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REGULATORY SCHEMES AND INVESTMENT BEHAVIOR IN TRANSMISSION OF ELECTRICITY: THE CASE OF ARGENTINA

CLEMENCIA TORRES*
Boston University

Abstract

The objective of this paper is to analyze the impact of the Argentinian regulation on the expansion of the network for high voltage electricity. Argentina reorganized its electricity industry in 1992, including the transmission network and adopted a new regulatory framework. The results for investment in transmission have been mixed so far. The new regulations apparently have not triggered the investment necessary to eliminate local bottlenecks in the transmission system. The persistence of these problems hinders the capability of the industry to ensure reliable and economical electricity in the long run. This paper attempts to explain the reasons for these mixed results.

I. Introduction

The objective of this paper is to analyze the impact of the Argentinean regulation on the expansion of the network for high voltage electricity. Argentina reorganized its electricity industry in 1992, including the transmission network, and adopted a new regulatory framework. The results for investment in transmission have been mixed so far. While the construction of new links benefiting a single large user and the expansion of existing lines have been undertaken, projects involving a larger pool of grid users have failed to materialize. This uneven pat-

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tern of investment in transmission stands in contrast with the continuous expansion of the generation sector during the same period. The new regulations apparently have not triggered the investment necessary to eliminate local bottlenecks in the transmission system. The persistence of these problems hinders the capability of the industry to ensure the reliable and economical electricity in the long run. This paper tries to explain the reasons of these mixed results.

The limited success of the regulation in inducing investment in transmission in Argentina is puzzling for several reasons: The Argentinean regulation of prices[1] and investment balances the direct intervention of the regulator with an active participation of other economic agents. With such arrangement, investment should happen if and only if there is demand for additional capacity, since there are channels for users to initiate the expansion proposal and to veto projects. Moreover, profit maximizing investors would be attracted by a sector where investment is fully subscribed before it is undertaken and the regulator enforces the payments of the charges. Finally, an open competition for the investment contract should ensure that investment will be implemented at the lowest cost.

For all these reasons, the correct application of the Argentinean procedures should in theory lead to the implementation of a timely and efficient expansion program. In reality, investment in transmission has been erratic, and projects involving a large pool of grid users have not materialized on time to meet the growing demand for transmission services.

This paper argues that, despite all its attractive features, the regulatory framework does not provide the correct incentives to elicit an efficient and sustainable expansion of the network. This lack of appropriate incentives come from different sources: In several instances, the rules do not include mechanisms to reduce the information asymmetry between the regulator and the regulated firm or the users. In other cases, they do but ignore the possibility of opportunistic reactions and hence they are not prepared to prevent or correct such behavior. Finally, some rules are not properly formulated and generate inefficient responses from users or investors.

In Argentina, the regulator is in charge of approving the investment proposal, supervising the bidding for the contract and of allocating capacity charges. With a perfectly informed planner competition for investment should indeed result in the selection of the least costly bid and the allocation of costs will be efficient and fair. The outcome of the bidding may not be optimal however if, as Baldick and Khan (1993) argue, the incumbent knows better the network than its competitors and the regulator, and has a first mover advantage in the public bid. Similarly, the allocation of capacity charges may not be successful if the regulator cannot accurately estimate the benefits of the project for the different users.

Even when imperfect knowledge of the regulator is recognized, the rules still implicitly assume that agents abide by the clauses of the initial agreement. The neoclassical assumption of selfish but non-opportunistic agents (Williamson, 1985) is illustrated in two of the steps of the procedures. Veto of the project by the users is useful because it allows to rectify mistakes of the initial cost allocation. However, opportunistic grid users could also reject a project if they are interested

in presenting their own expansion proposal. Likewise, the dual role of the incumbent in the investment procedures as the agent responsible for some of the steps and as a potential investor would not be problematic unless the firm behaves opportunistically and uses its administrative powers to favor its position as a bidder.

Three aspects of the Argentinean rules warrant special attention and part of the analysis will address why they do not provide appropriate incentives for an efficient investment: First, the allocation of capacity charges based in practice only on the increases in quantities carried through the grid and not on all the economic benefits resulting from the capacity expansion. Second, the free riding problem that comes from an incomplete treatment of the rights –associated with the payment of capacity charges– to use the new links. Third, the limited reliance on individual initiative in the process of selection of investment projects, where only one proposal at the time is analyzed and where the transmission firm cannot take the initiative to invest since all proposals must be initiated by the users.

Of course, regulation is not the only determinant of investment. Expectations about the future influence the decision of immobilizing resources over a long period of time. Trust and commitment are in turn affected by the strength of the regulator, the quality of the macroeconomic management of the economy, and the political stability of the country. The emphasis of this paper however, is rather on the "detail engineering of regulation" to use the classification of Levy and Spiller (1993), wheras the issues of commitment and credibility are studied more in detail in a companion paper (Torres, 1996). Suffice it to say to justify an analysis of the regulatory framework on its own, that Argentinean rules[2] and institutions appear to have enough credibility to significantly affect the behavior of interested investors[3]. This is evident in generation where 7,995 MW of new capacity are planned during 1993-1999 (a 44.9 per cent increase over the installed capacity in 1992)[4]. Ironically, it is precisely the outbursting of investment in generation in the Comahue region which has prompted a debate on the inability of the transmission market to meet the growing needs for its services.

This paper continues the analysis of the Argentinean regulation in electricity transmission started by the works of Damonte in 1992, Bastos and Abdala in 1994 and other authors cited in these articles. As these documents were written just when the reforms were being implemented, they analyze potential outcomes rather than concrete results. This is also the case of Covarrubias and Maia (1994), even though their description of the industry is fully up to date and provides useful factual information. Abdala, (1994) is the first to my knowledge to point out how the regulation produces an unfair distribution of the capacity costs. This paper agrees with this general assertion but goes beyond it by examining the specifics of this distortion and attempting to capture other channels through which regulation affects investment decisions. There is also a considerable amount of literature on the same topic in other countries. Among them, Baldick and Khan for the USA, Hunt and Shuttleworth (1994) for England, Green and Newbery (1993), Blanlot (1993), Spiller (1994) and Paredes Molina (1995) for Chile are the closest to my work in terms of making an ex-post assessment of the impact of the regulation on the expansion of the transmission system.

The paper proceeds as follows: Section two presents the electricity industry in Argentina with an emphasis on transmission. Section three analyzes the Argentinean regulatory framework for transmission. Section four proposes several explanations that relate the content of the regulation to the actual investment behavior. Section five concludes and suggests topics for further research.

II. The Argentinean Electricity Industry

A. Recent reforms

The privatization program and the restructuring of the electricity industry that took place in Argentina during the early 90s resulted in a shift from a small number of vertically integrated public enterprises to an industry organized around separate markets for generation, high voltage transmission and local distribution activities, with a centralized load dispatch center, and operated in large part (except nuclear plants and provincial utilities) by private enterprises. A regulatory reform was also implemented as part of the liberalization program.

The restructuring process was part of a plan of the Menem government to reverse the critical situation of the Argentinean economy. These changes were –and still are– implemented in several other industries and have been accompanied by other macro and monetary reforms. Reforms in electricity incorporated lessons learned from the Chilean and UK experiences as well as earlier privatizations in other Argentinean industries such as telecommunications.

The changes were mostly done at the federal level and have not yet substantially affected the provincial and local levels[5]. During the reorganization, the three major federal utilities (AEyE, SEGBA, Hidronor) were broken into numerous concessions. Argentinean's open bulk power market, the "Mercado Eléctrico Mayorista" (hereafter MEM) started operations in 1992. All generators, distributors, and large users directly connected to the high-voltage grid belong to the MEM. The transmission firm is not a member of the MEM since it does not sell nor buy electricity. Physical transactions in the generation and transmission markets are valued at spot market prices set according to the short run marginal cost of the system, while long term financial contracts are negotiated between the generators and their wholesale customers.

B. Current organization and performance

Table 1 summarizes the key features of the industry after the reforms. The Secretary of Energy oversees the industry. A National Regulatory Commission for Electricity (ENRE)[6] was created in 1992 for the electricity sector. ENRE reports directly to the Secretary whose approval is required in many instances, and the latter remains still a key regulatory entity[7].

There are around 30 generation firms in addition to the already existing provincial utilities. The privatization project for nuclear energy is now under discussion in the Congress. Nucleaoeléctrica Argentina S.A. (NASA) currently controls the nuclear plants[8]. Also remain public the shares owned by Argentina in CTMSG while Yacyretá is currently in the process of getting privatized. Both were binational joint ventures initiated in 1977 and 1980 respectively.

The generation sector has become increasingly competitive. In 1991, five public firms dominated 74% of the market (as per their share of installed capacity) whereas the share of the top five had fallen to 34.4% by August 1993. The biggest generator has now less than 8% of the market and the largest holding group controls 4.6% of the installed capacity. (Abdala, 1994).

SEGBA's transmission assets were joined in 1992 with those of AyEE and Hidronor to form TRANSENER, and five other sub regional concessions to be sold separately. Transmission for high voltage electricity operates exclusively within the wholesale market and the transportation to small and medium final users is left to the care of the local distributors.

