The Second Generation of Power Exchanges: Lessons for Latin America

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Almost two decades after the beginning of the Chilean and English experiments in power sector reform and privatization, many other countries have adopted or are in the process of adopting a model that promotes competition in the wholesale power market that is based partly on the pioneering efforts of those two countries. As often happens, successful pioneers become the most fervent apologists for their innovations, touting their validity for all kinds of situations, regardless of the specific conditions in each case. The Chilean and English models are the evolutionary basis of two models, which while having many features in common, reflect special conditions of time and place. Some of the countries that adopted these models often introduced significant improvements, as in the case of Argentina. In particular, Norway stands out as an example of a careful adaptation of the English model with satisfactory results. In addition, "second-generation" reformers like Spain, the United States, Australia and New Zealand have come up with sophisticated innovations that were often arrived at with support from a group of academics and experts who lent an almost religious air to the discussions.

However, some countries which adopted the English model but whose systems are dominated by hydroelectric power found themselves constrained by a structure that did not apply to their particular situations. And now, England and Chile are themselves radically revising their power trading arrangements. Does this mean that their systems failed and that the countries that adopted them should go on the alert and adjust their models? Or does it mean that the experiment failed and that the opponents of reform and those who maintained that it was impossible to mount a competitive model in the wholesale electricity market were right?

This paper attempts to answer these questions (or to add to the confusion) following the approaches of Sioshansi and Morgan (1999) and Henney (1998), among others. These authors seek first to understand the reasons for adopting one model or the other (geography, history, the starting point and desired end point) and then go on to analyze a set of elements that are critical to the behavior of the system and its evaluation. The first section looks at the purpose and objectives of power markets. The next section discusses the factors that determined the structure of the markets in Chile and England/Wales (E&W) and presents a summary of their hits and misses. The section that follows compares the characteristics of the systems adopted by the first generation of reformers, focusing on the experiences of Argentina, Norway and Colombia. It then proceeds to an overview of the variations introduced into second-generation markets such as Australia,

the United States and Spain. The concluding section sets forth lessons that could be used to further modify first-generation markets and by countries that are just starting to introduce reforms. However, the lessons do not lead to a "correct" model, since there is no such thing. Instead, they lead to a judicious position, which consists of adopting a commitment to follow a process that is guided by certain principles, accompanied by a large dollop of patience and realism.

What Do Power Markets Do?

The countries that have restructured the power system have similar goals. All of them seek to establish competition in the electricity market to achieve economic efficiency and higher quality services, as well as lower consumer prices for electricity. Yet, there are important differences in the immediate objectives of restructuring between developed and developing countries. In the developed countries, restructuring often responds to the desire to introduce competition into a mature industry in order to make it more transparent, efficient, service-oriented and self-regulated, as well as to reduce electricity costs. In many developing countries, which have defective infrastructure and a chronic lack of funds, the process is many times governed by the desire to attract foreign capital to meet growing demand (Sioshansi and Morgan, 1999). Developed countries also have a relative abundance of human capital and well-developed market institutions. This introduces an important difference in the path that the reforms take and in the role that can be played by markets in the initial stages.

Power exchanges or wholesale electricity markets, like all organized competitive markets, are primarily vehicles to facilitate transparent transactions in order to contribute to price formation, provide maximum incentives for efficient production and signal the investments needed in additional capacity. This holds true, provided that the nature of technology and demand allows the market to perform these tasks better than an administrative system. However, this does not exempt the market from the need for regulation, it simply alters the nature of regulation to enable it to cope with new problems such as *market power*, which is the capacity of one or more players to raise market prices and reap the ensuing economic benefits. Producers are naturally tempted to wield *market power* since the objective of the company is to earn profits.

The degree of competitiveness of a market is, therefore, measured by the speed with which potential or existing competitors and consumers respond to and prevent attempts to exercise a dominant position. Under such conditions, the actions of the regulator should result in lower prices, improved quality and a larger variety of products, provided that the industry can remain financially viable and make the necessary investments. The two key elements that assure competitiveness in the market structure are the number and size of the participants, and the rules that govern the operation of the market. These two elements interact with each other, since a specific structure demands a set of specific rules and a given rule is not necessarily good for all structures. In turn, the rules can be affected by other factors such as geography and the primary source of power (hydraulic or thermal). Lastly, the impossibility of storing electricity and the limitations that this

imposes on grid operations mean that the electricity market requires special care. A well-designed market, which is the key to competitiveness, becomes the regulator's main task.

