

The Theory of Relationship-Specific Investments, Long-Term Contracts and Gas Pipeline Development in the United States¹

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I examine gas pipelines as relationship-specific investments, illustrated by three highly distinct periods of development of the gas pipeline industry in the United States. The industry's first half-century (up to 1935) saw no federal regulation and a high degree of vertical integration, which transactions cost theory would predict. The hiatus of pipeline construction between 1936 and 1944 that followed witnessed the forcible breakup of the vertically integrated pipelines and the laying of the foundation for effective federal pipeline tariff regulation. The second period, starting in 1944 and lasting 40 years, saw the rapid growth of the sector under implicit long-term contracts for delivered gas with federally regulated prices. The era was typified by various social costs associated with attempts to regulate wellhead gas prices and certify new pipeline construction. A second transition period, lasting from 1984 to 2000, saw the rise of new long-term gas transportation contracts that established who held the property rights in existing cost-based regulated pipeline capacity. The industry's third and current period has seen genuinely competitive markets flourish in new gas pipeline construction and in a secondary market for pipeline capacity resale. Federal pipeline regulation after 2000 has sharply receded in general visibility, being relegated largely to enforcing property rights for cost-based regulated pipeline capacity in order to facilitate those competitive markets.

Introduction

In the United States, the extensive interstate gas pipeline network has singular traits appearing nowhere else in the world. Unregulated markets flourish in pipeline capacity (with web-based bulletin board trading and liquid spot and forward markets in transport rights) and genuine competition dictates who constructs new and expanded pipeline capacity. At the same time, every single interstate pipeline in

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the country is price-regulated—charging pipeline customers original-cost-based tariffs for long-term transportation contracts following a formula little changed since 1938. Those pipeline companies, in addition, are owned and operated separately from the highly-competitive and unregulated upstream gas producing sector and their downstream shippers (mainly regulated local distribution companies and merchant power generators).² The other two nationwide energy networks, which similarly transport energy long distances from producers to users (the oil pipeline and electricity transmission networks), have utterly nothing in common with these structural features of the gas pipeline industry. For one, they are almost completely vertically integrated. Indeed, the gas pipelines were once vertically integrated as well. What happened?

This paper examines what happened, from the perspective of the economics of relationship-specific investments. It charts the development of the industry's early vertical integration and its subsequent transition to the traits it displays today. It describes how the gas pipeline industry dealt with various impediments to vertical integration. In addition, this paper will examine how those who financed the pipeline network mitigated—through contracts—the extraordinary risk inherent in investing in highly capital intensive and immobile assets that have no other use than that for which they were originally designed.

There are five sections, corresponding to the three distinct periods—and market structures—in the development of the industry and the two lengthy transitions that led from one market structure to the next. Section I deals with the era of vertical integration and unregulated interstate pipeline transportation. Consistent with the predictions of transactions cost theory, gas pipelines of the first era were, in general, developed jointly by oil companies and existing gas distributors (the long-standing manufactured gas companies that had serviced cities since the early 19th century). Section II deals with the almost decade-long transition that began in 1935 with the federal prohibition of geographically-dispersed utility holding

² Storage operations are another element in the market, but as this paper focuses on gas pipelines, we lose nothing by leaving them out of the discussion.

companies. While that period witnessed no new gas pipelines, it was filled with considerable work on the foundation for the federal regulation that was to follow renewed construction in 1944.

Section III describes the forty-year era of regulated long-term implicit contracts for delivered gas. Gas pipeline construction rapidly expanded during this period as the financial markets found that the elements of the new federal regulation made for high quality, low risk, long-term contracts with the highly credit worthy distribution utility sector. While these delivered gas contracts allowed the industry to expand rapidly, they also created a problem in the market for the gas commodity. That second era also witnessed prolonged litigation in certifications for new pipeline capacity. But it was the inherent difficulty in regulating the market for the gas commodity, as such, that caused consumers to demand a change in the structure of the industry and the nature of the contracts involved.

Section IV describes the second transition period that saw a focus on creating property rights for shippers in the existing regulated pipeline capacity through long-term transportation capacity contracts. Over the course of 16 years, that transition split the marketing of gas apart from transport as a competitively supplied commodity and created the conditions for an unregulated secondary market in pipeline capacity rights, after the Coase Theorem. The resulting third period of pipeline development described in Section V has seen the continued development of competitive markets for gas and gas pipeline capacity, as well as a competitive market for new pipeline construction.

I. The Era of Vertical Integration

In this section, I first review the economic literature on *relationship-specific investments*. Such investments lead to the formation of *appropriable quasi rents*—a problem for which the two remedies are either to vertical integration or long-term contracts. Klein, *et al* state:

... as assets become more specific and more appropriable quasi rents are created (and therefore the possible gains from opportunistic behavior increases), the costs of

contracting will generally increase more than the costs of vertical integration. Hence, *ceteris paribus*, we are more likely to observe vertical integration.³

Indeed, theory points strongly to a vertically integrated gas pipeline industry, which marked its early development in the United States (as it did the similar oil pipeline industry). It was only when downstream integration was prohibited in 1935 that the gas pipeline industry sought contractual methods to deal with the risk of their unique and highly relationship-specific assets.

A. Relationship-Specific Investments and Vertical Integration

The three main transaction forms are (1) spot market transactions; (2) bi-lateral contracting; and (3) formal vertical integration. Professor Ronald Coase's 1937 paper on the nature of the firm focused on the later two.⁴ His fundamental insight was that there are costs to using what he called the "price mechanism" (his term for spot markets)—that is, transaction, coordination and contracting costs—that lead firms to form vertically integrated enterprises. As he states:

A factor of production (or the owner thereof) does not have to make a series of contracts with the factors with whom he is co-operating within the firm, as would be necessary, of course, if this co-operation were as a direct result of the working of the price mechanism. For this series of contracts is substituted one.⁵

Coase held that if the price mechanism really were the most efficient resource allocation apparatus, we would not have witnessed the rise of other institutional forms (like the vertically-integrated firm and long term contracts) to supplant it.

1. The Alternatives to the "Price Mechanism"

To a large extent, Coase was reacting to what he saw as a hole in economic thought, for there was then no acceptable theory to explain the existence of vertically integrated firms. In particular, he critiqued the earlier work of Professor Frank Knight, who had himself attempted to deal with the question of firm

³ See: Klein, B.J., Crawford, R. and Alchian, A., "Vertical Integration, Appropriable Rents, and the Competitive Contracting Process," *The Journal of Law and Economics*, Vol. XXI, No. 2 (October 1978), p. 298.

⁴ Coase, R. H., "The Nature of the Firm," *Economica*, Vol. 4, No. 16 (November 1937), pp. 386-405.

⁵ Coase (1937), p. 389.

integration in his well-known work on the nature of the firm.⁶ Coase believed that Knight had essentially concluded it impossible to “treat scientifically” the determinants of the size of the firm, when Knight concluded that:

the relation between efficiency and size is one of the most serious problems of theory, being, in contrast with the relation for a plant, largely a matter of personality and historical accident rather than of intelligible general principles.⁷

Coase enumerated various criticisms of this point of view, essentially holding that nowhere did Knight give a plausible reason why the price mechanism should be superseded. Instead, Coase focused on various sorts of costs for contracting in a specialized exchange economy as a reason for vertical integration and the size of the firm.

Subsequent writers have extended the literature by examining not just the cost of contracting, but the threat of opportunism confronting parties to a contract. That is, contracts may encounter circumstances not anticipated when the contract was struck or prompt “opportunistic” behavior by a party for which the other has no practical means to counter or redress.⁸ There are two elements in the study of post-contractual opportunistic behavior—the presence of *appropriable specialized quasi rents* and the extent to which such quasi rents are dependent on *asset specialization*.

2. Appropriable Quasi Rents

A transaction-specific asset realizes its full value only in relationship to a particular transaction and, thus, becomes less valuable if relegated to an alternative use. A common example outside gas pipelines is a rail line constructed to transport coal from a specific mine to a specific electricity generating unit. If the generator stops purchasing coal from the mine, the rail line may have no alternative use and

⁶ Knight, F. H., *Risk, Uncertainty and Profit*, The University of Chicago Press (reprint of 1921 edition), Chicago, Illinois (1971). The work was essentially a revision Professor Knight’s 1916 thesis at Cornell University.

