

# Electricity

Latin America has been the world leader in power sector reform. In the 1980s, Chile was the first country to introduce comprehensive reforms aimed at opening the sector to private participation and competition. By the 1990s, Latin America had the largest share of private electricity projects among all the developing regions: of a total investment of \$193 billion in the developing world, \$74 billion was placed in Latin America (World Bank, 2000). Brazil, Argentina and Colombia are among the top ten developing countries in the world in terms of private investments in the electricity sector, with projects worth \$29 billion, \$12 billion and nearly \$6 billion, respectively. Chile, Argentina, Brazil, Panama and Colombia are among the leaders in investment per capita (see Figure 12.1).

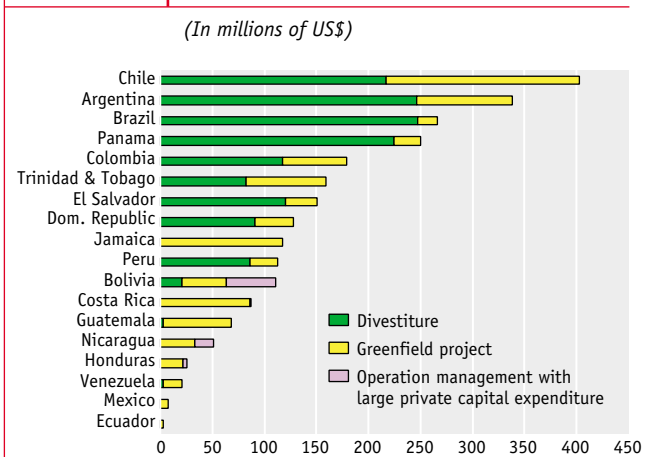
However, the process of electricity sector reform has occurred in waves, and so far has not reached all countries in the region. Chile was followed by Argentina in the early 1990s, and shortly thereafter by Bolivia and Peru. By the mid-1990s, reforms had spread to Brazil and Colombia, and in more recent years to several Central American countries, a trend that may eventually lead to the complete physical and regulatory integration of their electricity sectors. The major missing players in the reform process have been Mexico and Venezuela, where transfers of electric assets to the private sector have been small, and reforms truly scant.

Reform efforts must be viewed against the backdrop of the failures of the old regime. Lack of incentives for efficiency and tariff levels that did not reflect actual costs led to the generally poor performance of state-owned enterprises that accumulated huge financial deficits. Inadequate incentives were to a large extent related to the political abuse of utilities. Rent-seeking groups were allowed to capture the sector and distort objec-

tives. The consequences included generalized and poorly targeted subsidies, inefficient and insufficient expansion, and the use of the sector as a type of employment agency subject to corruption.

Reform of the electricity sector has produced several positive outcomes. Generation capacity has been expanded vigorously in sectors that have been reformed, with the major exception of Brazil, where greenfield activity has been slow to take off. Between 1990 and 1999, the private sector invested \$16 billion in new capacity, and by the end of the period the threat of power shortages had been reduced in most countries. Most privatized distribution companies substantially increased their efficiency by cutting technical and non-technical losses and reducing redundant staff while at the same time providing better service quality. The Chil-

**Figure 12.1 Private Investment in Electricity, 1990-99**



Source: World Bank (2001).

eans were pioneers in improving the efficiency of their privatized companies, and they later profited from the development of this expertise by participating in the privatization of many distribution companies in Argentina, Brazil, Peru and Colombia. A good example is CODENSA, the privatized Bogota distribution company that halved losses from 24 percent to 12.5 percent, increased customers per employee from 800 to 1,900, and reduced the frequency of service interruptions and mean interruption time by more than 30 percent in only two and a half years. Losses in Argentine and Chilean utilities are even lower, between 5 and 10 percent.

Wholesale prices have also been reduced in countries where competition has been introduced—up to 30 percent in Argentina and 20 percent in Colombia. Cross subsidies from non-residential to residential customers have been partially or totally dismantled in many countries.

In spite of these outcomes, there is growing concern over several unwanted consequences of the reform:

- Although new investors have entered the market, they have been few. Competition is generally limited and hampered by concentration.
- The main beneficiaries of lower prices have been large customers, and in some countries, prices are still high. There is no significant expansion of service coverage. Serving unprofitable segments remains a problem.
- Security of supply seems to have improved as a result of reforms, but the blackouts in Chile in 1998-99 and in Brazil in 2001 have raised concerns about the adequacy of the incentives introduced by the reforms.
- State-owned enterprises are still major players in some countries. They carry the burden of social programs and priorities, and some continue as vehicles for transferring rents to particular interest groups. Rather than being scaled down, some of these enterprises have in fact extended their participation.
- The regulatory system has not always evolved towards improved transparency, simplicity or certainty. Regulators, governments and legislators frequently clash over jurisdiction, interpretation and implementation of the reforms.
- Lack of competition and poor regulatory institutions have made for the transfer of rents to the private sector.

Thus, while there have been major achievements, significant problems threaten the direction and sustainability of the reforms over the long term. This chapter

identifies and examines the main issues in the design and implementation of regulatory reforms of Latin America's power sectors.

## Constraints to Liberalizing Power Sectors

Recent reforms of Latin America's power sectors have been largely motivated by the need to relieve governments of the heavy burden imposed by state-owned enterprises and to avoid further deterioration of services. According to the new paradigm, attracting private sector investors would reduce the financial burden and minimize regulatory problems by enlisting market forces to attain efficiency in the competitive segments of the market. A new incentive framework and even new regulatory institutions would be established to foster competition and efficiency, and to protect the consumer. Finally, social considerations would be addressed by using well-targeted instruments that are free of distortions.

