NÚMERO 314

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# Liquid Natural Gas and a New Policy for Pricing Gas in Mexico

MAYO 2004

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## *Resumen*

*La Comisión Reguladora de Energía de México implementó a mediados de los noventa una regla que vincula el precio del gas natural mexicano con el del Houston Ship Channel. Éste reflejó, en aquel momento, un mercado razonablemente competitivo. Sin embargo, el punto de arbitraje en Texas se ha desplazado al sur y gran parte del gas importado por México proviene de Agua Dulce, cerca de Corpus Christi, o de la Zona Cero, próxima a Brownsville. Dichos mercados son líquidos y el precio del gas natural en ellos es el Houston menos el costo de transporte. Cambiar el precio base al punto de compra podría reducir el precio del gas en México en dos veces el costo de transporte. Otro problema es que la demanda de gas natural en Estados Unidos se ha incrementado al punto en que el gas natural es un recurso escaso. Hay cuellos de botella en la importación del combustible y el precio de éste en el Houston Ship Channel refleja las cuasi-rentas asociadas a las dificultades en la importación de gas a los Estados Unidos.*

*Este artículo se refiere a la conveniencia de la regla cuando el precio del gas en el Houston Ship Channel refleja las cuasi-rentas asociadas con los cuellos de botella en la importación. Así, se muestra que si hay distorsiones causadas por un gravamen generalizado y un impuesto al precio del gas natural, entonces la regla basada en el Houston Ship Channel puede no ser la metodología apropiada para determinar le precio del gas natural en México.*

*La intuición detrás de este resultado es simple. Cuando la regla fue implementada, el gobierno mexicano tuvo la alternativa de gravar el gas natural para obtener ingresos. Pero no la eligió. El gobierno mexicano no necesita de los cuellos de botella, asociados a la importación de gas natural, para cobrar precios altos. A menos que los objetivos del gobierno mexicano hayan cambiado, capturar las cuasi rentas asociadas con estos cuellos de botella puede no ser la política correcta.*

## *Abstract*

*The Comisión Reguladora de Energía of Mexico implemented in the mid 90´s a netback rule for linking the Mexican natural gas price to the Houston Ship Channel price. At the time, the Houston Ship Cannel price reflected a reasonably competitive market. Since that time, the arbitrage point in Texas has moved south and most of gas that is imported to Mexico comes from Agua Dulce near Corpus Christi or Zone Zero near Brownsville. These are liquid markets and the price of gas at these markets is Houston minus transport cost. Changing the base price to the point of purchase would reduce the price of gas in Mexico by twice the transport cost. Another*

*problem is that the demand for gas in the United States has increased to the point where Liquid Natural Gas (LNG) is the marginal source. There are bottlenecks in the importation of LNG and the price of natural gas at the Houston Ship Channel reflects the quasi-rents associated with bottlenecks in importing of LNG into the United States.*

*This paper addresses the optimality of the netback rule when the price of gas at the Houston Ship Channel reflects the quasi-rents associated with bottlenecks in importing LNG into the United States pipeline system. In this paper, it is shown that if there are distortions caused both by general taxation and taxing the price of natural gas, then the netback rule based on the Houston Ship Channel price may no longer be the appropriate methodology for pricing natural gas in Mexico.*

*The intuition behind this result is simple. When the netback rule was implemented, the Mexican government had the alternative of taxing natural gas for revenue. It did not choose to do so. The Mexican government does not need the bottleneck associated with the importation of LNG to charge high prices. So unless the policy goals of the Mexican Government have changed, capturing the quasi rents associated with this bottleneck may not be the correct policy.*

# Introduction

Mexico has an energy market that is different from most other countries. The national oil company, Petróleos Mexicanos (Pemex) is a very important political and symbolic institution. Foreign interests initially owned the oil industry, and its nationalization in 1938 is viewed by many as an expression of Mexican sovereignty. Privatization of Pemex is politically impossible. This created problems in the pricing of gas, which were addressed by the netback rule. This tied the price of gas in Mexico to the Houston Ship Channel price. At that time, the Houston Ship Channel was viewed to be the nearest competitive market, but conditions have changed. The source of gas that is exported to Mexico is either Agua Dulce near Corpus Christi or Zone Zero near Brownsville. Theses are markets that are connected to Houston by uncongested pipelines. Gas from these sources is moving both to Houston and to Mexico and the price of gas at these markets is Houston minus transport cost. Another important change is that the price of gas in the United States reflects quasi rents to bottlenecks in importing liquid natural gas (LNG). This note is a reexamination of the optimality of the netback rule when the base price of gas reflects quasi rents to such bottlenecks.

