibrium of the concessionaire. The concession regimen reduces the possibility of opportunistic behavior by both sides, carriers and government agencies. As a result, it reduces the transaction costs associated with investments in natural gas pipelines.

In relation to the new government role, under Law 11,909, the Energy and Mines Ministry (MME) is responsible for planning the expansion of the gas transportation sector through its planning subsidiary, EPE (Energy Research Enterprise) (BRAZIL, 2009, Article 4). The Network Expansion Plan (PEMAT) will be developed by EPE based on their studies of the potential market for natural gas (BRAZIL, 2009, Article 6). This document will consist of a list of pipeline projects that may or may not be bid in accordance with MME criteria of priorities. Therefore, any pipeline project that will be bid has to be included previously into PEMAT. The Pipeline Expansion Plan will be valid for 10 years and may be reviewed annually. Another important feature of PEMAT is that it should contain a detailed description of the projects so that ANP can calculate the minimum tariff needed to recover the costs of the investment plus a return on capital previously defined (BRAZIL, 2009, Article 8).

The MME is also responsible for implementing new economic mechanisms to reduce investment risks in natural gas transportation. According to the 11,909 law, the MME can propose the concession of subsidies to projects that are not economically feasible without this kind of support. These subsidies may be offered by public-private partnership contracts and/or existing tax funds from liquid fuels (the Contribution for Intervention in the Economic Domain – CIDE) and electricity (Energy Development Account) (BRAZIL, 2009, Article 6).

According to this new law, ANP has an important role in the regulation of gas transportation. As soon as the MME has defined which pipeline projects will be bid, ANP has to calculate the tariff that recovers the capital costs of the project. After that, ANP has to

(footnote continued)

through tariffs charged directly to users of the service during an agreed upon period. In this way, the concession model possesses a contractual nature and a period of effectiveness.

⁷ The authorization is the means by which the state transfers to a private individual or legal entity the execution of a service of its competence. The business risk is transferred to the concessionaire that can charge a tariff for final users. The authorization is considered to be a unilateral and precarious act since it does not possess a contractual nature and the services are subject to inspection and conditions established by public administration.

⁸ The concession is the means by which the State attributes the exercising of a public service to a private individual or legal entity that is prepared to execute it in its own name, under the conditions laid down and unilaterally altered by public power, but under the contractual agreement of financial-economic balance, being remunerated by its own exploitation of the service in general and basically

conduct an open season in order to allocate the new transport capacity among the interested carriers (BRAZIL, 2009, Article 8). If demand for new capacity is bigger or smaller than the one previously projected, the tariff is recalculated based on a new demand. The process goes on until the new capacity demand is satisfied. The carriers that, at the end of the open season process, have requested new capacity, have to sign an agreement with ANP where they agree to contract the primary capacity paying the tariff previously defined in the open season process (BRAZIL, 2009, Article 10). These terms of agreement, after the concession bid, are transformed into firm contracts with the transport company with ship-or-pay clauses. The term of appointment is irrevocable and becomes part of the bidding documents, which reduces the investment risk in pipelines.

After the open season process, ANP conducts a bid to select the company that will build and operate the new pipeline. ANP sets the maximum tariff in accordance with the agreement terms signed by carriers and the costs of the reference project. The company that offers the greatest discount on the tariff set down in the open season process wins the bid. In fact the tariff that the carriers will pay is calculated, based on the discount offered by the winning company (BRAZIL, 2009, Article 17).

The concession contracts are for 30 years and may be extended for an equal period of time. The pipeline's third-party-access is guaranteed after a period of grace set by the MME (BRAZIL, 2009, Article 48). However, this period of grace may be a maximum of 10 years (BRAZIL, 2009, Article 11). It can also be revised by the MME if the primary carriers adopt some anti-competitive practices. The terms of third-party-access to the transportation pipelines may be set forth in firm or interruptible contracts. This contractual variability ensures the return on investment for transport companies.

Alongside the planning of EPE, the pipeline projects may be proposed to the MME by any player. However, MME has to approve the proposed project and ANP has to hold an open season to allocate the transport capacity and a public bidding procedure to select the transport company that will build and operate the pipeline. However, the winning company may differ from the company that proposed the pipeline project, it will depend on the bidding process.

