Regulation of the electricity sector in LA

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1. Introduction

Latin American (LA) countries have been reforming their electric sectors since the early eighties. Countries have experimented with a wide variety of systems ranging from early administered systems to recent systems which allow a wider scope to the market. Regulatory reform was facilitated by being done before privatization, so issues of regulatory takings did not arise. The reform of electric sectors in Latin America has been a process of learning by watching, where regulations have evolved as reform has spread over the region. The object of this paper is to present a description and evaluation of the reforms of the electric sector in LA.

The privatization-cum-regulation of LA electric sectors has been, in general terms, successful: privatized firms have increased their efficiency and coverage substantially. But these productivity gains have been passed on to consumers only in those cases where there is competition. Hence, the LA experience reinforces the idea that competition is the ideal regulator. And the main policy lesson that can be derived from the LA experience with privatized electric sectors is that countries should have a special concern with setting up conditions for privatization that lead to the broadest possible scope for competition.

New reformers have learned from the experience of countries that deregulated earlier in both Latin America and the rest of the world. This process has resulted in different generations of regulatory reforms. In this paper we distinguish three main regulatory generations. The first stage, which was restricted to Chile, started in the late 70s with the study of a new legislation, which was

introduced in 1982, and finished with the privatization of the major electric firms between 1986 and 1989. Chile's neighbors carried out the second round of reforms in the first half of the 90s, an example of regulatory diffusion. The third generation took place during the second half of the decade, and includes most of remaining Latin American countries. Understandably, the designers of each regulatory stage have attempted to extend the scope and depth of competition. Moreover, the speed at which reforms have been accomplished has accelerated. The changes made in Argentina from 1990 to 1992 took a whole decade to achieve in Chile.

Introducing competition in the wholesale contract market was a cornerstone of the Chilean reform and is in fact the only free market in the system. This is a market where power generation companies (Gencos) and large customers and distribution companies (Discos) establish long term supply contracts**.** Any shortfall in the availability of contracted energy by a Genco has to be purchased from other Gencos at a price that is determined according to administrative rules. Since participants in this market are located in different geographic points, a requisite for wholesale competition was the unbundling of transmission services. Thus the principle of open access to the transmission network was introduced, and Gencos and the transmission company (Transco) were set free to negotiate transmission fees. If the negotiations are unsuccessful, there is mandatory arbitration. The second major innovation was that investment in generation and transmission was freed and left to market forces. The principle is that the expansion of the electric demand leads to higher prices, increasing the profitability of developing new projects. Existing enterprises or potential entrants invest in generation whenever a project has a return on capital that is appropriate for the risk in the sector.

Although the market for large customers was completely deregulated, retail services remained highly regulated. Discos are required to provide the service within their (non-exclusive) franchise areas at a regulated retail price. This price has two components. The first one is the regulated price at which Discos purchase energy and power from generators. The second is the value added of distribution (VAD) that remunerates services provided by the Disco. A third major regulatory innovation was incentive regulation in computing the VAD. Prices are set in such a way that, in principle, an efficient Disco attains a predetermined rate of return.

Was privatization successful? Chilean companies have increased their capacity substantially: annual generation more than doubled between 1990 to 1998. Privatization also increased the productivity of utilities, by cutting energy losses by more than half, to 8.3% in 1997, by doubling productivity in distribution and by tripling energy generation by worker in the largest Genco. Although privatized companies have become substantially more efficient, these gains have only been transferred to customers in the areas in which there is competition. In the main market, the regulated wholesale price of electrical energy has fallen by 37.4%. Technological change has stranded (i.e., rendered their use uneconomical) a large fraction of existing thermoelectric plants. On the other hand, the final price to customers has not fallen to reflect the huge productivity gains that have been achieved since privatization. Between 1987 and 1998 the regulated price to consumers has fallen by only 17%. This situation has led to spectacular increases in the profits rates of distribution companies: the rate of return has gone from 10.4% to 35% in this period. This profit rates are striking considering the low risks involved in monopoly distribution.

Not surprisingly, the second generation of electric reforms was characterized by the introduction of pro-competitive regulations. Its main purpose was to increase competition in the supply of large customers, and many changes were introduced towards this end. Governments paid more attention to the restructuring of the sector before and after privatization. Horizontal unbundling helped ensure competition in generation and yardstick competition in distribution.[1] In order to facilitate competition in the wholesale market, transmission fees, as well as the charge for local distribution services for large customers are set either by the regulator or the pool operator. Vertical integration was either prohibited outright or limited. The threshold to be considered a large client was reduced. The spot market and membership to the pool operator, who commands the operation of plants, which previously was restricted to generators, has begun to include large customers. Moreover, some LA countries, instead of regulating the price at which Discos purchase electricity, require Discos to put their energy requirements out to tender among all generating firms.

Regulations became more flexible, bestowing more discretion on regulators. Regulations also exhibit more interest on quality issues and fines for bad service are considerable higher. The process of setting the regulated price became more transparent. In Chile regulators are not allowed to publish the information used in rate-setting except to the regulated firms, which prevents the demand side of the market from counteracting the lobbying pressure of regulated firms, while in Argentina public hearings became an important tool of the regulatory process. All these changes have made the markets in Argentina considerably more competitive than in Chile.

The trend of the third generation of regulatory frameworks is to further deregulate those segments of the electric sector which are competitive or likely to become competitive. Two major changes characterize this third reform stage. The first change is the introduction of retail competition, and the second change is the liberalization of the spot market.

Retail competition requires a new participant in the market: the energy broker. The introduction of this new participant means that small customers become able to buy electricity from competing brokers. The brokers in turn purchase electricity in the wholesale market and pay a regulated fee to Transcos and Discos for the use of their infrastructure. Since unbundling of distribution and commercialization activities facilitates competition in the latter, some LA countries exclude Discos from the retail market. Hence distributors are restricted to provide "wire" services. Other countries regulate the participation of Discos in the retail market in order to avoid unfair competition. There is not enough experience as of yet to evaluate the impact of this regulatory change in LA. Nevertheless it is possible to speculate about some of its advantages. First, it reduces the number of activities that need to be regulated. Moreover, brokers become an interest group with a specific interest in the proper regulation of Discos.

The second characteristic of this reform is the introduction of a free wholesale electricity market. Gencos are able make price and quantity bids which are used by the pool operator to build a supply curve of energy. This supply curve is used to command the operations (dispatch) of generating plants, rather than the merit order based on operational costs used by earlier reform

countries.[2] In countries that use marginal costs their estimation becomes a major dispute factor among the generators themselves and between the generators and the pool operator. An important advantage of the bidding system used by Colombia is that it leads to simpler rules of operation in the pool, since most of the information required to perform the dispatch of the pool are the offer prices. Its major difficulty is the possibility of strategic behavior by power generators, a real concern for bid markets with few participants. Stacchetti (1999) and Rudnick (1998) have documented the existence of strategic behavior in Colombian generators.

We can also expect that new regulatory reforms will develop as new challenges appear. First, the countries that privatized earlier will have to modernize their regulations, which are becoming obsolete as new reforms in developing and developed countries signal the way to freer and more efficiently regulated markets. Moreover, cross-border electricity transactions will increase, and this will be a force towards regulatory convergence in the region, as it will difficult to coordinate operation when partners countries have different regulatory frameworks. Second, the appearance of multi-utilities, and environmental restrictions will require changes in current regulations. Third, a weakening of the transmission and distribution monopoly may be expected in the future, as technology lowers the minimum size of an efficient generation plant.

What is in store for the future? Though there are several competing approaches to the regulatory design of electric systems, the one used by Nordic countries seems to be the most successful. In that internationally integrated market, Gencos have no obligation to supply energy to the pool and can establish physical, long term contracts with customers. An active market for standardized

energy derivatives has arisen. A day ahead and a two-hour ahead bidding market for buyers and sellers settle a major fraction of the remaining trades, leaving the spot (or "power regulation") market only for the last-minute small adjustments needed by the systems operator, thus reducing the importance of a market in which market power seems easy to exercise. Ancillary services that provide security to the system have their own markets. Finally, transmission constraints due to weak links between regions are reduced by raising prices in importing areas and reducing them in exporting areas, so that demand and supply responses reduce the energy flows though these links, thus providing signals to invest in generation or transmission in areas with high prices.

The next section describes regulation of generation in LA. This is followed by an analysis of transmission and then distribution. The fifth section describes regulatory governance problems in LA while a final section concludes.

2. Energy generation

In this section we examine the regulation of wholesale electricity markets in LA. We simplify the exposition by assuming that power plants and consumers, the two participants in the wholesale market, are located at the same spot. The transmission and distribution activities are

examined in the next two sections. Usually the legislation allows only large buyers to participate in the wholesale market. This means that consumers can be divided between large consumers who buy for their own consumption and distribution companies or commercialization firms, which buy in order to sell to small consumers.

There are two types of transactions in the wholesale market: long term supply contracts and spot sales. Given the economic impossibility of storing electricity, supply must meet demand at all times. Thus a spot market for electricity requires at the least, a central planner (or pool operator) that plans the actual operation (or dispatch) of generating plants in the very short term (every hour is usual and sometimes shorter periods are used).[3] LA legislation commands the pool operator to select the dispatch order that minimizes short term costs, independently of existing long term supply contracts.[4] The pool operator orders the price offers of generating companies (Gencos) and demands from users according to rank. Next it computes the price –the so called spot price-- that clears the market. Thus the *spot* price of energy is the offer price of the last-dispatched (and most expensive) plant in operation, and demand is satisfied by those plants that bid a price less or equal than the spot price.

