

Infrastructure investments and incentive regulation

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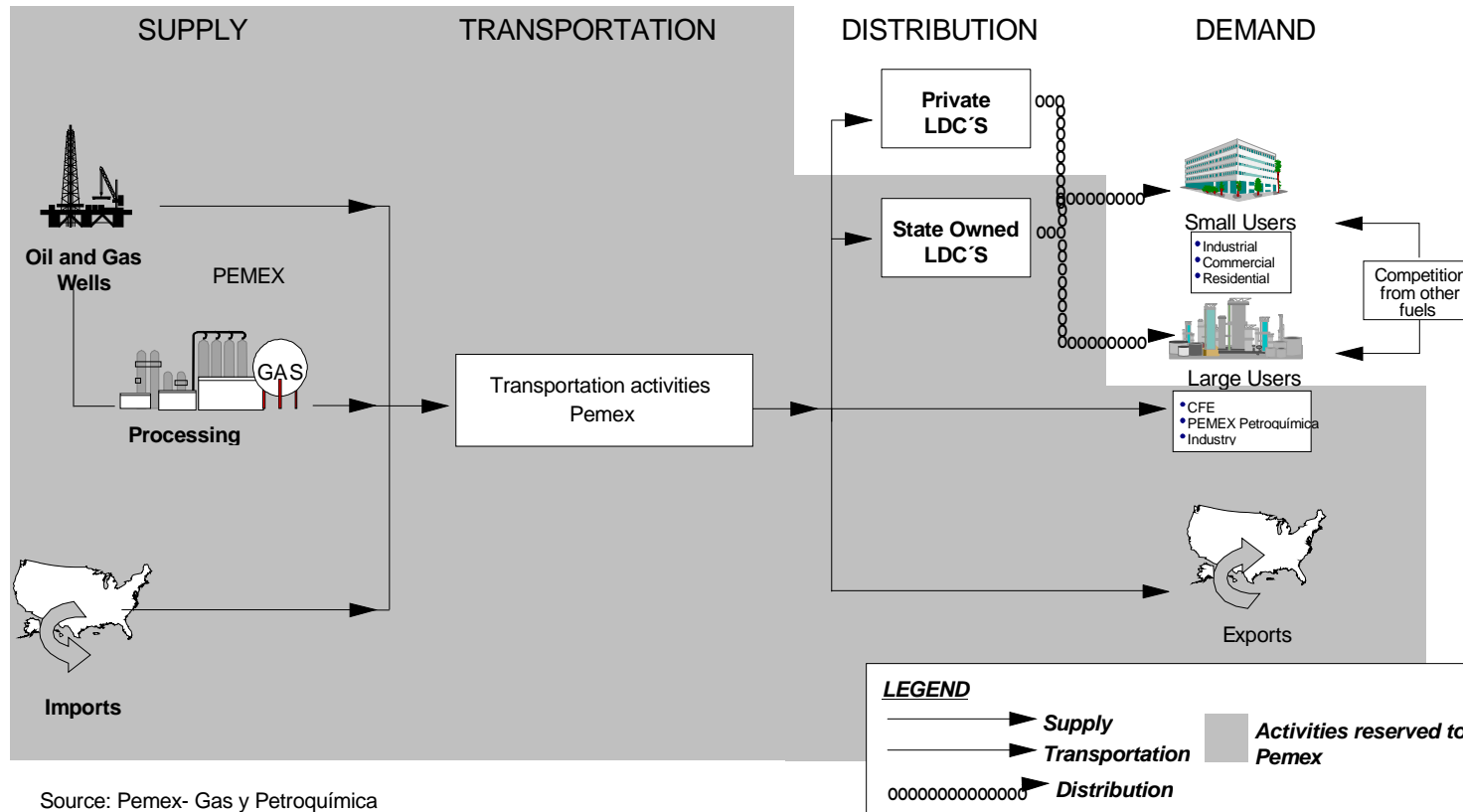
- Regulatory reform process of the natural gas industry
- Incentive regulation concepts
- Incentive regulation and its effects on infrastructure investment:
 - Transportation
 - Distribution
- Conclusions

