SECOND GENERATION REFORMS IN LATIN AMERICA AND THE CALIFORNIA PARADIGM

Hugh Rudnick and Juan-Pablo Montero
Pontificia Universidad Católica de Chile
Santiago, Chile

Abstract

In this paper we discuss second-generation electricity reforms being formulated in Latin America and how they are being reshaped by the California crisis, which had stood as a paradigm, at least in theory, for fully competitive markets. We argue that the main lesson policy makers in Latin America should draw from the experience in California and other electricity markets around the world is that the liberalization of wholesale markets will not result in more competitive outcomes where market concentration is significant, final consumers are isolated from actual marginal production costs and capacity is tight. At least in the case of Argentina and Chile, the California crisis has had a “positive externality” by persuading policy makers, at least momentarily, to postpone liberalization reforms and make them realize the complexities in implementing competitive markets.

Latin American electricity supply industry

The electricity supply industry in Latin America has faced a profound transformation, with no parallel worldwide. Challenges are diverse in the region, all countries requiring high investment to respond to very large growth of demand. While industrialized countries have an average annual growth of 1 to 2%, the Latin American subcontinent has an average growth of over 5% and higher in periods where their economies are expanding. Chile is a good example of growth rates present in the region (Fig. 1).

There are additional differences in the Latin American electricity industry. Systems are often of a radial nature, few meshed network and only few incipient international interconnections. Hydro generation dominates (71.8% of installed capacity, 1997 figures), often with plants in complex series hydrological schemes. Out of 190000 MW installed in the region, Brazil dominates with 31%, followed by Mexico with 20%, Argentina and Venezuela, each with 11%. Electricity consumption per capita is small as compared to the developed world (Fig. 2), which in part explains high growth and attractive opportunities for investment.

The electricity sector was developed initially, at the end of the 19th century, by private investors, often mining and industrial entrepreneurs bringing the technology to the region. However, while electric energy became a basic tool for development, the economic crisis of the 1930’s brought private investment to a halt. Governments started to take action and national electricity state-owned companies developed, examples being Eletrobras, Edelca, Endesa Chile, Electroperu, ISA, and Comisión Federal de Electricidad, among others. These state companies integrated vertically, performing all activities in the sector, and centrally planning operation and expansions. Often, these companies grew like states within a state, regulating themselves as state monopolies.

However, these state monopolies often had intrinsic conflicts, where efficient social supply objectives were confused with political intervention, where tariff subsidies and unemployment control coupled with inefficient management. High losses and economic and financial crisis of those companies resulted many times in problems with quality and security of supply. Worse than that, companies were not able to raise and support the needed financial credit to
maintain high investment to couple with high demand growth. States had to intervene, diverting resources urgently needed for other social objectives.

Within that framework, reasons for deregulation, and privatization, differ to those of similar processes elsewhere. The driver has been the need to establish conditions for economic efficiency and private investment. States withdrew from the electricity sector and took a subsidiary role, with the possibility to intervene only when private sector fails to do so, but mainly concentrating in regulation and control. With those objectives in mind, the centralized planning and operation was replaced with market–oriented approaches, in a process of de-verticalization, de (re) regulation and privatization.

Reform schemes have very much been conditioned by the mainly hydroelectric characteristic of the systems. All country deregulation models have constituted centralized Poolcos (Rudnick, Varela & Hogan, 1997), based on a monopolistic co-ordination of generator operation and market clearing, seeking to emulate perfect competition conditions based on marginal costs, with a centralized planning of their operation. Competition is stimulated at the generation level, with prices unregulated for large consumers, with a pass through scheme defined for small consumers. Table 1 summarizes wholesale market design aspects in countries that have led reform. Most countries introduced a two-part price scheme, where short-term energy marginal costs couple with capacity pricing, an additional economic element formulated as an adequacy signal to stimulate new investment and expansion. Marginal costs also incorporated nodal differences to reflect generation-transmission interaction.