In those countries that first deregulated their electricity markets in the region, the offer price of a plant is determined by law to be the short term marginal cost. This means that the pool is not really a market, since Gencos are not free to set their offer price. However, if short term marginal costs are computed correctly, plants are always willing to operate when mandated to do so. In countries that have deregulated their electric systems more recently, Gencos are free to make bids on

quantities and price. Even in those countries, demand is assumed to be inelastic in the computations of the spot price. Since dispatch is done independently of existing contracts, Gencos must trade energy. Firms that generate less energy than required to serve their contracts are net buyers of energy in the pool, and must settle accounts with net sellers using the spot price. In Chile all users are required to have contracts, so the spot market is used only for transactions among Gencos (though contracts between Gencos and clients can use the spot price as a reference) In Bolivia and in Argentina, most users buy in the spot markets and long term contracts are uncommon.

Large users are allowed to establish long term contracts with Gencos or to buy directly in the spot market. There are special rules for the transactions of discos. Countries that privatized their systems early usually regulate the retail price of electricity. Later reformers require Discos to contract electricity through competitive bidding, regulate the VAD.

2.1 Dispatch of power plants.

The pool operator must follow rules when dispatching power plants. As mentioned before, LA countries that reformed their electric sectors have followed two alternative approaches to pool dispatch. A first group of countries uses merit order dispatch, in which the pool operator ranks plants on the basis of short term marginal cost of operations and dispatch first those with lower cost. Bolivia, Chile and Peru use this system.[5] Colombia, which follows the UK approach, adopted a different approach.[6] Gencos make bids on price and available capacity, information

that is used by the pool operator to build a least cost dispatch function for the next day.[7] Argentina uses an intermediate approach: firms “offer" marginal costs for periods of six months.

It is easy to see that in a world of perfect information, no uncertainty and perfect competition these systems lead to the same, efficient, dispatch order. However, in the real world of imperfect competition, uncertainty, asymmetric information and lobbying, these systems may work differently and have advantages and disadvantages. The main advantage of using short term marginal costs to determine dispatch is that there is no possibility of strategic behavior by Gencos, a real concern for spot markets with bidding and few participants. Stacchetti (1999) and Rudnick (1998) have documented the existence of strategic behavior in Colombian Gencos. The same type of conduct has also been observed in the UK (Wolfram (1998), Newbery, (1998)). The danger of non-competitive behavior would be higher in Bolivia and specially Chile, countries that have small numbers of Gencos.

On the downside, the use of marginal costs requires that pool operators play a prominent role in determining short term marginal costs, specially in systems with an important hydroelectric component, as we show below. Thus the determination of the marginal cost becomes a major factor of disputes among the Gencos within the pool and between the Gencos and the regulator. It also becomes attractive for Gencos to lobby the regulator that oversees the pool operator to bend the rules in their favor. Disputes may arise both on which are the relevant components of the marginal cost and on the price of inputs used to generate electricity. For instance, determining the

appropriate price of an input such as coal, or allowing the use of an environmentally polluting source of energy may become major issues, as they can alter the order of dispatch

Most South American countries are heavily dependent on hydroelectric power for their base-line consumption. In an average year, the Andean countries and Brazil will satisfy about 80% of their energy needs through hydroelectricity. Even Venezuela, with its abundance in oil, derives more than 60% of its energy from.[8] This dependence leads to high supply uncertainty due to variations in annual rainfall. In order to understand the problem, it is important to realize that there are two basic types of plants for hydroelectric use. In the first type, there is no reservoir with significant storage capacity, so its power generation depends directly on the current flow of water, which cannot be regulated. In the Andean countries, the flow of water from rivers varies substantially over the year and between years, which means that the power generation from these plants is subject to significant uncertainty. On the other hand their operation is straightforward, since they always run at maximum capacity given the flow of available water: they are always the *base* plants of the system.

The second type of plant is connected to a reservoir. Water accumulated in reservoirs can be used today to displace other sources of electric power or it can be stored for future use. Hence the efficient operation of these plants depends on the option price of water. In turn, the option price of water depends on the expectation of future rainfall (which affects both the levels of the reservoirs and the amount of energy produced by hydro plants with no reservoirs), the current levels of the reservoirs, plans for future power plants and on the expected future marginal costs of

thermal plants.[9] Pool operators that use marginal cost dispatch have developed optimal control programs with various degrees of sophistication that determine the option price of water. Parameters that feed the program need to be estimated, all of which adds uncertainty to the determination of the marginal costs of these plants (for instance, the probability distribution of rainfall is based on historical records which may be biased by climate changes). Note how this complex process is intertwined with the determination of the marginal costs of the thermal power plants. The numerous parameters that are needed to run the model are a source of conflicts between thermoelectric and hydroelectric generators and between these and the regulator that oversees the pool operator.

In general it appears that the bidding system used in Colombia leads to simpler rules of operation in the pool, since most of the information necessary to organize the dispatch are the offer prices and quantities. The main restrictions the pool operator faces are given by transmission and integer constraints that must be considered in its least cost dispatch function.[10] Simplicity is thus a big advantage of bidding schemes for pool operation.[11] Nevertheless, a significant number of LA countries opted for schemes which use short term marginal costs to determine dispatch. This choice is explained by historical reasons. In the early 80's, Chile was the first country to reform its electric sector, in what may be seen as a *first generation* reform.[12] The designers of Chile's reform were engineers who were heavily influenced by the system used in France (see Rudnick (1998)). The introduction of the pool as the place where competing private generators coordinate their supply activities was a revolutionary change. This reform was probably tempered by the realization that there was no previous experience with such an approach, and with a

misunderstanding of markets (by present standards) that led to an "engineering" approach to reform.[13] When other countries in the region (Argentina, Bolivia and Peru) reformed their own systems, they turned in part to the Chilean experience and used Chilean consultants, leading to (improved) "second generation" systems that still used the same basic dispatch scheme. Colombia is a representative of a third generation reform that has more confidence in markets and that has learned from the experience of bidding for power of the UK, while El Salvador's and Brazil's reforms appear to belong to a fourth generation in which the pool operator is concerned only with the surplus, non-contract market for energy.

2.3 Incentives for investment and security

Perhaps the biggest revolution introduced by reformers of the electric sector was the notion that the profitability of the market would determine investment in generating capacity. This idea, which now seems obvious, was unprecedented in LA, where for a long time in most countries generating companies had been owned by the state and followed government directives in investment (using a systems engineering approach, if that). Under the new approach, high prices of electricity provide a signal to attract investment until the profitability in the industry is the same as the one that can be obtained in other activities facing comparable risks. Conversely, if electricity prices are too low, there will be no investment and the normal growth of the national economy will raise demand and prices until it becomes profitable to build new plants.

As we have mentioned, the spot price of energy pays for the short run marginal cost of generation. Hence there is the need to reward energy capacity in the spot market in order to have plants who come into use seldom except in dry years and do not earn inframarginal profits to pay for the capital costs. For efficiency, this reward should be equivalent to the marginal capacity cost (see appendix).[14] In most LA countries (including Colombia), the spot price of power is the annuity that would pay for the cheapest possible addition to capacity, i.e. an open cycle gas turbine. The spot price of power must be paid to owners of installed generating capacity, but this requires additional finesse. Since hydro-electric plants might not be able to provide much power in dry years, when energy is scarce, it would be inappropriate to pay them for all of their capacity. Hence, hydro-power plants receive payment only for the energy they are able to supply in dry years, which is called firm power (*potencia a firme*). Analogously the firm capacity of thermal plants is computed considering its normal failure rates. In Chile and in Peru power payments are determined ex-ante. Those firms that have supply contracts exceeding their firm capacity must buy power (i.e., spare capacity) ex-ante from other generators to cover the difference.[15] This system of payment for capacity ensures that there are spare plants that remain inactive most of the time but will still be available to produce energy during dry years.

Argentina introduced a different system to reward capacity, in which plants are paid as a function of the energy supplied over a pre-specified period. This scheme has caused distortions in the spot market, as firms are effectively paid twice for energy supplied: once in the spot market as the spot market price and once as a ``capacity'' reward. Since plants offer bids on their marginal cost for

six moths, firms have an incentive to shave their bids in an effort to capture the power reward, which distorts the efficient merit order and provides few incentives to capacity investment.

In most countries that have reformed their electric sectors, investment in power plants has been more than sufficient to cope with demand. For instance, in Chile the investments have been made ahead of the indicative plans prepared by the government. In Argentina there has been a serious oversupply problem, which has led to low costs for consumers and low profit rates for investors. In spite of the increased investment, in years of extreme drought, both Chile and Colombia have experienced supply problems –specially among regulated clients (see below)– which can be explained mainly by failures in regulation. In what follows we analyze the Colombian case, while the Chilean situation is analyzed in the section dealing with regulated prices.

After some unpleasant experiences with energy restrictions during the 1992 droughts, Colombia introduced a simpler approach to deal with droughts: limitations on the operations of hydroelectric plants dependent on stored water. The regulator decreed that if during the dry season the level of water in the reservoirs should fall below predetermined levels, the associated power plants would be dispatched only after all other bids became insufficient to cover demand. If the market were allowed to operate freely, owners of stored water would probably internalize the future value of energy and thus would use it according to its economic value. If this were the case, there would be no need to restrict the use of stored water.

Note, in addition, the claims in Stacchetti (1999) that some plants have substantial market power because of the restrictions on reservoir extraction. Rudnick (1998) notes that in Colombia around 35-40% of the generating capacity corresponds to out-of-merit generators, i.e. those that must operate independently of their bids. These generators are constrained by `` .. transmission grid weaknesses (transformation restrictions, line capacity limitations and compensation requirements), minimum water storage requirements and machine inflexibilities" which modify the ideal dispatch". Since these plants are paid based on their bids, and the operators know that they have to be dispatched, irrespective of bids, they have strong market power. Rudnick (1998) estimates that the cost of these restrictions as compared to the ideal merit order was around US$10MM a month in the period 1995-1997. It is important to observe, however, that this amount combines the cost of ``payments to dominant generators and opportunity costs to non dispatched generators", i.e., it mixes the rents accruing to market power with the costs of skipping merit order.

