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# Regulation of Natural Gas Pricing in Mexico

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## Abstract

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*This paper presents a case study of regulation of natural gas pricing in Mexico as a case of "successful" policy research. Studies done under an academic agreement between the Comisión Reguladora de Energía (CRE) and the Centro de Investigación y Docencia Económicas (CIDE) in Mexico City have analyzed the welfare efficiency implications of the netback rule based on the Houston Gas price that is used to set the domestic gas price. This rule results from a well structured welfare maximization general model. However, in practice the netback rule has been debated during several North American price spikes. Policy makers relied on CIDE studies to keep the netback rule. This case study examines how and why policy makers did so. The debate within the Mexican government is analyzed, and the actors involved in the policy discussions are described, as well as the relationships between CIDE and CRE that were developed, and that helped in the communication with policymakers. The methods of dissemination of research are also discussed.*

## Resumen

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*El artículo presenta un estudio de caso sobre la regulación del precio del gas natural en México como un ejemplo de política "exitosa". Estudios realizados bajo un convenio académico entre la Comisión Reguladora de Energía (CRE) y el Centro de Investigación y Docencia Económicas (CIDE), en la ciudad de México, han analizado las implicaciones sobre el bienestar de la regla netback (enlace hacia atrás) basada en el precio del gas en Houston, utilizada para establecer el precio del gas nacional. Esta regla resulta de un modelo general de maximización de bienestar bien estructurado. No obstante, en la práctica, la regla netback ha sido debatida durante varios eventos de precios altos en Norteamérica. Los hacedores de política se han apoyado en estudios del CIDE para mantener la regla netback. Este estudio examina cómo y por qué los hacedores de política tomaron tal decisión. El debate dentro del gobierno mexicano es analizado, y los actores involucrados en las discusiones de política regulatoria son descritos, así como la relación entre el CIDE y la CRE fue desarrollada ayudando en la comunicación con los hacedores de política. Los métodos de difusión en la investigación son igualmente discutidos.*

## *Introduction*

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This case study analyzes the regulation of the price of natural gas in Mexico as a case of “successful” policy research. In 1996 the natural gas price in Southeast Mexico was linked to a natural gas price benchmark in Houston plus net transport costs. This pricing regulatory formula is an implementation of the Little-Mirrlees method, so that the price in Houston is a measure of the opportunity cost to Mexico of consuming the gas rather than exporting it to the United States. Our studies at CIDE on the welfare efficiency implications of this formula—carried out within an agreement with the Mexican Energy Regulatory Commission, CRE—have shown that this netback rule results from a well-structured welfare maximization general model. However, in practice the netback rule has been debated during several North American price spikes. Many Mexican industrial consumers had not hedged during such events, and as a result there has been strong political pressure to drop the Houston benchmark in pricing gas. Policy makers have used our studies to keep the netback rule, and in parallel have designed various hedging procedures.<sup>1</sup> This case study examines how and why policy makers did so. The debate within the Mexican government will be analyzed as well as how the research carried out at CIDE helped. The actors involved in the policy discussions will be described, as well as the personal relationships between CIDE and CRE that were developed in doing the research, which eventually helped in the communication with the policymakers. Likewise, the methods of dissemination of our research at CIDE to other parts of the Mexican government and industry will be discussed. Other issues that are addressed in this case study include: the way the original research was funded; how the original idea of setting the gas price in Mexico according to the netback rule arose; the way research evolved over time; the parts of the Mexican government that became familiar with the CIDE’s research work, and in what journals the work appeared and in what other more readily accessible forms. The presentation of this case study is guided by a series of common template questions in two parts. The first part addresses the design of policy research, while the second part focuses on the use and impact of such research.

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<sup>1</sup> The CRE has typically required that natural gas local distribution companies get some type of hedging. However, the CRE only recommends industrial consumers to hedge. They sometimes chose not to buy hedging but to exert political pressure on the government so as to receive some kind of subsidy.

## 1.- Description of Research

### 1.1.- How did the idea for the study originate? What is the policy problem that the study attempted to address?

#### Origins of the study

In 1992 the Mexican government initiated modest changes to permit entry of private participants in power generation, and a more ambitious reform in natural gas was begun in 1995. Before this, state companies had controlled energy activities: Pemex in the oil and gas sector, and Comisión Federal de Electricidad (CFE) and Luz y Fuerza del Centro (LFC) in the electricity industry. So far, no decisions have been made on private participation and structural reform in gas production, oil extraction and processing, and production of petrochemicals. Structural reform of the electricity sector has been postponed.

The natural gas sector in Mexico was reformed in 1995 through an amendment of the Regulatory law of Constitutional Article 27 (the Gas Law) to allow private investment in new transportation projects and distribution, storage, and commercialization of natural gas. The law established general principles for developing the country's natural gas industry. Putting these principles in practice required creating a regulatory framework that specified the organization, operation, and regulations of the industry. Such a framework was designed in 1995 and presented in the *Reglamento de Gas Natural*. It explicitly took into account noncompetitive conditions in production since Petróleos Mexicanos (Pemex) would keep its statutory monopoly in gas exploration and production, and focus on increasing natural gas production and maintaining its existing large transportation network of more than 9,000 kilometers (Figure 1).<sup>2</sup>

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<sup>2</sup> Pemex' transportation network covers most of the country with the exception of the northwest and north-pacific.

Figure 1: Natural Gas Transportation Network of Mexico



A new regulatory institution, CRE, was created in 1993 to provide limited regulatory oversight of private investment in power generation.<sup>3</sup> The CRE's mandate was expanded and clarified in 1995 in tandem with the natural gas reforms. After the publication of the *Reglamento*, the CRE needed to have a clear idea of the many implications of the reform process that took place during 1995-1997. In particular, the CRE wanted to understand in depth the long-term economic welfare implications of specific regulatory policy decisions on natural gas pricing, given that Pemex would keep its monopoly on production.

In 1997, an academic agreement was signed between CRE and CIDE in order to start an academic program on energy economics and regulation to provide the Mexican regulatory authorities with solid academic background for policy decision-making on natural gas price regulation as well as in other

<sup>3</sup> CRE's original role in oversight the electricity industry is largely limited to issuing permits and approving wheeling and buyback charges for private sector generators. The Secretary of Finance (*Hacienda*) has a decisive role in setting retail tariffs and government guarantees, while the CFE predominates in the definition of bids for independent power projects, and contract contents

related areas. The CIDE-CRE agreement was also designed to provide researchers with incentives to write applied papers that could be published in top academic international energy journals, and that would consequently provide academic support to CRE's policy decisions.

### Policy problem

Mexico has an energy market that is different from most other countries. The national oil company, Pemex, is a very important political and symbolic institution. Foreign interests initially owned the oil industry, and its nationalization in 1938 was viewed by many as an expression of Mexican sovereignty. Pemex' union has historically been very powerful. Privatization of Pemex (and of the other energy State utilities) is politically impossible.

Liberalization of the natural gas sector is complex because the natural gas industry combines naturally monopolistic activities with potentially competitive ones. Pipeline transportation and distribution have natural monopoly characteristics and require regulation of price and nonprice behavior. Production is a contestable market, though in a few countries such as Mexico it is still maintained as a state monopoly. Marketing gas is also contestable, but the presence of a dominant upstream vertically integrated incumbent may pose significant barriers to entry. Market architecture decisions such as the degree of vertical integration, horizontal structure, and regional development are also crucial.