In practice, it has proven difficult to put such reforms into effect. Privatization is under way in most Latin American countries, but a large segment of the industry remains under government ownership. Similarly, activities have not always been unbundled, and the market structure remains integrated in many countries. Competition is in most cases limited to the very largest loads, and true retail competition seems a long way off. In many countries, the new regulatory framework is still not fully implemented and there is a lack of suitable regulatory institutions. The basic sources of the difficulties are technical and institutional.

### *Technical Features of the Electricity Industry<sup>1</sup>*

For nearly a century, the power sector has been thought of as a "natural" monopoly where efficient provision requires a regulated public or private monopoly. Most utilities have historically met their obligations by jointly providing the four primary electricity supply functions: generation, transmission, distribution and retailing.

<sup>1</sup> This section is based on Blumstein (2000), Borenstein and Bushnell (2000) and Joskow (1997).

The generation segment involves the creation of electricity using different technologies. The transmission of electricity involves the use of wires, transformers and substation facilities to transport electricity between generation and distribution centers. This includes the interconnection and integration of generating facilities into a synchronized network through scheduling and dispatching generating facilities to balance demand and supply (in real time), and management of equipment failure as well as network constraints. Finally, the distribution and retailing functions are related to delivering the final product to consumers at relative low voltages. Distribution requires wiring and transformers to reach customers, while retailing functions include metering, billing, making arrangements for supplies of power from generators, and other demand management services. Typically, retailing and distribution have been viewed as integrated functions.

Since the optimal scale of generating plants has declined,<sup>2</sup> the feasibility of competition in generation is now widely accepted. These technological developments, along with ideological changes, have opened the way for private participation and deregulation around the globe. As a consequence, regulators in many developed and developing countries have implemented reforms to improve the incentives for efficient operation of electricity utilities. In general, these structural and regulatory reforms are following the basic model applied to other network industries. Potentially competitive segments (generation) are being separated structurally or functionally from natural monopoly segments (transmission and distribution). Prices in the competitive segment have been deregulated, and services provided by the monopoly segment have been unbundled from the supply of competitive services. Prices in the monopoly segment are determined by power incentive regulations, and non-discriminatory access to "essential" network facilities has been mandated.

While the basic regulatory framework is straightforward, there are several key attributes of the supply and demand of electricity that have important implications for whether and how competition can be introduced:

- Electricity is extremely costly to store, so there must be a continuous balance between generation and consumption in real time. This task becomes more difficult because the demand for electricity varies widely from hour to hour and from day to day. Electric power networks are not switched networks like telephones,

where a supplier can make a physical delivery from one point to another without affecting the entire network. Because of the property of transmission, an imbalance of supply and demand at any location on an electricity grid can threaten the stability of the entire grid. Therefore, a transmission system is not only a simple transportation network, but also a complex coordination system where efficient network administration requires complete coordination of all generators and consumers in the system. Moreover, significant challenges arise for accurately measuring and settling consumer and generator financial obligations in a competitive electricity market.

- In general, the supply of electricity faces binding constraints at peak times. Generating units have hard capacity constraints that make marginal costs high once the level of production is near the full plant capacity. Currently, demand for electricity is almost completely inelastic in the short run. Almost no end-use consumers of electricity even have the technology to observe, let alone respond to, real-time prices that reflect the time-varying cost of procuring electricity at the wholesale level (generators' costs). Thus, little or none of the continuous balancing of supply and demand can be done on the demand side unless the grid operator forcibly curtails consumption.

- Because storage of electricity is extremely costly and capacity constraints on production from a plant cannot be breached for significant periods without risk of damage, there are hard constraints on the maximum amount of electricity that can be delivered at any time. The combination of this inelastic short-run supply (at peak time) and short-run inelastic demand makes short-term prices for electricity extremely volatile in the wholesale market. This situation is exacerbated if markets are not completely competitive. As many studies show,<sup>3</sup> tight supply conditions in electricity markets put sellers in a very strong position to exercise market power, raising prices above the level at which a competitive market would clear.

These inherent characteristics of the electricity industry raise many issues that any regulatory scheme must consider. Prominent among them are the need to con-

<sup>2</sup> The technological innovation in combined-cycle generating technology reduced the minimum efficient scale of new generating facilities.

<sup>3</sup> See Wolfram (1999) for England, Borenstein, Bushnell and Wolak (2000) for California, and Wolak (1997) for Norway, Australia and New Zealand.

trol and prevent monopoly power in the wholesale market, the need to maintain free access to bottleneck facilities, and the complications and trade-offs arising from having to simultaneously maintain system reliability and the security of supply while keeping price volatility low.

### *Institutional Endowments of Countries*

Referring to the United States, Joskow (2000b) states that antitrust policy must be designed keeping in mind the organizations or institutions that will be in charge of enforcing it. This advice becomes even more critical in the case of Latin American countries where institutions that in other regions are taken for granted—such as the rule of law, clear and accepted property rights, an independent and competent judiciary, mechanisms for peaceful dispute resolution, contract enforceability, and quality public bureaucracies and competition agencies—are either absent or incipient.

Although both starting points and objectives have been somewhat different, power sector reforms in Latin America have followed more or less the same lines as those of pioneering OECD countries. The notion that their approach should have considered the particular context in their countries seems to have been given scant attention by Latin American policymakers. Indeed, reform efforts appear to have been based on ideological considerations that assumed that the market could be trusted to solve the problem. A more cautious approach might have considered that, while some basic elements are essential, there is no universal model, and the success of sector reform depends on the institutional setting and the timing of the reforms. Unless those tacit or implicit elements are replicated or replaced with local versions, and unless reforms are coherent across the economy, transferring a model out of context is a considerable gamble. Indeed, while blueprints, best practices, international codes and standards and harmonization may prove useful for some of the more narrow technical issues, large-scale institutional development requires discovering local needs and capabilities.