4.3. Law 11,909 and the reduction in transaction Costs

The 11,909 Act tries to stimulate investment in natural gas transportation by creating new co-ordination mechanisms. As was discussed in Section 2, the pipeline investments have some specific characteristics that demand means of co-ordination that are different from those presented in the market. In other words, for investment in natural gas transportation to occur, some regulatory mechanisms are necessary to mitigate the risk of investment in assets with high specificities.

Thus, the MMEs planning of new pipeline projects ensures that competition between projects does not jeopardize the financial health of transport companies. The construction of pipelines that directly or indirectly serve the same market may raise the transaction cost due to the high asset specificities and high minimum efficiency scale of natural gas transportation. Therefore, projects will only be approved by the MME if there is a sufficiently high demand for transport capacity.

Another benefit of MME planning is that project approval occurs independently of those who propose it. That is, when the MME approves a project proposed by a transport company, this project is offered to any company that wants to participate in the concession bid. In theory, MMEs planning stimulates ex ante competition between transport companies. Therefore, network planning for an autonomous agent ensures an efficient allocation

of investments since the criterion to win the bid is the lowest tariff.

The presence of regulated long-term contracts reduces opportunistic behavior by the carriers and defines ex ante the investment schedule, annual revenues, tariff adjustment criteria, third-party-access rules, mechanisms for resolving disputes, penalties for breach of contract and a period of exclusivity that the first carriers will have in order to exploit the pipeline capacity.

Concession contracts attempt to solve the problems associated with the incompleteness of contracts by establishing ex ante the contract structure and the mechanisms for resolving possible conflicts ex post (BRAZIL, 2009, Article 21). According to Hart and Moore (1998), the problem of underinvestment remains when contracts are incomplete and there is room for renegotiation. The transport company will not have the incentives to invest if the carriers can appropriate a larger portion of the quasi-rent. The regulation of long-term contracts contributes to reducing the negative effects associated with adverse selection and moral hazard, thereby reducing the transaction costs associated with investments in assets of natural gas transportation.

The open season process and the commitment terms limit the opportunistic behavior of carriers and thus reduce transaction costs. The prior commitment of the carrier allows the transport company to know ex ante the transport capacity required and the maximum tariff that can be charged. Another benefit brought by the open season process is the reduction of trading costs. The primary capacity trade is not carried individually with each carrier. ANP gives the commitment terms signed by each carrier to the company that has won the bid. Consequently, the transport company turns them into firm transport contracts. As can be seen, the open season model defined by 11,909 Act encourages co-operation between the carrier and the transport company.

Since the open season process is carried out by the regulatory body and not by the transport company (as used to occur before Law 11,909) discrimination between different interested carriers is avoided. All of the demand for transport capacity that arises in the open season process has to be met even if it is necessary to re-dimension the project. Besides this, the tariff charged for the transport service has to be the same for all of the primary carriers without there being price discrimination. All of these mechanisms have the potential to increase competition in the natural gas transportation since it stimulates the entry of new carriers.

The public-private partnerships and the government's financial resources help to stimulate new pipeline investments, even when the previously contracted capacity is insufficient to fund the project. In other words, the government, through the MME, guarantees the return on investment by reducing the risks associated with prior contracting capacity. Fig. 2 shows the

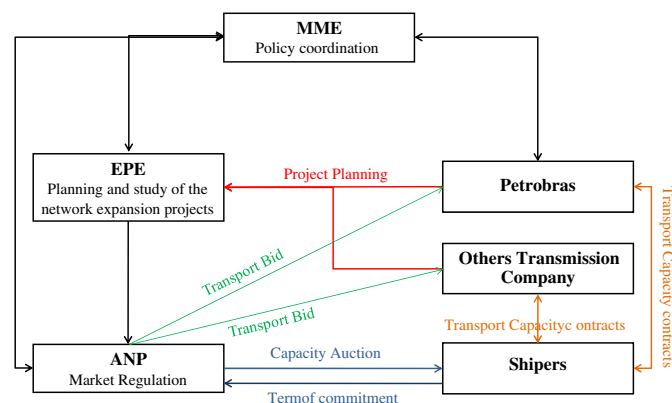


Fig. 2. Brazil: coordination mechanisms in the natural gas industry. Source: Author's elaboration.

coordination mechanisms introduced by the 11,909 Act for the natural gas industry.