The specific formal analysis of the hydrocarbons sector in Mexico is tricky. Difficulties arise from three sources. First, Pemex is a monopoly and many of the markets involved are regulated. Prices in these markets are not a good guide for economic decisions as to production. Second, oil, gas and natural gas liquids are often produced jointly, and in such cases it is impossible to allocate costs of production to a specific product.<sup>4</sup> Hence it is impossible to price associated gas by reference to the cost of production. Finally, the goods produced are substitutes in consumption. Gas and oil are substitutes in the generation of power; natural gas liquids, gas and oil are substitutes as feedstocks. This creates very difficult problems in regulating prices. The CRE has the responsibility of regulating the price of natural gas.

Technical and institutional difficulties are thus important problems in regulating the Mexican natural gas price. The CRE solved the problem by using an international natural gas price benchmark in Southeast Texas. The natural gas price at Ciudad Pemex in Southeast Mexico (where 80% of total natural gas is produced as a byproduct of oil extraction) was linked to the price at the Houston Ship Channel hub through a netback formula. The price of gas in Ciudad Pemex is equal to the price at Houston plus transport costs from Houston to the arbitrage point (currently at Los Ramones, in northeast

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<sup>4</sup> See Adelman (1963).



Mexico)<sup>5</sup> minus transport costs from the arbitrage point to Ciudad Pemex (Figure 1).<sup>6</sup>

This pricing regulatory formula is an implementation of the Little-Mirrlees method, which proposes the use of world prices for pricing traded goods.<sup>7</sup> Thus the price of gas in Houston is a measure of the opportunity cost to Mexico of consuming the gas rather than exporting it to the United States.<sup>8</sup> The netback rule also implies that the Mexican gas price remains insensitive to variations in demand for gas in Mexico, and that consumers are facing a flat supply curve. The amount of gas imported or exported works as an equilibrating factor.

The netback rule was published by the CRE in 1996.<sup>9</sup> It has been debated during several North American price spikes such as the one in the 2000-2001 winter.<sup>10</sup> The price of gas in Houston rose from around \$2.00 per MMBTU in January 2000 to almost \$10.00 per MMBTU by January 2001.<sup>11</sup> Many Mexican firms had not hedged and as a result found themselves in serious trouble. Plants were being forced to close. There was strong pressure on the CRE to drop the Houston benchmark in pricing gas. Pemex rescued the firms in trouble by offering a \$4.00 per MMBTU three year take or pay (hedging) contracts. The netback rule based on the Houston price remained and –along with the design by the CRE of mechanisms that promoted hedging by gas users– our studies were used by policy makers to support such policy decision.

### *1.2.- What were the time frame and the budget for the study? How were these determined?*

The CIDE-CRE academic agreement formally initiated in September 1997, and has consistently provided the Mexican energy regulatory authorities with academic background for policy decision making for more than seven years. CIDE and CRE initially signed an “umbrella” general contract agreement with an indefinite time horizon with the idea of arranging within this general agreement various “specific” subcontracts for time constrained specific issues. Since 1997, CIDE and CRE have arranged various specific agreements: four research agreements, and other staff training agreements. The research

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<sup>5</sup> The arbitrage point is the place where northern and southern gas flows meet, and where northern and southern gas prices coincide.

<sup>6</sup> See Comisión Reguladora de Energía (1996), section 4.

<sup>7</sup> See Little and Mirrlees (1968) pp. 92.

<sup>8</sup> See Brito and Rosellón (2002).

<sup>9</sup> Pemex had previously been using a very similar rule based on another Texas marker (Tetco and Valero). See Rosellón and Halpern (2001).

<sup>10</sup> See Arteaga-García and Flores-Curiel (2003).

<sup>11</sup> See *Appendix I* for Houston Ship Channel average prices in 2002-2007.

agreements have included a variety of topics on regulatory policy issues of the reform in the energy sector in Mexico. Their length has been variable.

The first two research agreements had 18 month duration, while the third one was extended to two years and the fourth lasted only a few months. By 1997, the CRE was not expecting to urgently need the research studies, especially the one on the regulation of the price of natural gas. The CRE however wisely foresaw that such a study would be needed a few years later in case the North American gas market would have to face price instability.<sup>12</sup> This translated in generous time spans for academic research on natural gas pricing, which was of course very well received by an academic oriented think-tank such as CIDE. Therefore, timeliness was important but it did not really represent a binding constraint for CIDE's research staff during the three major research contracts.<sup>13</sup> Likewise, the CIDE-CRE research contract agreements explicitly anticipated that the studies would be carried out under academic freedom, a fact that would potentially imply that sometimes the conclusions of CIDE's academic studies would not precisely coincide with a final CRE's policy decision (as was the case with the regulatory scheme for gas marketing).

Each of the first three major research agreements had a similar structure. They were composed of four tasks. Within each specific agreement, three research topics would have to be developed and an international conference would have to be organized. The idea of the conference was to present research results and to discuss them with national and international experts. The topics of the first agreement (1997-1999) included pricing of natural gas and liquid petroleum gas (LPG) production as well as pricing of natural gas distribution. The second agreement (1999-2000) addressed the regulation of gas marketing activities, the timing of investment in LPG pipelines, and the effects of the reform on natural gas production and distribution. The third major research agreement (2002-2004) included the study of incentives for long-term investment in electricity transmission and generation, and the analysis of the strategic behavior of Pemex in the natural gas sector. It must be said that the issue of regulation of the price of natural gas was progressively addressed in all the research agreements. This consequently rendered numerous academic publications.

The budget for each research agreement was determined according to the involved tasks. Enough funds were allocated to the elaboration of each research study. Support for traveling related to each study (meetings among researchers, attendance to congresses in order to present research results,

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<sup>12</sup> See *Appendix 1* for US wellhead prices in 1980-2025.

<sup>13</sup> An exception was the fourth small scale research contract, which was signed in 2002 and developed in few months. It was designed to support a policy decision of the CRE in order to avoid increasing the price of natural gas under Pemex' petition. Pemex wanted a displacement of the arbitrage point from Los Ramones (in the northern state of Nuevo León) to Cempoala (in the southern state of Veracruz), a change that would have implied an increase of the price of natural gas of around USD0.50 per Mmbtu.

and so forth) was granted as well as honoraria for the involved research staff. Likewise, enough financial funds were granted for the organization of the international conference, which included the participation of international recognized academic scholars, top government officials of Mexico's energy sector, top private sector representatives as well as representatives of the Mexican Congress. The conference budget included traveling funds and honoraria for international experts as well as for the event logistics.

The CRE funds of the three major research agreements' budgets constituted the core of CIDE's energy regulatory program. Through the years complementary financial funding was achieved by the program through grants from the World Bank, the Tinker Foundation the Mexican Science and Technology Council (Conacyt), the Inter American Development Bank, Stanford University, and the Naumann Foundation.

*1.3.- What analytical approach was selected, what research styles were employed, and why? How did the authors decide whom to include on the project team? What disciplines and experience, for example?*

#### Project team

The team project for the studies on regulation of pricing of natural gas was composed by two main researchers. The main participant from CIDE was Juan Rosellón who is a Professor at CIDE's Department of Economics, and was CRE's Chief Economist from 1995 through 1997 during which time he had a leading participation in the economic policy decisions regarding the regulatory reform process of the Mexican natural gas and electricity sectors. The other research team member was professor Dagobert L. Brito who is *Peterkin Professor of Political Economy* at the Department of Economics of Rice University. He was chosen because he is an expert in microeconomic modeling, optimal tax theory, energy economics, and law economics. Professor Brito had done several studies on energy policy for Rice's Baker Institute for Public Policy such as the Saudi petroline and alternatives to the Strait of Hormuz. This research team was complemented with CIDE research assistants graduated from the BA and MA economics programs at CIDE.