The reorganization resulted in the creation of two main transportation systems and a large number of provincial and independent suppliers: The main systems are the network for voltage higher or equal to 220 kV (STEEAT) operated by Transener and five regional transmission systems (STEEDTs) carrying electricity of equal or more than 132 kV and less than 400 kV. Other provincial enterprises which existed prior to the reorganization still function as vertically integrated utilities. Finally, Independent Transporter Companies (CTI) own, operate and maintain transportation links under a technical license granted by Transener. These independent carriers are sub-contractors for the national or regional concessionaires.

CAMMESA S.A. is a mixed non profit corporation created in 1992 to perform the economic dispatch of electricity, to coordinate the daily transactions in the wholesale market, and to supervise the provision of electricity at the lowest cost possible compatible with preset quality standards[9]. The economic dispatch is done by calling generators to produce on the basis of a merit order list, which ranks producers in decreasing order of reported marginal costs. This entity also sets wholesale prices and provides secondary services such as reactive power support, load-frequency control, and reserve management[10]. CAMMESA charges a fee to the participants of the MEM and has a budget with a ceiling equivalent to 0.65% of the total wholesales of electricity[11].

Finally, SEGBA was separated into three distribution enterprises for the Buenos Aires region and the distribution systems that belonged to AyEE were transferred to the provincial governments of their respective location. Large consumers, with requirements above 5 MW, can purchase their power through contracts directly negotiated with individual generators.

As a result of these reforms, the Argentinean electricity industry has recovered from the financial and physical crisis it faced in the late 80s: Poor planning in the 70s had lead to excessive investment in generation capacity, insufficient facility and network maintenance, and a lack of upgrade programs. The result was a physically deteriorated and unreliable system. A weak regulatory system with overlapping authorities and laws at the national and provincial level did not help

TABLE 1

THE ELECTRICITY INDUSTRY IN ARGENTINA

Stages	Market Organization	Pricing Scheme	Other Features
Generation	Competitive >30 firms	.Spot Px = SRMC(gen + trans.) of the system .Implemented by CAMESSA according to economic dispatch	.Free entry .Physical transactions in the spot market .Long term financial contracts with MEM clients
Transmission	.National Monopoly for 500 kV Network TRANSENER for 330, 220 and 132 kV	.Two part tariff= SRMC of trans. + other charges .Regulated by the Secretary of Energy	.Integrated National Network .Open access to all MEM participants .Open competition for investment in new lines
Dispatch & Coordination& Secondary Services	Mixed Non-Profit Private Entity CAMMESA	.Px= Service fee to all MEM participants .Defined in the Electric Law	.Board of Dir.includes all interested parties: Gen.; Dist.;Transm., Lge Users and Gvt .Supervises daily operation of the MEM .Implements tariffs for the spot market (Gvt has veto power on tariff matters) .Sets ex-post all accounts, including SRMC of transmission.
Distribution	Local Monopolies	.Px= Var. cost + Fixed Value Added from Distribution .Regulated by the Secretary of Energy	.Legal bypass for Large Users (>5MW)

to resolve these problems. Nor did raising tariffs during the 80s. Large users increased their own generation capacity, but this did not relieve the scarcity for the rest of the consumers. The lackof available supply in the 80s culminated in a series of almost daily interruptions. The industry suffered severe blackouts in 1989 and in 1990. In 1989, 34.4% of the generation capacity in the integrated system was out of service. This percentage climbed to almost 50% the next year and reached 59.2% in the first semester of 1992.

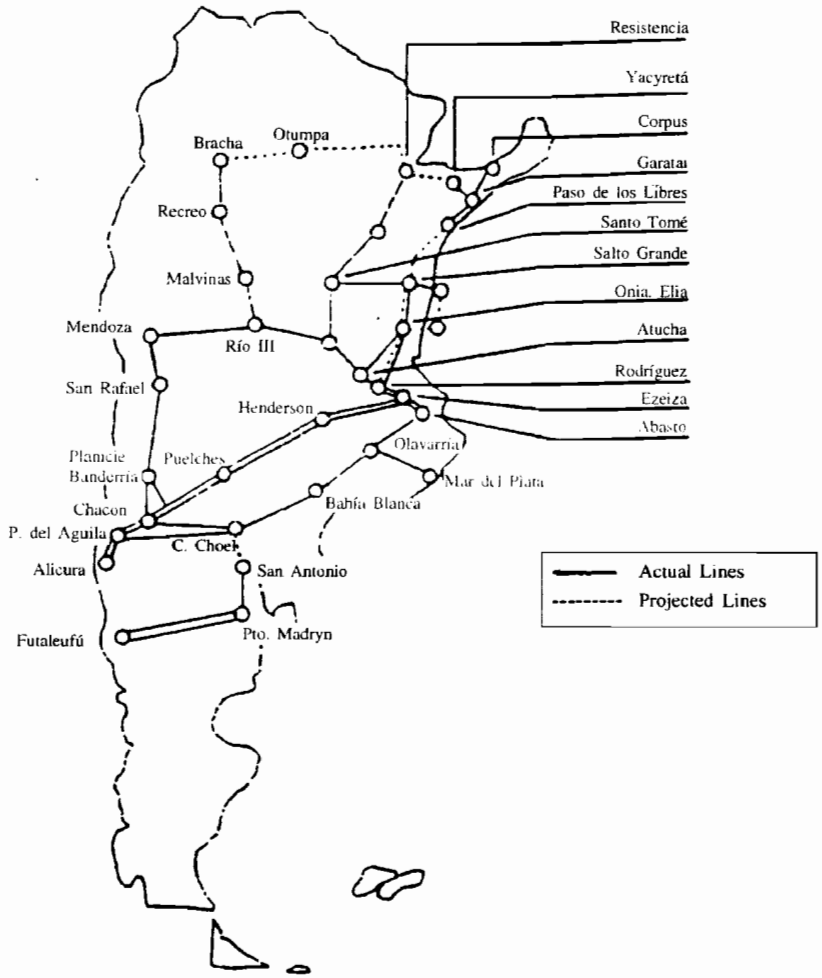
The problems of poor service quality and scarce maintenance were addressed during the privatization process, as well as in the Law No. 2404 and its bylaws. A well maintained infrastructure facilitates the use of the abundant resources of energy which are spread all over the country, save the extreme south. In 1993, Argentina had a total installed capacity of 17.801 MW, a 95% level of electrification and a annual generation of 52.441 GWhs. Generation capacity is highly diversified with 43% hydro, 50% thermal and 7% nuclear[12]. The massive program of investment implemented in the early 70s had many problems, but it did achieve the unification of more than 90% of all the production and consumption centers in the country through an integrated national network (SIN) of 13,812 km of high and medium tension lines of 550, 330, 220 and 132 kV. At present, the situation of the electric sector is in general satisfactory. Moreover, there are investment projects in generation that would increase installed capacity by 44.9 % during the period of 1993-1999 with 7.995 additional MWs.

In contrast with the dynamism of the generation sector, the expansion of the transmission network has been rather erratic. In 1992, Damonte pointed out some potential bottlenecks in the system: The Almafuerte-Rosario line which links the center and northeast of the country with the Coast, Buenos Aires and the South was experiencing occasional congestions. The Comahue-Buenos Aires corridor was operating under constraints at the peak of the system. Since then, investment in transmission links for the new generation units in Yacyretá region have been approved and are currently under construction, but the new generation capacity in the Comahue continues to be constrained by the lack of a fourth line of 500 kV. Transener has increased the capacity of the thirdline, but this was not sufficient to accommodate the increasing share of this region in the total generation of electricity which almost doubled from 1992 (12.5%) to 1994 (24.7%). A proposal to build the new line was dismissed in November of 1994 after having been vetoed at the public hearing by a group of generators who argued that they were assigned an excessive share of the financial burden. As a result, the electricity that reaches the metropolitan area of Buenos Aires (44.9% of the national consumption in 1994[13]) continues to be supplied at a higher cost by other less efficient generators.

The reforms of the electricity industry in Argentina solved important problems and set the stage for a smooth expansion of the generation capacity. To understand why they did not achieved the same results in transmission, I examine next the regulatory framework for transmission, and relate in the content of the regulation with the actual investment behavior in the following section.

TABLE 2

THE ARGENTINEAN NATIONAL INTEGRATED SYSTEM
FOR HIGH VOLTAGE ELECTRICITY



Source: Bastos, C.M. and M.A. Abdala: Transformación del Sector Eléctrico en Argentina, 1993. Graph I-2 p. 28.

III. The Regulatory Framework for the Argentinean Integrated Transmission System

I review the Argentinean regulatory framework from four angles: a) nature of transmission services; b) organization of the market; c) tariff setting rules; and d) investment procedures. This section is intended first to present the way Argentinean regulators understand transmission activities and their objectives in terms of operative efficiency, consumers' protection and network expansion. Second, it explores whether the actual rules correspond to the general approach and whether they contribute to the implementation of an efficient expansion path. Having explained how the Argentinean regulation should be expected to work, I turn in the next section to the question of how it has actually performed in inducing investment in the network.