⁷ Coase (1937), p. 394.

⁸ Professor Williamson defines opportunism as: “Self-interest seeking with guile, to include calculated efforts to mislead, deceive, obfuscate, and otherwise confuse. Opportunism should be distinguished from simple self-interest seeking, according to which individuals play a game with fixed rules that they reliably obey.” Williamson, O.E., *The Mechanisms of Governance*, Oxford University Press, New York and Oxford (1996), p. 378.

thus be rendered valueless. The capital projects contemplated in gas pipelines are highly transaction-specific as they are intended for the primary purpose of delivering gas from petroleum mining companies ultimately to gas consumers.

Such investments create opportunities for buyers to opportunistically “hold-up” sellers. That is, once the plant is dedicated to a particular purpose, absent a sufficiently exacting agreement or contract, the buyer can find some subtle or obvious pretext to lower the payment. The seller has nowhere to turn if that particular dedicated asset has only a small value in any alternative use. Quasi rent is that value that the buyer may capture this way.⁹ In any transaction with dedicated assets, as for gas pipelines, quasi-rents are vulnerable to opportunistic capture.

3. Asset Specialization and Idiosyncrasy in Investments

The risk of quasi rent appropriation depends on three main variables: (1) the frequency with which buyer and seller expect to interact in the future; (2) the level of uncertainty regarding future market conditions; and (3) the level of asset specialization—also known as investment idiosyncrasy—required by the specific transaction. The greater the frequency, uncertainty and idiosyncrasy, the greater the risk of quasi rent appropriation.¹⁰ In addition, the greater the time or location sensitivity, the greater that risk.¹¹

The consensus in the economics literature is that the most important variable in determining the structure

⁹ Klein, *et al.* (1978), describe quasi-rents and their potential appropriation in an example of a capital investment in a printing press. The amortized fixed cost of the printing press is \$4,000/day, its operating costs (borne by the owner) are \$1,500/day and it has a current salvageable value of \$1,000 (daily rental equivalent). A publisher buys printing service services from the owner of the press by leasing it at a contract rate of \$5,500/day, a price at which the press owner would break even on the investment (recouping amortized fixed costs and operating costs). Without another publisher around, the quasi-rent on the installed machine is \$3,000/day (equal to \$5,500 minus \$1,500 minus \$1,000). See: Klein, *et al.* (1978), pp. 298-299.

¹⁰ Williamson, O. E. , “Transaction-Cost Economics: The Governance of Contractual Relations,” *Journal of Law and Economics*, Vol. 22, No. 2 (1979), p. 247.

¹¹ Consider again the example from Klein, *et al.* (1978) of the printing press and publisher. The extent to which publishers could be held up by printers, and hence wish to own rather than contract for a printing facilities, is highly dependant on whether what is printed is time-sensitive or tied to a particular location. For example, newspaper publishers generally own their presses, while book publishers generally do not. For the newspaper publisher with papers to ship on a rigid local schedule, the inability to secure a local press would expose appropriable quasi rents to seizure by a printer. Book publishers, however, have considerably more flexibility both with respect to timing and location. They are not tied to any particular region or publisher, and do therefore not expose appropriable quasi rents to any particular printer.

and complexity of contracts is the third—the level of idiosyncrasy of investment.¹² A specialized investment is idiosyncratic or “transaction-specific” when it would not have been undertaken were it not for the given transaction. Such investments are those made to support a specific commercial relationship; by definition, they would be uneconomic (and therefore not undertaken) outside the context of that relationship.¹³

If a large portion of an asset’s quasi rent is strongly dependent upon another asset, like gas production and pipeline facilities, then both assets will tend to be owned by one party. The petroleum industry is a good example of these relationships:

Suppose several oil wells are located along a separately owned pipeline that leads to a cluster of independently owned refineries with no alternative crude supply at comparable cost. Once all the assets are in place (the wells drilled and the pipeline and refineries constructed) the oil-producing properties and the refineries are specialized to the pipeline. ... These specialized producing and refining assets are therefore “hostage” to the pipeline owner. ... Given the prospects of [the appropriation of the associated quasi-rents] oil field owners would, through shared ownership in the pipeline, remove the possibility of subsequent rent extraction.¹⁴

There are a number of reasons why the appeal of vertical integration in oil pipelines may not extend to gas pipelines to the same extent. Observing the persistence of vertically separated gas pipelines in the 1950s, de Chazeau and Kahn stated the following:

...the business of transporting oil differs critically from the transmission of natural gas. There is no counterpart in oil to the entrenched local gas distributor and the exclusive access to his patronage that the transmission franchise assures. Lacking an assured and rapidly expanding market, such as natural gas transmission companies have enjoyed, free

¹² See: Mulherin, J. H., “Complexity in Long-term Contracts: An Analysis of Natural Gas Contractual Provisions,” *Journal of Law, Economics, and Organization* Vol. 2, No. 1, (Spring 1986), pp. 105-117.

¹³ According to Williamson, there are three generally recognized categories of such specificity: (1) site specificity, where parties to a transaction are in a “cheek by jowl” relationship tied to a particular location; (2) physical asset specificity, where the investments made in equipment and machinery pertaining to that specific transaction have lower values (or no value) in alternative uses; and (3) dedicated, long-lived assets, where parties make investments that would not otherwise be made but for the prospect of selling a significant amount of product to a particular customer over a period of time. If the relationship is terminated prematurely, it would leave one or both parties with significant excess capacity the value of which cannot be recouped. See: Williamson, Oliver E., “Credible Commitments: Using Hostages to Support Exchange,” *The American Economic Review* (September 1983), p. 526. See also: Joskow, Paul L., “Contract Duration and Relationship-Specific Investments: Empirical Evidence from Coal Markets,” *The American Economic Review* (March 1987), p. 170.

¹⁴ Klein, *et al.* (1978), pages 310-311.

of serious competition from alternative sources at points of delivery, [note omitted] there is likely to be considerably less incentive and less assured financial advantage to be gained in an oil pipeline [vertically-separated] public franchise than in a similar franchise for the transmission of natural gas.¹⁵

The highly vertically integrated oil pipeline industry in the United States does not provide an exact parallel to gas pipelines regarding how an industry reacts to such relationship specificity. Perhaps the greatest difference is that oil pipelines transport a product that can be easily stored in tanks and shipped in vessels—either on the water or on wheels. Gas, on the other hand, is highly expensive to ship in liquefied form and generally impossible to ship in significant quantities over the roadways, railways or inland waterways.¹⁶

In other words, regarding shipping and storage options, oil producers and refiners have alternative modes of transport that compete with and thus lessen the appropriable quasi rents of an oil pipeline. Gas producers and distributors have no such modal flexibility, and therefore their exposure is greater. Economic theory would tell us that the early builders of pipelines were more firmly wedded to vertical integration in gas than even in oil.

¹⁵ See: de Chazeau, M.G., and Kahn, A. E., *Integration and Competition in the Petroleum Industry*, Yale University Press, New Haven CT (1959), pp. 344-345.

In the omitted footnote, they hit a key institutional distinction between the oil and gas transport business in the United States—the difference between *common carriage* and *contract carriage*:

Contractual integration, through long-term commitments between a non-integrated [oil] pipeline operator and refiners of suppliers of crude ..., is definitely inferior. *Indeed, it is dubious if a common carrier can bind itself contractually* to give specified service to one customer in possible preference to other potential future shippers with all of whom it is required to deal equitably; and a contract subject to pipeline prorating, in the event the limits of capacity are reached, would promise something less than an adequate *quid pro quo*. (emphasis added)

It is impossible to overstate the importance of common carriage status of oil pipelines, as determined in the 1906 Hepburn Act (which was modeled on railroad regulation), on the continued vertically-integrated, joint-ventured structure of the oil pipeline industry in the United States.