## *Background*

Difficulties in pricing gas 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. 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 feed stocks. This creates very difficult problems in regulating prices. The Comisión Reguladora de Energía (CRE) is responsible for regulating the price of natural gas. Initially, they solved the problem of pricing gas by using the Houston Ship Channel price as a benchmark to price associated gas produced at Ciudad Pemex.

The pricing rule based on the Houston Ship Channel price was an implementation of the Little-Mirrlees proposal for pricing traded goods. (See Brito and Rosellón 2002.) Little and Mirrlees proposed using the world prices for traded goods because these prices reflect the terms under which a country can trade. Thus, at the time, the price of gas in Houston was a measure of the cost of gas.[1]

The price of gas at Ciudad Pemex is derived through a netback formula based on a benchmark price in the Houston Ship Channel, the arbitrage point and the net transport costs. If Mexico is importing gas, as has been the case through out this period, the point where southern flow from Texas and the northern Mexican fields meets gas from the southern Mexican fields is defined as the arbitrage point. Since the price of gas from both sources must be the same at this point, the price of the Mexican natural gas at this point is the Texas benchmark price plus the transport cost from Houston to the arbitrage point less the transport cost from this point to Ciudad Pemex. The price of gas at Ciudad Pemex is thus the price at the Houston Ship Channel plus the cost of transportation to the arbitrage point less the cost of transportation from the arbitrage point to Ciudad Pemex. The physical arbitrage point at the time the policy was implemented was located at Los Ramones, which is the junction of the north-south pipeline with the pipeline that transports gas to Monterey. Gas from Ciudad Pemex was being delivered to Monterey. [2]

This pricing rule means that the price of gas in Mexico is insensitive to changes in the demand for gas in Mexico. Consumers of gas are facing a flat supply curve. The equilibrating factor is the amount of gas imported or exported. The decision to link the price of natural gas in Mexico to the price at the Houston ship channel by a netback rule solved some very difficult technical and institutional problems in a very simple fashion. The netback rule links the price of gas at any point in Mexico to the price of gas in Houston adjusting for the cost of transportation. The natural gas market in Mexico then has all the properties of the gas market at Houston.

Over the years, this rule has been under attack from Mexican industrial interests who want a cheap source of gas. We have done several studies defending the policy. Further, when the price of gas was low, the netback rule did not create incentives for Pemex to increase gas production in the south (by investing in equipment to produce pipeline quality gas) and the actual arbitrage point is now at Cempoala, in southern Mexico. This is the point where the pipeline that serves Mexico City joins the north-south pipeline.

In our study, "Strategic Behavior and the Pricing of Gas," we recommended that the arbitrage point be fixed at Los Ramones as long as Pemex has the *potential* to supply sufficient gas if they invested in adequate

[1] There were two other proposals discussed as a way of pricing natural gas in Mexico. 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. Note that at the time, using the price of gas in Houston does this in as much as the price of gas in Houston reflects the price of competitive sources of energy.

[2] It should be noted that Pemex has offered some long term contracts at a fixed price to enable firms to hedge.

facilities to clean gas to pipeline standards. This introduced the idea of a *virtual* arbitrage point in determining the price of gas. At the time that paper was written, the amount of gas reaching Cempoala was not substantial, but moving the arbitration point to Cempoala would have increased the price of gas to central Mexico by approximately $.40 per thousand cubic feet. The policy of fixing the price of gas at a *virtual* arbitrage point is not strictly optimal in that it violates the Little-Mirrlees Rule, but the distortion is not large and the policy created incentives for Pemex to invested in gas processing equipment. The CRE accepted our recommendation.

When the Little-Mirrlees rule was first implemented, the price gas in the United States was on the order of $2.00 to $2.50 per thousand cubic feet and the gas market in the United States was close to competitive. Thus, using the Little-Mirrlees rule with a Houston benchmark was a reasonable methodology to price gas. This is no longer the case. The price of gas is well over $6.00 and November 2004 contracts are over $8.00 even though the cost of the marginal gas, LNG, is around $3.50 per thousand cubic feet. The difference is due to the fact that at the present time there is not sufficient capacity to import LNG and as a result, the existing capacity is earning economic rents. Thus, the current pricing policy in Mexico is also imputing these economic rents to the gas produced at Ciudad Pemex. A recent study by Peter Hartley and Kenneth Medlock for the Baker Institute suggests that in a five to ten year horizon as the bottlenecks on LNG are eliminated the price of gas should be in the $4.00 to $4.50 range.