A. Nature of transmission services

The provision of transmission for high voltage electricity in Argentina is based on three premises:

1- Transmission as an independent activity: Transmission is undertaken independently of generation and distribution. The grid operator cannot sell nor buy electricity.

2 Open Access (OA) to the grid for all members of the Wholesale Market (MEM): Transener must serve with the existing network all users willing to pay the regulated tariff. This service has to fulfill some preset standards of quality, reliability and security.

3- Existence of a unique Load Dispatch Center operated by CAMMESA.

With the basic principles of independent activity, open access to the grid and a central load dispatch center, Argentina joins countries such as Chile, New Zealand and the U.K. As widespread as they are, these principles are not universal. In the USA, where many utilities have their own transmission links, defining the conditions for mandatory transportation services to third parties[14] is still a central topic of discussion[15]. The case of the "Electricité de France", a national vertically integrated monopoly is yet another example of organization of the sector.

The advantages of an open access policy are undeniable in a vertically segmented industry.

The OA principle is essential for real competition among generators. OA also reduces the monopoly power of distributors because it facilitates bypassing the local network for large users who can afford the connection to the main grid. Nonetheless, adhering to an OA policy when the system expands poses the problem of reconciling the rights of users who pay for the additional capacity with those of future participants of the MEM who will use the new links after the assets have been built. I pursue this point further in the discussion on the financing of investment.

The creation of CAMMESA fulfills two purposes: First, technical unity in the operation of the grid, which is necessary for security and reliability reasons, and

also to operate at the lowest cost of production. Second, economic unity, a fair access to all participants, to the extent that all interested parties sit on the CAMMESA's board of directors: a representative of the State and four members representing generators, grid operator, distributors companies and large users[16]. Most economists identify a system operator with the first function and some authors (Ruff, 1994 and Spiller. 1994) have suggested that such role could be granted to an independent monopolist, just as transmission or distribution. Creating a fourth market for system operation, however does not fit so well the second role, a forum for all interests to be heard, and this is why both in Argentina and in Chile (where the load center is managed as a "club of generators"), the system operator functions rather as a sort of mixed non profit organization.

B. Market organization

The objective of the Argentinean regulation is to ensure an efficient and reliable supply of electricity. To achieve this, the regulation favors competition wherever feasible (Table 1). There is free entry in generation and bypassing local companies is perfectly legal. The rules however, also emphasize stability in the financial and physical operation of the network to maximize the reliability of the transmission system. The interplay of competition and stability results in a transmission market with the following characteristics:

Argentinean rules state that for technical reasons, the high voltage network works best when operated by a single firm. On this basis, the Secretary of Energy has granted monopolistic rights to Transener for 95 years (to be reconfirmed after 15 years and thereafter every 10 years based on performance). With these rights also come specific obligations of the concessionaire to its customers.

Transener does not, however, have the obligation nor the privilege to invest in new capacity, and there is open competition for investment in network capacity. If newcomers win the bid, they build the new links and are entitled as shareholders to receive dividends from their investment, but Transener remains responsible for the operation of the integrated network. Transener supervises the contract during construction, monitors the compatibility of the whole system afterwards, and receives a fee for these administrating services[17].

Yet, newcomers are not given fully the same treatment as the incumbent in the Argentinean Electric Law since Transener supervises the compatibility of the entire high voltage network. This does not need to be the case, and this task could also be one of CAMMESA's responsibilities. Chile in that sense is an interesting example of how the load dispatch center CDEC-SICs that coordinates the daily operation of the Central Integrated System is also responsible for the security of the grid[18]. If CAMMESA were entrusted with this responsibility, the Secretary of Energy could grant concession licenses to different firms to operate on equal foot in the high voltage grid. These companies would be monopolists within their concessions, and the regulator could apply a "yardstick regulation" similar to the situation of local monopolies in electricity distribution, where there is a sort of "competition by comparison" that facilitates the regulatory task[19]. The network

would function as an integrated system while being owned by independent firms. This has been the option chosen in telecommunications where the government-owned national firm was broken into two regional monopolies prior to their privatization.

As a matter of fact, the transmission sector in Argentina is already an example of different companies owning and operating an integrated system: Besides Transener which has the concession for the 6,867 km of 500 kV lines, five other regional transmission companies are in charge of the remaining 6,945 km of lines with lesser voltage which are also part of the integrated system. An open question remains whether multiple ownership could be extended efficiently to the grid of highest voltage. The answer depends on whether the competitive advantages of multiple owners outweigh the increasing costs of coordination and possible losses in economies of scale and a final assessment would depend to a large extent on the size of the total network.

C. Tariffs for transmission services

1. Principal features

Prices for transmission services combine a traditional rate of return regulation for natural monopolies with a short run marginal cost pricing approach. To avoid the chronic deficit generated from pricing at SRMC in a sector with economies of scale, Argentinean regulators charge a two part tariff to the users of the grid[20]. The variable price per kwh transported is set at the short run marginal cost of operation which in transmission is essentially the value of the electricity lost during the process of transportation. These losses are identified in the calculations with the thermic losses of electricity between an exporting and an importing node of the system, and their value is implicit in the difference between the value of the electricity at these two nodes. (Nodal prices [21] are equal to the wholesale price of electricity at the center of the system adjusted by the respective node factors[22]). The "fixed" part provides the funds to finance the excess of average over marginal costs with a capacity charge; it also includes connection and maintenance-related fees as well as a complementary charge, i.e. a revenue reconciliation item that offsets the fluctuations of the SRMC and provides a stable income to the grid operator.

Total revenues of the transmission company include a normal return[23] on the long run cost of building and operating the installed capacity (not only on the value of the fixed assets). They are calculated for a five year period and the only variations come from penalties for failing to achieve pre-set standards of quality and reliability of the services[24]. These revenues are collected through a two part tariff charged to all participants in the MEM. The tariff varies among users according to their location to account for the fact that losses increase with distance[25].

As indicated in Table 3, tariffs collected from the users are identical to the revenues of the firm when the system operates without capacity constraint. But

TABLE 3

PRICING RULES FOR TRANSMISSION SERVICES*

A. WITH UNCONSTRAINED CAPACITY

REVENUES OF THE TRANSMISSION COMPANY =	TARIFF CHARGED TO GRID USERS	
Rate of return on Long Run Incremental Cost of building, operating andmaintaining the network	Two part Tariff Variable Charge	Other Charges
Fixed during five years	Unconstrainded SRMC =Differences between value of electricity at the sending and receiving nodes	a. Connection charges (Op & Maintenance of connecting facilities) b. Capacity charges c. Adjustment for differences between actual and estimated unconstrained SRMC

B. CONSTRAINED CAPACITY

REVENUES OF THE TRANSMISSION COMPANY <	TARIFF CHARGED TO GRID USERS	
Same as above	Local Variable Charge	Other Charges
	a. Unconstrained SRMC b Congestion costs (go to SALEX account)	Same as above

* Excluding penalties for failing to meet or rewards for exceeding pre set quality and reliability standards.

when the network experiences congestions, user charges exceed the revenues of the transmission firm in the area subject to the capacity constraint. This happens because, although variable charges increase beyond the SRMC of an unconstrained network to reflect both increasing SRMC **and** the value of the constraint, these additional funds are earmarked to finance future expansions. They go into a SALEX account[26] under the administration of the CAMMESA, and have no effect on the grid operator's income.[27]

I stated earlier that the clearing price of the electricity traded in the MEM is set at the SRMC of the system (See Table 1). However, the rule of one price is no longer applied when CAMMESA identifies a congestion in the system created either by generation or transmission constraints. In that case, the area is isolated from the rest of the system, and local prices of electricity clear the regional market, given transmission constraints[28]. Because SRMC of transmission are increasing when the network experiences a capacity constraint (footnote 25), local price elimi-

nates one possible obstacle to investing in new links: The perverse effect of higher variable costs implying higher economic rents for the grid operator. These rents come from SRMC of transmission in the constrained region being higher than average cost of the electricity transported through the entire network.

2. Dichotomy between pricing for transmission services and rules for investment

There is a quasi-dichotomy in the Argentinean regulation between the incentives for efficient operation and for optimal expansion of the network . Of course, prices and investment are linked ex-post since capacity charges levied on the beneficiaries are ultimately collected as part of the tariffs, but the rules for defining these tariffs are set independently of how investment is decided. This "dichotomy" was already noted by Schweppe et al. (1988) in their book on spot prices for generation and it also exists in the U.K. and the Chilean regulation: Price for usage reimburses fixed and variable costs *already incurred*, and pays the firm a return on this value. But tariffs do not provide incentives to expand the network if and when the need arises because the revenues of the transmission firm do not change to reflect an increasing demand for capacity.

More precisely, increasing demand for transmission capacity does not manifest itself in the transmission market because the economic dispatch ensures that the demand for transmission services by the selected generators never exceeds the capacity of the grid. No generators will be called to produce who could endanger the security of the grid. The demand for services thus is not related to the willingness to pay for it but to the selection of generators made by CAMMESA. Even if a generator could produce electricity more efficiently than others in the system, and therefore could be willing to pay more for the transmission services to reach that system, this generator will not be selected if his total costs of generation *and* transportation are *presently* higher than those of other producers. And if he is not selected, his willingness to pay for transmission services is totally irrelevant. Both the economic dispatch and the spot price are designed with a short term perspective and take capacity as given. Central dispatch ensures the provision of the cheapest electricity (in terms of generation and transmission costs) to the consumers, and a spot price reflects these costs with the existing network capacity[29].