<table>
<thead>
<tr>
<th>Country</th>
<th>Hydroelect. capacity %</th>
<th>Dispatch</th>
<th>Capacity payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>43 %</td>
<td>CAMMESA (Compañía Administradora del Mercado Eléctrico Mayorista)</td>
<td>Payment to gens contributing with energy in the 90 hours of the weekly peak demand period. Depends on dispatch. It is fixed at 10 US$/MWh.</td>
</tr>
<tr>
<td>Brazil</td>
<td>90 %</td>
<td>ONS (Operador Nacional del Sistema)</td>
<td>Payment being considered.</td>
</tr>
<tr>
<td>Chile</td>
<td>61 %</td>
<td>CDEC (Centro de Despacho Económico de Carga)</td>
<td>Payment to gens contributing with capacity in the yearly peak demand period (may-sep). Depends on availability, time to start and time to full load. Independent of dispatch. Capacity price defined by regulator every six months, fixed cost of gas turbine. It is fixed at 5.25 US$/kW/month</td>
</tr>
<tr>
<td>Colombia</td>
<td>66 %</td>
<td>CND (Centro Nacional de Despacho)</td>
<td>Payment to gens contributing with energy in dry season (dec-apr) in an extra-dry season. It is fixed at 5.25 US$/kW/month</td>
</tr>
</tbody>
</table>

Table 1. Wholesale market fundamentals

With the exception of Colombia, the markets organized around these power pools are not really spot markets like the ones observed in the pools of England and Wales and Australia where generators face no restriction on their bids. As explained in Table 1, generators in Chile and Brazil are dispatched based on estimates of their marginal production costs while in Argentina thermal generators have some bidding freedom. The Colombian Pool, on the other hand, is
quite similar to the England and Wales Pool in the sense that all energy is centrally dispatched by the system operator (SO) based on bids made by generators. Each generator submits a daily bid schedule consisting of a bid price and an available capacity for each hour of the following day. Every hour the SO dispatches the generators up to their available capacity to satisfy demand and the clearing price for that hour is equal to the bid of last generator being dispatched (it is a first-price multiunit auction).

The rest of the market is segmented, with central regulation for transmission and distribution. Transmission open access regulation is used, with global allocation of network costs in a use of system approach. Incentive-based regulation is used in distribution. Segmentation varied from country to country, with remains of vertical and horizontal integration. The Chilean market is the one with higher concentration, only three main generating companies controlling 94% of the installed capacity of the main system.

**Successes and failures**

Electricity prices have declined significantly in most Latin American countries in the last decade, reflecting decreasing marginal costs due to the arrival of combined cycle gas turbine technologies and important amounts of private investments have flown to the region. Security and quality of supply has increased, a striking example being Argentina with a drastic reduction of non-served energy from high rates of 16% a month (25% a day) in the late 80s to virtually zero today.

Those successes in Latin America have coupled with market design problems, with struggles in the governing of the independent operator, conflicts on wholesale market energy prices and capacity prices, difficulties in transmission open access and in distribution pricing. Most recently, concern has grown on signals of a decreased interest by the private sector in continuing the high rate of investment both in generation and transmission. This has been worsened in recent years with supply deficits in Chile and Brazil, affected by severe droughts, which have tested market designs to the limit.

The Chilean 1998-1999 supply crisis is a learning example. A severe supply disruption took place with rolling blackouts, conflicts among electricity companies and with the regulator, and a significant social and economic impact on society, which led the country to hurried emergency changes to the electricity law. Although the origin of the crisis was essentially conditioned by exogenous factors (a centennial drought), the elements that prompted the crisis were very similar to those that later influenced the California crisis. While short-term marginal costs increased up to the cost on non-served energy, regulated consumers—which account for more than 60% of electricity consumption—were making consumption decisions based on a long-term marginal cost of production completely isolated from the true marginal production cost at the moment. This uncoupling between supply shortage and forced demand inelasticity in practice meant a failure of the price system. Although generating companies had potential alternatives to cope with the crisis were the right prices in place (Diaz et al., 2000), the lack of such correct price signals slowed action, worsening impact on the companies themselves and the country as a whole.

