

Comments

Paul L. Joskow: I found Fischer and Serra's paper to be interesting and generally well done, and I agree with much of their analysis. The primary area in which I disagree with the authors relates to the creation of unregulated, bid-based spot markets for energy and ancillary services. They have underestimated the difficulties in creating competitive energy and ancillary services markets with good performance attributes, the potential problems resulting from horizontal market power, and the challenges of coordinating energy and ancillary services markets with efficient mechanisms for congestion management.¹ The discussion that follows focuses primarily on Chile, with a few comments on Argentina. These are also the two electricity sectors in Latin America that have been operating long enough to afford a reasonable amount of experience and performance information for the purposes of analysis. (The sector in Peru is practically a clone of the Chilean sector.)

Prior Reforms Significantly Improved Sectoral Performance

Prior to the relatively recent reforms, electricity sectors in Latin America exhibited, to varying degrees, a number of serious performance problems:

—Inadequate investment in new generating, transmission, and distribution capacity to balance supply and demand efficiently, which led to costly shortages and costly responses by industrial and commercial consumers (for example, backup generators). Consumers often faced long queues to get connected to the system legally.

I have benefited greatly from ongoing research with Soledad Arellano on the Chilean electricity sector.

1. Ancillary services refer to frequency regulation, spinning reserves, nonspinning reserves, and short-term replacement reserves, all of which are complementary to the production of energy.

—Prices that were too low to cover operating costs and capital carrying charges. This provided bad price signals for consumption, but more important, it severely limited the ability of the state-owned utilities to mobilize capital to pay for new capacity. It also led to deferred maintenance of equipment, which, in turn, led to shortages and poor reliability. This situation reflected, in part, the governments' tendency to limit price increases for utility services (namely, electricity, telecom, water, transportation) supplied by state-owned companies in an effort to combat rapid inflation.

—Low labor productivity as state-owned utilities in the sector became attractive places to provide employment for political reasons.

—High levels of so-called nontechnical losses (namely, theft of service).

—Concerns by potential investors about expropriation of investments, which resulted from the region's history of nationalization as well as from the absence of a credible regulatory framework to protect investments from regulatory or political takings. This situation further limited the sector's ability to attract capital and was another cause of shortages and reliability problems.

Whatever mistakes may have been made when the earliest reform programs were initiated (given the benefit of hindsight) and whatever problems might remain, all of the Latin American countries that implemented privatization, competition, and regulatory reforms have significantly improved the performance of their electric power sectors. Chile and Argentina have seen substantial supply expansion, major improvements in the performance of production equipment and system reliability, increases in labor productivity, and significant new foreign investment in the sector. These improvements convey important societal benefits. Are the systems perfect? No. Can the systems be improved? Yes. But we should not lose sight of what has been accomplished, and we should be confident that any additional reforms will improve rather than undermine sectoral performance, especially in Chile and Argentina, where sectoral performance has already improved very significantly.

In all of these countries, the reform program incorporated several components: the privatization of state-owned enterprises; the vertical and horizontal restructuring of incumbent utilities; the introduction of new regulatory mechanisms governing distribution and transmission; and the

introduction of competitive opportunities in the wholesale and retail markets. This package of reforms is often called liberalization, which is a rather imprecise term, or simply deregulation, which incorrectly describes the nature of these reforms. Ideally, the reform package should be analyzed to discover which individual pieces and what combinations of pieces have contributed to the observed performance improvements, as well as how they have made that contribution.

The Chilean experience and, to a lesser extent, that of Peru seem to suggest that privatization and incentive regulation in themselves have played a major role in stimulating the performance improvements. This must be the case because neither country has really allowed much competition. Specifically, competition is restricted in the following ways.

—What is generally referred to as a spot market in Chile is not really a market in the sense that the spot markets for energy in California, Norway, or England and Wales are markets. Indeed, it is little different from the centrally dispatched power pools like PJM that existed in the United States for decades before restructuring. Generators are dispatched based on estimates of their marginal production costs, and the marginal cost of the last supply unit called to meet demand determines the market clearing price. Network congestion and constraints are centrally managed by the system operator (the CDEC in Chile) in conjunction with the least-cost dispatch of generators. While this mechanism for dispatch and spot-price calculation gives generators incentives to keep their costs low and their availability high, it represents a simulated spot market for energy rather than a real spot market.

