

Designer Markets: The Art of Restructuring

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Abstract

The transformation of regulated industries in the United States over the last quarter century has seen some of them turned over entirely to competition (*deregulation*, e.g., airlines) and others introduced to competitive forces only in certain functions (*restructuring*, e.g., generation of electricity). Markets created through restructuring would not evolve on their own; they are designed in an effort to harness market incentives in pursuit of efficiency. The designed markets in restructuring vary with the technology of the industry, but always involve controlled introduction of a profit incentive B think of that as a carrot B along with some form of competitive pressure B think of that as a stick, and the question is always whether the stick can discipline the carrot. After a brief sketch of general principles, the methods used in restructuring telecommunications and electricity industries are examined with emphasis on the structure of the market relationships that result. Restructuring is a work (of art) in progress, with many market design problems remaining to be solved.

1 Introduction

Sprawling territorial monopolies have been transformed in the last quarter century.² The monopolies of old were vertically integrated, operating for instance across local and long-distance telephone services, or across the generation and transmission of electricity, but restructuring has separated such functions and opened some of them to competition. Unlike deregulation, which turns market regulation over to competition, restructuring aims to achieve efficiency in a partly regulated environment by harnessing market incentives. Restructuring a formerly regulated industry depends on markets that are designed rather than naturally evolved.

Restructuring is seldom pretty. It can involve jurisdictional limitations and political compromise, which affect how well its markets function, and of course it is often new and untested. Designer markets introduce competitive market forces where markets would not naturally arise, but where their efficiencies can be valuable. In simplest terms, they usually adapt two sources of market incentive: (1) the carrot of profit and (2) the stick of competitors= costs. The carrot is forward looking. It invites the firm to reflect costs more accurately in its pricing, and thus promote welfare, or to exploit market power through high or discriminatory prices. The stick looks sideways, or over the shoulder, out of concern that others may achieve lower costs and win customers away with lower prices. When the stick is strong it can dominate the carrot.

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²For a review of changes in U.S. law, see Kearney and Merrill (1998).

The carrot and the stick have been introduced to traditionally regulated firms through new mechanisms such as price-cap regulation. More ambitiously, where it was possible deregulation was used to bring back the competitive stick.³ Still more ambitious is the *restructuring* of regulated industries, which retains regulation in some parts but applies the healthy carrot or the brutal stick to other parts. We focus on designs to introduce market forces inside two restructured U.S. industries, telephone which is inherently a service, and electricity which is in part a commodity. Just as art reflects its subject, these restructured industries illustrate how market design responds to technology. Every telephone conversation is a different service, and all conversations are delivered through networks. This means that access by one company to the networks of others is crucial in order to complete calls, and other methods such as price caps may be used to induce efficient cost control. Unlike telephone service, electricity can be exchanged, so the carrot and stick of markets can be developed in portions of the route that it takes to consumers. Because of technological realities, the approaches to restructuring these industries are similar in Europe and the United States.

Traditional regulation in the United States granted monopoly status to private firms and then tried to avoid monopoly effects, but seldom attended to matters of the carrot or the stick. A rate-of-return regulated monopoly faced only a slice of the carrot, for example, because circumscribing profit pared its carrot incentive. And the firm faced a twig rather than a stick because its prices were based primarily on its own costs, so high costs could bring high prices and protect an inefficient firm. Price-cap regulation induced both the carrot and the stick, and these motives improved regulatory method.

Industries that came to be regulated often had facilities essential for the service that were controlled by a single owner, largely to achieve economies of scale. And restructuring usually introduces the carrot and stick by granting competitors access to those once-monopolized essential facilities. Tracks and other essential facilities of one railroad have been made available to other railroads for many years.⁴ A pipeline for natural gas is an essential facility for the gas distributor, who now has access to pipelines for transportation of natural gas.⁵ Even mail delivery for mail transporters, or for those who sort and code mail to make it easier for the Postal Service to handle, raises access pricing issues.⁶ Granting access to essential facilities opens some functions to competition. Long-distance telephone service providers were forced to compete when they were granted access to local monopoly exchange networks in 1984.⁷ And independent electricity generators had to compete in a wholesale market for electricity after they were

³For brief treatment of deregulation see Sherman (2001a).

⁴See *United States v. Terminal Railroad Association of St. Louis*, 224 U.S. 383 (1912) and 236 U.S. 194 (1915), which opened railroad facilities to railroads that had no ownership interest in them.

⁵For description of this access in the natural gas industry see Michaels (1993).

⁶For description of postal worksharing discounts see Sherman (2001b).

⁷For description of changes in telecommunications, see Temin (1987).

granted access to transmission wires.⁸

We begin in Section 2 by treating the restructuring of telecommunications, where regulation of local networks has shifted to price caps and where access to other networks plays a crucial role. The pricing of access to telephone networks is regulated in telecommunications, presumably to restrain the carrot and promote the stick of competition, but regulation is so strong it may be in conflict with such aims. Section 3 describes restructuring in electricity, where access to transmission networks supports competition among generators in wholesale electricity markets. New institutions are still being developed to coordinate electricity supply and transmission, and to allow broader responses in demand. Section 4 contains a summary.

2 Restructuring

Telecommunications

Regulating local telephone exchanges in the prices they can charge consumers remains a state responsibility, while access to networks is guided by the federal government. Section 2.1 considers local exchange networks, Section 2.2 examines the interconnection of B and access to B networks, and Section 2.3 describes federal guidelines for access.

2.1 Regulating Local

Exchange Networks

Rate-of-return regulation was as widely used in the United States as it was badly designed. It grew out of compromises in court cases, and gave virtually no attention to incentives in the regulated firm. Over time, mechanisms were developed to overcome this weakness of incentives in regulated firms. The stick of other firms = performances can discipline each regulated firm under yardstick competition,⁹ for example, which influenced Britain to create two telephone companies and foster comparisons when restructuring that industry in 1982.¹⁰

The idea of using A regulatory lag, @ the delay between rate cases, to motivate a single monopoly firm came from William Baumol (1968). He argued that the regulated firm would have incentive to control its costs while stuck with unchanging prices between rate cases, which serves as a stick. So he proposed a specific time period with fixed prices between rate cases, such as three years or five years. Britain exploited this idea with a form of telephone company regulation that allowed price to change according to a price index. The Retail Price Index (RPI) was used, and an improvement in productivity

⁸For description of this transition to competition in electricity see Joskow (forthcoming).

⁹See Shleifer (1985).

¹⁰England also moved to create more electricity generators, to foster comparisons, when deregulation began in that industry in 1990. The yardstick idea also had effects in the U.S. electricity industry, since part of the drive to restructure that industry came in states with less efficiently produced, higher cost, electricity. Those states were suffering in competition with low-cost-electricity states to attract and hold business and industry.

was required, called a RPI-X scheme. More generally, it was called a price-cap regulation. In the absence of competition, it was an impressive elixir. Using a price index as a benchmark avoids reference to the firm's own cost as a basis for pricing. That preserves the stick because the firm's own costs do not influence its prices, and that motivates the firm to control its costs.