#### Analytical approach

When we started our research on natural gas price regulation in 1997, we had several meetings with staff from Pemex. Under the request of the CRE, Pemex presented to us the models they used to compute gas prices across the country. For the case of LPG, Pemex used a very large programming model to plan production and to price LPG in Mexico. This model was very general and very detailed. When the vectors as to the quantities demanded and supplied

are correct, the model gave a detailed allocation of LPG. The duals of the model were the values of the product and the cost of meeting the demands. However, the model was too detailed to be very transparent as to the relationship between the variables. The extended model was a “black box” that had more than 1500 variables and 500 equations.

For the purpose of determining the price of gas in Mexico, the key variable we actually were interested in was the dual associated with the stock of gas. Large linear models are very easy to compute, but the solution can be discontinuous and the results can be less than transparent. Fortunately, for the purpose of determining the price of gas, the *Maximum Theorem* permitted us to reduce the Pemex’ extended model to a much simpler model whose dimensionality was that of the input and constraint set. Additionally, this model could be solved analytically.

#### *1.4.- How did they build their model or framework for analysis? Did the model evolve over the course of the research? How?*

We basically used the Maximum Theorem to reduce the Pemex’ extended model. We applied such a methodology to most of our studies on regulation of pricing of natural gas. In our Energy Journal’s seminal work<sup>14</sup> we derived the natural gas regulatory netback formula used in Mexico from the solution of the problem of a regulator that maximizes welfare subject to resource constraints in the pipeline network. The optimal prices of natural gas are the shadow prices in the optimization associated with the production of natural gas in Mexico. In particular, the netback rule is the shadow price of the scarcity constraint at Ciudad Pemex. This rule follows from the condition that Pemex should be indifferent between the sale or purchase of gas in Houston, and the sale of gas at any point in Mexico. Therefore, the price of gas in Mexico turned out to be the shadow price of the resource constraint of the non-associated gas produced in Mexico, and thus provided the price of natural gas that coincided with the regulators’ objectives.

These results were derived by identifying the microeconomic foundations of the policy problem, and by abstracting the most essential elements of a complex problem. For example, the pipeline system in figure 1 was actually reduced to a single pipeline connecting production in the South with production in the North. A careful analysis of figure 1 shows this. Ciudad Pemex is located at the south end of the system and produces most of natural gas as associated gas (that is, as a by product of oil extraction)<sup>15</sup>, while Reynosa-Burgos is located at the north end. Burgos produces 17.3% of total natural gas production and is a link to the Texas pipeline system. Two

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<sup>14</sup> Brito and Rosellón (2002).

<sup>15</sup> This means that it is impossible to allocate costs of production (or extraction) to most of natural gas produced in Mexico (see Adelman, 1963).

branches complement the pipeline system. One branch connects Ciudad Juárez (a place where gas is imported) and Los Ramones (the junction of the Southeast, Northwest and Northeast pipelines). The other branch of the pipeline connects the cities in the center of the country (including Mexico City) with the main network at Cempoala. The analysis of this relatively complex pipeline network can be simplified as a single pipeline connecting Burgos with Ciudad Pemex. The connections at Los Ramones and Cempoala might be ultimately modeled as mass points in the distribution of demand.

This model evolved over time so that we addressed closely related issues to gas price regulation. A first extension was done in order to study the effects of pipeline capacity on the netback rule.<sup>16</sup> We initially found that a pipeline capacity restriction that hinders gas exports is reflected in the domestic gas price through the shadow price of such a restriction. This is a corollary of the more general result that pipeline capacity restrictions generates rents to Pemex so that it does not have much incentives to invest in pipeline expansions. Even more, PEMEX is vertically integrated among production, transportation and marketing activities in the natural gas industry. This potentially permits PEMEX to carry out several strategies so as to preserve its vertical monopoly as well as to control pipeline capacity in order to circumvent the netback formula. When there is not enough capacity, the gas movement would not clear the markets, and Pemex could capture the rents associated with the capacity restriction. PEMEX' vertical disintegration would then contribute to a more competitive allocation of pipeline capacity, and hence to a better performance of the netback price regulation. Additionally, the CRE might enforce open access regulation as well as the monitoring investment in pipeline capacity so that there is always enough capacity and the gas market can always clear. Such a policy would generate sufficient savings to consumers of gas that they will be willing to pay for such investment.

Another extension was related to location of production. We paradoxically found that the social optimal place to develop production sites is close to the arbitrage point and not close to consumption areas. One more additional discussion on the netback rule was with respect to the benchmark price. The use of the South Texas price introduces to the Mexican market the competition of the US natural gas market. The efficiency of using the Houston price as benchmark relies on the assumption of competitive conditions in the Texas natural gas market. If such assumption does not hold, then the use of an alternative price might be justified. The recent increasing trend in the gas price and the expected future increase of LNG imports to the North American market might give good reason for the use of an alternative benchmark price.<sup>17</sup>

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<sup>16</sup> Brito and Rosellón (2002), Brito and Rosellón (2003b), Brito and Rosellón (2005a).

<sup>17</sup> Brito and Rosellón (2005a).

We later developed a more general model to study the netback rule,<sup>18</sup> since there were allegations that the netback rule could be partitioned in two so that the southern market could use a benchmark in South America as a reference price.<sup>19</sup> We developed a model where individuals located along a pipeline could spend their income on goods, an alternate fuel or gas. The price of gas was given by a nonlinear price schedule that was a function of location and the quantity of gas purchased. We showed that under such conditions, the general optimal price of gas is still the netback rule. If the market should become segmented the netback rule defines an upper and lower bound to the price in the segmented market. The possible segmentation that could occur in the Mexican gas market is between Los Ramones and Cempoala. If such a gap should occur, a one percent change in demand or supply would eliminate it, so this is not a very important issue.

Finally, we also studied some short-term regulatory measures that the CRE might use to provide PEMEX with incentives to increase supply in the domestic regulated market (and hence avoid a deliberated southwards displacement of the arbitrage point).<sup>20</sup> The first measure was to temporally fix the arbitrage point at Los Ramones so that Pemex had incentives to increase production (and investment) to a level corresponding to the price of gas implied by Los Ramones. The second strategy was to set a price based on the netback rule for internal gas transactions among PEMEX' subsidiaries. We showed that, although these measures can be at odds with long-run Pareto efficiency, their effects are minimal in the short run and helped to deal with political pressures to keep domestic gas price low.

### *1.5.- Where did they search for data? What false starts and surprises were there as they carried out the research?*

Most of the information that we obtained in order to study the microeconomic foundations of the netback formula and its structure of incentives was obtained from CRE and Pemex. The method was through interviews and presentations given to us by middle to top rank government officials. We were able to disentangle from these interviews and presentations the essential model being used and its economic efficiency implications

The process of formally analyzing the regulatory mechanism for pricing natural gas in Mexico appeared at the time unnecessary to some people within the government. They seemed to think that the use of complex mathematical models would not add anything essential to the discussion among policy makers, since some believed that economic theory was too abstract as to provide results that could be relevant in practice. However, once we set the

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<sup>18</sup> Brito and Rosellón (2005b).

<sup>19</sup> See Arteaga-García and Flores-Curiel (2003).

