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Second Generation Electricity Reforms in Latin America and the California Paradigm

Juan Pablo Montero
Hugh Rudnick

SECOND GENERATION ELECTRICITY REFORMS IN LATIN AMERICA AND THE CALIFORNIA PARADIGM

Hugh Rudnick and Juan-Pablo Montero*

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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.

1. The Latin American electricity supply industry

The electricity supply industry in Latin America has faced a profound transformation in the last two decades.[1] Despite challenges are diverse in the region, all countries require high investments to respond to a continuous increase in demand. Because electricity consumption per capita is relatively small (Figure 1), it is not surprising that while industrialized countries have had an average annual growth of electricity consumption between 1 to 2%, the Latin American subcontinent has experienced an average growth of over 5% during the last decade.

There are other characteristics particular to the Latin American electricity industry. Systems are often of a radial nature, with weakly meshed networks and only few incipient international interconnections. Hydro generation is the dominant supply source in the region with a share of 71,8% of the total installed capacity (1997 figures) and often with plants within complex series hydrological schemes. Out of the 190,000 MW

* Hugh Rudnick is Professor of Electrical Engineering at the Pontificia Universidad Católica de Chile (PUC). Juan-Pablo Montero is Professor of Economics at PUC and currently Visiting Professor of Applied Economics at the Sloan School of Management of MIT. We thank Richard Green and two anonymous referees for helpful comments and Fondecyt grant no. 1000517 for financial support.

[1] Note that our analysis mostly focus on South American countries and, particularly, Argentina, Brazil, Colombia and Chile.

installed in the region in 1997, Brazil dominates with 31%, followed by Mexico with 20%, Argentina and Venezuela, each with 11%.

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 state-owned national electricity companies developed, examples being Eletrobras, Edelca, Endesa Chile, Electroperú, 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 crises of those companies resulted many times in problems with quality and security of supply. Furthermore, companies were not able to raise and support the needed financial credit to maintain high investment to provide for high demand growth. As a consequence, states had to intervene quite often.

Within that framework, reasons for deregulation, and privatization, differ from 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 roll, 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 more decentralized approaches, in a process of de-verticalization, de (re)-regulation and privatization.

Reform schemes have very much been conditioned by the hydroelectric characteristic of the systems. All country deregulation models have constituted centralized generation pools, i.e., poolcos (Rudnick, Varela and Hogan, 1997), based on a monopolistic co-ordination of generator operation and marginal cost based dispatch seeking to emulate perfect competition conditions. 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 the design of the poolcos in countries that have led reform. Most countries introduced a two-part price scheme, where short-term marginal energy 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.

With the exception of Colombia, the "wholesale markets" organized around these power pools are not really markets like the ones observed in the pools of England and Wales and Australia where generators face virtually no restriction on their bids. As explained in Table 1, generators in Chile and Brazil are dispatched based on (audited) estimates of their marginal production costs while in Argentina thermal generators are dispatched

based on bids that can only be changed every six months. 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 day-ahead 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.

2. Successes, failures and need for further reform

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 flowed 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 if the right prices had been 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. Although 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. In practice these hasty solutions 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 regulated prices to final consumers are under attack. Resultant prices are questioned as not reflecting real market conditions, thus slowing new investments, weakening adequacy of supply and limiting the entry of new competitors.

Consequently, 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 by the rest of the region.[2] Criticism had arisen on the centralized poolcos, 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 types of transactions of the electrical product (ancillary services, reserves, load shedding, etc.), including financial derivatives (futures and options markets). Within the new line of

[2] In the case of Chile, this is particularly evident in the proposal for reform presented by the Executive in September of 2000 (CNE, 2000).

thinking, nodal price schemes were discarded and explicit capacity payments were either not considered or substantially modified.[3]

Retail competition was also seen as a necessity, with transparent distribution and transmission regulated pricing that would bring competition to all consumers. Large consumers could then directly negotiate for their power supplies with generators or buy directly in the spot market while smaller consumers (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.