This is why signals to promote investment are not channeled through prices for transmission services but treated as a separated issue in the regulation. It is worth noting that in Argentina, such dichotomy is not complete because the revenues accumulated in the SALEX account are earmarked for the financing of the network expansion whenever it would take place.

To illustrate the meaning of the price dichotomy and appreciate the accomplishment of the Argentinean regulation in transmission of electricity, it is worth looking into the treatment of capital cost recovering in the U.K. case. Up to 1993, the British regulation defined the revenues of the National Grid Company, owner of the E&W grid, on the basis of the total generation capacity with a RPI-X-price adjustment formula and without any relation to the value of the grid for the users. As in the Argentinean case, costs of the network capacity constraints (resp.

the value of the investment from releasing such constraints) were translated into higher (resp. lower) variable charges for use, called "uplift" charges in the U.K. However, contrary to the Argentinean regulation, there was no provision in the British rules to ensure the recovery of capital costs to whoever would undertake the expansion of the grid. As a result of this omission, NGC would not earn any additional revenue from investing in additional links, nor would it suffer from the higher costs of operating under capacity constraints which were borne by the users. Incentives to invest in transmission were evidently lacking. Not surprisingly, proposals for regulatory reforms over the next review period 1993-1997 emphasize the need to define investment cost-related prices (ICRP)[30].

D. Investment procedures

In Argentina large investment projects must be approved by the regulator, endorsed by the users of the new facilities and fully pre-subscribed before they can be undertaken. The proposal is subject to a close scrutiny to verify the economic relevance of the expansion, the technical standards of the project, its financial viability, and the grid users that will benefit from the new links. Once approved, the project goes through a public bidding and the winner receives a Build, Operate & Maintain (BOM) type of contract. Table 4 summarizes the details of the regulatory process[31].

1. Direct regulatory intervention and self-regulatory mechanisms

The rules for expanding the network share the general approach of the Argentinean regulation in transmission: The participation of all agents involved in the process generates a certain degree of self regulation which complements but does not substitute for the existence of an active regulator. I highlight here the specific functions assigned to the regulator, the users, the incumbent and the other bidders in the investment procedures.

a. The regulator: ENRE and CAMMESA

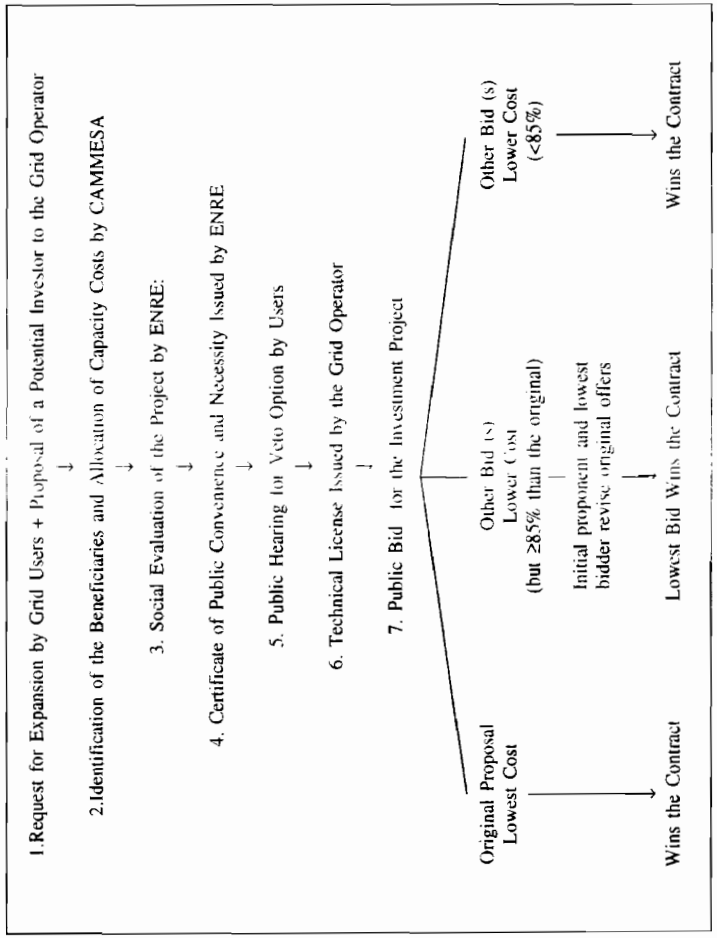
The regulator plays a decisive role in the process. He sets the rules of the hearings, provides a forum to exchange information between potential investors and future users, allocates the capacity charges among grid users, and supervises the public bidding. He lends his credibility to the long term contract signed between the parties by insisting on having a fully pre-subscribed project and by enforcing the rules for recovering the cost of the investment.

Most importantly, ENRE, and CAMMESA on its behalf, act as arbitrators of (first and) last resort in most aspects of the deal:

- ENRE makes a social and financial evaluation of the proposal, using a cost-benefit analysis of the operation of the system "with" and "without" the project in net present values. (The option "without" includes the net value of the electricity not dispatched) (step 3).
- ENRE approves the project for expansion as specified in the initial proposal

TABLE 4

INVESTMENT PROCEDURES FOR LARGE PROJECTS: EX-ANTE AGREEMENT



by issuing a certificate of public convenience and necessity (step 4). In doing so, it also confirms the identification of the beneficiaries and the cost allocation done by CAMMESA.

- CAMMESA identifies the initial pool of users that would benefit from the expansion and distributes the cost of the investment in proportion to their expected use of the new links during the two first years of operation. The formal identification takes place at this stage (step 1), although the presentation of the project already included an implicit assessment of the distribution of benefits (step 2).
- CAMMESSA is in charge of revising the allocation of capacity charges among grid users after the two first years of operation, to account for the benefits that will materialize over the remaining years of the amortization period. The revision also intents to have new participants in the MEM contributing to the cost of the investment.
- ENRE can interrupt the process at any stage, for instance if he has doubts about the technical license issued by the transmission operator, or if some eventuality arises that was not specifically considered in the law[32].

The active participation of the regulator and the choice of covering ex-ante the costs of the project reflect the belief that regulation is necessary to create a favorable environment for investors[33] in a sector with EOS and lumpy assets (Williamson, 1979; Levy and Spiller, 1993). Under these circumstances, a commercial long term contract is a priori incomplete because the lifetime of the assets, thirty years or more, is too long for all contingencies to be accounted for at the time of the signature. The intervention of a regulator can be more economical than investors charging a high premium for the uncertainty, and more credible than an alternative commercial contract with renegotiation, which would rely on future consensus reached independently by investors and users of the new links.

Nowithstanding the institutional safeguards provided by the regulation, the experience in Argentina indicate that these are not sufficient, neither, to make the long term contract complete. Investors actually seek further financial guarantees from the contributors that have been identified as beneficiaries by CAMMESA[34]. In that case, regulation may not always reduces the costs of the contract contrary to what is suggeested in the above paragraph. More important perhaps, future users do not share equally the financial burden of the expansion even if they have to pay capacity charges because these financial guarantees would not be transferable[35].

Another interesting feature of the regulation is the definition of economic benefits obtained from the expansion of the grid. For the purpose of allocating the cost of the investment among users, benefits in the Electrical Law are defined as the expected profits to the users of the additional transmission capacity. This definition fits the received theory on two part tariffs, which claims that capacity charges should be based on changes in capacity, not in actual use of the grid, to avoid distortions in users' short term decision of using the new links. In practice however, it would be difficult to estimate the increase in demand for transmission capacity fifteen years ahead with sufficient accuracy. As a solution, CAMMESA

has defined capacity as the expected use of the links over the first two years of operation. Within this time frame, CAMMESA defines the beneficiaries and thus contributors as the agents located in the zone of influence of the project –the group of nodes that would experience increases in the entry and exit of power as a result of the expansion[36]– and their share in paying capacity charges corresponds to their participation in the total increase in capacity within the zone. Section IV.B. elaborates on the advantages and limitations of this methodology.

b. Users of the grid

The consumers of transmission services play an active role in the investment decisions at several stages of the process: Investment is demand driven, they have a veto power on the project and they can bid for the contract in the final public auction.

To initiate the process, an interested investor needs to convince enough users of the need for the expansion. Any group of agents of the MEM can submit a project to invest, provided the proposal is made by users who represent at least thirty per cent of the pool of beneficiaries[37], and provided also that the group requesting the expansion includes an investor technically qualified to become a transmission firm. The proposal must have a detailed presentation of the expansion project and should include an estimation of a constant annual payment necessary to recover costs over 15 years (any deviation from these characteristics should be justified), (step 1).

After the project has been approved by the regulator, users can still veto the proposal in a public hearing if the dissatisfied customers account for at least thirty per cent of the identified pool of beneficiaries. The veto can happen if users do not support the investment as such and/or if they do not accept the cost allocation imposed by the regulator.