4.4. Market structure and the new regulatory framework

The analysis of 11,909 Act shows that the new regulatory framework of the natural gas industry creates some mechanisms of co-ordination that contribute to the reduction of transaction costs associated with transport contracts. However, as will be discussed below, this reduction of transaction costs is not sufficient to stimulate new private investors, especially in the contracting of transport capacity.

As we have seen before, neither Act 9,478 nor 11,909 limits cross-holdings between companies from different segments in the natural gas industry. Thus, although the natural gas industry presents itself as legally unbundled, in practice, Petrobras has a monopoly in the sector.

Petrobras' dominant position in production, importation, and distribution of natural gas and the lack of rules for property separation between transport capacity and the commodity confer on the Brazilian state company an almost monopolistic role in contracting transportation. Moreover, the risks involved in this operation (ship-or-pay clauses, long-term contracts, readjustment rules, etc.) demand some supply and selling guarantees which in the Brazilian market can only be offered by Petrobras.

Even if open competition in capacity allocation provides the same opportunity for all of the interested carriers, the market structure of natural gas industry in Brazil elects few or only one carrier. This is because a private distribution company or a consumer would only be interested in contracting the transport capacity of a new pipeline if it were possible to buy the gas directly from producers. Nevertheless, Petrobras' dominant position in production makes this direct acquisition unviable since the state company is interested in selling the gas and the transport service together. Thus, there are few guarantees for other carriers other than Petrobras that will be able to use the total capacity contracted.

On the other hand, an independent producer would only be interested in contracting transport capacity if it were possible to sell their gas directly to a distribution company or a consumer. However, as a large number of distribution companies have Petrobras as a shareholder and the market of free consumers is not very developed,⁹ there are few opportunities for independent producers to sell their gas directly in citygate or to the final consumer.

This situation creates certain distortions in the price of natural gas. The current composition of the final tariff for natural gas, paid for by an industrial consumer, composed of four parts: (1) the "Variable" or Commodity installment, (2) the "Fixed" installment, (3) distribution margin and (4) the federal and state taxes (ANP, 2011).

The part of the tariff that corresponds to transport activity consists of a variable and fixed installment. The "Variable" or Commodity installment corresponds to the cost of the natural gas molecule. It is adjusted quarterly and tied to an oil basket that is based on an international reference. The "Fixed" installment refers to the infrastructure cost and it is charged via a postal rate (in which the calculation is done regardless of distance) (ANP, 2011). This installment is fixed initially and updated according to

the retail price index (IGP-M). The problem with the "Fixed" installment is that it does not appear to be very transparent. Thereby, in the last years, the natural gas price in Brazil has increased more than the price in rest of the world (FIRJAN, 2011).

Although the contracting of capacity by carriers guarantees the return on investment in transportation and the bidding process allows any agent that offers the lowest transport tariff to construct and operate a pipeline, the market structure of the natural gas industry in Brazil does not permit the development of competition in natural gas transportation. Therefore, it is no use having different companies constructing and operating pipelines if there is only one carrier negotiating its own gas.

In other words, the reduction in transaction costs brought about by the new law is not sufficient to foster the entrance of new players in the market. Therefore, Act 11,909 has proven to be very important in stimulating investments in natural gas transportation assets, but it does not sufficiently improve competition. The question under consideration here is not whether Act 11,909 is good. The question is whether it can meet its initial objectives of promoting competition in the natural gas industry. Based on the analysis made in this paper, the answer to that question seems to be that it cannot.

5. Liberalization of the natural gas industry: two strategic examples for co-ordinating investment – USA and Spain experiences

There are examples of countries that have resolved their problems associated with *market design* of the natural gas industry and the lessons of these international experiences may help the Brazilian case.

In the USA, the investments in new pipelines were not affected by the liberalization of the market brought about by Administrative rule FERC 636 of 1992 (FERC, 1992). On the contrary, after this law came into force, there was a significant increase in the number of interconnections between the inter-state pipelines. Between 2001 and 2005, the transport and distribution infrastructure expanded 2.9%, increasing from 1,975,684 to 2,034,184 km of network (Almeida et al., 2007). In 2008, the finalization of 84 new projects, at a total cost of US\$ 11.4 billion, added 6000 km of pipelines to the north-American network (EIA, 2009). The numbers below show the evolution of natural gas transport infrastructure in the USA Graph 5.