Remarkably, price-caps can exploit the carrot to elicit socially desirable pricing, specifically Ramsey (1927) pricing instead of monopolistic pricing. Ingo Vogelsang and Jorg Finsinger (1979) showed that if constrained in a special way a multiproduct firm that was free to choose its prices under price caps would make socially desirable price choices.¹¹ This finding is important because, although not widely acknowledged, a major problem of rate-of-return regulation was that it did not control the firm's natural tendency to prefer monopolistic pricing.¹²

In practice there are complications. The measure of price level change may be imperfect. Regulators may err in setting a reasonable rate of technological progress to demand as a reduction in allowed costs. Estimating the potential for technical progress can be especially difficult in newly privatized industries, yet it must be done in advance as part of the basis for the price cap constraint. When errors are made in anticipating such progress, and adherence to a faulty price-cap would allow too much or too little profit to the firm, its actual cost may be used to influence price. The compromise that results is less perfect than pure price caps, but can still improve efficiency incentives in the firm.¹³

Over the last twenty years in the United States, price caps have become the regulatory mechanism of choice in the local telephone industry. Local networks provide basic residential and commercial telephone service and historically have been regulated by the states. Their regulation has moved from states relying totally on rate of return in the 1980s to three fourths of the states using price caps in 2002.¹⁴ The record of price caps compared with rate-of-return regulation shows they lowered operating cost, lowered prices for business customers, and stimulated more investment in modern facilities, although effects on quality are difficult to determine.¹⁵

Pressure for efficiency can also come from entry into local network service, where some network elements are seen as essential facilities, to be opened to competitors under federal guidelines. Such

¹¹The process is not perfect; see Sappington (1980) and Cox and Isaac (1987).

¹²For examples of pricing biases under rate-of-return regulation see Sherman and Visscher (1982) and Sherman (1989a, Ch. 9). Sherman (1989b) shows how peak and off-peak pricing periods are not motivated under rate-of-return regulation, but if such periods are used the firm's preferred peak-load pricing period will be shorter than is optimal.

¹³See Wolak (1998) for discussion of this trade off between referring to the firm's actual cost and avoiding any such reference. Combinations of cost-based and price-cap regulation that involve sharing are examined by Weisman (1993, 1994).

¹⁴See Sappington (2003).

¹⁵See Ai and Sappington (2002) and Sappington (2003).

access enables entrants, using facilities of an incumbent carrier, to compete with that incumbent in all aspects of service beyond the essential facilities. Access to local networks also can simply allow long-distance companies to complete their calls. When a local network can demonstrate that it is granting all requests for access to its facilities it becomes eligible to enter long-distance service, which of course opens further competition B with its pressure for efficiency B at the long-distance level.

2.2 Interconnecting Networks

New issues arise when separate networks are interconnected, which of course expands the externality benefit of the combined network by allowing each caller to reach more other parties. Telecommunications networks are organized in two different ways for the purpose of allowing access, and the second emphasizes new entry. First, each of two established networks may originate calls to parties served by the other network, so they need access to each other=s networks to complete those calls. This is like two railroads using each other=s tracks so each railroad can deliver for its own customers, because the services are complementary.¹⁶ Second, the owner of any established network has advantages over potential entrants, in part from its network externalities. To improve opportunities for new entrants the established network owner may be required to grant access to its essential facilities so entrants can combine them with their own facilities to provide service to customers. This is like having one railroad use the tracks and other equipment of a second railroad to serve customers in direct competition with that second railroad, because the ultimate services are substitutes for each other.¹⁷ With the networks separately owned they must reach agreement on terms for connecting each other=s calls, and setting such terms is the main new issue raised by the interconnection of networks.¹⁸

2.2.1 Complementary Telephone Networks

Each network collects a fee from the customer who originates a call, and from that fee the network has to compensate any other network that helps to complete the call.¹⁹ Bargaining may seem

¹⁶Railroads using each others= tracks is a long standing example of access. By exchanging access rights, each railroad can broaden its reach through network externalities, so access is motivated on a decentralized basis. For an early case that established the right of access to essential facilities see *United States v. Terminal Railroad Association of St. Louis*, 224 U.S. 383 (1912) and 236 U.S. 194 (1915). For a broad review of the essential facilities doctrine, see Lipsky and Sidak (1999).

¹⁷This is also like having a dominant newspaper company in a city print the newspapers of other newspaper companies so they can compete with it. Sherman (1976) proposed to preserve newspaper competition by this means.

¹⁸For thorough treatment of this problem see Laffont and Tirole (1998a, 1998b).

¹⁹If the recipient of the call shared in paying its cost, a different pricing arrangement could result. Because the practice of having the initiator pay for calls is so widespread, that practice is assumed here, although sharing the cost of calls between initiator and recipient can improve pricing incentives. For analysis of effects of having recipients contribute to cover the cost of calls, see DeGraba (2001).

quite simple when only two networks are interconnecting B as when a long-distance company wants to complete a call through a local network B but there is a complementary vertical relationship between long-distance and local networks that raises a problem much like double marginalization in manufacturer-retailer relationships. The Telecommunications Act of 1996 invited local and long-distance service providers to compete in each others= domains, and thus face access pricing decisions in both directions.

The double marginalization possibility is not unusual. When a manufacturer sells to a retailer who resells to consumers, for example, and each has some market power, the manufacturer will mark up its cost to set its price to the retailer, who accepts that price as a cost and marks it up again to set a price for consumers. The result is a higher price for consumers than a single integrated firm would set because the single firm would mark up its cost to consumers only once. A variety of vertical restraints, from franchising contracts to resale price maintenance, have been used by independent firms in an effort to avoid the effects of double marginalization, and antitrust law has gradually come to respect such restraints.²⁰

Since networks connect calls for each other, they can face double marginalization in two directions. That possibility can even be called *double* double marginalization. Double double marginalization might be overcome when two telephone networks exchange roughly the same volume of calls with each other, because they might be able to see the advantage of charging access to each other at marginal cost. Setting the access price at marginal cost would allow each network to maximize profit efficiently when it marks up marginal costs in pricing to consumers. If one network is larger than the other in generating call volumes, however, a possible lack of symmetry can change their incentives and interfere with their reaching agreement on an access price equal to marginal cost.

Suppose one network has many more customers than the other. Since it originates more calls the larger network depends on access to the other network much like the manufacturer in the manufacturer-retailer example. It wants to avoid double double marginalization and can see the advantage of a low access fee. But the smaller network may make its money on access fees for completing the larger network=s calls, and it might therefore resist low access fees. Such a difference in motivation can make agreement difficult on a common access fee that would overcome double double marginalization. To control this asymmetry in incentive, Carter and Wright (2003) propose to let the larger network choose an access fee that will hold reciprocally, because the larger network ordinarily is motivated to set a lower (but not below cost), and thus more efficient, access fee.

2.2.2 Substitute Telephone Networks

Suppose now that two networks compete for the same customers. And suppose, for concreteness, that the fraction of the first network's customers making calls to customers of the second network is equal to that second network's share of the overall telephone market. More calls from the first

²⁰For examples, territorial or location restrictions that control competition among sellers of the same brand were allowed in *Continental TV v. GTE Sylvania*, 433 U.S. 36 (1977) and a form of resale price maintenance was supported in *State Oil v. Kahn*, 871 U.S. 96 (1997). The virtue of such restraints to antitrust authorities is that they enable firms to achieve efficiencies of integration without actually integrating.

network will tend to go to the second when the second network's share of the market is larger, and then the first network will have to pay more access charges to the second in order to complete them. If access fees are set above marginal costs, the first network would of course prefer to complete those calls on its own network, which it can do by winning a larger market share. And the same argument applies to the other network.