Regulatory reform process of the natural gas industry

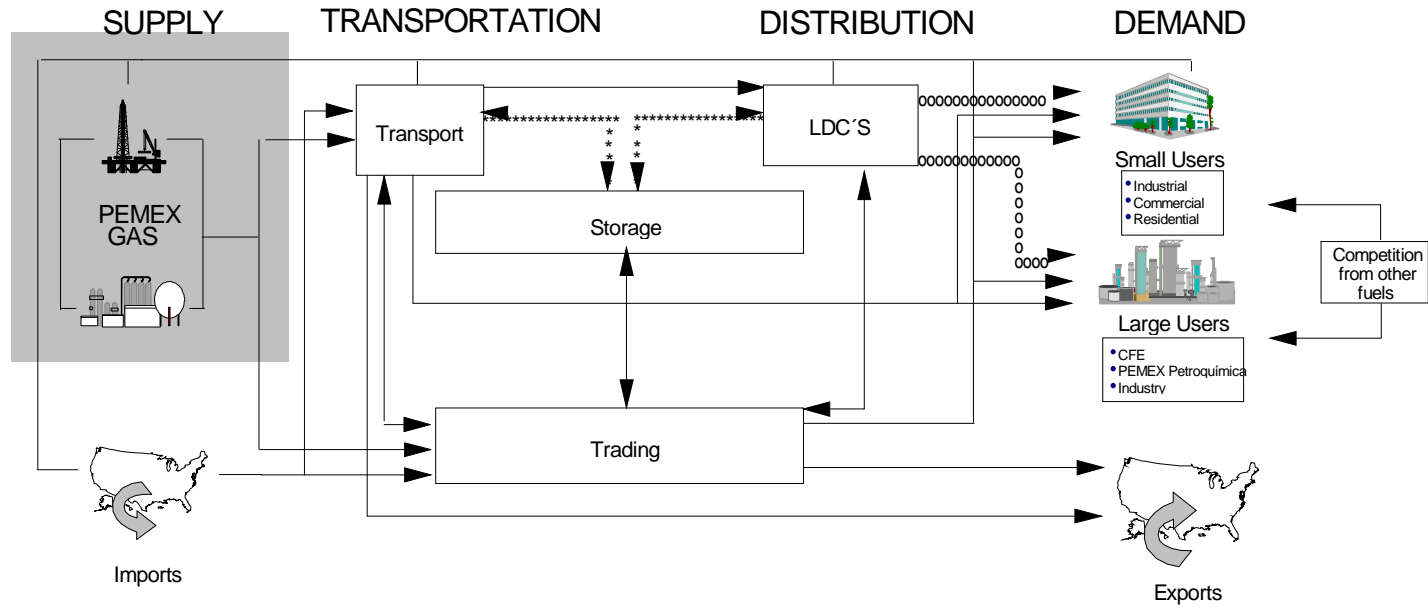
REGULATORY REFORM

- Make Pemex invest more in production and development of reserves, and keep in good shape the already existing pipeline transportation network.
- Attract private investment to develop infrastructure in distribution systems, new transportation pipelines as well as in gas marketing.
- All these through a regulatory-reform process that implied regulatory decisions regarding industrial structure and incentive regulation (prices, auctions, etc.).

Industry Structure Before 1995



Expected Evolution



DESCRIPTION	
	Supply
	Storage
	Distribution
	Trading
	Activities reserved to Pemex

Source: Comisión Reguladora de Energía

POLICY DECISIONS

Exclusivity

- Transportation: no exclusivity.
- Distribution: Twelve-year exclusivity.

International Trade

- Liberalization and elimination of the import tariff

Vertical Integration

- Vertical integration allowed providing there is one subsidiary for each activity. Subsidiaries at arm's length. Unbundling.
- Vertical integration between transportation and distribution: only when a transportation permit is necessary for a distribution project or vice versa.

Marketers

- Marketers need no permit to operate.

Pipeline Access

- Open access to transportation and storage.
- Distribution: Commercial bypass from day one

Incentive price regulation

- Transportation
- Distribution
- Production (yardstick regulation)

Incentive regulation concepts

- Few market niches with legal or natural monopolies (e.g.: transmission and distribution of natural gas and electricity).
- Regulation of monopolies is important since they are vertically interrelated with other competitive sectors.

“HISTORY” OF OPTIMAL PRICES

- First Best: marginal cost (70's).
- Second best: Ramsey prices (80's).
- Third best: Revelation principle/Laffont-Tirole (93).
- Fourth best: Theoretical models under practical restrictions (nowadays).

DESIRABLE PROPERTIES OF APPLIED MECHANISMS

- Pareto superiority.
- Efficiency improvements.
- Two basic concepts:
 - Price level.
 - Price structure.

Price-level regulation

ALTERNATIVES

- Cost-of-service regulation.
- Price caps. Adjustment factors (*RPI*, *X*, etc.).
- “Yardstick” regulation.
- Hybrid regulation.