—Large customers are theoretically free to contract directly with generators for their supplies (though they are not permitted to buy directly from the spot market), but in practice only very large customers that can connect directly to the high-voltage transmission system have this opportunity. The distribution company serving Santiago, for instance, has many customers that theoretically can contract directly with generators, but very few (perhaps only two) have ever done so. The reasons are (a) customers do not have access to an unbundled delivery tariff that separates delivery charges from generation charges and (b) generators are reluctant to steal the distribution company's retail customers, since the distribution company is itself a major contract purchaser of the generators' wholesale power supplies.

—Distributors are supposed to enter into contracts with generators to meet the forecast demands of their retail customers, but the prices in these contracts are regulated based on a forecast of nodal prices, not on real market prices, and the associated costs are passed through to retail consumers. Accordingly, the wholesale contract market is not really a competitive contract market. Moreover, if the forecast nodal prices are too high or too low, the resulting contract prices can have perverse incentives for investment in new generating capacity.

—The nodal prices, in turn, are theoretically collared by the “free market” prices paid by large industrial customers: they must fall within a band defined as 10 percent above or below negotiated contracts between generators and large customers. As just noted, however, competition in the free market is more limited than first meets the eye.²

—Theoretically, the market allows free entry of new generators, but transmission companies are not obligated to plan for or build transmission capacity in advance, and the regulatory framework does not establish a cost-based open access transmission tariff.³ Furthermore, the major transmission company is owned by the major generator, and they must, by necessity, interact closely with one another. As far as I know, no new generating companies have entered the Chilean market in the recent past, though existing generating companies have expanded generating capacity significantly.⁴

Whatever success the Chilean reforms achieved, they did not result primarily from a vibrant, unregulated competitive market for electricity. Privatization, incentive regulation, a simulated competitive spot market, and free entry by incumbent suppliers in response to administratively determined generation prices all contributed to the performance improvements.

2. Prices negotiated in the free market are confidential, and I have seen no analysis that indicates whether the negotiated contract prices are a binding constraint and, if they are, how large is their effect, if any, on the contract prices paid by distributors.

3. In contrast, open access transmission tariffs are provided for by Order 888 in the United States and the Grid Code in England and Wales.

4. The relatively recent availability of natural gas in Chile may facilitate entry of new suppliers and competition from cogeneration.

Competitive Spot Energy and Ancillary Services Markets: A Challenge

Fischer and Serra are quite critical of the reliance on the marginal cost–based spot market for generation in Chile, Peru, and, initially, Argentina. Admittedly, the situation is far from ideal, especially for a hydroelectric system based on stored water. The decision to rely on this framework was actually quite clever, however, given the situation in Chile when the reforms were originally introduced and even today given the very significant potential problems with horizontal market power in the Chilean generation sector (and in many other Latin American countries, Argentina being a notable exception). The Chilean reformers were also smart to combine this pricing, dispatch, and congestion management system with the use of free market contract prices to constrain the administered marginal cost–based nodal prices that are included in contracts with distribution companies and ultimately paid by captive retail consumers.⁵

Moreover, while Fischer and Serra recognize that good electricity market performance requires real competition and that problems of strategic behavior can emerge in generation markets, they do not adequately recognize how challenging it is to design short-term electricity markets so that they work well. The challenges associated with creating properly functioning spot markets for energy and ancillary services cannot be underestimated in light of the many problems that have emerged in bid-based markets around the world, including the United Kingdom, California, New England, New York, and Australia.⁶ Both the design of market rules and potential horizontal market power issues must be taken very seriously if market performance problems are to be avoided.⁷ The authors' conclusion that a bid-based market would be simpler than the current system in Chile is hard to square with recent experiences in the United States and England. For example, England and Wales have suffered ongoing

5. Assuming, of course, that a robust free market for industrial sales actually exists.

6. Fischer and Serra are silent on the topic of the supply and pricing of ancillary services, however.

7. It is not too helpful to speak of spot markets for electricity without defining the market rules, including the bidding rules, congestion management, settlement systems, and interactions between spot and forward markets and between energy and ancillary services markets. Fischer and Serra do not address these difficult and important issues for market design, which may explain why they consider unregulated spot markets to be simpler than the marginal cost–based dispatch and pricing system currently used in Chile and elsewhere in Latin America.