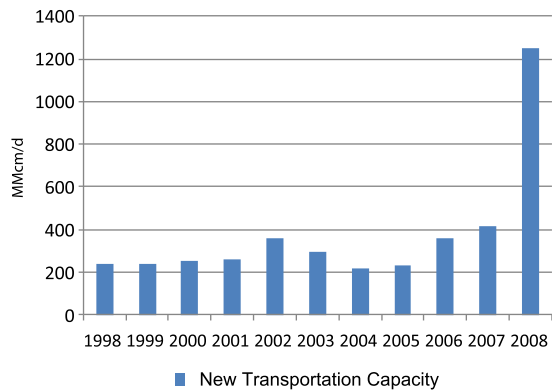
The high rate of growth of the already extensive and inter-connected natural gas transport network in the USA has some explanations that transcend the impacts of the regulatory structure over transaction costs. At the moment of liberalization and decentralization of the natural gas industry, the transportation segment in the USA was already at a very mature¹⁰ level.

According to Makhholm, (2009), the development of this segment in the USA was benefitted by the long period (1889–1935) in which transportation was completely deregulated. During this phase, the pipelines were financed through vertically integrated firms, and an extensive pipeline network appeared throughout the East Coast, from the major gas basins in Kansas/Oklahoma, to the upper Midwest. Gas distribution and oil producing companies owned both the inter-state pipelines and the gas in them.

During this period (1889–1935), the level of vertical integration of the industry was so high that in 1935, 80% of the pipeline networks were controlled by only the nine biggest integrated

⁹ Until June of 2012, only two Brazilian states (Rio de Janeiro and São Paulo) had regulated the free market. In São Paulo, a consumer can be eligible as a free consumer if its consumption is equal to or above 10.000 m³ per day, while in Rio de Janeiro, the minimum value that defines a free consumer is equal to 100.000 m³ per day. Until the date above, few consumers have shown interest in being a candidate for free consumption.

¹⁰ A natural gas industry with a high level of maturity is considered to be that which has an extensive transport network, a high number of interconnections, a large number of traders/carriers, a developed secondary market and a large number of producers.



Graph 5. USA: transport capacity growth per year.
Source: EIA (2009).

natural gas companies¹¹ (Makholm, 2009). This concentration is explained by the belief that without the guarantees given by the vertically integrated structure, it would be impossible to obtain the resources needed for financing the investments in transport ducts. It was only in 1935, after the discovery of various abuses practiced by the integrated natural gas companies, that the American congress passed the *Public Utility Act* (Makholm, 2007). This gave the Securities and Exchange Commission (SEC) jurisdiction over public utility securities. As part of its new jurisdiction, the SEC was given greater powers to simplify the holding company structures of gas and electric utilities.

The separation of transport activities from the activities of production and distribution after 1935 gave rise to the countless independent transport companies financed mainly by American pension funds (Makholm, 2007). In 1992, when the Administrative rule FERC 636 completely liberalized the USA natural gas industry, diverse inter-state transport companies operated the extensive network of gas-pipes throughout the country (Makholm, 2007). And countless producers, importers, large consumers and piped-gas distribution companies disputed the transport capacity of the inter-state pipelines among themselves.

Besides the high number of industry players, the development of new market mechanisms that allow the re-sale of primary capacity contracted by the initial carriers confers greater liquidity on the transport market. This reduces risks of primary carriers; facilitating the entry of new carriers and the financing of investments in new transportation ducts (Makholm, 2007).

Despite the fact that in USA cross-holding is not prohibited and there is no separation between the right of property of the commodity and the capacity, the huge number of players, both in production and in marketing, and the surveillance of anti-competitive practices by the FERC (Federal Energy Regulatory Commission) prevent the industry organization from creating entrance barriers. FERC, the body responsible for the regulation of inter-state pipelines, has adopted a favorable attitude to competition between the different owners of transportation pipes (Colomer, 2010).

Different from the European case and similar to the Brazilian one, no transport company is granted geographic exclusiveness in the construction of transport networks (Colomer, 2010). In this sense, the long term contracts between carriers and transport companies are shown to be the main mechanism in reducing the risks of investment. These contracts reduce the exposure of transport companies to the fluctuations in the demand for capacity and guarantee the return on capital invested.

