THE GOVERNANCE OF ENERGY DISPLACEMENT NETWORK OLIGOPOLIES

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THE GOVERNANCE OF ENERGY DISPLACEMENT NETWORK OLIGOPOLIES

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Executive Summary

For most of this century, the natural gas and electric power industries were regulated as natural monopolies. In recent decades, the industry structure and its regulatory model has become untenable for both industries. In practice, each industry now appears as three separate sectors with very different characteristics:

- A production sector that can be highly competitive with little regulation,

- A distribution sector that remains a natural monopoly under more or less traditional regulation, and

- A long-haul transmission sector that is oligopolistic, requires regulation to prevent the exercise of market power but is not amenable to traditional forms of regulation designed for monopolies.

Over the past decade, the Commission's job has been to manage the transition to competitive production (generation) sectors. Over the next decade, it will need to focus on new regulatory strategies for dealing with oligopoly transmission networks. This paper examines three problems: Why traditional regulation is poorly suited to address transmission issues, what makes gas and electric transmission distinctive from other industries and what are the basic issues on which future regulation must focus.

Traditional Regulation Is Inadequate

Three models have dominated regulatory thought and practice in the United States during the 20th century:

- The mathematical school seeks perfect ratemaking formulae that would set prices to ensure the growth of an efficient industry.

- The political school argues that most regulation is simply a cover for giving benefits to favored parties and punishments to others.

- Original cost of service (OCOS) ratemaking represents the ever-growing accretion of precedent to deal with specific regulatory issues as they have arisen.

Although each of these schools of thought represents a very old concept of justice, none is well-suited to the challenges the Commission now faces. They do not:

Use whatever competition is available to foster efficiency. Competition was possible for both natural gas production and electric generation long before American regulation was able to use them. This reflects partly the need for legislation to change regulatory focus (and in the case of gas, a Supreme Court ruling that required the Commission to regulate gas producers). It also reflects the strength of the dominant regulatory paradigms. The mathematical school aspired to perfect pricing for monopolies. The political school argued that the ability to produce outcomes outside of competition had value for regulators. And OCOS rate making tends to find competition a theoretical and practical annoyance. In the wake of unbundling, traditional regulation faces very similar problems in adjusting to competition within the transmission sector.

Foster dynamic efficiency. The mathematical school typically produces a solution to the problem of how best to use a given set of facilities and services. OCOS rates typically offer little in the way of incentives, except to increase throughput (regardless of the value of the additional units moved) and sometimes to cut costs. In any given year, this may be a reasonable approach to efficiency. However, the rest of the economy shows clearly that a more dynamic view is necessary. Better customer service is as important as lower costs. Innovative use of existing facilities and rapid, radical innovation for new facilities are hallmarks of the rest of the economy in the late 20th century. Very flexible, well-understood short-term markets are essential for commodities that customers cannot store.

Reconcile market-based commodity prices with regulated transmission services. Market-based commodity prices set a value on transmission service in the short run (the price difference between two points less an allowance for losses) and the long run (the customer's expectation of future short-run values). These values tend to be highly volatile, a characteristic that is not well-suited to traditional long-run rate setting. They also differ, as a general matter, from the transmitter's underlying cost of service.

Use forecasting and information sensibly. Traditional regulation depends on the ability of the regulator to forecast. In the long run, one must forecast demand for new facilities to approve them in the first place. In the short term, one must forecast units of service to derive rates, either according to the recommendations of the mathematical school or the dictates of OCOS. Yet centralized forecasting has a history of being almost universally wrong over the time periods required for regulation, thus undermining the rationale for most traditional methods of regulation. Conversely, traditional regulation has failed to develop the kinds of information needed for transmitting a competitive commodity. Instead of the highly detailed financial data currently available, new markets (and regulators) will need timely, accurate, available data on quickly changing markets.

Reduce the effort devoted to pure rent-seeking. Whether or not the political school is right in its strongest formulations, there can be no doubt that traditional regulation encourages regulated companies and many others to spend disproportionate resources on trying to get larger shares of a fixed pie rather than trying to become more efficient in any terms.

Summary. Traditional regulatory paradigms are fundamentally flawed. Relying on them has wasted hundreds of billions of dollars. This has shown up first as take-or-pay contracts in natural gas and stranded generation costs in electric power. It is also showing up as an unwillingness of gas customers to sign new contracts with pipelines at the full embedded cost rate (the capacity turnback problem).

The Nature of the Gas and Electric Grids Sets the Regulatory Agenda

The natural gas and electric grids have several distinctive features that play a key role in their regulation.

The grids are displacement networks. The transmission grid need not (indeed cannot) deliver specific packets of gas or power from a given producer to a given customer. In this, they differ from package delivery services or airlines that deliver specific packages or people to specific places. Delivery by displacement makes it possible to deliver more of a commodity with substantially less actual physical movement and in that sense offers considerable scope for cost savings. However, it also makes accountability harder to assign and enforce, thus it is harder to share out the benefits gained fairly and efficiently.

Displacement networks imply large externality issues. If markets are designed without great care, they will create many opportunities for individual parties to become free riders (benefiting from the activities of others without paying for them). Naive markets also let parties profit by sponsoring too much investment or by blocking efficient investment. These realities flow directly from the same difficulty in accounting for costs and benefits that is an inherent part of delivering a commodity through a complex grid by displacement.

The grids are oligopolies. Over some transmission paths, the transmission grids can be almost competitive. This is especially true if there is a good secondary market for transmission capacity. For other paths, there are one or maybe two suppliers. And for some purposes, the grid must operate as a single integrated unit, a natural monopoly. Thus, the grids are oligopolies in a double sense: many customers see an oligopoly of suppliers, and the mix of competition and monopoly can be imagined as averaging out to an oligopoly. For regulation, the double problem is that few or no analytic theories give good guidance about how to regulate oligopolies, and even less is known about how to handle a mix of competition, monopoly and oligopoly.

Customers have little or no on-site storage. As a result, they are dependent on the transmission system (including distant storage) rather than their own stocks at peak. With relatively low elasticities for many customers, the result is exceptionally volatile costs and prices for both commodity and transmission that consumers can not respond to (unless transmission is overbuilt). This causes several potential problems. One is that regulation has historically been very poor at dealing with risk and sending good price signals.

Both grids are infused with the public interest. This arises both from the use of eminent domain to condemn property to build the lines, from environmental externalities and from the natural monopoly features of the grids. So, fairness is as important as efficiency for regulators. The two can and should complement each other, but making them do so is difficult.

Both grids must operate (more or less) in real time. The gas grid can and should accommodate markets as short as a few hours, the electric grid operates much more rapidly even than that. Reliable, timely information is a major key to achieving good short-term markets.

Transactions costs loom unusually large in markets that should involve many, very rapid decisions.

Future Network Oligopoly Governance Requires New Strategic Goals

The most important implications of these basic features of the two grids are to:

- Manage market power. Market power will remain a reality because of the oligopoly character of the grid. Regulation will still be needed because of both market power and the public interest issues. Regulation will need to deal with short time frames and unusually volatile prices as well as longer term construction decisions.

- Establish good incentives. One key focus must be setting up institutions that encourage efficient market operation and investment in circumstances that are by nature highly risky. Incentives will matter more than cost recovery.

- Promote timely information. Another key focus must be to encourage good information systems and short-term markets. Information must not be used as a new way to exercise market power and must support short-term markets. The short-term markets must place a major emphasis on minimizing transactions costs.

The overall strategy for regulating the two grids can be summed up in four words: information, incentives, institutions and choice.

Information. Information is essential to the well functioning commodity markets for both gas and power. Since individual commodity markets are linked by the transmission system, good information is also essential for the transmission system. To support markets properly, the information should be timely, accurate and available to all market participants.

Information of this sort is largely a public good. Once produced, it is difficult to prevent others from using it. That is, it typically creates a free rider problem that discourages any single party from investing enough in information systems to make them efficient. This can be clearly seen in the inadequate market information systems currently in place for natural gas. As a result, information is an important concern of governance. In practice, that means it must be a key focus for regulators, although they may delegate much of the responsibility for developing and operating information systems to other governance bodies, such as standards boards.

Three other key points about information:

- Without clear standards and efficient systems, information can easily be used to establish market power for those who have access to it.

- Even without the exercise of market power, poorly integrated information systems will create needless transactions costs, largely by interposing a party who understands the data systems between buyers and sellers.

- Much of the data collected by regulators will need to change.

Incentives. In the new world of competitive commodity markets, an efficient transmission system is possible only if the players have good incentives. Stated baldly, this sounds like a truism. However, the difficulty of the problem becomes apparent when one lists a few of key incentives that players should have:

- To take good risks. (Traditional regulation often socializes risk, thus artificially reducing the cost to each party.)

- To operate the network efficiently (for the system operator) and to see appropriate price signals that will change behavior and help the grid operate better under stress (for shippers).

- To maximize the trading opportunities.

- To expand the grid efficiently (especially difficult in electric power because of loop flow).

- To innovate efficiently in both operation and service offerings.

- To reduce costs, probably through some form of benchmark regulation.

Some of these objectives can be achieved through changes in the ratemaking process. Many others require new institutions with rules that produce the right incentives.

Institutions. The emphasis in traditional regulation on setting rates and dividing benefits meant there was little need to consider institutions beyond the regulatory agency itself. In the future, institutions will be critical. If key industry institutions have credibility (that is, are seen as being fair) and encourage efficiency, all parties will have incentives to behave efficiently and regulation can succeed in its basic goal of protecting the public.

Major institutions that will structure the future include short-term markets, transmission operators (who should become independent of having any position in the commodity market), groups to decide on expansion (such as Regional Transmission Groups), industry standards boards (to define fair and consistent business practices and information requirements) and reliability councils.

Within each of these large institutions will be many micro-institutions, such as specific bidding procedures for auctions, notice provisions for entering transactions and governance procedures to determine how the institution will work. Each of these micro-institutions may have more effect on future industry operation than all the traditional rate-setting apparatus. Regulators must focus on these institutions in order to do their job well.

Choice. Behind all the other aspects of regulation is a simple goal: to ensure that all customers have choices and good information to make them. Perhaps most important is the growth of retail choice: final consumers of gas and electric power should be able to choose many different forms of service from many different providers. Two simple examples:

- They should be able to reduce consumption in real time (at least within a day for gas and an hour for power) in response to price changes. This lets customers pay for what they want and not for what they do not. It is the only way of reducing volatility to efficient levels, since it is the only way to discover true short-run elasticities.

- They should have the option of many possible forms of risk management, including fixed prices or bills for a peak season.

In addition, all players within the industry need more choices. For instance, transmission rights should be freely tradable, limited only if the trade is operationally infeasible.

I. Introduction

Much federal economic regulation in the United States covers transmission networks—natural gas, electricity, telecommunications, railroads and highways. These networks are highways for moving people, goods, messages and energy. The markets for network services range from some that are nearly fully competitive to others that are seen and operated essentially as public goods. High entry barriers, high sunk costs, scale economies and externalities have led governments to regulate or own most of these networks. At the same time, firms use the networks to compete in other markets, most of which are much more competitive. This paper focuses on the governance of the transmission networks for natural gas and electricity. These networks are distinctive because they combine the following features:

- They transmit a uniform commodity by displacement (unlike, say, roads or tele-communications, where each delivery is discrete).
- They are in large part privately owned (unlike most highways or waterways).
- They are owned by oligopolies rather than monopolies (unlike most distribution systems).
- There is little or no on-site storage of the commodity (unlike, say, coal delivered by railroads).

Together, these features create a distinctive set of regulatory (or governance) problems.

The federal laws regulating these networks date mostly from the 1930s. Most are modeled on industries with franchised monopolies. This seemed reasonable at the time, since federal regulation was meant to supplement State-level regulation of preexisting, monopoly distribution companies. These laws regulate prices and, over time, contract (tariff) rates have come to be set using original cost-of-service concepts. Entry and exit are regulated via franchises and certificates.

The monopoly franchise model was never entirely appropriate for gas and electric transmission. Many companies were involved from the beginning, although competition among them was minor until recently. With the growth of open access transmission and competition to supply gas and power, the oligopolistic reality has become ever more important. But, despite a great proliferation of theory on regulating monopolies (and deregulating competitive markets), there is today no simple coherent theory for regulating network oligopolies.

Earlier in the century, primitive communication and control systems may have encouraged vertical integration in the natural gas and electric industries. Today, communications technology has evolved so that vertical integration is no longer necessary for efficiency—and may create inefficiencies in the commodity markets trading on these networks.

Since the early 1980s, the Federal Energy Regulatory Commission (Commission) has worked to unbundle network service and rely more on markets (generally supported by the Administration, Congress and the courts). The result: more flexibility and reliance on contracts, information and market rules.

This paper describes the framework in which the Commission has been working—using the theory and concepts of industrial organization, transactions costs and game theory—called the governance of displacement network oligopolies. The governance framework includes rules to unbundle network services from commodities and trading rules for both transmission capacity and the commodity itself. Short-term network services with a backstop regulated tariff can allow for greater choice and flexibility. Information must be available quickly and electronically for both network and commodity trading. Open group governance plays a major role in setting rules and resolving complaints. Equity and efficiency are served by making no captive customers worse off during the transition.

In Chapter 4, we shall examine more specifically what will be needed for good regulation of the natural gas and electric transmission grids in the future. Before that, however, we must examine the features that make them distinctive. Whatever regulatory strategies are adopted in the future will need to be tailored to match these distinctive qualities.

II. Historical Background: The Inertial Baggage

A. Introduction

Early Public Utility Regulation

Every generation likes to imagine that it faces new and bigger (or at least better) problems than anyone has seen before. Nonetheless, most societies for which we have a written record have debated the questions: "What should be regulated?" and "How should prices be set?" The degree of central control versus decentralized markets has been the subject of much debate. Over time, philosophers laid out the principles of what we now call public utility regulation (although the term itself is recent).

In the fourth century BC, Aristotle advanced the idea of a "just" price without describing how to find it and believed that the purpose of trade was to increase consumer welfare. The issue was of more than philosophical interest. A simple example: the City Commissioners of Athens imposed a price cap on the services of flute girls (two drachmas a day) and set up a lottery to ration demand when the price would have been too high (see Grant and Kitzinger). Over time, what is important enough to regulate and how to regulate it changes. By 301 AD, Diocletian decreed fixed ceilings on wages and prices throughout the Roman Empire (see Bunson).

In the 13th century, Thomas Aquinas believed in controlling excess return on borrowed capital (usury), charging a "just" price, and the use of eminent domain for the public good. He defined a just price as a price falling within a range of the value to the buyer and the value of the commodity. (If there were a patron saint of public utility regulation Aquinas would be it.) If necessary, the just price would be determined by a duly constituted body—the Church. He agreed with Aristotle that consumer welfare should be the overarching objective, but most of his work focused on cooperation and compensation, not competition (see Sabine and Dempsey).

The scholastic philosophers also developed the concepts of opportunity costs (lucrum cessans), compensation for risk, and incentives. Their concepts of a "just" price did not require original cost-of-service regulation. Scholastic philosophy served the church and society well for several centuries before giving way to new (arguably improved) philosophies.

Historians debate the role and use of central control and competition to set prices. In the 12th and 13th centuries the concept of market competition was vague and economic power and property rights were highly concentrated. In France and England, the monarch granted royal charters (today called monopoly franchises) as favors to friends and payoffs to allies. The principal concern of the philosophers was justice and salvation. Spiritualism gradually gave way to materialism and mercantilism.

In the 18th century, economic scholarship was tied closely to scholarship in law, politics and moral philosophy. A more complete theory of using market competition to set prices was put forth by the British philosopher, Adam Smith (see Smith). With the arrival of Marx, scholarship in economics gravitated into areas that required greater use of mathematical tools and abstractions that limited its usefulness in analysis of actual markets (see Marx). Greed was hard to rationalize as a primary driver of markets so behavior and motivation disappeared from a considerable part of the literature. The Marxists thought they could change human motivation and centrally control prices and markets.

Modern Public Utility Regulation

In the 20th century, public utility regulation has become an industry in itself, first in the United States and increasingly around the world. To understand current regulatory debates, one must understand three major 20th century forces affecting utility regulation:

- The theoretical quest for efficiency (the mathematical school). Throughout the century, economists and mathematicians have developed ever more sophisticated approaches to pricing utility services. The underlying concern has been to produce the highest valued set of services at the lowest cost, while distributing benefits and costs fairly.

- The political reality that regulation is part of a larger society (the political school). Many scholars argue that the real effect of regulation depends not on economic theory, however sophisticated, but on the interests that structure the incentives regulators see.

- The embodiment of mathematical and political factors into a functioning bureaucratic system, primarily through the growth of original cost-of-service (OCOS) rate making. OCOS has grown into a highly elaborate machine to set rates and settle differences.

The first two forces reflect opposite sides of an argument at least as old as the ancient Greeks about the nature of justice, as reported in Plato's dialog between Socrates and Thrasymachus. The quest for efficiency represents the Socratic argument: justice consists of giving each his due and can be achieved through disinterested arbiters (in the ideal, by philosopher kings). The mathematical school has assumed that regulators act as disinterested arbiters, when not seeing themselves as philosopher kings.

The political school reflects Thrasymachus' argument that justice is the will of the stronger. Most obviously in regulatory capture theory, the political school agrees with Thrasymachus that, whatever the fine words, the result is to benefit the stronger (or richer). Later exponents of the political school refine what is meant by "stronger" (not always the regulated company) and develop a sense of regulation as a balancing of interests. But they always see "justice" as determined not by an ideal but by the interests of the moment.

Finally, OCOS rate making represents a third notion of justice: the common law accumulation of precedent. OCOS ***can*** be used to further an ideal or to feather a nest, in practice. However, the thousands of small decisions involved ***also*** take on a life of their own, often confounding both idealist and cynic Once established, precedents often limit options for future policy, force policy makers to use highly circuitous methods and prevail through simple inertia. "Justice" becomes the working of the machine.

B. The Mathematical School: The Quest for Efficiency

For most of the 20th century, economists sought theoretical understandings that would deliver efficient rates. The first challenge was how to achieve efficient pricing in the presence of large economies of scale. Ideally, short-term prices should equal short-term marginal costs. That lets customers use transmission as fully as is efficient and lets the transmitter provide service to those who most value it. However, transmission grids involve large, up-front, lumpy investments with economies of scale—later units of capacity cost less than earlier ones. As a result, if one builds an optimal amount of capacity, one cannot recover the costs of the investment from a pricing policy that always charges customers short-run marginal cost. That is, no one would voluntarily make the right investment if he was required to charge the "right" price all the time.

Most of the early effort of the mathematical school involved the problem of how to maximize both short and long-run efficiency. Typically, these efforts involved trying to find mathematical formulae that would produce rates that led to as efficient results as possible.[1]

The second key challenge was to reconcile static and dynamic efficiency. Static efficiency (maximizing the benefits of current plant, practices and technology) was the focus of the ratemaking literature. It continues to be the focus of much mathematical and (more recently) experimental economics. However, developments in most of the rest of the economy has shown that dynamic efficiency—innovation in both plant and practice, better customer service—is at least as important as static efficiency. Efforts to promote static efficiency largely ignored and often unintentionally discouraged dynamic efficiency. (Most ratemaking approaches amounted to a form of cost-plus pricing, which has proven to be notoriously bad at promoting dynamic efficiency in other contexts.) Efforts to address dynamic efficiency have focused on changes in market structure, such as open access or the use of auctions.

Finally, the attempt to graft efficiency-enhancing measures onto an existing regulatory system has led to a series of unanswered questions for the mathematical school. These tend to come in two forms: how to make the best of imperfect pricing schemes and how far market mechanisms can be allowed to work without destroying an existing fabric of regulation.

The Quest for Perfect Rates

Ramsey Pricing. In 1923, Frank Ramsey theoretically solved the problem of ideal taxation—that is, how to raise a fixed amount of revenue from taxes with the least harmful effect on efficiency. (Despite the common discussion of "Ramsey pricing" for utilities, Ramsey never wrote on public utility pricing.) As applied to recovering fixed costs for utilities, Ramsey pricing requires charging customers for their share in relation to their consumption alternatives (inverse elasticity of demand). This approach has two basic problems, even in the context of pricing for monopolies:

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[1] Thrasymachus might argue that "impersonal" pricing schemes are useful to regulators. The formulae offer an appearance of procedural equity (all customers subject to pre-established rules) while protecting regulators somewhat from complaints (the formulae, not the regulators, make the results so). But, in practice, regulators could still balance interests as they wished.

- It requires detailed knowledge of individual demands that is seldom, if ever, available.

- It assumes that the revenue required is set in advance and is not itself a subject of dispute. (This is largely a legacy of the approach's pedigree in solving a taxation problem.) In practice, the productive efficiency of regulated monopolies is problematic. Adopting a scheme that takes the productive efficiency problem as solved is a good way to ensure that costs are excessive. (The same argument applies to dynamic efficiency in general. For instance, there is little or no incentive to improve service quality.)

Marginal Cost Pricing. In 1938, Harold Hotelling argued that the best way to serve the public interest was to equate price to marginal cost, with the implication that somebody (such as the government) should pay for (subsidize) the revenue shortfall. This is the clearest (if not the best or most practical) way to address the problem of declining marginal costs in an industry with economies of scale. Indeed, the logic becomes compelling whenever one looks at short-term problems in isolation, which helps explain why variations of the position have continued to appear from time to time. The basic (and usually fatal) drawback is that most taxpayers usually fail to see why they should subsidize services instead of having the beneficiaries of the services pay for them.

Multi-Part Pricing. In 1946, Coase argued that multi-part pricing without subsidies should be used since, in addition to subsidies, Hotelling's scheme required estimates and forecasts which should not be taken as given. This implied that commissions should be concerned with the structure of rates and not simply the level of profit or average cost.

Non-linear or multi-part pricing techniques, in theory, solved the dilemma of choosing among second-best pricing schemes by using full price discrimination and a detailed knowledge of demand and supply functions, leaving everyone better off (see Willig, 1970). The elegant mathematics of Ramsey, Hotelling and their progeny seem to have overwhelmed the practical considerations of forecasting, estimation, measurement and management behavior required to make their ideas work. These schemes require a forecast of needs into the future and a matching budget for outlays from general revenues for enterprises that (in other countries) are often state-owned. Both straight Ramsey pricing and multi-part pricing require immense amounts of information (for instance, about demand elasticities) and forecasting. They also make (often tacit) assumptions about management incentives that range from simplistic to implausible.

Peak/Off-Peak Pricing. Finally, in the 1970s, an academic consensus developed simple efficient peak/off-peak pricing rules. Fixed costs would be paid by peak users. Off-peak users would pay only variable costs. Given that regulatory convention defined most operation, maintenance and administrative costs as fixed, this approach quickly foundered politically, since the peak occurred infrequently and users who saw price signals were often residential customers. It also raised some common-sensical questions:

- If strict peak/off-peak pricing is such a good idea, why is it so seldom observed in unregulated industries? For instance, in the deregulated airline sector the simple peak/off-peak concept has been replaced by "yield management systems"—basically complex price discrimination and market segmentation schemes. In unregulated markets, they are the key to profit. In regulated markets, they are also the key to greater efficiency and greater fairness.

- In a competitive market, peak prices would rise to clear congestion in the grid. This is roughly what happens now in natural gas markets. But the peak price in such a case is highly variable. At any given time, it bears little resemblance to a price set by an effort to recover fixed costs. Nor does it average out over any single winter, or over the life of any contract term short of the life of the line. As a result, the peak price in a regulated regime of this sort will not be a good approximation to short- or mid-term market prices.

  Why should religious significance be placed on theoretically accurate price signals to off-peak customers? One answer may be that peaking customers could pay a demand charge that, *ex ante*, would be the "right" long-term price. But this argument is far from pure theoretically. For instance, how does one decide what is the "right" amount of depreciation to charge over the length of any given contract?

- The division of all costs into "variable" and "fixed" is highly artificial. Costs sunk in initial construction are fixed in a way that administrative and maintenance costs are not. For instance, should peak users pay all costs for a billing system because the costs do not vary with each unit of throughput? Why? Similarly, return on equity is fixed only in the fictions of a rate case.

- Why does society seem to believe so strongly that, despite theory, peak users should not bear all fixed costs? In natural gas rate cases, off-peak users generally argue over the share of fixed costs they should pay, not that they should pay only variable costs.

On the other hand, the development of secondary markets for transmission capacity may introduce a form of peak/off-peak pricing through market mechanisms. So many of the issues raised by such pricing are important to current regulatory debates.

Elaborations. Optimal price regulation developed with very fancy schemes, especially in the area of electricity. Ramsey pricing was implemented in France by Allais and Boiteux to state supplied goods and services, in particular, electricity (see Allais, Boiteux). These concepts and approaches still remain strong in France today. In some socialist countries, the almost complete lack of market tests in the overall economy led to prices (far) below full long-run marginal costs, leading to over-consumption and under-investment
.

In theory, price discrimination can make everyone better off (see Brown and Sibley). But it often generates envy in the eyes of those paying higher prices, as well as the suspicion that higher rates for some customers result from inefficiency, rather than mathematical necessity. Politically, not all forms of mathematically efficient price discrimination are acceptable.

Dynamic Efficiency and Auctions

Economic regulation is justified by the need to prevent companies from exercising market power over customers. Traditionally, this has been associated primarily with the ability of companies to charge supra-competitive prices for a given good or service, either through withholding (creating an artificial scarcity) or through unjustified price discrimination. (The basic logic of Ramsey pricing suggest that efficiency for a true monopoly requires and justifies some but certainly not all price discrimination.)

It has become ever clearer that excessive price (or price discrimination) is only one form of market power. At least as important is the ability to foreclose technology, innovation and improved customer service or to offer such improvements to some and not to others (the equivalent of discriminatory pricing). Foreclosing technology and innovation can be accomplished by restrictive terms and conditions that do not allow for new technology (or new services from existing technology) to penetrate the market. This is, in effect, the dynamic efficiency side of market power. It is typically harder to detect and more difficult to treat than the static efficiency equivalent, and it went largely unaddressed for many years. Indeed, traditional regulation often forbade mechanisms such as market entry that would have undermined this form of market power.

Over the years, efficiency-seeking economists developed three techniques to encourage dynamic efficiency that are now venerable enough to be considered traditional. The first is open access to transmission systems.[2] This usually involves a requirement that transportation be unbundled from other services (usually the production or sale of the commodity). As this is the cornerstone of Commission policy in the last few years, we shall return to it later.

The second is incentive regulation. One tries to use the same basic ratemaking tools developed for static efficiency to set rates, but adds some mechanism that gives companies a reward for improving service or punishment for degrading it. These schemes have theoretical value, but have often foundered on practicalities and opposition by the regulated companies. We shall return to them also in discussing the Commission's efforts at ratemaking.

Finally, there has been an increasing interest in auctions. In 1961, Vickery introduced incentivized auctions to a broader audience. In 1968, Demsetz introduced the concept of auctions as a replacement for traditional regulation. In 1976, Williamson showed the need for careful auction design. New approaches, such as special auctions, offer ways to have incentives for honest representation and still satisfy marginal cost and "first best" principles (see Alger, O'Neill and Toman; Hogan; O'Neill and Stewart; and McAfee and McMillan).

Unanswered Questions

In theory, one might go much further in grafting market mechanisms onto a program of efficient rates. In practice, however, this proves difficult. Consider *ex ante* auctions to pay for construction before it takes place. This should be an extremely valuable technique in the regulator's repertoire, but in practice it is seldom used well. The value of *ex ante* auctions lies in the fact that sunk costs are variable or marginal before they are sunk. The charge for sunk assets would appear on the customer's bill over time like a home mortgage.

With economies of scale (subadditive costs), problems arise. Average costs are higher than marginal costs. The dilemma is to price marginal customers and marginal demand at

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[2]Though open access is relatively new in the United States, the basic idea is much older. In the 1820s British canal owners were not allowed to own any barges on their canals (see Johnson, p. 190).

marginal costs but to charge other customers enough to recover the full costs. The problem is practical, not theoretical. Auctions deal with problems of estimating demand by letting customers reveal it as they choose. But, customers may have incentives to misrepresent the value they place on the service, and incentives to discourage misrepresentation are often costly.

Short-term market mechanisms also sit uneasily with the cost-recovery philosophy underlying much of the mathematical school. The problem is that the marginal cost of extra transmission is low whenever transmission is unconstrained. Theoretically, in a competitive market, much (though not all) of the costs could be recovered during constrained peak periods. But this runs into difficulty since:

- Many practices (excessive investments in reliability, an undue incentive for capital expenditures) mean that most networks are probably overbuilt. So economic peaks seldom occur and cost recovery is unlikely. This is exacerbated if future efficiencies (for instance, in demand side behavior) lessen the height of peaks.