¹⁶ Further, unlike the relatively easy job of storing oil in tank farms, the storage of gas is mainly done in the porous rock (in depleted gas fields) or in specially-created hollow spaces in underground salt mines. The geology that allows for either storage method is not common on the map, and neither storage method is anywhere as economical or easily available as the above-ground storage of crude oil or refined petroleum products.

B. Vertical Integration in Gas Pipelines Through 1935

Professor Troxel, in his 1936 study of the costs and organization of long-distance gas pipelines (the first analysis of the gas pipeline industry by an economist), examined the role of vertical integration through utility holding companies. As he stated:

...recently constructed long-distance pipe lines have often been financed jointly by two or more corporate groups. One or more of the corporate interests may produce natural gas; other interests in the combination may be owners of customer distribution systems. For some of these jointly financed lines, there was no public sale of securities. For example, the Columbia Gas & Electric Corporation holds 70% of the voting shares of the Atlantic Seaboard Corporation in which Standard Oil of New Jersey is the other stockholder.¹⁷

Troxel noted that in addition to a lack of any federal price or service regulation of gas pipelines, no federal or state agency gathered data on gas pipeline construction. Nor was there a generally accepted line of demarcation between gas transmission and consumer distribution lines or field gathering lines. Nevertheless, using an assortment of publicly available data from industry directories and investment advisory services, he found that more than 60 percent of “trunk” gas pipelines were controlled by the nation’s five largest utility holding companies. Others found that by 1935, almost 80 percent of the gas pipeline mileage in the United States was part of nine major holding companies systems with extensive vertically integrated holdings in both gas production and distribution.¹⁸

Investment analysts at that time viewed vertical integration as a strength of the businesses, almost to the point of excluding a discussion of any other form of organization. One 1930 volume produced to inform investors, in a chapter entitled “Companies that are Well Balanced, Integrated Units” relates the following:

Among the companies principally or wholly engaged in the natural gas business and constituting complete units in the industry—producing, transporting and distribution

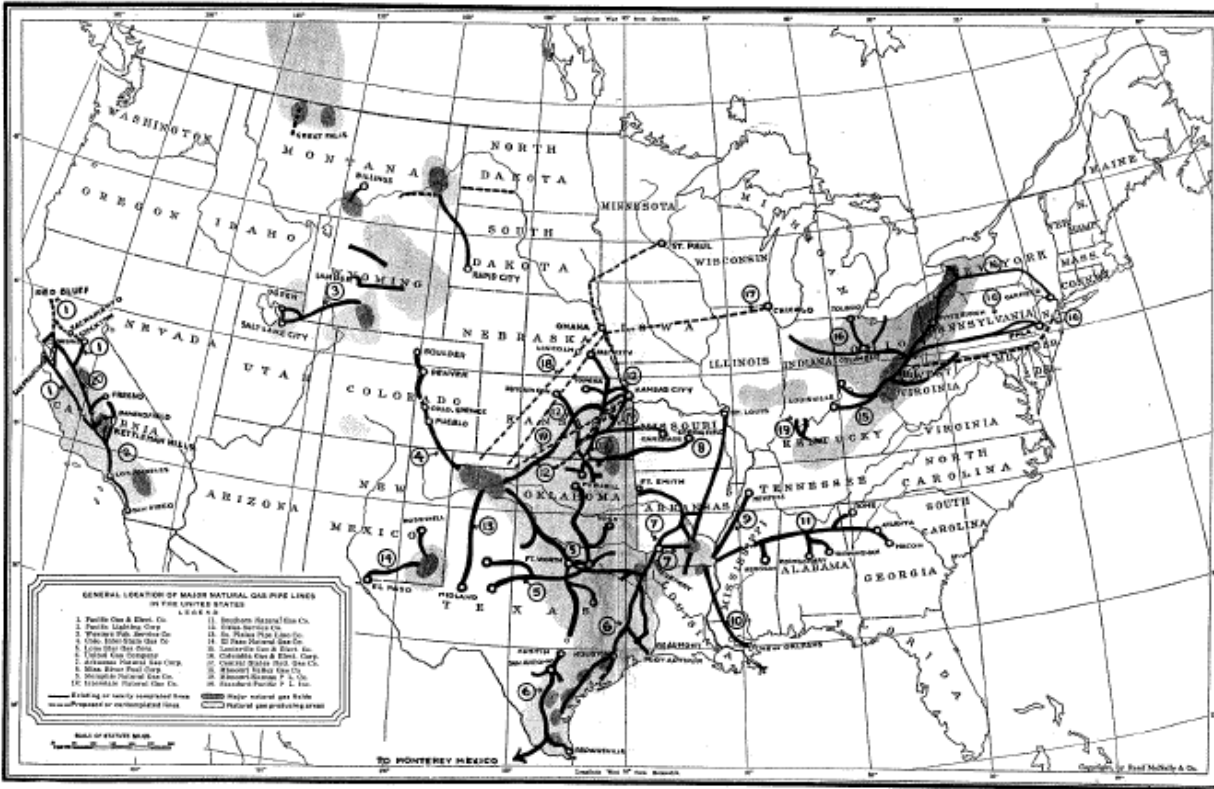
¹⁷ Troxel, C.E., “Long-Distance Natural Gas Pipe Lines,” *The Journal of Land and Public Utility Economics*, Volume XII (November 1936), p. 347.

¹⁸ Hooley, R.W., *Financing the Natural Gas Industry, the Role of Life Insurance Investment Policies*, AMS Press, New York (1968), p. 31.

through both wholesale and retail outlets—the following are by typical and prominent:”
 [then proceeding to list prominent vertically integrated utility holding companies]¹⁹

Figure 1 shows the major gas producing basins and pipelines in 1930.

Figure 1. Major Vertically Integrated Gas Pipelines in the United States, 1930



Source: Youngberg (1930), page 58

Table 1 shows the rapid pace of construction of vertically integrated gas pipelines in the United States in the late 1920s and early 1930s.

¹⁹ Youngberg, J.C., *Natural Gas, America's Fastest Growing Industry*, Schwabacher-Frey Company (1930), p. 21. Youngberg was listed as a Partner in Goldman, Jacobs & Co., of San Francisco.

Table 1. Gas Pipelines Built Under Vertical Integration, 1925-1936

Name of Company	Miles	Field of Supply	Principal Destination	Diameter (inches)	Date of Completion
Magnolia Gas Co.	217	Northeastern Texas	Beaumont, TX	14 to 18	1925
Interstate Natural Gas Co.	280	Monroe & Richland, LA	New Orleans	22 and 18	1927
Memphis Natural Gas Co.	250	Monroe and Richland	Memphis	18	Dec., 1928
Southern Natural Gas Corp.*	462	Monroe and Richland	Atlanta	22 and 20	Nov., 1929
Mississippi River Fuel Co.†	526	Monroe and Richland	St. Louis	22	Nov., 1930
United Gas Public Service Co.	158	Louisiana Fields	Franklin, LA	14	June, 1931
Lone Star Gas Co.	350	Panhandle Field	Fort Worth	20 to 16	1926
Cities Service Pipe Line Co.	450	Panhandle Field	Kansas City, MO	20	1928
Colorado-Interstate Gas Co.	340	Panhandle Field	Denver	22 and 20	June, 1928
Natural Gas Pipe Line Co. of Amer.	905	Panhandle Field	Chicago	24	Aug, 1931
Panhandle-Eastern Pipe Line Co.‡	1200	Panhandle Field	Detroit	24 and 22	July, 1936
Northern Natural Gas Co.	1100	Panhandle and Hugoton	Minneapolis	24 to 16	1932
United Gas Co.	150	Jennings (South Texas)	Monterrey, Mex.	12	1930
Atlantic Seaboard Co.	467	Eastern, KY	Coatesville, PA	22	Mar., 1932
Lycoming Natural Gas Co.	110	Tioga, PA	Syracuse, NY	20	1931
Western Pub. Serv. Corp.	345	Clay Basin, Wyo.	Salt Lake City	18	1929
Montana Power Gas Co.	200	Cut Bank, MT	Anaconda, Butte	20	1931
Montana Power Gas Co.	120	Dry Creek, MT	Bozeman	10	1931
Western Gas Co.	707	Jal, N.Mex.	Phoenix	16 and 10	Jan., 1934
Pacific Gas and Elec. Corp.	325	Buttonwillow, CA.	San Francisco	22	1929
Southern Fuel Co.	207	Kettlemen Hills CA	Los Angeles	26	1931
Standard Pacific Gas Line..	205	Kettlemen Hills CA	San Francisco	26 and 20	1931
Total Miles	9074				

Notes:

* The Tri-Utilities Company, a holding company, controlled the Southern Natural Gas Company.