Clearly, inefficiencies in the regulatory environment are not inevitable. Consistent regulations, along with regulatory institutions with clear incentives and sufficient resources, can in principle overcome any such inefficiencies. In practice, however, such problems are not easily solved in a country with a weak judiciary or a tra-

dition of political interference in judicial decisionmaking. Furthermore, lack of expertise and regulatory experience may seriously constrain the possibilities for achieving sustainable electricity market reform.

## **Obstacles to Power Sector Reform in Latin America**

Sustainable power sector reform in Latin America must address five major technical and institutional issues: separation of the roles of the state and the sequence in carrying out the reforms; achievement of workable competition in the competitive segments of the market; regulation of the non-competitive segment; adequacy of pricing, subsidies and incentives for long-term investment; and architecture of the regulatory institutions.

### *Separating the Role of the State and the Sequence of Reforms*

Table 12.1 shows that privatization of power sectors is far from complete in Latin America. In most countries, the state still controls sizeable amounts of the generation, transmission and distribution segments. Under these circumstances, problems may arise within the government itself, since the government assumes roles with respect to the electricity industry that range from legislator to regulator, owner and purchaser of electricity. This can cause conflicts of interest and erode regulatory power. Efficient governance requires that the various roles be separated, and that there be clear rules to define the rights and responsibilities of individual agencies, particularly for handling conflicts between different government interests and between government interests and those of private citizens or nongovernmental organizations.

While separating the roles of the state was almost an axiom among reformers, the evidence so far suggests that attaining this objective in Latin America has not been easy. The line between policymaking and regulation is still blurred. This is evident, for example, in the ongoing struggle in Colombia between the regulator and the ministry regarding liberalization of the natural gas market, as well as in El Salvador, where the responsibility for energy policy has not been clearly

**Table 12.1 Share of Private Sector Participation**

*(In percent)*

	Generation	Transmission	Distribution
Argentina	60	100	70
Bolivia	90	90	90
Brazil	30	10	60
Chile	90	90	90
Colombia	70	10	50
Costa Rica	10	0	10
Dominican Republic	60	0	50
Ecuador	20	0	30
El Salvador	40	0	100
Guatemala	50	0	100
Jamaica	20	0	0
Mexico	10	0	0
Paraguay	0	0	0
Peru	60	20	80
Trinidad and Tobago	40	0	0
Uruguay	0	0	0
Venezuela	20	10	40

Source: Espinasa (2001).

defined or vested in any particular institution. Furthermore, the lack of independence of regulatory institutions appears to be an issue in all countries in the region. For example, in Guatemala the regulator is placed directly under the Ministry of Energy, while in Colombia enforcement and oversight functions are performed by an organization that appears to be highly politicized. Consequently, the balance required between regulatory commitment and flexibility has been difficult to achieve.

Current reforms have been the result of negotiations between stakeholders who required compensation. Reformers were right in assuming that losers would oppose reforms—not only because they lost, but because compensation would make them winners. The problem is that the privileges, subsidies and all sorts of rent-seeking activities provided through compensation may have created an interest in a stalled reform, preventing the extension of the benefits of reform to those who most need them.

Because most utilities in Latin America were vertically integrated state-owned enterprises prior to the reform process, reformers in the region were spared the type of stranded cost debates that plagued liberalization in the United States and Europe. Nonetheless, by introducing stranded costs of its own, the sequence of reforms has proven to be critical to the performance of

the region's post-reform sectors. The textbook approach to sequencing the reforms would start with establishing a sound regulatory framework, continue by restructuring government assets and organizing the markets, and then proceed to privatization, starting with the distribution segment. This sequence has many advantages: it allows the sector to develop the desired structure, facilitates privatization by giving clear signals to investors, assures the presence of financially sound buyers in the wholesale markets, and avoids the presence of state-owned enterprises in competition with private companies. Unfortunately, the window of opportunity for the reform is usually very short, forcing governments to deviate from this ideal sequence.

Thus, lack of resources for investment in generation has forced most Central American and Caribbean countries to engage in costly build-operate-and-own (BOO) or build-operate-and-transfer (BOT) operations before undertaking the necessary reforms. This has left the burden of the power purchase agreements (PPAs) to financially weak state-owned enterprises. The lack of a clear regulatory framework and the urgency of these operations has allowed independent power producers (IPPs) to exact high rents and impose inflexible conditions like "take or pay" contracts that exacerbate the financial problems of the government-owned companies. Furthermore, accusations of corruption have surrounded many of the PPAs contracted prior to the reform.

As part of the reform bargain in Colombia, most distribution companies were not privatized and remained subject to the incentives and political patronage of the old regime. Thus, these companies continued to show high inefficiencies, such as billing only 70 percent of the energy because of physical losses, theft, lack of measurement and poor billing. Furthermore, many of these companies serve low-income and rural markets with limited payment capacity and high distribution costs that make them dependent on unreliable subsidies from the central government.

In Brazil, the reform process started with the privatization of distribution companies, which was the right thing to do. But it took an extremely long time to complete the regulatory framework and to put in place the wholesale energy market. This delay, together with other uncertainties, has been one of the main causes of the current lack of appetite for greenfield investment in generation in Brazil's electricity market.

**Box 12.1 Electricity Markets in Latin America**

**The pioneer and its followers.** Since the reform of the early 1980s, the wholesale market in Chile has consisted of regulated contracts with distributors and free contracts directly between generators and large customers (larger than 2Mw). A centralized dispatch model is used to price exchanges among generators, which are the only participants in the spot market. There is no market-clearing price that results from the interaction of supply and demand, but rather prices are set by an administrative system. The Chilean system is not designed to increase competition, but rather to promote private investment in generation and distribution. Chile's success in privatizing its power system without jeopardizing the continuity of service led Peru, Bolivia and other countries in the 1990s to follow its example.