- Market-based cost recovery can work only in a probablistic sense unless one has perfect knowledge of future demand. Otherwise, any given transmission link would be worth more than expected (if demand exceeds expectations) or less (if demand lags expectations). In either case, uncertainty means that the market does not serve to guarantee any given level of cost recovery. Practically, this means a shift in the focus of regulation from efficient mechanisms to allocate costs to efficient ways to allocate risk. Unfortunately, the mathematical school has never brought such considerations into play in devising practical regulatory policies.

- An inherently risky investment becomes even more so because of the nature of peaks. Off-peak prices are predictable (near zero), but peak prices vary greatly depending on demand. How much money could be recovered during peak seasons would also vary greatly from one year to the next.

Finally, it is worth noting the gap between the theory of economics and the practice of policy. Academics carefully lay out assumptions for the peer-reviewed published results. When academics give policy advice, they often ignore the assumptions or argue that the results are broader than originally claimed. As a practical matter, such simplification may be unavoidable. But as a result, academic policy advisors fall into the trap of claiming all the unassailable truth of “science” for policies that are unproven even theoretically in the complex real world. This, in turn, often leads to a healthy skepticism on the part of the decisionmaker that is infuriating for the theoretician.

C. The Political School: the Quest for Rents

The mathematical school largely ignored the institutional realities affecting those who actually set rates. Over time, a different school of analysis developed that saw the quest for efficiency as a mask for an essentially political process. That is, the theories were contradictory and arbitrary enough that both the choice and implementation of a rate-setting approach would be used to benefit those whom decisionmakers favored (or the decisionmakers themselves, given incentives within their agency). These writers did not necessarily deny that economic theory might deliver more efficient pricing, but they saw that for most participants, the real dollars at stake were more important than theoretical principles. They doubted that decisionmakers could long accord the principles a higher place than the interests of the parties. Although specific versions of the critique varied, some common threads emerge:

- Cost allocation and rate design are essentially exercises in mystification. Explanations for how they are done (either in overall approach or specific implementation) are more likely to be post-hoc excuses than ex-ante guides.

- Regulators are not white-coated technocrats carrying out some antiseptically correct algorithm. Rather they have their own interests, and their institutions have their own histories that are at least as important in shaping their actions as economic theory.

- To the extent that the efficiency hunters emphasized static efficiency, regulators and regulated companies created a comfortable world of dynamic inefficiency in which rents could be collected and distributed as apparently legitimate "costs." That is, the political school explained an inattention to dynamic efficiency as creating systems that benefitted a substantial number of the players, even at the expense of what eventually became very large stranded costs.

In 1940, Gray mounted a direct attack on public utility regulation calling it "alchemy." Political scientists observed that regulatory commissions did not seem to be pursuing the public interest. Bernstein, in 1955, advanced the life cycle theory of regulation. He explained that in the beginning of a commission's life it was young and attempted to protect consumers. As time went on, the process became burdened and was essentially very complicated. Control passed to the regulated firms or at least the commissions allowed the regulated firms to exploit their power.

During the 1960s, theorists argued either that regulation made no difference or that whatever rents there were would not be captured by the consumers. Evidence was put forth that rents were captured by factor inputs and not necessarily by the consumers. Labor and management both captured the inefficiencies created by monopoly through on-the-job rent dissipation.

The 1970s saw the development of capture theory: commissions would come to act in the interest of the firms they regulate. This can be seen as a strong version of the life cycle theory. But it is almost certainly too cynical, as was soon shown. It could not explain why state commissions disallowed significant costs incurred by electric utilities in the 1970s. Nor did it have a persuasive explanation for the deregulation of the airlines under the chairmanship of Fred Kahn at the Civil Aeronautics Board or the open access program and the deregulation of wellhead gas sales at the Commission.[3]

In the 1980s, the political school's efforts split into several areas. One theme focused on the simple evils of regulation. Theorists argued that regulators did not know what they were

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[3]Although gas producers once thought they would benefit from wellhead deregulation, most ended up losing when deregulation actually came during the 1980s.

doing and that whatever they did to control prices was futile, since the rents would be dissipated before they got to consumers. With the fall of communism, economics was reintegrated into politics. Regulation theory evolved into an agency theory that regulators were always less astute than those they regulated, so that the inability to gather enough information made the regulated firms the winners. This bridged over into an efficiency recommendation that one should try to coax the right decisions out of the regulated firms with proper incentives in their rate designs.

Another recent theme is to see commissioners acting to maximize the utility of their decisions. That is, they sort competing interests among various client constituencies, including the firms they regulate, customers and the politicians who appoint them. In a very real sense, commissions try to sort out and implement public policy. In short: there are many competing demands on regulators. Neither consumers nor the firms are the focus of regulation.

Beginning in the 1980s, many countries began to privatize publicly owned companies. Most saw the need to establish a regulatory regime to control natural monopolies. Most of these experiences are too recent to be evaluated. However, some lessons are clear. First, whatever evils may be associated with regulation, the alternative is not full deregulation. Both shareholders and customers need the protection that some form of regulation provides against either expropriation or pure monopoly pricing. The political necessity to reassure ratepayers and the economic necessity to reassure investors have made regulatory constitution-building into a global growth industry. In short, for better or worse, some form of regulation appears to be inevitable.

Second, the longest running new regulatory system (in the United Kingdom) provides some insights into the forces that impinge on regulation. In the 1980s, a Conservative government sold most state-owned utilities. While the desire to promote competition played role in the privatization, a major initial goal was to maximize revenues to the Exchequer by making the sale attractive. One lesson is that there is an inherent conflict between higher value (for which market power is a good thing) and the benefits of competition (for which it is not). In Britain, this tension led to compromises: for example, the sale of non-nuclear electric generating assets to two new private companies. Another lesson is that to the extent that the initial sale does not maximize competition, regulation takes on a larger role than it would need to have otherwise.

The nature of regulation also plays a major part in the valuation of the enterprise. The British experience suggests that this is particularly problematic because initial regulatory approaches are likely to prove infeasible over the long run. Thus, the British introduced a system of “price cap” regulation that was supposed to provide rate certainty while allowing companies to realize profits from any increases in efficiency they could achieve. As time went on, the policy of fixed rates became unsustainable because companies were able to wring embarrassingly large inefficiencies out of the system, leading to embarrassingly high profits on low benefits to consumers. The practical result was to adjust the price caps. The process used the same kind of information that Americans use in rate cases and that the British had explicitly foresworn. The point here is not that all regulation must collapse back onto a given form, but that the problems of balancing interests are real and not easily solved by simple panaceas.

D. The Mixing Pot: Original Cost-of-Service Regulation

Clearly, both the mathematical and political schools have captured an important element of truth about the regulatory process. The quest for efficiency has led to improved approaches to ratemaking and key institutional changes such as open access. These have almost certainly improved the performance of the affected industries compared to what might have happened with more naive approaches.

At the same time, there is no doubt that the regulatory system is part of a larger political system and operates powerfully to represent and reconcile important interests. Indeed, one of the key purposes of a regulatory system is to ensure that interests are reconciled in a way that the parties and the public see as legitimate.

Nonetheless, both schools have largely missed a basic fact: many or most regulatory decisions are driven by the logic of a particular bureaucratic system built up over many years of responding to both economic and political forces. That is, economic theory joins with political realities and inertia to create actual rates.

In the United States at both federal and state levels, this system has centered for almost a century on OCOS ratemaking and a quasi-judicial approach to resolving disputes. OCOS charges customers rates based on the need for the utility to recover the original (book) value of its investments over time in the form of depreciation, to make a reasonable return on the original cost of its assets that have not yet been depreciated and to cover its out-of-pocket costs of doing business, including operation and maintenance expense, administrative costs and (often) the cost of fuel (for electricity) or the commodity to be resold (in the case of natural gas). Economically, OCOS rates only accidently bear any resemblance to rates determined by market forces—competitive or monopoly. At best, they can be seen as adjustments to a long-term payment schedule under a regulatory compact.

The degree to which OCOS has taken on a life of its own can best be seen in a few examples:

- It typically contains no simple provision for inflation (because it became popular in a period of little or no inflation). Today, almost all federal legislation affecting money transfers over time (e.g., NGPA and tax laws) contains inflation adjustments. If enacted for the first time today, the regulatory laws of the 1930s might well prescribe inflation adjustments. In practice, the alternative has been frequent rate cases when inflation is high. This is not efficient and not necessarily to anyone's particular benefit, but it is a fact of regulatory life.

- Within OCOS, multi-part pricing, through terms and conditions of service agreements, has thrived, often relying on the work of theoretical economists and often to the benefit of one group or another. Does multi-part pricing actually improve efficiency? No one knows. It does lead to debates about how customers respond to utility bills, but empirical research produces equivocal results. In practice, particular multi-part pricing schemes tend to be adopted for fairly transient reasons (more emphasis on volumetric charges when a commodity appears scarce, for instance) and to survive because each scheme effectively creates entitlements.

- For natural gas pipelines and electric utilities, OCOS ratemaking has used rolled-in pricing for capacity expansions—that is, it averages the original costs of new investments into those of a larger set of pre-existing investments before setting rates. This shows how the machinery of ratemaking can pervert otherwise sensible approaches to achieving efficiency. Using a good *ex ante* auction for an expansion with rolled-in pricing would normally lead directly to overbuilding precisely because it made good use of price signals—the wrong price signals.

In the rest of this section, we shall examine in more detail some key problems that the nearly universal use of OCOS has created for regulators and regulated companies.

Information and Forecasts

OCOS depends on the ability of the regulator to forecast accurately. First, approving a project under OCOS involves judging that a company can recover its costs over the economic life of the asset and a commitment to find ways to give them a chance to do so.[4]

Every subsequent rate case depends on forecasts of key variables: units of service (demand), growth rates (to support Discounted Cash Flow models of return on equity), fuel costs and valuation of environmental effects (for integrated resource planning (IRP)) and relative fuel prices (to regulate fuel choice). Making OCOS rates efficient also requires accurate forecasting. With good forecasts, the ratemaking strategies of the mathematical school can approximate optimal, efficient, fair tariffs. With incorrect forecasts, most traditional forms of ratemaking quickly become inefficient and even perverse. Simple versions of OCOS techniques revise rates upward when customers want less service and downward when they want more, a result antithetic to both competitive markets and common sense.

Regulatory forecasting differs critically from the risk management that all companies do in the normal run of business. In normal risk management, businesses have their own money on the line and are accountable for any mistakes they make. They have every reason to weigh risks and potential gains closely. And no one but the company itself is hurt if they choose badly. In regulatory forecasting, customers bear most of the risk. To the extent that public policy, including guarantees of cost recovery, amounts to speculating on the future, the basic problem is clear: Those who make the decisions pay little or none of the loss.

Forecasting accurately enough for regulatory purposes has proven a fool's errand. For the last 30 years, forecasts designed to support regulation and more general public policy (IRP, allowable fringe competition under the NGPA and PURPA, rate cases) have been badly wrong. Simon argues persuasively that the observed long-term (more than 20 years) trend for

[4] This tends to be true even of projects constructed "at risk," which tend to be given regular rate treatment within a few years.

natural resources prices is down in real terms, mostly because of competition from substitutes or technological innovation that lowers production costs. However, policy forecasting has been based on the prevailing resource economics orthodoxy of the last 20 years—that prices must go up.[5] Since 1980, major forecasters have consistently guessed prices to be too high and production to be too low (see O'Neill, Whitmore, Meroney and Hall, 1996). Price forecasts have neither been close nor in the right direction. Resource forecasts have also been bad. They have consistently and drastically underestimated economically recoverable domestic oil resources for the last century (see Wildavsky and Tenenbaum). Demand forecasting has had similar problems.

Could regulators simply reverse conventional wisdom? No. Simon's results apply (if at all) only in the long run. The horizon for most regulated investments and regulation is less than 20 years, over which periods prices follow no simple trends.

Forecasting failures have led to many unhappy decisions. For instance, many people, from retail users to federal policy-makers, based decisions on the 1950s forecast that nuclear power would become "too cheap to meter."[6] Many natural gas policies in the 1970s anticipated long-term shortages and rising prices. As of 1996, metering is not a major part of nuclear power costs, while continuing stable, low gas prices result from continuing ample supplies. Ratepayers and taxpayers (as well as shareholders) have ended up paying for the mistaken investments based on forecasting failures.

Why is energy forecasting so poor? The most basic problem is that the issues are far too complex to capture in any practicable model. The forecasting profession also consistently underestimates the importance of:

- Political factors. The history of energy prices is largely political. The most important forces in predicting future oil prices have long been political developments in the producing areas. Domestic political forces have had profound effects on natural gas and electric prices (far more than the never-realized link that forecasters have drawn between future gas and oil prices).

- Innovation. Most models assume that improvement will be slow and many modelers greet new developments with astonishment. This is true not only for improving generation and production but also for ways to operate transmission grids more efficiently.

- Market forces. Forecasters severely underestimated the effects of conservation, as well as increasing efficiency caused by introducing market forces to the natural gas industry.

Finally, forecasts tend to cluster together. In many ways the forecasting profession is a guild, with regular meetings and discussions. Ostensibly, these meetings examine the value of various forecasting techniques, but inevitably they also facilitate social consensus on results.

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[5]This conventional wisdom remains strong. For instance, Public Service of Colorado recently chose to invest $260 million in scrubbers for a coal plant rather than $60 million in converting it to burn gas because it believed gas would be more expensive over the long run.

[6]Lewis L. Strauss, Chairman, Atomic Energy Commission, before the National Association of Science Writers (September 16, 1954), as reported in *The New York Times*, September 17, 1954, p. 5.

Pricing Issues: Inefficient Incentives and Cross-Subsidies

Inefficient Incentives. In 1962, Averch and Johnson argued that if a firm could make a return on capital and not on labor or efficient management, it would inefficiently increase capital assets. It would also "gold plate" its assets as much as regulators would allow to increase its return. Most analysts soon accepted that OCOS would tend to increase capital costs, other things being equal. This has further implications. For instance, a major objection to Ramsey pricing is not that it recovers fixed costs inefficiently, but that it too easily recovers excessive fixed costs.

Sometimes, OCOS can also artificially discourage capital investments. To the extent that later prudence reviews make the recovery of capital costs uncertain, OCOS adds risk to an investment. After the costs of some large nuclear plants were disallowed as imprudent in the late 1970s, some utilities saw capital expenditures as unacceptably risky and began to avoid them.

Whatever specific effects OCOS has on incentives to invest, it also reduces or eliminates the incentive to use other resources efficiently. Straight cost passthroughs for fuel costs give little or no incentive to minimize such costs. Similarly, companies have little reason to minimize the costs of labor or operation and maintenance, except for regulatory lag (the time between rate cases, when a company could benefit from reducing costs at the expense of having lower rates in the future). Finally, in most industries, increasing efficiency has come largely from improving customers service as well as from cutting costs. OCOS provides no substantial incentives to improve customer service.

Cross-Subsidies. Perhaps the most frequent dispute in actual rate-cases is the claim that a ratemaking scheme contains cross-subsidies. The term "cross-subsidy" has many inconsistent definitions. Economic theory recognizes a cross-subsidy when the price for some group of customers is below marginal costs or above the cost of the best alternative—for example, bypass. The best alternative must consider the alternatives of all possible coalitions of players (often called "stand alone" cost approach). Proving that a given rate-making scheme contains cross-subsidies in this sense can be difficult.

In cost allocation debates, a "cross-subsidy" is often declared when a player pays less than the costs allocated by a more or less arbitrary technique for allocating costs. This often leads to confusion that masks a debate over fairness or an effort to resolve questions of cost allocations that should have been made before costs were sunk. For example, postage stamp, quantity-distance or zonal allocations are often justified on historical or philosophical fairness grounds. In any case, rational debate can proceed only after parties agree on basic definitions.

Reliability, Overbuilding and Stranded Costs

Reliability. Some analysts argue that increasing competition in the gas and electric industries would compromise reliability.[7] Some use this argument to attack the idea of

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[7] Prepared Testimony of Dr. Robert A. Kramer in "Support of Application for Rehearing of FERC Opinion and Order No. 349" (Exhibit No. II-2), Appendix 2.

competition, and others argue that competition must be compromised to protect reliability. This argument may partly reflect the experience of cost-based regulatory regimes. Since prices do not adjust to market conditions, reliability is designed into the system through "rules," including curtailment schemes, and expensive investments. Historically, the reliability argument has been a weapon for those who wish to maintain the status quo.[8] In the early 1980s, gas pipelines argued that third-party gas would threaten network reliability. This fear was all the stronger for the fact that the old system had produced exactly such a result in the mid-1970s without competition. In the late 1980s and early 1990s, electric utilities argued that independent generators were a threat to network reliability.[9] From a competitive perspective, these arguments amount to attempts to tie non-network services to network services to avoid competition.

In fact, competition increases reliability in most industries. Competitive prices adjust to equate supply and demand. If demand rises or supply falls, the price rises to clear the market. Traders have profit-based incentives to sell when prices rise which, with good trading rules and institutions, translates directly to higher reliability.

How has competition affected reliability in the natural gas and electric industries?

In February 1994, a cold spell hit the Northeast. Many analysts feared for the reliability of the natural gas industry, since this was the first winter with natural gas markets unbundled under Order 636. Few worried about reliability in the electric industry, with its greater emphasis on traditional regulation and substantial excess capacity. As it turned out, natural gas markets performed well. Prices rose to balance supply and demand, and there were only very minor distribution outages, well removed from the interstate system. The electric industry, however, saw coal piles freeze and oil barges frozen in rivers away from generators. Rolling blackouts began, and the Federal Government in Washington closed to conserve electricity. The key is that profit incentives often provide a much stronger incentive to prepare for contingencies than regulatory planning. The response of the two industries presented a stark contrast in which commodity markets and open access performed more reliably than those with command and control approaches.

For natural gas, the winter of 1995-1996 presented a new, more severe test of reliability. Prices spiked at very high levels, but the market cleared. The best guarantee of future reliability seems to be the extension of market forces to those who do not see short-term market prices today, that is, to most retail customers.

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[8]The ingrained nature of opposition to unbundling is clear even in the language incumbent firms use. In the 1950s, AT&T argued that "alien" devices, phone connections and other terminal equipment were a threat to network reliability. Such arguments can be seductively strong—the FCC agreed with AT&T, but was later reversed by a circuit court (see Kuhn).

[9]See "Comments of the American Electric Power System on the Department of Energy 'Interim Report—National Energy Strategy,'" April 1990; testimony of Sherwood Smith, Senate Energy and Natural Resources Committee, March 14, 1990; and Electric Reliability Coalition advertisement in *The Washington Post*, March 1991.

Reliability concerns for electric power arose in the summer of 1996, when two massive outages occurred in the western United States. The problems were traced to a lack of maintenance (tree clearing) on the transmission lines and the transmission operator's failure to supply others with timely information. Increasing competition played no apparent role in the outages. Transmission maintenance is not subject to competition, and the transmission operator was among the entities least attuned to competition.

Where does the reliability debate stand today? The major unbundling issues have largely been resolved for natural gas and electric power at the interstate level (though not at the state and local levels). For interstate natural gas markets, reliability now serves as an excuse to avoid clarity on the terms of service. Pipelines retain much of their storage, ostensibly to promote reliability. They claim reliability benefits for old shippers when they wish to roll in the costs of new construction.

Reliability claims also serve in the gas industry as a way to restrict market operations at peak. When constraints begin to appear (or threaten to appear), pipelines declare "operational flow orders" that severely restrict how shippers can trade on the system. The effort to ensure "reliability" introduces a command and control approach to markets at precisely the time when service is most valuable and potential gains from trade are highest.

In electric markets, incumbent utilities used reliability as a major argument against the introduction of market forces, for instance, in arguing against the Energy Policy Act of 1992. More recently in the consideration of Order 888, they have softened their opposition to open access (and hence their use of reliability arguments), perhaps partly as a result of a promise to be able to recoup some of their stranded costs. In the future, the industry will need to develop new ways for handling legitimate reliability issues so that transmission owners are not suspected of manipulating the issue. Independent system operators and regional reliability councils consisting of industry players may be the best way to oversee reliability guidelines.

Overbuilding. The American regulatory emphasis on reliability led to three other problems:

- It gave regulated companies an ironclad reason to overbuild their facilities. All excess investment was necessary against the one day in 50 years (or 100 years or whatever) when supply might be most tight and demand most heavy. (Demand was assumed to be impervious to price, since regulated prices are averaged in a way that almost never lets customers respond to price changes in a period less than a month.)

- Two separate reliability issues were often conflated. On one hand, reliability is a guarantee against catastrophic network failure that would cut off service from millions in a matter of seconds (in the case of electricity). On the other hand, reliability is a guarantee to have enough of the commodity available to serve all firm demand at a constant price. The first guarantee offered a good way to instill fear into everyone in the process. The second justified much excess building. Using the two together put fear at the service of creating a glut.

- It engendered much confusion about the "obligation to serve,"which was a response to the possibility that a territorial franchise monopoly would serve only those customers that it was cheapest to reach. This argument is essentially about the expense of wires and pipes. But in the context of an integrated service provider, reliability came to mean a guarantee that the commodity would arrive as well. In a competitive market, this aspect of the obligation to serve becomes the ability to buy at market prices.

Stranded Costs. The eventual bill for overbuilding is stranded costs. The coming of competition exposed large-scale inefficiencies in both natural gas and electric industries, many of them in the form of stranded costs—facilities or contracts whose costs cannot be recovered in a competitive environment. In natural gas, most stranded costs took the form of take-or-pay contracts, obligating pipelines to buy gas at a specified price that turned out to be considerably above market levels. The implied liabilities may have reached $60 to $70 billion by the mid 1980s, more than the pipelines' net worth as an industry. In electric power, costly generation units and uneconomic contracts both played a part in the stranded cost problem. Estimates of stranded electric costs are as much as $200 billion.[10]

Who caused the stranded costs in the two industries? There is plenty of blame to go around. The prime suspects are utilities and the regulators. How should regulators respond if a utility asks to recover its stranded investment or obligation? Clearly, it is imperative to prevent a recurrence of the problem, but equally clearly, there is little gain in debating who was at fault.

Probably the best way to handle the stranded cost problem is through divestiture. Who was at fault does not matter if the answer is to transfer the assets to another entity. Selling the asset to the highest bidder gives it a market value, both valuing and minimizing transition costs.[11] An auction should also move the assets into the hands of the most efficient operator. Typically, the buyer will be independent of the transmission system so that it can get market-based rates. And the problem will not recur.

To the extent regulators caused the stranded costs, they will cease doing so since they will be out of the business of setting rates or guaranteeing an opportunity to recover costs. To the extent the utility caused the stranded costs, it also will cease doing so. It no longer owns or has contracts for the assets that caused the stranded costs and it no longer will operate as a regulated player in the commodity market. That is, if it retains some electric generation, say, it will be subject to the same competitive market forces and understandings as any other generator,

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[10]McMahan, Ron; Seiple, Chris; Knutson, Kent, "New Study Sharpens the Corners of the Electric Utility Deregulation Debate," *Media Release*, Resource Data International, Inc., February 7, 1997. Note that the stranded costs for both industries mostly involve generation and production facilities. A second wave of stranded costs may overtake both industries as inefficient investment in transmission facilities becomes more apparent. Prior to Order 636, there was a fear that not enough transmission capacity existed to handle unbundling. The opposite has occurred.

[11]In 1995, there was an interesting market test of the South Texas Nuclear Facilities. The City of Austin put its 16 percent ownership up for bid and received one bid. The bid was minus $150 million. Given the current operating circumstances, the market value of the entire plant is about minus $1 billion. It would probably be lower if the facilities control was part of the deal, then a more efficient entity could operate it or close it down.

provided that it cannot keep a dominant market share. Whatever specifically caused the problem has been solved.

Institutions

OCOS has thoroughly permeated the industries it regulates through the growth of particular institutions. As viewed by most of the mathematical school, institutions were essentially irrelevant. The point was to find the right answers whoever administered them. Institutions that govern network oligopolies generally are inertial and path dependent, the result largely of a series of haphazard adaptations to long-forgotten crises. Once established, they are hard to change. So historical quirk easily becomes hard-to-change reality. This basic fact gives OCOS much of its staying power and points up the impossibility of restructuring the industries without reshaping the governing institutions.

The power of existing institutions extends beyond the everyday policy decisions that are guided by precedents established for now-forgotten reasons (though this aspect of the institutions is also important.) Two key areas where existing institutions matter most are market structure and dispute resolution.

Market structure. Functions that may once have been natural monopolies now have varying degrees of competition. Many remain regulated by law long after competition could exist, and regulation itself is sometimes the greatest bar to competition. This can be seen in whole industries, such as trucking. Even after competitive forces begin to affect an industry, regulatory inertia tends to favor incumbents over entrants in any number of subtle ways.

Dispute resolution. In the United States, OCOS has coincided with a strong due process approach that hampers good results. Dispute resolution has become a highly legalized, time-consuming ritual. Those who control the process often have little or no formal training in the technical issues; this leads to reliance on dueling expert witnesses. They also have weak or negative incentives to resolve the dispute, which leads to delay.

A strict separation between trial and advisory staff increases the chance that the record will fail to address the policy concerns of the Commission as they evolve in the interim. As a result, the record had often been overtaken by events. The formality of the process prevents new facts from being considered, unless the case is sent back for further hearing. But that would simply start the whole cycle over again. In the end, decisions are often based on expediency rather than facts. Finally, due process as now understood creates a moral hazard for Commissioners. By the time a case returns from the trial process, new Commissioners have often been appointed.

As competition plays a more important role, the dispute resolution process becomes increasingly problematic. First, it is unfair. The trial process gives a strong advantage to those who can gain from delay, and especially to those who have captive ratepayers to recompense them for their expenses. Second, it is slow. For example, pipeline rate cases at the Commission take up to 3 to 5 years before a final order is issued. Uncertainty about basic transportation rates, sustained over such a long period, creates large and needless risk for all players in the commodity markets. Imagine what would happen if package delivery services offered rates subject to unknown refunds years later. The situation is worse in electric power and natural gas, because the transmission is a much higher proportion of total costs.

In summary, today's governing institutions for network oligopolies most benefit rent-seeking incumbents and are essentially market-hostile. The most urgent task for reforming regulation is to transform the governing institutions so that they tend to seek efficiency and support markets.

E. Electric Regulation in the United States

The electric power industry was unregulated from 1882 (Edison's Pearl Street Station) to the turn of the century. (See Table 1 for a summary chronology of developments in the gas and electric industries.) Even households sometimes had more than one physical supply of electricity. In 1898, Samuel Insull (whose indictments lay 20 years in the future) faced investments that had been rendered uneconomic by technical innovation and proposed the basic regulatory bargain: he would receive a franchised monopoly to supply electricity, and the monopoly would be subject to state regulation based on OCOS ratemaking and an obligation to serve.[12] The regulatory bargain recognized the apparent economies of scope in the industry (central power stations could generate much more efficiently than smaller local stations), and OCOS let Insull recover his "stranded costs." For most of the 20th century, the natural monopoly character of the industry was accepted virtually without examination because the economies of scale in both generation and transmission kept increasing. Cost-of-service (usually

[12]Samuel Insull, address before the National Electric Light Association, June 1898 (see McDonald).

Table 1. Chronology: Natural Gas and Electricity Use and Regulation

Period	Natural Gas	Electric Power
Pre-1900	• Manufactured gas • Gas competes with electricity for lighting.	• First central generating stations built: London and New York (1882) • First ac transmission system: 13 miles between Portland OR and Willamet Falls
1900-to early 1930s	• Metallurgical advances permitted development of pipelines to transport Appalachian and Southwest gas. • First large-diameter gas pipeline from Texas to Chicago (1931) followed by development of interstate gas transportation system	• Development of interstate electricity transmission systems • Federal Water Power Act (1920) developed hydroelectric power on navigable streams. • First power pool, the Connecticut Valley Power Exchange
Mid 1930s to 1970s	• Public Utility Holding Company Act (PUHCA) broke up the large, powerful trusts that controlled the Nation's gas and electric distribution networks.	
	• Natural Gas Act (1938) brought federal regulation to interstate gas. • The *Phillips* decision (1954) required sales for resale jurisdiction to apply to wellhead prices. • Natural Gas Policy Act (1978) started gas deregulation.	• Federal Power Act (1935) regulated interstate electricity transmission • The Public Utility Regulatory Policies Act (1978) created a class of non-utility generators and required utilities to buy their power.
	• The Powerplant and Industrial Fuel Use Act (1978) limited the use of gas for industrial and utility use.	
1980s to present	• The Natural Gas Wellhead Decontrol Act (1987) mandated full wellhead decontrol by 1993. • FERC Order 636 (1992) requires interstate gas pipeline companies to unbundle their sales and transportation services and provide open access to transportation.	• Clean Air Act Amendments of 1990 requires electric utilities comply with emissions limits • Energy Policy Act (1992) provides access to transmission • FERC Order 888 (1996) requires open access by transmission-owning electric utilities and market-based rates for generation. Companies must separate their transmission and power marketing functions.