† An Electric Bond & Share subsidiary

‡ The line to Muncie, Indiana, 960 miles, was completed in 1931.

Source: Troxel (1936), p. 347.

The holding company structure was clearly driven in part by the relationship specificity in gas pipelines, reinforced by the need to form complex industrial relationships in an era when it was hard to obtain industrial information for such infrastructure businesses (as Troxel had found). This was particularly true for interstate gas pipelines, which, at that time, existed in a regulatory vacuum—with no agency charged with collecting or publishing gas pipeline company data.²⁰

Ultimately, however, the vertical integration of gas pipelines at that time was not only about protecting quasi rents. These holding companies were large collections of both gas and electric companies, and more importantly for future reform of the gas sector, the source of manifest financial

²⁰ The third era of gas pipelines—contractualization—would indeed have been impossible without vastly improved public information flows made possible both by federal information requirements for the industry and modern web-based communication.

abuses. These abuses led to unusually strong Congressional legislation to sever the holding company links.

II. The First Transition: Vertical Integration Replaced by Regulation

The holding company structure encouraged a number of abuses, including the write-up of property values of subsidiaries and excessive service fees provide by affiliates.²¹ Such abuses can occur for any regulated company. Modern accounting regulation and meticulous scrutiny of affiliate transactions in experienced regulatory jurisdictions takes care of most of them. Up to the 1930s, however, American regulatory methods had not generally advanced to the level where they could readily handle such problems.²²

On top of abuses related to write-ups and affiliate abuses, the paramount abuse of holding companies involved pyramiding the control over regulated franchises. Before the 1930s, there was no federal regulation of electric or gas companies, and state commissions did not carefully regulate the organization of holding companies.²³ These holding companies allowed excessive returns at the top, in conjunction with extraordinary risk of financial collapse with even the slightest non-performance by the regulated franchises at the bottom.

Congress passed the Public Utility Act in 1935 deal both with this pyramiding and other perceived abuses associated with large interstate holdings of locally-regulated utilities.²⁴ Title I of the act (known as the Public Utility Holding Company Act—or PUHCA) gave the Securities and Exchange

²¹ Professor Phillips provides an excellent discussion of the abuses of the holding company structure among utilities in the United State by the mid 1930s. See: Phillips, C.F., *The Regulation of Public Utilities*, Public Utilities Reports, Inc., Arlington, Virginia (1993).

²² Modern industry regulatory practice proves that effective regulation requires strict and detailed regulatory control over accounting procedures. Such accounting regulation began with the Uniform System of Accounts, which Congress adopted in 1938 as part of the Natural Gas Act.

²³ Many of the state commissions did not have statutory control over property and security acquisitions, mergers and consolidations. Many had indirect regulatory powers to control such holding companies in these areas, but they did not use them. As Troxel stated: “They did not lack regulatory powers so much as they lacked perception, a strong feeling of public responsibility, and vigor.” Troxel (1947), p. 165.

²⁴ 49 Stat. 803 (1935). The Act was only repealed in 2005 by the Energy Policy Act (EPACT) of 2005 (Section 1263).

Commission (SEC) jurisdiction over public utility securities. As part of that jurisdiction, the SEC was given the power to simplify the holding company structures of gas and electric utilities. Troxel stated in 1947:

The Holding Company Act was a severe law. It was the most stringent, corrective legislation that ever was enacted against an American industry. Yet forceful actions were needed to straighten out the corporate organization and control of the electric and gas industries. The remedy was suited to the patient. Many holding companies were dissolved, partially liquidated, or reorganized. Unified, technically related systems replaced conglomerate financial arrangements that served the interests of financiers. Investment banker control of electric and gas industries was eliminated or modified; and the engineers became more important.²⁵

The SEC invited companies to submit proposals for their own reorganization. It was 1940 before formal proceedings began. The SEC sought to establish integrated systems that were confined to a single area and to ensure that the resulting holding company was not so large as to impair the local management, effective operation or effective regulation.²⁶ In the end, the corporate link between gas pipelines and local distributors, which had been blurred within a number of holding companies, became henceforth sharply defined.

Troxel minced no words in describing (in 1947) the unusually severe nature of the legislation and the role of what is arguably the most powerful American regulatory enforcement agency (the SEC) in doing so:

Breaking up the holding company system and forcing financial reorganizations on the remaining holding companies, the SEC is an uncommonly powerful regulator. American governments, functioning in an environment where the tradition of private enterprise still is strong, rarely liquidate or reorganize an established industry. The [alcohol] prohibition amendment destroyed investment values in the liquor industry, and antitrust legislation forced financial and marketing reorganizations in a few industries. But no other legislation ever equaled the Holding Company Act in bringing about broad managerial and financial changes. No law ever forced the divestment of about \$9,000,000,000 worth of property. Because Congress saw uncommonly bad practices by holding-company financiers, it was provoked to pass extraordinary legislation. Congress dealt bluntly with

²⁵ Troxel (1947), p. 172.

²⁶ Phillips (1993), p. 634.

irresponsible, notably acquisitive conduct, preferring to rebuild the corporate structures rather than to temper the practices.²⁷

With the PUHCA, Congress had effectively signaled the end of vertical integration of gas pipelines and gas distributors. Interstate gas pipeline mileage controlled by holding companies declined from 80 percent in 1935 to 18 percent in 1952.²⁸ Thenceforward, the relationship between these companies holding extensive relationship-specific investments was to be almost purely contractual. There was, however, no standard form of gas pipeline/distributor contract in 1935. But by the time the SEC came to enforce the act in the 1940s, Congress provided one—the Natural Gas Act (NGA) of 1938.

III. The Era of Regulated Prices and Implicit Pipeline Contracts

The Great Depression essentially halted new gas pipeline development. No long-distance pipelines were constructed from 1936 to 1944. When gas pipeline construction resumed it did so under implicit contracts with distribution companies for delivered gas under regulation of the Federal Power Commission (FPC). This new era also saw novel sorts of financing arrangements—invented specifically for the gas pipeline market by the American life insurance industry.

I first review the judicial, legislative and regulatory changes that allowed these new, implicit, long-term contracts to work. I then describe how a novel source of funds from the American insurance industry took that firm foundation for regulated charges as security for their financing of the vast growth of the gas pipeline business in the 1950s.

A. The Foundation for Regulated Gas Pipeline Contracts

The Natural Gas Act of 1938 (the NGA) was a novel piece of legislation in a number of ways. First, distinctly unlike the Congressional legislation aimed at regulating oil pipelines (the Hepburn Act of 1906), the NGA specifically avoided the common carriage model of regulation (which had been applied

²⁷ Troxel, (1947), pp. 187-188.

²⁸ Hooley (1968), pp. 34-35. There were specific, relatively uncommon, exemptions granted to the PUHCA, such as that allowing National Fuel Gas Corporation to remain in control of its highly interconnected and overlapping gas pipeline and gas distribution operations in New York and Pennsylvania.

originally in the late 19th century by the Interstate Commerce Commission to American railroads). Instead, Congress gave to the FPC the power to regulate interstate gas pipelines as public utilities, which would then have particular obligations to serve their connected distribution customers. A large part of the federal government's switch in regulatory methods was the experience gained in the States in the regulation of their own utilities.²⁹ Equally important, however, to the development to the new generation of pipelines that were to follow in the late 1940s were four features that were to form the bedrock of future American utility regulation—all of which came essentially during the moratorium on gas pipeline construction. These features are: (1) the NGA's Uniform System of Accounts; (2) the Supreme Court's final say on what constitutes a *fair return* to investors in public utilities; (3) Congress's specification of precisely what constitutes *due process* in the regulatory adjudication of regulated prices; and (4) the decision of the National Association of Railroad and Utility Commissions (NARUC) to decide on the role for *depreciation* in regulated charges.