Over the last two decades there has been a veritable avalanche of excellent literature on the subject. The articles by Sioshansi and Morgan (1999) and Henney (1998), as well as the study by Frank Wolak (1997) on the impact of market rules on price formation in restructured electricity markets are excellent sources of information on the subject (this article is largely inspired by their analysis). Other analysts, such as Larry Ruff (1999) present full descriptions of many aspects of the markets and advocate the need for a centralized compulsory pool. To appreciate the concerns that occupied the attention of the designers of second-generation markets and the solutions they came up with, it is useful to group them into six key issues:

1. Should a centralized compulsory auction or contracts, or both, be adopted?
2. Which auctions or offer procedures and which price determination processes work best? How much transparency is needed?
3. What is the best way of balancing supply and demand? What role should demand play in price determination and should prices be decided *a priori* or *a posteriori*?
4. How should access to transmission systems with limited capacity be prioritized?
5. How necessary are capacity payments and how can the reliability of the system be guaranteed?
6. Which and how many institutions does the market need to function?

The need for a centralized compulsory auction in the wholesale context is perhaps the most controversial of all the above questions and has been the source of the greatest differences among second-generation markets. The answer to this question determines most of the responses to the others. For some, such as Larry Ruff, the success of competition in the electricity market thus far is mainly due to the development of spot markets integrated with physical dispatch in real time. Ruff argues that this is the only practical method of internalizing the externalities inherent in the real time operation of electrical grids and that without it, many markets are unacceptable, inefficient and unreliable. This explains why many experts think that an efficient market should reflect short-term marginal costs. On the other hand, the proponents of the E&W pool reform argue that the market should be more like a commodities market, rather than a good imitation of the results of the centralized dispatching that prevailed earlier, which determined the design of the original pool.

The Pioneer Markets:
Determining Factors in their Design and Subsequent Performance

As Richard Green (1998) notes, in spite of English claims that their competitive system was the first in the world, the Chilean model had been in effect for over a decade when the English competitive system was established. However, Chile's system was based on a very special form of competition. Curiously, the design of the electricity markets in both countries was affected by very similar factors.

The Chilean Case

The peculiarities of Chile's political regime and the fact that it was the first country to privatize the sector allowed for the execution of a gradual transition. The National Power Commission and the establishment of a price system for transactions on the wholesale market date back considerably farther than the first privatizations. The need to minimize surprises for potential investors was the dominant concern in designing the Chilean system. While the true cost of that decision would not become evident until the system had been operating for some time this concern of the system's designers was not unfounded, given the great fear in the private sector of making the large investments that a system growing at the rate of 6% a year demanded. This was compounded by the fear that an eventual return to democracy could reverse the reforms. The result was that the regulator had almost no discretion to make subsequent adjustments. In the opinion of many analysts, this rigidity was the main reason why the limitations would not be addressed for a long time. Another reason may have been the moratorium on criticism that independent analysts and international institutions granted to the Chilean experiment for fear of jeopardizing it.

However, these were not the only factors that influenced the initial design. The designers of the new system were faced with a predominantly hydraulic system with a regulating reservoir, Lake Laja, whose operation was based on a well-tested model. The optimum management model for Lake Laja (GOL) made it possible to determine the cost of water in the reservoir with relative certainty and, hence, to establish short-term prices for efficient trading among power generators. The system adopted for market operation was limited to trade between generating companies and was based on theoretically maximum costs which, in practice, ended up being the costs used for all transactions among generators. There was no market-clearing price that resulted from the interaction of supply and demand, but rather prices were set by an administrative system. As a result, Chile lacks a spot electricity market since it is not possible to buy power on a makeshift basis. Although contracts exist with free clients, they are not trades. One of the reasons is that there is no system of charges or tolls for spot transmission, a legacy of the original design that ignored monopolistic aspects.

Despite the fact that apologists of the new system argued that economies of scale were not relevant in Chile and, therefore, that competition could take place in the generating market, most projects in the pipeline were large-scale hydraulic projects that required

hefty investments. This conspired against a segmented structure that would promote competition. The Chilean system was structurally flawed from the beginning. Moreover, these flaws were not compensated for in the design of market rules, thereby creating the opportunity for the main players to seek and establish *market power*.

England and Wales

Although the form and fundamental nature of the Chilean and English systems are quite different, the starting conditions that affected the systems' design were very similar. In both cases, the main objective was to break the government monopoly over power generation and transmission, to create a competitive market and to privatize the industry. Although democratic, the third Thatcher government enjoyed a large parliamentary majority that gave it de facto control over legislation. However, as in Chile, in order to sell the industry the government needed a complete project to ensure that the system could function on a commercial basis, while maintaining supply continuity.