OCOS) regulatory regimes established at the state level between 1898 and 1935 governed the industry.

By 1935, a series of court decisions had blocked States from regulating interstate commerce in electricity.[13] Congress passed the Federal Power Act and the Public Utility Company Holding Act to fill the "regulatory gap" with federal regulation. The OCOS regime was adopted at the federal level.

Through the middle of the century, the optimal plant size grew to more than 600 megawatts. Industry structure reflected pervasive OCOS regulation. Large investor-owned utilities typically sold "bundled" service including generation, transmission, and distribution for a single price to retail customers in exclusive territories. But monopolies were local, not national. Today, more than 3,000 electric utilities and over 4,000 generating facilities produce and sell electricity (see Table 2).

By the 1970s, the industry's reliance on large plants and monopoly services became questionable. The market risks in building very large plants became clear in an era when demand grew much more slowly than forecast. The large plants provided far more capacity than was actually needed, and the lead times for construction made it very difficult to respond to unexpected changes in the market. Prices started to rise after six decades of decline (see Figure 1). Consumption, not surprising, also paused (see Figure 2). Part of the reason for sluggish demand growth was the increase in price caused by project overruns, especially on nuclear plants. Whether these overruns arose from forces companies could not control (such as a changing regulatory environment) or from a failure to discipline costs (as is common with cost-plus pricing), the result was the same. Finally, large plants also proved less economic than imagined because more capacity needed to be held in reserve against the possibility of an outage at one of the very large plants. All of these problems occurred during a decade punctuated by oil price shocks that increased concern about energy prices in all forms.

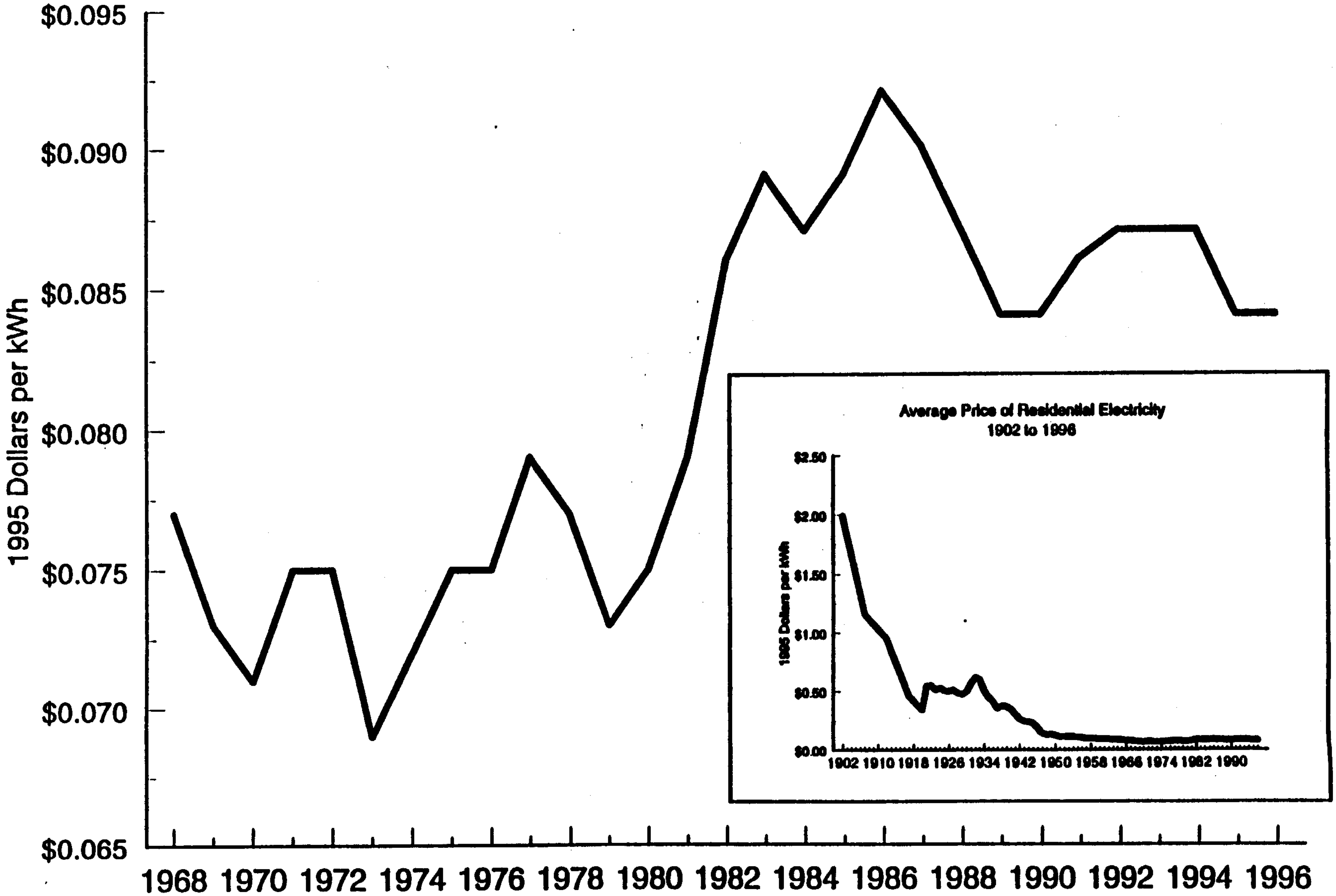
The OCOS regulatory regime showed real signs of strain during this period, as state regulators began to disallow costs on some large plants on grounds that the companies had been imprudent. The specter of imprudence made clear that large investments were now risky for the companies who made them (instead of only for their customers). But it did not begin to value the true risks in any way that competitive markets would recognize.

Congress also responded by passing the Public Utility Regulatory Policy Act (PURPA) in 1978. Among other things, PURPA set up a competitive fringe market in generation. This let new entrants chip away at the utilities' traditional monopoly status, despite the utilities' reliability concerns. Unfortunately, this competitive fringe had several unusual features. Prices were set at "avoided cost" (what the utility would otherwise have spent to meet the need). This was determined differently in every State, and was often set considerably too high or too low. Second, some technologies were given special advantages. As a result, many of the plants built under PURPA are anything but competitive. Nonetheless, it quickly became clear that many companies besides utilities could build generating facilities without degrading reliability.

By now, new technology and the growth in market size have substantially erased the scale economies in new generation. (Even large plants are now small relative to overall electric markets.) Electricity from non-utility generators in particular has grown more than 400 percent over the last 12 years as wholesale markets for generation have become much more

[13] Missouri v. Kansas Natural Gas Co., 265 U.S. 298 (1924) and PUC of R.I. v. Attleboro Steam and Electric Co., 273 U.S. 83 (1927).

Fig 1.
Average Price of Residential Electricity
1968 to 1995



Sources: 1902-1970: Energy Information Administration, *Annual Outlook for U.S. Electric Power*, 1985 ;1971-1994: Energy Information Administration, *Annual Energy Review*, 1995; 1995-1996: Energy Information Administration, *Natural Gas Monthly*, January 1997.

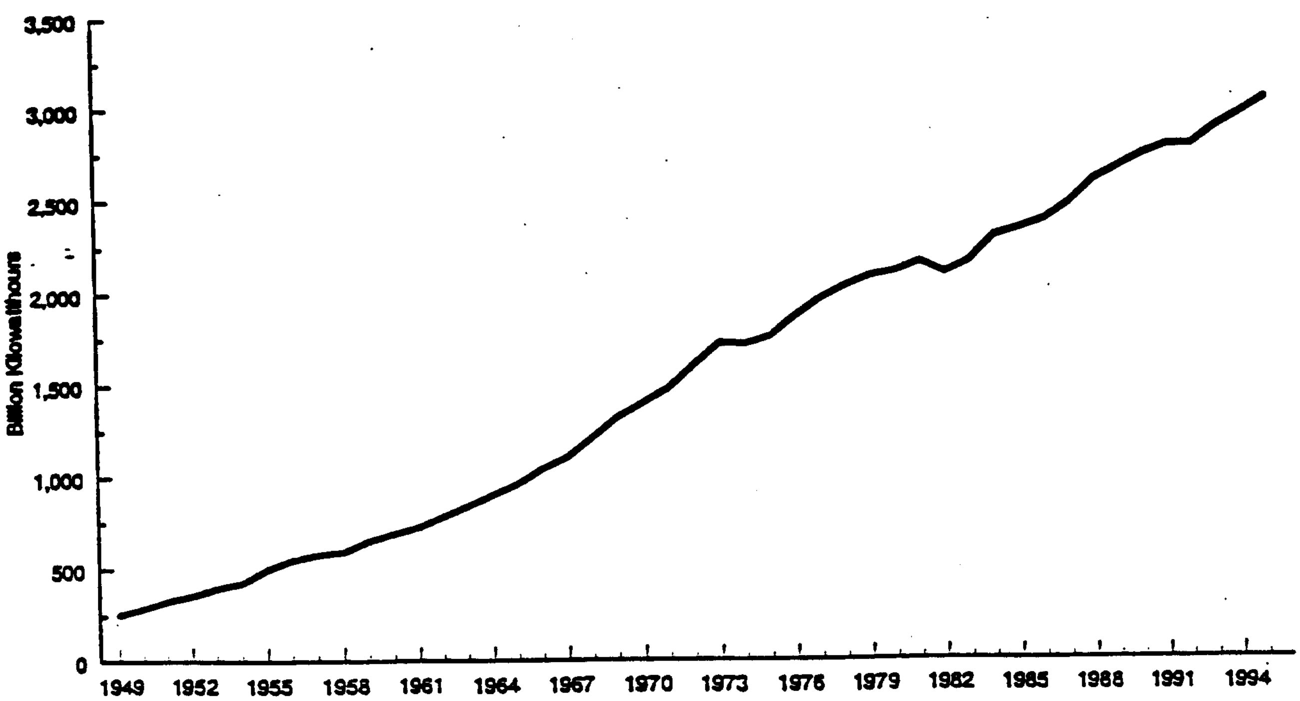
Notes: 1996 price is 10-month average. Prices adjusted using Producer Price Index.

Table 2. Electric Utilities Operating Generating Plants, Number and Capacity, Selected Years, 1960-1995

Year	Investor-Owned		Publicly Owned		Total	
	Number of Utilities	Capacity (gigawatts)	Number of Utilities	Capacity (gigawatts)	Number of Utilities	Capacity (gigawatts)
1950	158	38.7	610	12.8	768	51.5
1955	161	71.3	698	22.0	859	93.3
1960	167	115.5	734	33.7	901	149.2
1965	170	161.5	759	47.1	929	208.6
1970	174	237.4	778	62.5	952	300.0
1975	179	376.7	779	85.8	958	462.6
1980	181	458.7	756	112.9	937	571.6
1985	183	507.0	739	133.7	922	640.7
1990	183	554.5	742	141.6	925	696.1
1995	180	564.5	732	143.0	912	707.5

Note: Data compiled from 1995 Form EIA-860 using nameplate capacity, year-in-service and retirement dates. Capacity from 1950 through 1970 tends to be underreported by 5 to 25 percent. Company ownership based on 1995 Form EIA-861 does not reflect unites that have changed operators during the time series.

Figure 2. Overall Electric Consumption, 1949 to 1996



Source: Energy Information Administration, *Annual Energy Review*, 1995 and Energy Information Administration, *Electric Power Monthly*, February 1997.

competitive.[14] These changes, together with significant overbuilding that occurred over the last two decades have led many to conclude that competition can and should govern generation. However, geographically concentrated historical ownership patterns that may prevent competition from flourishing.

The biggest obstacle to potential competition is generation was the ability of transmission owners to refuse access to other generators. The Commission began to require open access as a condition for mergers in 1988 (Utah Power & Light Company, Opinion 318, issued October 26, 1988).

In 1992 Congress passed EPAct, which required the Commission to order access for individual wholesale customers under Section 211 of the FPA. In April 1996, Order 888 required utilities to provide open access for others to use their transmission networks. It is similar to both Orders 436 and 636 for natural gas. Section 211 also allows the Commission to order expansion of capacity. In Order 889, the Commission established Open-Access Same-Time Information Systems (OASIS) and asked industry groups spearheaded by EPRI and NERC to work out the details.

Since the passage of EPAct, the Commission has paid more attention to governance institutions for the industry than it did before. First, the Commission strongly encouraged the development of Regional Transmission Groups (RTGs) to coordinate transmission issues within each region and to plan for expansions to the grid; several RTGs have been formed since 1993, including one that covers the entire western grid. Since Order 888, the Commission has also encouraged the growth of Independent System Operators (ISOs) to manage the day-to-day operation. The ISO represents a step beyond functional unbundling to ensure that the grid really does operate in a non-discriminatory way. ISOs are developing rapidly in many areas of the country, including California and the Northeast.

ISOs and RTGs are both governed by boards consisting of representatives from all segments of the industry. Exactly how the representatives are chosen, what voting rules they use and what role public bodies (regulators and elected officials) play differ from case to case. Nonetheless, both ISOs and RTGs are quintessentially American institutions. They rely on checks and balances among all industry segments to help prevent unfair advantages. That is, they create a system of political power as the crucial check on potential abuses of (economic) market power. This approach is generally seen as “democratic” and may be the only effective way to provide believable guarantees that the organizations are independent of any particular part of the industry.

F. Natural Gas Regulation in the United States

In the early years of the 20th century, the gas industry had a very similar structure to the electric industry. Most gas was manufactured locally from coal and fed into local distribution systems. Gas companies were regulated at the local or state level. With the discovery and development of natural gas, first near large markets (for instance in Appalachia) and then as an adjunct to the oil business in the Southwest, long-haul transportation became an increasingly important part of the business. Pipelines began to link the Southwest with the Midwest. A series

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[14]Energy Information Administration, *Changing Structure of the Electric Power Industry: An Update* (Washington, DC, December 1996), p. 132.

of Supreme Court decisions declared that neither the producing state nor the consuming state could regulate the interstate pipelines (which, in those days, formed a very sparse grid that conformed much more to a franchised monopoly theory of the business than today's grid does.)

To close this "regulatory gap," Congress passed the Natural Gas Act in 1938 and brought federal regulation to interstate gas commerce. In 1954, the *Phillips* decision, a literal reading of the law by the Supreme Court that had no empirical or theoretical rationale, required sales for resale jurisdiction to apply to wellhead prices. A series of political blunders blocked its repeal by Congress and the system of price and contract regulation, once implemented, created entitlements that made it politically more difficult to correct. From the early 1960s to the mid-1980s, interstate natural gas prices were set and translated to city gate by the Federal Power Commission (now the Federal Energy Regulation Commission), creating vertical bilateral monopolies and Balkanized quasi-franchised markets.

The 1970s saw serious inflation and artificial shortages in interstate natural gas markets, leading to a very negative view of public utility commissions. Many natural gas policies wrongly anticipated long-term shortages and rising prices. Instead of introducing market forces to ration supply and bring incentives to the markets, efforts were put into administrative curtailment schemes. High inflation exposed the shortcomings of OCOS regulation. Purchase gas adjustment (PGA) clauses began in the early 1970s as a way to let the pipeline's sales rate track forecasts, increasing, regulated wellhead prices without revisiting the rest of its costs. The quid pro quo was a general rate case every 3 years. From then until the early 1990s, general debates about each pipeline's costs and prices took place every 3 years. Similar rituals still take place at the state level.

The Natural Gas Policy Act of 1978 (NGPA) started to deregulate gas as a commodity and ended the rigid separation of interstate and intrastate markets. The NGPA and the Commission's success with open access led Congress to push the use of market forces even further. The Natural Gas Wellhead Decontrol Act of 1987 mandated full wellhead decontrol by 1993 and urged non-discriminatory open access to improve the competitive structure of gas markets.

The transition to open access for the natural gas transmission network and greater commodity competition started in the mid-1980s. In late 1985, the Commission issued Order 436 authorizing voluntary open access on pipelines. By late 1986, only one company had accepted the invitation. Over the following year, with further Commission encouragement, most pipelines applied for open access, but their compliance with many details was weak and piecemeal.

This meant that gas commodity markets were not as competitive as they could have been. Nevertheless, in 1987, a Commission staff paper suggested incorporating auction techniques as a part of the ratemaking process. In 1988, the Commission proposed a rule for secondary tracking of natural gas transmission. Several individual programs were approved by the Commission. These programs were so narrow in scope that few of the Commission's objectives were achieved—piecemeal change was not working.

In 1983, the first signs of a visible spot market (that is, a market with generally available published prices) began to appear. With the advent of spot markets, players looked for places to buy and sell gas. The concept of market centers started to develop, first in the production area. In 1988, the NYMEX had proposed a futures market, originally with deliveries at Katy, TX, but finally settling on the Henry Hub in Erath, LA. Many argued it could not work or would distort the market. It is now accepted by many market players as the basis for intermediate-term pricing and it is being used in longer term contracts.

In the early 1990s, visible spot markets developed in downstream markets near potential market centers such as Chicago, IL, Niagara, NY, and Kern River, CA. This led some producers, pipelines and distributors to ask the Commission to take a market-oriented (as compared with a pipeline-by-pipeline) approach to production area rates and tariff conditions.[15] Without a generic market approach, pipelines are faced with the classic “prisoner's dilemma game”—if all play all can benefit, but without all playing it does not work.

One major problem the Commission faced was how to allocate pipeline service efficient-ly. Even partial competition for gas as a commodity made it important to give transportation to those who most valued it. But OCOS rate-making provided no way for price signals to ration capacity. The Commission considered several approaches to the problem during the late 1980s.

In 1991, the Commission proposed a rule that became Order 636. Issued in 1992, Order 636 supported and encouraged market center development to simplify transactions and enhance opportunities for additional network efficiencies through better use of capacity. The players and the dynamics of the markets will largely determine the exact directions in which the market develops. Order 636 dealt comprehensively with the problems of Order 436 by mandating unbundling, continuing the transition to the era of open access and commodity competition. It sent a clear signal that the institutions and organizations in natural gas markets were changing in significant ways. Order 636 mandated a “release” or secondary market in capacity rights. This program was much more flexible than the earlier experiments, but contained safeguards to prevent abuse. Additional flexibility will be granted as safeguards are no longer needed to prevent abuse.

To help the short-term prices reflect the value of short-run transportation, secondary markets appear to show the most promise. Transactions involving gas as a commodity and network services (transportation, including storage) were unbundled with a flexible secondary market in network services.

Almost all observers of the natural gas industry now believe that the structural changes were necessary, perhaps overdue, and that significant benefits have been realized. Actual costs caused by Orders 436 and 636 were minimal, but the reformation process made costs already in the system more visible. Further, to mitigate the impact of cost shifts, Order 636 tried to effect a transition to more efficient markets using essentially a no-losers test. Open access lowered prices to consumers. Although transitions can be problematic, consumers have generally benefitted greatly during the transition to open access. From 1985 to 1995, residential prices fell 20 percent in real terms reversing a decade-long upward trend (see Figure 3). Since average consumption per household also fell 8 percent, average gas bills were 27 percent lower. This happened during a time when overall consumption was increasing (see Figure 4). The general consensus is that, the benefits of open access seem large (see Winston; Crandall and Ellig).

Since then, natural gas markets have changed from local, highly segmented markets to larger, competitive regional markets. Increased use of computing and communications have

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[15] See Transco request, November 5, 1992, RM91-11.

profoundly changed the industry. The Commission has made electronic trading a priority. Markets can clear faster and more efficiently.

Regulations tend to outlive their useful lives and intended purposes. Natural gas wellhead prices have fallen since 1985 and have been completely deregulated since January 1, 1993. The original rationale for PGAs was largely gone by the early 1980s, but they continued until late 1993. With the death of PGAs, pipelines are no longer subject to an automatic 3-year rate review. They may file rate cases only when inflation is high and costs rise. But using inflation to trigger rate reviews is not in itself good policy. Nor is simply tracking costs. Both dull incentives for efficient operation.

In 1988, the Commission required gas pipelines to establish Electronic Bulletin Boards (EBBs) for posting information on affiliated transactions. In Order 636, the Commission required capacity release information and auctions on pipeline EBBs. In 1993, the Gas Industry Standards Board (GISB) was established; it is investigating use of Internet-type communications and trading. Pipelines now are using more real time communication and control. This trend to greater electronic communication and control will continue and spread inevitably into trading. Both gas commodity and capacity release markets are likely to become at least hourly within a few years.

G. Outlook

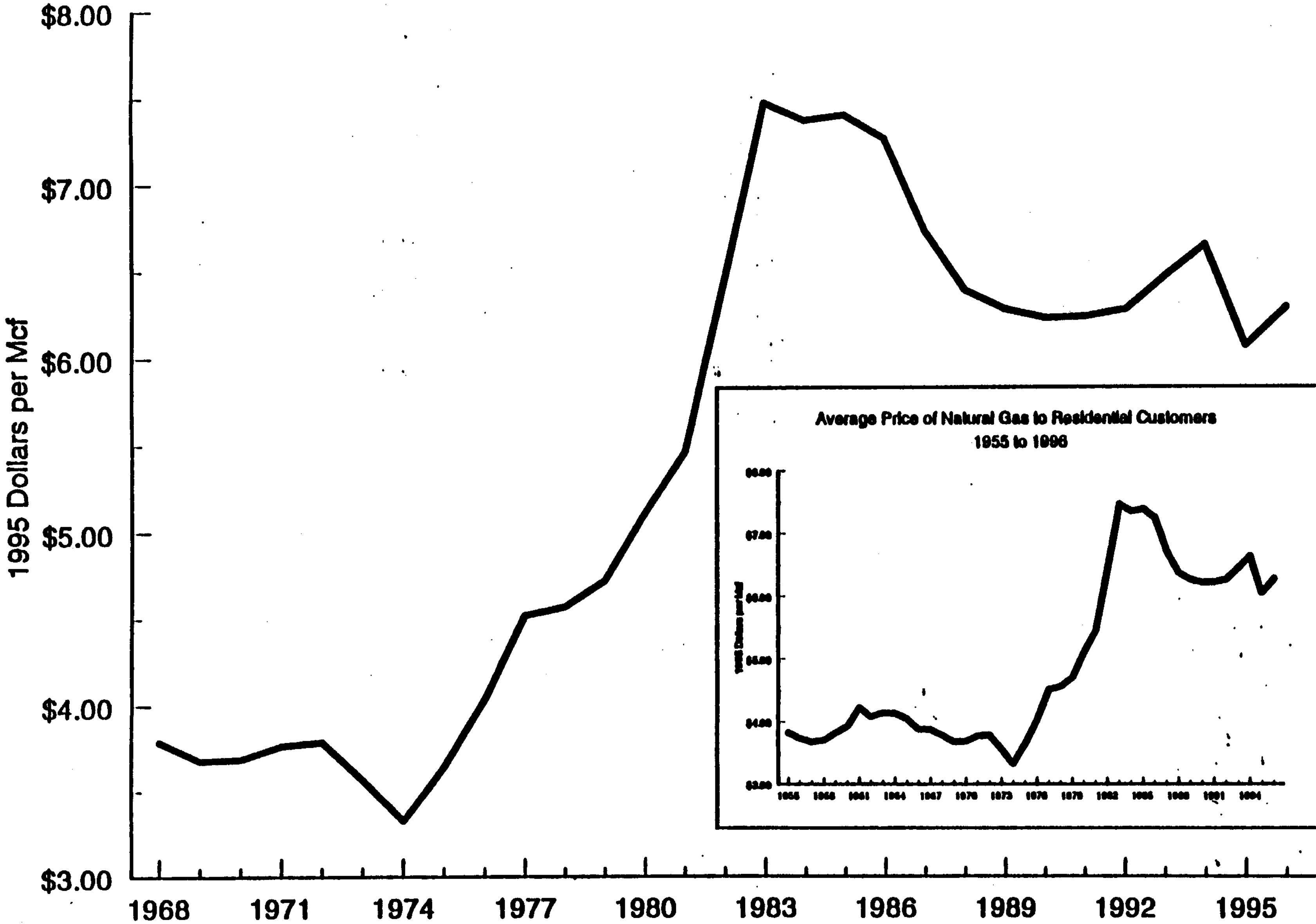
Both natural gas and electric industries stand on the verge of a radically new world, much more market-driven than ever before. The result is a slowly unfolding crisis for regulation. Traditional regulation largely ignores competitive markets in favor of accounting costs, centralized prediction and centralized planning. It overuses neoclassical microeconomics, econometrics, financial accounting and formal dispute resolution while underusing engineering economics, transactions costs economics, game theory and industrial organization concepts.

The mathematical school gives us concepts and techniques for establishing efficient rates. The political/rent-seeking school tells us that it takes more than mathematics to govern human nature.

Fig 3.

Average Price of Natural Gas to Residential Customers

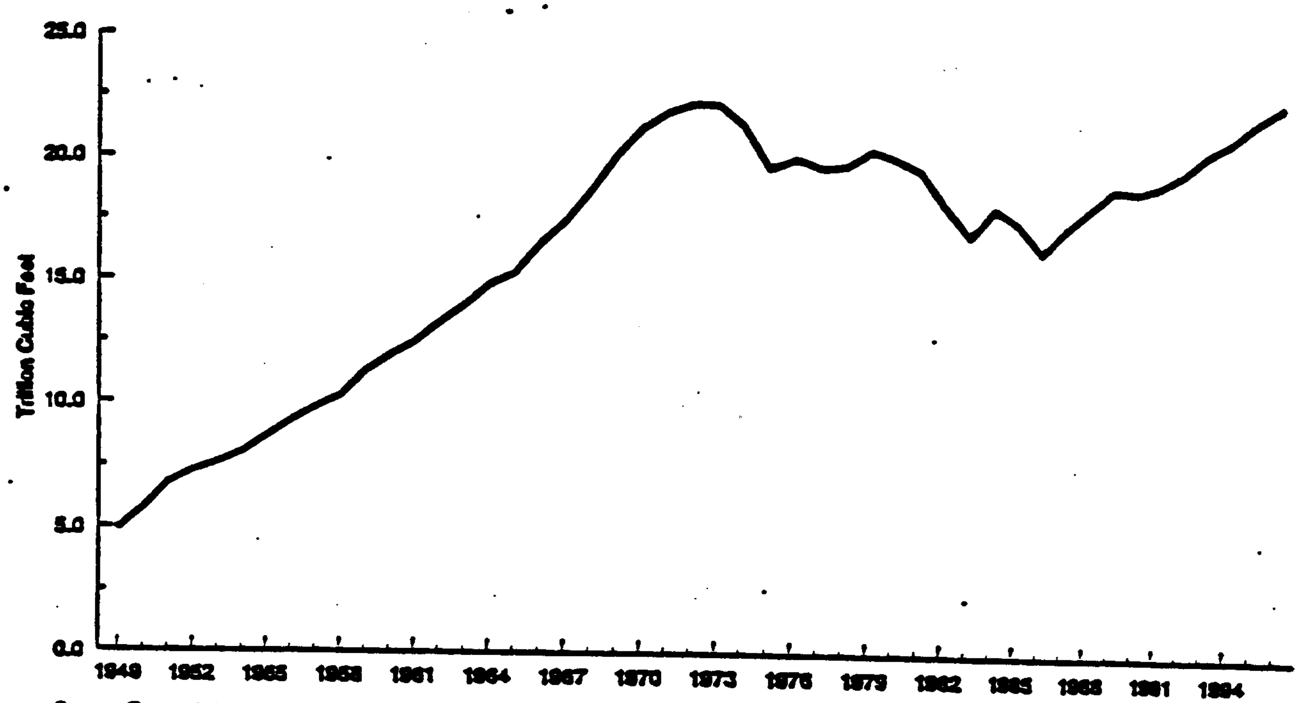
1961 to 1996



Sources: 1955-60: American Gas Association, Gas Facts, 1977; 1961-66: Bureau of Mines, *Minerals Yearbook*; 1967-95: Energy Information Administration, *Annual Energy Review*, 1995 and *Natural Gas Monthly*, January 1997.

Notes: 1996 price is 10-month average. Prices adjusted using Producer Price Index.

Figure 4. Overall Natural Gas Consumption, 1949 to 1996



Source: Energy Information Administration, *Annual Energy Review*, 1995 and Energy Information Administration, *Natural Gas Monthly*, December 1996.

What should future policy be toward transmission networks? OCOS regulation is no longer appropriate because it is no longer effective. The paradigm for regulatory policy must shift to creating robust institutions that allow for many possible changes in market conditions and rely on much more decentralized decisionmaking. This is largely uncharted territory. Market-based regulation or the governance of oligopolies is missing from much of the academic theory of regulation, since it is a relatively new phenomenon. Deregulation is certainly one option, more of an external force coming from legislative or executive bodies than an internal regulatory initiative. On the empirical front, there is evidence that tight oligopolies are likely to outperform regulated monopolies. In any case, there must be considerable flexibility in rate structures to create meaningful incentives for the firms and their customers to behave efficiently.