market power problems despite very significant entry of new generators and mandated divestiture by the largest incumbents; dramatic changes in market rules are scheduled to be introduced in November 2000 in response to perceived market performance problems.⁸

It would be extremely unwise for Chile to change to a bid-based spot market for energy and ancillary services without dealing directly with what could be very significant market power problems. It's not just that ENDESA, the largest generating company, controls about 60 percent of the existing generating capacity in the large central region (which accounts for the bulk of the electricity demand in Chile), controls 70 percent of the potential sites for future hydroelectric facilities, and owns the transmission company serving the central region, although these attributes are certainly indicative of potential market power problems.⁹ In addition, the transmission network experiences significant congestion under certain conditions, especially in and around Santiago, which could create load pockets and local market power problems. (The network in the central region, which includes Chile's major cities, is not interconnected with the network in the north or with any other country.) Before introducing a bid-based short-term market for energy and ancillary services, reform designers should undertake a serious analysis of potential market power problems, in the context of a well-defined set of market rules.¹⁰ If the potential for market power problems is significant, the introduction of bid-based short-term markets for energy and ancillary services should be accompanied by market power mitigation strategies. Some combination of horizontal deconcentration, fixed-price supply contracts which provide incentives to expand rather than to withhold supply, and bid caps will be required.

8. See for example the numerous reports on market performance problems published by the Market Surveillance Committee of the California Independent System Operator (www.caiso.com) and by the Market Monitoring Committee of the California Power Exchange (www.calpx.com). Similar problems have emerged in the New England and New York markets. In England and Wales, generator market power has been a continuing problem and represents one rationale for changing the spot market trading and pricing arrangements that have been in place for the last decade.

9. The control of hydroelectric sites may become irrelevant if other generation sources, such as combined cycle gas turbine facilities, are cheaper than developing new hydroelectric resources.

10. Such a study must go beyond just calculating aggregate generation concentration ratios. Because electricity cannot be stored, it is important to look at the configuration of the ownership of generating capacity with different cost attributes and under different supply and demand conditions.

Designing a market power mitigation strategy will not be easy, and it must be based on good analysis of where the market power problems are likely to lie.

In this regard, let me note that while Argentina now gives generators more bidding freedom than does Chile, it has a much larger electricity market than Chile, and when the market was restructured it was designed to be structurally more competitive, with many competing generating companies. Furthermore, a vibrant, competitive natural gas market has facilitated competitive entry into the sector. I am not optimistic that this competitive environment could be replicated quickly or easily in Chile or in several of the other smaller Latin American countries mentioned in the paper.

Distribution Regulation and Retail Competition

The mechanism that Chile adopted to regulate distribution companies clearly provided good incentives to invest, to reduce costs, and to reduce both technical and nontechnical losses. The distribution regulatory mechanism combines elements of yardstick regulation, price caps, and replacement cost accounting. Once base prices are set, this regulatory system makes the distribution company the residual claimant on cost reductions, and it gives them powerful incentives to control costs and reduce losses. Despite the theoretical elegance of this regulatory system, several problems are likely to occur in practice.

First, reliance on a “model distribution system” to set base distribution prices (a form of yardstick regulation that was also applied for many years in Spain with mixed success) is good in theory but hard to implement in practice. Determining the appropriate attributes of a good model distribution system and relying on replacement cost accounting—with the attendant problems of properly measuring economic depreciation—places an enormous information burden on the regulators. In practice, it would be better to rely on a simpler, theoretically less-pure system based on price caps, such as that used in England or the United States. (The United States began to abandon replacement cost accounting in the 1930s because it was too hard to regulate and was frequently abused.)

Second, as indicated above, the absence of unbundled transport charges for distribution service significantly limits the development of a vibrant contract market for industrial customers. If this contract market were an

option for more industrial consumers, it could play an important role in disciplining prices paid by residential and small commercial customers, provided that the marginal cost–based nodal pricing system were retained for purposes of dispatch, congestion management, and pricing for captive retail customers. (This was, course, the original intent of the framework adopted in Chile.)