None of the complications caused by the need to respond to large variations in available energy occur in interconnected systems with dominant thermoelectric generation, where the main problem is how to pay for security in case plants fail (a power rather than an energy failure). In these countries some plants must run constantly (rolling reserve) at less than full capacity just in case of failure of other plants and they must be remunerated appropriately.[16] Power failures, on the other hand, are relatively rare (excluding extremely dry conditions) in systems with an important component of hydroelectric power based on reservoirs, since there is always the possibility of using more water to generate electricity in selected plants which play a stabilizing role for the

system. In these countries the amount of water stored in reservoirs provides an indication of the possibility of scarcity of energy ahead of time, hence they are "energy" rather than "power" failures.

2.4 Regulated energy prices

As mentioned before, Discos buy energy and power for their customers and pass-through the purchase prices (plus charges covering distribution and others) to consumers. Early reformers, in order to defend the interest of small consumers, regulated these prices. Moreover, they feared that residential and small commercial users would be unable to deal with wide variations in the price of electricity. Hence they set pricing schemes that change slowly in response to supply conditions. The basic approach used by Bolivia, Chile and Peru to smooth price fluctuations is to determine a forward-looking medium term (three to six months) price of energy with the essential characteristic that it is computed as the expected value of the short term marginal cost over a 24-48 month horizon. The models use different scenarios of future rainfall, which are then averaged. Computing expected prices also requires forecasting the future growth rate of demand and future capacity expansions.

There is always a danger of populist practices in the regulated price of energy, since politicians who want to score points with voters lobby for lower prices. .[17] In order to ensure that the regulated price does not deviate too much from reality, in Chile and in Peru the regulated price must be inside a band, centered around the average price of contracts negotiated between

generators and large customers. The width of the band is 10% around the reference price..[18] On the other hand, there is also intense lobbying by Gencos, who dispute the parameters and other characteristics of the model used in the determination of the regulated price. For instance, Gencos question which costs are variable in the short run and should be included in the marginal cost determination of the regulated energy price.. This point is illustrated by a dispute that took place in Chile in early 1999. A Genco signed a long term contract with gas pipeline company for gas transport, which set the transport price and a floor on the transport volume the company was required to pay. Should the fixed part of the transport cost in the contract be considered a fixed or a variable cost? Similarly, consider the case of a vertically owned specialist port for coal, whose main use is to unload coal to its upstream owner. Should the capital costs of the port be considered part of fixed costs?[19]

A major difficulty with price smoothing arises in countries where hydroelectricity is the main source of power, ie., how to compatibilize the inherent variability in energy availability with an unresponsive demand due to the fixed regulated price. If during a drought there is an energy shortage, regulated consumers in Chile and Peru are entitled to receive a compensation for undelivered energy priced at around four times the normal cost of energy.[20] This is the *outage cost* and is usually calculated as the cost to users of an energy shortage which is anticipated (as opposed to an unexpected power shortage). In principle, these compensations create the correct incentives for consumers since they face the opportunity cost of energy when supply is restricted, thus leading to reduced consumption. Similarly, power companies that are net buyers under restricted supply (i.e. have contracts that exceed their generation capacity in those conditions) face

incentives to make deals with large users in order to reduce the energy provided to them. Finally, compensations also creates incentives to buy from firms which have spare (self-) generating capacity.

Unfortunately, the magnitude of the compensations in relation to the normal price of energy creates enormous incentives to haggle about the fulfillment of the conditions under which compensations are paid, since Gencos with energy deficits are understandably unwilling to pay. In fact, Gencos have never paid compensations in Chile, even though there have been periods in which supply has been restricted: 1989-1990 and more recently in 1998-1999. A special codicil was introduced into the law (apparently at the instigation of the main Genco), restricting the payment of compensations to years no drier than those used in the modeling of the regulated price. While there is some argument as to the convenience of the codicil, a far worse problem was that the codicil did not specify what was the relevant price in case the limitation applied. Hence, during the energy restrictions of the Chilean crisis of 1998-1999, consumers and users faced the standard regulated energy price, so the incentive mechanisms (driven by compensations) to increase supply and to reduce consumption described in the previous paragraph did not apply. The lack of forces driving the market to equilibrium resulted in random outages, which imposed a large cost on society. More flexibility by the regulator under those circumstances would have solved the problem by raising prices appropriately in order to respond to the changed availability of energy.[21]

Another problem, endemic to Argentina and Bolivia, is the fact that Gencos are unwilling to supply energy at the regulated price, i.e., to make contracts with Discos. In fact, in those two

countries there are almost no long term contracts between Discos and Gencos. In Bolivia the spot price has usually been higher than the regulated price (see below). Thus Gencos were unwilling to offer contracts at this price, and distribution companies had to buy at the spot price and sell at the lower regulated price, making losses. The government compensated the discos by levying additional charges (the "z-factor") to cover the losses on users every three months. Similarly, in Argentina there are virtually no contracts, since distributors pay large fines for all power cuts to consumers, but there is a limit to the amount they are allowed to pay the generators, which is given by the average of the three month expected marginal spot prices (this is all they can charge consumers for energy). Since the distributors cannot pay for additional security, generators are not willing to sign medium term contracts with security specifications, which implies that the distributors are just as well off by buying spot and not risking a medium term contract. Every three months Argentine consumers have to settle any differences between the regulated price paid by distributors and the spot prices (as occurs, unintentionally, in practice in Bolivia). In contrast to Bolivia, this settlement can go both ways. This means that Argentine consumers face price risk and should respond by modifying their demand is response to expected changes in price.

In third generation countries such as Colombia, the regulated prices follow a simple scheme in which distribution companies offer tender contracts for energy. This approach is simpler than regulating the price, but it is more sensitive to market imperfections (Stacchetti 1999). Apparently for this reason, Colombia includes explicit restrictions on the size of the firms in certain segments of the electric market and the regulator is considering the determination of a regulated reference price.

2.5 Competition in generation

An important problem in several LA countries is the lack of competition due to concentration in power generation. This is specially acute in Chile and in Bolivia. In the main Chilean interconnected system the Herfindahl index reaches 5800, with only three major participants. The major Genco has 60% of installed capacity and its holding company owns the main transmission facility and the largest electric distribution company, serving more than 40% of distribution in the country. The same company owns more than 70% of the remaining water rights that could potentially be used to generate electricity. This dominance of the market, coupled to the complexity of the electric legislation, has ensured that there has been no entry into the market since privatization. Potential entrants are afraid of confronting this behemoth, specially considering the possibility of discrimination within the pool, the lobbying power of the dominant firm, the problems in legislation, the possibility of discretion by the regulator and the inefficiency of the judicial system for companies seeking redress. The formation of this dominant company was a major mistake in Chile's privatization process and in the period that followed, when it was allowed to buy additional plants that were being privatized.

In Bolivia, the rules at privatization guaranteed no competition to the three participants for the first five years, This was a big mistake, even though the companies made investment commitments in exchange for this promise. Using real data it can be shown that it was in no company's individual interest to add capacity, i.e., not adding new capacity was a Nash equilibrium (See Rios-Cueto

1999). The fact that each firm individually would lose profits by investing, coupled to the restrictions on entry, resulted in very little capacity becoming operational during this period. Due to demand expansion the spot price climbed quite rapidly and reserve capacity dwindled. Because of the investment commitments at privatization, the firms had to build the required new plants, but kept them out of operation while announcing that they would be operating in the short term.[22] These announcements were incorporated into the computation of regulated price, which explains why the regulated price was usually below the spot price. If free entry into the power generation market had been allowed, the threat of newcomers would have led the firms to add the plants they announced. In fact, when the entry restriction was close to being lifted, the plants finally started going into service.

Argentina is a market with intense competition, where energy prices are very low. This is caused in part by the distortion introduced by the capacity reward, which depends on the energy supplied by the power plant. Because there are many firms that compete strongly, it appears feasible to introduce a bidding system in the near future.[23] Colombia is also a country with many competitors, but there is always the nagging worry that firms will integrate horizontally and reduce competition and affect the working of the spot market.

3. Transmission

In the previous section we have assumed that power plants and large users (including discos) are all located in the same place. In this section we analyze the more realistic case in which plants and users are spatially localized. This means that competition in the market requires the existence of a network through which electricity can be sent from producers to consumers, with no discrimination in the access to the network by the various participants in the market. The transport system can be divided into transmission and distribution, though the precise legal division varies from country to country. For our purposes, however, transmission refers to high voltage lines carrying energy over long distances, whereas, distribution refers to a network of low voltage lines within a city and its environs. We will assume that all participants in the wholesale market are connected to the transmission grid.

The regulatory frameworks of all LA countries consider transmission to be natural monopoly that requires regulation. Hence countries that privatized or are privatizing their electric sectors have implemented non-discriminatory open access rules in transmission. Moreover, they have chosen a multilateral approach where a common grid is financed by all users (Rudnick et al., 1998). This scheme is coherent with the minimum cost dispatch rule (based on bids or marginal costs) adopted by most LA countries. The challenge is to develop efficient rules to allocate the cost of the grid among users. Inefficient cost allocation could hamper competition in the wholesale market, and provide inappropriate economic signals for the expansion of the electric system. LA countries have used or proposed different criteria for allocating transmission costs among grid users. An additional source of differences is related to the rules for financing of expansions in the transmission system. In some countries the transmission company is responsible for the expansion

of the system -–mainly in Central America-- while in other countries the users propose and finance expansions. The degree of market regulation also differs from country to country.