1. The Uniform System of Accounts (1938)

Effective regulation requires that regulators themselves define consistent and sustainable accounting procedures to be used by regulated companies. The early history of regulation in the United

²⁹ Some writers, like Professor Pierce, conclude that the rejection of common carriage was done principally at the behest of gas pipeline interests as a way of maintaining a degree of monopoly control over gas sales.

Congress had chosen [common carriage] with respect to oil pipelines in 1906. [note omitted] With interstate gas pipelines required to provide equal access to their facilities to all third parties, thousands of producers would be free to sell to hundreds of gas distributors and millions of consumers in a perfectly competitive gas sales market. The pipelines objected to this approach, however. They sought instead a form of government intervention that would protect them from competition in both the transportation and the sale of gas. Congress obliged by enacting the Natural Gas Act of 1938 (NGA). (Pierce, R. J., "Reconstituting the Natural Gas Industry from Wellhead to Burnertip," *Energy Law Journal*, Vol. 9, No. 1. (1988), p. 6.)

While the gas pipeline companies may have desired a rejection of common carriage, I think a more compelling case can be made that the rejection of common carriage occurred for two other reasons. First, as an operational matter, it is not at all clear that distributors would have agreed to anything other than firm contractual access to their competing pipelines, a type of service inconsistent with common carriage (see the comment in footnote 15 by de Chazeau and Kahn). Second, the period after 1906 saw great advances in the practical regulation of public utilities. It provided Congress a convenient model upon which to seize to provide the guaranteed pipeline service to distributors that a common carriage supplier could not practically do for the delivery of difficult-to-store natural gas without holding considerable excess capacity in pipeline and gas processing facilities.

States was characterized by infamous accounting abuses, including overstated expenses, unverifiable investments in plant and equipment, a lack of separation between utility and non-utility businesses and overcapitalization.³⁰ Such abuses were effectively ended with the adoption by federal regulators of the Uniform System of Accounts as part of the powers granted by Congress under the NGA. The specification of these strict accounting standards were gradually accepted by the states.³¹ The widespread adoption of these regulatory accounts rarely left energy utilities and their regulators in substantial dispute over basic financial issues (like profitability, depreciation expenses or the admissibility of particular costs).³²

For the purpose of future investors and lenders to pipeline projects, the accounting standards were key to safeguarding investments put to the use of the public. That is, iron clad accounting rules significantly diminished the type of abuses that could create uncertainty in the recorded value of assets used for regulated ratemaking.³³

2. The *Hope Natural Gas* Decision (1944)

In the United States, the fundamental legal limitations on the ability of regulators to take actions on regulated charges that damage the value of utility investors' property come from well known Supreme Court decisions. Best known is the case of *Federal Power Commission v. Hope Natural Gas*.³⁴ In that case, the Supreme Court found that the value of the property that investors provide in regulated

³⁰ See: Phillips (1993), pp. 216-217.

³¹ Although the National Association of Railroad and Utility Commissioners (NARUC) drew-up a set of uniform regulatory accounting standards in 1920, a general nationwide revision of accounting standards began in the 1930s, led by the state regulatory commissions in Wisconsin and New York. It was less than two years after the NGA that the FPC specified the uniform accounting systems, which spread to most state Commissions in the 1940s. See Troxel (1947), pp. 121-122.

³² From the perspective of recently-constituted regulatory agencies around the world, these accounts seem amazingly tight and uniform. Indeed, the regulator actually provides the pages for the utilities in their jurisdiction to fill out

³³ The Uniform System of Accounts never applied to the Interstate Commerce Commission's regulation of the oil pipeline industry in the United States. Even today, after the FERC inherited the job of regulating oil pipelines, there is still no unambiguous "rate base" for most of the major oil pipelines in the country—a debilitating consequence for regulating that industry in the orderly manner applied to gas pipelines.

³⁴ *Federal Power Commission v. Hope Natural Gas*, 320 U.S. 591 (1944).

enterprises was safe from seizure by regulators only if those investors earned a return on their capital consistent with that which could be earned on enterprises of similar risk in the marketplace. Regulators were required to use a utility's original book costs less depreciation (or some readily equivalent calculation) as the basis for determining prices that were "just and reasonable." This change cut through decades of regulatory tail-chasing on the question of how to value the "rate base." Even today, normal utility tariff reviews (as well as substantial changes in regulatory rules) reference this particular judicial precedent.³⁵

For the purpose of complete contracts, the *Hope* decision was critical. It sharply limited investor uncertainty regarding the ability of regulators to act in a manner that would damage the value of the assets that investors would devote to regulated enterprises.

3. The Administrative Procedures Act (1946)

The 1930s in the United States was a time in which considerable legal analysis was devoted to determining the legality of utility regulation's growing impact on the value of property of regulated assets. At that time, regulators had the power either to reward or punish the utilities in their jurisdictions and greatly augment or shrink the value of those utility investors' property. Accordingly, legal scholars and the courts questioned whether utility regulators were acting within the confines of power actually

³⁵ Those who wrestled with utility valuation during the early decades of the 20th century knew the potential power of the *Hope* decision. When the ink was barely dry in 1947, Troxel said presciently:

Judged by its legal history, the reasonable valuation of public utility property is a tough old bone on which many have chewed without getting good and satisfying results. ... The meaning of reasonableness, which is always something less than perfectly clear and conclusive in a democratic society, is more confused than crystallized by so many gnawings on the valuation bone. Some secondary matters such as used and useful property or valuations for working capital and land already seem to be quite well settled by acquiescence of judicial opinion, but a reasonable definition of tangible property value still is disputed. The Supreme Court has, I think, the elements but not the refinements of reasonable regulation in the *Hope* decision; at least it centers attention on the primary question of reasonable earnings rather than reasonable property values, and it is in a good position to reorient commission behavior in future decisions. Yet, our society still is so attached to private property values that the Court may not be able to keep away from them as further cases come to it. (Troxel (1947), pp. 283-284.)

granted by legislatures. Within the relatively vague limits of existing regulatory statutes, discretion was given to regulatory commissions that was not extended by specific legislative mandate and seemed to violate the United States Constitution's prohibition for the taking of property without due process.

To address these issues, Congress acted by passing the Administrative Procedures Act of 1946.³⁶ That act specified meticulous procedures to be followed by all regulatory commission that would assure Constitutional due process. It specified timing limits, the need to act upon evidence, the ability of witnesses presenting that evidence to be cross-examined, and many other aspects of the work of regulators. The Administrative Procedures Act imparted much greater fairness, predictability and transparency than had been the case. As such, it facilitated the forming of the specific gas pipeline contracts that were to follow.

4. NARUC's Policy on Depreciation for Ratemaking (1943)

The National Association of Railroad and Utility Commissioners (NARUC), the organization linking all state and federal regulatory bodies, issued what it called a "Herculean" report on utility depreciation in 1943.³⁷ For the purpose of writing complete contracts for gas pipeline capacity, such well-defined rules for treating depreciation were critical. Henceforth, investments in utility infrastructure, including gas pipelines, would follow meticulous engineering standards for depreciable lives. More importantly, depreciation in ratemaking would be the explicit mechanism by which investors' capital would be returned to them over the useful life of regulated assets. With the Uniform System of Accounts and the NARUC policy on depreciation, investors always knew where their property was—on the utility's books. And the *only* way it could be removed from those books was through a depreciation charge in regulated tariffs—thereby safely returning the value of investments in regulated assets to investors over those assets' useful lives.

³⁶ See: Moynihan, D. P., *Secrecy: The American Experience*, Yale University Press, New Haven, Connecticut (1998). Former Senator Moynihan (Democrat – New York) discussed the historical and political origins of the Administrative Procedures Act.