III. Important Concepts

A key problem in regulating network displacement oligopolies is that they differ from other industries in crucial ways:

- The physical nature of the transmission grids imposes a particular structure on economic activity: in particular, delivery by displacement creates unique opportunities and problems, the topology of the grid is closely related to cost and market power, and the lack of on-site storage in some grids (natural gas and electricity) greatly changes the nature of peak pricing problems and can lead to highly fragmented markets.

- Ownership patterns impose a very complicated mix of competitive and monopoly features within an essentially oligopolistic frame.

- The interconnections within the network create unusually large externality issues. Without care in structuring the industries, market forces would find many opportunities for free riders, overbuilding or underbuilding capacity and greatly affecting the value of other people's investments.

- Most network oligopolies are infused with the public interest, both because of their natural monopoly features and because most rest on the use of eminent domain to obtain rights of way. As a result, fairness or equity is as important a concern as efficiency is. Fortunately, equity and efficiency can and should be complementary. Unfortunately, making them so is not easy.

- Transactions costs can be unusually important, especially for short-term transactions. An efficient market institution in most displacement networks must make reducing transactions costs a high priority.

- The role of information is changing very rapidly. More information is available faster than ever before and can be used to support markets. But much of the information traditionally collected is of little value in a market context.

- Risk lies at the heart of network economics. Yet the traditions of the industries offer almost no help in understanding or dealing well with risk.

- The transition to market mechanisms brings to the fore basic institutional questions that were solved long ago in other industries. The physical nature of the grid and the oligopoly ownership structure present unique problems in controlling market power and encouraging efficiency.

This section explores these differences.

A. Displacement Networks

Transmission by Displacement

The transmission grids for electricity, natural gas, and (to a great extent) oil are displacement networks. That is, the only physical requirement is that the quantity removed from the network at the delivery point be equal to the quantity supplied (adjusting for losses) at the receipt point. In package delivery, message delivery, and human transport, the actual product put into the network must be the same as the one that is delivered to the specified delivery point. One person's visiting grandmother may not be substituted for another. By contrast, delivery of the actual input to a specific point in a displacement network is unnecessary and often physically impossible.

Displacement networks offer potentially large economies, since there is no need to track specific packets of the commodity. In effect, "capacity" can be created by changing the configuration of inputs and deliveries. In non-displacement networks, this cannot happen. At the same time, delivery by displacement makes it harder to assess charges for use of the system, since the network externalities are difficult to attribute to specific shippers especially as the networks become more reticulated. For example, the cost of transmission service does increase with the distance that the commodity moves physically. However, delivery by displacement means that the distance the commodity moves physically often fails to match the distance implied by the financial transaction.

The proper approach to levying charges to receive and deliver commodities in a displacement network starts with the physical burden that the transaction places on the network, not with a simplistic interpretation of the financial transaction. This is hard to do both in theory and practice. Even the language works against understanding, and those working in displacement networks resort to the jargon of non-displacement networks. For example, the often-used terms "counterflow" and "backhaul" have strained meanings in displacement networks since neither actually happens.

Finally, the transmission owner may have reasons to perpetuate confusion. For several years, pipelines argued that transported gas competing with their bundled sales needed to wait several days for the specific packet of gas to move through the network. (In reality, delivery by displacement began within a few hours.) From the pipelines' viewpoint, this "technical" (but incorrect) argument gave their bundled sales service an advantage over unbundled transmission service.

Externalities

Historically, the main justification for regulating energy displacement networks was that they are natural monopolies. More recently, public good and externality arguments have become more prominent. An externality is any cost or benefit that is "external" to the person making a decision. In contrast to an internal cost borne directly by the decisionmaker, an externality is borne by or accrues to others and, therefore, is not considered properly in the decisionmaking process. Decisions can have both positive and negative externalities. For example, a new major airport will have positive and negative externalities. The increase in demand for commercial land by the businesses associated with the airport (hotels, restaurants, etc.) may increase land values for some current owners, but noise from aircraft may reduce the value of homes in surrounding areas.

"Network" externalities occur when a change in the transmission network changes the ability to transact elsewhere on the network. The physical laws governing transmission sometimes substantially increase the size of these externalities, especially in electricity. Similarly, adding or eliminating any single link in an integrated network can change transmission capacity throughout the network.

Externalities affect both short-term flows and long-term investment. Changing the location of sources and loads changes the short-term capacity of the network. Long-term incentives to invest in expanding the network can be either inefficiently high or low. Incentives are too low when the public good characteristics of transmission become influential in the investment process. When rent-seeking opportunities, like rolled-in pricing, are available, the incentive to build will be too high—the new network link helps the sponsors at the expense of others.

Public goods represent a specific type of externality. In general, public goods create positive externalities that are enjoyed by many or all non-owners of the good. A public good has two distinguishing characteristics: non-excludability (the owner is not able to exclude others from using and/or enjoying the benefits of the good) and non-rivalry or non-destruction of consumption (one person's use of a good does not diminish the amount available to others). One of the most frequently used examples of a public good is national defense. Everyone is defended, and the protection of one person does not reduce the protection for others. Parks are quasi-public goods, where entrance fees create some exclusion and congestion means that when enough people "consume" the park experience, they reduce the value for each other.

The energy displacement networks are quasi-public goods, especially when they are overbuilt. The law requires open access but not free access. Exclusion is unlawful, but access is not free. After the system is built, usage costs are relatively small compared with the unit cost of construction, and congestion management is key. For reliability reasons, systems are often built to meet unanticipated contingencies during infrequent, extreme conditions. So, the system is uncongested much of the time. Use of the system when uncongested is non-rival because one use of the system does not diminish its availability for others. When the system becomes congested, it loses its non-rivalry characteristic. Therefore, it is not a pure public good. It merely has public good characteristics much of the time.

For regulators, public good issues arise in ensuring that the private incentives to expand the network are correct and that free rider problems are avoided. The free rider problem occurs because any contemplated investment that increases the capacity of the network is likely to benefit and cost parties that are not affiliated with the investor. This is particularly true when investments are made solely to increase the network reliability.

The other side of the free rider problem is rent-seeking. Rather than causing too little investment due to positive externalities that the investor cannot capture, rent-seeking causes too much investment by imposing negative externalities on others. Rent-seeking is usually associated with an activity that transfers wealth from some parties to the rent-seeker as a result of some activity or investment (e.g., lobbying for a legislative agenda). In this case, the transfer of wealth appears as a negative externality to some parties on the network and a corresponding positive return for the investor. How big a problem rent-seeking is depends on the governance rules for the network.

The inefficiency occurs when the benefit to the investor is much larger than the social benefit of the investment. For example, if investors build a line that raises the commodity price at a node in the network where they own production, they (and any other producers at the node) will receive a transfer of wealth. In some cases, this transfer is much larger than the social value of the line; hence, the terms "rent-seeking" or "business-stealing" (see Mankiw and Whinston). The transfer of wealth occurs as too many firms enter a market for a homogeneous product and steal business from firms already in the market.[16]

Can market mechanisms provide incentives to expand the transmission network efficiently? Theorists have proposed various ways to structure property rights and institutions to "internalize" the externalities so that they are borne by the decisionmaker. The goal is a system where private costs and benefits of expansion to the investor are roughly equal to the net social benefit of the expansion. If individuals (or coalitions of individuals) have incentives to make efficient decisions, decentralized decisions in the market could replace centrally planned transmission expansion. However, if we cannot find a market oriented solution based on new forms of property rights or other policies, alternative forms of governance may be beneficial or even necessary.

Centralized decisionmaking carries dangers of its own. In the future, almost any central governance system imaginable is likely to have incentives for at least some inefficiency. The key to crafting public policy efficiently is to compare the costs and benefits of each alternative.

Cost and Topology

At the bulk level in the United States, electricity and natural gas are transmitted almost exclusively through single (non-duplicated) networks of lines or pipes that have many similarities. Oil is largely transported through such a network. The combination of river systems and large water lines (especially in the West) amount to another displacement network. Construction costs have large economies of scale and a large part of the costs are sunk and fixed. Post-construction variable costs of moving a commodity are low (although "out-of-pocket" costs are considerably higher if operation and maintenance costs are included). At peak periods, the paths can be constrained, in which case the value of the paths (in terms of opportunity cost or price in a secondary market) can be very high, even though operating costs remain low.

In these industries, it is almost always less costly to build a single network than to build redundant and competing networks. In part, this is the result of scale economies: larger capacities typically require less than a proportional cost increase compared with smaller capacities. In addition, the high percentage of sunk costs associated with these networks,

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[16]Their example shows that a potential wealth transfer from the existing to the new firm can provide an incentive to enter a market, even if the entry is harmful from a social or efficiency perspective. The business-stealing effect is not unique to transmission networks. It happens throughout the economy from fast food restaurants (if MacDonalds and Wendy's open stores next to each other) to airframe manufacturers (Boeing's 747, Lockheed's L-1011 and McDonnell Douglas's DC-10). The problem may be greater in displacement networks because many effects are widespread and interrelated, and also because of the tacit public-interest bargains made to build facilities (eminent domain).

together with the difficulty of siting new lines, makes it extremely difficult to build a separate network to compete with an existing one. Legislation and regulation have acknowledged and reinforced these characteristics by granting the right of eminent domain to the transmission owner only.

Transporting companies often claim that displacement networks offer economies of scope if they offer bundled service, that is, if the network owner also buys, sells and distributes the commodity. These economies are hard to articulate and are often present only in the eye of the beholder. In theory, scope economies occur when transactions and coordination costs are high. The network economies that are inherent in displacement networks are a form of scope economies. Regulated companies often argue for scope economies that go beyond those inherent in the network, saying (for instance) that there are scope economies in being both transporter and monopoly commodity broker. But such positions have proven to be excursions into mystification, rather than arguments supported by evidence. In any case, regulation is generally not good at creating incentives to take advantage of any such scope economies that might exist due to the failure to eliminate x-inefficiencies or to reward the possible efficiencies.

New communications and control technology will make economies of scope arguments more difficult and less relevant. Tying non-monopoly services to monopoly services based on old economy of scope arguments should be highly suspect. Without equal access to the network monopoly service, competition in non-network service is distorted and inefficient.

Both economies of scale and any existing economies of scope involve creating services for which it is inherently difficult to allocate costs “accurately.” Thus, traditional regulatory approaches always have a degree of arbitrariness to them.

In a displacement network topology, the definition of markets is very important and difficult. A bottom-up approach is important. Each node in the network should initially be treated as a market (possibly a monopoly or monopsony market) and aggregated when appropriate. The nature of the connections between points, the underlying topology of the transmission system, is critical for markets to work. This makes the specific topology of the grid and the specific constellation of sources and loads at any given time extremely important in the two industries.

Grid constraints can fluctuate rapidly, and the fluctuations can be exacerbated by the lack of fast information and trading systems. Larger markets can fragment into many smaller markets, and short-term price volatility can be high. In addition, efficient short-term operation requires a tight integration of market mechanisms with the physical configuration of the system. Market power is much easier to exercise if buyers do not know the price. Captive customers and services with market power must be identified.

The control of the network is often by use of the commodity transmitted. Electricity, gas and oil are used to maintain voltage or pressure in networks. An important difference between electricity and pipeline networks is the valve. Electric networks have not yet been able to successfully overcome the effect of Kirkoff's laws, although the future developments of FACTS technology may provide the control equivalent of valves.

A single network provides a platform for greater competition in commodity trading. The commodity market can be competitive if it is restructured and unbundled from the network services. Due to non-convexities in costs and physical constraints (e.g., Kirkoff's laws) markets may have empty cores and cycle (see Von Neumann and Morgenstern and Luce and Raiffa). Trading rules are needed, both for commodities and for transmission capacity rights, to bring competition and efficiencies to these markets. Flanging the rate design and trading rules for short- and long-term markets is difficult.

The Strategic Importance of Storage

Natural gas and electricity differ from other displacement networks in that neither offers customers any substantial degree of economical on-site storage. In contrast, both water and oil can be stored on site, as can most other commodities from grain to metals to coal.

The basic similarity in the role of storage in the gas and electric industries is an important point, and one that is often misunderstood in the misleading slogan that gas can be stored and electricity cannot. It is true enough that natural gas is stored, in depleted reservoirs, in other underground formations such as salt caverns, in liquefied natural gas storage tanks and, to some extent, by packing the compressible fluid in the pipeline system itself. However, none of these forms of storage (except, arguably, line pack) is normally located at or near the point of consumption. So stored gas must move through the transmission grid to reach customers.

In the electric industry, there are limited forms of direct storage (for instance, pumped hydro). But the basic function played by storage in natural gas—meeting imbalances and peak loads—is played in electricity by spinning reserves (for immediate balancing needs), by storing electric potential in the form of fuel at generating sites (for less immediate market changes) and by holding peaking units in reserve (for longer-term peaking needs).

The essential similarity with natural gas is that this “storage” is seldom located at or near the point of consumption, so “stored” electricity must move through the grid to reach its market. (In addition, increasingly competitive markets may reveal that both industries have over-invested in some forms of storage, especially seasonal underground reservoirs for gas and peaking units for electric power.)

The strategic importance of storage in the two industries is the same. At peak, transmission lines are usually constrained. If shippers had on-site storage, they could use their own reserves to correct for the inability of the grid to make all the desired deliveries. But, since customers cannot store the commodity themselves, they must deal with transmission constraints at peak.

The lack of on-site storage contributes to observed volatility of commodity prices. Table 3 shows a measure of volatility for natural gas prices compared with many other commodities. Before the winter of 1995-96, gas prices were among the most volatile of any commodity. During the winter, gas price volatility was extraordinary. This reflects the lack of both real-time markets and on-site storage. Electricity prices in Britain have shown similar extraordinary volatility. A final unusual feature of these industries is the short duration of very high peaks (see Figure 5). Unlike, say, oil prices, gas prices fall quickly. This is not surprising. Prices fall almost immediately once constraints are relieved.

B. Information and Risk

Information

Perhaps the most significant technological advance of the last half of the 20th century is the computer. The cost of computing has fallen by an order of magnitude in each of the last four decades. Computer hardware that cost $10 million in the 1950s now costs less than $1,000. A similar revolution has taken place in communications. In both, Schumpeter's theory of creative destruction appears to be at work. A top-of-the-line PC depreciates almost fully in trade value over 2 to 4 years, while losing none of its physical capabilities.

With good computing and communications, it is difficult to overstate the importance of good, timely information. Information innovations have allowed, in part, unbundling of transmission and commodity sales. Good information is necessary to design rates and then benchmark and reward performance. Good information is needed for efficient trading and electronic markets. Good information is needed to prevent and punish inappropriate opportunism. Poor and untimely information makes rate setting, policing and efficient market functioning much more difficult.

Information is a quasi-public good. The debate about information is about how to collect and supply it. Advocates of free markets do not argue the value of information, but argue that the markets will supply enough information. If what the market supplies is always the efficient amount, the argument is a tautology. This school of thought ignores the public good aspects of information. Information is not destroyed in consumption and the cost of supplying information, once obtained, is low.

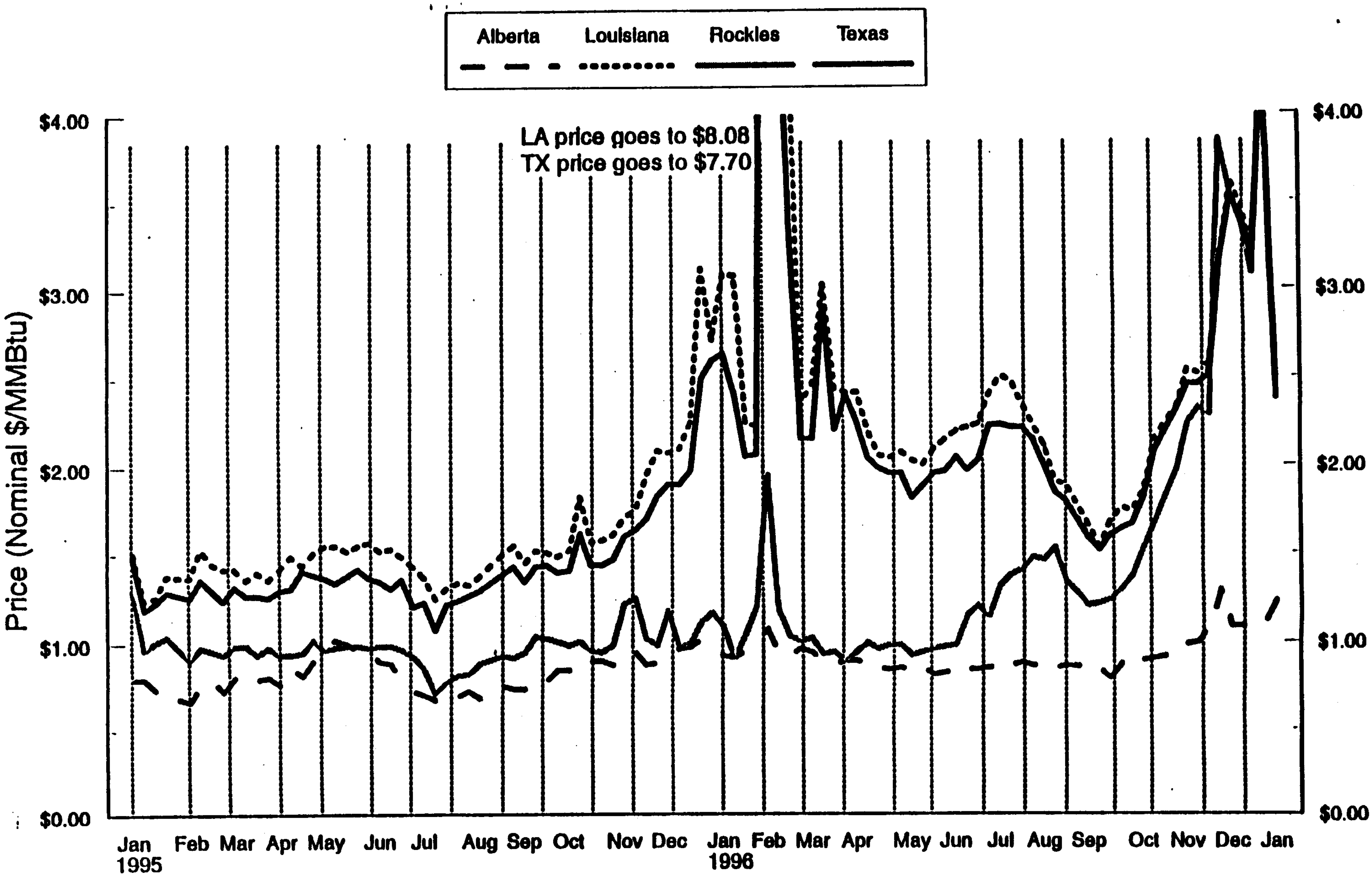
Table 3. Summary of Volatility in Selected Cash Markets

Cash Market	Beginning Year	Average Monthly Volatility	Highest Monthly Volatility	High Month
Natural Gas/Henry Hub (Oct 1993 to March 1996)	93	0.41	4.69	Feb-96
October 1993 to October 1995	93	0.23	0.57	Feb-94
November 1995 to March 1996	93	1.95	4.69	Feb-96
Pork Bellies	94	0.26	0.70	Aug-95
Coffee	94	0.21	0.68	Jun-94
Unleaded Gas	94	0.18	0.43	Oct-94
Eggs (Large White)	92	0.15	0.35	Jul-95
Live Hogs	94	0.13	0.35	Dec-94
Soybean Oil	70	0.12	0.65	Oct-73
Heating Oil	94	0.11	0.31	Feb-94
Broilers	92	0.11	0.30	Mar-95
Wheat	95	0.11	0.33	Aug-95
Liquified Propane Gas	95	0.11	0.33	Feb-96
Brent Blend Crude Oil	91	0.10	0.54	Jan-91
Crude Oil	92	0.09	0.26	Feb-96
Oats	94	0.09	0.21	Dec-95
Sugar	94	0.09	0.19	Apr-95
Butane	92	0.09	0.41	Feb-96
Cotton #2	70	0.08	0.44	Sep-86
Spring Wheat	84	0.08	0.34	Jul-93
Platinum	86	0.08	0.33	Aug-86
Corn	94	0.08	0.17	Jul-94
Palladium	88	0.08	0.20	Oct-90
Silver	94	0.08	0.20	Mar-95
Cocoa	94	0.07	0.16	May-94
Gold	70	0.07	0.45	Jan-80
Copper	71	0.06	0.35	Nov-87
DOW Transportation Index	93	0.06	0.10	Sep-94
Soybeans	94	0.06	0.13	Jul-94
Live Beef	94	0.06	0.13	Jul-94
Peso Exchange Rate	93	0.05	0.44	Dec-94
S&P 500 Stock Index	60	0.05	0.46	Oct-87
Feeder Cattle	94	0.05	0.12	May-94
NY Stock Comp. Index	84	0.05	0.43	Oct-87
German Mark	91	0.05	0.11	Mar-91
British Pound	91	0.04	0.18	Sep-92
Japanese Yen	91	0.04	0.12	Aug-95

Note: Monthly Volatility = (Highest Daily Price - Lowest Daily Price) / Lowest Daily Price. For natural gas price, the daily price is the mean of the high and low prices as reported in *Gas Daily*. For all other markets, the daily price is the closing price.

Figure 5.

Weekly Wellhead Prices



Source: *Natural Gas Intelligence* and *Natural Gas Week*. Data through January 6, 1997.

Market participants asked to supply information on surveys often do it voluntarily. The most reliable prices are put through structured filters of verification and judgment, but are constantly the subject of speculation about their authenticity since the connection to an actual transaction is murky. Nevertheless, it appears that anonymity is sufficient for disclosure. These problems with reported prices can be used as evidence that the prices are wrong or the markets are not functioning efficiently.[17]

Some who oppose easy electronic access to information argue that the ease of access to price information could promote collusion among sellers. For example, the airline reservation system is criticized by some as a means of easy discovery of prices because it aids price fixing. While there may be some truth to this, it is virtually impossible to keep prices secret. If the customers do not know them, the prices do not act to attract customers in the first place. Elimination of announced prices in an automated auction system would most likely only serve to raise the transactions cost of doing business.

Some argue that price, cost, technology and contract information are intellectual property. Cost and technology may be valid arguments for confidential information in competitive markets; but for a monopolist without competition from other suppliers, some of this information is necessary for regulating against inefficient behavior. Protection of technological innovations is provided by disclosure and patent and copyright protection. The timing of release is impor-tant. Some information may be delayed until its value as “intellectual property” has depreciated.

It is much more difficult to protect contractual information in a competitive market since it must be disclosed in the course of negotiations. The process of buyers and sellers interacting will reveal contractual innovations. The only issues are when the information on release becomes available and how much it costs to obtain. In strong oligopoly markets this exchange of information is much weaker.

In a competitive market, trade “secrets” of contracting have short lives. In order to trade, sellers must reveal proposed contracts to buyers. Buyers then “shop” for similar terms from other sellers. Soon there are no “secrets.” In non-competitive markets this is not the case and leads to price discrimination and market segmentation. Therefore, requirements to reveal special contracts of regulated firms only serves to perform the functions of a competitive market.

Risk

Any long-term construction project is risky. But investments in displacement networks are likely to be exceptionally risky. As the commodities delivered by displacement networks become more and more subject to competitive markets and as secondary markets develop for transmission rights, the value of transmission can become exceptionally volatile. In effect, transmission rights become an option to buy or sell a commodity in one place instead of another.

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[17]Pricing anomalies may indicate potential problems in short-term markets. A pricing anomaly occurs when prices between various market locations for the same commodity do not correspond to the way prices should behave given existing transportation matterns between producing or supply areas and consumption or market areas for the commodity and given existing transportation prices. At certain times for some markets, gas appears to move from a higher priced market to a lower priced market. Or, in other cases, gas may have been flowing to a higher priced market, but the fuel charge (the minimum possible transportation charge) exceeded the difference in price between the higher and the lower priced market. In either case, there appears to be a pricing anomaly.

At any given time, that option is worth the difference in spot prices between the two places, not embedded costs. Figures 6 and 7 show the range of spot prices and implied transmission values for the natural gas grid for 1995 and 1996, while Figures 8 and 9 do the same for electricity.

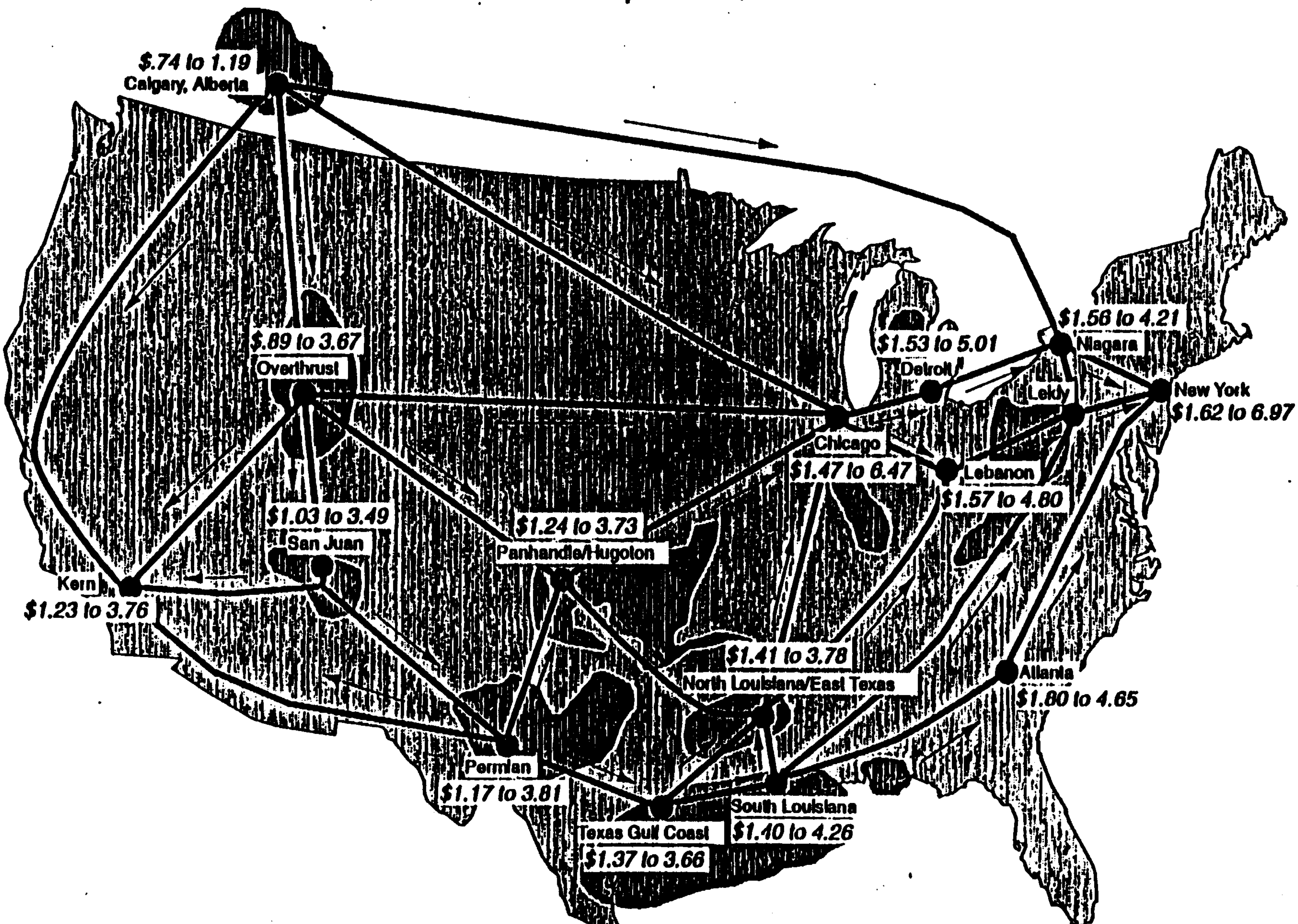
Over the long term, transmission rights become tools for managing the price risk of the underlying commodity, since they prevent network congestion from affecting the price one pays or receives for the product. But taken by themselves, the value of transmission rights can be highly volatile, especially for industries that have little or no on-site storage, and even more for industries that also have little or no real-time pricing. In certain peak conditions, they may be worth many times more than the typical underlying value of the commodity itself at unconstrained times. This appears to have happened for natural gas for a few weeks during the 1995-96 winter. But on an uncongested link in the grid, the secondary market price for transmission should sink to variable cost. In fact, this is (roughly) what is observed in natural gas markets at non-peak times (see Figure 10). Similarly, Figure 11 shows the pattern for electricity.