Competition for market share can develop even if product differentiation gives each network an element of market power in attracting some customers to its own network. As long as keeping calls within your own network as it grows larger can lower your net cost, including access fees paid to the other network, that incentive to grow larger will tend to induce more competitive pricing for telephone service to consumers. At the same time, competition might inspire higher access fees, as the competing networks attempt to raise each others= costs. So it will not ensure optimal pricing for access to networks or for telephone service to consumers.

Even though the networks are now substitutes, there is still complementarity between them, since some calls are supported by both of the networks, so they might see the advantage of pricing access at marginal cost. Setting access fees closer to marginal cost will also moderate the urge to grow larger, since it lowers the cost of completing calls on rival networks. As noted in Section 2.2.1, the networks can exploit the complementarity of their services and share the benefits more easily as the volume of calls exchanged are more equal. The volume of calls between interconnected local exchange networks (LECs) might be approximately equal, even when the LECs differ in size. Even though they might be able to tame double double marginalization by exchanging access at marginal cost, strategic motives based in part on size differences can still get in the way.²¹

How can a firm enter this competition of networks for customers?²² Entry could be difficult against an incumbent owner of a network who already enjoys the benefit of network externalities. Interconnection can make local network competition possible, because it allows the entrant to reach customers of the incumbent network, and vice versa, thus broadening network externalities, but the entrant cannot easily build facilities to establish connections to its customers one by one. Foreseeing this difficulty while seeking competition, the Telecommunications Act of 1996 called for incumbent networks to offer elements of their facilities for lease to entrants. Examples of network elements are billing, signaling, or call switching services. Entrants could then build some of their own facilities and lease other elements from the incumbent. Having incumbents and entrants as direct competitors makes efficient access pricing very important.

²¹The strong assumption that the fraction of one network's customers making calls to another network is equal to that other network's share of the overall telephone market, and vice versa, tends to make the actual number of calls from one network to the other equal. To see that, suppose the larger network has N customers and the smaller network has n ($N > n$). Then by assumption $N/(N + n)$ calls go from large to small network, while $n/(N + n)$ calls go from small to large network. These two numbers are equal. Exchanging an equal number of calls helps the networks realize the advantage of pricing access at marginal cost to avoid double double marginalization. Of course the fraction of calls may not match the market shares. A smaller network comprised mainly of called parties that are commercial (e.g., pizza sellers) might receive many more calls than it originates, and such a network might want to exploit a rival through high access prices.

²²For analysis of entry and its effects in this setting, see Sappington and Weisman (1996).

2.3 Pricing Access to Telephone Networks

Thus, the unrestrained carrot alone may not bring optimal pricing to interconnected telephone networks. Granting access can influence pricing, and there are two main ways to do it. The first way settles for introducing the stick of competition into only one vertical stage, or function. Under terms of the 1982 court decision that opened the long-distance telephone service market in the U.S., for example, local exchange carriers (LECs) were prevented from participating in other activities \mathbb{B} such as long distance service \mathbb{B} on grounds that it would complicate regulation. If allowed to provide long distance service, the LEC might be able to create advantages for itself, which could cause inefficiencies that regulators might fail to detect. Regulation is simpler under clear rules that bar LECs from long-distance markets, but economies of scope may not be realized because the firm is not allowed to offer combinations of local and long-distance services.

The second way to manage access spills across separate functions, and allows competition between the access provider and the firms that are granted access. The Telecommunications Act of 1996 took this step by allowing local network operators to compete against each other and to compete also in long-distance markets once they met requirements for opening their local markets to competition. This allows the most efficient organization to come into existence, although an error in setting the access price too high or too low can lead to inefficiency by inviting more service provision from a less efficient operator.

2.3.1 Theories of Access Pricing

Two main theories guide access pricing, the efficient component pricing rule (ECPR), which is based on cost, and the familiar idea of Ramsey pricing, which is based on cost plus demand elasticity. The efficient component pricing rule (ECPR) can create a stick, and it also provides a carrot for the grantor of access.²³ The ECPR calls for an access price that equals the provider's direct cost of arranging access, plus any opportunity cost of providing that access. Including direct cost creates a stick, in that competitors who can supply other parts of the service at lower cost can set lower prices and win customers. The inclusion of opportunity cost in the optimal access price offers a carrot. It lets the incumbent recover as opportunity cost the profit it loses by granting access, so it will be willing to grant access.²⁴

The ECPR also motivates efficient entry, and only efficient entry. The potential supplier who seeks access must produce at the same or lower cost in the *other* stages of producing the service. Even

²³This idea was first proposed by Robert Willig (1979). Important developments and applications have been made by William J. Baumol. See, for example, William J. Baumol and Gregory Sidak (1994).

²⁴Including the ECPR's opportunity cost may not be so important in setting access prices between two networks that exchange approximately the same number of calls, because then the opportunity costs may offset each other, but it generally motivates the incumbent to offer access.

if the incumbent provider has lower costs than any potential entrant, perhaps from being the first supplier and having superior technology, no other supplier will want to accept the offer of access, so the industry will remain a monopoly, requiring access is still desirable. It puts pressure on the incumbent monopoly to keep costs down and quality up; if it slips in either aspect of its service another supplier will be able to enter through the access offer.

The efficiency of the ECPR depends on the level of the final service price, which the ECPR takes as given. If that final price is high, perhaps because the monopoly is not regulated effectively, the ECPR can still motivate efficient entry and also motivate the incumbent to allow the entry. But if the final product price is not reduced sufficiently by such entry the overall effect may not be efficient. Where competition can be so effective that it makes the final service price a competitive one, or if competition exists in that final service market, the goal of what is called the market efficient component pricing rule (MECPR) can be achieved.²⁵ The MECPR essentially relies on competitive market prices to constrain the level of opportunity cost.

²⁵For discussion of MECPR in the context of pricing access to local exchange telephone service elements, see Sidak and Spulber (1997), pp. 307-92.

The MECPR retains desirable properties of carrot and stick but focuses on alternative sources for a competitive price in the market for the final service. A competitive final service market lowers the incumbent's profit and thus the incumbent's opportunity cost of granting access. The ECPR uses the incumbent's actual cost as a reference point, and allows recovery of the incumbent's opportunity cost even when it is high. The MECPR imposes the stick of other firms' costs and forces the opportunity cost to a competitive level.

If the incumbent's opportunity cost is not included as the ECPR requires, the incumbent loses the profit incentive to grant access and may even want to sabotage an entrant, except of course when networks can trade connection service in kind. Both the ECPR and the MECPR presume a competitive final service market in the sense that whichever firm has a lower price can win all the business. Indeed, either the original access provider or the entrant might have lower costs and take over the entire final service market. Differentiated products or services, with less sharp and less extreme outcomes, are more difficult to treat.²⁶ Differentiated services and final service prices are considered in Ramsey pricing for access.

Ramsey prices define an ideal, rather than a process for reaching it, but they can often be implemented by price-cap incentive arrangements. When products or services are differentiated, so demand or supply elasticities are less than infinitely elastic, welfare can be improved by applying Ramsey pricing principles.²⁷ Ramsey prices will not reflect the knife-edge conditions that can be implicit in the simple ECPR or MECPR, and they allow achievement of the greatest welfare even when demands are not infinitely elastic.