Third, distribution companies presently have an obligation to enter into contracts with generators to meet their forecast demands. However, there does not appear to be a real market for these contracts, because the prices are predetermined based on forecasts of marginal costs (and associated nodal prices) and because the largest distributor and the largest generator are commonly owned.

Finally, little effort has been made to separate competitive services supplied by the distributors from the regulated distribution activities they provide. Accordingly, the former may be subsidized by the latter. In addition, customers are probably not getting a fair share of the revenues earned from facilities they have paid for, such as pole attachments and conduit use associated with cable TV and telephone systems that use distribution system facilities.

A Reform Program for Chile

So, what is to be done to further reform the electricity sectors of first-generation reformers such as Chile? The authors are certainly correct that the Argentine system is better than the Chilean system, other things equal. But things are not equal. The Argentine system cannot be replicated instantly in Chile because the Argentine market is much larger, is much more structurally competitive, and benefits from a competitive natural gas market. At the very least, Chile must resolve the potential market power problems in the generation segment before it can rely on unregulated competitive bid-based markets for energy and ancillary services.¹¹ Moreover, even in electricity markets that are structurally com-

11. This is true about many of the other Latin American markets as well. It is hard to imagine that El Salvador and Bolivia, for instance, would have workably competitive generation markets without some overlay of contractual restrictions on market power. The restructuring programs implemented in some of these countries appear to reflect bad advice from the World Bank, which seems to think that two competitors makes a competitive market.

petitive (for example, California and New England), market design flaws and local market power problems continue to undermine the efficiency of bid-based markets. Unlike the authors, if I were advising the Chilean government, I would not place the introduction of unregulated, bid-based short-term markets at the top of my list of reforms. Rather, I would continue to rely on the current marginal cost bidding system until a number of other structural problems were fully addressed. These include the following:

—Require the distribution companies to unbundle tariffs and make available unbundled transport service at regulated, cost-based rates governed by incentive regulation mechanisms. Eligible retail customers could then negotiate for their power supplies with generators or markets or buy directly in the spot market. Any customer with a real-time meter should be allowed to purchase directly from generators or through marketing intermediaries. I would not extend retail competition to small residential customers at this time because evidence from England and the United States suggests that the costs of doing so outweigh the benefits.

—Adopt a simpler, tougher system for regulating distribution charges and require cost separations of regulated from competitive activities.

—Require distribution companies to rely on competitive tenders for contracts to serve the supply needs of their retail customers who are not eligible to shop directly in competitive wholesale markets or through retailing intermediaries. In the short run, use the forecast nodal prices, including the capacity payments, plus an adder of 10 percent as price caps in this bidding process.

—Limit the amount of generating capacity that any distribution company can own in order to give competing generators a crack at the distribution company's captive retail demand and to ensure that retail marketers can find generation suppliers to back up their contracts with retail consumers who can shop directly for their power supplies.

—Create an independent transmission company,¹² require it to have an open access tariff, and give it transmission planning and expansion obligations for the system. If distribution companies also own generating facil-

12. ENDESA, the largest generation, transmission, and distribution company in Chile's central region, has announced that it will sell its transmission company later this year.

ities (whether directly or through an affiliate) and engage in wholesale or retail marketing, then any high-voltage transmission facilities they own should be transferred to the independent transmission company as well, at a reasonable price.¹³ If the distribution companies do not own generating facilities and are not competing as retailers or wholesalers, then such a transfer would be unnecessary. In this way, the transmission company would be fully independent; third-party generators would be assured that self-dealing and cross-subsidization are not giving some generators a competitive advantage because of their ownership relationship with the transmission operator; and all generators would feel comfortable discussing investment plans—and associated transmission capacity needs—with the transmission company without fear that the information would get back to a competing generator affiliated with the transmission company.