The Commission has encouraged the growth of a formal secondary market for gas pipeline capacity—the capacity release market. Prices in this market do not show nearly as pronounced a peaking pattern as those implied by the spot price differences (see Figure 12). Seasonality is clear, but the price paid for released capacity is significantly above zero at all times. In part this reflects the fact that many releases take place for fairly long periods, so that the price each day reflects a risk management premium applied over a long period. Another way of saying this is that when price caps prevent prices from rising high enough to reflect peak constraints, sellers are likely to begin to sell capacity for longer periods so that they can, in effect, stretch the peak payments over non-peak periods as well. To some extent also, prices in the release market may reflect broader social norms. It is rare indeed to see *pure* variable cost pricing during off-peak periods at hotels or restaurants, despite the variations implied by seasonal rates and early-bird specials.

In electric power, many have proposed congestion or opportunity cost pricing. This form of transmission pricing would precisely mirror the type of pricing suggested for natural gas in Figure 10.

Repeat the short run often enough and it becomes the long run. The long-run value of transmission rights is equal to one's expectation of the revenue stream that could be realized from selling it every day (or hour) for a period of years. This value is also highly uncertain, since congestion prices are very difficult to predict, especially over a long time. Thus, if a transmission link is slightly too large, its long-term value on the secondary market may be much less than its embedded costs. Or, if it is too small, it may be much higher. To the extent that neoclassical economics works and prices really do converge to variable cost, the value of a transmission link is effectively on a knife's edge, both in the short and long term. In this circumstance, cost recovery in the traditional sense is possible only by enforcing severe market distortions. Risk management becomes the essence of the problem both for market participants and regulators.

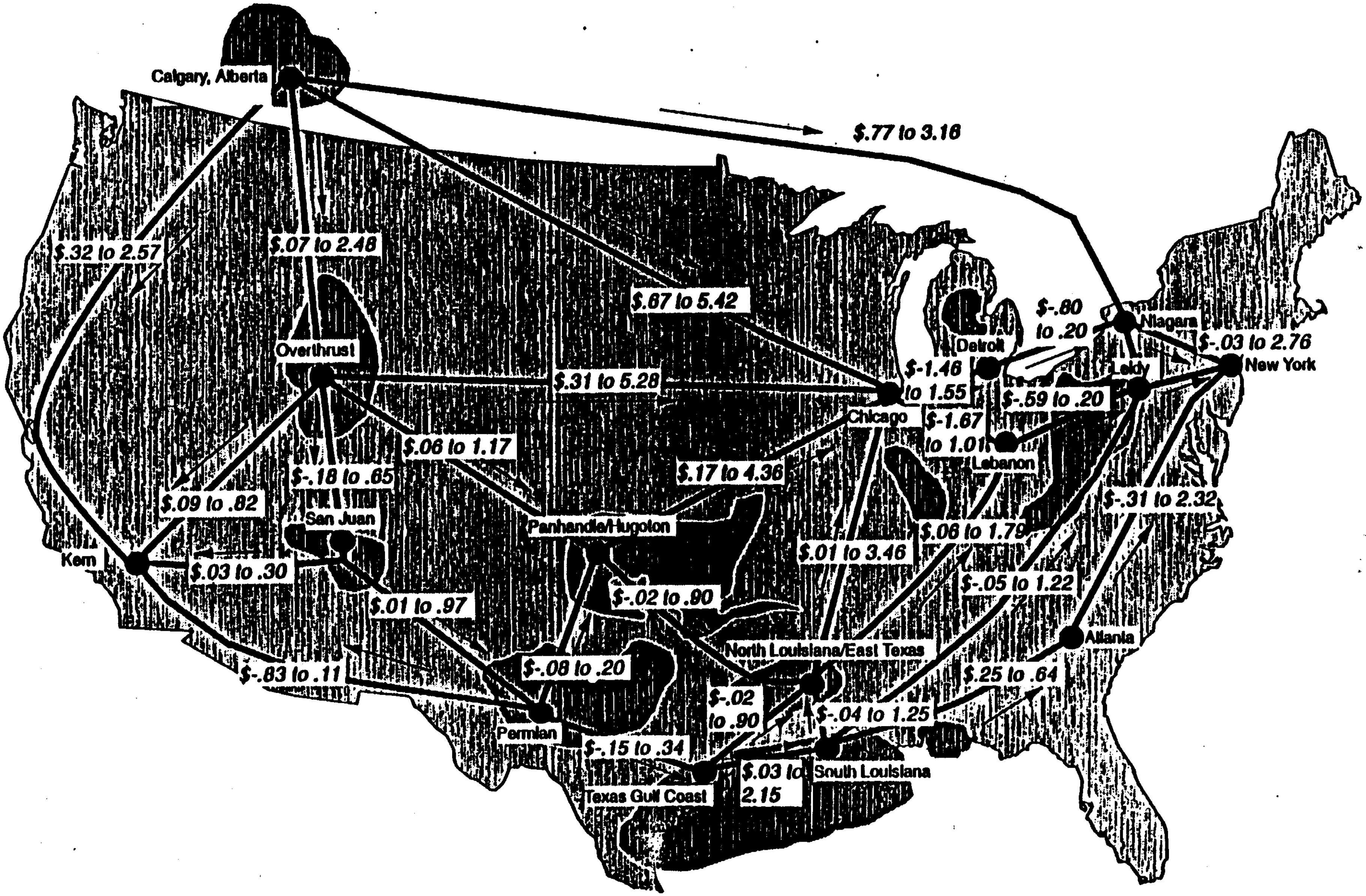
Figure 6.
Range of Average Monthly Natural Gas Spot Prices, 1995-96
Dollars per MMBtu



Source: *Nat... Gas Week*. Data through December 30, 1996.

Notes: M... average prices for selected delivery points. Prices for Alberta and Niagara ... Canadian spot transactions of 12 months or less. Prices used for D... from Colum... at Maumee, Ohio. Spot prices reflect transactions of 31 days or less. ... price is the median of the prices assigned to a market center area.

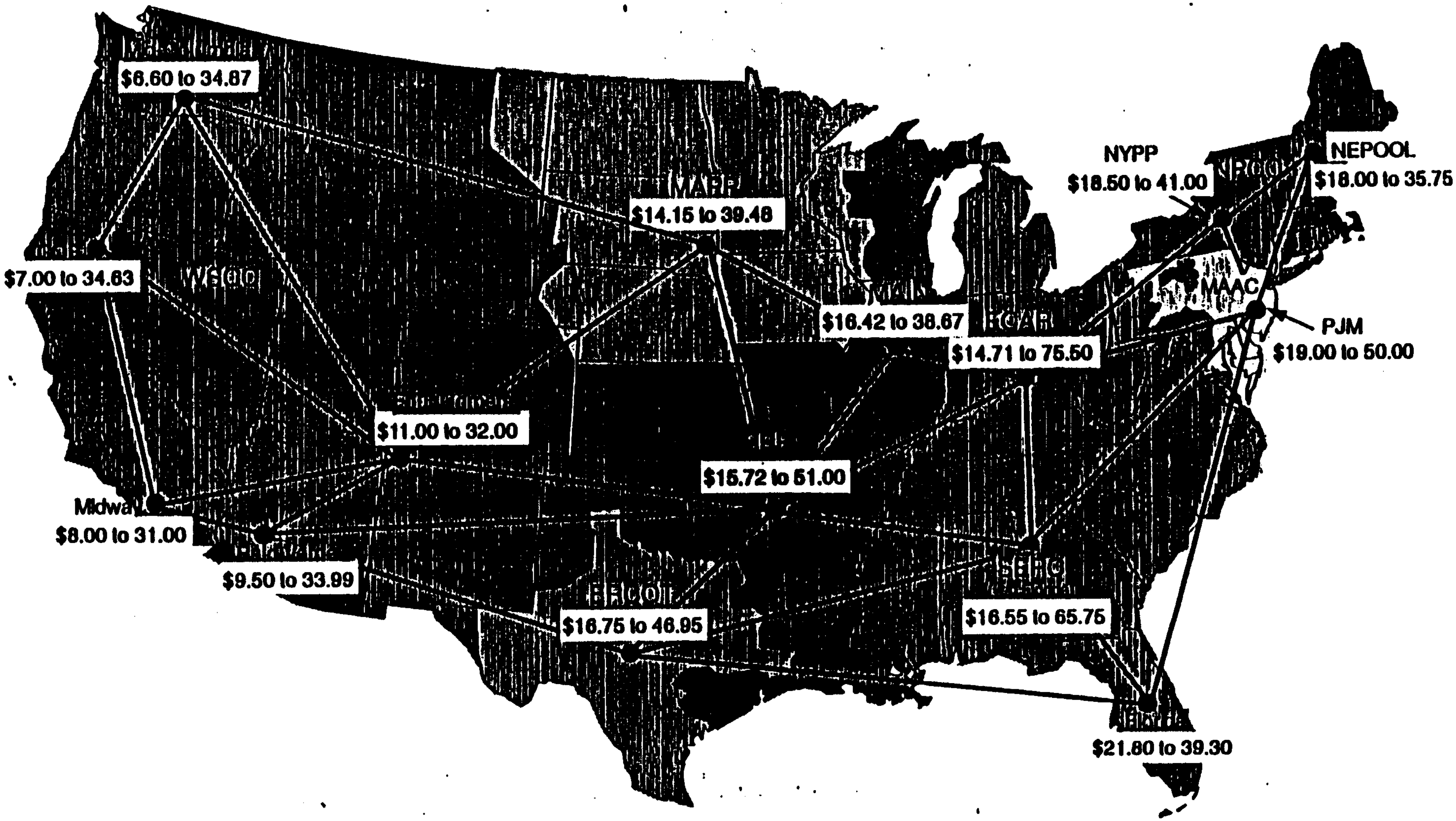
Figure 7.
Range of Average Monthly Natural Gas Price Differences, 1995-96
Dollars per MMBtu



Source: *Natural Gas Week*. Data through December 30, 1996.

Notes: Monthly average prices for selected delivery points. Prices for Alberta and Niagara are for Canadian spot transactions of 12 months or less. Prices used for Detroit are from Columbia Gas at Maumee, Ohio. Spot prices reflect transactions of 31 days or less. Monthly price is the median of the prices assigned to a market center area.

Figure 8.
Range of Weekly Electricity Spot Prices, 1995-96
Dollars per MWh



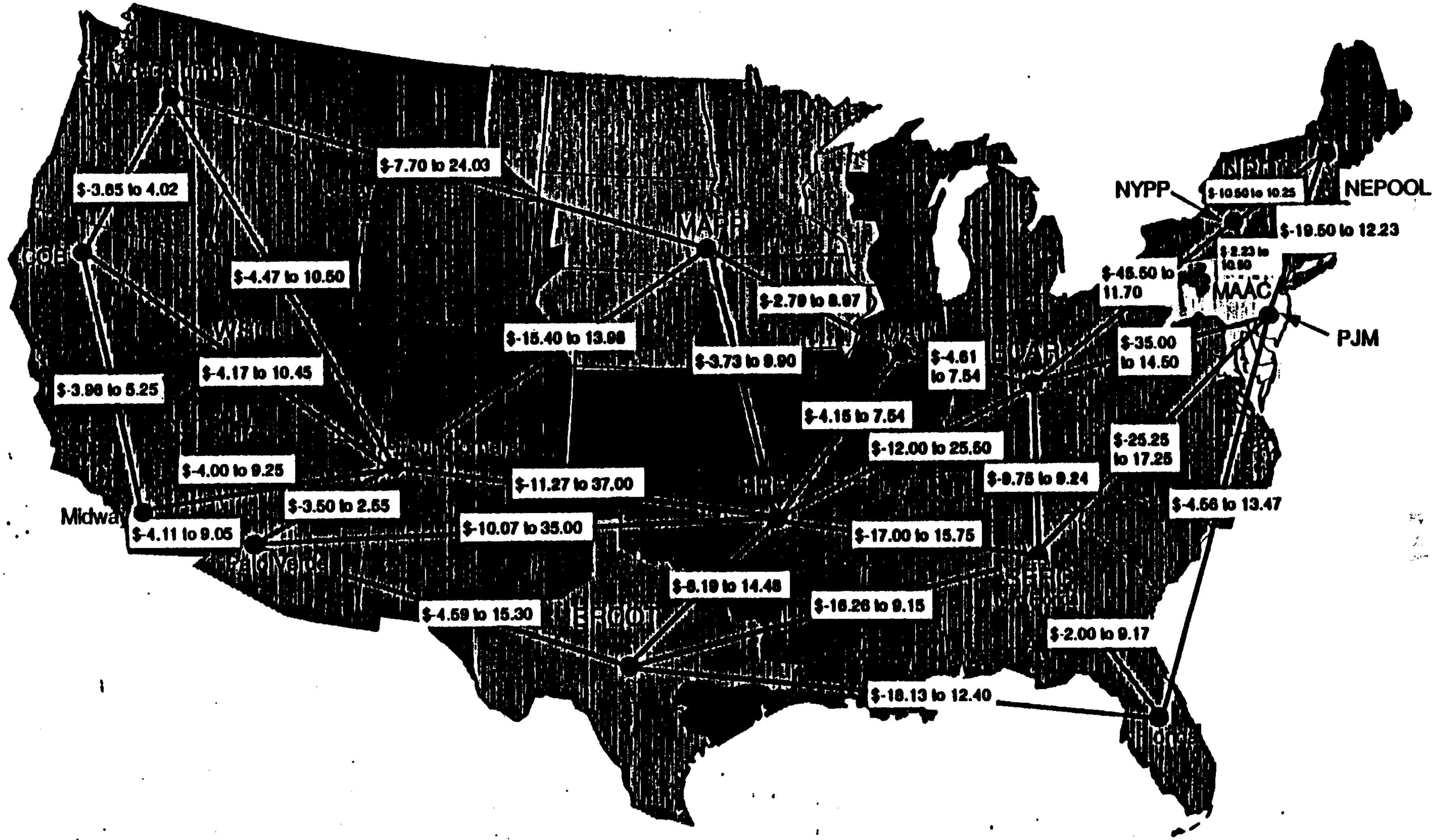
Source: *Power Markets Week.* Data through December 27, 1996.

Note: ...ices are index prices for on-peak electricity prepared by *Power Markets Wee...* ...ased on assessments of where the bulk of dealmaking occurred. The pric... ...IEPOOL, NYPP, PJM, ECAR, SERC, SPP, ERCOT, MAPP and MAIN ar... ...nsactions within those market areas. Mid-Columbia prices are for se... ...its within Washington State. All other prices are for specific points.

Figure 9.

Range of Weekly Electricity Spot Price Differences, 1995-96

Dollars per MWh



Source: *Power Markets Week.* Data through December 27, 1996.

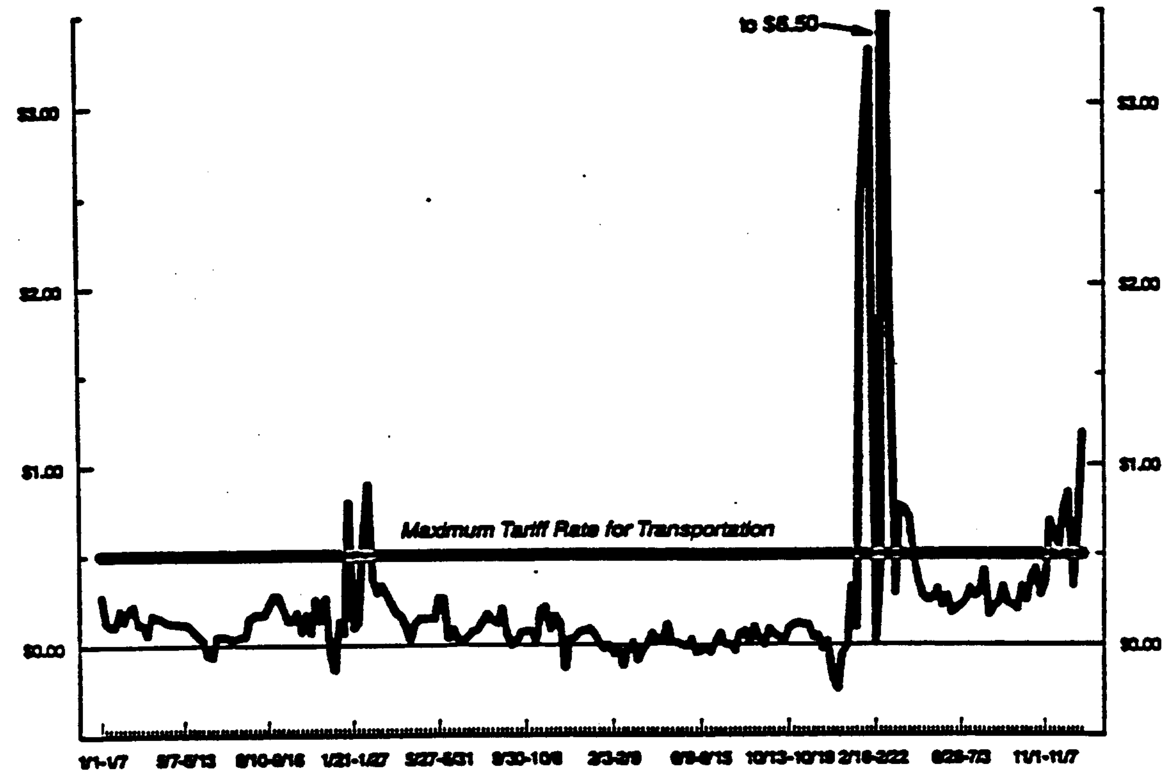
Note: Prices are index prices for on-peak electricity prepared by *Power Markets Week* based on assessments of where the bulk of dealmaking occurred. The prices for NEPOOL, NYPP, PJM, ECAR, SERC, SPP, ERCOT, MAPP and MAIN are for transactions within those market areas. Mid-Columbia prices are for several points within Washington State. All other prices are for specific points.

Figure 10.

Implicit Price of Transportation from South Louisiana to Chicago

Average Weekly Chicago Spot Price minus Average Weekly South Louisiana Spot Price

January 1993 to December 1996

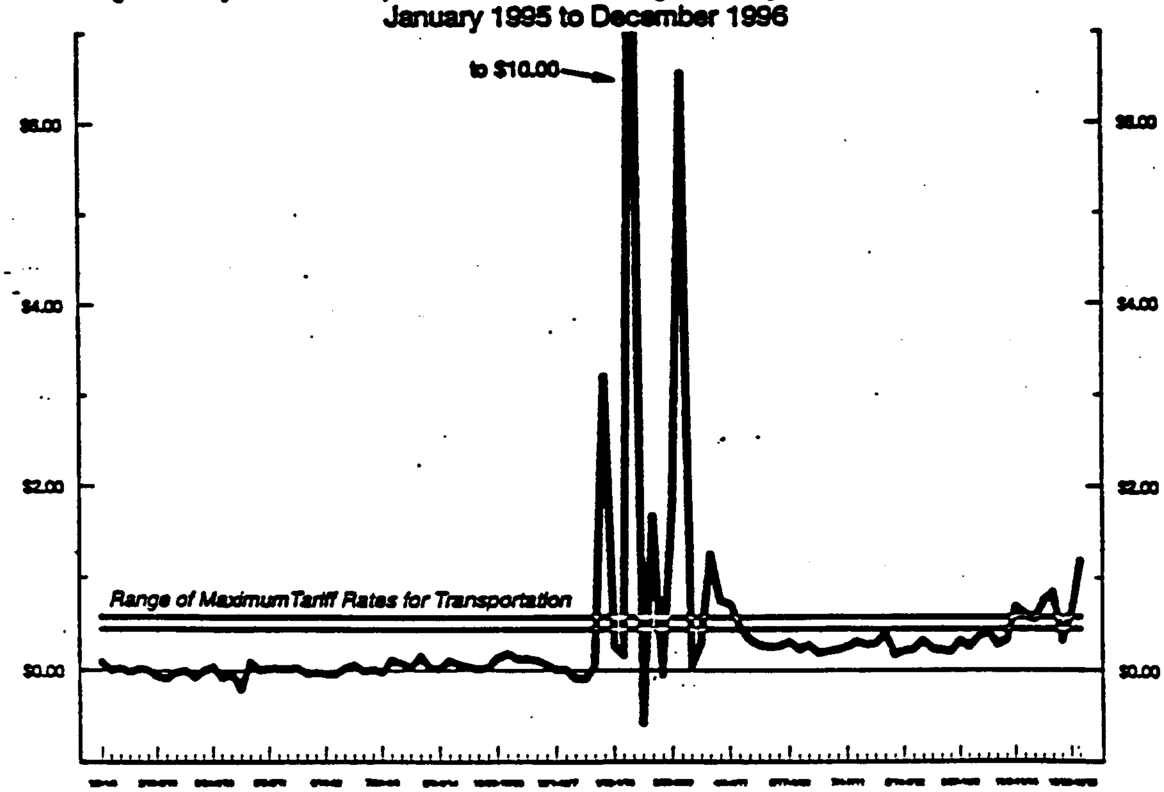


Sources: *Gas Daily*, Weekly Weighted Average Prices and PI Grid. Data through January 2, 1997.
Note: Tariff rate is the IT rate from Natural Gas Pipeline.

Implicit Price of Transportation from South Louisiana to New York

Average Weekly New York Spot Price minus Average Weekly South Louisiana Spot Price

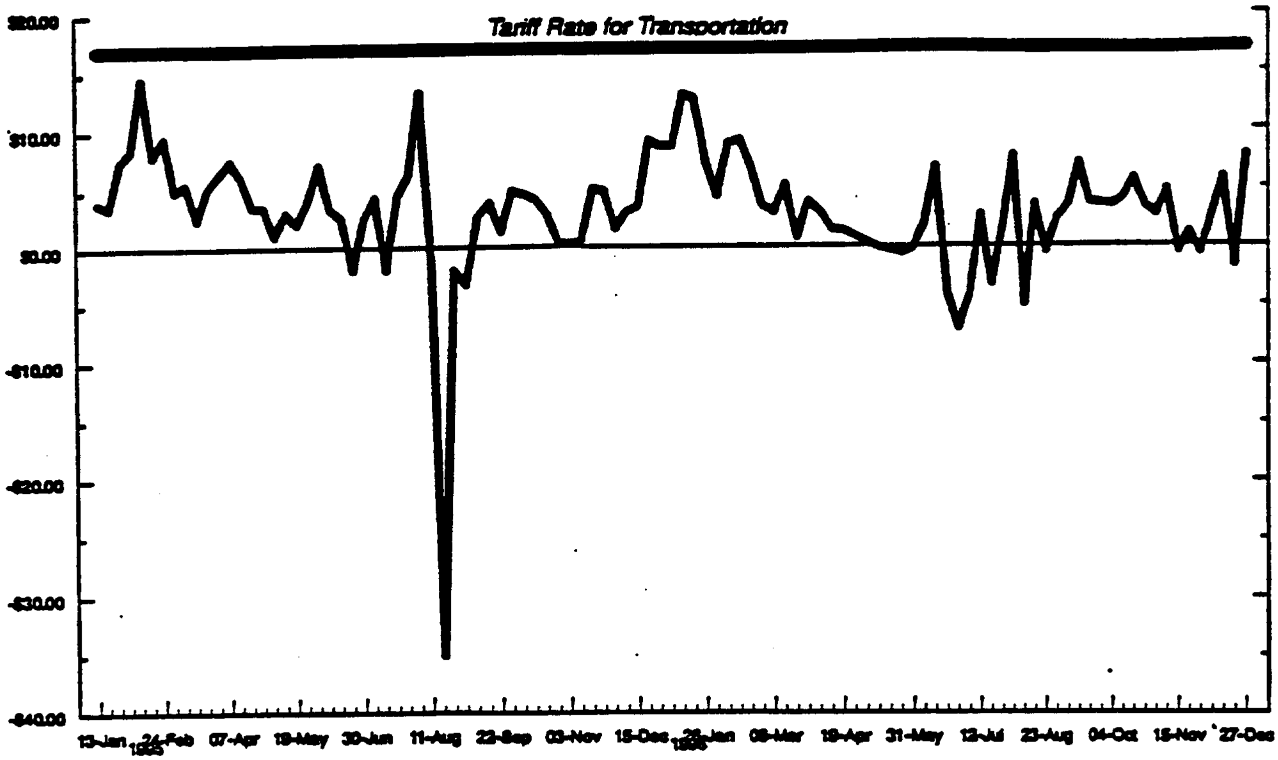
January 1995 to December 1996



Sources: *Gas Daily*, Weekly Weighted Average Prices and PI Grid. Data through January 2, 1997.
Note: Tariff rates are IT rates from Columbia, $0.45; Tennessee, $0.59; Texas Eastern, $0.57; and Transco, $0.44.

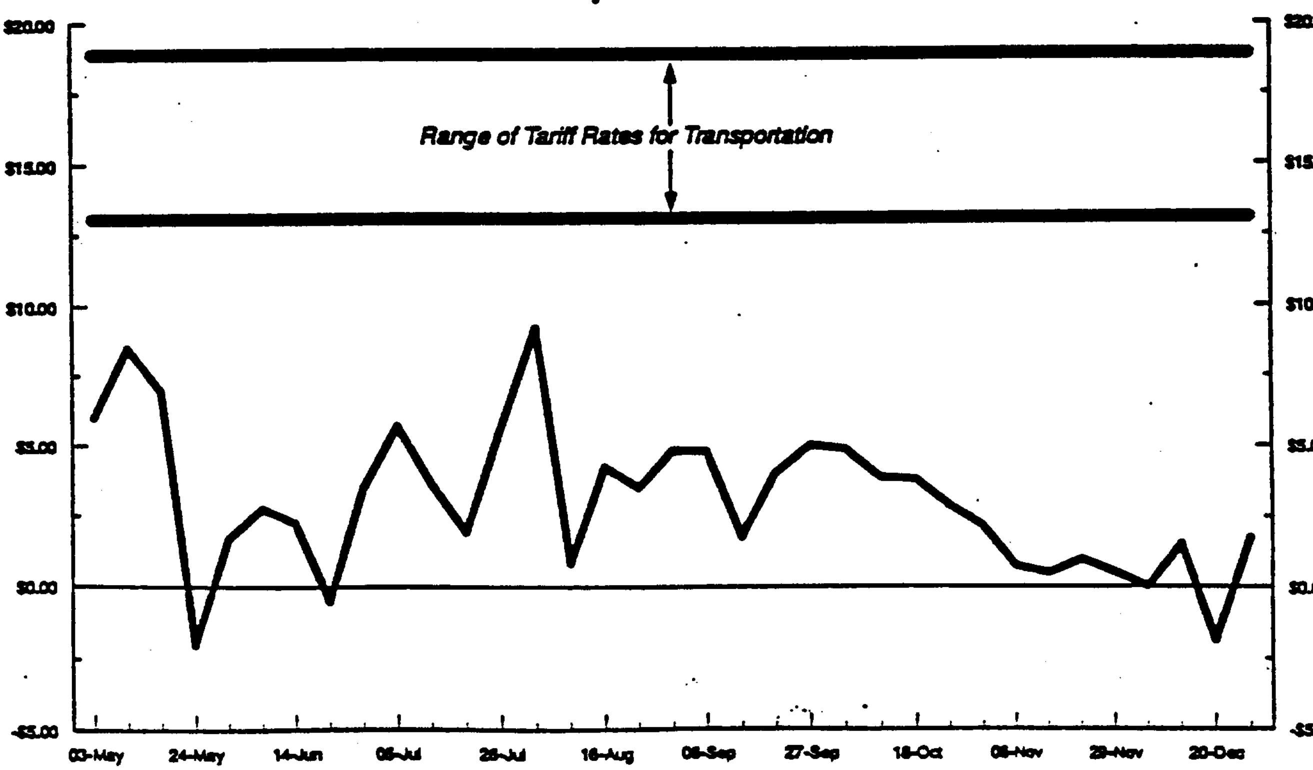
Figure 11.

Implicit Price of Transmission from ECAR to PJM
Average Weekly PJM Spot Price minus Average Weekly ECAR Spot Price
January 1995 to December 1996



Source: *Power Markets Week*. Data through December 27, 1996.
Note: Tariff rates were calculated using *RDI* Interconnect database and Order 888 tariffs.