The allocation of transportation capacity is carried out by open competition conducted by the transport company itself and monitored by the FERC. The aim of the regulatory commission in monitoring the processes is to avoid there being discrimination between the interested carriers. Furthermore, it is the duty of FERC to inspect anti-competitive practices by the primary carriers.

Unlike Brazil, the high number of players in the production as well as in the trading segment, the supervision of competition by FERC and the development of secondary capacity markets are sufficient to stimulate new investments and the entry of new carriers in the transportation segment. Thus, the high level of competition in the production and commercialization segments and the active role of FERC in inspecting anti-competitive activities prevent that the cross-holdings and the non-separation between carriers¹² and traders¹³ create barriers to the entry of new players in the transport segment (FERC, 2009).

In less developed markets, such as the Brazilian case, the reduced level of competition in the production and trading of natural gas, imposes barriers to the entry of new players in the industry, mainly when the model of legal separation of the industry does not restrict the cross-holdings and the distinction between carrier and trader is not made. In cases where a level of maturity of the network and the natural gas markets are not sufficient to guarantee the entry of new players in the transport segment, the liberalization and decentralization of the natural gas industry demands a re-definition of the industrial organization model.

In Spain for example, the development of the natural gas industry is recent.¹⁴ Graph 6 shows that natural gas consumption has grown effectively from 1995. The transport network of the natural gas industry in the country is characterized by a small number of interconnections and by a reduced extension of duct networks (CNE, 2005). Furthermore, the secondary and spot markets are not very developed so that the trading of transport capacity basically depends on the bilateral negotiations between carriers.

Therefore, the liberalization of the natural gas industry in Spain, from the adoption of European directives (Directive 2003/55/EC of the European Parliament and of the Council), has demanded the reorganization of the sector's industrial structure (EU, 2003). Different from the North American case and similar to the Brazilian one, the Spanish transport network was developed based on the state monopoly company, ENAGAS. Following the liberalizing tendencies of The European reforms of the 1990s, in 1994, ENAGAS was sold to *Gas Natural SDG*, beginning the liberalization of the Spanish natural gas industry (Pardo, 2009). In 2000, the Royal decree 6/2000 raised ENAGAS to the category of system operator, demanding the separation of regulation from the activities of transportation, storage and re-gasification.

Therefore, unlike the USA, the transportation segment in Spain is designed to be a private regulated monopoly of ENAGAS. The competition in the transport service is limited to the trading sector. Traders have to compete among themselves for consumers and also for the primary capacity of new pipelines. So, despite the monopoly of ENAGAS, the degree of competition among carriers is quite high.

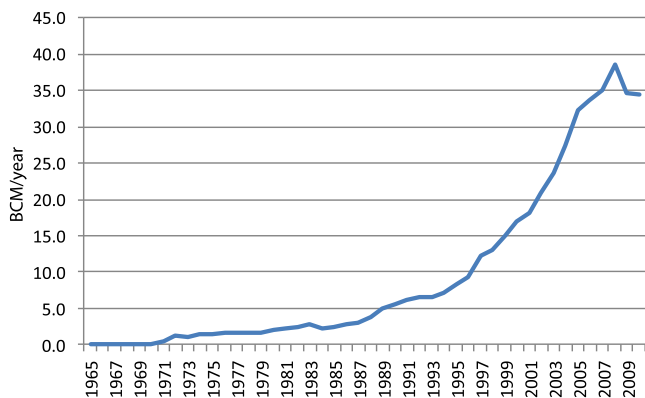
In Spain, no distinction is made between carrier and trader. Unlike the Brazilian (post Law 9,478) and the North-American cases, there is no competition *ex ante* through investment, not even a *pipe-to-pipe* competition, since only ENAGAS is authorized to construct new transport networks (Colomer, 2010).

¹² Player that have the right to use de transport capacity of the pipeline.

¹³ Player that sell natural gas.

¹⁴ The opening up of the natural gas market in Spain began in 1999. Sales activity only effectively began in 2000.

¹¹ Production, transportation and distribution Companies.



Graph 6. Spain: natural gas consumption.
Source: BP (2011).