³⁷ National Association of Regulatory Utility Commissioners, *Public Utility Depreciation Practices*, Washington D.C. (1968), p. iii. The agency dropped "Railroad" and added "Regulatory" to its title in 1967.

B. The Form of the Regulated Implicit Contracts

As a result of the NGA, the implicit contracts for gas pipeline services arose that specified the sales of natural gas by the pipeline companies to distributors, as defined in the regulated tariffs (a book containing all terms, conditions and relevant existing regulated prices, as well as sample copies of service agreements, contracts, nomination forms, etc.). The specific tariff books for each gas pipeline company differed, but all specified the following in some fashion:

- **Availability:** This limited service to shippers that had duly executed a service agreement (*i.e.*, a contract)
- **Qualifications for service:** Various technical qualifications were required for sales customers taking service from the pipeline.
- **Delivery points:** The shipper had particular delivery points. The service agreement could restrict the type of deliveries between primary and secondary points, or give discretion to the pipeline company.
- **Rates and charges:** This would specify the maximum FPC-authorized rates, as appearing on summary pages elsewhere in the tariff book.
- **Monthly bills:** This term specified the nature of the monthly bill that would aggregate the various rates and charges
- **Failure of the seller:** This provision described the consequences of the failure of the pipeline company to deliver applicable flows and pressures and the consequences to the monthly bills.
- **General terms and conditions:** This covered all applicable safety and security obligation as listed in the general Code of Federal Regulation.

All of the individual sheets in the tariff book were individually approved by the FPC (and later by its successor the FERC). They were subject to change as the result of a tariff investigation. For example, changes would be approved as a result of a general tariff review, at least to the existing “rates and charges” pages even if all other characteristics of the service remained the same. In their totality, the pages of the tariff book represented a firm contract for the delivery of gas, under specific pressures and qualities and at specific locations. It could change only at the direction of the regulator. Furthermore, while the individual service agreements between gas pipeline and their customers had a specific duration

(20 years was common), those agreements were renewable at the sole discretion of the customer under the maximum approved rate. That is to say, the pipeline contracts were essentially perpetual.

C. Federal Regulation as Security on Pipeline Loans During the Industry’s Rapid Postwar Expansion

Vertically separated gas pipeline operations are notoriously difficult to finance with investor capital—precisely because of the challenges posed by relationship-specificity. Most countries in the world operating significant gas pipelines today did not even try to motivate investor funds for the purpose—they built their lines instead with public funds (even if they were later privatized).

The period after the prohibition of vertical integration posed a problem related to the source of funds. The life insurance industry played the dominant role in solving that problem. In the period of the gas industry’s rapid post-PUHCA expansion, just before and after 1950, approximately 78 percent of bonds in natural gas pipeline companies were held by life insurance companies. Most of the remainder of pipeline financing came from private pension funds and personal trusts (*i.e.*, other “trustee investments”) that looked to the life insurance industry for guidance. Table 2 shows the heavy involvement of the life insurance companies in the rapid post-war expansion of the gas network.

Table 2. Life Insurance Bond Financing of Gas Pipelines, Selected Years

<i>Year</i>	<i>Pipeline Bonds Owned by U.S. Life Insurance Companies (in millions of dollars)</i>	<i>Total Natural Gas Pipeline Bonds Outstanding (in millions of dollars)</i>	<i>Percentage of Pipeline Bonds Outstanding Owned by Life Insurance Companies</i>
1945	170	318	53
1949	975	1,211	81
1950	1,130	1,452	78
1955	1,884	2,920	65

Sources: Life insurance company holdings from Institute of Life Insurance, *The Tally of Life Insurance Statistics*, November, 1950, and February, 1957; pipeline bonds outstanding from U.S. Federal Power Commission, *Statistics of Natural Gas Companies* (Washington, D.C., U.S. Federal Power Commission, 1955), p. ix.

Source: Hooley (1968), p. 48.

The basic problem in attracting any long-term loans to the industry was that such gas pipelines represented “unseasoned” investments. That is, it was the general policy of life insurance companies (and other trustee-driven investments) to require a satisfactory earnings record over a 10 year period as a prerequisite for investment. Gas pipeline investment risk was generally believed to be greater than the risk assumed when acquiring traditional institutional investments (for example, real estate mortgages and the bonds of most telephone and electric utilities of the time, which had been in business for many decades). Nevertheless, life insurers financed most of the six-fold expansion of interstate gas shipments between 1946 and 1959.³⁸

A number of events occurred to thrust life insurance companies into this role. Part of the reason was a shortage of highly secure, long-term investments for the life insurance industry at the time, aided by the new FPC regulation. Prior to the NGA, the unregulated interstate gas pipeline business was considered by investors to be of distinctly higher risk compared to telephone or electric companies’ securities. With the NGA and the inauguration of federal regulation, gas pipelines took on the role of utilities—with similar risk profiles.

Still, however, the life insurance industry was not prone to loan money in extractive industries.

As Professor Hooley put it:

Why have life insurance companies loaned billions of dollars to enterprises whose main business it to transport a wasting asset thousands of miles from the Southwest to the consuming regions of the United States? How have these traditionally conservative institutions attempted to protect their investments secured by wasting assets?³⁹

The answer lay in the robustness of the new federal regulation of the industry. The life insurance industry after the NGA was willing to take FPC regulation as security on long-term loans to the industry, knowing that: (1) their investment was safely embedded in the uniform accounting system, based on original

³⁸ Hooley (1968), pp. 13, 45.

³⁹ Hooley (1968), p. 1.

cost⁴⁰; (2) the returns granted to the pipeline companies would “fair” (under the *Hope* definition) based on the opportunity cost of capital; (3) that depreciation would be calculated in a way to recoup pipeline investments from customers over their useful lives; and (4) ultimately, the income needed to cover the debt gas was the sound credit standings of the distribution gas utilities.

Table 3 shows the rapid construction of new pipelines from 1944 through 1956 under the implicit contract arrangement associated with selling delivered gas under FPC-regulated tariffs.

Table 3. Gas Pipelines Built Under Implicit Long-Term Contracts, 1944-1956

Name of Company	Miles	Area of Supply	Principal Destination	Diameter (inches)	Date of Completion
Tennessee Gas Transmission Co.	1,265	Texas Gulf Coast	Cornwall, WV	24	1944
Texas Eastern Transmission Corp.*	1,340	East Texas	New York City	24	1945
Texas Eastern Transmission Corp.†	1,475	East Texas	New York City	20	1945
El Paso Natural Gas Co.	1,200	Permian Basin	San Francisco	26-30	1947
Michigan-Wisconsin Pipe Line Co.	1,609	Panhandle/Hugoton Field	Milwaukee/Detroit	24	1949
Transcontinental Gas Pipe Line Co.	1,840	Texas-LA Gulf Coast	New York City	26-30	1950
El Paso Gas Co./Pacific Gas & Electric	1,100	San Juan Basin, NM	San Francisco	24-34	1950
Tennessee Gas Transmission Co.	520	Northwest Pennsylvania	Boston	24	1951
Texas-Illinois Natural Gas Pipeline Co.	1,300	Texas Gulf Coast	Chicago, IL	26-30	1951
Trunkline Gas Co.	1,300	Louisiana Gulf Coast	Central Illinois	24-26	1951
Algonquin Gas Transmission Co.	300	New Jersey	Boston	24	1953
Gulf Interstate Company	1,150	Louisiana Gulf Coast	West Virginia Pipe terminus,	30	1954
Southern Natural Gas Co.	450	Louisiana Gulf Coast	Monroe Field	20-24	1954
Southern Natural Gas Co.	1,200	Louisiana Gulf Coast	Michigan	30	1956
Pacific Northwest Pipe Line Co.	1,487	San Juan Basin	Seattle	22-26	1956
Total Miles	17,536				

Notes:

* Conversion of "Big Inch" oil pipeline

† Conversion of "Little Big Inch" oil pipeline

‡ The line to Muncie, Indiana, 960 miles, was completed in 1931.