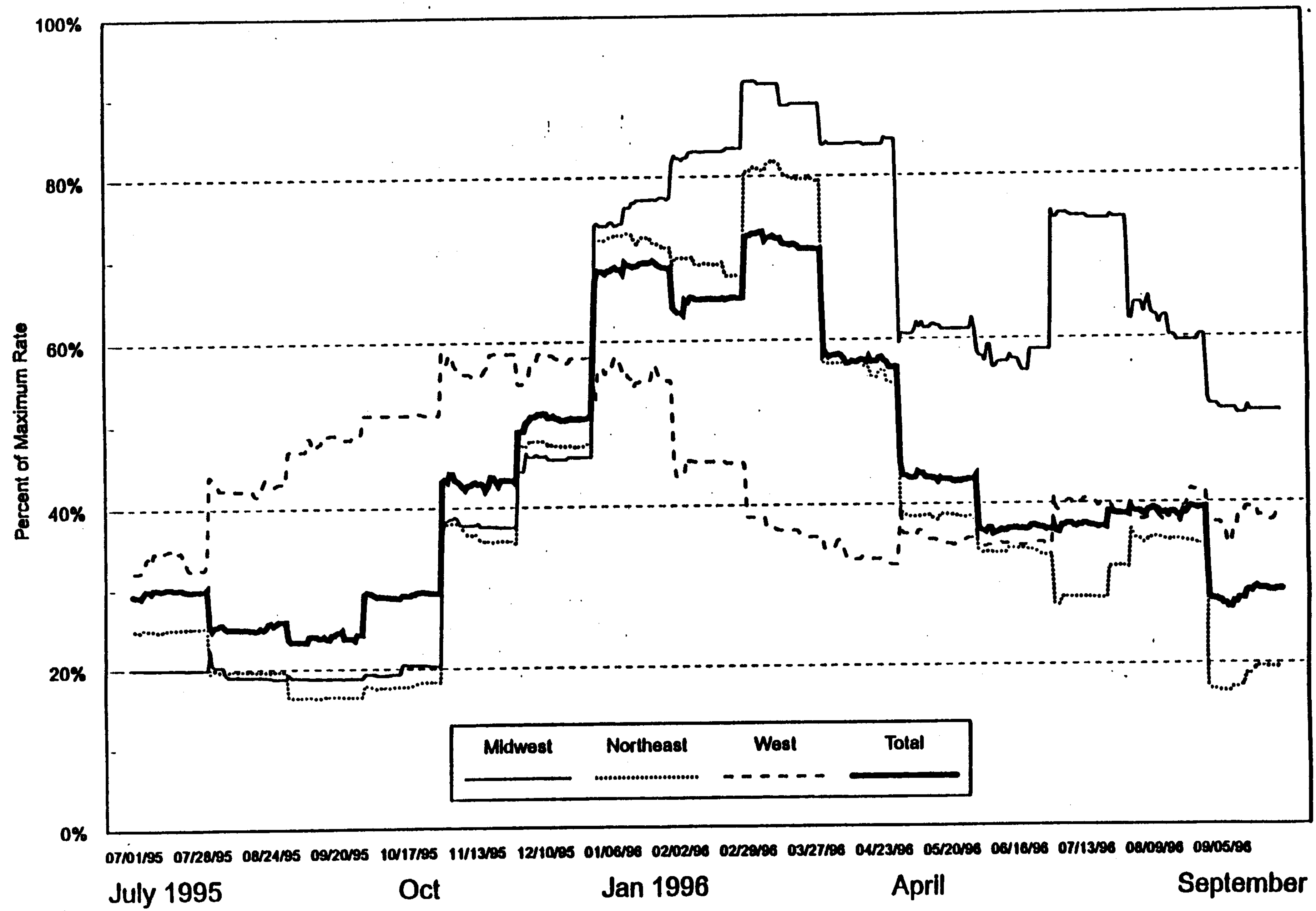
Implicit Price of Transmission from SERC to Florida
Average Weekly Florida Spot Price minus Average Weekly SERC Spot Price
January to December 1996



Source: *Power Markets Week*. Data through December 27, 1996.
Note: Tariff rates were calculated using *RDI* Interconnect database and Order 888 tariffs.

Figure 12.
Capacity Release, Average Daily Percent of Max Reservation Rate

Selected Regions, Based on Principal Pipeline Delivery Area
Percent of Maximum Rate for All Outstanding Short Term, Reservation Basis Deals



N[illegible] al includes additional not shown in regional breakdowns.

Unfortunately, given the history of at least the gas and electric industries, risk management has little place in the traditional way that both companies and regulators have operated. (Hence, in part, the possibility and magnitude of the stranded cost problems.) As noted earlier, both companies and regulators believed in their ability to forecast the future, despite the clear evidence that getting a forecast right was equivalent to winning the lottery. They also believed (less publicly, but more practically) that the regulated company's market power would always allow them to make good any forecasting problems later. If the market value of capacity was too low, the company could simply act as a monopolist to use Ramsey pricing (or some approximation) to make good the difference. Or if the value was too high, the regulator could impose binding price caps and find some way to ration the capacity (perhaps to those who had held the rights before). The problem is that secondary capacity markets severely undermine the ability to make these adjustments effectively—even if the markets are not fully competitive.

The difficulty of grafting a reasonable approach to risk onto a traditional regulatory regime is severe. Compared with the precision and elaboration of thinking about risk in other industries, the concept of putting a company "at risk" in natural gas or electric power is both vague (What does it mean? How much risk? Under what conditions? With what loopholes?) and unsophisticated (What risk is being managed? At what price? For what purpose?). The assumptions behind today's regulatory tools avoid important institutional, uncertainty, long-term and dynamic issues. Consequently, these important issues are often left to unstructured side discussions. Later, after costs are sunk, they are revisited under the vague constructs of the "compact," "prudence" and "used and useful."

Traditional regulation can delay the needed changes if it fails to understand incentives in moving from command-and-control approaches, fails to recognize the information revolution or fails to change dispute resolution techniques that resemble criminal procedures to something easier, less formal and less confrontational.

Another emerging problem for traditional regulatory approaches is the rate case. To the extent that rate cases continue, they will be problematic because they tend to focus attention away from the market. However, the future might see very infrequent traditional rate cases as we rely on other approaches to keep rates just and reasonable. Since the death of purchase gas adjustment clauses in 1993, pipelines are no longer be subject to an automatic 3-year rate review. Pipelines may file rate cases only during periods of inflation when costs increase. Infrequent rate cases would raise a different set of problems. But using inflation to trigger rate reviews is not in itself good policy. Nor is simply tracking costs. Both dull incentives for efficient operation.

C. Oligopoly Markets

North American energy markets range from those that are highly competitive to monopolies. Lack of opportunities for short-term trading, high transactions costs, poor information and intermittent network constraints can cause markets to become less competitive. The ownership pattern of the American electricity, oil and natural gas networks is unusual. First, these industries are, for the most part, privately owned and have been for many years. In most parts of the world, similar networks have been or still are state-owned (as are the American water and highway networks). Second, these industries are not owned by a single monopolist, but by a group of companies. Most other countries are considerably smaller than the United States, and privately owned networks tend to be monopolies (as most distributors are in the United States). Thus, the

United States faces a problem largely unknown in other countries: how to govern a transportation network owned by an oligopoly of private firms. Further, largely due to historical market development, commodity markets may be highly concentrated and vertically integrated.

The oligopoly nature of the natural gas and electric markets is complicated. In natural gas, long-haul pipelines do not have strict geographic franchises. As a result, most face competition in some markets, either from other pipelines following similar routes, from pipelines that connect to different supply sources or markets, or from local distribution companies. In some cases, a fairly large number of pipelines may compete in a given market, and the result may be essentially competitive. At the same time, most pipelines serve some markets in which they are the sole supplier or hold a dominant position. Any given pipeline is likely to range simultaneously from a monopolist in some markets to a nearly competitive firm in other markets. Two additional factors make the situation even more complex:

- There is a secondary market for pipeline capacity, where the sellers consist of all the rights-holders on the pipeline. This adds a layer of competition in short-term markets, but

- Shippers may also exercise market power. This is especially likely near the extremities of the system where transmission service can resemble a bilateral monopoly. In some markets with multiple pipelines, some shippers have more market power than the network operators. (See Table 4 for some examples on natural gas pipelines.)

In electric power, transmission companies do typically have geographic, often franchised, monopolies. In this case, the grid has the basic character of an oligopoly partly because power trading can occur at a distance that goes beyond one transmission company's area, and some lines are jointly owned. More fundamentally, Kirkoff's laws and loop flows mean that all transactions on the grid affect all transporters. The result is an odd situation: on one hand, large parts of the grid operate as a single machine, but ownership of the machine rests in the hands of many companies. The industry's traditional response has been to govern the grid partly as a club (for instance, through reliability councils, pools and split-the-savings rates) and partly as a pseudo-competitive set of services (for instance, contract path pricing). In the future, this implies that transmission constraints will be increasingly important for regulators. To the extent that transmission constraints create islands within the electric grid, they localize markets in ways that are likely to reinforce local concentrations in ownership of generation.

Economic theory is much better at handling competitive and monopoly industries than it is at handling oligopolies. However, even the theories of oligopoly that exist may offer mislead-ing guidance for these industries, with their odd juxtapositions of competition and market power. On the other hand, the mix of competitive and non-competitive parts of the network can be useful. In some cases, it is possible to tie allowable price changes in captive markets to those a company experiences in competitive markets, as the Commission has done for some oil pipelines.

Table 4. Concentration of Capacity Holding in Interstate Pipeline State Markets

Pipeline	State Market	HHI	Notes
Algonquin Gas Transmission	Rhode Island Massachusetts Connecticut	0.90 0.31 0.14	Providence Gas controls 95% of CD in Rhode Island. Much of the deliveries in Rhode Island are off a lateral from mainline through Massachusetts so Massachusetts is not included in Rhode Island State market.
Florida Gas Transmission	Southeast Florida Florida Panhandle Central Florida	0.56 0.34 0.15	These concentration statistics are based on a previous OEP study using detailed data on deliveries from a rate case.[2]
Northwest	Colorado Oregon Idaho Washington	0.86 0.62 0.39 0.26	The flow on Northwest is a multidirectional which complicates the definition of the market for released capacity. The results for Northwest are based on a best guess at the prevailing direction of flow.
Southern Natural	South Carolina Georgia Alabama	0.66 0.37 0.23	South Carolina Electric & Gas Co and South Carolina Pipeline Corporation together control 100% of the CD in South Carolina on Sonat.
Tennessee	New Hampshire Rhode Island New Jersey	1.00 1.00 0.46	Energy North and Valley Gas Co. control 100% of the capacity in New Hampshire and Rhode Island, respectively. Public Service Electric & Gas controls 64% of the CD in New Jersey.
Texas Eastern	New York New Jersey	0.51 0.31	Con Edison and Lilco together control 96% of the CD in New York on Tetco.
Transcontinental	New York New Jersey Pennsylvania	0.36 0.20 0.12	Brooklyn Union, Con Edison, and Lilco together control 100% of the CD in New York on Transco.

D. Transactions Costs

In the broadest terms, transactions costs are the costs of exchange. They are analogous to friction in a physical system. Spulber argues that a conservative estimate of such costs would amount to at least a quarter of GDP in the United States (see Spulber, 1996). When specifically included in the analysis, conclusions can change radically. Transactions costs include the costs of gathering information, locating and analyzing an opportunity, negotiating the agreement, and safeguarding the contract. In an industry with relatively high transactions costs, these factors usually lead to different market and/or governance structures to lower these costs (see Williamson, 1979.)

The factors most relevant for energy displacement networks are: (1) sunk costs of investments made to enter a market that are largely unrecoverable if the firm attempts to leave the market; (2) the limited ability of entities to make efficient decisions caused by incomplete or costly information (bounded rationality); (3) the complexity of the decision; and (4) the uncertainty of the ability of some to benefit without paying an appropriate share (opportunism).

Sunk costs are relatively high in the displacement networks because assets are immobile and have little alternative use. High sunk costs lead to high transactions costs because they give entities in the market incentives to behave opportunistically after costs are sunk and raise the cost of negotiating and enforcing agreements.

At peak periods, efficient decisions are extremely complex and transactions occur at a faster pace. This is partly a function of the complexity of the networks, in which many individual decisions interact with each other (especially in electric power). It is also a result of the fact that conditions change rapidly and unpredictably enough to require frequent new decisions. In particular, an efficient market in either natural gas or electricity would require a good market mechanism for avoiding penalties and imbalances. But the nature of such a market would require that the market clear rapidly (up to several times an hour for electricity and several times a day in natural gas), that market prices reflect constraints on the underlying transmission grid and that the overall set of decisions maximizes the value of the system for all parties taken together. It is virtually impossible to imagine how a decentralized system of buyers and sellers trying to seek each other out could possibly make such a market work. The transactions costs might approach the national debt. Without on-site storage, some centralized short-term market mechanism is essential.

Transactions costs include the cost of regulation or governance. These costs cannot be avoided, even if one eliminates the existing regulatory system. Whether it is the common law of contracts, anti-trust law or elaborate regulatory mechanisms, all markets have governance structures. Too often the costs of governance are discounted or ignored completely. These costs include the administrative costs of the governance structure and inefficient incentives of the governance mechanisms. These costs must be weighed against the level of inefficiency that will result from allowing inefficient incentives (for example, the withholding of capacity to induce an artificial shortage and drive up the price) to guide market participants in the absence of any type of governance. This consideration is definitely not unique to electricity. However, the apparently high level of sunk costs, potential for opportunism and externalities caused by the mutual dependence of market participants on the interconnected network lead many to believe that governance structures are important.

Institutional Design

Highly structured markets exist side-by-side with highly unstructured markets. Highly structured markets include the stock and commodity exchanges. They are overseen by commissions. Yet, no one is prohibited from trading on these exchanges. Electric power pools are another example of structured trading. The government auctions such things as debt instruments and the electromagnetic spectrum under very structured rules. Trading institutions need rules, governance structures and public oversight. When concentrated markets are emerging from decades of regulation, trading institutions and oversight become very important.

Trading Institutions and Market Mechanisms. Elementary neoclassical economics presents market exchanges as if transactions were short, costless and anonymous with many buyers and sellers. This is too simple.[18] Vickery and Demsetz are usually the neoclassical starting point for auctions in regulated industries. Williamson has shown that institutional details can make or break the auction process. In many actual markets, transactions costs are high, while players are not anonymous, often both buyers and sellers are too few for the theory to work properly. Information is often fuzzy; business is repetitive; and reputation counts. How buyers

[18]In mating and matching rituals (institutions), unlike in perfect markets, there can be first mover advantages to some institutional arrangements. For example, in a matching process, where the male proposes and the female accepts or rejects, the males achieve a higher level of their preferences (see Roth and Sotomayor).

and sellers are matched is not simple. How much does one spend to search and arrange for the best deal (gas or mate) and what are the rules of the game? Limited competition exists now in interstate gas transmission markets (in some interruptible markets). Making good trading rules and establishing trusted market makers are key for the industry's future.

Both private and public institutions operate and oversee markets (see Table 5). The New York Stock Exchange (NYSE) is a private institution that makes rules for membership and trading. The Securities Exchange Commission (SEC), in turn, oversees the NYSE. The Commodities Futures Trading Commission oversees future exchanges. These institutions have rules and audit standards for information disclosure.

Governance Institutions. Governance—rules, regulations and mores—is unavoidable in civilized human society, and for good reason. Even within strict economic theory, there are simple examples, such as games with empty cores (see Luce and Raiffa, Von Neumann and Morgenstern or O'Neill, 1990) that demonstrate the inability of individual profit motivation to achieve an efficient solution in all cases. Von Neumann and Morgenstern argued that "standards of behavior," that is, rules, are necessary to deal with these problems. Common sense suggests (and history abundantly confirms) that institutions are human creations that can be more or less fair, more or less efficient.

Just as in construction, where design tools like computer aided design programs and other simulation devices differ from the tools of actual construction (for example, saws and hammers), the design tools in regulation (for example, game theory, institution building, creation of property rights and trading rules) differ from rate-setting tools (auditing, cost allocation, billing/rate design). Some tools are shared, but too often regulatory bodies rely heavily and incorrectly on the rate-setting tools to design the institutions.

New tools and approaches will be needed to design institutions and settle disputes. To design institutions one must conceptualize and deal better with coalition formation, games with empty cores, moral hazards, free rider problems, externalities, private goods and property rights, natural monopoly, public goods and transactions costs. Methods for dealing with these issues are not well established in the regulator's tool kit.

Regulatory tools are also being redesigned, and some new approaches to dispute resolution are in vogue. Players are allowed to bargain, but all too often the bargains are subject to a later, *ex post*, regulatory review that strips much of the meaning away from the bargain. *Ex*

Table 5. Commodity Auctions and the Governance Structure

Auction	Private Institution	Government Institution	Law
Stock	New York Stock Exchange	Securities and Exchange Commission	Securities and Exchange Act
Futures	New York Mercantile Exchange	Commodities Futures Trading Commission	Commodity Futures Trading Commission Act
SO_2 Allowances	Chicago Board of Trade	Environmental Protection Agency	Clean Air Act
Spectrum	None	Federal Communications Commission	Federal Communications Commission Authorization Act
Transmission Capacity	Pipelines/Utilities	Federal Energy Regulatory Commission	Federal Power Act Natural Gas Act

ante prudence makes more sense than "gotcha" or *ex post* prudence. Profitability is tied to the firm's efficiency which includes quality service for its customers.

Demand side market-oriented institutions can be employed efficiently to bridge market failures in information and discount rate gaps. When designing new approaches, it is important to recognize the differences among private goods, natural monopoly goods and public goods. These determinations help indicate the most efficient institutional approach to the markets.

Competitive market forces will substitute for many activities that were traditionally heavily regulated. However, this can only be effective if regulation is replaced by institutions that foster effective competition. To allow the market to continue to develop, regulation must ensure that the market is fair and open to all who can benefit from it. Such openness in markets runs counter to the understanding and interests of many parties accustomed to a regulated monopoly model of the industry.

In the primary market, most of the existing tools and institutions for setting prices presume or need natural or legal monopolies to be workable. In an attempt to quantify as much as possible and leave as little as possible (apparently) to politics, analytic techniques like rate base valuation, rate-of-return analysis, functionalization, cost allocation, rate design, prudence (*ex post*), and simulated competition (for example, yardstick or benchmark approaches) have been introduced into the process. Although these efforts at quantification are often assigned certain analytic powers, they are more arbitrary than most think. They are often used to finesse the fairness issue using the fog of technical jargon.

Whatever tools are used, maximum transport prices in most primary markets will continue to be established periodically at the Commission. Over time, however, transmission prices may be less regulated when competition is sufficient.

IV. Displacement Network Oligopoly Governance: Information, Incentives, Institutions, and Choice

A. Introduction

This section describes new governance structures for displacement network oligopolies. It combines the physical realities of displacement networks with concepts from game theory, transactions costs economics and organization theory. In recent years, as warfare has changed, the military has recognized the central importance of what they call Strategic C^3, or C^3I: Command, Control, Communications and Intelligence. Without emphasis on these areas, the American military would be vastly less capable than it is. As the commodities transported on displacement networks are increasingly sold in competitive markets, regulators must learn the value of what might be called I^3C: Information, Incentives, Institutions and Choice. Unless regulation is organized around these needs, it will lead to increasingly inefficient results, to the extent that it does not become simply irrelevant.

Structures must also take into account the differences between short-term markets and long-term markets. The lack of on-site storage makes short-term markets critical to efficiency and fairness. Consider a key short-term problem that network displacement industries face: allocating peak capacity on the grid efficiently in the face of rapidly changing constraints. Solving this problem requires I^3C. I^3C is also essential to address the most important long-term issues that regulation faces: how to deal with sunk costs and how to encourage long-run efficiency.

B. Information

The information revolution has critical effects on displacement network industries. On one hand, better information is the life blood of developing markets. It allows previously monopolistic or strongly oligopolistic industries to become more competitive by lowering the cost of entry and lowering transactions costs. The markets themselves then generate far more information about real economic value than ever existed before. On the other hand, improved information also allows better and less intrusive regulation of non-competitive services by monitoring regulated services and dealing with more problems on an exception basis.

Information to Support Markets

At the most basic level, better information allows the unbundling of network and non-network activities. Without better information and access to it, unbundled service becomes more expensive and less competitive. With good information, the network can become an independent platform to allow and enhance competition among non-network activities.

To work well, markets need substantial amounts of timely information. In heavily regulated industries, the most basic information about what buyers and sellers would be willing to pay or take is often obscure. As has been found by experience, cost-of-service rates bear little resemblance to market rates with or without market power. In the opening phases of competition, lack of good price information is a typical (and serious) problem. Over time, market forces themselves tend to alleviate the most severe price information problems. Marketers exploit arbitrage possibilities that become increasingly smaller as competing marketers offer customers better deals. Regulatory mechanisms (such as a secondary market in capacity) become clearer as players use them more.

A lack of authoritative information on price can introduce considerable uncertainty into the market. Figure 13 shows the range of daily prices quoted for (relatively well-developed) up and downstream natural gas markets during the winter of 1995-96. Reported spreads of this sort within a day may have many causes. But they have one certain result, to increase search costs for everybody, since it is hard to tell what is a good deal and may decrease the number of traders, since information costs may deter entrants. It complicates hedging. And it leads to apparently inexplicable behavior, where the commodity flows from a place with a higher quoted spot price to a lower one.[19] Lack of good inexpensive price information makes oligopolistic markets transactions more costly, less reliable, and less competitive than they should be. This can lead to fewer traders, higher concentrations and less competition. Unreliable spot prices also compromise the use of risk management techniques, which depend on knowing what spot market prices are and having confidence that they are not being manipulated.

Market Timing. Customers need information on prices of both commodity and transmission over very short time intervals if they are to decide efficiently whether and how much to buy and sell. Even with centralized auctions, customers need to give bids (information) to the network operator rapidly and have the network operator respond rapidly. (The term "rapidly" has somewhat different meanings in the different industries, minutes to an hour in electric power or an hour to several hours in natural gas.) Independent system or network operators need technical system information as well as offers to buy and sell, to ensure the operational feasibility of the set of transactions. The communication system, along with its computational capacity, limits how quickly and efficiently an ISO can respond to changing conditions, including emergencies. Pricing some services may amount to finding a way to incorporate price information into the responses the operator makes to changing conditions.

Finally, the timing of markets can be a problem. In networks that do not have on-site storage, timing is unusually important. Markets for hourly and daily trading can be extremely different from markets for monthly or weekly trading. Well-developed and accepted market institutions are needed to trade quickly at different time intervals. Otherwise, what price information is available can easily conflate the prices of different lengths of service, increase uncertainty at all time intervals and miss opportunities for efficiency enhancing trades.

To the extent that spot markets provide problematic prices, the pricing of short-term transmission service on the secondary market is even more compromised. Transmission of a

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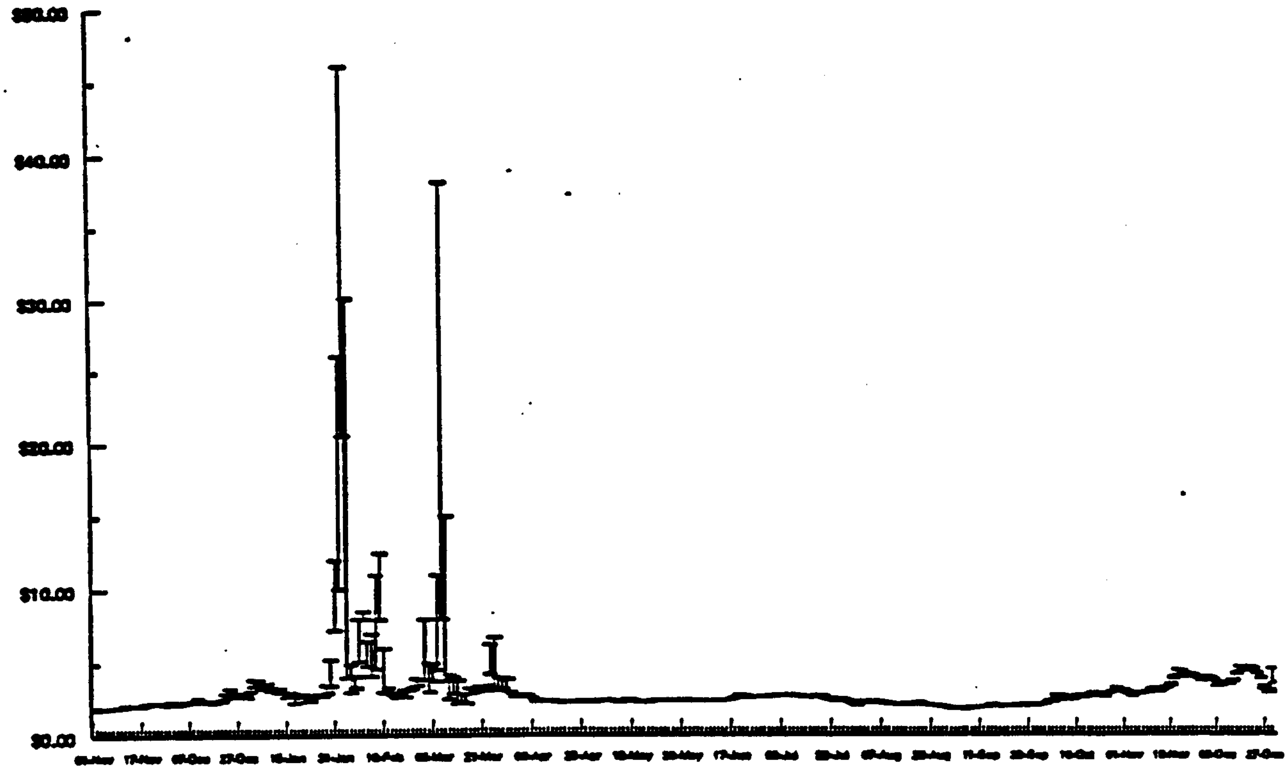
[19]Atlanta/New York and Northeast anomalies.

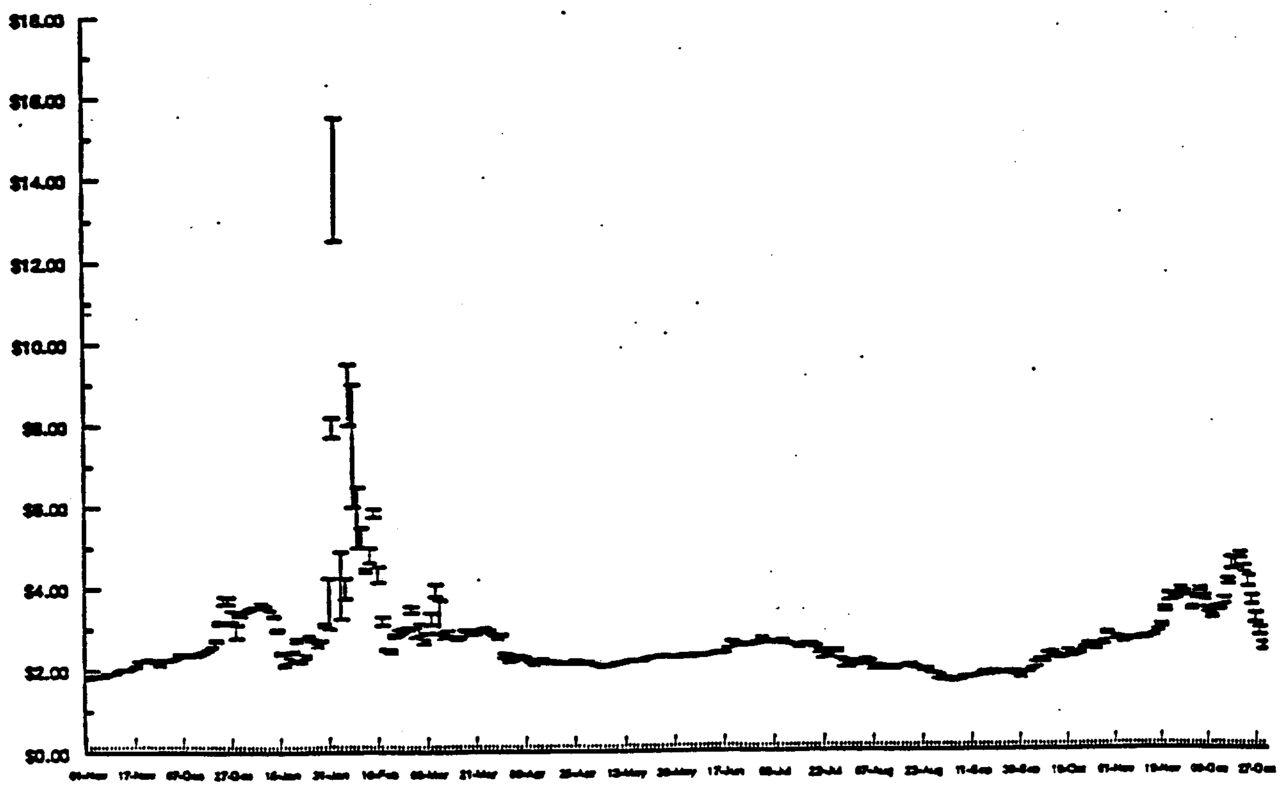
Figure 13.

Daily High and Low Prices at the Chicago Citygate



Source: *Gas Daily*, Daily Price Survey. Data through March 29, 1996.