—Reform transmission regulation and pricing. Creating an independent transmission company is only one step in effectively reforming the transmission network to support competitive energy markets. Generation and transmission are characterized by significant economies of vertical integration. Unfortunately, extensive vertical integration between generation and transmission within a natural electricity supply region is not conducive to the development of robust competitive markets. Accordingly, creating a fully competitive electricity sector necessarily requires sacrificing some of these economies. The hope is that the costs arising from vertical separation can be kept small, while the benefits from expanding wholesale and retail competition will more than compensate for the diseconomies

13. If the generating facilities were operated completely independently of the transmission and distribution networks, through a separate affiliate, then the self-dealing issues could be resolved without requiring separate ownership of generation and transmission. In this case, however, any economies of vertical integration would necessarily be lost if the transmission and generation affiliates had to operate completely independently. Accordingly, it is not clear that there is any social value in continuing common ownership. Moreover common ownership of generation and transmission on the same network requires continuing regulatory monitoring of the integrated firm to enforce independence requirements. In the United States, federal regulations do not require generation divestiture by transmission owners, but they now do effectively require the creation of independent regional system operators to run the transmission networks when these networks are not independent of market participants. New England, New York, and California have strongly encouraged generation divestiture, however. England, Norway, Australia, Argentina, Spain, and other countries that have implemented electricity sector reforms rely on independent transmission companies.

of vertical separation. This happy result is not guaranteed, however. The challenge is to develop incentive regulation mechanisms for the transmission company, transmission pricing and congestion management mechanisms, and complementary energy and ancillary services market rules that maximize the benefits of competition and minimize the costs of vertical separation. This will be very hard work.

—Consider building transmission connections between the central system and the northern system and between Chile and Argentina to increase competition among generators, to increase reliability, and to bring lower cost generation to Chile when there is excess capacity in neighboring systems.

—Better understand the horizontal market power problems that would emerge with a bid-based system and develop a market power mitigation program involving deconcentration, fixed-price contracts, and bidding caps.

—Finally, once generation market power problems have been identified and mitigation measures put in place, introduce a set of competitive, bid-based forward and real-time markets for energy and ancillary services, with market rules and associated market institutions based on best practice drawn from experiences in other countries. Rely on the existing marginal cost-based bidding and pricing system as a market power mitigation mechanism in the interim.

William W. Hogan: The authors have provided us with a detailed review of market design and regulation in the electricity sectors of Chile, Argentina, Brazil, and Bolivia, with some comparison of the later reforms implemented in Colombia and El Salvador. Beginning with Chile, which led the world in electricity restructuring, these Latin American countries have been at the forefront of innovation in the design of electricity markets.

This experience in electricity restructuring has produced a great deal. Innovation and investment have been substantial, both from domestic sources and through the entry of foreign owners. Not everything has been an unqualified success, however, and the benefits of change have not always flowed through to the final customers. Furthermore, some of the remaining problems have actually reduced reliability or created perverse incentives in need of further reform. Hence the timely contribution of this paper.

A fundamental feature of the reform of electricity markets is the separation of the potentially competitive elements of the electric system from the remaining monopoly elements. Since the monopoly elements—mainly the wire businesses of transmission and distribution—play such key roles in the system, public oversight and regulation are clearly needed. The result then is far from a complete *laissez-faire* approach, where government would totally withdraw from its role as sector regulator. Rather, regulation of the monopoly elements must adapt to support the operation of an energy-generation market and the other supposedly competitive sectors of the electricity system.

In every country that restructures, this new regulatory requirement presents a significant challenge for government. An old feature of this challenge lies in the difficulty of understanding the incentive effects and impacts of regulation. There is an asymmetry of information between the regulator and the monopoly companies, which clouds our understanding of what is happening and how regulatory decisions will affect behavior. The same asymmetry affects analysis of the industry undertaken by scholars interested both in the general economic principles and the distillation of improved policies. Hence we all are in debt to the authors for producing such an extensive comparison of the developing experience in several countries. The authors describe the subject countries as “learning by doing” as they experiment with alternative details of market design and regulation. In addition, we are all learning by watching, and careful observation is a key to avoiding repetition of mistakes.

There are many elements to the problem, running from incentive regulation to principles of governance, and the paper covers much. Here my comments focus on the centerpiece of market design around the monopoly transmission system. Designing institutions for use of the monopoly facilities and regulating the remaining monopoly are integral parts of the problem. The issues here are complex, subtle, and always interconnected, not coincidentally because of the complex interconnections of the grid. The authors summarize these special features of the electricity system, which imply that the simple property rights taken for granted in other markets may not be available to internalize the many externalities present in use of the transmission system. Some form of centralized coordination and control is necessary, and this remaining monopoly function presents an unfamiliar challenge for market design and regulation.