<sup>20</sup> See Brito and Rosellón (2003b).

formal model and derived the first order optimality conditions we were able to explicitly obtain a first very interesting (and somewhat surprising) result. The netback rule defines a peculiar structure of incentives. Small changes in the distribution of gas might result in big changes in its price. Pemex might divert production from the regulated market (or simply reduce its production or flare gas) to bring south the arbitrage point, and then cause an increase of the domestic natural gas price twice greater than the change in the marginal cost of transport. This does not change the efficiency properties of the netback rule, but it does change the allocation of economic rents. Regulators should then consider this when monitoring investment and production strategies of Pemex and when implementing location changes of the arbitrage point.

This first result was essential in capturing the attention of policy makers, which promptly understood the importance that mathematical analysis had for policy discussions on the netback rule. From this point on, the framework provided by analytical policy research was generally accepted as crucial in all regulatory policy questions on natural gas pricing.<sup>21</sup>

*1.6.- As the research was carried out, what contacts did the researchers have with the sponsors of the research or with other potential users? How did these contacts affect the research?*

### Contacts and relationships

Our research on regulation of natural gas pricing was motivated by real public-policy problems faced by Mexican authorities. Our project then contributed to the linkage of economic theory and public policy, helped in the development of relevant applied economic research in Mexico and, consequently, in basing public-policy decisions on theoretical concepts. To achieve this, we always had close relationships with the CRE staff during the elaboration of the studies. In each 18-month cycle of the CIDE-CRE agreement, feedback from CRE policy makers was obtained from each of three or four work-in-progress seminars (where CIDE researchers presented the development of the project), and from the project's international conference as well. Through these mechanisms we were able to get very valuable insights from CRE staff of all ranks and specialties. When needed, we also arranged additional personal meetings with experts on specific issues. We especially had a very close relationship with the CRE chairman at the time (Dr. Héctor Olea), several commissioners (Lic. Javier Estrada, Ing. Rubén Flores, Lic. Raúl Necedal), and with the CRE's chief economist (Lic. Francisco de la Isla).

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<sup>21</sup> Other results of our models on regulation of natural gas pricing are summarized in the last section of Part I.

We also had occasional personal meetings with staff from Pemex and the Secretaría de Energía (the energy ministry of Mexico). In particular, meetings with Pemex were most important at the beginning of the project so as to figure out the general structure of the models that CRE and Pemex had in mind to set the price of gas. We in addition had personal meetings with industrial consumers' organizations (such as *Concamin*) in order to discuss natural gas regulation in Mexico

Contacts with other potential users or people interested in our research—such as staff from other government agencies, industrial consumers, congressmen, international scholars, and so forth—were mainly achieved in each international conference of the CIDE-CRE agreement. For instance, the conference of the second cycle of the CIDE-CRE research agreement took place during October 30 and 31, 2000, and included the participation of international experts such as Eytan Sheshinski, (Harvard), Dagobert Brito (Rice), José Luis Guasch (World Bank and UCSD), Catherine Wolfram (UC Berkeley), and Daniel Fessler (private energy consultant) as well as top government officials of Mexico's energy sector such as Luis Téllez (Secretary), Andrés Antonius (Deputy Secretary), Mauricio Touissant (Deputy Secretary), Carlos Hurtado (Office of the President of Mexico), and Héctor Olea (CRE's chairman). Industrial consumers participated with various top private sector members such as Angélica Fuentes (Mexican Natural Gas Association), Eduardo Andrade (Mexican Electricity Association), while the Mexican Congress also attended with people such as PAN's Senator Rodriguez Pratts. Local academia was also represented by members of *El Colegio de México*, *Centro de Investigación de Energía* (UNAM), *Instituto de Investigaciones Eléctricas*, ITAM, and (of course) CIDE.

#### How did these contacts affect the research?

All these contacts were fundamental in the design of the research. We were able to corroborate at first hand the opposed objectives of several actors, especially of CRE and Pemex. The questions asked in the policy discussion desperately asked for a formal approach to the problem of natural gas price regulation in Mexico. The complexity and speed of the public policy making have traditionally made impossible that Mexican regulatory authorities were able to analyze topics that require rigorous academic research. Due to their nature, these topics had had a secondary place in the policy makers' agenda. Typically government officials and consultants had to face short-term challenges. However, CRE authorities understood that although research on medium and short run topics could be temporarily postponed, their analysis was fundamental for the coherent and sustainable development of the energy sector. Price setting of domestic natural gas was one of such topics.

In the last seven years there have been hot discussions on the best way to determine the price of domestic gas in Mexico among the several actors of



the gas industry. Besides the Little-Mirrlees netback rule, there have been at least two other proposals discussed as a way of pricing natural gas in Mexico (Appendix 2). One was to use the cost of production, and the other was to use the cost of substitutes for natural gas. The first suggestion is not possible as most natural gas in Mexico is produced as a joint product with oil and there is no well-defined cost of production. There is not a free market in many of the substitutes for natural gas in Mexico so it is not possible to use these prices. Compared with such alternatives, our studies showed the efficiency superiority of the netback rule. Even more, using the price of gas in Houston achieved taking into consideration the cost of substitutes in as much as the price of gas in Houston reflects the price of competitive sources of energy.<sup>22</sup> The CRE adopted our recommendations both at the time of designing the actual regulations as well as at several times when the netback rules was attacked mainly by industrial consumers which sought to implement a “Mexico price” based on much lower benchmark prices. Energy policy makers used our studies to explain that the best welfare strategy for Mexico was to set the price of domestic gas in terms of its international opportunity cost, and to hedge from sudden price spikes. The netback price based in the Houston benchmark provided the opportunity cost of consuming domestic gas in Mexico rather than exporting it to the United States. The fact that our papers had been published in various prestigious academic journals helped energy officials in Mexico to solidly support the netback rule.

### *1.7.- What results and findings were generated?*

- Brito and Rosellón (2002) evaluated mechanisms for linking the Mexican market for natural gas with the North American. The netback formula is shown to be an application of the Little-Mirrlees principle (Little and Mirrlees, 1968), and relies on the fact that the Houston hub is has a liquid market of future contracts to hedge against externalities. The formula, however, can also lead to incentives to increase the price of domestic natural gas by diverting production from the regulated market. Pemex can sell gas to its own subsidiaries or simply reduce its production in order to bring the arbitrage point south and increase the price of domestic natural gas twice more than the value of marginal cost of transportation. Short-term regulatory measures that the CRE might use to provide PEMEX incentives to increase supply in the domestic regulated market include fixing the arbitrage point at a level that forces Pemex to increase production and investment, and setting a price based on the netback rule for internal gas transactions among PEMEX’ subsidiaries.

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<sup>22</sup> Benchmark regulation has also been tried in several other countries. In some oecd countries, (Germany, the Netherlands, Switzerland, Spain, Sweden and Denmark) gas prices are set according to prices of substitutes. Countries like Belgium, France, United Kingdom and Italy use a mix of the this principle with cost-based pricing, while the price of imported gas has been determined in countries like Japan and the United States by adding the price at the border plus costs of transportation, distribution and storage.