If there are $i=1, \dots, n$ services to be provided that are independent of one another (all cross elasticities are zero), solving a constrained welfare problem is straightforward and yields for the i th service the socially optimal Ramsey pricing rule:

$$(P_i - C_i) / P_i = k / E_i,$$

where k , the Ramsey multiplier, is a constant less than 1 and $E_i = (M Q_i / M P_i) / (P_i / Q_i)$ is the price elasticity of demand for the i th service. Every ratio of price minus marginal cost over price is modified from the monopoly level by the same constant, k , to yield revenue just sufficient to cover total cost. Being less than one, k lowers the markups over marginal costs to a level that merely allows the firm to break

²⁶ See Sidak and Spulber (1997), pp. 300-304, for an analysis with product differentiation.

²⁷ See Laffont and Tirole (1996), Armstrong, Doyle and Vickers (1996), and Armstrong and Vickers (1998) for treatments of access pricing using Ramsey principles.

even.²⁸ That pattern minimizes the loss in welfare when prices are set above marginal costs in order to cover fixed costs and eliminate a deficit.

To illustrate, suppose an incumbent monopoly provider of local service also operates a long-distance network, while a competitor operates another competing long-distance network. If the competitor and the monopoly have equal cost and face identical demand elasticity, then Ramsey access prices will be the same as those defined by the ECPR. But if elasticities for the two services differ, Ramsey prices can yield greater welfare than ECPR prices, because they take elasticities into account and pay attention to welfare losses. If the competitive provider of long-distance service faces a more elastic demand than the monopoly provider, for instance, the Ramsey price for access to the incumbent's local network will be lower than the price according to the ECPR. This follows because the incumbent monopoly network, with its less elastic demand, should charge a higher price to consumers, so $p_1 > p_2$, and thus make a greater contribution to the fixed cost of the local network. That is how Ramsey prices can reduce the welfare loss from prices that are set above marginal cost in order to cover fixed costs.

²⁸ Since k is less than one, and it multiplies the right-hand side of each Ramsey-price equation, it is as if a number greater than one was multiplying all of the elasticities, or E_i 's, in the denominator of each right-hand side.

Another issue is whether the incumbent network loses one customer for every unit of access granted to the competitor. If the competitive network will attract customers who would not have gone to the incumbent, then the incumbent does not face a full one-to-one loss of its customers for every call delivered by the competitor. Then the Ramsey access price can reflect just the fractional loss to the incumbent for every customer served by the competitor, rather than the full profit for one unit, and the incumbent's incentive to offer access will still be preserved.²⁹ This adjustment would be needed to reflect true opportunity cost under the ECPR as well, but it can be included in solving for Ramsey prices when the demands and their cross-elasticities are taken into account.

How can Ramsey pricing be achieved? As noted in Section 2.1 above, price-cap regulation can induce Ramsey pricing. Laffont and Tirole (1996) apply what they call a global price cap, including access as if it was one of the firm's services, and show that welfare-maximizing Ramsey prices may be induced.³⁰ Regulation might be needed to deal with double marginalization, which price caps will not solve, and to avoid unusual nonoptimal outcomes.³¹ A policy in the form of ECPR or MECPR can still serve to open up entry possibilities, but it will not reach the subtleties that Ramsey prices will include when elasticities differ. Incentives from price caps can induce the stick in existing firms, and they channel the carrot toward welfare maximizing pricing.

2.3.2 The Practice of Access Pricing in the U.S.: The FCC Guidelines

The Telecommunications Act of 1996 is founded on the idea that competition can function broadly in the telecommunications industry. Under the Act, incumbent local exchange carriers (ILECs) are to open their networks to competitive local exchange carriers (CLECs) so the latter, by leasing facilities, may provide competing services. After showing its network is open to competition, an ILEC may enter long distance markets, and of course long distance carriers may enter local markets.³² The Act allows telephone service providers to offer video services and cable service providers to offer telephone service. Wireless telephone service operates with little government regulation and, so far, fledgling

²⁹For analysis of this customer displacement issue, and other important relations between the ECPR and Ramsey prices, see Armstrong, Doyle and Vickers (1996).

³⁰Conditions are admittedly ideal in their example, because they assume future (rather than past) quantities can be used in for working out the prices. See Cox and Isaac (1987) for modification of price-cap regulation, based on experimental findings, to improve its dynamic effectiveness with last-period costs as reference point.

³¹Relying on elasticities can yield a price below incremental cost, so it is not subsidy free and may therefore distort entry decisions. See Faulhaber (1975). Tests can be made, however, and where a Ramsey price is found to be lower than incremental cost, the latter can be used instead as the basis for price.

³²The incumbent local exchange carrier (ILEC) must comply with a 14-point checklist, showing that its network is open to competition, before it is allowed to send long distance calls to distant parties over its own and others' telephone networks. Long distance providers such as AT&T or Sprint or a competitive local exchange carrier (CLEC) can lease facilities from an ILEC and offer local service.

telephone services using the Internet are unregulated.³³ Everyone, it seems, can compete with everyone else.

To set guidelines for access prices, the Federal Communications Commission (FCC) used neither the ECPR (or MECPR), nor a system of price caps to induce Ramsey pricing, although most states use price caps to regulate the prices to consumers that are set by the ILECs. Access pricing under FCC guidelines was to be forward looking, and would apply to separate elements of the local network. Instead of using the ILECs' actual costs for these elements, the FCC based access prices on what it called Total Element Long Run Incremental Cost (TELRIC), essentially the long run incremental cost for each service but using the best available technology, not necessarily the technology actually used by the ILEC. Notice that this avoids reference to the ILEC's own cost, and thus preserves the stick incentive.³⁴ Notice also that opportunity cost, an important part of the ECPR, is not included.

As an alternative to the ILEC's own cost, the TELRIC guideline offers a hypothetical cost, somewhat like the replacement cost standard that was available for rate-of-return regulation but was seldom used because it was so hard to administer.³⁵ While TELRIC rates impose an element of the stick on ILECs, by not relying on their actual costs, and also avoid double marginalization, they can interfere with decisions where the carrot is involved. For example, two interconnecting LECs will not even try to negotiate a reciprocal rate for access once the TELRIC rate, which one of the parties will prefer, is available as a default option. The low TELRIC rates may bring entry by CLECs, but probably through facilities leased from the ILEC. Discouraging investments by CLECs limits the possibility for innovation, which was another goal of the Act. Finally, the ILEC also may be reluctant to invest if compensation for granting access is deemed inadequate.

The FCC's TELRIC guidelines have been much disputed. They were proposed for pricing unbundled network elements (UNEs), such as billing, signaling, or switching services, which meant that CLECs could pick and choose among individual provisions of already existing interconnection agreements without accepting the terms and conditions of those agreements in their entirety. The U.S. Court of Appeals for the Eighth Circuit found the FCC rule to be unreasonable and held that the FCC had exceeded its authority.³⁶ But the United States Supreme Court largely supported the FCC's authority under the 1996 Act in January 1999 and sent the case back to the appeals court on remand.³⁷ After the

³³See Barnaby J. Feder, *A Judge Says Minnesota Cannot Regulate Internet Calls*, New York Times, October 9, 2003, p. C8.