The tradition of centralized management of the sector and the existence of centralized dispatching by order of merit, which the government had agreed to maintain to calm the fears of Central Electricity Generating Board (CEGB) engineers regarding economical dispatching and the stability of the system, led to the adoption of a compulsory pool model. Curiously, the model was called GOAL, which sounds like an English version of Chile's GOL, although in this case it represented a chiefly thermal system and marginal prices were used instead of marginal costs. As in the case of Chile, the initial design of the English/Wales (E&W) system had flaws that limited the number of participants. In this case, the flaws resulted from the government's commitments to play a leading role in promoting nuclear power (see Henney, 1998). This flaw was the source of most of the opportunities for exercising *market power* that plagued the E&W system in subsequent years. Again, as in the case of Chile, E&W adopted a very inflexible system of governance which made it extremely difficult to introduce changes, in this instance caused by the need for consensus among all the participants in the pool. Unlike the Chilean case, however, the existence of a single regional tariff made it impossible to establish price discrimination by zone, which would have made it easier to deal with congestion problems.

Criticism of the English pool, particularly the lack of competition because of the exercise of market power, could fill a number of volumes. In addition to the works already mentioned, interested readers can refer to the studies by Richard Green (1998) and to those included by OFFER, the English regulator, on its Review of Electricity Trading Arrangements (RETA). The criticisms presented in the final RETA document are summarized below (OFFER, 1999).

1. Bids into the pool by generators do not reflect cost. Movements in pool prices have not matched reductions in generating costs in the past. Although market power has been a factor in maintaining high prices, the present trading arrangements have facilitated the exercise of market power.

2. Limited demand-side involvement within the pool leads to higher overall prices and taller price spikes.

3. The complexity and lack of transparency of the pool's price-setting processes has inhibited the development of derivatives markets and reduced liquidity in the contracts market.

4. Capacity payments do not provide very effective short-term signals to encourage generation and demand to respond to rapidly changing circumstances. In addition, these complex and administered payments provide a poor long-term signal for the need for capacity.

5. Generators and suppliers do not face fully the costs and consequences of their actions because neither group makes firm commitments to generate or consume electricity. This will lead to inefficiencies as interaction between the gas and electricity markets increases.

6. Pool governance procedures are inflexible and have precluded change or delayed reform.

Norway: A Rebel with a Cause

In sharp contrast to the E&W system, the Norwegian model, extended in 1996 to Sweden and the other Scandinavian countries through the creation of Nord Pool, does not involve compulsory offers in a centrally-dispatched pool, but rather sales through bilateral contracts between consumers and producers. The pool serves as a wholesale market for marginal power supplies. In this case, generators and consumers decide voluntarily whether they want to sell or buy electricity through this market. Nord Pool is actually composed of two markets that operate simultaneously with the bilateral contracts market. At any given time of day, transactions are conducted on each of these markets and through bilateral contracts. There is also a futures market on which weekly financial futures contracts are negotiated for periods ranging from one week to three years. The Daily Power Market, or spot market, trades in fixed volumes of power at prices set one day ahead for each of the 24 hours in the day. To reconcile the differences between programmed and real demand and to maintain the integrity of the system, there is also a balancing market or a Power Regulation Market.

The reasons why the designers of Nord Pool opted for a long-term contracts system, instead of a pool as in the E&W, result from the system's starting conditions. Most generation in Norway (and, to a lesser extent, in the other Scandinavian countries) is hydraulic. This means that power can be stored and long-term contracts make more sense than in the case of E&W, where a thermal system is more appropriate for the day-to-day operation of a centralized pool. Furthermore, Nord Pool is highly decentralized. Sixty percent of the power generated in the Norwegian system is produced by small companies mainly belonging to municipalities, Statkraft SF produces about 30% and the remaining 10% is produced by a subsidiary of Norsk Hydro. Generation in Sweden is also

decentralized, (although less so than in Norway), which makes a contracts system more desirable than a compulsory pool. Another interesting aspect of Nord Pool is its use of price zones as a tool for addressing problems of congestion in the grids.

Paradoxically, despite its relative success and the lessons that many countries in similar situations could learn from it, the Norwegian experience is not widely known or used as a reference by the Latin American countries. However, it has served as an example for the second-generation wholesale markets, including the proposal for E&W.

The Models Spread: The First-Generation Markets in the Region

Mutants and Clones of the Chilean Model: Argentina, Peru and Bolivia

Chile's success in privatizing its electric system without jeopardizing the continuity of service led a number of countries in the region to follow in its footsteps. The adoption of a competitive model by England and Wales, the exhaustion of the traditional model in most countries and the rise of a new economic development model also contributed to this outcome. The multilateral banks welcomed and pondered the Chilean experiment. The original designers became the most sought-after consultants by countries considering reforming their systems. However, the experience was not accepted in its entirety in all countries.