Nevertheless, different from what it might appear to be, the monopoly of the transport segment by ENAGAS has not worked as a barrier to the entry of new traders. In order to avoid that the control of the system operator by some companies compromises the development of competitive forces, several alterations in the asset structure of ENAGAS were introduced. First, it was required that the regulation activity of the operator should be separated from transportation, storage and re-gasification activities (Colomer, 2010). Afterwards, the shareholding equity of each group of shareholders in ENAGAS was restricted to 5% so that equity and control of *Gas Natural SDG* were drastically reduced (Pardo, 2009). The process of ENAGAS equity restructuring was aided by the company IPO (Initial public offering) in 2002, so that in 2009, around 70% of the company capital was being negotiated on the stock market (ENAGAS, 2009).

Besides ENAGAS equity restructuring, other mechanisms were adopted in Spain to decentralize the industry. Third-party-access was guaranteed not only in the case of transportation pipes but also in the cases of re-gasification, liquefaction and storage infrastructure. In Spain, due to its high dependency on the importation of natural gas (98% of consumption in 2010 was provided by imports of natural gas), third-party-access guarantees to re-gasification¹⁵ and storage infrastructure has proven to be of fundamental importance to fostering competition in the supply of energy (BP, 2011).

Still, in the context of stimulating competition, trading activity was totally separated from the other regulated activities such as transportation, distribution, storage and re-gasification. If the same business group exercised more than one regulated activity, separation of accounting of different activities was required in order to avoid possible anti-competitive practices, such as crossed subsidies and tariff and non-tariff discrimination.

In 2007, the liberalization of the market (SPAIN, 2007) was extended to residential consumers so that, currently, the final natural gas market has proven to be completely liberalized in Spain (ENAGAS, 2009). In this context, to encourage competition and the entry of new carriers/traders, a capacity compulsory resale was introduced (gas release of 25% of importation contracts of Algerian gas, from the company *Gas Natural*, for new retailers). Besides this, the government fixed a maximum participation of 70% of any trader in the final market (Gómez and Durbán, 2005).

Regarding the use of transportation pipes by carriers/retailers, one year after the initial contracting of capacity, the system operator (ENAGAS) may demand the freeing of the contracted unused capacity by the primary carriers/traders if it judges that

holding on to the reserve capacity is harming the entry of new players in the market. Thus, 25% of the transport capacity is destined to the short term market (maximum 2 years) and each retailer will not be able to hold more than 50% of the short term market (SPAIN, 2009).

What one notices in Spain, is that in spite of the control of natural gas transportation infrastructure by ENAGAS, the sale of the fuel has developed along competitive lines. In the transport segment, the dispute of the primary capacity by carriers, the equity restrictions imposed on ENAGAS and the devolution of the contracted capacity that is not been used guarantee that there is no control of the transport service by one or a few carriers. Thus, it is noted that despite the low level of maturity of the natural gas industry in Spain the level of competition is increased by the restructuring of the industry.

The analysis of the organizational model of the natural gas industry in the USA and Spain shows, first, that the high number of players in the sectors of production and marketing and high level of maturity of the natural gas transportation network act as important factors to encourage the entry of new investments in the sectors of transportation, even if the regulator does not restrict cross-participation and does not differentiate carriers from traders. The second conclusion is that in cases where the transport network is shown to be not very developed and the number of players in production and trading is reduced, it becomes necessary to adopt regulatory mechanisms that limit the level of concentration in the industry, as has been seen in the Spanish case. Thus, the analysis of the two international experiences is important in identifying recommendations for the Brazilian case to be made in the next section.

6. Lessons for the Brazilian market

As we analyzed in Section 2, the natural gas industry has some characteristics that require the coordination of investments between the different sectors of the chain. In Sections 4.2 and 4.3, we saw that the new Brazilian legal framework, brought about by 11,909 Act, aims to reduce the risks for new investors by defining a new coordination mechanism structure. The new role of the government (MME, EPE and ANP); the price regulation; the open season; the signing of a term of commitment; the bid process; the concession contracts; the regulation of third-party-access; all of these factors reduce the transaction cost and have the potential to improve competition in the natural gas industry, especially in the transport segment.

However, as shown in Section 4.4, the industrial structure of the natural gas sector in Brazil discourages the entry of new investors, especially in the transport sector. In the new regulatory framework, market risk lies totally with carriers that assume the entire risk of ship-or-pay contracts signed with transport companies. Accordingly, in order to develop competition in the transport segment there is a need to encourage the entry of new carriers. Therefore, it will be necessary to create regulatory and market structures that reduce the risk of shipping (loading) natural gas.