Consumers are more than simple "watching dogs". Grid users can also become the independent transporter company if they meet the technical requirements (step 7). Since Transener is responsible for the compatibility of the whole network, there is no conflict of interests between their dual role as users of the grid and owner of some of the links.

c. The incumbent company: TRANSENER

The regulation assigns specific tasks to the current grid operator during the procedure: First, it acts as an intermediary between the group proposing the expansion and the regulatory agency. The initial proposal is submitted to the transmission company in charge of the network to which the new links would be connected (step 1). Second, it must issue the technical license for the project after ENRE has approved the initial proposal (step 6). The first role (intermediation) simplifies the bureaucratic steps, and the second (issuing the technical license) uses the technical expertise of the transmission operator. Then, as any transmission company, the grid operator is also a potential bidder for the contract in the last stage of the process (step 7).

d. Competitors for the investment contract

Argentina has made a significant contribution to the regulation of transmission networks by explicitly introducing competition for new capacity and confining the monopolistic rights of the incumbent to the existing network. This is true even with the caveat discussed in the organization of the market on the inequality between the incumbent and the newcomers (see section IIIB) as long as the project is sufficiently attractive for new investors. Competition for the investment contract can potentially reduce the risk of monopolistic exploitation of grid users, and lead to the selection of the best project. All this could reduce the need for direct regulation by the state.

After a project for additional capacity is approved, a public auction is organized by the initial solicitors of the expansion under the direction of ENRE. If no bidder offers a lower cost than the original offer, the investor who presented the project obtains the contract. If one or more bids are lower, but equal to or above 85% of the initial cost estimate, the lowest bidder and the author of the original proposal are given 72 hours to improve their respective offers. After this delay, the project is granted to the lowest bidder. If the lowest bid is below 85% of the cost in the original proposal, the contract is immediately granted to the lowest bidder.

2. Recovering capital cost in the MEM from all grid users

Argentina has chosen to recover the capacity costs of the network in the wholesale market (MEM), and to distribute the burden among either generators or distributors and large users according to their respective benefits in each project under consideration. This approach corresponds to the one recommended by I. Perez-Arriaga (1992) and by G. Read (1988) for the case of New Zealand but differs from the practices followed in Chile where only generators are charged transmission tariffs. While in a market without imperfections the distribution of the capacity charges over the different stages of production is irrelevant, in imperfect and thus regulated markets the allocation of capacity charges is often one of the most controversial aspects of regulating investment activities[38]. This is because in the former, end users always end up paying all the costs, whereas in the latter, the real impact of who pays these costs depends on the pricing rules in each stage of the process, as they determine how upstream costs are eventually passed onto to final consumers[39].

In Argentina, the treatment of capacity charges affects differently the distribution companies, depending on whether they have been privatized. For the companies that remain under the control of either provincial governments or cooperatives, price regulation include a passing through clause (Table 1). In this case, their customers will be indifferent between paying directly for the expansion of the grid, or having the charge levied on the local distributor. Even though the companies that have been privatized, Edenor, Edesur and Edelap, are subject to the same price regulation, there is an additional clause that explicitly forbids them from passing the capacity charges to their clients. So far, no major expansion of the transmission grid has occured in a net-importer region, and the clause has yet to be enforced, but it is likely that private distributors will be reluctant to assume the financial burden of an expansion under these conditions.

The channels though which capacity charges affect generators are more complex. They sign financial contracts with their clients, and therefore the extent to which they pass on them these charges depend on the terms negotiated in the long term agreements. However, even if all negotiated contracts were identical, charging a personalized fixed fee to generators as it is done in Argentina and Chile is not neutral and can increase the efficiency of the sector as a whole. It makes some more competitive than others by exposing their true economic cost of production (inclusive of transmission costs). The cost ranking that sets the order in which generators are called to produce incorporates these differences and can result in a more accurate selection of generators. This net positive impact would not occurred if capacity charges were imposed on the distributors alone or directly on the final users[40]. Allocating the cost of the expansion among generators can also promote individual efficiency of investment in generation. The reason follows a "peak load pricing" logic: If generators faced the cost of the investment in transmission derived from their use of the grid, they could choose their demand for capacity by adapting their own optimal investment decisions in additional plants, in terms of timing, size and location of the new generation units.

E. Conclusions on investment procedures and pricing rules

In general, the balance between direct regulatory intervention and use of market mechanisms, that exists in the investment procedures and in the pricing rules in Argentina, sets the basis for an efficient operation and expansion of the network. In a sector with economies of scale and specific and lumpy assets, regulation corrects the imperfections of a monopolistic market by reducing uncertainty and creating safeguards that prevent anti competitive behavior. It creates an improved environment where market mechanisms are encouraged and can work efficiently.

In this context, the Argentinean regulation exhibits several features that in theory should lead to an efficient expansion of the electrical network. First, investment is driven by the demands of users who also can veto the proposal, and the final contract is allocated through a public bidding. Thus, expansion should happen if and only if there is sufficient demand for additional capacity and should be executed in the least costly fashion. Second, a two part tariff that recovers variable and investment costs according to an ex-ante agreement between investors and future users should attract profit maximizing investors, as the contract is supervised and enforced by the regulator. More generally, by using pricing rules that guarantee the firm's revenues over five years, the regulator bars himself from expropriating the value of the assets after the firm has sunk considerable resources in the sector. Grid users should be willing to pay for the new capacity since pricing arrangements also protect them against monopolistic practices.

The form in which Argentinean regulators have adapted the SRMC-pricing approach to transmission services deserves special consideration. SRMC-price in

the Argentinean market for transmission contributes to a greater short term efficiency not only because it sends a signal to the users to indicate the economic cost of transporting their load, but also because the creation of local markets in congested area allows prices to reflect continuously costs in every part of the system. The design of the two part tariff also helps eliminating some of the obstacles to an appropriate investment program because local prices and the existence of the SALEX account eliminate the situation where congested links generate excessive rents for the grid operator and discourages investment in new capacity.

Nevertheless, the actual investment behavior has not followed consistently an efficient and timely path. The next section examines the reasons why this has been the case.

IV. Why has Investment in the Argentinean Network Been Inadequate?

Why has investment been insufficient to eliminate local bottlenecks in the national system? What went wrong in the case of the Comahue-Buenos Aires project? Is this an isolated incident in an otherwise well functioning setup? Or is it a manifestation of the inability of the regulation to promote an efficient expansion of the network system? I believe the latter to be the case.

Before turning to discuss the limitations of the current regulation, it is worth understanding why the success stories do not prove the qualities of the regulatory framework. First, the investment in new links in Yacyretá was undertaken under public ownership and was financed for the most part by the government, after a study performed by CAMMESA identified the owner of Yacyretá as the main beneficiary of the expansion. Therefore, the project did not test the credibility of the procedures in the eyes of the private sector. Second, the expansion of the capacity of the third line in the Comahue, a small project with one year of amortization was completely financed with the earmarked funds of the SALEX account, and no users had to actually pay additional charges.

Thus, the proposal for building a fourth line in the Comahue region appears as the first case in which the overall procedure is implemented. I argue in this section that the limited potential for the regulation to induce sufficient investment in the grid –beyond the single case of the fourth line in the Comahue– arises from insufficient incentives to elicit efficient decisions. This limitation comes from different sources: First, in some instances, investment rules do not include mechanisms to reduce the information asymmetry between the regulator and the regulated firm or the users because they implicitly assume that the regulator has a thorough knowledge of the sector. Even when imperfect knowledge of the regulator is recognized, the rules still implicitly assume that agents always abide by the clauses of the initial agreement. In consequence, the regulation is not prepared to deal with opportunistic behaviors. Second, some of the rules for pricing and investment are not properly formulated and would elicit inappropriate reactions from users or potential investors. The distinction between the two sources is somewhat artificial, for wrong rules can themselves induce a strategic response, but it is useful for the analysis because it emphasizes the origin of the inadequate incentive, be it informational problems or inappropriate rules. Consider now the specific problems of the regulation as they fall under each of these headings.

A. Strategic behavior and informational problems

1. Strategic behavior of grid users

The dual role given to the consumers of transmission services in the investment procedures can produce an ambiguous behavior. Since users are entitled to become investors, potential beneficiaries may refrain from giving all pertinent information (such as their own expansion plans if they were generators) at the initial stages of the process. They can also exercise their veto power later and then present an alternative proposal from which they would benefit as users and as investors. Moreover, the small number of users which facilitates the scheme of direct consultations also increases the risk of collusion to win the investment contract in transmission by firms who otherwise are fierce competitors in the generation market. Integrating ownership of activities *per se*, either upwards (generators) or downwards (wholesale customers), does not threaten equal access to the network because dispatch decisions are taken by CAMMESA. The problems I refer to here arise because of the strategic use of information on benefits by the users **rather than** by a restricted access to the grid to harm other competitors.

The need for a strategic use of the veto can be eliminated by allowing several projects to compete for a given expansion of the network capacity (See below). Still, the misuse of information about the benefits may persist. This defeats the purpose of allocating ex-ante benefits and charges of the project, if regulators cannot verify projections on expected profits from using the new grid. A solution would require either the prohibition of users to invest –this eliminates the problem– or a change in the form of identifying beneficiaries and allocating costs.