The lesson that Argentina took from Chile's experience was the need to ensure broader competition by unbundling the sector's structure both vertically and horizontally. At the same time, changes in generating technology (namely, the advent of the gas turbine and combined cycles) lessened the importance of economies of scale and permitted the potential number of participants to rise. Several countries complemented these measures by establishing limits on the percentages that a given agent could own in a given business and in other complementary businesses in the sector. Yet, international mergers and acquisitions demonstrated that not all the loopholes had been closed tightly enough to prevent collusion of interests and the attainment of market power by certain actors. Curiously, however, the shortcomings of the market rules in the Chilean model were not sufficiently rectified, with the partial exception of Argentina. The Peruvian wholesale market and, to a lesser extent, the Bolivian market are almost perfect clones of Chile's with regard to their rules, differing only in certain details. In these two countries, the marginal value of water in plants with reservoirs is determined by a market administrator through centralized optimization of operations, using *ad hoc* mathematical models. In Peru, the wholesale market is also a club of generators, like in Chile.

The wholesale electricity market model in Argentina differs somewhat from the Chilean model in makeup and details. CAMMESA is not a club restricted exclusively to generators, but includes all the market agents, making it less vulnerable to capture. Dispatching continues to be based on costs, but the basis is the generators' semiannual statements of costs, including hydraulic power. Spot prices are used for trade between generators but also distributors (at a stabilized price) and large users can buy on the wholesale market. Other innovations include the introduction of payments for auxiliary

services and procedures to deal with congestion. However, not all the changes are improvements since in some cases, such as capacity charges, they have given the wrong signals. In short, the main innovations of the Argentine model are improvements in the structure of the sector, which make it more competitive, and in wholesale market governance, which makes it more independent. Changes in the market rules also facilitate participation, but they are limited in scope. Argentine authorities are currently studying changes to modernize the wholesale power market and adapt it to new trends. The goals are to allow generators more flexibility in preparing their offers, a day-ahead market, more options for different types of contracts, replacement of the capacity payment with auctions of available capacity, changes in the transmission rules and the involvement of demand in spot market auctions.

The Empire Strikes Back: The Case of Colombia

Paradoxically, the Colombian case, which shares many characteristics with Chile, such as a predominantly hydraulic system and tested management models for trading, was the one that moved farthest away from the model by adopting a system of centralized auctions and a pool similar to the E&W Pool. Although bilateral contracts are permitted, they are financial in nature, similar to contracts for differences, and use the pool price for reconciliation. Therefore, there is no liquidity in the contracts market. The price formation process is similar to that of England and Wales, with identical bid patterns for hydraulic and thermal generators. Nevertheless, the fundamentally hydraulic and decentralized nature of the system, as well as its earlier experience with contracts and opportunity trading would lead one to recommend the adoption of a procedure similar to Norway's. The type of market adopted in Colombia was no accident. The selection of Coopers & Lybrand as the consultant to design the market rules came replete with the type of model. However, the Colombian model was novel for the region. Today it is still the only market that sets the price based on auctions of offers to the participants and not on costs. Colombia was also the first market to include suppliers as participants.

Several authors, including Perez Arriaga (1999) and Benavides (1999), have extensively documented the problems experienced in the Colombian power market. Apart from the well-known problems of *market power* and lack of transparency that plagued the E&W model, there are also the problems of complexity in the offers and inadequate treatment of volatility stemming from the large hydroelectric generation component. The adoption of administrative measures to solve the problems of reliability of supply, reservoir levels and capacity payments have become a continuing headache and the source of opportunities for undue interference by the legislature.

Another Rebel with a Cause: Brazil

Although Coopers & Lybrand, the consultants for Brazil, sought to impose the same model they had recommended for Colombia, local experts succeeded in convincing them that Brazilian conditions required different solutions. The Brazilian power system is over 95% hydraulic, it has a large storage capacity and it is made of groups of physically interdependent reservoirs and plants that are located in the same river basin (Veiga

Pereira, 1999). Coordinated operation of the system could account for close to 20% of the additional firm power that would be obtained if producers were to make their offers individually. Interdependent decision-making by the generators means that it is virtually impossible for them to know the cost of water for each individual. This stands in the way of daily auctions such as those used in the E&W Pool. The system adopted in Brazil involves a long-term contracts market and a spot market for the balances administered by the system operator with the help of a complex mathematical model. Some observers, such as Estache and Pardinas (1998), affirm that surprises may crop up during implementation because of the complexity of the proposed design. However, Brazilians have demonstrated a capacity for innovation that can be useful for other countries with similar systems. As noted by Pereira (1999), for example, some problems may be solved by means of Firm Power Certificates that can be traded in the market.