In Brazil, potential carriers are those other producers besides Petrobras, importers of natural gas, local distribution companies and free consumers. However, because of the Brazilian market structure and some characteristics of industry regulation, there are few incentives for these agents to manifest their interest in the activity of shipping natural gas.

As we have already seen, natural gas producers will only take the risk of shipping natural gas if they can sell their gas to final consumers. In order to do that, a few things are extremely important: (i) the producers have to be permitted to transport their gas to the treatment plant; (ii) they have to process their gas

¹⁵ The 75% of imports come from LNG.

in UPGN; and (iii) in the natural gas market, the conditions of competition between them and Petrobras have to be the same.

However, the absence of any guarantees of third-party-access to transfer pipelines; the high costs and the large economies of scale associated with building a new UPGN; the type of Petrobras' shareholding in local distribution companies; and the low level of market openness; all these factors excessively increase the risk for new carriers. Therefore, independent gas producers often have to sell their natural gas directly to Petrobras¹⁶ (Petrobras is frequently a partner in production; 94.3% of the natural gas production are from fields operated by Petrobras).

In analyzing the reform of the natural gas industry in Spain and the USA we can list some contributions to improving competition in the Brazilian natural gas market. In Spain, competition in this market is guaranteed by limited participation of any company in ENAGAS to 5%. The liberalization of the natural gas market is encouraged by the restriction of the market control to 70% and by the re-selling of 25% of the import contracts of Natural Gas to other carriers. The requirement to release unused contract capacity to other carriers also improves competition. In the USA, besides the high level of maturity of the industry, the market openness and the effective FERC supervision of anti-competitive practices, stimulate competition in the transport segment.

As shown in the above paragraphs, market openness is extremely important in reducing the risks of independent natural gas producers, especially in Brazil where Petrobras is a large shareholder in local distribution companies. Another important contribution to market liberalization is the emergence of new players (large consumers) interested in playing the role of carriers. Thus, the liberalization of the natural gas market, as seen in the Spanish and USA cases, has made an important contribution to increased competition in the transport segment.

Two others means of expanding the market to other carriers are first, by reducing Petrobras' share in the distribution segment and second by regulating third-party-access to the re-gasification facilities. The incentive for local distribution companies to buy natural gas from Petrobras will be as great as Petrobras' share in the distribution segment. Besides the reduction of Petrobras' share in the distribution segment, third-party-access to re-gasification facilities is essential to stimulating competition since it stimulates the entry of new suppliers (importers).

Finally, another important mechanism to stimulating the entry of new carriers in the transport segment is the development of a secondary market for re-sale of capacity. The USA secondary transport market reduces the risk for initial carriers because it reduces the ship-or-pay costs of contracted and unused capacity. However, the development of a secondary transport market requires the creation of some regulatory mechanisms that organizes the re-sale process. The greatest difficulty in creating a secondary market in industries with a low level of development is to prevent anti-competitive practices and market control by a small group of companies. Thus, the development of a secondary market requires greater supervisory powers by regulatory bodies.

The analysis of some international experiences and the limitations of the new regulatory framework of the natural gas industry in Brazil allow us to make some recommendations in terms of energy policy. First it is important that ANP and other public bodies responsible for the regulation of competition should act more effectively against anti-competitive behavior and discriminatory practices by both carrier and transport companies in order to stimulate competition.

Another important change concerns the openness of the market. The increase in the level of competition in the natural gas industry necessarily entails the gradual opening of end markets. In Brazil, however, the liberalization of markets depends on the regulations of each state. In this sense, there are many differences among the states where the free consumer model has already been set up. Therefore, so as not to create distortion among the different states, Brazil must homogenize the federal and state regulation of the natural gas industry.

Free access to transfer pipelines and to re-gasification plants are other important aspects that must be addressed by ANP if increasing competition in the supply segment is to be an objective. The lack of regulation of third-party-access in the case of these types of infrastructure creates barriers to the emergence of new carriers, which in turn inhibits competition in the transport segment. Although it is important to define periods of exclusivity by guaranteeing the return on investment, monopolies must not be created in these important infrastructures.