3. Lessons from California

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 wondered 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 from the original design. Apparently, the Californian decentralized approach is being replaced with an approach following the UK Pool model. The current centrally 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,

[3] In the case of Chile capacity payments were explicitly eliminated in the new proposed legislation (see CNE, 2000). Argentina and Colombia are considering different capacity schemes including those in Pennsylvania-New Jersey-Maryland (PJM). Colombia is also studying an advanced scheme of capacity contracts in which the power authority buys call options from generators at some strike price (Vázquez et al., 2001).

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 require. In what follows we organize the discussion on the lessons from the California crisis around five topics: market power, hydro predominance, system governance, demand-side response and capacity payments.

3.1 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 the Colombian 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 from falling below a minimum level.

With the exception of Argentina, concentration of ownership is relatively high in most countries in the region. It seems that 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 for generation and preventing the exercise of market power. Further, because antitrust legislation is generally weak or non-existent 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 policy design does not provide many insights on how to prevent the exercise of market power.[4] We believe that one of the main policy mistakes was to require the three large investor-owned-utilities to work exclusively with the PX day-ahead market without letting them sign long-term contracts. Although utilities were free to hedge in the PX forward market, for some reason this market never really developed and consequently utilities ended up purchasing almost all their energy in the spot PX market.[5]

In any case, the use of bilateral contracts, whether is voluntary or mandatory, can be an important instrument to reduce market power (Green, 1999, Villar and Rudnick, 2002). As more generation is contracted in advance, generators find less profitable to withhold

[4] Problems of market power have been detected even before the crisis of the summer of 2000 (Borenstein et al., 2000).

[5] It is an open research question whether forward and future markets for electricity have the potential to develop as well as future markets for other commodities such as oil and gas.

capacity or raises prices in the spot market simply because part of their output has been already contracted at a price different than the spot price. In anticipation of more competition (i.e., lower prices) in the spot market, firms are also likely to sign more competitive contracts.

Many countries in the region do not seem to provide the basic conditions for the development of competitive wholesale markets. Either significant 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 not only consider divestiture and mandatory contracting measures but also 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.

3.2 Hydro predominance

Another condition that has not a parallel in California is the predominance of hydroelectricity in Latin America. There is little knowledge world wide on the exercise of market power 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 to deal explicitly 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 resulting from 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 owned generation markets, or for that matter, that these are the most difficult to design. Hydro power plants involve high fixed costs 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 absence of market power, particularly in predominantly hydro markets (Watts and 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 strategic manipulation by the large reservoirs. They found that hydro plants increased spot prices by decreasing the water transfers from wet to dry seasons.

In a short-term simulation exercise for the main Chilean system, Villar and Rudnick (2002) also found significant problems of market power. They assume a linear demand with elasticities varying from –0.04 to –0.4 (depending of the level of consumption), that all energy is sold in the spot market and that firms bid for quantities and prices for each hour during a particular day. They compare three market structures: the competitive market (competitive), the current market of three companies in which one is a predominantly hydro-based (game by firms) and a hypothetical market in which each power unit represents an independent company (game by units). Hydro generation and price levels for each market structure are presented in Figures 2 and 3 respectively. When the market is not competitive there is a substantial shift of water resources from periods of high demand (11-13 and 17-21) to periods of low demand resulting in tremendous price increases. As indicated by the units game, divestiture has an important effect but is of limited scope because hydro units are relatively large.

Colombia provides some interesting 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 restrictions on 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 more market power than otherwise. Much more theoretical and empirical research is needed to understand problems of market power in hydro systems and means to mitigate it.

Bilateral contracts, whether financial or physical, can have an important effect in diminishing market power in a mainly hydro system (and it is demonstrated in simulations by Villar and Rudnick, 2002). 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 other hand, if dry conditions arise, the spot price can dramatically increase. Thus, contracts become a valuable tool to stabilize revenues. The more capacity contracted the less the impact of spot prices on generator revenues. As more capacity is engaged, opportunities for the exercise of market power are reduced and more generators may be available to bid residual energy required in the market.

3.3 System governance

A market design with an ISO and a PX is more a complex structure 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 bias 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, we believe that this restriction played a crucial role in the development of the crisis. It is important that the PX constitutes only a voluntary market and only for complementary adjustments to the contracts market, and so are the concepts being considered in Argentina and Chile.