Second Generation Markets: What Separates them from the First Generation and Why?

The countries that launched reforms in their systems in the middle of this decade, including Australia, Spain, New Zealand and the United States, had more time to study the practical behavior of the different models used by the original reformers. More importantly, they were able to benefit from the academic debate over the initial models. However, the form and function of markets was dictated by starting conditions. This paper limits itself to a discussion of the experiences of Australia, Spain, California and the Pennsylvania-New Jersey-Maryland (PJM) Pool in the United States as well as the proposed new structure for the E&W market (referred to as E&W II[1]).

Table 1 compares the features of all the markets selected, including Nord Pool, whose most pertinent aspects are described below. It should be underlined that with the exception of the initial period of Nord Pool (in Norway), none of these markets have been operating for more than two years, while E&W II is still in the design stage.

Centralized Compulsory Auctions, Contracts or Both?

As mentioned earlier, the crux of the discussion lies in the convenience of continuing to employ the system of centralized compulsory auctions typical of the E&W market and most of the first-generation markets (except for Norway). The problems of lack of competition that plagued the E&W market, and the apparent success of Norway, means that the response adopted in most cases (the United States, E&W II and Spain[2]) follows the Norwegian experience, at least in part, by allowing physical contracts. The general trend is toward what Perez Arriaga (1999) has called "successive markets." That is, it is more desirable for the market, rather than a model, to resolve trade in successive rounds ranging from long-term contracts to operations in real time, including the old daily auctions. The main characteristic of the new organization is that it includes several very

[1] An excellent comparison of trading arrangements can be found in the OFFER report (1999) and in RETA Background Paper No. 2, February 1998, Electricity Trading Arrangements in Other Countries.

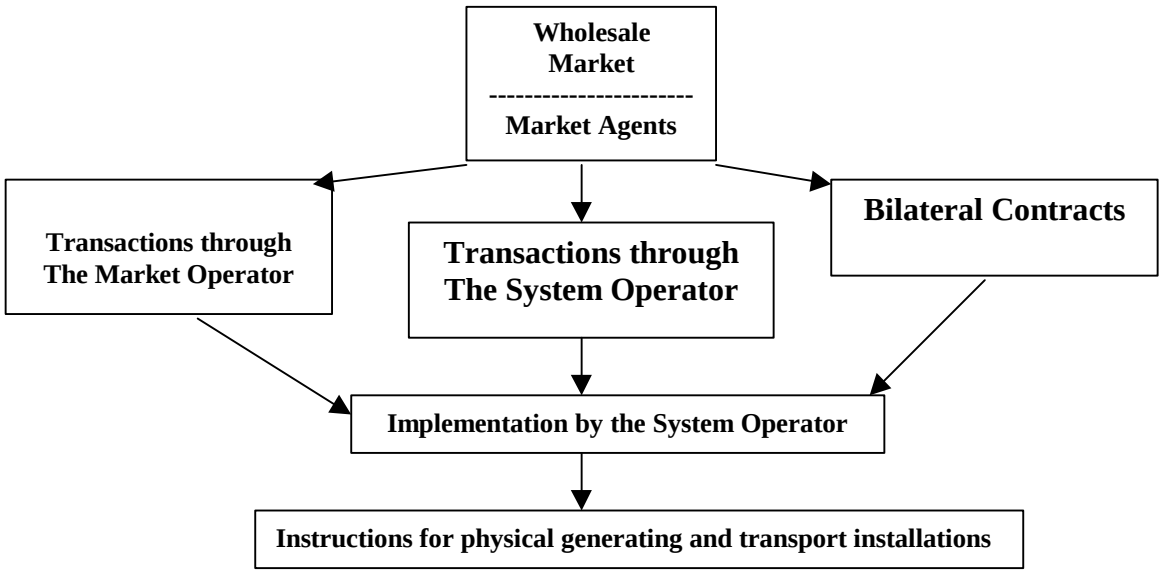
[2] The Australian market remains centralized and compulsory.

simple markets that permit transparency, trade in only one of the market's products, employ firm transactions, and permit additional subsequent transactions for fine-tuning.

The complete organized market would include a succession of different kinds of markets. Starting with the long term, there would be organized futures and forward markets to negotiate standardized long-term contracts with a horizon ranging from several years to one week. The contract periods could be blocks of similar hours (e.g. peak, flat and trough) for different kinds of days (e.g. weekdays and holidays). The daily physical market (where all demands not already contracted would be fulfilled and where all participating agents should be backed by available physical capacity to produce or consume) is the core of the entire set of transactions and its price serves as a reference for others. There would also be shorter-term markets to negotiate adjustments, as well as markets for other products, such as management of restrictions or operating reserves. A weekly market could have a shorter horizon than the futures market, followed by a daily physical market.