In the Brazilian case, the legacy of the period of state monopoly requires that the natural gas market is gradually liberalized. It is important to balance the conditions of competition among carriers. Thus, the re-definition of the structure of the natural gas industry is essential to stimulating the entry of new carriers.

Finally, an institutional and regulatory basis must be created for the development of a secondary market. This will allow the risks of initial carriers to be mitigated. However, as proved earlier, the development of a secondary market will require a greater effort by ANP and other bodies that regulate competition.

It is clear that the current structure of the natural gas industry, inherited from the period of state monopoly, has created a series of barriers to increased competition in the transport segment. In this sense, the emergence of new carriers requires a number of regulatory instruments to reduce the risks associated with transport contracts. However, such changes should be gradual so as not to compromise the levels of investment and development of the natural gas industry. Although the Petrobras monopoly undermines the development of competitive forces, until now it has been essential for the development of the industry in Brazil.

7. Conclusions

Bearing in mind the level of industry concentration in Brazil, the new regulatory framework defined by Law 11,909, is not sufficient to guarantee stimulus to the entry of new players in the natural gas transport segment.

The natural gas industry has some characteristics that require investment coordination between the different chain sectors. The asset specificity, as previously discussed, can compromise the investment in a liberalized market if opportunistic behavior increases the transaction cost and, consequently, the investment risk.

The regulatory reform in the Brazilian natural gas industry aims to reduce the risks of new investors because it defines a new coordination mechanism structure. By defining the projects that will be approved, the MME aims to reduce the risks associated with the physical and dedicated asset specificities. Price regulation prevents the TSO from using its monopoly power to earn above-normal profits. In neo-institutional terms, price regulation prevents a quasi-rent appropriation.

The open season reduces both the cost of trading and the ex post risk of opportunistic behavior. Moreover, the signing of a commitment term signals a future revenue flow that facilitates project financing through securitisation mechanisms. The bid process is a way of introducing competition into natural monopoly structures. The concession contracts determine the quality specification of the services and the criteria of third-party-access

¹⁶ In spite of having been responsible for 90% of the natural gas production in 2010, Petrobras was responsible for 98% of the sales of natural gas during the same year (ANP, 2011; Petrobras, 2011).

to the transmission network. Thus, the concession contract reduces the risks for both shippers and transport companies if it clearly defines the operating rules of the transportation service. Finally, the clear definition of the roles of each institution in planning and regulating the gas industry reduces the uncertainties related to government intervention.

The definition of a stable institutional framework thus enables the reduction of regulatory and political risk, which increases the players' pre-disposition towards co-operation, not only among themselves but also with the government.

However, the industrial structure of the natural gas sector in Brazil discourages the entrance of new investors in the transport sector. Despite the competition in the construction of new gas-pipe projects being guaranteed by the bid process, the definition of the open competition as a mechanism for allocating primary capacity does not guarantee that new shippers should appear. Thus, considering the level of industry concentration, the new regulatory framework defined by Law 11.909 is not sufficient to guarantee stimulus to the entry of new players in the transportation segment.

The analysis of the organizational model of the transport segment in the North-American and Spanish cases permits some recommendations for the Brazilian case. Primarily, when one considers the reduced level of maturity of the transport network and the high market concentration in the production and trading segments, it is important that clear limits should be defined for the participation of other players in the natural gas transport segment. Therefore, the setting-up of restrictions to cross-shareholdings has been shown to be an important mechanism of *market design* that avoids opportunistic behavior by transport companies. Furthermore, the separation of trading from other activities (production, transportation and distribution), is essential to the development of competition not only between carriers, but also in the production segment, since it prevents the dominant company from creating barriers to the access of new producers and new traders to the transportation and distribution infrastructures. Finally, the liberalization of the end markets, in eliminating the monopoly of distribution companies in the sale of natural gas, permits the appearance of new carriers (large consumers) interested in contracting transport capacity; thereby further stimulating competition in the capacity market.

Comparing the different paths adopted by other liberalized regions – the USA and Spain – the consequences of the new model introduced by gas law 11,909 are unclear. In other words, it is still unclear how the Brazilian costs associated with central coordination decisions will be shared, or how the economic engagement of stakeholders may or may not drive investment decisions. Unless the industrial structure of the natural gas industry is changed, it is expected that investments in new pipelines will continue to be guided by central planning and, consequently, by Petrobras.

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