Price-structure regulation

ALTERNATIVES

- Fully distributed cost pricing.
- Price bands.
- Restricted flexibility:
 - Average revenue.
 - Tariff basket.

AVERAGE REVENUE REGULATION

- Sets a cap on revenues per unit.
- Does not set fixed weights that limit tariff rebalancing.

TARIFF-BASKET REGULATION

- Cap set over an index.
- Fixed weights

$$I(p) = \sum_{i=1}^h w_i p_i$$

TYPES OF WEIGHTS

- Chained Laspeyres.
- Paasche weights.
- Fixed Laspeyres.
- Ideal weights.
- Flexible weights (average revenue).

POLICY OPTIONS

- Price level regulation: Cost of service or incentive regulation?
- Price structure regulation: Tariff basket or average revenue?

INCENTIVE REGULATION

- Promotes productive and allocative efficiency.
- Light-handed regulatory intervention.
- Captures virtues of both price cap and cost of service methodologies:
 - Limits firm's risk.
 - Provides incentives for cost reduction.
 - Protects consumers.

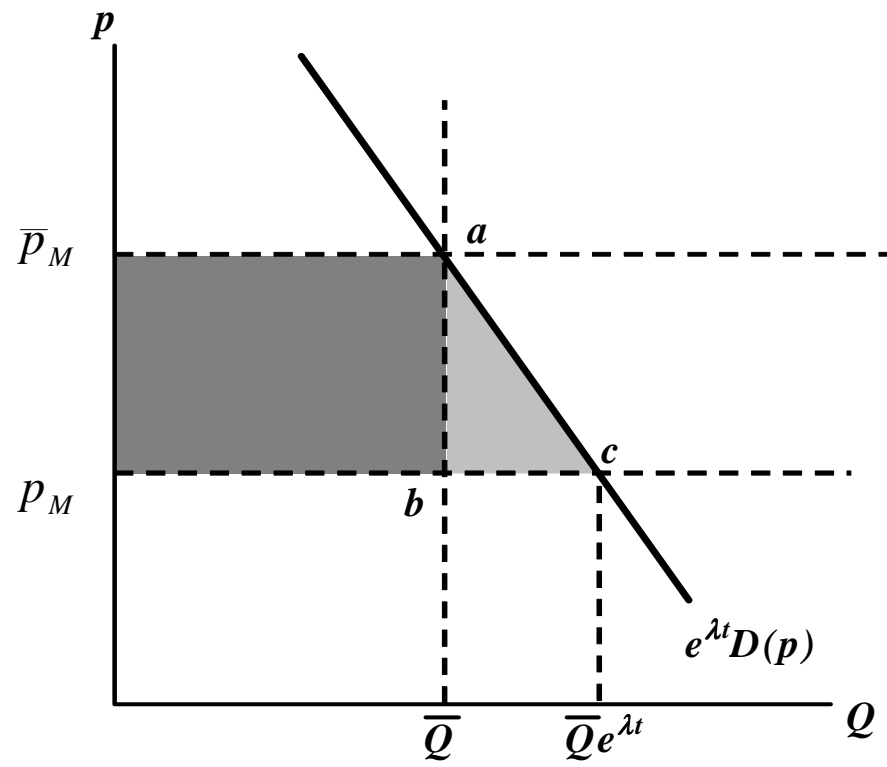
Incentive regulation and its effects on infrastructure investment

Transportation

- A regulatory scheme that provides incentives for the development of the transportation network is being sought.
- A first structural basic problem is of course Pemex' vertical disintegration. Pemex has incentives to congest the pipeline network so as to get congestion rents, evade price regulation, and deter the entrance of competitors in gas transportation and marketing activities.
- In the case of vertical disintegration, several incentive regulatory alternatives are analyzed so as to attract private investment.
- Two proposals:
 - **Brito, D. L. and J. Rosellón**, (2005), "Implications of the Elasticity of Natural Gas in Mexico on Investment in Gas Pipelines and in Setting the Arbitrage Point," in Repsol YPF-Harvard Kennedy School Fellows 2003-2004 Research Papers, William Hogan, editor, Cambridge, MA, Kennedy School of Government, Harvard University, April, http://www.ksg.harvard.edu/m-rcbg/repsol_ypf-ksg_fellows/03-04_research_papers.pdf
 - **Vogelsang, I.**, (2001), "Price Regulation for Independent Transmission Companies," *Journal of Regulatory Economics*, vol. 20, no. 2, September.