The crisis also demonstrated, dramatically, the difficulties of the political class to face emergency conditions in energy supply. Despite the regulator had legal tools to manage the crisis by bringing spot prices closer to marginal costs, ill thought solutions were taken to ensure supply and protect quality and security, but in practice created new problems that later weakened the contract system, leaving distributing companies with no support to ensure future electricity provision.

A similar questioning has arisen in Argentina, criticizing the pass through price scheme, even in normal non-emergency conditions. The centralized dispatch and the correspondent regulated prices to final consumers are in the firing mark. Resultant prices are questioned as not reflecting real market conditions, thus slowing new investments, weakening adequacy of supply and limiting new competing entrants into the market.

**Need for second-generation reforms**

Thus, the need to reform the market regulations and increase competitive conditions has been seen as a necessity. Argentina, Chile and Brazil, among others, have been searching for alternatives. While the UK Pool has served as the model for Colombia, the California line of thinking arose as a new paradigm that was studied with interest for the rest of the region. Criticism had arisen on the centralized poolcos (where energy is dispatched according to audited costs
instead of firms’ bids), formulating the need for a second stage of reform, establishing highly flexible mechanisms of decentralized exchanges, and achieving real market mechanisms, with wholesale and retail competition.

While the second-generation concepts are not unique to California, as countries such as Norway, the UK (with its recent NETA scheme) and Spain have made similar reforms, the California model arose as the paradigm in the region. Given the vast experience with the operation of centralized pools, it is surprising that the alternative restructuring option along the lines of the pools in the UK and Australia was not seriously considered at the time.

The defined objective was, within the California paradigm, to replace the centralized pools and to force "perfect" competition with the laissez faire model of the power exchange (PX), coupled to an independent system operator (ISO) that dispatches essentially based on long-term physical bilateral contracts plus short term unrestricted bids. Critics of the Latin American schemes argued that commercial agreements should determine the dispatch through successive markets, with supply and demand independently considering all relevant variables in their decisions, including business uncertainties. They argued that this would also allow development of markets for all type of transactions of the electrical product (ancillary services, reserves, load shedding, etc.), including financial derivatives (futures and options markets). Within the new line of thinking, nodal price schemes were discarded, as well as explicit capacity payments (they would have to be incorporated, if needed, in energy bids).

Retail competition was also seen as a necessity, with transparent distribution and transmission regulated pricing that would bring competition to all consumers. Large consumer could then directly negotiate for their power supplies with generators or buy directly in the spot market while smaller consumer (mostly residential) could have the option to buy power from different retailers including the actual distribution company. The concept of regulated consumer would be gradually phased out, with demand driving prices and quality of supply. This meant further segmenting the industry at the distribution level, separating the operation and maintenance of the distribution network from power retailing.

Chile first (CNE, 2000) and Argentina later formulated reforms to their regulations among these lines. These second generation “a la California” reforms had the following elements in common: decentralized dispatch based on physical contracts, wires separated from retailing at the distribution level, capacity payments eliminated, system operator separated from power exchange and regulated consumers phased out in stages (for example, Chile would go from 2000 kW to 200kW in 5 years).

Lessons from California for Latin America

With the California crisis developing and its power exchange being closed, the concern arose in Latin-American countries about the validity of this new paradigm for second stage reforms. The California crisis froze the changes and questioned the new reform proposals. Countries questioned themselves if they were seeking a remedy worse than the disease, assuming that unregulated bid based spot exchange markets that also drive system operation were simpler than their counterpart. They also wandered about the dominant positions that may develop in highly horizontal and vertically integrated conditions.