3.4 Demand elasticity

Another important factor that contributed to the California crisis was the "elimination" of any possible demand-side response by the use of price caps to final consumers. Similar conditions could arise in the regulation of pass through 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 produced disastrous results in California, upon freezing prices to final consumers, while IOUs, without long-term contracts, were buying at higher values in the PX. Fixing prices may discourage new investments deterring the necessary expansion in generation.

Latin American proposed reforms have also exclusively focused on the supply side of the market neglecting the central role that demand-side response can play in the development of the competitive markets. As discussed by Montero and Rudnick (2001) for the case of Chile, the development of mechanisms that permit final consumers to react to price changes in the wholesale market has not only lead to allocative efficiency in the short-run but also to substantial savings in capacity investments.

In addition, through effective retail competition demand can respond to price fluctuations and help alleviate market power. Transactions among generators, end users 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 savings from lower electricity bills.[6]

3.5 Capacity payments

One 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). While in theory spot prices provide the right incentives for new investments even in capital incentive industries (unless demand is totally inelastic), several market analysts argue that in electricity markets such price signals are insufficient and can lead to underinvestment. In that regard, most of the actual

[6] See Borenstein (2001) for a further discussion of these issues.

Latin American regulations contain a provision to prevent that from happening; the so-called 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 under consideration, particularly in Chile, is a matter that deserves a greater analysis.[7] While traditional capacity payment schemes (like those in Colombia, Argentina and Spain) may not necessarily provide appropriate incentives for new investments, there are alternative market-based mechanisms that could be considered such as the creation of some form of capacity markets (as in PJM) or having the regulator buying call options from power generator at some strike price (Vázquez et al., 2001).

4. 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. 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. 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.

We believe 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 requires a comprehensive approach that take into account simultaneously both the supply and demand side of the market. It has become evident that liberalization will not result in more competitive outcomes unless potential market power problems are explicitly addressed. Policy makers must study different mitigation options such as divestiture (e.g., Argentina), minimum amount of contracting and possibly price caps.

In addition if energy prices are thought to be insufficient to secure the proper amount of installed capacity, we think that market-based mechanisms should be the preferred policy option instead of the traditional capacity payments actually in place in most countries of the region. A sound market design must also assure that final consumers (with the exception of small residential consumers) are not isolated from wholesale market prices. Moreover, demand liberalization does not need to wait for supply liberalization. Real-time pricing can be gradually introduced while the (audited) marginal costs that clear the pool dispatch can serve as a proxy for the wholesale market price.

[7] Without discussing its effectiveness, it is worth pointing out that Spain, with a model very much inspired in California, maintains a capacity payment scheme.

Although at a lower pace, energy regulatory reform in the region will continue and significant regulatory changes will eventually develop. Fortunately, these changes are or will be 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.

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Table 1. Power pools designs

Country	Hydro capacity	Dispatch	Capacity payment
Argentina	43 %	CAMMESA (Compañía Administradora del Mercado Eléctrico Mayorista) Economic dispatch defines hourly marginal cost Hydro and thermal gens declare their prices on a weekly basis every six months. There are price caps defined by regulator for thermal gens and defined procedures for estimating the value of stored water. Nodal pricing.	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$/MWh.
Brazil	90 %	ONS (Operador Nacional del Sistema) Economic dispatch defines monthly marginal cost Thermal gens variable cost are audited. Hydro gens dispatched according to cost of water calculated by ONS.	Payment being considered.
Chile	61 %	CDEC (Centro de Despacho Económico de Carga) Economic dispatch defines hourly marginal cost Thermal gens variable cost are audited. Hydro gens dispatched according to cost of water calculated by CDEC. Nodal pricing.	Payment to gens contributing with capacity in the yearly peak demand period (may-sep). Depends on availability, time to start and time to full load. Independent of dispatch. Capacity price defined by regulator every six months, fixed cost of gas turbine. It is fixed at 5.25 US$/kW/month
Colombia	66 %	CND (Centro Nacional de Despacho) Economic dispatch defines operation Energy Power Exchange receives daily bids from gens (prices and energy), hourly price determined without considering network restrictions.	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