- A reduction in import tariffs does not imply an increase in natural gas imports from the US, and has a small effect on the domestic gas price (proportional to the tariff reduction). Additionally, it is socially optimal to develop new gas production sources closest to the arbitrage point rather than to load centers. These results are due to the existence of a monopoly in production, and the netback formula is still shown to be the second best option to liberalization in production (see Brito and Rosellón, 1998).
- The netback policy is critically conditional on the existence of adequate pipeline capacity. If there is insufficient capacity, the movement of gas will not clear markets and it will be impossible to implement the netback rule. Rents will accrue to Pemex (Brito and Rosellón, 2003b). For example, Pemex can capture the rents associated with the constraint by selling output forward, and could then become a monopoly in the forward firm-service market. While Pemex should not be prohibited from entering into spot or futures contracts to sell gas, the price of gas should be the net back price based on the Houston Ship Channel at the time of delivery. Pemex should not be permitted to discount the price of gas from the Houston netback price –or the regulated transport tariffs– even in a nondiscriminatory fashion because it can carry out several strategies (such as cross subsidies that Pemex might carry out due to its vertical integration) and evade regulation. This regulatory strategy is equivalent to vertically disintegrating Pemex in the gas market.
- In an open economy where agents can chose between gas and alternative fuels – and where the density function describing the distribution of agents along the pipeline can have intervals that are empty as well as mass points– the netback rule is Pareto optimal if the gas market is not segmented (Brito and Rosellón, 2005b). The Mexican gas market has not been segmented as gas from Ciudad Pemex reaches Los Ramones. However, if the market should become segmented the netback rule defines an upper and lower bound to the price in the segmented market. The possible segmentation that could occur in the Mexican gas market is between Los Ramones and Cempoala. If such a gap should occur, its impact would not be important since a small change in demand or supply would eliminate it.
- The expected future increase of LNG imports to the North American market and the recent increasing trend in the gas price might however give good reason for the use of an alternative reference price (Brito and Rosellón, 2005a). There is evidence that pipeline network capacity restrictions in Texas preclude the arbitrage between the LNG import price and the Houston natural gas price (see Hartley and Medlock, 2005). Therefore, the use of a net present lower benchmark price (that considers the possibly lower future gas price resulting from the increased entrance of LNG to the Texas market) might be justified.<sup>23</sup>

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<sup>23</sup> However, this is a very different reason to propose a change in the benchmark price to most of the reasons proposed by Mexican industrial consumers.

## 2.- USE AND IMPACT OF RESEARCH

### 2.1.- How was the research communicated and disseminated? How did the researchers work through the way the presentations were made for different audiences?

The results of our research on regulation of natural gas pricing were disseminated among the energy authorities of Mexico, various other government agencies, consumers, the academic community as well as the Mexican general public. Our preferred way of dissemination (both national and international) was the publication of our papers in refereed journals.<sup>24</sup> This process was also a means to evaluate the academic soundness of our work. The publication process is however of long-run nature due the normal editorial refereeing timing of international journals. We therefore made available preliminary versions of our work through the CIDE's working paper series. Likewise, most of the original versions of the papers were uploaded to the CRE's webpage. This permitted a wide dissemination of our results to the industry and other government agencies. Likewise, the CRE used our studies in meetings with other government entities such as the Secretaría de Energía, Pemex, and the Secretary of Finance

Another important way of communicating our results in more direct and simpler ways was through the CIDE-CRE conferences. These conferences included the participation of international recognized academic scholars, top government officials of Mexico's energy sector, top private sector representatives as well as representatives of the Mexican Congress. They were divided into technical sessions and policy sessions and the topics discussed included the recent debates regarding the reform of the gas and electricity sectors in Mexico. They were covered by the national media including TV, radio, and press. Under the CIDE-CRE conferences we were not only able to impact public policy in the Mexican energy sector but also the national public opinion.

The more technical details of the results of our project reached authorities through progress seminars and personal meetings with officials of the Secretaría de Energía and the CRE. Typically, the mathematical technicalities of our papers were discussed with specialized (mid ranked) government staff, while the intuitive policy implications were discussed at large with (higher ranked) policy makers.

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<sup>24</sup> The various publications on natural gas price regulation (as well as in other subjects) that were produced under the CIDE-CRE agreement are presented in *Appendix 3*.

Additionally, dissemination of basic results reached the general public through non-technical articles and interviews in national journals as well as through interviews with the media including national TV and press.<sup>25</sup>

Our work also reached the international academia community by means of refereed academic international conferences such as those of the *Econometric Society*, the *Latin American and Caribbean Association (LACEA)*, the *International Association for Energy Economics (IAEE)*, and the *US Association for Energy Economics (USAEE)*, and presentations in US universities (such as the Harvard, Princeton, Cornell, UC Berkeley and Rice), as well as in several national conferences including those of the Mexican Association for Energy Economics (AMEE) (the Mexican chapter of the IAEE).<sup>26</sup> Our joint work with researchers in the US also contributed to let the international community of energy economists know about the distinct policy problems (and the formal solutions) in the Mexican energy sector.

## 2.2.- What impacts did the research have?

The research changed a policy or institutional structure and found a new number or example: someone followed the recommendations.

By the end of 2002 Pemex asked the CRE for an increase in the price of natural gas by moving south the arbitrage point from Los Ramones to Cempoala. We recommended that the arbitrage point should temporarily remain at Los Ramones. Although that in the long run (say, more than 5 years) we agreed that it is necessary to respect the market price—and the location of the arbitrage point—in order to promote competition and innovation, we proposed this short run measure (say, 2-3 years) of fixing the arbitrage point and implicitly keeping an incentive compatible price cap on Pemex production activities since:

1. CRE had argued to have evidence of Pemex' lack of incentives to invest in natural gas production and exploration,<sup>27</sup> as well as other monopolistic behavior in other parts of the industry (such as transportation and marketing).
2. Political constraints did not allow to increase the gas price or the CRE or the Secretary of Finance to make lump-sum subsidies to industrial consumers.

The idea was then to make Pemex choose the contract that corresponded to a scenario of higher production investment. We supported this recommendation by calculating the change in price that the 500-mile movement of the

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<sup>25</sup> For example, the results of our papers were presented in down-to-earth language in national newspapers (*El Financiero*, *Reforma*) and magazines (*Tecnogas*).

<sup>26</sup> See *Appendix 4* for a list of main conferences and seminars.

<sup>27</sup> Gas flaring as well as deviation of production from regulated to non-regulated markets.

arbitration point from Los Ramones to Cempoala would cause: USD0.38-0.50 per Mmbtu.<sup>28</sup> Given the other distortions in the economy –and a relatively small gas flow of gas from Los Ramones to Cempoala at that time– a distortion that small is simply not large enough to argue that economic considerations should trump political considerations in the setting of the arbitrage point. We also provided another colloquial example. Suppose the arbitration point were at Los Ramones and 10 MCF a day of gas was reaching Los Ramones from the southern fields. Now a *tortillería* that consumes 20 MCF of gas a day moves from Monterrey to Puebla. The arbitration point is now at Cempoala. Does it make sense to change the entire pricing structure of gas in central Mexico because a *tortillería* had moved from Monterrey to Puebla?

The CRE followed our recommendation and issued a formal legal *Resolución* on this matter.<sup>29</sup>

The policy research changed the rhetoric or vocabulary about an issue.

In our studies we referred to the formula used to set the price of natural gas in Mexico as the “netback rule”, the “Little-Mirrlees Rule”, or even the “Brito-Rosellón formula”.<sup>30</sup> The first term is a concept widely used among energy specialists. We used it to reflect the benchmark nature of the rule and its use of net transport costs. This term helped to make clear in the policy discussions that the formula was not considering production costs or referring to the prices of alternate fuels.