**The first generation of power pools.** The Chilean experience was not accepted in its entirety in all countries. By the early 1990s, Argentina had learned from Chile's experience that to ensure broader competition it was necessary to vertically and horizontally unbundle the sector's structure and to establish limits to cross-ownership. Changes in generating technology, such as the gas turbine, had lessened the importance of economies of scale and permitted the potential number of participants to rise. The wholesale electricity market model in Argentina differs somewhat from the Chilean model in makeup and details. The system operator 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 distributors (at a stabilized price) and large users can also buy on the wholesale market.

**A second generation of power pools.** Colombia, which also has a predominantly hydraulic system, decided to break even further from the Chilean model. In the mid-1990s, it adopted a system of centralized auctions similar to the England and Wales pool. Although bilateral contracts are permitted, they are financial in nature, similar to contracts for differences, and use the pool price for settlement. The price formation process is also similar to that of England and Wales, with identical bid patterns for hydraulic and thermal generators. The Colombian model was novel for the region. Today it is still the only market that sets the price based on bids from participants rather than on costs. Colombia was also the first market to include suppliers as participants.

**The newcomer.** Initially attracted to the Colombian model, the Brazilians ultimately concluded that local conditions demanded local solutions. The Brazilian power system is over 95 percent hydraulic, has a large storage capacity, and is made up of groups of physically interdependent reservoirs and plants that are located in the same river basin. Coordinated operation of the system could account for about 20 percent more power than 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 England and Wales 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.

**Achieving Workable Competition**

Establishing competitive markets for electricity has become a more difficult task than anticipated in most Latin American countries. In addition to the plethora of implementation problems that have plagued markets in more developed countries, Latin American countries face difficulties of their own. Small size, country risk and the strategic behavior of big investors conspire against the minimum number of players needed to ensure competition in the market. As a result, there is a trade-off between competition, which keeps prices down but increases investors' risk, and the comfort usually sought by lenders for infrastructure projects. In several coun-

tries, a growing market and the reliance on hydroelectric resources has made an energy constrained system more the norm than the exception, exacerbating price volatility and market power. In still others, lack of human resources, weak or a lack of institutions to oversee and regulate competition, and the ambiguous role for the judiciary have made it difficult to oversee competition and enforce regulatory measures.

It should be stressed that effective competition is not a question of "yes" or "no". There are degrees of competition, and the real question consequently concerns whether it is possible to create "workable competition." Since there is no general standard for what constitutes such a market, some kind of qualified judg-

ment based on an evaluation of barriers to competition and actual market performance is inevitable.

In the debate on electricity market reforms, attention has focused on spot markets for electricity, or electricity pools. In most places, this market has been organized as some form of auction, but the details of the auction vary considerably. In some countries, participation is limited to (major) generators, while in others, participation is basically open to all, including consumers and traders of electricity. In some countries, participation in the electricity spot market is mandatory (for large generators), whereas in other places electricity may be freely traded outside the pool. The format of bids varies enormously with regard to time period (hourly, daily), price offers (single, multiple) and detail (plant, generator, location). Market prices may be uniform (e.g., according to the marginal successful bid) or discriminatory (according to individual bids), sometimes containing payments for capacity and other services. In some countries additional auctions are held for regulatory power and ancillary services.

Latin American countries have adopted different designs for their spot markets, but most use a type of cost-based pool following the pioneering Chilean example (see Box 12.1). The exceptions are Colombia, which has an England and Wales (pre-reform) type of pool, and El Salvador, whose pool resembles the Nordic model.

There is no ideal market design, since no one can fully prevent market power. But the difficulty of coping with market power may be exacerbated by a poor market structure. Perhaps the most obvious examples are those in which an insufficient number of competitors has been established before market-based exchange is introduced. Market failure is often the result of excessive optimism with respect to what transactions may be efficiently delivered by decentralized means, given the size of the market. When markets are small, the real question is not so much whether there are measures that can make competition effective, but rather what can be done to mitigate the consequences of imperfect or nonexistent competition.

Even by the standards of most markets, electricity generation in most Latin American countries is heavily concentrated. The three biggest producers in Argentina and Brazil, where competition is greatest, control 30 percent and 40 percent of the respective national markets. In the other countries, this measure of concentra-

**Table 12.2** Market Share of the Three Largest Firms  
(In percent)

	Generation	Transmission	Distribution
Argentina	30	80	50
Bolivia	70	100	70
Brazil	40	60	40
Chile	50	100	50
Colombia	50	100	60
Costa Rica	100	100	80
Dominican Republic	50	100	50
Ecuador	50	100	60
El Salvador	90	100	80
Guatemala	70	100	100
Jamaica	90	100	100
Mexico	90	100	100
Paraguay	100	100	100
Peru	100	100	100
Trinidad and Tobago	100	100	100
Uruguay	100	100	100
Venezuela	90	90	90

Source: Espinasa (2001).

tion stands at 50 percent or more (see Table 12.2). Concentration is also high in the natural monopolies segments. Since market power is a fact of life in the electricity sectors, regulation is a must.

Other factors that conspire against vibrant competition are vertical integration and the limited scope for retail competition due to weak industrial bases and small per capita residential consumption. It is not clear in these cases whether the separation by segments of the electricity market will persist or is even desirable. In Guatemala and El Salvador, there are no limits to vertical and horizontal reintegration. In Colombia, various models of integration and public and private ownership coexist, and limitations to concentration have been legally challenged. Reintegration makes it more difficult to control anti-competitive behavior and imposes an additional burden on regulators.