Finally, there also are differences relating to the property of the system. In most SouthAmerican countries the main Transco, which handles the dispatch of power plants and in some cases operates the system, is still controlled by the State, though there are plans to privatize them in the future. So far only three countries have privatized their transmission systems: Argentina, Bolivia and Chile. In Central America, transmission companies will remain in public hands and retain exclusive rights to international interconnections. However, in all LA countries concessions are granted to private investors for the construction of new lines. CA needs to integrate its markets in order to reduce market power, increase security at a reasonable cost, and to take advantage of scale economies. Thus CA countries have signed an interconnection treaty, but implementation is still at an early stage. Integration will work better if regulation in Central America converges, especially in transmission, but this may require regulatory changes. Hence the decision to maintain state ownership is a means of retaining flexibility, since after privatization it is more difficult to change the laws as companies complain that it represents regulatory takings.

3.1 Cost Allocation

The allocation of payments for transmission among the different users requires the identification of the system that must be paid and the costs that must be covered (Rudnick et al., 1998). In

general, the LA countries consider payments to economically adapted systems (i.e., systems that are not overbuilt). The owner of the transmission system receives a predefined payment that covers operation and maintenance costs plus the long run annualized replacement value of lines and other equipment required by the grid. Most countries apply some form of incentive regulation, i.e., the costs that are compensated are only those of an efficient firm. The allocation of these costs among users is a complex issue, and schemes that appear similar can lead to widely differing results.

Large scale economies in transmission systems complicate the allocation of transmission costs among users. One obvious source of revenues is the *marginal cost* corresponding to the differences in energy and capacity prices at different locations, since it represents the marginal value added by the grid. However the strong scale economies imply that in general these payments are not sufficient to amortize the grid. Countries in the region have adopted two-part tariff systems, where a fixed payment is added to the marginal income in order to finance the system. In theory, the fixed cost should be apportioned to users according to the benefit each of them derives from the transmission system.[24] Now, the difficulty in identifying the beneficiaries and the extent of the benefits increases exponentially with the complexity of the grid. Moreover, the same transmission line might benefit consumers or generators depending on time of day, season, hydrology, or other conditions. The problem is that the allocation of payments affects the localization of power plants and consumers and hence the cost of the transmission system. By making users and consumers pay for the benefits they derive from the transmission network, they internalize the impact of their localization decisions on the cost of the network.

Argentina and Chile, the first countries to derregulate their electric sectors, chose to allocate transmission payments solely to gencos. According to Rudnick et al. (1998), this was justified by the belief that gencos required the transmission services to reach consumers. This might have seemed a reasonable approximation at the time, since in both countries a large fraction of demand was concentrated in a single city, where the marginal gencos were located. This situation, combined with simple lineal or radial transmission grids, justified the approximation. But systems have become more complex and this approximation may no longer be appropriate. Countries that underwent derregulation later used a different approach. In Peru, although only gencos pay transmission costs, they are allowed to pass them on to their regulated customers, which means there are few incentives to localize close to users. Other countries, such as Colombia and Bolivia, divide transmission costs between gencos and consumers. Moreover, Colombia's regulation explicitly imposes the condition that costs should be split in half between consumers and gencos.

In general, measuring the benefits to users in order to allocate the fixed cost of the transmission system is not an easy task. The detailed studies that are required would still be sensitive to the many assumptions that are necessary to arrive at a result. For this reason, LA countries have resorted to gross simplifications. The allocation of transmission fixed cost is usually based on some measure of the use of the network, the exception being Peru where gencos pay connection tolls as a proportion of their *potencia a firme* as defined in section xxx. Most countries define a two step process. First, regulators determine what is called the *area of impact (area de influencia)* of each user. This area usually consists of those components of the transmission system --lines,

transformation stations, and other installations-- which are affected by a marginal increase in the power injections of a generator or by the withdrawals of a consumer.[25] Most LA countries measure the impact during peak conditions, but it could also be computed using other operating conditions, as is done in Bolivia. The second step in the process is to allocate the cost of the facilities included in the area of influence among users. These *distribution factors* are usually based on the maximum power to be transmitted, either during peaking conditions or at other times. Rudnick et al. (1998) have shown that the choice of the rules by which usage is measured has an important effect on outcomes. In simulations performed for Chile, the results differ widely, with allocations of the fixed cost to generators ranging from 17.6% to 87.0%, and with the share of an individual plant fluctuating from 0.7% to 13.0%.

In order to measure the use of the transmission network regulators/pool operators either simulate the expected operation of the system under optimal economic dispatch rules over a finite horizon, or use historical data as in Argentina. No country uses *ex post* reconciliation of predicted with realized flows. Hence the operational decisions by the network user are not affected by the choice of the method used to allocate payments. Nevertheless, the choice might have a serious impact on investment decisions, as we discuss below. In addition to marginal rates and tolls, some countries levy wheeling charges for contracts between generators and consumers located outside their area of influence. Spiller (1995) has argued that these wheeling charges create inefficiencies: they reduce consumption below the optimal level and they create market power in isolated zones. Finally, the locational premium may be insufficient to promote investment in far away generation, reducing the use of the transmission link.

Some countries exclude congestion rents, which arise from constraints on the transmission grid, from the marginal charges paid to the grid owner. This exclusion distorts the operation of the system, as marginal costs are not properly measured. Moreover, the exclusion of congestion rents from the variable income increases the size of the fixed cost. This is undesirable, given difficulties in allocating the fixed cost among users. On the other hand, if the owner of the grid keeps the congestion rents (as occurs in some countries), there are perverse incentives for the grid owner to manipulate dispatch and prevent grid expansion in order to increase congestion rents. Hogan (1993) has proposed assigning the congestion rents to users according to ownership rights to the congestion rents. The income from the initial auction of capacity rights should be used to reduce the fixed cost. The pool operator will simply be a conduit for the distribution of congestion rentals. Argentina uses a derivative approach, in which congestion rents are paid by users into a fund that is used to finance expansions of the grid.

3.2 Expansion of the transmission system

In most LA countries, except some Central American countries, there is no obligation on the owners to expand the transmission grid. This implies that the open access obligation to third parties is limited to installed capacity. Usually the expansion of the system is proposed and financed by users, but it requires the approval of the regulatory agency and/or the pool operator. The expansions undertaken have to be coherent with the economically adapted system designed

by the regulator. Chile is an exception since the decision to expand transmission is left solely to interested investors.

Spiller (1995) discusses two ways of financing new investments in transmission: ex-post cost recovery and ex-ante subscription of investment costs. Both methods are used by LA countries. If investment is recovered though ex post lump sum payments, it does not distort the operation of the system. However, Spiller emphasizes that if the lump sum payments are based on measures of use, this method might lead to an inefficient pattern of investment in generation. For instance, payments could discourage Gencos from investing in distant locations even when there is excess transmission capacity.[26] Also, gencos that are considering investing in a new plant will not internalize that by locating in one place they may force an investment in transmission, while they may have no effect on investment at other places.[27] Even when the supplementary fixed-cost charges are independent of use they could discourage efficient generation investment if the charge is excessive. In Peru the ex post payments depend solely on firm capacity, so they provide inadequate economic signals for location as we have mentioned before.

Under the subscription method users who benefit from the investment agree in advance to pay the fixed charge required to finance the investment, probably under a long-term contract. Thus, the grid will be expanded when the benefits accruing to a coalition of users exceed the expansion costs. Because of scale economies in transmission development, the efficient expansion path exceeds the amounts required by present users. Hence, once the investment is made, the open access requirement implies that some users will be able to benefit from an investment towards

which they did not contribute. This free rider problem can be reduced if a third party, such as the pool operator, allocates the fixed cost among users. However, this approach does not completely solve the problem. Since future users will free-ride on the investments paid for by current users, they may decide to wait until the conclusion of the expansion, thus avoiding payment. This situation leads to underinvestment both in transmission and generation, raising generation and transmission congestion costs. This problem is somewhat mitigated if subscribers are awarded the rights to eventual future congestion rents Hogan (1993).

Most LA countries employ the subscription method. Users request and, after approval from the regulator, pay for new transmission capacity undertaken on their behalf. Argentina uses two different schemes for financing of transmission expansions. The first scheme consists of an agreement between the transmission firm and users, who finance the expansion. Users that finance the expansion have the right to perceive congestion rents during the 15 year period of amortization of the investment. In the second method, the process is triggered at the request of a fraction of eventual beneficiaries. The pool operator estimates the allocation of the fixed cost of the expansion to eventual beneficiaries. The project is rejected if more than 30% of eventual beneficiaries oppose it. If the project is approved in a public hearing, the regulator calls for a public auction for the construction, maintenance and operation contract. Bidders compete on the basis of the annual levy to be paid by beneficiaries. The second scheme should facilitate agreements by reducing free-ridership However, since there is no consensus on the cost attribution procedures, those that feel harmed by the allocation would be likely to reject it. In fact, the incentive process to promote

new investment in transmission is being revised, as investors have become reluctant to invest in new lines.[28]

3.3 The Regulation of Transmission

Latin American countries display large differences in their approach to regulating transmission. Chile has, by far, the least regulated transmission in the region. Although the regulation sets some guidelines, transmission fees are directly negotiated between the transmission company and each genco. Lack of agreement leads to a compulsory arbitration process. Transmission franchises are subject to free access rules, but they are not required to build new lines. Moreover, new franchised lines are not evaluated by the regulator. Since all users share the cost of lines, they could be required to pay for undesired investments that provide benefits for other users. Moreover, since it is difficult for parties to agree on the efficient transmission system required, there is an incentive to overinvest. In partial mitigation, the regulator does provide a ten-year investment plant for generation and transmission that minimizes the present value costs of investment, operation and rationing the system. This plan is only indicative, but it can be used in legal arbitration.