With respect to the latter solution, economists are currently exploring different options for market-based schemes adapted to the peculiarities of electricity that would achieve an efficient allocation of these rights. Their relevance would in large part be a function of the nature and flexibility of existing institutional arrangements in the different countries: Multilateral contracts (Hogan, USA), bilateral contracts (Oren, Spiller, Varaiya, and Wu in the USA), peak-load pricing approach for transmission charges (Shuttleworth and Hunt for the British case, Einhorn for the USA), and public auctions of rights (Abdala, Arrufat and Torres for Argentina).

2. Ambiguous position of the incumbent

The role of Transener in the investment process reflects the regulator's desire of using the incumbent's position to simplify the administrative procedures and of utilizing his knowledge to guarantee the technical qualifications of the project.

Notwithstanding these advantages, there can be a conflict of interests because the current grid operator is also a potential bidder for the contract. This dual role creates an incentive for the incumbent to use his administrative powers to favor his own position as a bidder, for instance by offering a lower cost to meet the technical standards that he has himself defined when issuing the technical license of the project. Under this scenario, the "self-regulation" power of competition for the market is weakened and the bid becomes in fact one more instrument for the incumbent to exercise its monopolistic power.

Directing all requests for expansions to CAMMESA and entrusting this entity with the obligation of issuing the technical license could prevent the potential conflict. As already noted, the entity in charge of the economic dispatch of electricity, CAMMESA in Argentina, could assume other technical functions such as supervising the compatibility for the whole network without any loss of efficiency for the integrated grid; it could as well be prepared to replace the grid operator in issuing the technical license for the investment projects.

3. *Imperfect competition for the investment contract under asymmetric information*

The Argentinean regulation assumes that all participants in the public bidding for the contract have the same information when they make their offer. However, Baldick and Khan (1993) argue that the quality of an investment project depends significantly of the knowledge of the existing network. If the incumbent firm, TRANSENER has a better knowledge of the grid than its competitors and the regulator, it will maintain its privileged position in the public bidding even if it does not have a role in the administrative procedure.

This asymmetric information between the grid operator and the regulator and other bidders complicates the task of the regulator. Opening investment to competition under these circumstances reduces but does not eliminate the problem of dealing with an incumbent which remains in many aspects a regulated monopoly.

There is a considerable theoretical literature on regulatory mechanisms to induce efficient investment under asymmetric information. Yet, to my knowledge, the only applied proposals to implement these theoretical recommendations are the work by Reichelstein (1991) on procurement contracts with the government, the proposal of Einhorn to use peak-load pricing in transmission in the context of electrical system of the USA, and the incentive-regulation approach sketched by Vogelsang (1989) in his study on investment in transmission.

B. Inappropriate rules

Three aspects of the Argentinean rules warrant special attention: 1. The allocation of capacity charges among users and the shortcomings of the pricing rules that further distort the value of these charges; 2. an incomplete treatment of rights of use associated with the payments; 3. the limited reliance on market and individual initiatives in the selection of investment projects.

1. *Inaccurate definition and allocation of benefits and financial responsibilities*

Consider the allocation of capacity charges: According to the law, these charges should be proportional to the economic benefits resulting from the capacity expansion, but in practice, they are based only on the expected changes in quantities transported in the zone of influence of the project. Such a narrow interpretation of benefits on the basis of changes in the usage of the grid underestimates the number of beneficiaries and puts an excessive financial burden on a smaller pool of identified users[41]. Following a cost-benefit approach, Abdala (1994) proposes that the assessment of economic benefits should also include changes in cost and prices due to the increase in transmission capacity. In the next paragraphs, I translate his proposal into practice by analyzing the missing elements in the current regulation.

A comprehensive approach to the definition of benefits from expanding network capacity requires a shift from a link-based to a total-system approach, and the starting point is no longer the "area of influence of the project" but the whole grid. The methodology based on the changes in flows within this area overlooks the reduction in variable costs and the elimination of negative costs externalities in the network as a result of the investment in additional capacity. It also ignores the reduction in the price of electricity traded in the wholesale market when more and/or cheaper electricity is brought into the market after the construction of the new lines.

a. Reduction in variable costs

Investment reduces SRMC of transmission by relieving the congestion of the links and reducing the losses of electricity during the transportation. Pricing rules for transmission services in Argentina correctly includes a payment for congestion costs that disappears once the capacity constraint is released. Therefore, the first amendment to the current methodology should be to include this reduction in the variable price in the benefits from investing. It is important to note that because SRMC is significantly increasing in output and decreasing in capacity when the grid is congested, the beneficiaries are all the users whose cost have fallen, even if their loads have not increased after the expansion. Whether a modification in the methodology will capture all the reduction in the short term costs of using the grid due to the expansion in the capacity will depend on the accuracy of the regulator's estimations of the congestion costs.

b. Reduction in cost externalities

Insufficient capacity creates other costs for the system beyond the area experiencing the capacity constraint, but the Argentinean regulation does not include these "cost externalities" in the congestion charges. One well known example is the existence of *parallel flows or "loop flows"*. According to Kirchoff's laws of physics, electricity travels over all available paths between generators and customers loads, following the path of less resistance and dividing itself according to

electrical characteristics, or "impedances". If a line is taken out of service, the power originally flowing on that line is instantaneously distributed to all remaining transmission paths, and this increases the cost of transporting electricity also in the rest of the grid[42]. Tightly meshed systems are more affected by this and other cost externalities than radial networks[43].

The case in the Comahue illustrates how the "area of influence" methodology fails to capture either of the two cost effects. Since CAMMESA only looked at changes in quantities in an area that is a net exporter of electricity, the resulting beneficiaries were mostly local generators, and they were assigned most of the capacity costs. Taking also into account the reduction in costs would have revealed a different pool of beneficiaries and thus contributors. This is true because cost-based charges for transmission services that are paid in Argentina both by generators and by wholesale buyers would have reflected the lower cost of transportation for other generators outside the area and also for the wholesale buyers of electricity. This argument explains why the project approved by ENRE, was vetoed in the public audience by more than 30% of the identified beneficiaries, even though the need for larger capacity in that region is undeniable.

c. Reduction in the price of electricity in the wholesale market

Lower costs of transporting electricity drive down the price of the electricity traded in the wholesale market. The decrease in price will happen sooner if, as it was the case for the Comahue-Buenos Aires corridor, adding a new line allows more electricity to reach the market, and/or more efficient producers to access the system. More and cheaper electricity improves the welfare of final users (the size of the impact depends on the price elasticity of demand). Thus, because the origin of this lower price is the construction of new transmission capacity, it is fair to assign part of the capacity costs to consumers: Directly, with charges paid by large users in the MEM, and indirectly, with charges levied on the distribution companies and passed onto their customers through the regulated tariff.

In sum, a correct allocation of the capacity charges is a matter of efficiency as well as of fairness. The persistence of bottlenecks and higher prices in the MEM because of the vetoing of the investment project in the Comahue shows the consequences of failing to achieve a fair allocation of capacity costs.

d. Shortcomings of the pricing rules

Besides the discussion on the initial definition of the capacity charges, the analysis of the Argentinean regulation for transmission suggests that the estimations of the two part tariff can be improved on two accounts: The denominator of the capacity charge and the definition of the SRMC. Both improvements would lead to consumption decisions that reflect more accurately the cost of the service. Closer to the subject of this paper, the changes would also provide a better estimation of the demand for capacity and of the value of investing in additional capacity.

The choice of the denominator for calculating the capacity charge is not completely divorced from the current use of the grid, even though the Argentinean regulation adopts a two part tariff with a capacity component defined in theory

separately from the variable price. Capacity charges based on annual estimates of the demand for network capacity in the two first years of operation are likely to blur the difference between sunk costs and avoidable ones and to affect the short term decisions about the usage of the grid[44] at least during these years. Moreover, the problem, i.e. the actual linkage between capacity charges and actual use of the grid, is exacerbated by the form in which the law charges users of the grid that will acces the network after the initial allocation of charges. The base used to assess their contribution will be their participation in the expected use of the grid in the trimestrial projections done by CAMMESA.

I submit that using a time horizon of two years to distribute the benefits of a network whose useful life exceeds thirty years does not provide an accurate answer. To be sure, capacity in a electric networks is a complex concept and the Argentinean attempt to provide a concrete answer constitutes in itself a significant progress[45]. The central argument of this analysis is, however, that a horizon of five to seven years forms a better base to define the expected demand of different users for transmission capacity than one single year. Reliable projections can be obtained for five or seven year periods, which is also the length (five years) of the regulatory review for the revenues of the transmission company. Users that pay the capacity charges resulting from this alternative calculations will then take their decisions to use the grid purely on the basis of the SRMC of transmission. At the same time, given the reasonable accuracy of the projections, such a methodology will be fair to all users and will facilitate the definition of capacity charges and associated rights for the entire period of amortization.