It is our conjecture that a pricing formula based on a combination of the *cost* of delivering gas to the LNG terminal under construction at Altamira and the price of United States imports would a more appropriate methodology for determining the price at Ciudad Pemex. The idea is similar in concept to the *virtual* arbitrage point, which the CRE has already implemented. Another alternative is to price gas at its opportunity cost if it were being exported. This is an idea that has been suggested in the press. This price has the advantage that there would not be incentives to attempt to export Mexican gas.

It is a well-accepted principle in economics that eliminating rents does not create distortions. The models we present in this paper are intended to illustrate that when bottlenecks exist in the supply of gas, the netback rule may fail. The problem is sufficiently complicated that a careful analysis is needed to formulate a correct policy under these new circumstances. The demand for gas in Mexico is on the order of 500 mcfd so there is a substantial amount of money at stake.

## II.-The Model

The problem can be illustrated in a very simple model. Consider an economy where the welfare function depends on consumption of a private good, $X$, a public good, $Z$ and gas, $Q$. The welfare function is the given by

$$\int_0^T e^{-rt} U(X,Z,Q)dt \tag{1}$$

where $T$ is the planning horizon which we will assume is the time the constraints on the importation of LNG are no longer binding. At that point, the price of gas is $p_3$ as it is assumed that at that point there is enough capacity so that LNG can be imported without bottlenecks and the constraint on importing LNG is no longer binding. For simplicity we will assume that total output is fixed at $Y$.

Define $Q_1$ as gas produced in Mexico, $Q_2$ as gas imported from the United States and $Q_3$ as LNG imported. Thus the supply of gas in Mexico is given by

$$Q = Q_1 + Q_2 + Q_3. \tag{2}$$

The constraints on the production of Mexican gas and imported LNG are given by

$$Q_1 \leq \overline{Q}_1 \tag{3}$$

$$Q_3 \leq \overline{Q}_3 \tag{4}$$

Define $p$ as the domestic price of gas, $p_2$ and $p_3$ as the price of gas imported from the United States and LNG respectively and $t$ as the tax rate on income. The price of the goods $X$ and $Z$ are normalized to 1. The budget constraint of individuals is

$$X = (1-t)Y - pQ \tag{5}$$

The budget constraint of government is

$$Z = tY + pQ - p_2Q_2 - p_3Q_3. \tag{6}$$

Government revenue is tax revenue plus the revenue from the sale of domestic gas. We will assume that the rents from importing LNG, $(p-p_3)Q_3$, go to Pemex and thus to the government. The differential equation for gas reserves $R$ in Mexico is given by

(7) $$\frac{dR}{dt} = -Q_1.$$

We will define $p_1 = p_1(t)$ as the costate variable associated with gas reserves in the dynamic optimization we are formulating. Recall that the costate variable gives the opportunity cost to the planner of the stock at that point in time.

Finally, we will assume that the price of gas is such that

(8) $$p \geq p_3.$$

This is means that the price of gas in Mexico will never be less that the cost of LNG on board ship, excluding the rents to the regasification facilities.

The planner maximizes (1), subject to (2) through (8). Let $\lambda_i$, $i = 1,5$ be the Lagrange multiplier associated with the constraints given by (2) through (6). The Hamiltonian for the maximization is given by

(9) $$\begin{aligned} H &= U(X,Z,Q) + \lambda_1[Q_1 + Q_2 + Q_3 - Q] + \lambda_2[\overline{Q}_1 - Q_1] + \lambda_3[\overline{Q}_3 - Q_3] \\ &+ \lambda_4[(1-t)Y - pQ - X] + \lambda_5[tY + pQ - p_2Q_2 - p_3Q_3 - Z] + \delta[p - p_3] \end{aligned}$$

The control variables are $X$, $Z$, $Q$, $Q_1$, $Q_2$, $Q_3$, $p$ and $t$. The first order conditions are

(10) $$\frac{\partial U(X,Z,Q)}{\partial X} - \lambda_4 = 0$$

(11) $$\frac{\partial U(X,Z,Q)}{\partial Z} - \lambda_5 = 0$$

(12) $$\frac{\partial U(X,Z,Q)}{\partial Q} - \lambda_1 - \lambda_4 p + \lambda_5 p = 0$$