³⁴Under the FCC proposal of TELRIC rates, the ILECs could not profit from the use of old and inefficient equipment, so they might be motivated to install improved resources. Of course low access prices might also discourage such investment by ILECs.

³⁵For criticism of the TELRIC guidelines and of the Supreme Court's support of them see Weisman (2002) and for a related analysis see Sidak (2003). For arguments more favorable to methodologies like those in the FCC guidelines, see Falch (2002), Gasmi, Kennet, Laffont, and Sharkey (2002), and Kennet and Perez-Reyes (2002).

³⁶*Iowa Utilities Board, et al v. Federal Communications Commission*, 120 F.3d 753 (1997).

³⁷See *AT&T Corporation, et al. v. Iowa Utilities Board, et al.*, 525 U.S. 366 (1999).

appeals court decided the remanded case its decision was again appealed to the Supreme Court, which in May 2002 confirmed the FCC's authority to impose a forward looking pricing methodology (TELRIC rates).³⁸ In addition, the Court dealt with the ILECs offer to CLECs of unbundled network elements (UNEs), which are the signals, switches, and other elements of the local network. The Act requires that they be made available to entrants but does not say who is responsible for combining them when less than the total set of them is leased. The Court ruled that the FCC could require ILECs to combine leased UNEs for CLECs that were unable to do it themselves.

Thus, FCC guidelines substitute for networks' decisions and thereby make regulation stronger than before, rather than weaker to invite competition as the Telecommunications Act proposes.³⁹ A policy that attracts many entrants until they become a significant part of the LEC market may have positive effects, but will be hard to sustain when the policy encourages entrant growth without eliciting new investment. At the same time, it might not bring loud cries of confiscation from ILECs because they are regulated in other aspects of their business by the states, often through price-caps, and such regulation may offset short falls in access-price revenue. Nevertheless, the TELRIC policy should be viewed as a temporary way to spur a form of entry to local networks, one that will give way in time to some later generation of access pricing rule that will more effectively sustain a competitive regime.⁴⁰

3 Restructuring Electricity

The main pricing issue in telephone networks involves access, such as the price charged one network to complete calls on another. Telephone networks do not operate separate wholesale markets for those calls as they might if the calls were commodities, like the wholesale markets that are opened inside networks where electricity is bought and sold. Another difference, at least in the United States, is that, except for the largest customers, metering devices do not allow customers to respond to price changes in electricity and partly for this lack of response demand is very inelastic. Moreover, electricity cannot be stored, and when demand increases it cannot be postponed with a 'busy' signal. Indeed, if demand and supply do not balance continuously the network will collapse,⁴¹ a result that can be avoided only by skillful coordination. Before restructuring, such coordination was provided by separate monopoly

³⁸See *Verizon et al. v. FCC et al.*, 535 U.S. 467 2002. The *Review of Network Economics* published a symposium on the implications of this decision in September, 2002.

³⁹In February, 2003, the FCC delegated slightly more authority to the states for regulating access fees according to FCC guidelines, but made no significant change. See Stephen Labaton, AF.C.C. Leaves Most Rules on Network Leasing In Place, *New York Times*, February 21, 2003, p. A1.

⁴⁰For an example of a promising rationale for unbundling network elements see Hausman and Sidak (1999).

⁴¹As Jacqueline Weaver (forthcoming) puts it, 'It is as if, when one plane in the air develops trouble with a wing flap and starts nosediving, all other planes in the air simultaneously drop out of the sky.'

electric utilities in their franchise territories. Now, if electricity markets are to function successfully, new institutions must provide that coordination.

Access is as crucial to electricity restructuring as it was to telephones. General access to transmission grids came with the Energy Policy Act of 1992 (EPA), which built on initiatives contained in the Public Utility Regulatory Policy Act of 1978 (PURPA). PURPA and the EPA enabled independent power producers to sell power at wholesale, so a wholesale market seemed feasible. This led political leaders in high-cost states to ask whether the stick of market competition could cure inefficiencies in the industry. Electricity restructuring followed. The design of electricity markets will first be discussed in Section 3.1, to be followed by brief treatments of major problems: market power in wholesale markets in Section 3.2, transmission problems in Section 3.3, and problems with retail competition in Section 3.4.

3.1 Electricity Market Design

A world of regulated monopoly electricity providers, who vertically integrated the functions of electricity generation, transmission, and distribution, is now giving way to a restructured world that contains markets. These restructured electricity markets have four main players: (1) companies that only generate electricity, (2) networks that transmit electricity, (3) agencies that oversee and coordinate the transmission networks, such as an Independent System Operator (ISO), an Independent Transmission Provider (ITP), or a Regional Transmission Operator (RTO),⁴² and (4) distribution companies, or line companies, that deliver electricity to final customers. Where there is retail competition, it involves a fifth set of players: marketing companies known as Electricity Service Providers (ESPs). They purchase power and hire a distribution or line company to deliver it to customers, whom they bill for the services.

Generating companies are open to the stick of competition. They offer wholesale electricity to the ISO at a range of quantities and prices for a given time period. Their offers of supply interact with demand in the form of quantity and price bids from line companies or ESPs. A wholesale market price for electricity results for that time period. This wholesale market is complicated. Larger generating companies possess a range of units, from base-load units that operate at low cost as long as they run all the time, to more costly peaking units that are able to run part of the time. Apart from incentives that come from controlling a range of units, generators can ordinarily profit when demand is high, and they also receive payment for being *on call* to produce if needed. While offering particular electricity services to such a market, each generator faces the costs of other generators as a stick.

⁴²There are slight differences among these organizations which we shall ignore. ITP is the ascendant appellation, but we rely on the currently common name, the ISO.

Competition is sometimes also introduced at the retail level. Then merchant marketing companies, or ESPs, bid at prices and quantities to buy in the wholesale market.⁴³ Line companies engage in bidding to get electricity for distribution to customers if there is no retail competition. ESPs are separated from generating, transmitting, or distributing facilities, but specialize in identifying consumers' needs and finding ways to serve them. They also ensure that usage is recorded and bills are properly rendered and collected. A stick can be created through the competition of several ESPs, so regulation of them may be unnecessary.

The Federal Energy Regulatory Commission (FERC) regulates transmission grids, while state commissions regulate line companies. Owners of transmission grids are ordered by the FERC to offer nondiscriminatory access for all generators who want to transmit electricity.⁴⁴ Access to transmission service is to be awarded on efficiency grounds, so no generator will have an advantage over others either in the convenience of its transmission service or in the rates paid for it.⁴⁵ A transmission company that was part of a vertically integrated utility might maintain a generation monopoly by denying transmission access to other generators, or if it made connection for others more difficult or more costly it would certainly have an advantage in competing with them. Avoiding such outcomes is one reason some states require physical divestiture of transmission and distribution facilities from electricity generation plants as part of their restructuring plans.⁴⁶

Although institutions vary across states, the typical ISO operates a wholesale electricity market. It collects bids and offers for an exact time period of, say, thirty minutes, and for that time period it places offers to sell in order, from low to high prices, and it orders bids to buy from high to

⁴³Traditional public utilities essentially sold bundled services together, including electricity, transmission and delivery. With restructuring, electricity is produced by generating companies, sold to final users by ESPs which did not exist under monopoly organization, transmitted by transmission companies, and delivered by former distribution companies, who also step down the voltage and carry the electricity to final users.