Since competition in electricity markets in the region is limited, most power pools are "cost based," with the system operators performing economic dispatch using an optimization algorithm fed with technical information and fuel cost provided by thermal generators and the cost of water for reservoirs. (The only exception is Colombia, as described in Box 12.1). While discretion in presenting the information and use of capacity charges varies by country, the main function of the power

pool is to price exchanges among generators. Nonetheless, even this limited spot market may be captured in a concentrated market with poor governance, as has been shown in Chile. However, given the difficulties in operating a fully decentralized market even in the most developed countries, the cost-based approach does not seem to have been such a bad idea after all, particularly in small countries. Here, market size may render competition unworkable and more cautious approaches may be required.

The lack of strong and complementary institutions undermines the performance of the reformed industry and may even slow the pace of reform. For instance, at best, the absence of a relevant competition policy and competent antitrust bodies leaves the regulator with the burden of overseeing competition; at worst, this task is left in the hands of unqualified bodies subject to capture. Consequently, the number of workable options for market architecture is limited. Legal uncertainty is also an important issue arising out of institutional constraints. It can discourage investors and also give them the wrong incentives, and investors may seek comfort in the capture of judiciary and regulatory institutions.

Before concluding that concentration is inevitable, those measures that do exist for improving competitive conditions should of course be given due consideration. Some of these constraints may be removed or lessened through time and effort, thus making feasible the type of workable competition that reformers originally had in mind. For instance, a larger market could be formed by integrating regional markets, as intended with the Central American countries. Such an institution would not be easy to create and will take some time to develop, as the experiences of the much more integrated economies of the European Union have shown. In addition, there is still a need to carefully craft the transition periods to avoid having the interests created during the interim period prevent the attainment of the ultimate goal. If markets are not workably competitive, then market-power mitigation mechanisms must be put in place. Finally, it is important to mention that the experiences of Chile and, to a lesser extent, Peru, seem to suggest that privatization and incentive regulation themselves have played a major role in stimulating improved performance in these countries. When initial conditions are not favorable, gradual development may be desirable.

### *Regulation of Noncompetitive Segments*

Electricity transmission and local distribution are usually considered natural monopolies. Typically, a country has one company operating its transmission network and a number of regional monopolies operating its distribution networks. With the exception of some ancillary services, there is little scope for actual competition in the provision of electricity transport services (though benchmarking may be possible).

The regulatory regime for the network business may take many forms, but some form of incentive regulation is required to achieve efficiency; purely cost-based regulation is unlikely to produce cost efficiency. Regulations must take into account the incentives both for short-run operation of existing networks as well as for extending the networks while meeting quality constraints.

The tariff system should help finance the expansion of the transmission grid. Because transmission costs are usually a small portion of the customer price, efforts by the regulatory agency to “fine tune” the allowed rate of return on transmission are unlikely to significantly reduce consumer prices. Most importantly, if this rate is too low, there will be insufficient investment, causing congestion costs and strengthening local market power. Consumers will pay a high price in the long run for a small reduction in price in the short run.

Countries have adopted different price-setting mechanisms for the three broad segments (generation, transmission and distribution) of the electricity industry. The mechanisms include the cost of service (or market), price caps, and the efficiency standard scheme (see Table 12.3).<sup>4</sup>

The efficiency standard scheme first developed in Chile and later adopted by Bolivia, is based on the cost of a model distribution system. It is a combination of yardstick regulation, price caps and replacement cost accounting. Critics point to the enormous information burden that this method imposes on the regulator.<sup>5</sup> The

<sup>4</sup> The generation segment refers to the cost of generation that is passed to the regulated final consumer, and the transmission and distribution components refer to the wire portion of such services. The generation component is referred to as “market” when the prices at which the retailer buys energy in the wholesale market are passed on to the consumer adjusted by losses with some sort of smoothing. “Cost of service” refers to the traditional method used by utilities in the past, and “efficiency standard” refers to the Chilean method for the wires segment.

<sup>5</sup> See Joskow (2000a) and Jones (1993).

Table 12.3 Price-setting Mechanisms

	Generation	Transmission	Distribution
Argentina	Market	Price cap	Price cap
Bolivia	Marginal cost	Price cap	Efficiency standard
Brazil	Market	Cost of service	Price cap
Chile	Marginal cost	Cost of service	Efficiency standard
Colombia	Market	Price cap	Price cap
Costa Rica	Cost of service	Cost of service	Cost of service
Dominican Republic	Market	Cost of service	Cost of service
Ecuador	Market	Cost of service	Efficiency standard
El Salvador	Market	Price cap	Efficiency standard
Guatemala	Market	Cost of service	Efficiency standard
Jamaica	Cost of service	Cost of service	Cost of service
Mexico	Cost of service	Cost of service	Cost of service
Paraguay	Cost of service	Cost of service	Cost of service
Peru	Marginal cost	Efficiency standard	Efficiency standard
Trinidad and Tobago	Cost of service	Cost of service	Cost of service
Uruguay	Cost of service	Cost of service	Cost of service
Venezuela	Cost of service	Cost of service	Cost of service

Source: Espinasa (2001).

inability of the Chilean system to transfer to final consumers the gains in efficiency obtained at the generation level has prompted a review of the procedures.

It is not yet possible to assess the success of methodologies used in Argentina, Brazil and Colombia because there have been no periodic reviews. The outcome of Argentina's review, currently under way, will shed light on this issue. It is easier to understand the difficulties faced by small countries because of asymmetries between the regulator and the regulated.