Negotiations between the gencos and the transmission companies have never been successful, leading to arbitration. The outcomes of arbitrations are not predictable, since they do not create jurisprudence. The problem is further complicated by the fact that the largest genco owns of the

grid company. Since the owner of the grid has no service obligation, scale economies in transmission gives a competitive edge to the associated genco, and the grid company has been accused of favoring its parent company. Colbun, an independent genco eventually built a line that runs parallel to the main transmission line after being unable to reach an agreement with the transmission company. This was an inefficient option, but the genco preferred the independence gained by owning its line to depending on negotiations with an unregulated monopoly owned by a rival.

These difficulties have created uncertainty in the development of the generating sector, which appears to have reduced new entry into the sector. In June 1997, the Antitrust Commission ruled that, within a ``prudent'' period, the main Genco's transmission subsidiary should become an independent joint-stock company that operates exclusively in the transmission segment, thereby opening the company up for other parties to participate in ownership. In 1998, the Chilean regulation was modified in order to correct some of the problems that had been observed. According to the new rules, the regulator is responsible for determining the the area of influence of each generator, whereas before it was negotiated. There is some scope for regulatory discretion, but this seems to be a minor problem in comparison to the previous situation.

In most other countries there is better regulation of the transmission sector, and specially, no other country allows the control of a transmission company by a genco. In these countries, the regulator and/or the pool operator determine the cost to be recovered by the transmission company and its allocation among users. In Argentina and Brazil the pool operator pays the transmission company

an annual fixed fee, and then divides the fee among generators. In Guatemala, if negotiations over the fixed payments between the parties do not reach a mutually satisfactory conclusion, they are regulated. Expansion of the system requires the agreement of a fraction of participants, the approval of regulators, or both conditions. Regulations restrict cross-ownership between generators and distributors and transmission system. Furthermore, transmission companies are not allowed to trade in the electric markets.

It is probable that the observation of the Chilean experience with transmission, coupled to the belief that generation and commercialization would be more competitive if transmission was adequately regulated, have influenced the design the closely regulated transmission system used in the countries that reformed their electric sector later. However, the gains from better regulation of transmission are somewhat frustrated by the lack of consensus on the allocation of transmission costs among users. The methods implemented to allocate the fixed cost differ from country to country. Since none of the methods have analytical support, users that feel that they being mistreated by the allocation scheme, tend to contest it. This has led to conflicts between interested parties, and between them and the regulators. The volatility of transmission charges has slowed the expansion of the grid, as it does not provide a stable signal for operation and expansion. Moreover, inefficient pricing systems can impair competition and provide inappropriate economic signals for the expansion of the system.

What is perhaps most surprising, is that transmission systems are relatively inexpensive, and amount to only a small fraction of the investment in power generation. Nevertheless the disputes

about the allocation of these costs can have important effects on the efficiency of the system. In some cases it might be more efficient to have simple though theoretically imperfect rules to cumbersome rules that are supposedly efficient.

4. Distribution and Commercialization

Discos deliver electricity from the transmission network to small users (large users often connect directly to the transmission line). They receive the electricity at substations where the voltage is lowered from the high voltage used in transmission to the low voltage used by the distribution network. Most LA countries award distribution Most LA countries award distribution franchises (sometimes non-exclusive) that impose the obligation of providing the service within the franchised area. In early LA reformers, distribution companies buy electricity for their clients and pass through the purchase price. Hence the regulated price for a small consumer has two distinct components: the price at which Discos buy electricity and the value added of distribution (VAD). Later reformers, following the UK example, have explicitly separated local transportation from commercialization services, allowing for retail competition. In this approach, small consumers contract directly with any of various competing electric brokers. In turn electric brokers buy electricity in the wholesale market and pay regulated fees to transmission and distribution companies.

Since distribution is a natural monopoly, it is subject to price regulation in all LA countries. Although the VAD may or may not include commercialization services (mainly measuring, invoicing and commercial offices), regulation in LA countries shares some common principles. The main objectives are self-financing of companies, the pursuit of efficiency, and the transfer of efficiency gains to consumers. Usually the VAD is set so that an hypothetical efficient distribution company (Disco) achieves a predetermined rate of return. There are, however, some differences among LA countries. With respect to service quality regulations, some countries have concentrated in setting up technical standards whereas other countries have chosen to measure service standards. Countries also differ in the types of subsidies they use: while some use cross-subsidies among classes of users, others use direct subsidies to special groups that are financed from the public budget.

4.1 Incentive regulation: the theory

There are two distinct options to price regulation: the traditional choice is the cost of service approach, which sets rates to reflect the costs of the firm, while incentive price-setting stresses the pursue of efficiency in the firm. In its standard form the traditional approach was based on rate-of-return targets, but faced at least two problems: the lack of incentives to reduce costs (since inefficiencies would be passed on to consumers) and the over-expansion of investment through the Averch-Johnson effect (1962).

Incentive regulation attempts to correct the main problems of the rate-of-return approach, by separating tariff setting from the realized costs of a firm. The most common versions are price caps and efficient firm models. In the latter prices are set in such a way that an efficient firm attains a established rate of return. Prices are reviewed every few years. In between review schedules, prices change according to a relevant inflation index, but firms keep any profits from cost reductions. The problem with this approach is that it requires knowing the costs of an efficient firm. If only one firm provides the service, it will have a strong influence on what the regulator considers an efficient firm. However, when the same service is supplied by different local monopolies facing similar conditions, the information monopoly is weakened. For example, the model for a firm among various could be the most efficient firm among the remaining firms, a case of yardstick competition. If there is no collusion, firms have incentives to lower their costs because this does not affect their own tariffs. Countries with few firms could resort to international benchmarks.

Price caps (PC), also known as RPI X, consists of a cap set on tariff increases, where the cap moves according to price inflation minus an X factor representing an *ex-ante* estimation of future efficiency increases. Every few years, X is adjusted. Any increase in efficiency beyond X is appropriated by the firm. If X is an unbiased estimator of future productivity gains, this scheme provides the correct incentives to the firm. An advantage of this approach compared to the efficient model, is that it only changes the rate at which prices move over time and not the price itself, reducing the level of conflict in the regulatory process. Although there is no explicit mechanism for determining the X factor, price capping has another advantage over efficient-firm

pricing. It is easier for the regulator to identify potential efficiency gains than to build a credible efficient firm case from scratch.

An alternative to price-setting is temporary franchising as pioneered by Demsetz (1968). The franchise is periodically auctioned, and is awarded to the bidder offering to charge the lowest price for the service. Firms have similar incentives to raise productivity as in incentive price regulation. The main advantage of this scheme over price regulation is that the tariff arises from a competitive process. In turn, its main difficulty arises when substantial sunk cost investments are required.[29] Here, two possibilities arise. First, the fixed capital is owned by the government. In this case the problem is to ensure that the franchisee will provide adequate maintenance. The second possibility is that all or a substantial part of the investment is financed by the franchisee. Here the challenge is to provide appropriate incentives for the operator to make the required investments, especially close to the end of the franchise period. Dnes's (1991) proposal is that when the franchise is re-bid the new operator should compensate the old one for the investments made. Investments should be valued through a technical process stipulating arbitration clauses in case of disagreements. However, the valuation process once again leaves room for disagreement.

4.2 Implementation

To the best of our knowledge, Chile was the first country to explicitly introduce incentive regulation. The 1982 legislation defines rate-setting schemes based on marginal-cost pricing in simulated efficient enterprises. The VAD is recalculated every four years by determining the

operating (including energy losses) and maintenance costs of an efficient firm and setting rates to provide a 10% real return on the replacement value of assets. These rates are then applied to existing companies. If the actual average industry return on the replacement value of assets exceeds 14 percent or falls below 6 percent, rates are adjusted to the nearest bound. The hypothetical efficient firm is built on the basis of the real firm that is believed by the regulators to be the most efficient among existing firms, introducing an elementary type of yardstick competition.

Most LA countries have followed Chile's lead in implementing efficient firm pricing. Among others, Peru, El Salvador, Nicaragua, Colombia, Brazil and Panama use benchmarking in defining efficient standards. However, there are differences in their actual implementation. Brazil' distribution companies were unbundled horizontally; large Discos companies were split and sold to distinct investors. The largest cities have two or three Discos, which will be allowed to compete. Hence in addition to yardstick competition, some direct competition among Discos is expected, at least along their common boundaries. Smaller countries where this approach is less appropriate, as in Panama, are more likely to rely on international benchmarking to determine the efficient model firm. However, even in El Salvador existing distribution companies were split in a way that allows for direct competition in their boundaries: two different companies service the capital city. Bolivia, as most countries in the rest of the world have opted for price capping. In their approach, five elements of costs have specific gain factors (X).

Argentina choose a different approach. Distribution companies operate under a 95-year concession contract, which is broken into nine 10-year management periods (except the first one

that lasts 15 years). Before the start of each management period the regulator sets the tariffs to be applied during the next management period, and calls for a competitive auction for control of the Disco. If the current owner submits the highest price, it retains ownership. Otherwise, the investor offering the highest bid obtains the concession and pays the bid price to the incumbent holder. During a management period, tariffs are adjusted according to an index formula contained in the concession contract. Tariffs may be reviewed after 5 years, if the Disco files a petition with reasonable arguments. The regulator can grant the desired tariff increase after conducting a public hearing and contracting an independent cost study. Distribution costs are computed as the average incremental cost of the network, adjusted for a least-cost expansion investment plan for a efficient firm and are based on demand growth assumptions. Buenos Aires is divided into two distribution areas assigned to different companies, but these are not allowed to compete.