Daily High and Low Prices at the Henry Hub



Source: *Gas Daily*, Daily Price Survey. Data through December 31, 1996.

commodity is worth the difference in spot prices between two places less the losses involved in transmission itself and transactions costs. When the spot prices at each end of the potential movement are unclear, the value of the transmission is even more uncertain.

Electric industry players all think that they know what the spot price is. But the price of electricity at any specific time or place is not well known in the spot market. In fact, some of today's power pools operate in a way that hides the actual price. Better information is needed to focus incentives, manage risks, and allow choice.

Electronic Trading. Equally important is the effort to streamline the process for delivering information. Since the mid-1980s, the Commission has been working to increase its computing and electronic information capability. Much of the Commission rules and data are now available through dial-up capabilities. At the same time, it has ordered the industry to make information available in the same way.

The Commission has encouraged firms to start electronic trading markets at market centers along with futures markets (currently in three locations for gas and two for electricity). It is supporting efforts to move to Internet-type access for information and trading. With more spot market activity, pipeline capacity releases and market centers, phone and fax communication could not handle all trades efficiently. Transactions lead times of a day or more were too long and negotiation was too costly.

Role of Regulation. As information on commodity prices and transmission constraints becomes critical for the overall functioning of the industry, improving the accuracy and timeliness of information is a key governance issue. The best role for regulation may simply be to require good information systems and let industry groups decide how to achieve the specifics— provided that no one segment of the industry dominates the technical groups.

Information to Support Governance

Information is critical to the continuing regulation of transmission services. It is key to tracking the success or failure of incentive schemes, to benchmarking either for cost or service quality, and to monitoring market-based prices for possible market power abuses.

At the foundation of good incentive regulation is benchmarking. Benchmarking is the process for measuring and rewarding a company by comparing costs and service quality to those of other companies supplying the same services. This information can also be used to construct an index for industry-specific inflation and productivity or simply to adjust returns to equity under an OCOS model. This avoids the incentive problems of traditional OCOS regulation and the impossibility of finding a good economy-wide index for adjusting a price cap. It also puts companies into a form of competition with each other, even where they do not directly serve the same customers. To benchmark rates in this way, however, requires extensive detail from the industry (though probably less overall than is required today). A further positive externality is that information on best practice is easy to construct and diffuse into the markets.

In some cases, the data required for continued regulation resemble those required traditionally. For instance, if a company’s rates are benchmarked to industry-average costs, cost information is needed from companies in the industry similar to that already required. However, it will need to be made more directly comparable across companies and probably does not need to be as detailed. With the capability to move, store and process vast amounts of data, data quality not quantity becomes very important. Therefore, the auditing function and other error detection becomes even more critical. These functions can benefit from additional automation and structured sampling.

In other cases, a new form of regulation will require quite different information from that previously collected. Service quality data, including reliability information, for instance, will continue to be important. Traditional wholesale regulation has talked about but largely ignored service quality or given it second class treatment. The very idea of assessing customer satisfaction is ridiculed in many regulatory circles. This is not surprising. After all, in a traditional rate case, customers would have every reason to badmouth their suppliers to get a better deal. But this view is almost certainly too pessimistic. Indeed there is good reason to believe that optimizing customer service is a major source of improved efficiency throughout the economy. This can mean offering the best service or offering the combinations of service that customers most want at prices they find attractive.

Quality measures can be both qualitative and quantitative. Response times to service requests and outages are examples of quantifiable quality. Well structured surveys benchmarked over many companies can quantify hard-to-measure quality of service. Failure to account for quality creates opportunities for firms with market power to increase profits by lowering quality.

In still other cases, the essence of the information problem lies in crafting credible complaint procedures that lead to timely resolution of conflicts. In judging allegations of unfair business practices and other forms of market power, complaint mechanisms (along with an independent governance for the transporting company) are likely to be crucial.

Perhaps the most important aspect of information for future regulation is a basic difference in purpose from that used in the past. Future regulation must no longer try to base its decisions on forecasts of future conditions, whether in the form of units of service for individual companies or larger trends in the energy industry or the overall economy. Monitoring, customer service measures, benchmarking and complaint processes all focus on what is currently happening, not what might happen in the future.

Disclosure. Many observers of these industries argue that most information should be confidential. In highly competitive markets much of this information is revealed to traders through negotiations and is difficult to keep secret. It would be wrong to use a regulatory hammer to try to keep secret information that would be revealed in competitive markets. Further, in regulated oligopoly and monopoly markets, much of the information is needed to regulate efficiently.

Some of the arguments against disclosure are at least partially respectable—for instance, that widely available information may make it easier to enforce abusive and legal cartel agreements or that any company ought to be able to have some proprietary information. In practice, network oligopolies tend to have many institutions that would help maintain inefficient and unfair collusion. In these cases, information availability will prevent certain types of behavior. It will also allow those who are subjected to market power to obtain the evidence they need to back up any complaint they might make. The arguments for secrecy in markets with a long history of strong oligopoly markets are weak.

Concentrated network oligopoly markets need high degrees of cooperation to maintain reliability and to establish efficient platforms for competitive commodity trading. When there is a choice between secrecy and disclosure in concentrated oligopoly markets, it is normally better to err on the side of disclosure. It is safer legally, information creates a self-monitoring system, and it is easier to remedy a mistake. It is far easier to eliminate a reporting requirement than to create one. This inertia inhibits moving to better forms of governance. When confidentiality is important (for example for proprietary reasons), the regulatory decision is more than a matter of simply saying yes or no. A company's need for confidentiality may be reconciled with a regulatory need for disclosure in several ways. For instance, the release of certain information may be delayed or restricted to only some parties. Furthermore, data may be aggregated to mask proprietary information.

A final reason given for avoiding disclosure of information is that the reporting is a burden. However, if designed properly, much or most disclosure would be a simple electronic transfer from the company's information system to the Commission's. However, the effort to make disclosure cost-effective is crucial. To begin with, it should be possible to eliminate many information requirements that serve no regulatory purpose. As one example: purchased gas adjustments for interstate pipelines once required immensely detailed reports running to hundreds of pages for each company twice a year. (They also included projections of future activity.) This sort of data requirement disappeared entirely with the growth of true open access.

C. Incentives

All markets have rules. They may be formal or informal. Rules create incentives and change behavior. Incentives must be considered in greater detail and focused to evoke desired behavior.

Rules in regulated markets generally are more formal. In the past, regulators gave too little consideration to the importance of the incentives that given measures fostered, with the result that much regulation positively encouraged inefficient behavior. Traditionally also, command and punish approaches were strongly emphasized. These were often ineffective, if only because regulatory commissions often shrank from actually imposing the contemplated penalties (for instance, through prudence reviews). Incentives also take on a different significance when competition is the policy objective. For traders, incentives to trade within the rules are necessary. And the network operator should have incentives to promote competition in commodity trading without favoring individual traders. At the same time, the operator must have incentives to operate and expand the network efficiently. Clearly, incentives in a new regulatory regime will require careful consideration. In some happy cases, a single mechanism may simultaneously give several of the right incentives to many players. (Well-designed markets often do this.) In other cases, one set of incentives may have to be traded off against the other. In any case, with lighter-handed regulation, the outcome for all players should depend far more on the incentives that are built into regulation than on specific outcomes the regulators may have in mind.

In a displacement network, all physical trades involve the network operator. "Bilateral" trade occurs only on paper. As a result, it will sometimes be reasonable for the network operator to assess penalties against those who create imbalances. However, the purpose of these penalties should be only to prevent damaging behavior. So traders should have a chance to respond to potential penalties but changing their behavior. This probably means real-time monitoring and trading of imbalances. Penalty revenues should not be a profit center for the network operator. Revenues from imbalance penalties should go to firms that were shorted or overproduced, not to the network operator.

Incentives to take good risks are important. Oversocializing risk allows players to become free riders. The traditional regulatory approach implicitly socializes the risk. That is, it mushes together many costs and charges them to customers based on some approach other than who caused or helped solve a problem. The British electric industry has an updated version of this mushing process in its "uplift" charge, which masks a multitude of sins and virtues. Unnecessary socializing of risk is poor policy for the future. It breaks a basic principle of accountability. Similarly, if fuel choices or even suggestions are made by the government, firms that follow these choices will claim entitlement to recovery of costs above market. Although rules dealing with externalities need to be in place, fuel and capital choices in energy production should be returned to the market.

Short-Term Incentives

Incentives can play an important role in reliability if designed properly. If suppliers are allowed to profit from their ability to supply, more supplies will be available. If buyers can save money by postponing or not consuming during critical times, more will do so voluntarily. The very short-term market involves enough discretion and potential for innovation that the independence and incentives for network operators are crucial. If an operator has incentives to maximize trading possibilities and to make the market fair and efficient, it will find many ways to do so. If it does not (for instance, if it can benefit from congested paths or trading on its own account), a regulatory approach to correct this bad incentive would need to be severe and heavy handed.

In short-term markets, the most important incentive issues probably have to do with imbalances. Trading opportunities are key. Traders will try to game any set of penalties or cash-out provisions that are not tied directly to simultaneous spot markets. In short-term markets, the key is to avoid arbitrary penalties by using better electronic trading to let traders cash-out, buy or sell at posted market prices.

Long-Term Incentives

Expanding a network efficiently is difficult, especially in the electric industry. To the extent that changes provide incentives for some to become free riders, there is a tendency to underbuild. To the extent that it creates incentives for inefficient rent seeking, the tendency is to overbuild. In either case, it is hard to get the price signals right. Given current control technologies, every expansion changes the flow of power on the rest of the grid. In doing so, it changes both the capacity available to others and the value of the capacity they have.

A regulatory system that frequently uses rolled-in pricing for expansion creates large incentives to overbuild. For these systems, that use the existing customer base to subsidize expansion, the problems of getting good incentives for future grid expansions are a severe conceptual as well as practical problem. The general solution to this problem is to give more meaning to contracts and the property rights they create.

In long-term markets, the four most important issues are probably how to use ratemaking to reward good management rather than just capital investment, how to facilitate the design of rates for existing facilities, how to avoid discouraging innovation and how to make capital expenditure decisions when externalities are large and often hard to estimate.

Rewarding Overall Company Performance. Regulation of transmission rates (as opposed to commodity prices) remains problematic, especially in the long run. Traditional approaches will fail in the primary market both because of the impossibility of forecasting (as noted earlier) and because of the arbitrariness of the approaches used. In an attempt to quantify as much as possible and leave as little as possible (apparently) to politics, analytic techniques like rate base valuation, rate-of-return analysis, functionalization, cost allocation, rate design, prudence (*ex post*), and simulated competition, have been introduced into the process. Although these efforts at quantification are often assigned certain analytic powers, they are more arbitrary than most think. They are often used to finesse the fairness issue using the fog of technical jargon.

Rate Setting. If we are consistently wrong in forecasting supply and demand (e.g., units of service or billing determinants), we should look for other ways to set rates. One key is to set rates in a way that gives all parties an incentive to behave efficiently no matter how the future turns out. Incentives are generally better than coercion or lottery-type guesses in getting results. Robust policies should rely on designing good incentives, establishing good institutions that do not depend heavily on forecasts, arbitrary allocation tools and expensive dispute resolution.

Rate-of-return regulation distorts corporate incentives substantially, leading both to an over-emphasis on capital expenditure and an insufficient interest in customer service and human capital. Some traditional regulatory mechanisms have particularly poor incentive properties. For instance, fuel adjustments clauses that allow straight cost pass-through of fuel costs give companies weak and only indirect incentives to find the best fuel prices or to optimize their fuel use.

Many approaches have been suggested to address the problems of rate-of-return regulation, many of them under the rubric of "incentive regulation." Incentive regulation comes in many flavors. For instance, recoverable fuel purchase costs can be tied to spot market prices. Any better or worse performance can directly affect the company's profits (in a pure scheme) or can be shared with customers. For broader transmission service, price cap regulation is a common approach. Price caps are established for each service and allowed to change according to some pre-determined index less an allowance for presumed improvements in productivity. In theory, this severs the connection between the company's own costs and its prices, and also eliminates biases toward or away from capital. In practice, the index typically fails to track reasonable costs for the company (usually because it is an economy-wide index or because it fails to take into account dramatic efficiency gains possible in the first years without cost-of-service regulation), and needs to be revisited. When it does, much of the ritual and paraphernalia of rate cases returns, typically focusing on the productivity factor and the company's own costs.

Benchmarking, where possible, improves any incentive program. Since the firm's rate caps are based on its own industry costs, there is little need for a productivity factor, the index can be presumed to track the firm's reasonable costs (unless proven otherwise) and the index will reflect any large initial productivity boosts. Devising benchmark approaches to service quality will be particularly challenging and important, but the potential benefits make it worth the effort.

Allocating and reallocating scarce capacity has been a problem. Current tools will need to be enhanced with new computer-based tools including simulation and optimization software. If costs are subadditive, additional problems arise. Most of the existing tools and institutions for setting prices presume or need natural or legal monopolies to be workable. Price discrimination, which lies at the heart of most of these approaches, can become increasingly difficult to the extent that transmission services are competitive in either primary or secondary markets. (This is not to say that transmission markets are fully competitive, but it is to say that the very existence of secondary markets and oligopolies means that some degree of competition is present.) The dilemma is how to price marginal customers and marginal demand at marginal costs but also to find a way to recover the full costs.

Even where price discrimination can still be practiced, customers have strong incentives to misrepresent the value they place on the service. Incentives to discourage misrepresentation are often costly. Consequently, new approaches, such as introducing well-designed auctions, can be established in ways that have incentives for honest representation and still satisfy marginal cost principles (see Vickery, the appendix of Alger, O'Neill and Toman, O'Neill and Stewart, and also the FCC auction discussion, e.g., McAfee and McMillan).

Whatever tools are used, the Commission will continue to set maximum transmission prices in most primary markets. Over time, however, transmission prices may be less price-regulated when competition is sufficient.

Innovation. One of the key elements of a good long-term regulatory policy is to avoid discouraging innovation. The growth of market mechanisms prompts technological innovation. For instance, salt dome storage can now deliver very large gas quantities into pipelines very quickly and could become a pumped storage alternative for electric peak markets. As a result, some storage operators may be able to supply pipeline customers with a short-notice service that can compete with the pipeline's “no-notice” (or just-in-time) service.

Adapting tariffs and rates to a previously unimagined service requires much quicker regulatory evolution than has been typical in the past. In many cases, the process is complicated by the fact that new technologies are competing against existing companies that do not want to lose part of their business.

Incentives for Building. One way to resolve the dilemma between competitive forces (that tend to equalize prices) and the need to recover fixed costs (which typically requires price discrimination) is to attack the problem *ex ante*. Before a transmission link is built or expanded, price discrimination is feasible because a secondary market does not exist. Price discrimination can also be efficient. Companies offering competitive construction projects can offer even higher-paying customers a better price if they include the marginal customers who are willing to contribute something toward fixed costs. Thus, before construction, it is possible to give higher-valuing customers the choice of lower rates with marginal customers or higher rates without them. (If the higher valuing customers try to insist on lower rates without price discrimination, they will end up scuttling marginal projects.) Providing for full recovery of fixed costs before construction would prevent a crucial problem. When the new project turns out to be more or less valuable than anticipated, there is no windfall or stranded cost to worry about. Later short-term prices on the secondary market can safely reflect short-run marginal cost, regardless of whether it is above or below embedded cost.

Finally, the economics of new construction are difficult. While *ex ante* agreements are valuable in allocating risk and getting the right forms of price discrimination to bring marginal buyers onto the system, they do little to fix the problem of externalities: both free riders and rent-seek abound in potential expansion projects. Here it has proven difficult to forge straightforward market mechanisms that give appropriate incentives to potential sponsors. In many cases, it may be that the best approach is through a somewhat different kind of mechanism, an institution that represents all major stakeholders. Such a group would create a form of countervailing political power that should help prevent both free-riding and inefficient rent-seeking. It will, quite likely, be less efficient than an equivalent market mechanism, but more efficient than the many imperfect market mechanisms that can easily be devised.

Two features of traditional regulatory regimes are to be avoided. The first is the need for a regulatory body to examine and certify a project. This used to require absurd rigidities (20-year contracts for everything, for instance). It also involved the regulatory agency in a de facto (but ultimately false) guarantee against risk for all participants. The second is the use of rolled-in pricing. Typically, this leads to price signals that are too low, capacity that is too large, and contracts that are revised by administrative fiat. In later years, this could become a stranded cost.

Commission Experience with "Incentive Regulation"

The Commission has considered three forms of "incentive regulation": market-based (uncapped) rates, indexing and negotiated rates.

Market-Based Rates. In 1987, the Commission removed price controls on Transwestern's commodity sales service because it lacked market power. Its largest customer walked away. Since then, the Commission has granted market-based rates when the seller lacks market power, that is, when the customer has good alternatives. It has granted market-based rates to sellers of many regulated products and services in the gas, electric, and oil markets.

Indexes. The Commission now uses an indexing scheme for oil pipeline rates and has invited gas pipelines to propose incentive schemes that fit under very general parameters. The biggest obstacle to incentive programs is the lack of good information to measure and reward results. Incentives to avoid detrimental behavior on the networks are necessary. Receipt and delivery penalties outside of scheduled quantities are necessary to maintain the integrity of the network. Recently gas network operators proposed to raise penalties and tighten scheduling tolerances. These provisions are incentives to change behavior and should be established on a regional basis along with standardized trading systems to avoid penalties.

Negotiated Rates. The Commission has also adopted a policy that lets natural gas pipelines negotiate rates with customers, provided that the customer always has the option of a backstop service available at OCOS rates. This lets pipelines tailor rate structures to the needs of individual customers. For instance, it might allow a pipeline to offer customers rate structures other than the recourse or backstop. The Commission is also considering letting the pipelines negotiate service quality against the recourse service quality. This could give pipelines considerable incentives to improve services in ways that customers value, a very important form of improved efficiency in an economy where improved customer service is often at least as important as lower costs.

The negotiated rates policy can potentially change the nature of regulation for transmission grids. Such a policy gives transporters an incentive to degrade the recourse service just as surely as it does to improve the negotiated service. The price differential customers are willing to pay depends on the difference in quality between the two services, not on the absolute level of either. In an overall economy, where most industries see service improvements every year, transporters might not even need to make the recourse service less attractive. It may be enough simply not to let it improve. For instance, if frequent intra-day markets were available only as a premium service with monopoly prices, customers might soon find that they simply could not afford to stay with the recourse service.

This implies different regulation. Instead of being concerned with simple price levels, the Commission will need to concentrate on the terms and conditions of service as a way to exercise market power and with the fairness of the bargains struck between sellers and buyers to arrive at market-based rates. It will also need to consider externality effects of negotiated services. For example, some changes to terms and conditions can compromise the competitiveness of other markets (especially secondary capacity markets), even if they benefit the individual customer. This would have the effect of denying the benefits of competition to third parties.

In electric power, the Commission has so far concentrated on trying to achieve competition in generation markets. Transmission pricing remains largely unchanged so far.

D. Institutions

Institutions matter. Good institutions create trust, provide information, oversee markets and resolve disputes. Bad institutions lead to mistrust, uncertainty, needless risk, higher transactions costs and dispute perpetuation.

Microeconomic theory often simply assumes that good institutions exist and work effortlessly. In reality, institutions in most industries grow over time and some bad features can be perpetuated for many years, especially if some major players have a stake in maintaining them.

For industries with newly developing competition, the existence of good institutions is especially problematic, partly because of the interplay between competition and cooperation. On one hand, large networks depend on close cooperation among players to operate efficiently. On the other hand, competition to produce better services at lower prices is essential, at least for the commodity part of the business. This implies the need for governance to ensure both that cooperation does not become collusion and that competition does not become self-defeating. As a result, a major objective for future regulation is to define the interfaces of competition and cooperation. Network operations need management incentives that are compatible with policy objectives: for example, universal service, protection of captive customers and maximum efficiency.

OCOS has no strong institutional component. The model assumed that forecasts would be perfect and corporate boundaries would appropriately define markets.[20] Secondary

[20]Recent institutions like integrated resource planning have been described as combining the worst aspects of due process and central planning. There was a strong tendency to overbuild. If supply was short, markets cleared by fiat, e.g., curtailment.

transmission markets are of no importance—indeed they may be seen as something of an alien attachment to a model with perfect foresight. Even spot and derivatives markets—a nearly universal feature of other commodity markets—tended to be rudimentary or non-existent in traditional models of regulation. For network displacement industries two types of institution are critical.

- **Markets** for the commodity itself and for many aspects of transmission

- **Governance** to address market failures including externality and public good issues.

Fostering institutions that can both encourage efficiency and be seen as legitimate is the essence of today's regulatory problem. Good markets and governance mechanisms can mean the difference between the success or failure of an otherwise sound policy. Institutional reform must take advantage of new information technology and shed practices that presumed monopoly markets.

Market Institutions

In network displacement industries, key markets that need better trading institutions include: spot commodity markets around the network, futures markets that offer a standardized and relatively inexpensive way to hedge many risks, other derivatives markets for more sophisticated risk managers and secondary markets for transmission capacity. Sometimes, respected market-makers can create these markets fairly easily. NYMEX has three gas futures markets and two electric futures markets.[21]

In other cases, regulators can encourage the growth of market mechanisms, as the Commission did with natural gas market centers in Order 636. Similar efforts to encourage the growth of markets can be expected in the electric industry.

In still other cases, such as gas spot markets, developments are patchy, with information deficiencies playing a key role. How well the secondary transmission market works will strongly affect the functioning of spot markets and determine how easily and cheaply players can arbitrage price differences around the grid. Official and gray versions of secondary markets for natural gas can operate side-by-side, leading to considerable confusion and needless risk.

Market approaches should not end with setting up markets for capacity and commodity. Regulators can and should make much greater use of auctions for key problems involving costs that are either sunk or soon to be sunk. Auctions can evaluate and maximize the value of stranded assets and help decide among competing new construction proposals. Auctions also figure prominently in new approaches to environmental problems, as with pollution permits.

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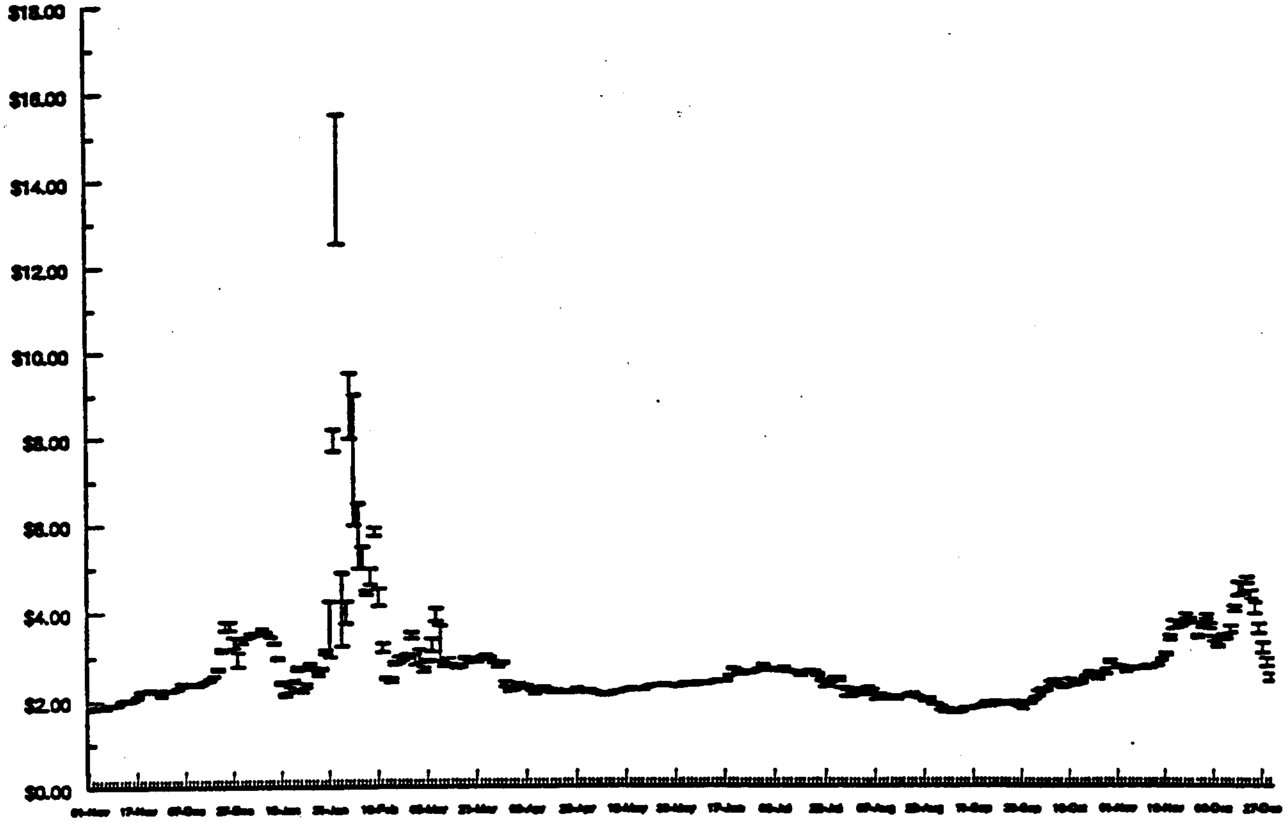
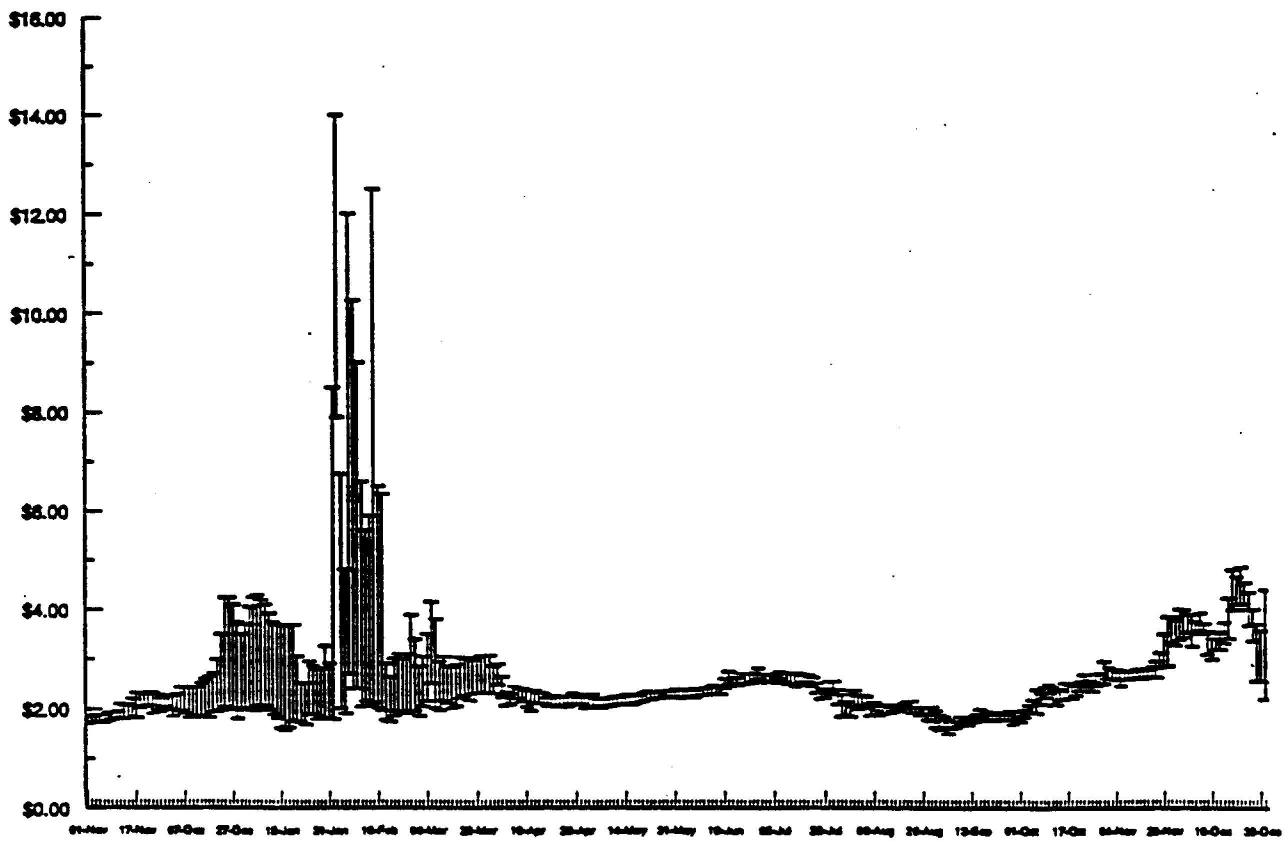
[21]Even in these cases it takes time for shippers to understand the full implications of what the market offers. A simple example is that many shippers implicitly thought that the futures market could hedge price risk including basis risk (the difference between their local price and the pricing point referenced in the futures contract). Many of them lost substantially in the 1995-96 winter when price gaps opened between the Henry Hub, where the futures price was quoted, and in many other places. This is an interesting case history for institutions in that the futures market worked just as it was meant to, but it could not work well for real customers until they had enough experience to know what that really meant (see Figure 14).