The authors identify many successes and highlight significant errors found in the Latin American restructuring and privatization experience. For an example of the mistakes, consider the structure of the supposedly competitive generation sector. It seems elementary that restructuring by privatizing one or a few dominant firms, with little or no regulatory oversight, would be a recipe for high prices and high profits. So too would creation of a new “competitive” market with substantial barriers to entry. Yet such mistakes have been made, with predictable results. As we know, these errors are not unique to Latin America. It has become almost a commonplace that the special characteristics of the electricity system make it difficult to mitigate market power, and the usual rules of thumb about the required number of firms or contestable markets need to be reconsidered. In this regard, the present paper helps add an important measure of analysis to the developing literature.

The region’s successes are also apparent. Part of the regulatory apparatus is in the design of the market institutions. Where property rights are not well defined, markets are not good at market design, and one task of governance is to establish the rules of the market. Apparently all the countries examined here have built their market designs around the notion of central coordination through the framework of constrained economic dispatch. The authors identify differences in the details of how this coordination system is implemented, particularly whether or not the dispatch is based on predetermined marginal cost estimates or generator bids. The core structure is the same, however. The authors’ critique of the details may miss the bigger picture: all these countries have avoided substantial problems that have arisen elsewhere whenever this basic model has been rejected in favor of a less explicitly centralized system, with institutionalized inefficiency and too much reliance on decentralized decisions. In truth, decentralized coordination is a myth in the electricity system, with its many constraints and requirements for instantaneous balancing. The formally decentralized models cannot operate without well-defined rights and rules for using the transmission system, and they end up with *de facto* central coordination but uneconomic dispatch.¹ This can hardly be the way to support an efficient competitive market. While obvious to the engineers,

1. For a window on this debate and the problems in the United States, see Federal Energy Regulatory Commission (1999).

this necessity for central coordination is harder for economists to accept. Happily, these Latin American countries appear to recognize their success in this domain and are building to improve this model.

Another success in all these countries is the use of this coordinated economic dispatch with locational prices that reflect the constraints in the transmission system.² Apparently all the countries except Colombia have adopted this critical feature as the natural consequence of designing a market to support competition in generation. This is no more than an application of marginal cost pricing, a centerpiece of competitive market theory. Were it not so controversial elsewhere, we might overlook the importance of this feature of the market designs in Latin America. Marginal cost pricing reinforces the coordinated dispatch and is the only form of pricing that is self-policing. This gives the generators the correct operational incentives and reinforces the dictates of reliability.

The availability of locational marginal cost-based prices would provide the support for other features of the market that appear to be underappreciated or absent in the designs of the countries reviewed here. The most obvious problem is the failure to simply charge these prices through to all final retail customers. Like their counterparts elsewhere, governments here have been unwilling to fully embrace the market by presenting customers with the opportunity costs of their decisions. Hence there is a mix of approaches that avoids the obvious step of using the wholesale marginal cost price as the unbundled retail price of energy, with a separate charge to pay for the wires. Some countries have regulated average cost rates, while others at most use a projected cap on marginal costs with a good deal of smoothing and averaging. This is important for an obvious reason: it is difficult to operate half a market, one with price-sensitive supply but no price response in the case of demand. The United States has experienced serious problems that in effect eliminate the demand response to high prices. This failure of market design means that when supplies are short, prices can get very high indeed. The rules appear to be different for large industrial customers, but Fischer and Serra do not address how well the demand side is integrated in the markets in Latin American countries, or whether demand is sufficiently flexible to serve as a force to help mitigate market power in generation. The analysis of demand side participation in

2. Rudnick, Soto, and Palma (1999).

the market might benefit from a further inquiry into the Latin American experience.