4.3 Results in earlier reformers

We focus on the Chilean and Argentine experiences, which are the only ones where enough time has passed that it is possible to draw some conclusions. The privatization of distribution companies led to substantial new investments and efficiency improvements in both countries. The Chilean largest distribution company more than doubled its sales from 1987 to 1997. It also managed to cut energy losses from 19.8% to 8.3% and raised the number of clients per worker from 376 to 703 in the same period. The service expansion is explained by the relaxation of financial constraints faced by public enterprises; combined with a comparatively stable and impartial regime of contract law for privatized utilities (Levy and Spiller, 1994). In turn, private-

sector managerial capacity explains labor productivity gains. The isolation of public services from political pressures has also helped to improve performance indicators. Political meddling made it almost impossible for state-owned companies to dismiss low performance workersbefore privatization, especially if they had political backing. Last, but not least important, there is a regulatory system that encourages efficiency (Levy and Spiller, 1996).

Despite these gains, after two rate reviews, the prices of regulated services have not fallen to reflect the huge productivity gains that have been achieved since privatization. Between April 1987 and April 1997 the all-inclusive tariff paid by consumers in the central (and most densely populated) zone in Chile fell by 11.4% in constant dollars, despite the fact that the generation price has fallen by 37.4%, energy losses were reduced substantially, and labor productivity increased significantly in the same period. Moreover, it become easier to stop service to customers who did not pay their bills or to penalize those that pilfer services. This situation has led to a significant rise in the rate of return (ROR) of distribution companies. For instance, the ROR of the largest distribution company (serving almost 40% of the population) rose from 10.4% in 1988 to 35% in 1997. The profitability of other distribution companies shows a similar behavior. Such rates are way above those being earned by Gencos, even though Gencos are subject to far greater uncertainty since they do not have a captive market and they face hydrological variations.

It seems there are problems inherent to incentive regulation that have prevented efficiency gains being fully passed on to consumers. Rate setting based on simulated efficient enterprises requires considerable judgement, and the regulatory process is increasingly becoming a bargaining process.

The Chilean regulatory agencies do not seem to be well prepared to deal with this type of process: they are at a technical (and other) disadvantage with respect to the regulated firms. Moreover, privatized utilities have acquired political and social leverage and exert enormous influence in defining the efficient firm. Recent rate-setting episodes have also made explicit the problem of information asymmetry: regulators have had serious difficulties in gathering precise cost data from utilities. Even efficient-firm regulation requires actual data from firms, as costs depend, among other things, on customer density, topography and demand per customer. It is therefore difficult for regulators to build a credible efficient-firm when they do not have full access to companies' data.

Specific aspects of the Chilean legislation also contribute to these results. Regulators are not allowed to make public the information used to compute rates except to the regulated firms, which blocks consumer protection agencies from counterbalancing the pressure of the firms on the regulator. By contrast, in Argentina, tariff reviews require a public hearing. Moreover, existing regulation does not promote truthful data revelation. The procedure defines the operating costs of an efficient firm as a weighed average of estimates made by consultants hired by the industry and by the National Energy Commission (NEC). This procedure provides obvious incentives for each party to bias its estimates. In the price-setting process, the discrepancies in the estimates have exceeded 50%. A better solution would be for an arbitrator to have to choose between the two estimates.

Argentina also displays significant improvements in coverage and in efficiency after privatization. Annual investment rose five times labor productivity increased more than 100% and the distribution losses fell from 28% to 10% in five years. It is still to early to know whether the periodic rebidding process will work. The risk is that the information advantage that the incumbent franchisee might inhibit potential bidders, reducing the scope for competition. The main advantage of Argentina's bidding mechanism is that it reduces the risk of conflicts during price setting. However, tariffs are still the ones set by the regulator at privatization as firms chose not to ask for a tariff review after the first five years.

4.4 Retail competition

Some LA countries such as Brazil and El Salvador have opted for retail competition. Colombia is planning on reducing the threshold of a free client to zero, thus permitting retail competition. In order to allow for retail competition, regulations must establish non-discriminatory open access to distribution networks. Enforcement of non-discrimination rules is facilitated when distribution companies are excluded from the commercialization business. Some countries, allow distribution and commercialization companies to compete for the supply of end users, imposing restrictions on the participating Discos. Brazilian Discos need to keep separate accounts for their commercialization activities, and cross subsidies are forbidden.[30] In El Salvador, when the Disco supplies the end user, the terms and conditions of supplies require annual approval from the regulator, while other suppliers are free to set their own tariffs.

In other countries, like Chile, theree is no competition in retail markets and only generators are supposed to compete for the supply of large customers. Moreover, non-discriminatory access to the distribution network is a requisite for sustainable competition. However, under the present legislation, in countries such as Chile and Argentina, distributors have priority in the usage of the network, which means that the introduction of independent power brokers would require significant changes in the legislation.

The main advantage of separating energy sales from distribution services is that it reduces the number of different activities that need to be regulated. As an example, the Chilean Discos have increased their profits by raising the prices of related, non-regulated services. Some Discos have have profit rates of 50% in meter rentals, with huge differences (14 times) in their rental rates, with no economic justification. For this reason, the regulator is considering the regulation of related services. Even though some of these services could be provided by third parties, the close relation between the Disco and the customer acts as an entry barrier. If energy sales were separated from distribution, most related activities would be determined in a competitive market. Hence, there would be no need to determine the charges for the commercialization services. Moreover, traders would be interested in that distribution companies are properly regulated, so there would be a counterweight to the lobby of the disco. An additional advantage of separation is that it is possible to supply residential consumers with plans that are adapted to their characteristics (i.e. different combinations of price, quality of service and volume), without imposing to heavy a burden on the regulator.

4.5 Large customers and distribution

In most countries LA only large consumers, defined as those with a maximum power demand in excess of a certain threshold are free to buy energy from sources other than the Disco. Generators or electricity traders willing to sell energy to large customers located inside the area serviced by a distributor may require using the network of the distribution company, unless they want to duplicate lines. In Chile, the use of the distribution grid must be negotiated with the Disco and is not regulated. As a consequence, there is very little competition for large clients within distribution franchises, since a genco must negotiate a toll for the use of the grid with a competitor. If no agreement is reached there is a mandatory arbitrage process which is lengthy, onerous, and has uncertain results. There is enough uncertainty in this procedure for independent generating firms to have desisted in their attempt to supply such clients directly. In addition, the distributors are generating firms' main customers, so taking clients from them is bound to be costly. It is important to note that lack of competition in the supply to large customers is important for regulated customers, because the regulated node price cannot deviate too much from the average of the contract prices (see section xxx). Argentina has followed a different approach, distribution companies are obliged to provide transport services at a regulated toll to all consumers with a maximum demand greater than 30 Kw.

5. Regulation and governance

Regulatory governance has been a classic weakness in LA. There are three main reasons for the problems of regulatory agencies in LA, none of which is specific to developing countries but that are exacerbated in their environment (see Laffont (Cancun 1999)):

- Regulators are often subject to pressures from populist politicians or from industry lobbies.
- Regulators receive low salaries and can be captured, either in revolving door schemes or through outright corruption.
- Badly designed regulation coupled to an inefficient and often corrupt judicial system.

An early approach to the problem of regulation of the electric sector in LA. Levy and Spiller (1996) emphasized, in an article originally written in 1991, the importance of the institutions of regulation as a means of ensuring investment in an area in which, due to the large sunk costs and the lengthy periods to recoup investments, it is easy to expropriate firms. The lack of independent institutions in LA creates an expropriation danger. This form of governmental opportunism can lead to inefficient levels of investment. Hence, Spiller and Viana (1996) claim that the advantages of flexible regulation have to be measured, in LA, against the possibility of regulatory opportunism. They praise the extreme rigidity of the Chilean system and the fact that regulatory measures can be appealed in the courts as a means on attracting investment to the sector.

5.1 Populism and regulatory rigidity

Until the reforms, regulators in LA were often pressured by politicians into setting tariffs that were lower than the ones required for sustainable investment and even maintenance of equipment from revenues (see Spiller and Viana, 1996}. Hence, the quality of service was low as the state owned electric companies were often starved for funds for investment and even maintenance. In several countries the state owned companies appeared when the tariff-setting process surrendered to populism and rates were set too low for private investment, setting the way for the takeover or replacement by the State of private utilities.[31]

When the new electric law was introduced in Chile in 1981-82, the legislator was interested in assuring potential investors that they would not be expropriated by the regulator. Hence decision power was were taken away from regulators and embedded into the law. This led to an extremely comprehensive and complex electric law, which included details which are normally left to regulatory determination. At the time, this seemed a good bargain: in the early 80's, Chile's approach was revolutionary and required convincing investors that the rules of the game would not change according to regulatory whim (Spiller and Viana, 1996). This feature was effective in attracting investment when the sectors were eventually privatized, but had the undesired effect of making the regulatory framework rigid and unable to adapt to different conditions.

This inflexibility became costlier as the environment changes and the system remains inflexible, as shown by the 1998-1999 drought. During the crisis the whole governance system collapsed and the country was subject to avoidable prolonged and black outs, without, so far, any compensation

to users. This caused an estimated US$300MM in damage to the economy. Fischer and Galetovic (2000) have shown that the failures of regulatory governance during the crisis derived in part from the lack of flexibility embedded in the law, which reduced the powers of the regulator to respond quickly to the drought, coupled to the pressures of producer lobbies on the regulator.

The rigidities in Chilean legislation became entrenched, since none of the existing players wanted to change the rules, in this case for fear of arousing populist instincts in the legislator. For instance, under the Chilean system the law does not include the possibility of special payments to plants that provide modulation services (plants that react to short term changes in demand or supply to maintain equilibrium), and there is no easy way of providing differentiated service qualities to residential consumers, without legislative intervention. Moreover, from the point of view of established generating firms, one of the ``beneficial'' side-effects of the complexity of the regulatory environment is that it deters entry, since it requires inside knowledge of the system to operate efficiently. It is only when a major crisis strikes the system (the 1998-1999 drought and blackouts) that legislators are able to push for changes. Even then, reforming the system is not guaranteed since the affected players will direct strong lobbies against changes that affect their interests.