Chile provides good evidence on this change of perspective regarding the potential benefits of market liberalization. The reform program designed by the Executive (CNE, 2000) was originally scheduled to go through congressional review and approval by the beginning of 2001. For several reasons, including the events in California, the Executive decided to postpone congressional review until further studies and analysis about the most appropriate reform program were conducted. A new draft of legislation is being crafted with dramatic differences respect to the original design. Apparently, the Californian decentralized approach is being replaced with an approach following the UK Pool model. The current centralized dispatched system based on audited marginal costs would then be replaced with a dispatched system based on firms’ actual bids. Bidding rules, however, would give firms much less freedom than in the UK Pool. As an effort to prevent market power problems, bids could be changed on less frequent basis, perhaps, monthly or even every six or twelve months.

California provided important lessons for Latin America, on issues such as market design (centralized bid-based pools vs. decentralized systems), decoupling of the different stages of market operation and physical operation, market governing, environmental restrictions, market power and gaming, capacity payments, contracts and demand price elasticity. It showed how partial deregulation could make matters worse than otherwise and how lengthy and uncertain legislative processes can have detrimental effects on investments. California also showed that electricity deregulation
must be understood as a dynamic regulatory process where institutions must be flexible enough to introduce changes as circumstances so require.

However, care must be exercised when making the comparisons. The starting point for these new reforms in Latin America is an electrical sector already deregulated, that has for some time been seeking competitive generation markets, and where in essence the objective is to advance to new competition levels and to overcome some of the restrictions that have surfaced.

**Market power**

A factor that is being thoroughly assessed in California is that of market power exercise and its impact on PX prices. Although there is no coincidence by analysts of the real level of power exercised, a global concern has grown on the matter. Latin America has conditions that may worsen what took place in California. In fact, the experience in Colombion pool has not been very different from the experience in California in terms of market power problems. Particularly during periods of scant rainfall the exercise of market power has become a serious problem. The exercise of market power has been facilitated by relatively high concentration levels (3 largest companies own about 55% of installed capacity) and a provision that prevents water levels in the different reservoirs to fall below a minimum level.

With the exception of Argentina, concentration of ownership is relatively high in most countries in the region. The long-term trend is for just a few operators to manage the region, both at the generation level and the distribution level. In such conditions it may be more difficult to develop mechanisms to assure free entry to the market of generation, avoiding market power or cartel agreements. Further, because antitrust legislation is generally weak or non-existence in Latin-American countries, it seems that the design of any deregulatory effort must be comprehensive enough to incorporate means to diagnose and mitigate market power problems in case they appear.

Unfortunately, the California path to restrict market concentration is not an example either. The actions taken against the three large investor-owned-utilities, and the restrictions imposed, almost destroyed two of those companies, with the consequent social impact. They were asked to vertically disintegrate, selling most of their generation assets and transferring their transmission assets to the control of the system operator. They were required to work exclusively with the power exchange, without letting them hedge with bilateral contracts or financial future instruments. The regulator was unable to predict the damage that those restrictions would have on those companies.

Thus, many countries do not seem to provide the basic conditions for the development of competitive wholesale markets. Either divestiture or market expansion through interconnection with other markets would be required before market liberalization. In the case of Chile, it seems obvious from the international experience that a market where three generating companies own 94% of the installed capacity is very unlikely to yield competitive outcomes. Before liberalization of the wholesale market the government of Chile should seriously consider building transmission connections between the central and northern interconnected systems and, perhaps, between Chile and Argentina (Montero and Sanchez, 2001). This would considerably increase competition among generators and would reduce the proportion of hydropower generation that is also a concern for the well functioning of these markets.