The second term was the one that really reflected the essentials of the formula. By saying that we were using the Little-Mirrlees formula to set the price of gas in Mexico, we were implicitly saying that it was much more important that the formula considered the international opportunity cost of Mexican natural gas rather than its cost of production, given that most natural gas in Mexico is a byproduct of oil extraction. This point was explained in an op-ed published in the national newspaper *Reforma* in 2001.

The policy research usefully summarized a vast terrain and provided a framework for later policy debate and research

As explained before, Pemex used a very large programming model to price LPG in Mexico. The Pemex’ extended model was a “black box” that had more than 1500 variables and 500 equations. We were able to simplify this extended model to a much simpler model with few equations that could be solved analytically, and that provided the same information of the Pemex model plus many more valuable insights. We think this was an important contribution to regulatory policy making in the gas industry. Pemex followed its role of a huge company trying to flood a small regulator with too much

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<sup>28</sup> See Brito and Rosellon (2003a), and Brito and Rosellón (2005b).

<sup>29</sup> See Comisión Reguladora de Energía (2002).

<sup>30</sup> This last term was used in Comisión Federal de Competencia (2004).

information. CRE (and almost all the non-Pemex parts of the government) were not able to understand Pemex model to price LPG until we did our simplifying job. The general model that we developed for LPG<sup>31</sup> was also later the basis to develop the rest of our analysis for natural gas pricing.

The policy research provided a factual foundation for debate

In our study on the implications of the netback rule on gas marketing,<sup>32</sup> we recommended that Pemex should be vertically disintegrated or, at least, it should not be permitted to discount the price of gas from the Houston netback price, or the regulated transport tariffs. These recommendations were done because vertical integration allows cross subsidies that in turn fosters Pemex' monopoly in gas marketing and even allows it to evade regulation. Likewise, it provides Pemex with poor incentives to expand pipeline capacity. More specifically, PEMEX-Transportation monopolistically might offer access to its pipeline capacity. This service is supplied to PEMEX-Marketing as well as to potential private competitors in a supposedly contestable market. However, if open-access clauses are not carefully enforced by the regulator, Pemex might allocate most of its capacity and gas sales to PEMEX-Marketing, and argue lack of capacity to meet gas sales to other consumers at a regulated price. PEMEX-Marketing could then sell gas at a price above the netback price. Even more, under constraints of pipeline capacity, Pemex could use cross subsidization from gas production and transportation activities to marketing activities so as to be able to further increase the final gas price.<sup>33</sup>

The CRE did not follow our advice to vertically disintegrate Pemex or to prohibit Pemex to discount the price of gas from the Houston netback price. Political pressures from unions and other political forces in Mexico would not permit to institutionally touch Pemex because they argued that it would be a prelude to privatization. The CRE instead issued in 2000 the Directive on Firsthand Sales of natural gas,<sup>34</sup> so as to regulate Pemex' gas marketing activities.

The underlying assumption of the Directive on Firsthand Sales was that Pemex would retain a de facto monopoly in gas marketing and therefore had to be regulated. However, the asymmetry of information between the state monopoly and the regulator made this task extremely difficult. Moreover, even though the Directive permitted consumers to modify gas contracts with Pemex—which opened the door for possible contracts with other gas marketers—the market power Pemex wields deterred entry of marketing

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<sup>31</sup> See Brito, Littlejohn and Rosellón (2000).

<sup>32</sup> See Brito and Rosellón (2003b).

<sup>33</sup> PEMEX' natural gas transportation functions are carried out by the "Pipeline Area" of PEMEX' subsidiary *Pemex Gas y Petroquímica Básica* (PGPB). PEMEX' gas marketing functions are performed by PGPB's "Natural Gas Area" while international marketing activities are made by PEMEX' international subsidiary (PMI).

<sup>34</sup> See Comisión Reguladora de Energía (2000).

competitors. This situation was further worsened when, under harsh political pressure from industrial consumers, the Mexican government implemented in 2001 three-year take-or-pay Pemex hedging contracts with a fixed price of 4 dollars per Mmbtu, which eliminated any potential competition from private gas marketers.

Although regulatory developments in gas marketing have been somewhat unfortunate in terms of increasing competition, our studies timely gave policy makers the elements to previously gauge the negative impacts that their (politically driven) policy decisions would have on welfare.

### The policy research changes an analytical question

When industrial consumers proposed to have a “Mexico price” much lower than the opportunity cost of natural gas (given by the Houston benchmark), we pointed out that this issue had to be analyzed as a problem of distribution of rents. The use of a price lower than the opportunity cost would have transferred money that could have been used by the government in social expenditures. This effect would have been vital in terms of Mexico’s social policy: it would have been very difficult to justify in the Mexican Congress a transfer of public funds from (say) poverty fight to a group of firms that competed under NAFTA, with similar input and capital prices to those of their North American competitors (including natural gas), but with advantages in the price of natural gas.

This approach made clear to policy makers of different parts of the Mexican government the very important rent-distribution implications of changing the Little-Mirrlees rule.

### *2.3.- In retrospect, what to you was the strongest point of the research? What might the researchers have done differently, in hindsight?*

I believe that the strongest point of the research was to do something that had rarely been attempted before in the practice of public policy making in Mexico.<sup>35</sup> Namely, to formally study the microeconomic foundations of a policy problem. This proved to be very well received in the policy discussions because it provided a framework to contextualize the different opinions on the best way to set the price of natural gas in Mexico.

Additionally, the analytical results that we obtained in our models have proven to be true in practice. For example, those related to the structure of

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<sup>35</sup> The market for policy research is relatively a new one in Mexico. Policy makers have traditionally not been too fond of basing policy decisions on formal academic studies. However, for the last ten years public policy research programs have strengthened in Mexican research institutions, such as ITAM, UDLAP, ITESM, UIA, and CIDE. CIDE is very well positioned in this new market because —since its creation 30 years ago— most of its research projects have addressed real-world policy problems.

Pemex' production incentives due to the netback rule; our predictions on the effects of import tariff reductions as well as the consequences of not vertically separating Pemex on gas marketing.

In retrospect, however, I think that we lacked more collaboration with the CRE in order to widely explain our results to different actors, especially the industrial consumers that always retake the same “Mexico price” political discussion every time there is volatility in the North American gas market.

#### *2.4.- What tentative lessons might be derived from this example? Lessons for policy analysis, for how to organize research, for funding and fundraising, for how to disseminate research, for how to think about “successful” policy research...or other types of lessons*

This case study aimed to present in colloquial language an example on how theoretical concepts developed by an academic think tank (CIDE) were relevant for policy makers faced with the challenge of designing a coherent and detailed price regulatory framework. It sought to describe the rationales that supported a policy decision process which listened to economic theory, international experiences, and market players. The paper then presented how complex economic concepts were taken into account in reaching concrete decisions. Therefore, it showed an example of how a bridge between abstract theory and practice can be built. Hopefully, this should be of interest to policy makers who try to find some theoretical guidance while in the churn of day-to-day operations.

Some lessons can be derived from this exercise. A brief list is:

#### Policy Analysis/ how to think about “successful” policy research

- Since theory is most often based on very restrictive assumptions, it will be the unusual case in which reality and the assumptions of economic theory coincide nicely. Nonetheless, theory can always provide a useful reference framework for policy making.
- Therefore, a perhaps trivial and sometimes forgotten lesson is that the results of economic theory should always be taken with reference to the assumptions of the model. A decision maker should try to compare such assumptions with the prevailing real-world conditions that are present before trying to apply any theoretical result.
- Regulation is best perceived and applied only as a substitute for competition. Regulatory measures should only be taken when and where natural or artificial market power or barriers to entry into contestable markets exist.
- The general objective of regulatory authorities is to maximize welfare subject to incentive and individual rationality constraints of the firm. The solution to this



problem should reconcile several conflicting goals: i) provide enough rents to firms, ii) efficiently allocate rents between firms and consumers, and iii) minimize the costs of carrying out regulation (through incentive-compatible regulatory mechanisms).