⁴⁴In 1996, the FERC issued two orders for transmission systems that provide a framework to support the functioning of competition in a market for electricity. First, in its Order 888, FERC required the owner of a transmission line to offer nondiscriminatory access to any company wishing to send electricity to any wholesale buyer, such as a local distribution system or a power marketer. See Order 888, *Promoting Wholesale Competition through Open Access Non-Discriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities*, issued April 24, 1996, 75 FERC ¶ 61,080. Second, Order 889 required any party that operated transmission facilities in interstate commerce to participate in an open-access, same-time information system, to provide information electronically about available capacity, prices, and other necessary information for a market in power to operate. See Order 889, *Open Access Same-Time Information Systems*, issued April 24, 1996, 75 FERC ¶ 61,078.

⁴⁵FERC's Order 2000 focuses on impediments to competition in transmission systems, largely because they were built by private utilities who could discriminate in favor of their own, or their affiliate's, marketing activities. This order is available at <http://www.ferc.gov>.

⁴⁶Two-thirds of the states that restructured electricity had at least some divestiture of generation facilities. See Wolfram (forthcoming).

low prices. The ISO then finds the price at which quantities bid and quantities offered will be equal, and imposes that price on all the implied transactions. Normally all generators will receive that price, and all buyers will pay that price. Long-term contracts may exist among participants also, and a sizeable portion of electricity is usually exchanged on that basis. The ISO coordinates transmission services as well. As demands rise or fall at different points on the transmission network, congestion may develop because there are limits to the amount of electricity the wires can carry.

To maintain balance across the network, the ISO operates markets in what are called ancillary services, most importantly a market for reserve capacity to be available just in case it is needed. To facilitate the provision of such reserves, a market of the type just described is conducted on a day-ahead basis, so the ISO can see what is expected tomorrow and provide reserves to meet departures from that expected outcome when tomorrow arrives. The market for reserve generation would array offers under various readiness conditions, sometimes with fixed as well as variable payments to compensate generators for being ready to produce even if no production becomes necessary. These reserves are also used for congestion management across the transmission system by providing power where it is needed but where transmission congestion prevents it from being transmitted. In some parts of the United States this coordinating function is provided by RTOs, one of which oversees power supplies in each of the ten regional reliability councils in the North American Electricity Reliability Council (NERC).⁴⁷

In order to avoid conflicts of interest, the ISO normally is not allowed to own generation capacity, although it might own and operate a transmission grid connecting generating companies with distribution companies.⁴⁸ Questions about incentives in ISOs remain to be answered, because it is not clear that totally efficient, unbiased, and ownerless oversight is possible. Thus far, in states that restructure, generation appears to employ fewer workers and have lower non-fuel expenses.⁴⁹

This brief sketch cannot capture the complexity of electricity markets, but it conveys main ideas and may hint at many of the problems that can develop. Market power can arise in generation and transmission operations, for example. Introducing retail competition has been difficult also in part because of difficulties in the transition to markets. To overcome some of these problems, the FERC proposed a

⁴⁷Thirty million people went without power in the Northeastern United States during a shocking "blackout" on November 19, 1965, which led to formation of a voluntary industry organization called the North American Electric Reliability Council (NERC). Its ten regional councils have authority to intervene and coordinate the generation and transmission of power by member utilities. The regional councils are charged with keeping electricity reliable in three synchronized electricity grids that cover Canada, the United States and parts of Mexico. They were successful in this task until August 14, 2003, when the Northeastern United States suffered an even more devastating blackout involving fifty million people. This failure was probably due in part to the increased burdens that restructuring has brought to transmission facilities.

⁴⁸It might be possible to have ISO's as large as the three synchronized electricity grids in North America. Alternatively, ISO's might be created in each state in the U.S., especially if this form of competition develops separately in each state. As noted, an RTO operates in each of the ten regional councils in the NERC. One regional council lies within the borders of Texas, and its RTO serves as ISO for the Texas electricity market.

⁴⁹See Wolfram (forthcoming).

Standard Market Design (SMD),⁵⁰ a set of policies and procedures intended to induce efficiency incentives by using the best rules yet discovered. Major problems with electricity restructuring can briefly be described.

3.2

Market Power in the Power Market

If the stick of competition is weak, the carrot may bring inefficiencies due to market power. To avoid such inefficiency, generating companies are evaluated by the FERC to determine whether they have market power, and if they do their prices must be approved by FERC.⁵¹ Only if a generating company has no market power is it allowed to choose its own offer prices for the wholesale market and operate under the carrot of profit. Initially, concentration measures were used by the FERC to judge market power, and under this standard generating companies were seldom found to have market power. But concentration measures are inappropriate to judge market power when separate units of capacity are controlled by suppliers.

Holt, Langan and Villamil (1986) showed in experimental markets how control over marginal units of capacity can give market power to a firm that does not have a large market share. What is important is whether one firm controls capacity bridging the range between total capacity in the market and total demand. In that position, one party can influence market price by withholding capacity, so there can be market power and incentive to use it. Rassenti, Smith, and Wilson (2000) found support for this view of market power in experimental electricity markets and Borenstein, Bushnell and Knittel (1999) show problems with concentration measures in actual electricity markets. In late 2001, the FERC moved toward a new Supply Margin Assessment (SMA) test to evaluate market power that compares a firm's capacity with the difference between total capacity and peak demand, as this experimental work suggests.

Withholding capacity from the market (called physical withholding), or bidding some units at high prices (called economic withholding), can be profitable when capacity is scarce. Generating companies feel the carrot, and the stick is weak when capacity is scarce. Withholding can raise the market price, which will benefit other units that the large generating company still has in the market. This means the incentive for withholding is independent of others (generators need not collude), which makes it a general problem in wholesale electricity markets. Withholding grows less serious as more power is committed under bilateral long term contracts, since parties to such contracts cannot profit from a high spot price.⁵² In California, where for some time bilateral contracts were not permitted, Borenstein, Bushnell and Wolak (2002) found that market power could be blamed for 59 percent of the increase in wholesale electricity prices from summer 1999 to the crisis in summer 2000. They estimated competitive prices, based on

⁵⁰The Standard Market Design is a 640 page document, available at <http://www.ferc.gov>.

⁵¹See Wolak (forthcoming).

⁵²Long-term contracts can reduce the incentive to withhold, because with more units already committed on a long-term basis there is less to be gained from a short-run price increase. For analysis of this contracting effect see Green (1999).

costs that included influences like increased natural gas prices and the more costly generating units that are pressed into service when demand was high. Against such a benchmark they found market prices substantially higher.⁵³

England and Wales have operated a competitive wholesale electricity market since 1990 that has shown signs of market power.⁵⁴ In 2001, the basis for setting price in their wholesale market was changed by the adoption of a New Electricity Trading Arrangement (NETA). Until NETA, participation in the wholesale pool was compulsory so bilateral contracts were not used. NETA allowed bilateral contracting, which soon became the basis for the vast majority of transactions. Under NETA, balancing transactions to coordinate the system are no longer settled at a uniform price, but instead follow a pay-as-bid system in which offers that are accepted receive whatever they offered instead of a uniform price.⁵⁵ Only a small fraction of transactions take this pay-as-bid form. Electricity price has declined since NETA, perhaps because the generating sector is increasingly competitive, and bilateral contracts reduce opportunities for profitable withholding.