**Hydro predominance and its impact**

Another condition that has not a parallel in California is the predominance of hydroelectricity in Latin America. There is little knowledge world wide on market power playing in predominantly hydroelectric systems, nor on its impact on an adequate reservoir usage and on price volatility. Because a system with a large fraction of hydropower is subject to constant changes in supply and costs and to periods of very tight capacity (i.e. during droughts), the deregulatory design needs explicitly deal with this issue. California showed that market power problems are particularly serious during periods of tight supply.

Brazil, with its dominantly hydro-based power system, faces an electricity crisis product of a severe drought. Rather than questioning the effect of dispatch rules and poor investment on the crisis, the Brazilian case seems to suggest that predominately hydro-based systems provide the least favorable conditions for the development of competitive, privately own generation markets, or for that matter, the most difficult to design. Hydro power plants involve high fixed cost and negligible variable costs. There is a risk that prices can be held down by the regulator during periods of tight capacity (i.e. drought) and can fall close to zero during periods of excess rainfall in a competitive market.
Research is being performed in the region to identify the possibility of liberalization of the market through bid-based schemes and the presence or not of market power, particularly in predominantly hydro markets (Watts & Rudnick, 1998). Kelman, Barroso and Pereira (2001) demonstrated that in a highly hydro system like the Brazilian one, long-term system dispatch could be significantly affected, particularly through manipulation by the large reservoirs. Simulations with analytical market models with strategic producers show that the total output produced is smaller from the least-cost solution. Further, the strategic hydro plants increased spot prices by decreasing the water transfers from wet to dry seasons.

Villar and Rudnick (2001) made a Nash-Cournot simulation exercise of short-term dispatch in the main Chilean system. The extreme case, where all energy is sold in the spot market, with no contracts, was simulated, with bids for quantity and prices within a week or a day. A dynamic game simulation of a competitive market was made, considering elastic linear demand curves. Two levels of gaming were compared with the competitive condition: games by generating units maximizing benefits and games by companies, also maximizing benefits. Figs. 3 and 4 illustrate preliminary results.

Colombia provides some evidence of the complexities in dealing with problems of market power in systems with a large fraction of hydropower plants. To avoid tight supply conditions, the Colombian pool puts restriction hydro units’ bids when water levels are below some predefined levels. Stacchetti (1999) claims that such an approach has helped some firms to effectively exercise market power. Much more theoretical and empirical research is needed to understand problems of market power in hydro systems and means to mitigate it.

The use of bilateral contracts can be an important instrument to reduce market power (Green, 1999). In hydro based systems contracts would be of interest, given the high price volatility. A particular aspect of those systems is the variability of the income of the agents in the market. In the short term the volatility of the income is small, since water can be stored transferring energy from off peak hours to peak hours. However, in the mid-term the income can register important fluctuations. Predominantly hydroelectric systems are designed to assure supply under adverse hydrology conditions, however this situation rarely occurs. As consequence of this, most of the time the spot market is low, due to overcapacity. On the contrary, if dry conditions arise, the spot price can dramatically increase. Thus, contracts become a valuable tool to stabilize revenues. The more capacity contracted the lesser the impact of spot prices in the generator revenues. The more capacity engaged, opportunities for market power reduce, a more generators may be available to bid residual energy required in the market.

**System governance: the ISO and the PX**

A market design with an ISO and a PX is more complex of structuring than a centralized Poolco type scheme. Very central to the success of this market model is the governance design of those entities, avoiding what happened in California. The participation of agents of the market (for example, generators) that may benefit from decisions may introduce pollution to the decision process and cloud its needed transparency. This has been recognized by FERC, which ordered changes in that regard. Proposals in Latin America to separate the operator and the exchange, as private audited companies in which market agents do not participate, except the transmitter in the operator, seem better solutions.
Even though the requirement that the three California IOUs centered their exchanges in the PX, restricting the establishment of bilateral contracts, was of a transient character, most of the crisis originated in this restriction. It is importance that the PX constitutes only in a voluntary market and only for complementary adjustments to the contracts market, and so are the concepts being considered in Argentina and Chile. The characterization of the PX as a voluntary market and not obligatory was also outlined by FERC as one of the actions to face the crisis. As indicated before, possibilities for market power exercise also reduce.