### *Price Volatility, Subsidies and Fostering Private Investment*

Deregulation leads almost by definition to more price volatility. When price controls are lifted and pricing decisions are decentralized, it is to be expected that prices will react more rapidly and with greater amplitude to shifts in underlying supply and demand conditions. This expectation has been corroborated by the experience of most deregulated electricity markets, including those in England and Wales, Scandinavia, and, more recently, El Salvador and California. Both consumers and investors complain about price volatility, although for different reasons. Consumers see any price hike as permanent, while investors fear that low prices will never recover and prefer a guaranteed stream of

revenues to reward their investment. Not surprisingly, consumers and investors agree on the appropriateness of government subsidies to solve their problems if prices are not to their liking.

The underlying causes of price volatility are usually volatility in demand or supply conditions, market design flaws, and market power. Given the unique characteristics of the electricity sector it should come as no surprise that prices fluctuate considerably when there are changes in demand or supply conditions. Changes in the weather, in general economic conditions, or in the supply of fuels would more or less immediately feed into electricity prices. Such price fluctuations are unavoidable in a deregulated market, and to some extent they may be desirable signals for the efficient use of a scarce resource.

On pure efficiency grounds, economists tend to advocate a hands-off policy regarding price volatility that results from fluctuations in demand and supply conditions. To the extent that price volatility is considered a cost to market participants, instruments exist that can hedge against the associated risk. Indeed, as a response to fluctuations in market prices in most deregulated electricity industries, secondary markets have developed that offer the required hedging instruments (fixed-price contracts, futures, forwards, etc.).

Nevertheless, politicians and regulators may be unwilling to expose consumers to the full consequences

**Box 12.2 Blackouts: A Tale of Two Crises**

California and Brazil are facing severe power shortages. Pundits have been quick to point to similarities between the two crises in order to reinforce whatever their preconceived or ideological point of view happens to be as to what causes such events: lack of adequate investment, unexpected rise in demand, failure or lack of deregulation, etc.

But while it may be tempting to draw quick conclusions from this parallel, a closer look finds significant differences in both the causes and the management of these respective crises. Keeping these differences in mind helps better analyze the apparent coincidences.

Lack of adequate generation resources at a critical transitional period during the implementation of reforms was certainly at the core of the problem in both markets. Deregulation implies adopting new coordination mechanisms between distribution and generation, a process that requires some adjustment and makes the system vulnerable in the early stages. However, how these mechanisms will work in a particular system is not always clear beforehand. For example, most analysts of California's problems agreed that the lack of long-term contracts as a hedge against volatility limited the entrance of new investors, exacerbated opportunities for generators to exercise market power, and eventually led to the bankruptcy of distributors. Brazilian distributors, on the other hand, were fully contracted as part of the transitional arrangements, and for all practical purposes the spot market did not exist. Thus, when the government pushed for an emergency program to bring thermal plants on line, there were few buyers among the distribution companies. Moreover, the lack of adequate provisions to hedge foreign exchange risks in imported natural gas further diminished investors' appetites. While it is partly true that the crisis was caused by a sudden lack of supply and the generally volatile nature of Brazil's primarily hydroelectric power supply, it is also true that the system

itself had no provisions to allow for adequate handling of a mishap.

A common feature of both the Californian and Brazilian reforms was the unusual long debate that preceded them, which gave time for special interests to entrench themselves and introduce significant modifications to the processes that ultimately made them more vulnerable. Five years after the first privatization of a distribution company in Brazil, the system still lacked a clear framework for private investment in generation. Local politicians and interests associated with the old state-owned enterprise managed to paralyze the privatization of generation assets. In California, the debate led to a compromise system with a long transition period that increased its vulnerability.

Both governments were slow to understand the real dimensions of the crisis and react to it with a credible plan. State and federal regulators blamed each other for the California crisis and failed to agree on a strategy to solve it. Furthermore, California's regulators dug their own grave by foreclosing the price option as a tool to manage the shortage. In Brazil, turf wars delayed establishment of an adequate contingency plan, despite early warnings that one was needed.

In one critical respect, the Brazilian experience diverges from that of California. The Brazilian government was willing to use the market to allocate the shortage to avoid rolling blackouts. The government imposed a rationing quota and left large users free to trade their share or sell it in the spot market. A surcharge was imposed on heavy residential users, but they were granted bonuses if they saved more than their quota, while consumers failing to meet their quotas were subject to temporary disconnection. If this strategy survives legal challenges and is successfully implemented, it may become one of the best lessons Californians may learn from the Brazilians.

of the market. Clearly, such a response may be reasonable if there are no hedging instruments. However, impeding price movements correspondingly reduces the incentive to develop such instruments. It is only when the development of such instruments is unlikely (due, for instance, to weak financial markets) that price regulation can be advocated as a means of protecting market participants against the costs of price volatility. Moreover, the dampening of natural price movements may increase the shortage problems that were the main concern in the first place. For instance, the incentive to maintain reservoir levels high depends on the expecta-

tion of future prices—which is reduced if prices are capped. Dampening seasonal price movements also gives perverse signals to consumers, as in the 1999 Chilean crisis when consumer-regulated prices and reservoir levels were simultaneously falling.<sup>6</sup>

All this having been said, it may nonetheless be advisable to introduce temporary measures to protect consumers against price volatility in order to avoid unnecessary disruptions to the market reform process. In-

<sup>6</sup> See Fischer and Galetovic (2000).

Table 12.4 Households with Electricity, by Income Decile

*(In percent)*

Decile	Bolivia 1999	Dominican Republic 1998	Honduras 1999	Guatemala 1998	Mexico 1998	Brazil	
						1988	1999
1	18	77	33	26	81	48	80
2	18	83	40	41	89	65	85
3	57	80	62	51	94	74	91
4	68	86	64	56	96	81	94
5	82	92	73	60	97	88	96
6	86	93	77	58	98	92	98
7	91	89	80	68	98	95	99
8	97	97	81	83	99	97	99
9	98	96	86	79	99	98	100
10	97	97	82	91	99	99	100

Source: Household surveys.

intervention in the marketplace is of course less controversial if there is excessive price volatility due either to market design flaws or the abuse of market power. It is important, however, to determine which of these possibilities is the real cause. It is of little use to tamper with market design elements if the real problem is the abuse of market power. The repeated terrorist attacks on the Colombian transmission grid in 2000-2001 led to a de facto fragmentation of the market and provided strong incentives for generators to exercise market power. Thus, spot market prices during the first quarter of 2001 showed unusual spikes until the regulator intervened the market to acknowledge its fragmentation.