The FERC Standard Market Design (SMD) includes many elements aimed at mitigating market power. The main weapon proposed for limiting market power in wholesale markets is to put a cap, or upper limit, on offers. When generating capacity is scarce (defined relative to peak demand), price caps automatically become effective to limit the advantage that scarcity might otherwise give to generators. Another, higher, cap moderates the problem of inelastic demand, which is exacerbated by metering costs that keep consumers from facing higher prices when electricity is scarce. The SMD also provides for planning, to ensure adequacy of generation and transmission resources and thus to limit scarcity.

3.3 Transmission Troubles

The transmission networks were built by monopoly electric utilities, and were designed to control the transmission of electricity in the areas those utilities served. Connections between such networks were mainly to exchange power for emergencies, not to create an integrated network. Moreover, a generation company in such a local network may not want the network expanded if that will bring competing electricity from other areas (always resist the stick). The FERC's SMD offers a host of

⁵³For analysis of the role of energy trading in the California crisis, plus a wealth of other information, see Weaver (forthcoming).

⁵⁴For evidence of market power in England and Wales see Wolak and Patrick (1997) and Wolfram (1999).

⁵⁵For description of the England and Wales procedures, see Green (forthcoming). For criticism of pay-as-bid procedures in wholesale electricity markets, see Kahn, Cramton, Porter, and Tabors (2001) and Kahn, Porter, and Tabors (2001). If competition is strong enough, incentives in the uniform-price market are like those in a second price auction: bids and offers can be entered at valuations or costs in a nonstrategic way because the individual bid or offer is not expected to determine price. The classic analysis of these auction procedures is by Vickrey (1961). A pay-as-bid market is like a first-price auction in which participants must guess the bids and offers of others and try to beat them, so they behave strategically, and may set lower prices to win contracts.

policies to contain such motivation, including more enforcement of open access requirements.⁵⁶

Transmission lines can only carry so much electricity, or they will melt from excessive heat. So transmission is limited to rated capacity levels. Congestion on the wires can then prevent transmission into areas of high demand, called load pockets, and the resulting scarcity can create local market power. Even without market power, when electricity cannot be delivered into an area because of congestion the price on the importing side of the congestion can be high. The cost of electricity is higher on the importing side because older and less efficient facilities must be used there to meet demand when electricity from other locations cannot get past congested lines.

To help deal with load pockets, a separate local price is set for areas that cannot receive as much power as desired because of line congestion. These local prices are called locational marginal prices (LMPs), and they determine fees for using the congested lines. The difference in prices at two ends of a congested line provides an ideal congestion charge for use of that congested line, as it puts the cost of congestion on those who cause it. The FERC's SMD recommends such pricing. A variety of transmission rights instruments help those transmitting electricity to hedge against the uncertainties of fluctuating congestion fees.

Investment signals from congestion charges constitute a lumpy carrot that complicates private enterprise investment decisions in transmission facilities. Congestion may produce a large congestion charge on a line, for instance, but expanding the line eliminates the congestion and with it the financial benefit of building the line. This problem of on-again, off-again investment signals might suggest public ownership as a possible arrangement for financing and controlling transmission investment.⁵⁷ But some degree of private ownership may be workable with clever arrangements that preserve efficiency incentives.⁵⁸

3.4 Squeezed Retail Competition

Retail competition in electricity has not been a great success in the United States. Large numbers of residential consumers have not switched to new electricity service providers, mainly because two transition problems have blocked the carrot and limited the scope for competitors= price reductions. First, residential consumers were favored by low regulated rates, and lowering prices to win political support for restructuring was more difficult from an already low starting point. Indeed, without new cost reductions, prices for residential consumers might rise with restructuring because costs should have a

⁵⁶For description of restructured transmission operations see Cameron and Cramton (1999). For criticism of some proposed SDM features see Cook (2003).

⁵⁷Central control may not solve all problems. England adopted a regulated national grid company (National Grid Transco), but still had a blackout over 40 percent of London on August 28, 2003. See Heather Timmons, "Blackout in Britain Raises Questions About Following Its Example," *New York Times*, September 2, 2003, p. C4.

⁵⁸For devices to facilitate sound private investment incentives see Hogan (forthcoming) and Joskow and Tirole (2000). The lack of such clever incentives may be a weakness of restructuring that contributed to the blackout in the Northeastern United States and Canada in August, 2003. The added burden of electricity trading may have overwhelmed a transmission system not yet adequate to provide it.

clearer influence on prices, and costs for residences are higher than old regulated prices would indicate.⁵⁹

Second, there is the problem of stranded costs,⁶⁰ the reduction (usually) in asset values that follows from the introduction of competition. Since many regulated electric utilities made investments that at the time were deemed prudent, under a traditional regulatory compact the values of those investments merited protection. But when a charge must be included to compensate investors for such stranded costs, that makes it still harder for competitors to offer consumers lower prices. Raising extra money for stranded costs, while also lowering prices from what was a favored reference point, presents a double barreled challenge for retail competition.

These handicaps faced by retail competition are harmful because competition at the retail level is expected to introduce benefits from more efficient pricing. Currently most U.S. consumers have no way to respond to real-time electricity prices. Under rate-of-return regulation, providers of electricity had no incentive to conserve capacity by using any form of peak and off-peak pricing. Even crude time-of-use pricing would be valuable, because prices that respond to predictable scarcities can enhance efficiency. But the prices in U.S. homes do not respond to short-run supply conditions because metering electricity by time of use is costly and few arrangements have been made to communicate price information on a continuous basis. When the price of electricity in residences does not change between peak and off peak demand conditions, despite its scarcity at peak times, consumers can show no elasticity in their demands.⁶¹ No price signal curbs consumption, even though peak electricity might be extremely costly, so a carrot for consumers is blocked. An opportunity to respond to price signals currently exists only for large commercial and industrial customers.⁶²

Three main ways of eliciting consumer response can be noted.⁶³ (1) time-of-use pricing, which takes advantage of general patterns of demand that occur by time of day and season of year and sets

⁵⁹Residential demand fluctuates more than commercial and industrial demands, and for that as well as other reasons residences tend to be more costly to serve.

⁶⁰Also, in efforts going back to 1978 to stimulate a wholesale market the federal government created a class of independent generators and required electric utilities to buy their power, sometimes at high rates. The effects of these uneconomical contracts are harmful under competition, and they add to stranded costs.

⁶¹In northern European countries, where time-of-use pricing is common, homes use heat-storage devices at night when rates are low to release heat during the day and avoid paying higher daytime rates. This practice is almost unheard of in the United States, because the peak and off-peak pricing that would motivate it is so rare.

⁶²See Edwin McDowell, *Cooling the Empire State Building on the Cheap*, @ *New York Times*, April 16, 2003, p. C 7. Managers of the Empire State Building say they saved \$48,000 last summer (and would have saved \$200,000 if they had been able to start before August) by switching between cooling methods depending on current prices. Under deregulated pricing they are planning to make ice at night when electricity is cheap and use it in their cooling system during the day when rates are high.