**Demand response and price elasticities**

One of the causes of the California crisis was the wrong decision on price caps to final consumers. Similar conditions could arise in the regulation of pass trough prices in Latin American countries. A wrong forecast by the regulator of the resulting evolution of prices could result in lower or greater values, as compared to real market prices. This wrong forecast resulted deadly in California, upon freezing prices to final consumers, while IOUs, without hedging contracts, were buying at higher values in the PX. Fixing prices may discourage new investments, in practice reducing the election options of the consumers and limiting the necessary expansion in generation. A wrong forecast in Chile is blamed for a reduction of private investment in the generation market.

Considering totally inelastic consumers is also seen as a failure of design in the California market. The same happens in Latin American reforms, thus subtracting a central tool in the development of the competitive markets, which is that of allowing demand response to price fluctuations. These reform models agree in the little importance they give to the elasticity of demand, as an economic signal and as stabilization instrument of the market. The development of mechanisms that permit final consumers to react to price changes in the wholesale market has multiple social benefits (Montero and Rudnick, 2001), in addition to permitting to face critical situations as those experienced in California.

Through an effective retail competition demand can response to price fluctuations and help alleviate market power. Transactions between generators, end user and a number of intermediaries, including retailers, brokers and the existing distribution company would take place freely. End users would be free to choose their supplier and to negotiate their contracts. Introducing consumer choice and demand responsiveness can have some limits, however. The cost of metering for small consumers may be higher than the cost of lower electricity bills (see Borenstein (2001) for a further discussion of these issues).

**Capacity payments**

An aspect that has not been sufficiently studied in California relates to economic signals for new installed capacity, fundamental in markets with significant growth and highly subject to supply shocks (e.g. droughts). Most of the Latin American regulations contain a signal to this effect, which are the capacity payments (see Table 1). It often remunerates investment in generation by its contribution to peak capacity, independent of its energy contribution. The elimination of this capacity payment in the second-generation reforms being thought in Argentina and Chile is a matter that deserves a greater analysis. Spain, with a model very much inspired in California, maintains such capacity payment and in fact it is studying the creation of capacity markets, based on a contract reliability base and financial options. The concept in study compels to distributors to contract a product "capacity", assuring a certain minimal level of long term reliability.

**Concluding remarks**

There is no doubt that the California crisis has reshaped reform programs across Latin American countries. In the case of Argentina and Chile, the authority has been persuaded, at least temporarily, to postpone liberalization reform and apparently has desisted from using a decentralized approach like the one in California and in Chile begun considering a centralized bid-based system like the pools in UK (before NETA) and Australia. In this sense, the California crisis has been fortunate because a liberalization of the generation market in Chile at this moment makes little sense given the high degree of horizontal concentration and the vertical integration between distribution and generation.

On the other hand, whether a centralized approach like the one in the UK pool can be more or less effective in preventing the exercise of market power than a decentralized approach is an open question. There are neither theoretical nor empirical arguments that can answer such question. A centralized bid-based system, however, does allow the regulator to move gradually from an audited cost dispatch system to fully liberalized market. For instance, it is possible at the beginning to restrict firms’ bids to be changed on less frequent basis than on a daily basis.
Nevertheless, energy regulatory reform in the region is a dynamic process, and further changes may develop. Fortunately, these changes are being implemented in a region where the different agents and the regulators have already walked a path of reform, and are learning from their own success and failures as well as those of others. The path is still being defined, but clearly the naive approach to an ideal unregulated bid based spot exchange market has been discarded.

Acknowledgements

Thanks for the support from Fondecyt Project 1000517.

References


CNE (Comisión Nacional de Energía), Project to reform the current electricity law, Document for public discussion, September 2000 (www.cne.cl)