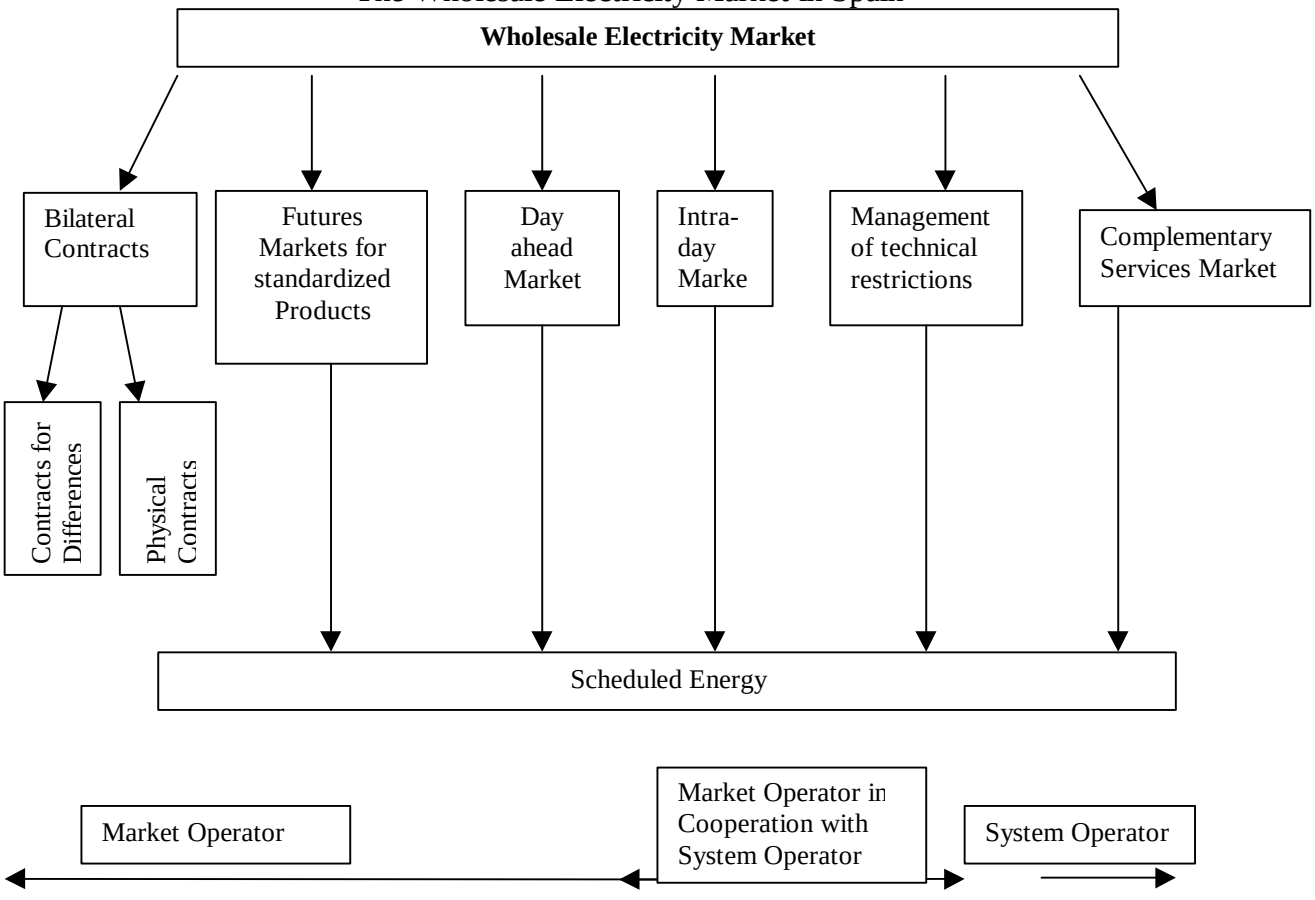
Figure 1 illustrates this concept as applied in Spain, but the detail varies with each market, as is clear from the earlier discussion of Nord Pool and as can be seen when comparing the information in Table 1. Figure 2 illustrates the various markets in the Spanish system.