Analysts have been unanimous in blaming the lack of demand response as one of major reasons behind the collapse of California's electricity market in 2001.<sup>7</sup> Even limited applications of real-time pricing (RTP) only to large consumers should have been enough to dampen the price spikes and ameliorate the blackouts. Nonetheless, the fear of high transaction costs and an insufficient understanding of the importance of demand elasticity prevented the timely adoption of such measures. In this respect, there are some lessons that California can learn from Latin America (see Box 12.2).

In some Latin American countries, governments have subsidized prices to avoid passing on the volatility in oil prices or the stranded cost of the reform to consumers. Conversely, some countries have granted special conditions to investors, tax holidays, and higher prices for local renewable energy, the cost of which will ulti-

mately be borne by consumers or taxpayers. While some of these measures may be justified on individual grounds, they may create problems of their own. Given that the financial burden of the electricity sector has been a major problem for most governments, it is not realistic, nor perhaps advisable, to make investment in the electricity industry dependant on public money.

A more critical issue is that of expanding electrical service to those segments of the population that still lack access to it. As indicated in Table 12.4, access is heavily skewed against the poor. Well-designed subsidies could help extend service coverage to unprofitable markets, alleviating some of the constraints to access faced by the poor.

In order to improve investment incentives, market institutions that allow for risk management should be encouraged. It is also essential to reduce regulatory or political risk. One could argue that a weak government, susceptible to capture by industry interests, would provide an environment conducive to private sector investment. However, there is little doubt that the best guarantee for efficient investment is stable and predictable regulations. The difficulty is, of course, how to establish and commit to such a policy.

<sup>7</sup> See Borenstein (2001).

### *The Architecture of Regulatory Institutions*

One of the main hypotheses of this chapter is that the Latin American countries lack the political and regulatory institutional conditions necessary to support the types of reforms they are implementing. Reforms and institutional conditions should conform. One way to go about this is to improve regulatory institutions and human resource endowments. Otherwise, reforms have to be modified to better fit actual institutional conditions until existing constraints are overcome. In considering options for regulatory architecture, the reformer must have a clear model of how government works and its limitations. This should include the asymmetry between the regulator and the regulated, the problems implied by multiple tasks and agencies, the compromise between commitment and flexibility, and the nature of the constraints involved in choosing the regulator.

- *Capture by the state or capture of the state*

Any system of regulation faces two opposite risks. According to the “grabbing hand” view,<sup>8</sup> one risk is that the regulatory agency may become hostage to the political interests of the politician or bureaucrat. Even if the old state-owned enterprise is partitioned and privatized, unless there are adequate checks and balances, politicians will continue rent-seeking activities using regulation as their new vehicle. The opposite risk is that the government may become an agent of private principals. Small countries with weak institutions and few restrictions on market structure may end up in a situation where powerful firms are able to shape the rules of the game to their own advantage. In network utilities, the outcome could be vertical and horizontal integration, increased prices, and provision contract clauses transferring all the risks to the state and yielding handsome profits to the powerful firms.

Both captures are equally worrisome, and in many cases it may be impossible to fully avoid them. Developing a consistent and predictable regulatory environment requires creating regulatory institutions that are sufficiently independent to withstand pressure from particular groups, including interested politicians. At the same time, these institutions must have limited powers so that they do not unduly interfere in the operations of industry players. Achieving this theoretical goal in small and weak countries remains a work in progress

and will take some time and effort. The task may be less painful if, as suggested by Joskow (2000b), regulations are framed taking into account the people who will have to implement them.

- *Multi-task and multi-agency problems*

Any system of regulation can be viewed as a contract between firms, regulators and the executive and legislative powers that is likely to be incomplete and subject to renegotiation. The reasons for this perspective include not only unforeseen external circumstances, but also changes in objectives and shifts in the balance of power or the strategic behavior of the parties (due, for instance, to a learning process). In order to minimize transaction costs during the life of the contract, the first step of a regulatory system is to establish the architecture, rules and processes that can improve commitment by all parties. The separation of roles is thought to improve commitment because it helps create checks and balances between the regulators and prevent regulatory capture by interest groups or the regulated firms. However, effective separation requires bureaucratic procedures that may increase the costs of transaction. Separation may also be hampered in practice by the lack of specialized expertise or cooperation between the various regulatory agencies.

While separation of regulatory powers may be a good way to avoid capture, in practice the scarcity of human resources may limit the use of this option. In most small countries there is only one agency in charge of regulation and enforcement, and in some, the regulator is in charge of several infrastructure sectors. In countries such as Colombia and Chile, where the functions of regulation and control are split into two different agencies, the control of market power has been difficult to implement, and jurisdictional conflicts have been frequent. This problem is exacerbated by the lack of adequate regulatory bodies in countries of the region. Strengthening antitrust agencies throughout Latin America could improve the potential efficiency of regulatory outcomes, especially for electricity, because it would give room for more ex post monitoring controls that are less prone to capture by the industry.

In large federalized countries like Argentina and Brazil, there is a role for the states or provinces in the

<sup>8</sup> See Shleifer and Vishny (1998).

regulation of the local transmission and distribution business. This requires a minimum level of expertise at these levels. While it may be argued that being close to the regulated firm helps the task of the regulator, this advantage must be weighted with the duplications and use of scarce human resources that it implies. Careful and balanced distribution work between the federal and local agencies is a must.