FIRST PROPOSAL

- Sufficient investment in pipeline capacity so that bottlenecks do not develop.
- A policy that makes sure that there is always sufficient pipeline capacity so that the gas market can always clear should be followed.
- Such a policy would generate sufficient savings to the consumers of gas that they will be willing to pay for such investment in the rate structure. Consumers would be willing to pay for this capacity.



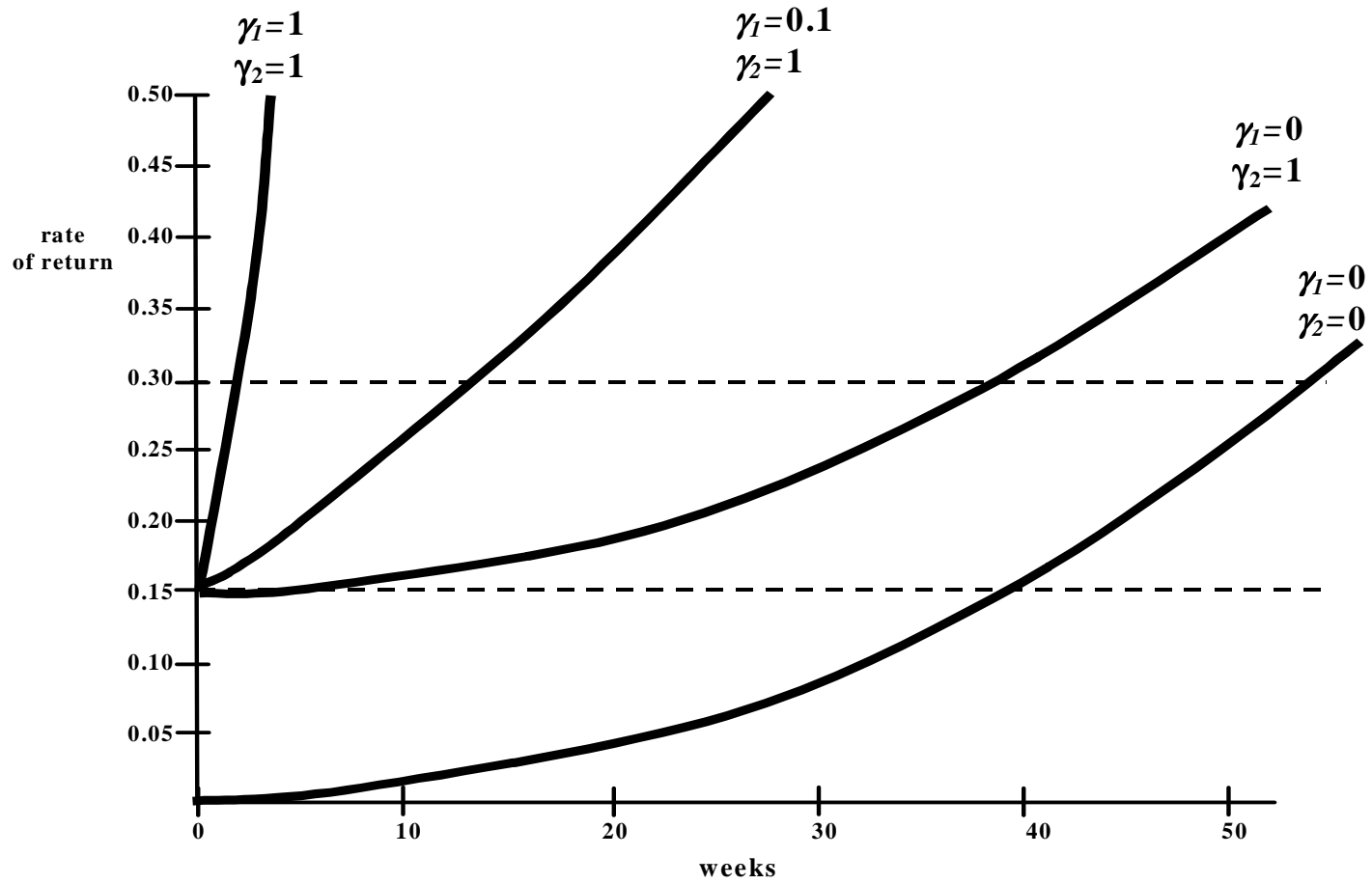
Pipeline capacity

WELFARE LOSS FUNCTION

$$\varphi = \int_0^T e^{-rt} \left\{ \frac{\bar{Q}(e^{\lambda t} - 1)[\theta(\bar{Q}e^{\lambda t}) - \bar{p}_M]}{2} + \gamma_1 \bar{Q}[\theta(\bar{Q}e^{\lambda t}) - \bar{p}_M] - \gamma_2 \varphi \right\} dt + e^{-rT} C_0$$