⁶³See Borenstein (forthcoming).

price accordingly so consumers are informed (they can do the laundry at night), (2) real-time pricing, which requires more expensive meters that can adjust and communicate prices to reflect actual conditions of electricity costs all the time, and (3) interruptible service contracts, which allow commercial and industrial users to agree in advance to curtail electricity use when it is scarce by paying a fixed fee that protects a chosen level of usage against interruption (giving the user a trade-off between protection against outage and cost). Ideally, such consumer responses can influence wholesale markets, so buyers can make better estimates of needs knowing that consumers will respond to increases in prices and wholesale demand will be more elastic. This insinuation of market forces reveals a main benefit of introducing markets into electricity networks. Not only can the stick of competition force efficiency, but B if soundly constrained B the carrot opens opportunity for those who ultimately are served to respond to the true costs of the services they receive.

These possible pricing benefits of retail competition have been limited because almost all state restructuring plans have lowered prices to residential consumers and provided payment for stranded costs, thereby forcing residential prices so low that there was little room for competing electricity service providers to enter the market. As incentive to switch to a new ESP, consumers seem to require at least a five percent reduction in their rate, and the transition situation for electricity restructuring seldom allows that. The stranded cost problem grows smaller with the passage of time, however, and time also makes old regulated rates for residences a more distant reference point. So the passage of time may improve the opportunity for retail competition and the efficiency benefits it might bring.

4 Summary

Restructuring former monopoly network industries in the U.S. has involved a shift in regulatory mechanisms, mainly to price-caps, and the introduction of competitors by granting them access to existing facilities. Introducing markets inside networks can bring serious problems, and careful design is needed to have the stick of competition discipline the carrot of profit. Effective markets will not evolve on their own. Pricing motives will not always serve efficiency in telephone networks, and creating markets in electricity networks is even more ambitious. Despite these problems, the opportunities in both industries are considerable. Telephone is a service industry, while electricity is more of a commodity. The pace of innovation in the telephone service industry is remarkable today, and would probably not have been matched by the old regulated-monopoly regime. Electricity markets require new thinking about market power, plus a wide variety of new arrangements to provide efficiency incentives, not the least of which would allow consumers to respond to a changing price of electricity. In both industries, ultimate benefits in lower production cost, innovation, and allocative efficiency appear to be worth the costs of change.

Price-cap regulation has played a larger role in the telephone industry as states adopted it to improve local telephone regulation. The Telecommunications Act of 1996 changed the industry more dramatically. This national policy altered the simple jurisdictional boundary between state and federal regulators that had existed for years, under which regulation within states was accomplished by the states

while interstate and international services were regulated by the federal government.⁶⁴ Among other things, the Telecommunications Act required the Federal Communications Commission (FCC) to provide guidelines for pricing access to local telephone networks as a way to foster competition, which it did by basing prices on a much disputed cost reference point (TELRIC). Such heavy handed regulation may be needed to stimulate entry. Even mutually agreed upon access pricing may suffer from double double marginalization, a problem that cannot be solved by global price caps because each network may not adjust for the complementarities involved. Rules such as the one proposed by Carter and Wright (2003) to have the larger network choose the reciprocal access price might help to overcome this problem.

After the Telecommunications Act was passed, capital spending in the industry jumped from \$40 billion in 1996 to \$80 billion by 1999, but sales did not grow with capacity, rates of return fell, and investors were unhappy.⁶⁵ AT&T reorganized into four separate companies, essentially repudiating the business plan it had pursued for the first three years after the Act was passed, and WorldCom changed its plans in a similar way. Meanwhile, prices fell for consumers which, after discovery of accounting irregularities, led to the bankruptcy of WorldCom.⁶⁶

New developments continue to change the telephone industry. Wireless telephone service is booming, with many new competitors participating all around the country and more than half the population owning a wireless phone. About one million wireless phones are put into service each month, some actually replacing wire-line phones. Prices for wireless service are unregulated, and they have been falling.⁶⁷ The thriving wireless alternative puts growing pressure on regulators to sort out the wire-line phone access pricing problem. Communication by e-mail and the Internet, as well as entry by foreign telecommunications companies, also threaten wire-line telephones. These forces strengthen the stick faced by wire-line networks, and they will help to motivate efficient access pricing.

Electricity restructuring also faces a host of carrot and stick incentive problems, which began when independent generators were granted access to transmission lines and could participate in wholesale markets for electricity. Transmission system operation is a major problem, where a mixture of integrated utilities, independent generators, and independent system operators (ISOs) function with different rates, terms, and conditions. Independent generators do not always have reliable access on equal terms as affiliates of integrated utilities, and the collapse of the Northeastern and Canadian transmission network in August, 2003 suggests that transmission system investment decisions need better planning and

⁶⁴For discussion of the issues involved in this change in jurisdiction and authority, see DeBow (1998).

⁶⁵The rush to install led to excessive network capacity. See Gretchen Morgenson, "From WorldCom, an Amazing View of a Bloated Industry," *New York Times*, March 16, 2003, Sec. 3, p. 1.

⁶⁶For analysis of WorldCom and its relation to the industry see Sidak (2003).

⁶⁷The Omnibus Budget Reconciliation Act of 1993 required the FCC to auction electromagnetic spectrum for wireless communications in a way that brought at least two winners in any region and thereby served to instill competition. Prices fell from the establishment of wireless phones in the early 1990s until 1998, and since then have risen slightly, but a greater range of services was offered for the higher recent prices.

coordination. A major focus of the FERC's Standard Market Design is transmission management, with procedures and institutions to overcome problems presently faced by some generators that prevent markets from functioning efficiently.⁶⁸ Competition at the retail level has been handicapped by the transmission process itself, and until competition at that level arrives more efficient pricing may not be introduced.

Market power can result when there is too much carrot and not enough stick, and it arises especially in the wholesale electricity markets that have been fostered by access to transmission networks. New conceptions of market power are relevant and new devices are needed to deal with it. But many devices are being considered. England and Wales shifted to bilateral contracts and adopted pay-as-bid pricing for balancing transactions, for example, and a variety of means to mitigate market power has been applied in existing markets. Broadening transmission networks to enlarge local markets will also help to control market power. The FERC's SMD includes many methods for mitigating market power. Forcing generation companies to become smaller through divestiture is still a possibility, although maintaining a mixture of generator types is often valuable to a generating company.

Retail competition has not developed enough to overturn the unchanging prices to consumers that rate-of-return regulation encouraged through its lack of incentive to conserve capacity. So far, there has been little room for entrants, who were expected to bring more efficient pricing. They cannot undercut existing prices because regulated prices for residences were low to start with and forms of taxation are also being used to compensate producers for losses in their asset values due to competition. Interruptible service contracts are being introduced for commercial and industrial users, but time-of-use pricing or real-time pricing are not there for residences because no retail competition promotes them. Consumer responses could affect wholesale markets by making wholesale demand more elastic and reducing opportunity for market power.

Restructuring is a way to design markets that would not arise on their own. Requiring access on a broad scale in order to create competition is a revolutionary regulatory action, justified on grounds that it fosters competition which in turn motivates efficiency. The power to regulate price is extended to a power to regulate a right of access along with its price, and it has been applied to both telephone and electricity industries. Restructuring is a work in progress, and to a degree it is a work of art as well as an application of knowledge.

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