Figure 1
Successive Markets in the Spanish Wholesale Electricity Market



A comparison of the designs adopted in two different systems in the United States (California and PJM) illustrates the differences that can exist. While the California design is closer to the generalized scheme presented above, PJM is more of a mixture between a pure pool and the California design. Although physical contracts can exist in PJM (since all generators have the option of supplying bilateral contracts), there is also the option of participating in the pool auction. The system operator proceeds to dispatch to everyone who has not presented individual scheduling. The PJM system operator has much more power than the one in California where there are separate and independent System Operator (SO) and Power Exchange (PE). In practice, there are about 30 power exchanges called scheduling coordinators. Lisa Cameron and Peter Cramton (1999), in an instructive comparison between the two systems and the results of the first year of operation, conclude that both appear to be functioning reasonably well. They also note that both systems are undergoing adjustments and modifications to fine-tune their operations. In fact, California's intra-day (hourly) markets were quickly dismissed because of lack of liquidity.

Figure 2
The Wholesale Electricity Market in Spain



Auctions, Price Determination and Transparency

The main concern with regards to auctions or offers has been flexibility in the proceedings and transparency in price formation. In the search for transparent mechanisms, most of the markets described in Table 1 have opted for procedures in which each hour of the day is auctioned independently and where technical and economic conditions that agents can express in their offers are simplified as much as possible. Offers by generating plants can only be expressed in the total volumes of power to be sold or bought in each hour and the corresponding price ($/kWh) for each of them. In this way, the generators are forced to 'internalize' in their simple offers the variety of costs they could incur in a series of possible situations. Markets based on simple offers have the advantage of lending greater transparency to the dispatching process. However, they introduce risks into the process of offers by the generators, which must be compensated by suitable management mechanisms. The creation of a series of successive markets offers a solution to this problem. In contract markets, the trend is toward transparency by requiring that all transactions be made in the market, like Nord Pool. However, California permits confidential bilateral contracts.

Balancing supply and demand and price determination

The Norwegian system of establishing a balancing market and its extension in Spain to the system of successive markets offers a solution to the problem of supply and demand equilibrium. In general, all the markets studied can revise their positions in something very close to real time. In some markets, such as in Australia, volumes can be revised but not sales prices, and PJM allows adjustments to be made. In all other markets, adjustments are made through new transactions on shorter-term markets or are subject to rescheduling. Remuneration in balancing systems is paid at very short intervals; in California, it is paid every 10 minutes and in the others the maximum term for making offers on the balancing markets is very close to real time. In all cases, the final settlements are paid at the prices prevailing on one of the markets and are not determined by administrative measures. In systems with very volatile markets or when the goal is to prevent speculation, a dual settlement system has been used to encourage most transactions to be conducted on longer-term markets. According to Sioshansi (1999), the Californian system in which generators make last minute offers means that the system operator is involved in the market, with dubious results. Sioshansi contends that the Australian system avoids the problem completely by defining the prices *a posteriori*, and appears to have functioned well.

There is full agreement in all the markets regarding the need to include demand on an equal footing with supply. Where this rule has been introduced, demand has generally played a small part, but the experience of Nord Pool is encouraging.

Prioritizing access to limited capacity transmission systems

In this case, second-generation reforms provide solutions that originate in the starting conditions. Following Norway's example, some solutions favor the establishment of price zones to resolve congestion problems. This is the case of E&W, California and Australia. New Zealand and PJM favor a nodal prices solution, which in the case of New Zealand where generation is remote from consumption, appears to be well thought out. The controversy has been very heated between the proponents of the nodal system, led by Professor Hogan, and the rest of the reformers, who continue to be skeptical that such a sophisticated system is justified in cases with a meshed network and generation very close to load, as in PJM. Henney argues that the starting conditions played a large part in this decision and that sophistication jeopardizes the transparency of the process and creates more problems than it helps to solve. Although in theory the nodal system offers a more exact solution, the advantages of obtaining it can sometimes be small in comparison with the volume of transactions at stake.

Capacity Payments and the Reliability of the System

Reliability of supply depends on adequate generating capacity to cover long-term demand and accommodate short-term fluctuations in supply and demand. There are two systems for achieving this outcome in the countries studied. The first is based on spot prices and futures to provide long-term investment and short-term availability signals. These systems permit clients and suppliers to determine the maximum price they are willing to pay for secure supplies. California, the Scandinavian countries, Australia[3] and E&W II have adopted this solution. Spain retains a capacity payment but argues that its main function is to compensate for sunk costs. The second system uses centralized planning procedures to determine the reserve levels required for the entire system and establishes a capacity market that permits suppliers to optimize their reserve levels. This is the case in PJM and New York.

As Table 1 shows, capacity payments are not very popular in second-generation markets. Continuity of supply does not appear to be a very worrisome problem, but it should be noted that none of the countries studied has a market that is growing at rates comparable to those in Latin American.