(13) $$\lambda_1 - \lambda_2 \leq 0 \qquad Q_1[\lambda_1 - \lambda_2] = 0$$

(14) $$\lambda_1 - \lambda_5 p_2 \leq 0 \qquad Q_2[\lambda_1 - \lambda_5 p_2] = 0$$

(15) $\lambda_1 - \lambda_3 - \lambda_5 p_3 \leq 0$ $\qquad Q_3[\lambda_1 - \lambda_3 - \lambda_5 p_3] = 0$

(16) $-\lambda_4 + \lambda_5 + \delta \leq 0$ $\qquad p[-\lambda_4 + \lambda_5 + \delta] = 0$

(17) $-\lambda_4 + \lambda_5 < 0$ $\qquad t[-\lambda_4 + \lambda_5] = 0$

(18) $p - p_3 > 0$ $\qquad \delta[p - p_3] = 0.$

The differential equation for the costate variable is

(19) $$\frac{dp_1}{dt} - rp_1 = -\frac{\partial H}{\partial R} = 0$$

with the transversality condition:

(20) $$p_1(T) = p_3.$$

Solving (19) and using the transversality condition (20), we get

(21) $$p_1(t) = p_3 e^{r(T-t)}.$$

To solve the system, we will assume that taxes are positive, as is the case in Mexico. Note from (17) that if $t > 0$, $\lambda_4 = \lambda_5$ so the marginal utility of income is the same for public or private consumption. Then, equation (12) can be written as:

(22) $$\frac{\partial U(X,Z,Q)}{\partial Q} = \lambda_1$$

so $\lambda_1$ is the shadow price of gas. If gas is not a free good, $\lambda_1 > 0$ and from (10), (11), (14) and recalling that $\lambda_4 = \lambda_5$, we get

(23) $$\frac{\frac{\partial U}{\partial Q}}{\frac{\partial U}{\partial X}} = \frac{\lambda_1}{\lambda_4} = \frac{\lambda_5 p_2}{\lambda_4} = p_2.$$

Since the price of $X$ is normalized to be 1, the marginal rate of substitution is equal to the ratio of the prices. This is equivalent to the netback rule. This is not surprising since we have assumed a first best world where taxes do not create distortions. High gas prices do not have indirect impact on welfare through employment and investment and the government collect all the rents from the LNG bottleneck.

Let us now drop the assumption that the government collects all the rents from the LNG bottleneck. The government's budget constraint is now

(24) $$Z = tY + pQ_1.$$

This is tax revenue plus the revenue from the sale of domestic gas. We will assume that the rents from importing LNG, $(p - p_3)Q_3$, go to the owners of the LNG terminals.

The new Hamiltonian for the maximization is given by:

(25) $$\begin{aligned} H &= U(X,Z,Q) + \lambda_1\left[Q_1 + Q_2 + Q_3 - Q\right] + \lambda_2\left[\overline{Q}_1 - Q_1\right] + \lambda_3\left[\overline{Q}_3 - Q_3\right] \\ &+ \lambda_4\left[(1-t)Y - pQ - X\right] + \lambda_5\left[tY + p(Q_1 + Q_2) - p_2 Q_2 - Z\right] + \delta\left[p - p_3\right] \end{aligned}$$

The first order conditions are:

(26) $$\frac{\partial U(X,Z,Q)}{\partial X} - \lambda_4 = 0$$

(27) $$\frac{\partial U(X,Z,Q)}{\partial Z} - \lambda_5 = 0$$

(28) $$\frac{\partial U(X,Z,Q)}{\partial Q} - \lambda_1 - \lambda_4 p = 0$$

(29) $$\lambda_1 - \lambda_2 - p_1 \le 0 \qquad Q_1\left[\lambda_1 - \lambda_2 - p_1\right] = 0$$

(30) $$\lambda_1 - \lambda_5(p - p_2) \le 0 \qquad Q_2\left[\lambda_1 - \lambda_5(p - p_2)\right] = 0$$

$$(31) \qquad \lambda_1 - \lambda_3 \leq 0 \qquad Q_3[\lambda_1 - \lambda_3] = 0$$

$$(32) \qquad -\lambda_4 Q + \lambda_5 [Q_1 + Q_2] + \delta \leq 0 \quad p[-\lambda_4 Q + \lambda_5 [Q_1 + Q_2] + \delta] = 0$$

$$(33) \qquad -\lambda_4 + \lambda_5 < 0 \qquad t[-\lambda_4 + \lambda_5] = 0$$

$$(34) \qquad p - p_3 > 0 \qquad \delta[p - p_3] = 0$$

Note that $t > 0$ implies that $\lambda_4 = \lambda_5$, thus (32) becomes

$$(35) \qquad -\lambda_5 Q_3 + \delta \leq 0 \qquad p[-\lambda_5 Q_3 + \delta] = 0.$$