- While applying this general conceptual framework, the regulatory authority must not forget that regulated firms have more information than the authority does. However, authorities must also be aware that the principle of revelation—a result from the mechanism design theory<sup>36</sup> provides a conceptual framework to address the issue of policy making under asymmetry of information.<sup>37</sup>
- Benchmarking is a plausible option as long as the appropriate (competitive) benchmark is selected.

### Dissemination of research

- Several means of disseminating research should be sought. While publication in international refereed professional journals is fundamental to validate the study, conferences, op-eds in major newspapers, and TV and radio interviews are important to explain in colloquial language the proposed policy and its implications.
- Likewise, close contact with client policy makers is essential to adjust research in progress and to communicate results among the government various actors, which might have opposed objective functions.

### How to organize research

- Topics of research should be chosen in consensus with policy makers. Although they can be related to day-to-day problems addressed by policy makers and consultants, it is important that such topics are specific, of long-run and academic nature, and that they do not duplicate studies done by other consultants or CRE staff.
- Cycles of 18-24 months are adequate to develop quality academic research relevant to actual policy, to interact with policy makers and other actors, and to disseminate the basic results.
- Teams of two to four researchers (plus RA's) might be sufficient to carry out research. International teams might be assembled. Online collaboration is the basis for development of the studies but occasional personal meetings proved to be most useful.

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<sup>36</sup> See Laffont, J.J. (1988), ch. 5.

<sup>37</sup> Namely, that the asymmetry-of-information problem can be solved by applying methods of regulation which induce firms to reveal their true level of efficiency and to behave accordingly.

## Funding

- A general agreement of academic collaboration between the think tank and the government agency proved to be administratively important in our case. This general agreement set the basic institutional infrastructure to develop specific research contracts.
- Funding from the CRE was essential to initialize the CIDE's program on energy economics and regulation. However, once the program became solid we were able to attract funds from other sources, both national and international.
- In the elaboration of the budget, we had to consider CIDE's overheads as well as administrative expenses. However, most of the budget was focused to research expenses, and the organization of the international conferences.
- Flexibility from CIDE in the amount and the form of payment by CRE proved to be very useful for the long-run stability of the CIDE-CRE agreement.

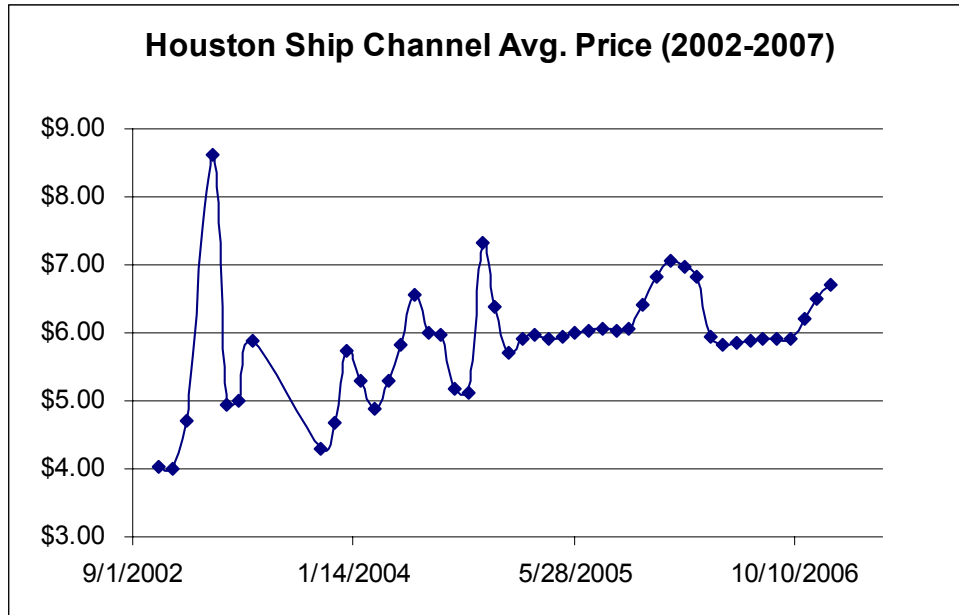
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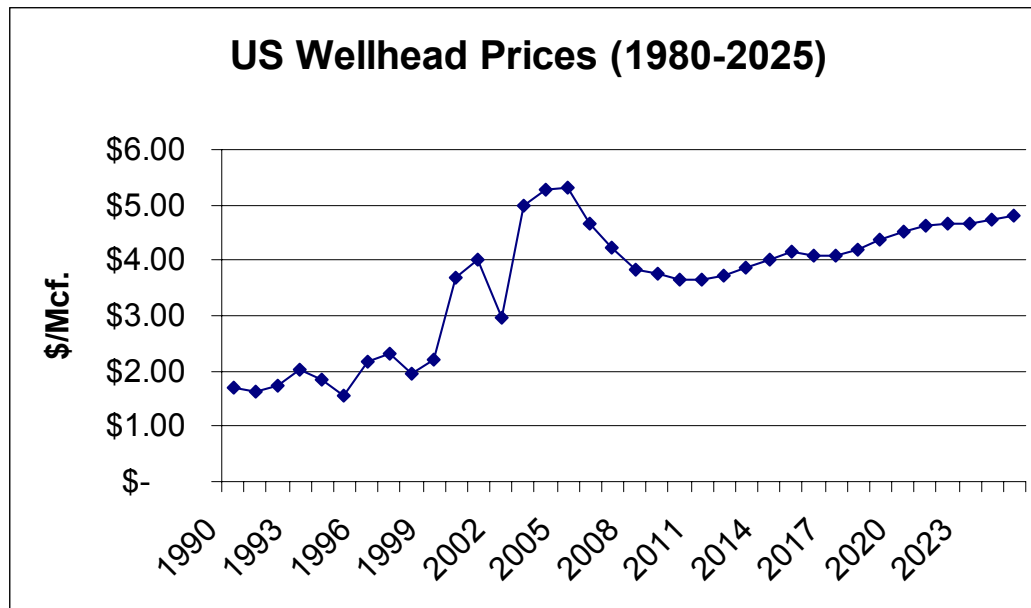
## Appendix 1

### *Houston Ship Channel Average Prices*



Source: X Group Gas Indices ([www.10xgroup.com](http://www.10xgroup.com))

### *Natural gas prices in the US*



Source: U.S. Energy Information Administration ([www.eia.doe.gov](http://www.eia.doe.gov))