Expanding the horizon to calculate the capacity of the network to five or seven years as a base for distributing capacity costs leaves still unanswered the question on what to do with grid users that access the network in between renegotiations of the base. There is not easy answer. The Argentinean solution of using trimestrial projections links use and capacity charges but offers a concrete solution to avoid free riders in the grid. An alternative solution would be to expand the base for the new comers from trimestrial to yearly projections until the next round for renegotiation of capacity charges for all users. Whether this would represent a significative improvement over the current procedure would depend on the administrative costs of switching the base and on the elasticity of the demand for transmission services.

With respect to the SRMC, critics of SRMC-pricing in transmission as presently implemented (Wu et al. 1994) argue that defining SRMC as the value of the thermic losses fails to capture all the relevant costs of transportation. This can happen in a grid without capacity constraints either because the estimations of the thermic losses are not accurate, or because electricity losses can be also related to other factors in addition to the heat-factor[46]. As noted before, the presence of capacity constraints in the network exacerbates the inaccuracy of the estimates. Congestion costs defined as the increase of thermic losses in the congested lines underestimate the value of the capacity constraint for the entire network. I refer the reader to the previous paragraphs for an analysis of how these inaccuracies can prevent efficient investment decisions.

2. Incomplete definition of capacity rights and the free rider problem

An important topic of discussion in all network industries are the type of rights that accompany the charges covering capacity costs. The Argentinean regulation makes a significant contribution to this debate by proposing a concrete definition of the initial rights but falls short of giving a complete treatment to the question. The resulting uncertainty on the value, ownership and tradability of these capacity rights hinders investment in new transmission links because users can be unwilling to commit themselves to finance a thirty year project when other users can later free ride by accessing the grid and using it without bearing the cost of the construction.

On the positive side, Argentina has solved the apparent contradiction between an open access policy to the network and the allocation of rights for the new links. The two aspects are reconciled in the Electric Law which refers to the initial rights to use the new capacity (rather to own it), and applies the rule of use-or-lose these rights (and be financially compensated for it).

On the negative side, the temporal dimensions of capacity charges and associated rights of use are left unresolved. There is no mention about how nor how often will the reallocation of capacity costs take place during the remaining thirteen years, and this legal vacuum creates uncertainty for the original holders of rights about their compensation if they do not use the new links because they have been displaced by other generators on the list of economic dispatch.

This is not a case of an incomplete contract where regulators have introduced flexible mechanisms to address future contingencies. Contracts dealing with assets with a useful life of more than thirty years are bound to be incomplete, and in that case, regulatory flexibility is a welcome feature. The problem of the Argentinean regulatory framework is rather that it fails to address at all the issues of incompleteness and flexibility. This legal vacuum prevents the rights associated with the capacity charges from being truly a tradable commodity[47].

3. Limited reliance on markets and individual initiative

According to the Argentinean bylaws, investment procedures must always be initiated by users of the grid. A demand driven investment is an efficient way of verifying the social benefits of a project when communication among users is costless and there is no risk of collusion among them. But when conflicts among users arise, or if any of them have a hidden agenda, the preeminence given to the users can paralyse investment projects which are socially desirable. This is what happened in the Comahue. The problem did not arise in Yacyretá because the expansion mostly affected a single large generator, nor did it occur when Transener increased the capacity of the third line, since as already mention the project t did not entail actual payments by the users.

Under these investment regulations, the incumbent company can bid for a project but it cannot take the initiative to invest on its own when it sees the opportunity to do it and assume the risk of recovering his costs before or after the

investment is made. It remains an open question whether these limits on investment proposals lead to a more efficient expansion of the grid. On the one hand, the natural fear of excessive investment in a monopoly regulated with a rate of return rule supports this policy. On the other hand, Baldick and Khan (1992) argue that the design and timing of a good project does not depend only of the capacity to be added, but also on many characteristics of the existing network, which the current grid operator knows better than each individual user. Moreover, the control of the technical and other social requirements of the project by the regulator can still be used to prevent excessive investment. If the latter arguments are true, depriving the transmission company from the initiative may unnecessary waste opportunities for efficient investments to take place.

The complexity of an investment project brings up the second way in which the selection process is excessively rigid. Only one proposal is discussed to add a given capacity to the network, and a single criterium, cost minimization, guides the selection of the winner for the contract. But as noted above, projects that differ by their location, configuration, amount of excess capacity contemplated in the design, etc., can result in the same added capacity. Cost is only one on the variables for measuring the desirability of the project. Moreover when the regulator looks at a single project at a time, users can veto a project in order to later present themselves another proposal. Allowing for several projects to be presented simultaneously implies a more complicated process but may lead to a better selection.

V. Conclusions

The relevance of the Argentinean regulatory experience with its achievements and remaining problems is not limited to the context of this country, nor to the case of transmission in electricity. Decisions about an optimal expansion in a network with economies of scale and lumpy assets, about how to finance the investment, who should bear the costs, and what are the rights associated with the capacity charges are questions that are also important for other network industries such as gas and telecommunications.

In reviewing the regulatory experience of Argentina in transmission for electricity and in particular the procedures for investment, this paper found a regulatory framework with important achievements and some limitations that were identified in the analysis. I briefly summarize both aspects and suggest directions to overcome some of the problems found through the analysis of investment behavior in the grid.

The Argentinean regulation of transmission internalizes the notion that both market forces and regulation have a role to play to achieve efficiency in the transmission sector. While acknowledging the limitations that technical characteristics –asset specificity and economies of scale– imposes on the action of market forces, the government implemented a series of institutional reforms that promoted these action wherever it was perceived to be feasible. At the same time, the govern-

ment recognized that even within a more competitive environment, the remaining imperfections in the transmission market and the need for coordination of the whole industry required some degree of regulatory intervention. The main achievement of the regulatory framework has been to implement rules that attempted to balance the actions of the market with the role of the regulator and to introduce a series of checks and balances at different stages of the process.

The framework that resulted was not flawless. First, by ignoring the possibility of opportunistic behavior by the different agents, the regulator designed rules that could be subject to a strategic manipulation of the regulated parties. Moreover, the possibility of a strategic behavior weakens the efficiency of the checks and balances embedded in the law. Second, the actual rules deviate in several instances from the principles stated in the law. Some of the deviations could be easily corrected, but their presence reflects difficulties due in part to peculiarities of the electric fluid (parallel flows, common costs, ambiguous definition of capacity). Third, although the regulation does not requires a perfectly informed regulator, this paper argues that the rules underestimate the degree of actual information asymmetry between the regulator and the regulated parties. This lack of information facilitates strategic actions of either investors or users and limits the potential of regulation to correct some of the problems of implementation. Two of them are particularly importing in affecting investment behavior: The choice of the investment project and the allocation of capacity costs among current and future users.

An answer to overcome the limitations of the present regulatory framework requires a change in the methods rather than in the objectives of the planner: However, alternative solutions can be complex: Simultaneous evaluation of different proposals requires a high degree of expertise for the regulator and a considerable use of administrative resources. Further investigation is needed to formulate a scheme adapted to the characteristics of electricity that achieve a fair allocation of capacity charges and a definition of tradable rights. To be implemented, the scheme will have to provide a satisfactory solution to the definition of capacity as the base to calculate access or capacity charges, and to the distribution of charges between producers and consumers of electricity.

This research suggests that a greater reliance on market based strategies could be adopted to select the best investment proposal and to define the appropriate capacity charges or access price. Along these lines, Abdala, Arrufat and Torres (1995) have proposed issuing transmission capacity rights (TCR) in a public auction to finance the expansion projects. These rights would be purchased on a voluntary base and will be tradable at the equilibrium price to be determined in the auction. Since simultaneous projects can be submitted simultaneously to be auctioned, it is the users themselves, rather than the regulator who will select the investment project. The tradability of right solves the problem of free riders and eliminate the need for further renegotiations of the financial burden. In this mechanism, there is no conflict between the existence of rights for capacity and the open access policy. The scheme proposed in their paper relies much more on the market initiative than the current regulation, but the regulator continues to play a

important role in setting the standards of quality and reliability of the projects as well as the guidelines and procedures for the submission of investment projects.

Finally, more empirical analysis is required to evaluate the degree of asymmetrical information between the regulator and the regulated firm in an integrated electrical network. A realistic assessment of this asymmetry would indicate whether the decision to expand should be taken through incentive mechanisms that delegate the investment decision to the firm and induce it to expand when it is socially appropriate, rather than having the regulator imposing an investment plan. Advancing on these three fronts will provide a better environment for efficient investment in transmission and will increase the long run efficiency of the electricity industry.

Notes

1 Variable charges are set at the short run marginal cost of transmission (SRMC), but the revenues of the firm are defined with the traditional rate of return regulation for natural monopolies. The result is a two part tariff with a revenue reconciliation item that offsets the fluctuations of SRMC and provides a stable income for the grid operator.

2 Payment schemes and other regulations on entry, quality and reliability.

3 Hill and Abdala (1993) discuss these aspects of the reforms undertaken by the Menem government.

4 ENERLAC '93. SIEE/OLADE. December 1993. Cited in Covarrubias and Maia, 1993.

5 For instance, there are numerous cooperatives for distribution in the interior of the country and some provinces have also distribution firms that own generation units. On the other hand, in 1993, the provinces of San Luis,Rioja, Tucumán, Formosa and Santiago del Estero started a program of divestiture of utility assets.