Since $p \geq p_3$, it follows that $p > 0$ and thus $-\lambda_5 Q_3 + \delta = 0$ which implies that $\delta > 0$ and thus that $p = p_3$. Thus, in this model, the correct price of gas in Mexico is the cost of LNG in the absence of bottlenecks. The intuition behind this result is very simple. In as much as there is no cost to the government in raising revenue by general taxation or selling gas, the price of gas is chosen so as to minimize the rents that accrue to the owners of the LNG facility.

The next step is to model the problem in a manner that reflects the distortions and the distributional and political costs caused by taxation and the use of the sale of gas to raise revenues. To do this correctly requires a good estimate of the distortions caused by various taxes as well as the weight of various groups in the political process that we are modeling as an optimization. For the purpose of this exercise, let us assume that the cost of these distortions can be measured by a quadratic loss function/ Further, we will assume that we can ignore income effects in $X$ and $Z$ so the difference between $\lambda_4$, the marginal utility of private consumption and $\lambda_5$, the marginal utility of public consumption remains constant. The objective function is

$$(36) \qquad \int_0^T e^{-rs}[U(X,Z,Q) - \alpha_1 p - \alpha_2 p^2 - \beta_1 t - \beta_2 t^2] ds.$$

We will also assume that the policy parameters that describe social preferences have not changed in the period since the netback rule was implemented. We will assume that the government gets the rents from regasification so the problem is identical to the first example except for the change in the objective function.

The planner maximizes (36), subject to (2) through (8). The Hamiltonian for the maximization is given by

$$
\begin{aligned}
&H = U(X,Z,Q) - \alpha_1 p - \alpha_2 p^2 - \beta_1 t - \beta_2 t^2 \\
&+\lambda_1 [Q_1 + Q_2 + Q_3 - Q] \\
&+\lambda_2 [\overline{Q}_1 - Q_1] + \lambda_3 [\overline{Q}_3 - Q_3] + \lambda_4 [(1-t)Y - pQ - X] \\
&+\lambda_5 [tY + pQ - p_2 Q_2 - p_3 Q_3 - Z] + \delta [p - p_3]
\end{aligned} \tag{37}
$$

All the first order conditions remain unchanged except the ones with respect to $p$ and $t$. These are:

$$[-\alpha_1 - 2\alpha_2 p - (\lambda_4 - \lambda_5)Q + \delta] \leq 0 \qquad p[-\alpha_1 - 2\alpha_2 p - (\lambda_4 - \lambda_5)Q + \delta] = 0 \tag{38}$$

$$-\beta_1 - 2\beta_2 t - (\lambda_4 - \lambda_5)Y \leq 0 \qquad t - \beta_1 - 2\beta_2 t - (\lambda_4 - \lambda_5)Y = 0 \tag{39}$$

Define the solution of this problem as $\hat{p}$ and $\hat{t}$. Now let us solve the problem the planner faced when the netback rule was first implemented. At that time LNG was not a source of gas so the planner's problem was defined by maximizing (36) subject to

$$Q = Q_1 + Q_2. \tag{40}$$

$$Z = tY + pQ - p_2 Q_2 - p_3 Q_3. \tag{41}$$

$$p - p_2 \geq 0, \tag{42}$$

as well as equations (3), (5), and (7).

The Hamiltonian for the maximization is given by

$$
\begin{aligned}
&H = U(X,Z,Q) - \alpha_1 p - \alpha_2 p^2 - \beta_1 t - \beta_2 t^2 + \lambda_1 [Q_1 + Q_2 - Q] \\
&+\lambda_2 [\overline{Q}_1 - Q_1] + \lambda_4 [(1-t)Y - pQ - X] \\
&+\lambda_5 [tY + pQ - p_2 Q_2 - Z] + \delta [p - p_2]
\end{aligned} \tag{43}
$$

The first order conditions with respect to *p* and *t* are

(44) $$-\alpha_1 - 2\alpha_2 p - (\lambda_4 - \lambda_5)Q + \delta \le 0 \quad p\left[-\alpha_1 - 2\alpha_2 p - (\lambda_4 - \lambda_5)Q + \delta\right] = 0$$