## Appendix 2

### Pros and Cons of Pricing Options for Natural Gas

<i>Price based on</i>	<i>Pros</i>	<i>Cons</i>
Costs	<p>Reflects costs. Prices are related to costs at the wellhead in most countries with a competitive natural gas market.</p>	<p>No marginal cost of extracting Mexican natural gas because it is a byproduct of oil. Does not reflect the opportunity cost of selling Mexican natural gas in the North American market.</p>
Comparisons with other fuel prices	<p>Reflects prices in international markets. Prices of substitutes are economically related. There are price series data.</p>	<p>Potential prices of substitutes subsidized in non-explicit ways. International markets of substitutes have different dynamics to the natural gas market. Accounts for opportunity cost of other markets, not the natural gas market.</p>
A benchmark	<p>Considers the opportunity cost of Mexican natural gas in the North American market. The relevant benchmark, the Houston Ship Channel, is a liquid market, it has an associated hedging market, it is close to the physical connection to the Pemex pipeline system. Methodology has some similarities with prior Pemex methodology. Marginal costs of imported gas and domestic gas are the same at the arbitrage point.</p>	<p>Brings disturbances from U.S. weather into the Mexican market.</p>

## Appendix 3

### Publications on Regulation of Natural Gas Pricing in Mexico

- (1) Brito, D.L. and J. Rosellón (2005), "Price Regulation in a Vertically Integrated Natural Gas Industry: The Case of Mexico", *The Review of Network Economics*, forthcoming.
- (2) \_\_\_\_\_ (2005), "A General Equilibrium Model of Pricing Natural Gas in Mexico", *El Trimestre Económico* (with D.L. Brito), forthcoming.
- (3) \_\_\_\_\_ (2004), "Implications of the Elasticity of Natural Gas in Mexico on Investment in Gas Pipelines and in Setting the Arbitrage Point", *Working Paper*, CIDE , E-299.
- (4) \_\_\_\_\_ (2003), "Strategic Behavior and the Pricing of Gas", *Working Paper*, CIDE, E-259.
- (5) \_\_\_\_\_ (2003), "Regulation of Gas Marketing Activities in Mexico", *Estudios Económicos*, Vol.18, No.1 January-June.
- (6) \_\_\_\_\_ (2002), "Pricing Natural Gas in Mexico; An Application of the Little Mirrlees Rule", *The Energy Journal*, Vol. 24, No. 3.
- (7) \_\_\_\_\_ (2002), "Una nota sobre la regulación del gas en México: Comentarios críticos", *El Trimestre Económico*, Vol. 69 (3), No. 273, January-March.
- (8) Brito, D.L., W. L. Littlejohn and J. Rosellón (2000), "Pricing Liquid Petroleum Gas in Mexico", *Southern Economic Journal*, Vol. 66, No. 3, January.
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- Rosellón, J. (2003), "Different Approaches Towards Electricity Transmission Expansion", *The Review of Network Economics* , vol. 2, issue 3, September.
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- Kristiansen, T. and J. Rosellón (2003), "A Merchant Mechanism for Electricity Transmission Expansion", *Working Paper*, CIDE, E-276.
- Rosellón, J. (2003), "Pricing electricity transmission in Mexico", *Working Paper*, CIDE, E-270.
- López Calva, L. F. and J. Rosellón (2000), "The Reform of the Natural gas Market in Mexico: Effects on Production and Distribution", *Working Paper*, E-198, CIDE.



## Appendix 4

### Conferences and seminars where the research under the CIDE-CRE agreement has been presented

#### **2004**

*XIV Seminario Repsol YPF-Harvard KSG*, organized by Harvard University and Repsol-YPF, La Coruña, Spain, June 24-26.

*Seminar on Energy Regulatory Developments in North America*, organizer and speaker, co-organized by SENER, CRE and CIDE, Mexico City, January 13.

#### **2003**

*23rd IAEE North American Conference*, Camino Real Hotel, Mexico City, October 19-21.

*2nd Workshop on Applied Infrastructure Research*, "Regulation and Investment in Infrastructure Provision-Theory and Policy," Berlin University of Technology, DIW Berlin, Berlin, Germany, 11 October.

*LACEA 8th Annual Meeting*, Universidad de las Américas, Cholula, Puebla, October 9-11.

*University of California Energy Institute*, Center for the Study of Energy Markets, Seminar Series," April 28.

#### **2002**

*22nd Annual North American Conference of the USAEE/IAEE: Energy Markets in Turmoil: Making Sense of it All*, presentation: "Incentives for the Expansion of Electricity Supply and Capacity Reserves in the Mexican Electricity Sector", Vancouver, Canada, October 6-8.

*Regulación y Competencia en los Mercados de Electricidad (Regulation and Competition in Electricity Markets)*, presentation: "Asignación de Precios de la Transmisión de Mercados de Electricidad", organized by the CRE, APEC Y CFC, Mexico City, May 30-31.

#### **2001**

*VI Annual Meetings of LACEA*. Montevideo, Uruguay, October.

*Conferencias sobre Petróleo y Gas Natural, Oxford Institute for Energy Studies/CIDE, CIDE, Mexico City, October.*

*La Reforma Estructural del Sector Eléctrico Mexicano, Conferencia Tinker-CIDE, CIDE, Mexico City, September.*

*La Realidad Económica Actual y sus Corrientes de Interpretación: Un Debate Inicial, Instituto de Investigaciones Económicas, UNAM, Mexico City, September.*

*International Program on Privatization Regulatory Reform and Corporate Governance, Princeton University, Princeton, N. J., July.*

*Cuarto Congreso Nacional de la Asociación Mexicana para la Economía Energética, El Sector Energía en México de Cara al Siglo XXI: Tendencias, Política, Abastecimiento y Financiamiento”, México D.F., June 13-14.*

*24th International USAEE/IAEE, Conference 2001: An Energy Odyssey?, Houston, Tx., April 25-27, 2001*

## **2000**

*Seminario Internacional CIDE-CRE, Reforma Estructural y Regulación en el Sector Energético, Mexico, October 30-31.*

*V Annual Meetings of LACEA. Río de Janeiro, Brazil, October 12 through 14.*

*21st Annual USAEE “Transforming Energy”, Philadelphia, Penn., September 24-27.*

*Conference on Global Climate Change, Rice University, Houston, Tx., September 7-8.*

*International Program on Privatization Regulatory Reform and Corporate Governance, Harvard University, Cambridge, Mass., July.*

*Tercer Congreso Nacional de la Asociación Mexicana para la Economía Energética, “El Futuro Energético de México”, México D.F., May 25-26.*

*Seminario del Departamento de Economía, Universidad de Guanajuato, Guanajuato, Mexico, May 12.*

## **1999**

*54th European Meeting of the Econometric Society, Santiago de Compostela, Spain, August 29 through September 1.*

*XII Latin American Meeting of the Econometric Society, Cancún, Mexico, August 2-6.*

*International Program on Privatization Regulatory Reform and Corporate Governance, Harvard University, Cambridge, Mass., July.*

*Segundo Foro Regional para la Reforma de la Energía Eléctrica*, Campeche, Mexico, April.

*Desafíos y opciones para el sector eléctrico mexicano. Qué podemos aprender de la experiencia internacional*, UNAM, Mexico D.F.

## **1998**

*Colloquium Cornell Institute for Public Affairs*, Cornell University, Ithaca, New York, September.

*Reforma Estructural y Regulación en el Sector Energético*, CIDE. Ponencia: “México D. F., August (this conference provided two papers that were later published in 1999 in *Economía Mexicana: Optimal Price Regulation for Natural and Legal Monopolies* (Ingo Vogelsang), and *Reform of Electricity Supply Industry* (Peter Hartley).

*International Program on Privatization Regulatory Reform and Corporate Governance*, Harvard University, Cambridge, Mass., July.

## **1997**

“The impact of Globalization and Privatization on Malaysian and Asia”, presentation: *Regulatory Reform in Mexico's Natural Gas Industry*, organized by HIID, Harvard University, Langkawi, Malaysia, November.