6 Acronym from the Spanish name: "El Ente Nacional Regulador de Electricidad". It is composed of five Commissioners appointed by the President of the Republic, with the agreement of the Congressional Energy Committee, for a five year mandate. The emphasis on technical proficiency is apparent in the requirement for the vice president to be an economist, and for having at least one lawyer and one engineer among the Commissioners.

7 At the provincial level, the Federal council of Electricity (CFEE) is directed by the Secretary of Energy (SE), and formed by representatives of each province. Municipal utilities and electrical cooperatives still operate under the same local regulatory guideline as before, but they can now benefit from the more competitive wholesale market.

8 CONEA, previously responsible for the regulation and the operation of the nuclear plants has being reestructured in three separate entities: NASA S.A., a company that owns and manages the plants, the "Ente Regulador Nuclear" a public entity responsible for the regulation of the sector, and CONEA who retains the responsability for research and development and other related tasks.

9 This entity replaced the Unified Dispatch Center (DUC) previously owned and operated by AyEE.

10 The supply of central dispatching and other secondary services fits the description of a monopoly although it is not usually perceived as a separate market. This is because usually the dispatching entity is usually owned by some or all the participants in the other stages of production. See Ruff (1994) for the implications of changing this perception.

11 Bastos and Abdala, 1994; pp. 150.

12 With the generation units under construction, these percentages are expected to become 37% hydro, 46% thermal-diesel and gas, and 14% nuclear by 1995 (Abdala, 1994).

13 The entire province of Buenos Aires accounts for 58.9% of the total electricity consumed in the country in 1994 (CAMMESA, Reprogramación Trimestral, Feb-Abr. 1995).

14 Retail wheeling, which would extend OA to final users is also very much at the heart of the discussion in the USA, while it is a non-issue in Argentina and Chile.

[15] The debate remains largely centered around the existence of a transmission market as such even though the government has started promoting competition, in particular with the Energy Policy Act of 1992. Quoting Tabors (1994, pp.213): "Within the US, the transmission economics and pricing problem has been defined as one of "open access" and of wheeling. In the other grid pricing systems evaluated, open access was a given and a good."

[16] The state has a veto power on key matters related to the determination of tariffs.

[17] The fee is equivalent to 3% of the total value of the investment project during the construction, to 4% of the transmission revenues during the amortization period and 2.5% thereafter (Abdala, July 1994 p.15: ftn.19.)

[18] The incentives for entrusting CDEC-SIC with all functions related to the usage of the grid were particularly strong in the Chilean case, since the grid itself was owned by the largest generation company, ENDESA at the time where the laws were passed. (DFL 2 of 1982; Decree. 6 of 1985).

[19] This possibility of competition within the high-voltage system was first brought to my attention by I. Vogelsang.

[20] See Perez- Arriaga et al.(1994) for an international comparisons of the rate making procedures.

[21] The nodal price at the exporting node reflect the value of the electricity to the generator at that node and the nodal price at the importing node reflects the cost for the wholesale customers at that importing node. It is important to remember however (see Table 1) that the clearing price of electricity in the wholesale market is unique (except in isolated areas) and set at the center of the system.

[22] The center of the system is an arbitrary point of the grid, usually close to a main consumption center . The nodal factor (F_i) is a marginal cost measure of losses related to the link between a particular node i and the center of the system, and to the trafic among them. It is based on the derivative of line losses (dL) with respect to the load (dB) in that node i. $F_i = (1 + dL/dB^i)$. (Arizu and Caruso, 1992; Abdala, 1994).

[23] The rate of return [for transmission and distribution companies] is not guaranteed for individual firms, but as an average for the industry, this rate should be similar to the rate of return on other activities with comparable risk. (Law No. 24065, Art. 40 and 41).

[24] Rewards for notoriously exceeding availability standards will also apply after the first 10 years .

[25] Electrical losses are linear in distance and increase with the square of the current. Thus, marginal losses are a quadratic function of instantaneous current, but at lower levels of capacity utilization, constant marginal cost are a sufficiently accurate approximation.

[26] SALEX stands for :"Subcuenta de Apartamiento para los Excedentes por Restricciones a la Capacidad de Transporte".

[27] See Law 24,065, annex 18 for the methodology used to estimate congestion costs.

[28] Whether local prices are higher or lower than the equilibrium price for the rest of the system depends on the origin of the constraint. Lines can be congested due to an excess of demand or of potential supply of electricity to be transmitted to or from the isolated zone.

[29] See Wu, Varaiya, Spiller and Oren (October 1994) for more on this topic.

[30] See Hunt and Shuttleworth (1993), Vickers and Yarrow (1991); and Ruff (1993) for the discussion of the U.K. regulation of investment in transmission.

[31] Smaller upgrades and construction of dedicated lines are implemented through bilateral arrangements agreements but also require the approval of the regulatory agency.

[32] For example, no procedure to follow is specified in the law if two different proposals were presented simultaneously for the same expansion capacity (Abdala, Oct.1994).

[33] An exposition of the advantages of recovering investment costs through a system of prices that includes explicitly a long-term component, see the NRRI report by K.Kelly and others (1987) pps. 178-187. The authors develop the arguments of J. Jordan for including explicitly capital costs in prices (1983, 1985).

[34] This practice was detected in the initial stages of the proposal for the fourth line in the Comahue, although it did not finally materialize since the project did not go through.

[35] For more on the distribution of capacity costs and on alternative solutions to the methodology utilized by CAMMESA, see Abdala, Aruffat and Torres (1995).

[36] Chile and Argentina use a method of marginal participation or area of influence, while New Zealand measures the electric use based on an average participation. See Perez-Arriaga, Rudnick et al., IEEE , Feb. 1995). The Chilean interpretation of the benefits is also currently under revision. (Tabors, 1994).

[37] This percentage is based on the total value of the benefits, not on the number of grid individual users

[38] Of course, generators and wholesale users would both try to avoid charges whenever it is possible if they believe that this would affect their profits. This opportunistic behavior fits the description of O. Williamson (1979,1985) of agents with bounded rationality. However, in the case of the market for transmission services, a profit maximizing behavior rather than a myopic foresight seems a better explanation for the recurrent controversies.

[39] It also depends on the relation between the size of the fixed fee and the demand of the user since the heavier the fee, the more likely will it interfere with the consumption decision of the users.

[40] There will be no such impact either in the U.K. setup where wheeling tariffs do not vary with the distance.

[41] This excessive burden was also noticed by Spiller (1994) in Chile, although the situation of the users is not identical to the Argentinean case because in Chile charges to generators do not reflect the value of the capacity constraint.

[42] If the congested line (AB) has less reactance than other non congested links connected to the same exporting node (AC), the presence of capacity constraint in that single line may also reduce the overall capacity of the whole network because it sets a limit to the load that can be transported on the other line (AC) without violating the constraint imposed by the congested line. The limit exists because the electric fluid will go through the line with less reactance even though that is where the capacity constraint is. See Baldick and Khan (1993), Hogan (1992) and Oren, Spiller, Varaiya, Spiller and Wu (1994) for a more formal discussion of these topics

[43] An USA-Canadian organism, the ITCF, has recently signed a General Agreement on Parallel Flows (GAPP) to improve the estimation of these flows and their explicit computation as part of the wheeling costs. A draft proposal has been issued but still awaits implementation (Perez Arriaga, et al. IEEE, 1995)

[44] The size of the distortion depends on the price elasticity of the demand and still awaits an empirical analysis.

[45] For example, the capacity of the links is reduced when the transfer of reactive power to some nodes increases. This transfer may be necessary to maintain a constant voltage in these nodes and is different from the electricity transported through the links. This effect is not captured currently in the Argentinean rules. Baldick and Khan (1993), Stoll, (1989) and Spiller et al. (Oct. 1994) analyze in detail the concept of capacity in electrical networks.

[46] There can also be losses of electricity during the transmission because of the ionization of the air and other factors related with the characteristics of the lines and of the connecting facilities. These losses increase with the voltage of the lines but are independent of the quantity of electricity transported through the grid. (Damonte, 1994).

[47] A simple form of preventing free riders is to have clearly identifiable and tradable rights of use (Coase Theorem). But the remaining uncertainty after the first two years means that these rights of use are not actually tradable, even if they were initially correctly assessed by CAMMESA.

References

ABDALA, MANUEL A. (1994), "Transmission Pricing in Private Owned Electricity Grids: An Illustration from the Argentine Electricity Pool". Mimeo, Cordoba, Argentina. July.

ABDALA, MANUEL, J-L. ARRUFAT and C. TORRES (1995), "Auctioning of Transmission Capacity Rights: A Market Based Mechanism to Allocate Property Rigths in Electricity Network Investments'. Mimeo, Buenos Aires.

ARIZU, H. and L.M. CARUSO (1992), "Pricing System in the Argentine Wholesale Electric Market". Mimeo. Buenos Aires.

BALDICK, ROSS and E.P. KHAN (1992), *Transmission Planning in the Era of Integrated Resource*