More subtle is the connection between locational pricing and long-term property rights in the transmission system. The problem of pricing transmission and developing property rights for existing and new capacity is a, or perhaps the, central problem of market design. These countries have the key ingredient in the availability of the locational marginal prices, but they have not gone far enough in exploiting the idea. The problems appear in many ways. Consider the authors' discussion of the complexity and variety of rules for the allocation of responsibility of the fixed, joint, and largely sunk costs of the existing grid. After reviewing this experience, the authors conclude that methods for allocating the fixed cost vary from country to country, and none of the methods have analytical support; thus, users tend to contest the allocation scheme when they feel they are being treated unfairly. This resonates with the experience elsewhere. Too much attention is devoted to the collection of sunk costs and too little attention to providing the incentives for future investment. Furthermore, virtually every discussion of policy for dealing with transmission costs begins with the flawed assumption that there is a well-defined method that will give the "correct" allocation of sunk costs, somehow based on usage. Of course, from an efficiency perspective, the less the allocation of sunk costs is based on prospective usage, the better.³ The opportunity cost of congestion should determine the price for transmission usage, with a separate set of access charges to pay for the wires. And there is no known theory for the unique allocation of such joint costs. There is an inherent arbitrariness in the allocation of the costs for the existing grid. The task is to design pricing rules that respect this distinction between recovery of fixed costs and opportunity costs of congestion.

For new transmission investment, this problem is less pronounced, and it would be possible to simplify the assignment of cost responsibility if we could also assign property rights for the investment. There is a clear need for a system of property rights in transmission, rights which are hard to define. This is a long story, but the essence is captured in the observation that the same complex interactions in the grid that make central coordination absolutely necessary also make it impossible to define a workable system of physical property rights that will determine the use of the

3. Transpower New Zealand Limited (2000).

system.⁴ However, with a coordinated economic dispatch and locational prices, it is possible to define a set of financial rights that serve the same purpose. The opportunity cost for transmission between two points is the difference in the locational prices. If transmission usage were priced this way, then a perfect hedge against this price would be a financial contract to receive the same price difference. If the owner of the financial transmission right (FTR) actually uses the system, then the usage would be without net payment for system congestion, just like with a physical right. If the owner of the FTR does not use the system, the payment under the FTR is the same as if the corresponding physical right had been sold at the market-clearing price. Furthermore, this financial settlement system can work without affecting the economic dispatch, and everyone faces the right price incentives at the margin. Congestion in the coordinated dispatch makes it impossible to guarantee the physical delivery between two points, but with locational pricing it is always possible to guarantee financial compensation. From the perspective of the market, therefore, the FTR system provides a practical alternative to the impractical physical rights model.⁵

Viewed as the substitute for the physical property rights, these FTRs offer a natural tool available for supporting new transmission investment. Those who wish to expand the transmission system to avoid future congestion cost payments can receive a set of FTRs created by the expansion. Although this form of property right would not eliminate all the complexities of economies of scale and scope, it would seem to be a necessary element of any market-oriented system of transmission expansion. It would also provide a connection with incentive regulation by providing a well-defined measure of the product of the transmission owner. To the extent that the transmission owner maintains the capacity of the network, a feasible set of FTRs will always be funded out of the congestion rentals from the economic dispatch. Any revenue deficit, therefore, would be attributed to a deficiency in either the capacity of the grid or the dispatch, and would provide a measure of the opportunity cost of any such deficiencies that would reinforce the right incentives to maintain the grid and improve the dispatch. Of course, this is just one element of the

4. Hogan (2000).

5. Hogan (1992). For an implementation of this idea in the United States, see the Pennsylvania-New Jersey-Maryland Interconnection, at www.pjm.com.

broader need for better incentive regulation of the remaining monopoly, along with improved governance mechanisms. But this is one area in which the Latin American countries can benefit from the experience developing elsewhere.

Many messages can be gleaned from Fischer and Serra's work. The message I would emphasize is the continuing importance of regulation even though we seek greater reliance on the market. Furthermore, the requirements of regulation are quite different when the objective is to direct a monopoly in one part of the system to support competition in other parts of the system. The design details, some of which seem arcane, can make a huge difference in the outcome. The Latin American countries reviewed here have come far and taught us a great deal. Fischer and Serra give them due credit, but they point out that there is still much ahead in the journey. This paper, and similar analyses that are appearing in other parts of the world, provide a better foundation for adopting market designs that avoid the problems of our early mistakes and improve upon the design that flowed from the path-breaking work in Latin America.

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