- *How much flexibility?*

Since regulation is an incomplete contract between regulators and business, there is a trade-off between the credibility of the regulatory commitments and the flexibility required to accommodate unforeseen circumstances and changes of interests of the various actors. When there is little credibility because the rule of law is weak or property rights are poorly protected, the advantages of flexible regulation must give way to the strength of rigid rules. This explains the extreme rigidity of some power sector regulatory systems in the region that followed the Chilean example.

The Chilean experience exemplifies the trade-off: the rigidity of its regulatory system was key to assuring potential investors that their investment would not be expropriated by the regulator, but it had the undesirable effect of making the regulatory framework unresponsive to changes in the environment, as shown by the 1998-99 drought.

The California experience demonstrates that the design of electricity markets is an unfinished business. Adjustments are inevitable, and the challenge is to create a system that ensures efficient rule changes. Panama and some states in the United States have adopted similar approaches, setting up market surveillance groups made up of independent outside experts to “institutionalize change.”<sup>9</sup> Their experiences suggest two lessons. First, the experts must be perceived as independent and objective. In small and medium-sized countries, this probably means hiring experts from outside the country. Most knowledgeable people within the country will be perceived as biased, at least initially, because of past connections with the industry. Second, the experts must have a broad mandate. They should be charged with assessing not only the performance of the market, but also of the system operator and the regulator. And they should be able to recommend changes in structure as well as rules.

- *Choosing the regulator*

Another issue related to the possibility of capture is the choice of regulator. Estache and Martinot (2000) consider three types of regulators: “careerists” who are more likely to move to the industry they regulate once they finish their tenure in the civil service; “professionals” who are usually former industry managers willing to keep some influence on the regulatory process; and “politicians” who see the civil service as part of their political career. Given the implicit incentives of these types, it would be optimal to shift the balance of power towards the politicians and away from the professionals and even the careerists. This conclusion is at odds with the standard recommendation given by practitioners. The usual reasoning is that politicians do not necessarily respond to their main constituents, the electorate, and are also prone to capture by special interest groups. The length of tenure of the regulators may also help fight capture: shorter tenures may reduce this risk. However, the standard recommendation is in favor of longer tenures, under the presumption that this allows for greater independence and regulatory stability. What this shows is that the issues related to the choice of regulator imply a series of trade-offs that should be resolved in the context of each individual country. No blueprint has yet emerged, and choosing a good regulator remains more an art than a science.

Corruption may be viewed as a result of poor selection of officials and inadequate incentives. According to this view the solution to the problem may therefore involve finding better people and improving their incentives. Some countries (including the United Kingdom) have appointed as regulators people with little or no previous connection to the industry, sometimes coming from other industries or from academia. However, that option may be of little use for some countries, given the constraints on human resources and their limited institutional endowment. One wonders if a solution would be to establish regulatory boards with international representation, maybe as a scheme of international collaboration for parallel improvement of institutions in different countries.

<sup>9</sup> See Ariza, et al. (2001).

## Conclusions

The main proposition of this chapter is that while power sector reform has made significant progress in Latin America, major challenges remain. Some of these challenges arise because of the technological features of electricity markets, and others because many Latin American countries lack the institutional development and human resources implicit in the models that have been adopted. As a result, gains from reforms have varied from country to country. Nonetheless, successful reform should be measured with a pragmatic yardstick, weighing what is desirable with what is feasible.

As countries have privatized and attracted private investment, substantial improvements in productive efficiency have been achieved and a process of institutional learning has been put in place. However, the consumer has not always benefited from these improvements, competition remains an elusive goal in many countries, and investors are still reluctant to commit their capital in greenfield developments without considerable guarantees and demanding high prices. Service coverage is still limited in some countries and, with a few exceptions, subsidies have not been used wisely. Government still has a significant presence as an entrepreneur in many countries, and the separation of roles has been hard to accept. Thus, regulation is a work in progress.

Some of the other key lessons from experiences with power sector reform include the following:

- Institutional constraints prevent establishing an effective regulatory and investment environment. Because institutions take time to develop, it is sometimes preferable to take an evolutionary rather than a big bang approach to reform. However, to avoid getting locked into a limited design, there must be a clear vision from the outset of the long-term goal, and well-defined conditions that can trigger major changes.
- It is critical to keep the wires business, transmis-

sion and distribution independent of supply, generation and commercialization. However, it is still unclear how to involve the demand side in the market and realize the potential of retail competition.

- Even if competition is not feasible in the short term, care should be taken not to foreclose future options for competition when present constraints are removed.

- The existence of a constraint-free transmission system is of vital importance for the market, and its expansion should not be limited by narrow efficiency considerations. The public sector must still play an active role in the expansion of transmission grids in most countries.

- It is now widely accepted that institutional and technical constraints prevent competition in small markets. While the jury is still out on the debate as to how to best regulate a small system or the type of market arrangements that minimize the exercise of market power, there is no doubt that the worst action would be to ignore the problem and simply expect that players will behave properly.

- Regulatory intervention is always required in the power sector, but how to achieve it remains an open question, given information asymmetries and institutional constraints that make enforcement more difficult. One criterion for the design of the regulatory system may be to minimize the regulatory transaction cost in the short term in order to buy time to develop the necessary institutional capacity. The main consideration when designing or evaluating a regulatory framework should be a straightforward assessment of the people and organizations that will be in charge of implementing and enforcing it.

- Given the limited amount of research on regulation of power sectors, the best piece of advice for the moment would be to be pragmatic, take institutional weaknesses into account, avoid turnkey solutions, and stay abreast of international developments.