F.O.C.

$$\frac{\frac{\bar{Q}(e^{\lambda T} - 1)[\theta(\bar{Q}e^{\lambda T}) - \bar{p}_M]}{2} + \gamma_1 \bar{Q}[\theta(\bar{Q}e^{\lambda T}) - \bar{p}_M] - \gamma_2 \varphi}{C_0} = r$$



SECOND PROPOSAL

- Vogelsang's suggestion for regulating price structure in electricity transmission considers congestion problems (short run) and capacity problems (long run).
- Two-part tariff cap:
 - Usage fee solves congestion problems.
 - Fixed fee recovers capital costs.
 - Rebalancing between usage fee and capacity fee provides investment incentives.
 - Transmission quantities are used as weights.

VOGELSANG'S MODEL

$$\max \Pi^t = p^t q^t + F^t N - c(q^t, k^t)$$

subject to:

$$\sum_i p_i^t q_i^w + \sum_j F_j^t \delta_j^w \leq (\sum_i p_i^{t-1} q_i^w + \sum_j F_j^{t-1} \delta_j^w)(1-X)$$

$$F^t \leq F^{t-1} + (p^{t-1} - p^t) q^w / N$$

$$q^t \leq k^t$$

Incentive regulation and its effects on infrastructure investment

Distribution

- The regulatory reform process in distribution combined the design of auctions for exclusivity in distribution geographical areas (competition for the market), as well as incentive regulation for distribution tariffs, so as to attract investment.
- Auction design sought to reach a balance in the trade-off between risk management (through the granting of exclusivity) and incentive provision (implicit competition between the LDCs and Pemex).
- The design of price regulation tried to reach equilibrium in the trade-off between investment attraction to *greenfield* projects (average-revenue incentive regulation) and consumer-surplus maximization (through tariff-basket incentive regulation and competition for the market).

CRE'S PLAN

- Competition for the distribution market. Greenfield projects. Biddings grant 12-year distribution exclusivity.
- Average-revenue regulation used during the first five-year period. Tariff-basket is used later on.
- Prices must be set at the start of the period based on a forecast of Q_t .
- Need of a correction factor to adjust for estimation errors.
- Average revenue regulation provides the needed flexibility in tariff rebalancing during the initial stages of greenfield projects.

LITERATURE REVIEW. THREE RESULTS

1. Under stable cost and demand functions, and myopic profit maximization the chained Laspeyres index induces convergence to Ramsey prices.
2. Assuming stable cost and demand functions, and myopic profit maximization, average revenue regulation causes divergence from Ramsey prices.
3. In a dynamic setting with changing cost and demand functions --and/or non-myopic profit maximization-- the chained Laspeyres index generates prices that may diverge from the Ramsey structure.

LITERATURE REVIEW: POLICY RECOMMENDATIONS

- Chained Laspeyres index should be used under cost and demand stability.
- Under risk and uncertainty there is no reason that justifies the use of the Laspeyres index.
- Average-revenue regulation is a softer constraint than the chained Laspeyres index. It helps to attract investment.
- Under changing demand conditions, what are the effects of average-revenue regulation on consumer surplus?

The Model

Ramírez, J.C. and J. Rosellón, (2002), "Pricing Natural Gas Distribution in Mexico," Energy Economics, Vol. 24, No. 3, pp. 231-248

- Under changing demand conditions, what are the effects of average-revenue regulation and competition for the distribution market on consumer surplus?
- Two effects: strategic effect and stochastic effect.
- Solution: set usage charge close to zero while fixed charge strategically set to bear burden of misprediction.
- Stochastic effect alone: Consumer surplus decreases (increases) as the firm is more risk loving (averse) and when there is less (more) demand uncertainty.

$$\max_{p_t, F_t} E \left\{ \sum_{t=1}^T \beta^t (p_t Q_t - c(Q_t) + F_t) \right\}$$

subject to

$$Q_{t+1} = Q_t(p_t) - K_t$$

$$F_t \leq E\{Q_t(M_t - p_t)\}$$

$$Q_T \geq N$$

$$\beta^t \in [0, 1]$$

Conclusions

MAIN LESSONS

- The policy design of incentive regulation to attract investment to infrastructure should consider the effects of industry-structure and vertical-integration decisions on defining a level playing field for all market players.
- Decisions on price regulation should consider reaching equilibrium in at least two trade-offs:
 1. Risk management vs. Incentives
 2. Investment attraction vs. Consumer-surplus maximization.