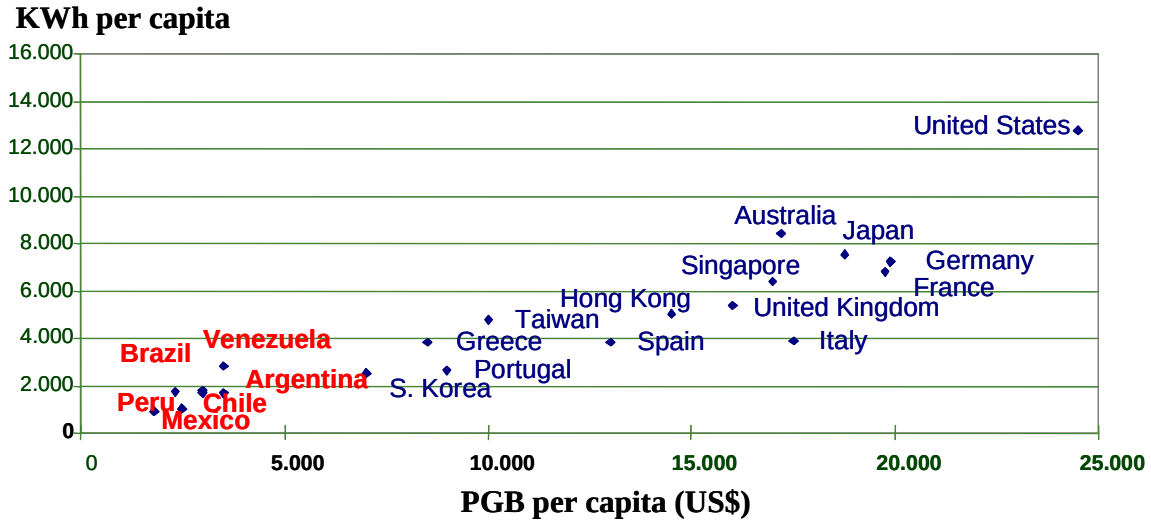

Figure 1. Per capita electricity consumption and PGB (1997)

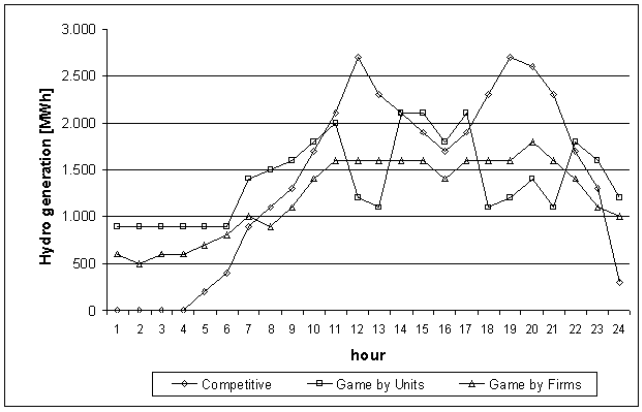

Figure 2: Total hydro generation

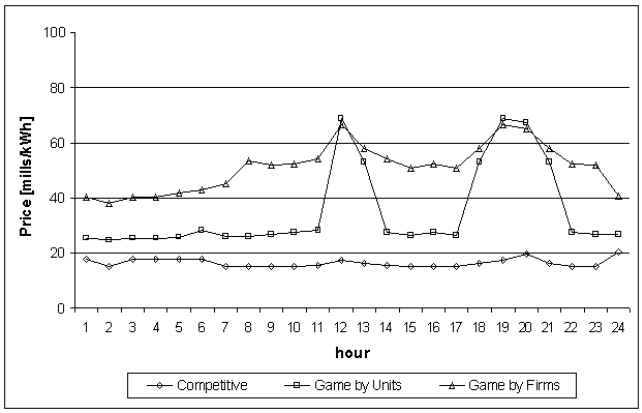

Figure 3: Clearing prices