Source: Tussing and Barlow (1984)

D. A Side Effect of Federal Regulation—Pipeline Divestiture of Gas Production

The provisions of PUHCA were designed to dismantle the highly pyramidal structure of widely dispersed regulated utilities in the various states. Those provisions did not themselves break the link

⁴⁰ While the original cost accounting might appear to impose inflation risk on lenders, that risk was ameliorated by the specification of a nominal cost of capital (*i.e.*, including the inflationary component) as a return on the un-depreciated values of the investment.

between gas pipelines and gas production. However, the FPC original cost accounting, which assured the life insurance companies in their pipeline underwriting role, effectively removed the incentives for that link.

For property used to provide services to customers, including capital put into pipelines *and* gas production properties, the law specified that the FPC provide for a “fair” return on original cost. In effect, this would mean that pipeline-owned gas supplies could not fetch a market price. In a period of rising real gas prices, this meant that it was far more preferable to spin off pipeline-owned supplied and purchase them in the market rather than own them as part of an FPC regulated utility.⁴¹

IV. The Second Transition: Regulation Replaced by *Contractualization*

The era of implicit contracts facilitated the rapid expansion of the gas pipeline industry. At the same time, however, its novelty as a form of interstate transport regulation (as opposed to the familiar forms of common carriage dealing with oil pipelines or railroads) invited new market problems, transactions costs and inefficiencies. To be sure, no industry regulatory regime escapes such issues. The history of regulation displays many cases where regulations (or regulators) failed to protect consumers, disrupted markets or crippled the industries they were charged to oversee. By the 1970s and 1980s, such problems led to vigorous calls on the part of gas consumers for a changes in gas pipelines’ role in the market. In this section, I illustrate two of these problems that prompted calls for new types of gas transportation contracts freed from being limited only to providing delivered gas: (1) problems associated with the regulation of gas prices paid by pipelines; and (2) lengthy and expensive fights surrounding the certification of new pipelines.

⁴¹ See: Casteneda, C. and Smith, C., *Gas Pipelines and the Emergence of America’s Regulatory State*, Cambridge University Press (1996), p. 138. There is no unanimity of opinion regarding the effect of federal regulation on incentives of pipelines buy gas from their own producing units. Others conclude that pipeline companies could profit through high-priced transactions with gas producing affiliates. Referring to the period after the passage of the NGA, Pierce (1988) states (p. 7): “The [FPC] encountered a significant problem in performing its consumer protection function in one recurring context, however. When a pipeline purchased gas from its own production division or subsidiary, the FPC was concerned that the pipeline might pay itself an excessive price in order to earn through its unregulated production activities the monopoly return on its pipeline activities that FPC regulation otherwise denied it.”

A. The Gas Acquisition Problem—Shortage and Surplus

While the NGA was passed by Congress to administer utility-style regulation to interstate gas pipelines, it was not originally intended to apply cost-based regulation to the gas producing sector. The naturally monopolistic pipelines under the NGA acted as the “purchasing agent” of gas for their connected distribution customers. The weighted average cost of gas for the pipeline companies was added as a pass-through expense to the delivered pipeline tariff. The FPC permitted pipeline companies no margin on the cost of “gas acquired for re-sale” (a specific line-item in the Uniform System of Accounts). At the same time, pipeline companies were not obligated under the NGA to provide third parties access to their pipelines (as was the role for the common carriage regulatory regimes for oil pipelines and railroads). As Professor Pierce put it, pipelines were permitted to act as classic “tollgates lying athwart a trade route.”⁴² Pierce’s quip should not necessarily be taken as a criticism of the NGA, for acting like a regulated “tollgate” was not a novel role for gas pipelines to play. All regulated energy utilities at the time of the NGA were charged with acquiring necessary energy supplies on their customers’ behalf.

In specifying utility-style regulation for the nation’s gas pipelines, however, the NGA created a problem that bedevils utility regulators to this day—how to ensure that regulated energy network monopolies acquire energy supplies prudently, at fair market prices, in the interest of their connected utility customers? The utility—gas pipelines in this case—are *agents* on captive customers’ behalf. They have no corporate interest or funds of their own at stake. They operate only under the general set of regulatory incentives set for them by their regulators. There was not at the time of the NGA in 1938, nor is there today in 2006, an agreed set of rules for how regulation (that is, either regulators or the regulated

⁴² Pierce (1988), p. 7. Pierce generally provides an excellent review of this era leading up to contractualization.

companies themselves) should act in such circumstances always to serve the interest of the captive consumers for whom they are the ultimate monopoly supplier.⁴³

The gas acquisition problems facing pipelines, as agents for their customers, ultimately contributed through complex means to a perceived gas shortage in the 1970s (which enraged gas consumers and led for calls for industry reform) and perceived surpluses in the 1980s (which verged on crippling gas pipeline companies and gave the FERC the ability to extract such reforms despite lacking the power under the NGA unilaterally to impose them). I describe the perceived shortages and surpluses in turn.

1. The Run-up to Shortage

In acquiring supplies in the then-unregulated gas market after the late 1940s, the FPC and gas pipelines quickly ran into difficulties, both with their own regulations and with the courts. There were two general types of concerns. First, there was concern that pipelines still affiliated with production companies would pay excessive prices for those supplies.⁴⁴ Second, as pipelines successively contracted for gas production in particular regions, rising customer demand would give the remaining un-contracted gas supplier market power, both with the ability to charge monopoly prices for themselves and possibly to drive up prices generally through the “most favored nations” clauses then prevailing in gas production contracts.

The first concern was not apt to be debilitating, particularly in the era of the Uniform System of Accounts and careful FPC regulation. By the time gas pipelines resumed their construction activities with the industry’s rapid growth in the late 1940s, the FPC was probably adept-enough, as a general matter, to deal with affiliated interest transactions. To the extent that there was a genuine market, supplied largely

⁴³ For a modern take on how regulators struggle with this acquisition “agency” problem for electric utilities in competitive—but sometimes volatile—wholesale and power markets in the United States, see: Makhholm, J.D., Meehan, E.T., and Sullivan, J.E., “*Ex Ante or Ex Post?: Risk, Hedging and Prudence in the Restructured Power Business*,” *The Electricity Journal*, April 2006 (forthcoming).

⁴⁴ Pierce (1988), p. 7.

by unaffiliated producers (which was indeed the case by the 1950s), the FPC could well have dealt with such a problem.

The second concern—the possible exercise of market power in the producing fields—was more difficult to solve.⁴⁵ It led to two Supreme Court cases that explicitly extended FPC control over wellhead gas prices.⁴⁶ Particularly with respect to the latter case, the 1954 *Phillips* case, the Supreme Court decision opened the door to cost-based regulation of wellhead gas prices that did not end completely until the late 1980s.

For much of the 1950s after the *Phillips* case, gas producers and distributors were in litigation surrounding what it meant to regulate gas prices and how those regulated prices were to be set. Gas producers fought vigorously against any form of gas price regulation in the field. They and supported legislation that passed in 1955 the United States Senate—by a whisker—but was vetoed by Present Eisenhower because of questions regarding how it had been enacted.⁴⁷

Gas consuming interests had a different perspective. To them, the questions were whether uncommitted gas suppliers could exercise market power vis-à-vis the pipelines, and further whether the

⁴⁵ Pipelines are generally supposed to possess *monopsony* power in the fields, not be subject to monopoly power. As a general matter, there is always the possibility of exploitation of organized producers by pipeline purchasers. However, the pipelines of this era were merely agents for captive customers, competing at the margin for the uncommitted supplies in the producing fields to which their pipelines led. As Professor Kahn said in testimony before the FPC in 1959:

...the striking characteristic of price behavior in all leading markets in the last ten years has been the upward thrust of market prices imparted by new buyers looking for additional supplies, and the consequent necessity for established buyers to follow, either immediately or with a lag. So far as discrimination between various sellers in the same field is concerned, the introduction and widespread incorporation in long-term contracts of the most-favored-nation and price-renegotiation clauses have certainly tended to eliminate this, and in so doing have substituted the threat of monopolistic for that of monopsonistic exploitation. (Before the Federal Power Commission in the Matter of Champlin Oil & Refining Co., *et al.*, Docket Nos. G-9277, *et al.* (1959), Testimony of Dr. Alfred E. Kahn p. 108).