(45) $$-\beta_1 - 2\beta_2 t - (\lambda_4 - \lambda_5)Y \le 0 \qquad t\left[-\beta_1 - 2\beta_2 t - (\lambda_4 - \lambda_5)Y\right] = 0$$

(46) $$p - p_2 \ge 0 \qquad \delta\left[p - p_2\right] = 0$$

Define the solution of this problem as $\bar{p}$, $\bar{t}$, $\bar{\delta}$. From our assumption that $\lambda_4 - \lambda_5$ is constant,

(47) $$\frac{\left[-\alpha_1 - 2\alpha_2 \hat{p} + \hat{\delta}\right]}{\hat{Q}} = \frac{\left[-\alpha_1 - 2\alpha_2 \bar{p} + \bar{\delta}\right]}{\overline{Q}}$$

If $\hat{Q} \ge \overline{Q}$, it follows that $\frac{\alpha_1}{\hat{Q}} \le \frac{\alpha_1}{\overline{Q}}$ so

(48) $$\frac{\left[-2\alpha_2 \hat{p} + \hat{\delta}\right]}{\hat{Q}} \ge \frac{\left[-2\alpha_2 \bar{p} + \bar{\delta}\right]}{\overline{Q}}$$

and since and $\hat{p} > \bar{p}$ , it must be that $\hat{\delta} > \bar{\delta} > 0$. Thus, in this example, if it had been the case that it was initially optimal to chose a Texas base price for gas, the optimal base price for gas is the price of LNG afloat if the policy parameters have remained stable.

The point illustrated in the example is intuitively clear. When the netback rule was implemented, the Mexican government had the alternative of taxing natural gas for revenue. It did not choose to do so. The Mexican government did not need the bottleneck associated with the importation of LNG to charge prices higher than the Houston market would imply using the netback rule.

Conditions have changed. Mexico has a new government and it may well be that the desired policies that we are attempting to represent by the parameters $\alpha$ and $\beta$ have changed. The point of this paper is not to prescribe a pricing policy – that is beyond the limited scope of this work – but to point out that conditions have changed and that the arguments we made for net back rule (based on the Houston Ship Channel) may no longer the valid now that the price of gas in Houston reflects the bottlenecks in the importation of LNG.

## Conclusions

The first two models show that, in very simple models where taxation does not cause distortions, the optimal price of gas is very sensitive to the assumptions made. In the first model, it was assumed that the government captured the rents associated with LNG terminals and the net back rule was optimal in the second model the sale of gas transfers rents to the owners of the LNG facility. Since the sale of gas and taxation are substitutes for the government in raising revenue, the optimal policy in this model is for the government to raise revenue by taxation and lower the price of gas as much as possible.

The first two models are unrealistic in that they assume there are no distortions in taxing or using the sale of gas as a source of government revenue. In the third model we assume a linear-quadratic loss function to capture this tax distortion. We show that if the policies represented by these parameters are stable, then the net back rule based on the Hoston Ship Channel is no longer an optimal policy.

The essential point in the argument is that the price of gas in Mexico serves two functions. It allocates a scarce resource and it is an important source of revenue for the government. Given the low elasticity of the demand for gas, taxing gas does not involve a large loss of consumer surplus. That being the case, the decision to price gas at its opportunity cost that was made when the netback rule was implemented reflected the social, economic and political judgment that using gas as an instrument of revenue was not appropriate. If the conditions that justified that judgment are still valid, then the net back rule is no longer an appropriate policy for pricing gas. When the net back rule was implemented, the price of gas at the Houston Ship Channel reflected opportunity cost of gas. Today, the price of gas at the Houston Ship Channel reflects the quasi rents to the bottlenecks in importing LNG. One alternative is to price gas in Mexico to reflect that fraction that is imported and to price the domestically produced gas at the price of LNG afloat. Thus if twenty percent of gas is imported, the Mexican price would be twenty percent of the Texas price plus eighty percent of the price of LNG afloat. Another alternative that has been suggested in the press is to price gas at its opportunity cost if it were being exported. This pricing mechanism has the advantage that there would not be incentives to attempt to export Mexican gas.

Further, the Texas gas market has evolved and the arbitrage point within Texas is either at Agua Dulce near Corpus Christi or Zone Zero near Brownsville. Theses are liquid markets and the price of gas at these markets is Houston minus transport cost. Even, if it is decided not to change from a

Texas based price, the use of Houston Ship Channel as a base needs to be reexamined.

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