During the nineties privatization of public utilities became more fashionable, and the risk of expropriation correspondingly smaller. Thus, when other LA countries reformed their electric sectors, the danger of populist measures was perceived to be relatively smaller and countries were able to design less detailed electric legislation without deterring investors. Argentina and Colombia adopted this approach, stating only major principles in the law and leaving it to the regulatory

agencies to determine the details.[32] There are obvious advantages in this approach, if the fear of regulatory takings is small. However, even when the regulator is legally allowed to change regulations, lobbying may make it difficult. For example, in Argentina it has been hard to change the distortionary mechanism for rewarding capacity, because there are always firms that are harmed by the proposals to reform the scheme.

Colombia separated the basic principles, which appear in the electric law, from the regulatory details which are left for the regulator that interprets the law. Under this approach, companies direct clarifications of the legislation to the regulator, which issues binding statements on the firms. This information is publicly available on the net, so any entrant can analyze the trends and decide on whether to enter the market.[33] Regulatory flexibility, however, can also lead to problems. After the 1992 drought, the regulator became extremely sensitive to the possibility of power cuts during future droughts. Hence a first draft of restrictions on the use of stored was introduced at privatization. The newly privatized company established long term supply contracts with users. When the drought of 1997 arrived, the rulings on the use of water became stricter (a case of regulatory takings) and the company had to buy high priced energy in the spot market to fulfill its contracts, while it remained with substantial amounts of unused reserves after the drought. Now there are plans to introduce an options market for water rights which will provide signals to the market and the regulator and will make it less likely hat the regulator will intervene in the market again.

5.2 The institutions of the electric sector

In LA countries, the regulator of the electric system is usually divided into two independent regulators, the first of which deals with planning, policy and norms, while the second works on supervision of the norms themselves. This may be reasonable as following from the same principle that argues that the design and enforcement of legislation should be kept separate. However, in some countries this separation is incomplete. In Chile, for instance, there are parameters that go into the calculation of the distribution charge that are calculated by the Comisión Nacional de Electricidad, normally in charge of policy, and others by the Superintendencia de Electricidad y Combustibles, normally in charge of supervision and enforcement of the regulations. This is inconsistent with the arguments in favor of two regulatory organizations and leads to problems such as regulatory inefficiency, infighting and weakness towards organized pressures.

Another major institutional player is the pool operator. Hence, the internal organization of the pool, its members and its governance rules play important roles in the smooth functioning of the electric system. This is specially true in countries using marginal cost pricing, in which the pool operator designs optimal control models that determine the operation of reservoir-based power plants. Once the rules have been set, it becomes very difficult to change them, because they are considered regulatory takings by the affected firms. Since regulatory changes usually have a differential effect on the various firms in the market, depending on the type of plant they own, the regulator can be accused of favoring one of the firms when introducing regulatory changes in the pool.

In Chile governance and operation of the pool were not carefully designed.[34] Until recently, the Chilean pool operator had no infrastructure and the dispatch was made by the transmission company, which in turn was owned by the main Genco. Moreover, the pool operator –called CDEC-- is basically a club of Gencos, which means that consumers has no say in decisions which will affect the prices they face. Decisions must be consensual and any divergences are settled by the regulator. The constant conflicts among the members have led to difficulties in coordinating operations (for example, between 1994 and 1997 the regulator had to settle 20 disputes between Gencos). Moreover, net buyers in the pool during supply restrictions (usually hydroelectric Gencos) have refused to pay what they considered exorbitant prices during periods of supply restrictions, i.e. during droughts, referring the issue in dispute to the inefficient and unprepared legal system. This behavior creates weak incentives on generators to invest in thermal as opposed to hydroelectric capacity.[35]

Moreover, the legal responsibility of the pool operator was weak as, until recently, it did not have a precise legal status. Recent legal reforms have led to some improvements relating to its independence and composition. New rules (introduced in December 1998) establish the legal status of the pool operator, increase its responsibilities and makes it more independent. Moreover, the spot price in the pool covers a complex process of bargaining among members over issues such as modulation services indivisibility and other problems. A new entrant with no contracts would confront these implicit rules which are not reflected in the spot price (see also Wilson (1999)). The risk of entering and facing discrimination from the other producers is large unless the entrant has long term contracts for a large fraction of its production.

Peru and Colombia have systems that improve on the Chilean pool operator. Though the composition is similar (except that Colombia admits a representative of the discos), they have their own independent personnel. Their decisions also require unanimity and disputes are settled by the regulator. In Argentina and in Bolivia, the pool operator encompasses all the participants in the market : generators, large users, transmission companies, distributors and the regulator (presumably to represent the interest of regulated users). Decisions in both countries require a majority rather than consensus, but whereas in Bolivia the regulator can only cast a vote in case of a tie, in Argentina the regulator has veto power. This is probably inconvenient, as it tends to reduce the independence of the pool operator and allows political considerations to intervene in technical procedures.

5.3 Penalties and enforcement

As mentioned before, South American countries suffer from a problem of credibility of the regulator, in the sense of regulatory takings mentioned in Spiller and Viana (1996). In an effort to correct for this fear, in first generation countries it protects companies too much. Hence, it ended up with a weak regulator that lacks relevant information and the means of obtaining it, is starved for funds, is subject to strong pressures from electric lobbies and finally, does not have the tools to enforce regulations. Chile is remarkable in the weakness of the regulator: it has never been able to impose the compensations to consumers envisaged in the case of a shortage of energy. The possibility of appealing the regulatory decisions to the courts has made the regulator even

weaker.[36] The rules that allowed no entry of new Gencos in Bolivia for five years after privatization had the effect of delaying the entry of new operating plants for the period of the restriction. Established Gencos were constantly making announcements of entry and then delaying it.[37] Once again, we find that the regulator is to weak to act in the appropriate way: i.e. to lift the entry restriction from companies that announced projects that did not enter the market.

On the other hand, Argentina has shown that a regulator can impose strong penalties: when the distribution company for Buenos Aires left a neighborhood without electricity for two weeks the penalties exceeded US$70MM. Colombia also has a strong regulator, which took over command of the system when during the 1997 drought he came to believe that hydroelectric power companies tended to use their water too fast. Of course, this turned out to be a mistaken and costly belief.

Finally, it seems there are economies of scale in regulation and in competition (at least for the smaller and mid-sized LA countries) that imply that small countries are at a disadvantage. Note that the average plant in Bolivia is 50MW in size, due to security concerns and because demand is so small that larger plants would initially have been underutilized.

5.4 Vertical integration and regulation of monopoly power

Regulatory weakness exacerbates the problems of vertical integration. There is an extensive literature on the relation between vertical integration and monopoly (see Perry, 1989). It shows

that vertical integration can be beneficial or detrimental for social welfare, depending on the specifics of the case under examination. It has often been argued that the possibility of double marginalization in oligopoly markets or the existence of economies of scope imply that in general, vertical integration is beneficial and in general not related to monopolization of a market (see Brunekreeft, 1997, Emmon, 1997, Lee, 1995, and Kaserman, 1991). Recently, Economides (1991) has argued that when there is monopoly over a bottleneck, vertical integration provides incentives for the monopoly to expend resources in degrading the quality of service to competitors.[38] Using Economides as a basis, Engel, Fischer and Galetovic (2000) showed that, in the context of imperfect information by the monopolist (and the regulator), open access and service requirements are insufficient to promote competition, and that vertical separation reduces the possibility of monopolization of downstream shipping by a seaport, even if we admit the possibility of underhand agreements between the regulated port operator and independent shipping companies. Galetovic (2000) has used these ideas to develop a model of the electric sector in which vertical integration of a regulated transmission company leads to consumer prices that are higher than those in the absence of vertical integration, even when any degree of scale economies is present.

Among all South American countries, Chile is the only one in which there are no restrictions against vertical integration of transmission and generation. Other countries in the region learned from this experience: there was no new entry into the system and there were many complaints by competitors in the generating industry against the dominant company, which was also the owner of the transmission system. When these countries reformed their electric regulation they all introduced

restrictions on vertical integration.[39] It is interesting that Chile is also the country in which it is easiest to enter the markets for distribution and transmission, which are notorious natural monopolies, while it did little to promote entry into generation, where the benefits of entry are larger (see section 2).

6. Conclusions

Since the early days of reform of the electric sector in LA the approach which seemed revolutionary at the time has become common sense.[40] The Chilean reform, which is only twenty years old, looks primitive from the point of view of later reforms and it seems a transitional form between the state-owned firms such as Electricité de France, which was very influential in the main designers of the reform, and the full-fledged market oriented reforms of the Nordic countries.

Countries that followed Chile in reforming their electric sectors have made substantial changes, which have led to freer market and enhanced competition. Although these changes have improved the functioning of markets, they can not be considered best practices in regulation at international standards. The fear of regulatory takings is still present in LA and it affects the scope for reform. Nevertheless, the road to the future seems to include the following aspects:

1. A movement towards a system in which various markets interact: long term contracts; derivatives, both financial and physical; and a series of markets close to the actual time of

dispatch. Having various markets serves two purposes: it reduces the importance of market power by reducing the amount traded in the market which is most sensitive to market power (the final adjustment market), and rewarding plants of different capabilities such as fast response but high cost as well as low cost baseline plants. The [1]energy markets should be coupled to markets for ancillary services that provide quality.