Finally, the growth of commodity markets in displacement networks at peak times requires integrating the physical constraints of the system with the commercial desires of the players. Otherwise, opportunistic gaming will undermine both the legitimacy and viability of the market. The peak market problem results from system constraints that cause markets to segment into smaller regional markets. They do not conform to state lines, nor to historic service territory boundaries. This implies the need for regional institutions, including independent system operators (ISOs) and regional transmission groups (RTGs). The key is to integrate market signals into the physical constraints necessary for reliability. To address the problem well, the institutions need to automate many processes. It is probably not realistic to think of an intraday auction that does not include some automated bidding and standardized contracts. The institution must also be adaptable, since technical innovation is very likely to improve the potential performance of the market. The problem for regulators: most Commissions have little experience or expertise at designing institutions and often fall back on cost-of-service concepts.

Figure 14.
Daily High and Low Prices at the Henry Hub



Daily High and Low Prices in South Louisiana, Not Including Henry Hub



Source: *Gas Daily,* Daily Price Survey. Data through December 31, 1996.

Most would agree that a single entity should operate an integrated network to ensure coordination and to maintain the stability of the system. However, since the system controller can provide a substantial competitive advantage to itself for commodity trading, many advocate that an independent system operator (ISO) be given control of the regional transmission network. As envisioned by the Commission in the open access rule (Order 888), an ISO would go a long way to prevent discriminatory control of the transmission system.

The ISO is designed to be an efficient market maker, anonymously matching buyers to sellers to maximize the gains from trade (minimize costs) while maintaining a specified level of reliability in the transmission network. The algorithms used by the ISO to minimize costs also establish the appropriate prices at each node in the system so that any participant in the market, large or small, will be aware of the price and have the ability to respond in real time. Participation in this market would be voluntary. A "bilateral" contracting market would exist in parallel for those who chose not to participate in the ISO's market.

Investment in transmission capacity is risky, both *ex ante* and *ex post*. In regulating assets with natural monopoly characteristics, *ex ante* competition and better specified contracts can be used to foster efficiency. *Ex post* prudence, interpretation of a vague regulatory "compact" and cost allocation invite unnecessary Monday morning quarterbacking, risk and a destabilizing effect on long-term investment. Further, it is essential that players have ways of managing the risk to which they are exposed. This has direct implications, such as the importance of forward markets (often for time periods that go beyond most futures contracts). But in turn, the forward markets depend on having well-functioning short-term markets.

Similarly, the externalities of grid expansion can probably only be properly considered in regional groups that bring all the stakeholders together using the Commission to resolve disputes. Designing the institution wisely is likely to be the key to obtaining good results. The Commission has also proposed Regional Transmission Groups (RTGs) which are the longer term complement of ISOs. RTGs make network rules, plan expansions and resolve disputes.

Industry Governance Institutions

Governance is particularly critical for network displacement industries. Markets tend to be new, so that their governance is more problematic than it is for other industries. The unusually high potential for the covert exercise of market power through control of the grid, for free riders and for serious externalities make good governance of the grid a necessary pre-condition for the growth of efficient markets. The decision to require unbundling of network service and commodity service is primarily driven by two goals: to regulate only what needs to be regulated (natural monopoly and necessary service) and to make the commodity market more competitive.

More generally, governance structures should define the way the industry will deal with sunk costs. One key is to separate or unbundle commodity trading (that needs well-structured markets) from transmission services (that need a form of governance that does not presume competition) and to give players opportunities to trade transmission entitlements. The governance structures that oversee transmission should focus on services from sunk cost, natural monopoly physical network assets and operate by getting the parties that will be most affected by the rules to make them. Key governance issues include: (1) market-supporting rules, (2) mechanisms to handle technical issues, (3) regional governance, (4) dispute resolution, and (5) continuing regulation.

Market-Supporting Rules. Key among these is open access to the transmission grid. It is tempting to think that one need merely say the magic words "open access" and reform is complete. In fact, it can take years to find a practical regime that achieves the goals of open access (non-discriminatory access for all comers), especially if some degree of vertical integration for the transmission owner is allowed to remain.

The growth of market mechanisms has prompted other technological innovations also. For instance, salt dome storage can now deliver very large gas quantities into pipelines very quickly. As a result, some storage operators may be able to supply pipeline customers with a short-notice service that can compete with the pipeline's "no-notice" (or just-in-time) service. Adapting tariffs and rates to a previously unimagined service requires much quicker regulatory evolution than has been typical in the past.

In electric markets, automated short-term auctions exist in many areas. Members submit offers to buy and sell and a computer program matches trades for maximum gains within feasibility constraints. In Order 888, the Commission ordered open membership. If the advocates are right, people will join voluntarily and the pools will continue to flourish. A key question will be whether in the new transmission era contract rights will be available and defined, or whether there will be parallel path models. Parallel path models are very hard to deal with because of loop flow and externalities. The activities of one party flow over into someone else's property rights, and affect someone else's assets.

Mechanisms to Handle Technical Issues and Set Standards (e.g., GISB). Many of the problems facing displacement networks are essentially technical in nature. These include both traditional engineering issues (What is the effect of adding a new link to an electric grid?) and new information issues (How does one build a consistent market-information system?) The traditional regulatory focus on strict legalism is badly suited to deal with these problems.

In practice, markets are critical. Secondary markets are particularly important in letting parties correct errors and bad guesses in building the transmission network. The role of regulators now is to establish trading rules and to monitor the markets to ensure that they are performing properly. However important secondary markets are, they can be difficult to construct from the bones of a traditional regulatory regime. To have a secondary market in transmission, property and contract rights must be tradable. Traditional approaches leave such rights vague, which greatly impairs efforts to trade them.

Many market efficiencies also depend on setting standards. It does not matter exactly how many details of a transaction are handled, but market liquidity depends on having the details done the same way for all transactions. Examples include timing issues for capacity resales and quantity definitions for futures contracts.

In the gas industry, the Commission has encouraged all sectors of the industry to work together through the Gas Industry Standards Boards (GISB) to resolve as many technical and standardization issues as possible. GISB has succeeded in solving many of the problems. In other cases, a decision on standards may benefit one industry group over another, and in these cases a consensual organization like GISB is likely to be less successful. Even when consensus is not possible, issues can be framed so that areas of disagreement are clear.

Regional Governance. Many of the key issues in governing the networks are essentially regional in nature. They require bodies that can find acceptable solutions across a region. In many cases, a structured grouping of the stakeholders in the region can hammer out sensible approaches to problems without referring all disputes to the traditional regulator. There can be an inherent tension in these institutions. On one hand, the institutions may be trusted only to the extent that there are credible guarantees of independence from any particular player or group. This can often be ensured by requiring super-majority voting of some form. On the other hand, innovation is more easily stymied if a relatively small minority can block change.

One transmission pricing issue is location-sensitive rates. Currently, postage stamp rates provide highly distorted location signals based on corporate or political boundaries. Megawatt-kilometer rates could offer some distance sensitivity in rates or zones. Another approach, suggested in the California proposals would be congestion pricing, which would increase the price for bottlenecks. It is also necessary to define and price ancillary services. The pricing debate has created shibboleths. Consider "or" pricing. Outside of this industry, no one knows what "or" pricing is. If the transmission facilities are really interstate, they need to be sited and approved at the federal, rather than state, level to ensure uniformity.

Dispute Resolution. To the extent that the industries can develop new ways to resolve disputes, they will benefit. Traditional due process is slow and costly. It therefore adds risk for all parties and gives the advantage to those with deep pockets (especially those who can pass the costs through to captive customers). The current formal dispute resolution process is best characterized as a credible threat to be avoided. Less formal and more technical approaches should be tried. Only if they fails, should a formal process be used.

Reform is necessary. Where technical issues are in dispute, the process must become more technical and less legalistic. The Commission goes further than the APA requires in its quasi-judicial approach to fairness. This, in turn, creates delay and administrative cost. The process should be either reformed or used as a last resort. Other dispute resolution methods need to be employed. For instance, tribunals where technical experts are in greater control of the process and mediation should be tried.

The formal process can be improved. First, companies should file all information with a rate case, and the Commission should reject any rate increases that are not fully supported. Information already on file should be submitted by reference (saving a second audit of the data). Second, the Commission should write a specific hearing order, even if it takes several months to obtain sufficient information. If needed, the Commission could issue the hearing order and the suspension order separately. Third, if the rate case is not fully supported, the request for additional information resets the suspension clock. Fourth, the hearing should focus on facts and the rounds of briefs should be cut in (at least) half. Finally, the Commission should set deadlines for action.

There are other ways to achieve these objectives, such as to:

- Use streamlined litigation processes, such as paper hearings.

- Appoint settlement judges to resolve disputes at the request of parties prior to filing a rate case.

- Base the rate suspension period on the difference between the pipeline's requested cost of service and Staff's preliminary estimate.

- Issue supplemental hearing orders that give more guidance about the issues.

Continuing Regulation. Almost all the new governance structures that may be created in these industries rely on the existence of a clear backstop for situations where the institutions meet problems they cannot resolve. (The existence of such a backstop is often a necessary requirement either to goad parties into forming new institutions or to persuade reluctant parties to join developing structures.)

As a general rule, government institutions should be as small as possible both in size and scope to deal with the mission. For example, FERC is charged with issues involving interstate commerce in electricity, natural gas and oil. Activities that are not interstate in scope, such as gathering and local distribution, should be the province of local governments. This new approach to regulation requires a new approach to the use of institutions. On the other hand, institutional regulation to promote competitive markets must be applied fairly to all players.

The Commission believes that it is responsible for regulating the transmission system, but in the traditional way for regulating monopolies. Attention to the design, focus and encouragement of institutions has become important to the governance shift. One approach to governance is to regulate the network as a public club. The regional and local players form the organization, write the rules and plan the network. The Commission would set general parameters and resolve disputes that cannot be resolved at the regional level. For example, ownership and ownership rights should be available to anyone who can put up the money.

Where regulation is needed, decisions must be quick—justice delayed is justice denied, not "due process." For example, operating with the uncertainty of refunds (years later) adds unnecessary transactions risk and is probably not an acceptable way of doing business in a more competitive world. Where the search starts, transition and billing will take place in intervals measured in hours not days.

E. Choice

The final key element of a new approach to displacement network oligopolies is the development of greater choice for shippers. The old approaches gave great importance to prescribing the "correct" choice, whether in sizing a new line or deciding on the degree of reliability that shippers should have. The new approach emphasizes finding ways to turn over many more choices directly to shippers. Typically, additional choice can make the systems far more efficient. Network customers are given choice through their rights to trade capacity and negotiate rates. Since network service is subject to many externalities, choice should satisfy the criteria that other customers' service is not harmed.

Key areas for increasing customer choice include giving them the ability to choose:

- Response to price changes
- Rate structures
- Service quality
- How much risk to bear.

Short-Term Choice

Customer choice is crucial in very short-term markets. If most see no short-term price signals (as they usually do not today), they have no meaningful choices to make. They must then either overinvest in the grid (and production) to serve large loads that do not see and cannot respond to price at the worst of times or else institute some scheme of administrative curtailments.

Ultimately, very short-term pricing for customers could give them the ability to choose between the commodity and cash according to the real economic value at different times. This differs vastly from rates that are set for months or years at a time with after-the-fact "true ups," or even from time of day rates that are set in advance. With customer choice in the short term, the industry could be much more efficient and lower the burden placed on administered curtailment schemes by reallocating capacity to those who most value it most. It would lower the need for peaking facilities compared to the current regime, while providing good price signals for future peaking facilities.

Long-Term Choice

In the future, customers should be able to choose how much (and what kind of) reliability they need and are willing to pay for. Thus, one customer may insist on keeping traditional levels of service (almost absolutely guaranteed, except if a tree falls on the power line), while others may accept a certain level of outages, perhaps with a specified notice period. Such a system of customer choice would give customers more that they value for their money and at the same time would change the long-term investments that make sense for the industry.

Transmitters may be able to provide better service quality, perhaps for a higher price (or lower quality for a lower price). This set of choices could include reliability (guarantees of the delivery of the commodity) and, in some cases, include the quality of the commodity itself. A new form of regulation would encourage transmitters and customers to find better mixes of quality and price, as well as ensuring that the basic, backstop service improved over time.

Capital and environmental risk change when the market is removed from cost-of-service regulation. Under traditional cost-of-service monopoly regulation, the customers bear most of the firm's risk even though firms earn an unspecified risk premium. In competitive markets, the customer can choose to share risk through contracts or joint ventures.

Privatized risk taking can yield positive externalities. For instance, expensive environmental retrofits are simply put in rate base or plants are retired with full cost recovery. In non-regulated markets these investment risks are mostly visited on the equity owners. Therefore, in a non-cost-of-service market, decisions would favor low capital cost and low environmental risk. The essence of investing in the infrastructure of the grid is to manage the risks associated with the investment. Letting shippers and builders assume different levels of risk for different periods (as in the choice to reserve capacity or to depend on the secondary market) is one of the most important areas of potential customer choice—and also improved efficiency.

Regulatory Choice

Whenever new policies are efficiency enhancing, it is theoretically possible to make choices Pareto optimal. That is, customers and sellers can be made better off without making anyone worse off. This should be the goal of choice for captive customers at least during some transition period. For those who chose to seek the rewards from competition, they must be allowed to fail.

Industry Choice

With open access, customers have many choices in buying the commodity. Additional flexibility lets firm capacity holders resell their holdings on a secondary market. In gas, the Commission has started a negotiated rate program where the gas pipeline and its customers may negotiate the pricing terms of their network service contract if a recourse contract is available at a Commission-determined "just and reasonable" rate and no harm is done to other customers. The idea is to loosen the control over the specifics of the rate design, allowing Pareto adjustments to recourse service. One way of doing this is simply by allocating costs of given services to a specific customer or group of customers and letting the regulated firm negotiate its own rates. That way the cross-subsidy problem is dealt with in the cost-allocation step. Another way to do that is to essentially establish a regulated rate and let the customers negotiate away from it.

Retail Choice

There is a real possibility that in a few years these markets will go from command and control regulation to pressure-packed, dinner-invading, telemarketing retail competition. Figure 15 shows the growth of retail access in the gas industry over the last 10 years. It is important that information, e.g., real-time prices (at least on an hourly basis), is made available to all buyers and sellers, network use and entitlements reflect full marginal costs, electronic markets for trading of the commodity and network entitlements be established, careful consideration be given to the design of incentives, and focused open governance structures consisting of market participants be established to make rules these systems work. None of this can happen without high-quality well-structured electronically available information.

Better communication and control systems will make it harder to show the efficiency of franchised monopoly gas merchants against that of competition. Retail sales service has no inherent large natural monopoly characteristics if it is bundled with the network services. Large transactions may lower average transactions costs creating scope economies. Economies of scope are difficult to demonstrate under normal circumstances, but are subject to additional challenge from new communications technology. (For similar reasons, the local phone company no longer chooses the long distance carrier or the customer's terminal equipment.)

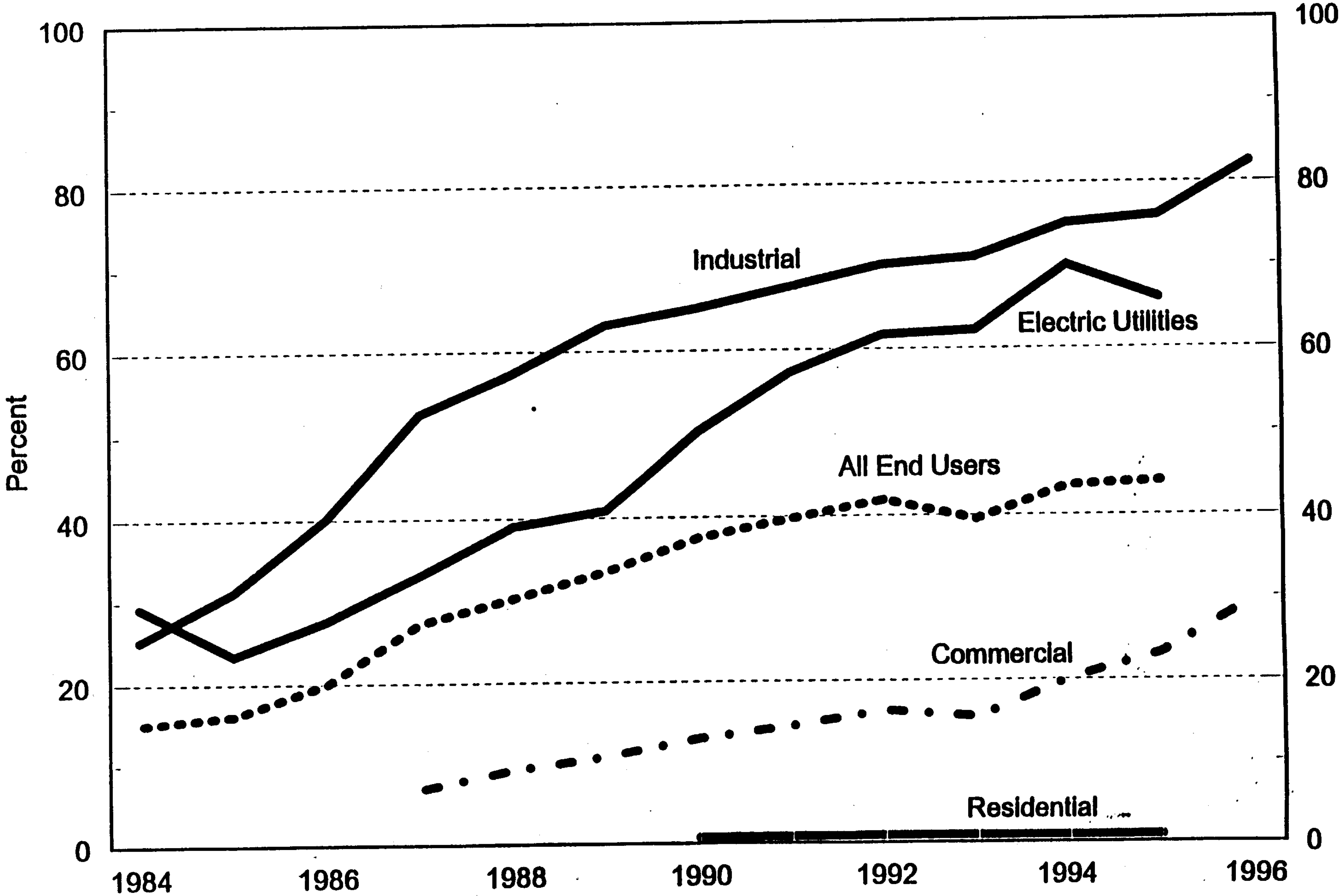
Many think the political pressure for local unbundling will come from the industrial customer. If retail prices are not competitive, pressure may also come from more potent political forces like the school boards and archbishops who must heat, cool and light schools, churches and hospitals.

Real-time pricing has longer term implications also. Incremental peak load costs are often substantially higher than average costs. Despite this, peak-load pricing is either weak or non-existent. This could change with the introduction of real-time pricing at the retail level. With fiber optic cable or similar innovations, two-way automated communication between customers and their utilities—electric, gas, and water could be introduced. Prices could be transmitted, appliances turned on or off in response and meters read automatically. It is not a great conceptual stretch to see customers programming their use of appliances based on hourly prices of natural gas and electricity for the next 24 hours. This may stimulate significant peak shaving, that is, real-time demand side management. Further, the retail customers could easily be given a choice of sellers.

Under the old structure, demand-side management (DSM) started with a bribe. Utilities made money by generating electricity. Therefore, it was necessary to bribe the utility not to generate, or more politely, give it an incentive not to generate. In an unbundled system, no bribe is necessary because the companies are separate.

The idea of demand-side-efficiency needs more market and less management. What are the market failures inhibiting the development of demand side markets? Demand-side applications do not have economies of scale. There may be information market failures. That is,

Figure 15.
Percent of End User Sales Unbundled, by Sector
Total United States, 1984 to 1996



ces: Energy Information Administration, *Natural Gas Annual 19*[illegible] *Natural Gas Monthly*, January 1997.
.e: 1996 figures for commercial and industrial are based on 10-mo[illegible] olumes.

the customers may not know enough to choose the efficient option. The answer is to give them information.

Customers do not have good information about when to cut back on consumption and they have no monetary incentive to reduce use on peak, even if they did have the information. Real-time market prices solve the bad price signal problem. This may do wonders for DSM because it says that if you can conserve on the peak, you can save a lot of money.

There may be discount rate problems. Residential customers are usually assumed to have very high discount rates. They do not like to buy equipment that has long-term paybacks. Let marketers and sellers arbitrage those discount rates.

V. Summary and Future Developments

Much economic regulation is devoted to networks and markets that are connected physically by a transmission network. These networks require long narrow stretches of property rights to move information, commodities or people physically to different locations. Often, obtaining property rights to the corridor requires condemnation of private property and environmental impacts or externalities in the surrounding area. This process alone creates a public interest and barriers to entry. The sunk costs, natural monopoly and public good aspects of the industries add to the need for governance structures. "Free market" advocates call for deregulation but ignore eminent domain questions and often call on antitrust laws to work a magic that is hard to understand. On the other side, many want these markets to be managed publicly for a greater good that includes subsidizing certain groups and actively promoting environmental causes. Without strong governance of the network, the competitive efficiency of the commodity market may be compromised.

The search for new approaches to regulation is a worldwide phenomenon. The Network Oligopoly Governance approach relies more heavily on the game theory and transaction cost schools because the learning from these schools has been underemployed. Important concepts that get more attention are information, incentives, institutions and choice. At the same time, forecasting models, continuing *ex post* allocation of sunk costs and rules that limit choices need less emphasis.

In many ways the biggest problem is a transition in how to think about the industry. Proposals for competition and unbundling started out like heliocentrism. When Galileo argued that the earth revolved around the sun, he was speaking against the church religion. Competition started out as heresy for many in the natural gas and electric industries—but it is now almost universally accepted.

The transition from OCOS to NOG is like the transition from the physics of Newton to the physics of Einstein. Discrimination is judged through the concept of relativity (similarly situated customers). Newtonian physics works well except at the extremes—the atomic and cosmic scales. It is usually taught without introducing friction. The atomic scale is similar to short-term markets. Short-term markets move too quickly to be disciplined by any traditional cost-of-service concept. The cosmic scale is similar to long-term markets.   Long-term markets require more attention to contracts for cost-allocation signed before costs are sunk rather than after the fact. Black holes could be useful for sunk costs.

Although friction is usually omitted from basic physics, engineers are made painfully aware of friction, thermal losses and constraints in advanced courses. In practice, reducing friction is key to efficiency improvements. Reducing transaction costs in markets is often the key to making markets both more efficient and more competitive.

When current trends are combined with new policies for greater gas use, painting an accurate picture today of natural gas and electric markets in 5 or 10 years should be no easier than it has been for the last 20 or 30 years. This means that the continuing design and development of efficient institutions should be the most important task of regulatory bodies.

Two major policy approaches are needed for these markets to flourish. Both involve dealing better with risk and uncertainty. First is a new approach to resource economics. Classical resource economics and current price forecasting techniques are bankrupt but continue to operate. They have failed to explain or even help understand natural gas, oil and coal price trends. Government involvement in fuel choice has institutionalized the problem. Fuel choice and generation decisions need to be turned back to private markets.

Second is to adapt regulatory approaches that recognize the huge sunk cost and interdependence of the transmission network and rethink basic and long accepted paradigms. Economic topologies of networks need to be better understood. Market power in the network will not be uniform. Subnetwork types such as webs and radials need to be identified and analyzed. Analysis and regulation of subnetwork webs may require different approaches from the bulk transfer or radial links that interconnect the grids. The extremities and interior of the network may require separate analysis and regulation. Isolated areas in the network may have market power. Managing the pockets of high market power in the network is critical for efficiency and fairness.

When pursuing efficiency, Pareto policies should be a goal. There should be no forced losers. Captive customers should not be forced to suffer in the name of higher benefits. Where possible, the regulation should foster choices and balanced negotiating flexibility.

Governance structures focus on giving market participants most affected by the rules the opportunity to make the rules in a fair and open structure. In regulating assets with natural monopoly characteristics, *ex ante* competition and better specified contracts can be used to help foster efficiency. *Ex post* prudence, interpretation of a vague regulatory "compact" and cost allocation invite unnecessary Monday morning quarterbacking, risk and a destabilizing effect on long-term investment.

With additional choice, good, timely information is key to good decisions. To take advantage of the information revolution, better information, communication and control systems are needed. Better monitoring prevents and detects some unwanted behavior.

The case-by-case approach must give way to a regional market approach. Introducing effective competition on the network and effective regulation of the network is not a simple process of sitting back and watching, but a careful step-by-step process, with new institutional arrangements involving industry players in a more cooperative atmosphere.

In a commodity market, a new approach is to unbundle network service from the commodity trading. In the new environment of network oligopolies, neither the concepts from franchised, regulated monopoly nor those from perfectly competitive markets are directly applicable. A blend of competition and cooperation is necessary to achieve the greatest benefit. Fostering or forcing, if necessary, cooperation in the operation of the network is essential.

Some of the changed imperatives for regulation include:

- Focusing on regulating the network assets and services. Network assets have sunk natural monopoly (subadditive costs) characteristics. Decisions where there is an empty core can be especially problematic. To the extent possible, create an *ex ante* approval process with a well-specific contract.

- Not forcing network competition where cooperation is necessary for the network to work efficiently.

- Creating management incentives for the network that are compatible with policy objectives, for example, protection of captive customers and maximum efficiency. Reward good management not just capital investment.

- Avoiding tying non-network service that can be competitive to network services. It is an invitation to be mischievous and distort the market. Economies of scope arguments must be quantified and documented, not asserted.

- Establishing good institutions and incentives for competition to work. Let players be re-warded for lower costs or higher quality. Do not dictate results. Allow mistakes.

- Focusing regulation on bad behavior not good behavior.

Good governance structures for strong oligopoly markets are not well understood. Command-and-control, cost-of-service regulation is fading quickly in many markets. Laissez-faire approaches create more opportunity for behavior with negative effects on other players and society as a whole. A middle ground is evolving.

The idea is to loosen the control over the specifics of the rate design, leaving that either to the firm to negotiate and to allow the cost minimization of the firm to take place. (Allow and do not suffocate Pareto adjustments.) One way of doing this is simply by allocating costs of given services to a specific customer or group of customers and letting the regulated firm negotiate its own rates. That way there is no cross-subsidy problem. Another way to do that is to essentially establish a regulated rate and let the customers negotiate with I as an option.

State/Federal Focus

Efficient network operations require regulation at the federal, state and local levels to be coordinated. The most important consideration in the governance structure of commissions is the independence and technical training of the public’s representatives. High quality technical expertise is needed to examine proposed changes to the regulatory environment. Understanding and keeping current with technological changes will be more important than the rote application of yesterday's tools.

The new regulatory focus at the federal level is on the regulation and siting of transmission, the oversight of regional groups, and the concern with interstate environmental issues. At the state level, electric generators become industrial plants subject to local and regional environmental requirements including water and air quality. States will still site distribution wires and industrial plants. They will still be in charge of ensuring that the contracts for and with core customers are prudent and reliable. But it should not be cost-of-service focus but the regulation of prudent contracting. They will participate in regional groups. They will deal with local environmental issues and demand-side issues. Benchmark incentives should replace cost-of-service approaches.

The Commission is not and should not be interested in regulating distribution systems. However, even this simple notion involves rethinking our approaches to the industry. The separation of distribution and transmission has never been important in a traditional vertically integrated utility. But now, it will be important to clarify what jurisdiction belongs to the States and what to the Commission. The most important role of the distribution systems is to ensure that core customers have choices. Even residential customers should have choices and opportunities. In a short-term market, a distribution company could offer a simple unbundled service to purchase at market prices on a real-time basis. The customer could respond to real-time prices. Later the customer could be given additional choices.

The search for new approaches to energy regulation is a worldwide phenomenon. The Texas Railroad Commission and the Interstate Oil Compact Commission formed the blueprint for Saudi Arabia and OPEC to try to manage crude oil markets. Europe is looking for new institutions. Many utilities are state-owned. In the future, they may be privatized (as in England) and/or will need to trade across state/national boundaries. The European Union has already reduced trade barriers and transactions costs. In Europe, significant efficiency gains can be realized from additional choices on its interconnected grid.

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