Market Institutions

Can the system operator carry out the dual function of operating the system and the electricity market? Is an independent institution such as a market operator necessary? With the exception of Australia and PJM where the system operator also operates the market, the trend is to have two different types of operators. In California, in addition to the power market itself, there are scheduling coordinators who act as market operators. In cases where several institutions exist, their functions vary. In California, the independent

[3] The system operator in Australia also buys auxiliary services to maintain reliability.

system operator administers three markets: a competitive market for purchasing auxiliary services, a real time market and a congestion management market. The power market administers another three: a daily auction for each hour of the following day, a within the day daily market and a contract market.

What Can We Learn?

Although it is always possible to learn from the experience of others, the lessons will only be truly useful if we are also willing to study the context in which the experiences took place. This article shows that the model adopted for each country or system depends on historical, geographical and political circumstances, in addition to purely technical ones. Moreover, it has also been shown that despite questions about their efficiency, the original reformers and the first generation carried out an important, if not crucial task, in developing competitive electricity markets. The experiment has not failed in any country so far. Current adjustments to the systems are intended to improve competition rather than return to centralized systems. However, what lessons can the countries of Latin America learn from the second generation of power markets?

1. *The design of new power markets is a highly dynamic process* in which adjustments are continually being made to incorporate experiences and fine-tune details. This demands a great deal of flexibility. However, experience has also shown that the market is not afraid of these adjustments provided they are intended to ensure that the power exchanges perform their function, which is serving as a forum for the operation of a competitive market. The original reformers and some of the subsequent generation feared that a credible system would require very rigid schemes. These fears are proved groundless by the many experiments in progress that are being tracked closely by the market.

2. Contrary to prevailing concerns at the time of the adoption of the California and PJM models, *experience has shown that a centralized compulsory market is not necessary.* This and other differences of opinion can be resolved by comparing the results of the many experiments under way. The trend appears to be moving away from centralized compulsory markets to systems that permit the market to resolve problems in successive rounds, but with firm commitments that can only be altered with new contracts. The first-generation markets in Colombia and Argentina are considering some of these modifications, and their adoption could lead to substantial improvements in present operations.

3. It is also clear that generators cannot be expected to make offers to the pool in a way that mimics centralized dispatching and that *the problems of simple offers can be solved through balancing or successive markets.* Experience also confirms the first lesson learned from the Chilean experiment, which is that you can't have it both ways. No matter how sophisticated the system of offers, only broad competition prevents a dominant market position. As in all competitive markets, transparency is crucial. This is particularly important for small markets such as those of the Central

American countries, where participation in larger regional markets is the key to competitive operations.

4. Administrative market management measures, such as the capacity payment, which are common in all the region's systems, and restrictions on the operation of reservoirs used in Colombia to guarantee the reliability of supply, are dangerous tools that often produce perverse incentives. However, this does not exempt designers from carefully examining the implications of all the market procedures they seek to introduce. This recommendation is particularly important when adopting mechanisms to increase demand participation in the formation of prices, which is indispensable if the market is to be truly competitive.

5. The mechanisms used by the countries for rationalizing access to the system vary, but experience indicates it is fundamental to *bear in mind the relative magnitude of the distortions they are attempting to solve with models that are often complicated and not transparent*.

6. *The type and number of institutions required for the operation of the market are vitally important.* This is the case in the countries of Latin America and the Caribbean where basic institutions (such as the courts, oversight agencies and the rule of law) are often weak. Institutions specific to the electricity market are especially importance, particularly where the opportunity cost of human resources is high. Although institutions are paramount to the proper functioning of markets, the simpler their functions the greater their chances of success.

Table 1

Characteristics of Second-Generation Markets

Category/system	Australia	California	PJM	E&W II	Spain	Nord Pool
1. Type of Pool	Compulsory	Voluntary	Mixed	Voluntary	Centralized Voluntary	Voluntary
2. Reconciliation of supply/demand	System operator	Balancing market	System operator	Balancing market	Successive markets	Balancing market
3. Type of Offers	Volume and price. Volumes can be adjusted up to one hour beforehand	Volume and price. Portfolio. Offers are firm for each market round	Volume and price	Volume and price. Offers are firm for each market round	Volume and price. Offers are firm for each market round	Volume and price. Offers are firm for each market round
4. Participation by demand	Negative generation	On the hourly and balancing markets	On the daily market	On the successive markets	On the successive markets	On the successive markets
5. Congestion management	Zonal	Zonal	Nodal		Zonal	Zonal
6. Security of supply	Reserve contract by the system operator		Reserve market Shared capacity			
7. Institutions	System operator	Over 30 market exchanges, system operator	System operator	Market exchanges	Market Exchange, system operator	Market Exchanges, system operator

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