2. Market power has been a problem in most bidding systems, so it is essential to unbundle firms vertically and horizontally or at least to have rules that ensure that small, non-integrated entrants have a chance to compete in the market. Moreover, the rules in the market should be designed to reduce market power and to be flexible so that they can be modified if firms learn to use the rules to the detriment of competition.

3. Distribution should be unbundled into its components: commercialization services firms and a local transport monopoly. Commercialization services are potentially competitive if entrants are not mistreated by the incumbent. This is a distinct possibility if the incumbent retailer is owned by the owner of the regulated distribution grid. If ownership separation is impossible, quality of grid service should be monitored carefully by the regulator, which should also try to avoid discrimination of the grid owner against rivals. One attractive possibility is the division of the incumbent retailer into several firms. From the point of view of users, retail competition allows plans that are tailored to the specific needs of the user. Moreover, retail competition simplifies the tariff setting since the regulated service is simply the price of local transport.

1

4. Transmission constraints should occur in efficient transmission systems, but they should provide signals for increased investment in transmission or in increased investment in plants in importing areas. The Nordic approach of dynamic transmission areas, where prices adjust to eliminate the excess flows in congested transmission lines, appears to provide the correct signals for investment (even though economies of scale imply that efficiency requires a fixed payment for investment in additional transmission capacity).

5. The pool operator should include the various participants in the market and not become a generating club, as it is in several LA countries, since the participants will set internal rules that limit entry into the market.

6. Since international connections will become more common, increasing local competition, it is important that rules of operation are compatible between the various countries involved in these supra-national electric systems.

Finally, we must conclude by recalling that the early LA reforms were useful, both in leading the way for other countries and in raising efficiency in their own countries. Nevertheless, they are now obsolete and should be updated. There is no single best approach at present, as countries experiment with a wide array of different institutional arrangements. This means that any new reforms should include flexible rules that can be adapted to new advances in the regulation and design of electric systems.

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Appendix: Optimality of the marginal cost rule.

We consider a simple model where there are only two types of plants, with marginal costs $c_1 < c_2$ and unit capacity costs $F_1 > F_2$. The capacities of the two types of plants are $\bar{q}_1$ and $\bar{q}_2$. All transactions are spot price transactions, since this is a long run model and without uncertainty there should be no need for contracts. Plants receive a payment for energy equivalent to their sales at the spot price. They also receive a power payment that covers the unit cost of capacity in type 2 plants. We assume perfect divisibility of plants.

The power curve q(t) shown in the bottom of figure 1 describes the ordered demand, assumed fixed, for energy versus hours (or half hours, depending on the dispatch) of the year. The hour of highest demand in the year occurs at T = 0. The lowest demand occurs at $\underline{T}$. Let T_1 be defined by $\bar{q}_1 = q(T_1)$. For all $T \in [\underline{T}, T_1]$, supply can be covered with the low marginal cost plants. For all hours $T \in [0, T_1]$, demand requires that in addition, at least some of the capacity in high marginal cost plants be used and $q(0) = \bar{q}_1 + \bar{q}_2$. The total cost of each type of plants can be written as:

$$C_1 = c_1 \int_{T_1}^{T} q(t)dt + c_1 \int_{0}^{T_1} \bar{q}_1 dt + F_1 \bar{q}_1$$

$$C_2 = c_2 \int_{0}^{T_0} \{q(t) - \bar{q}_1\} dt + F_2 \bar{q}_2$$

$$C_1 = c_1 \int_{T_1}^{T} q(t)dt + c_1 \int_{0}^{T_1} \bar{q}_1 dt + F_1 \bar{q}_1$$
$$C_2 = c_2 \int_{0}^{T_0} \{q(t) - \bar{q}_1\} dt + F_2 \bar{q}_2$$

(1)

and total revenues, including the capacity payment are:

$$R_1 = c_1 \int_{T_1}^{T} q(t)dt + c_1 \int_{0}^{T_1} \bar{q}_1 dt + F_2 \bar{q}_1$$
$$R_2 = c_2 \int_{0}^{T_1} \{q(t) - \bar{q}_1\} dt + F_2 \bar{q}_2$$

(2)

Obviously, the high marginal cost plants cover their costs exactly. To find the installed capacity on low marginal cost plants, note that $R_1 = C_1$ implies that $(c_1\text{-}c_1)T_1 = (F_1\text{-}F_2)$ or;

$$T_1 = \frac{F_2 - F_1}{c_2 - c_1}$$

To show that this assignment of capacity is the one that minimizes cost, consider the upper part of figure 1. It shows the total cost of operating the two types of plants as a function of the number of hours of operation. Clearly, it is effcient to operate the low marginal cost plants if they are used for more hours than the intersection of the two curves, which occurs precisely at T_1.

Notes

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1 Compare it to the case of Chile, where the dominant Genco in the central region, generates about 60% of energy and is the owner of the transmission grid. In 1992, a holding that owns distribution companies which have 45% of all clients took control of the Genco.

[2] Developed countries have established sophisticated energy markets which bids by buyers, thus obtaining a demand curve. Moreover, they have long term forward contracts, derivatives and sometimes decentralized markets (see Millan (1999) or Wilson (1999)).

[3] In large countries, there may be several organized mechanisms which are in constant communication if the systems are interconnected. The pool operator is also responsible for system integrity and thus for responses to unforeseen spikes in supply or demand.

[4]El Salvador and Brazil are the exception. In these countries the pool operator dispatches only non-contracted energy. Generators and other operators in the pool are required to submit bids on price and available capacity after physically fulfilling contracts.

[5] Though Peru is considering introducing a bidding for thermal power plants (not for hydraulic power).

[6] For UK derregulation see Green, R. (1998).

[7]This is the theory, since in practice, about a third of the plants in Colombia operate in out-of -merit order due to transmission constraints and other problems, see Rudnick (1998).

[8] Argentina seems to be the only country in South America in which thermoelectricity is dominant.

[9] In specially rainy years, when reservoirs are full and letting off water, and all energy is produced by hydroelectric plants, the marginal cost of energy is zero.

10 In Colombia, following the UK example, all bids are based on delivery at a single geographic point, thus sacrificing spatial differences.

[11] This statement must be qualified, since there currently are many alternative bidding systems, with various degrees of complexity.

12 The concept of marginal cost pricing was first designed for the state owned Electricité de France.

13 The distrust of private markets for utilities was also widespread in developed countries at the time.

14 Large customers' freely negotiated prices are likely to include investment costs. Moreover, they usually consist of a short run marginal cost plus a capacity payment.

15 A similar system of payment for capacity is used in Bolivia and Colombia

16 In Argentina, plants must include a reserve for these events (hence it is factored in the investment decision). These reserves can be traded between plants and the exchanges are remunerated with the difference between the spot price and the marginal cost of the least expensive plant that keeps a reserve. In Colombia there are plans to establish a market for rolling reserve. Other countries, such as Chile, do not remunerate these services.

17 As in the case of the spot price of power, in most LA countries (including Colombia but not Argentina) the regulated price of power is the annuity that would pay for the cheapest possible addition to capacity, i.e. an open cycle gas turbine. Since this is a fairly well established price, there are few disputes between the regulator and firms in this regard, excepting the disputes on the appropriate size of the plants.

18Note however that in Chile the majority of the free contracts are themselves indexed on the regulated price, a fact that reduces the usefulness of the price band.

19 Incidentally, Fischer, Galetovic and Serra (1999) show that given the incentives implicit in short-term marginal cost dispatch, consistency requires that any fixed payment in a supply contract be excluded from the computation of short term marginal costs.

[20] Regulated consumers have implicitly paid an insurance because the outage cost is included in some of the hydrologies that are used to compute the regulated price of energy.

[21] See and Fischer and Galetovic (2000).

[22] In one case, it was necessary for the regulator to physically take over the plant to start generation

[23] As an intermediate stage, the marginal cost bids will probably last a week rather than the present six months.

[24] The use of the Shapley value imputation to cover fixed costs is better but determining the imputations is not an easy task.

[25] An alternative would be to define the area of influence as those components of the system that are affected by the maximal injections of a plant or by the maximal demand of a user.

[26] *Excess transmission may appear when transmission expansion takes place in discrete jumps due to economies of scale.*

[27] However, this last possibility seems unlikely when transmission companies have no obligation to serve, and when the expansion of system is regulated and requires the agreement of other users, as in some LA countries.

[28] EL Salvador has a similar system: those that require expansion pay for them. However, the pool operator may ask the regulator the approval of so called common benefit expansions, and request that the beneficiaries finance them.

[29] Williamson (1985) has noted that the type of long term contract usual in the Demsetz scheme is subject to renegotiation, in which case many of the attractive properties of the approach are lost.

[30] It is probably needless to mention that the observability of compliance with this clause is unlikely.

[31] See Harberger (1956} (a paper written in 1956 and recently published) for the point of view at the time, or Rudnick (1991} for a retrospective of the development of the electric sector in South America.

[32] Bolivia and Perú followed the route of detailed legislation.

[33] In Argentina, public hearings on proposed regulatory changes are used to a similar effect.

[34] The designers were influenced by their previous experience of collaboration under a state-owned system and thus were unaware of the potential for disputes between members of the pool and on how a good design could minimize these disputes and the associated coordination costs .

[35] It also deters new entrants which would add thermal capacity in the expectations of high prices under droughts.

[36] Recent changes to electric legislation have given more powers to the regulator: It is not clear, however, if the changes were thought out carefully or were a hasty response to the deficiencies during the drought.

[37] Apparently they made these announcements in order to curb pressures against the restriction.

[38]See also Vickers (1951} for the case of a regulated integrated monopoly lowering quality to downstream competitors.

[39] Several countries have also set limits to horizontal integration.

[40] See Spiller (1997) for another example of small LA countries leading the pack in telecomms.