⁴⁶ These cases were *Interstate Natural Gas Co. v. FPC*, 311 U.S. 682 (1947) and *Phillips Petroleum Co. v. Wisconsin*, 347 U.S. 672 (1954).

⁴⁷ Pierce (1988), p. 8. Apparently, as Pierce relates, the deciding Senate vote was cast by a Senator who allegedly changed his mind at the last minute after receiving a large sum of money from a gas producer.

price that would elicit the incremental production should automatically apply to supplies previously contracted for 15 of 20 years. Speaking again in 1959, Kahn stated:

...although there are exceptions, typically, it appears, the upward thrust of prices in producing fields is provided by the entry of newer pipeline companies seeking supplies in areas where they have not purchase theretofore, especially where the buyers is under some pressure of time ... to obtain certification, and particularly on purchases of large volumes. This upward thrust is then, apparently, typically transmitted with a varying time lag to additional purchases by existing pipelines in the field, and to small volume contracts as well as large, although differentials remain or may remain.⁴⁸

The FPC's ultimate plan involved the regulation of gas prices by aggregate fields, due to the complete administrative infeasibility of applying cost-based regulation to individual producers. But the administration of such regulation, and the litigation involved itself proved administratively burdensome and extended throughout the 1960s.⁴⁹

The sluggish administration of field price regulation was widely believed to have contributed to the apparent gas shortages that had developed in the early 1970s as energy prices generally increased following the 1973 Oil Embargo. But in response to calls at the time to abolish wellhead price controls, there was no unanimity on how to address the problem. Professor Kahn, then Chairman of the New York Public Service Commission said in hearings before Congress:

In these circumstances ... deregulation of gas will surely raise price gouging opportunities; the probable windfall to the industry is a price monstrously out of proportion to the benefits that deregulation might be expected to bring. I regard simple deregulation in these circumstances as totally unthinkable, and I cannot bring myself to believe that Congress will be willing to enact it.⁵⁰

⁴⁸ Kahn (1959), pp. 70-71.

⁴⁹ Professor MacAvoy estimated that the total costs of the area rate proceeding to set gas prices cost tens of millions of dollars each year. MacAvoy, P.W., *The Natural Gas Market: Sixty Years of Regulation and Deregulation*, Yale University Press, New Haven and London (2000), pp. 11-12.

⁵⁰ As cited in: Sanders, M.E., *The Regulation of Natural Gas: Policy and Politics, 1938-1978*, Temple University Press, Philadelphia (1981), pp. 148-149.

Congress responded with very gradual and complicated partial deregulation of gas prices with legislation in 1978.⁵¹ However, a number of factors in the gas market had already lessened the severity, if not removed, the shortage situation of the early 1970s by dampening gas demand or increasing gas supply.

2. The Run-up to Surplus

Quite apart from what was happening in the field market for natural gas, pipeline companies after 1978 remained gas purchasing agents for their captive customers. Furthermore, despite the lessening shortage by the late 1970s, many gas pipeline companies continued to purchase high-priced gas under a two-tier regulated pricing structure that kept separate “old” and “new” gas. The expense of “new” gas took two forms. One was simply a high price. The other was embodied in high “take-or-pay” terms (which required very high and consistent takes) or terms related not to a fixed quantity but on “deliverability” (which committed the interstate pipeline buyers to contractual takes not calculated on a fixed contract quantity but on whatever the seller was able to “deliver” from a well).

Many gas pipelines in the late 1970s and early 1980s thus purchased incremental gas supplies at high prices, and high take-or-pay restrictions for whatever producers were able to extract from particular wells. The price at which they sold those supplies as part of their delivered gas contracts with customers, however, was the average of all their gas acquired for re-sale to captive customers. In essence, this made the marketability of pipeline acquired gas contingent on mixing “old,” regulated gas supplies with the “new,” decontrolled gas.

When the market for gas softened in the mid 1980s, and the “old” gas price restrictions phased out, many pipeline companies paid very large bills for gas not taken under those take-or-pay contracts with new gas suppliers. That is, under the existing market conditions by the mid-1980s, most of the gas pipeline companies in the United States had greater or lesser take-or-pay liabilities for gas they could not market to customers at their prevailing average cost of gas. When the FERC in 1984 prevented them

⁵¹ The legislation was the Natural Gas Policies Act of 1978 (15 U.S.C. 3301 *et seq.*).

from holding their customers responsible for all of their purchased gas, many gas pipeline companies in the United States faced imminent financial ruin as total unmarketable take-or-pay liabilities reached approximately \$11.7 billion at the end of 1986.⁵²

The FERC seized upon this situation to give the pipelines a “Hobson’s choice.”⁵³ That is, the FERC gave gas pipelines two options in this period of excessive commitment to purchase gas supplies given the state of the market: (1) pipeline could accept open-access status and provide transportation of gas owned by others on a first come, first serve, nondiscriminatory basis under a “blanket” certificate; or (2) a pipeline, consistent with the language in the NGA, could decline to become an open-access carrier and could continue to exclude all third parties from transporting gas on its system.⁵⁴ Like all of the other changes in the gas pipeline industry in the United States, considerable litigation surrounded this choice. The Court of Appeals commented on the voluntary nature of this choice regarding whether to accept the terms of voluntary open access status, stating:

First, refusal of the option [of a blanket certificate for open access] may spell bankruptcy: inability to provide blanket-certificate transportation for fuel-switchable users may *in certain market circumstances* cause critical load loss. Of course acceptance of the option may also be fatal. But when a condemned man is given the choice between the noose and the firing squad, we do not ordinarily say that he has “voluntarily” chosen to be hanged.⁵⁵

The nature of the market, combined with various sorts of pressure from the FERC, led all interstate gas pipeline companies to “voluntarily” accept the first option by the end of the 1980s. Without the complex set of events that resulted first in perceived shortage and then in pipeline acquired surplus, it is doubtful whether without a basic amendment to the NGA those pipelines would ever have committed voluntarily to opening their pipelines to third party supplies.

⁵² Pierce (1988), p. 40.

⁵³ An apparently free choice when there is no choice at all. Thomas Hobson, a late 16th century stable owner, gave his customers the choice of the horse closest to the stable door, or no horse at all.

⁵⁴ These were two options as part of FERC Order No. 436, which was the first FERC policy on implementing third party access to gas pipelines in the United States.

⁵⁵ From the Court of Appeals decision on Order No. 436 (*Associated Gas Distributors v. FERC*, 824 F.2d 981 (D.C. Cir. 1987), p. 82, (emphasis added)).

The voluntary acceptance of open access was the beginning of a process by which property rights in the value of pipeline capacity was transferred to their customers.

B. New Certification Litigation

The era of regulated long-term implicit contracts for delivered gas also made new pipeline certification an administrative affair. Throughout the period of regulated long-term delivered contracts, new pipeline certification and construction involved extensive evidentiary litigation on “economic need” before the FERC. Under the NGA, the FERC was instructed not to authorize a new pipeline unless it found that it was required in the public interest. Pipeline companies engaged in competition in two ways to meet this “public interest” test: the first was to convince a range of distribution companies to support a particular project and the second was to out-compete other rival prospective pipeline projects to demonstrate the “economic need” for their own particular project. If a particular pipeline company or consortium won that test, they would receive the approbation of the FERC and hence a “certificate of public convenience and necessity” required to build.

One typical example involved proposals to expand gas pipeline to the Northeastern part of the United States in the late 1980s. The FERC received dozens of different applications from competing transport companies to serve that new load. For example, in what was called the “Northeast U.S. Pipeline Expansion Projects” proceeding begun in 1987, the FERC in March 1988 consolidated applications filed prior to its open-season deadline into 31 distinct projects. The Commission made a preliminary determination that 20 of the projects appeared to be competitive or mutually exclusive and therefore entitled to consideration in a hearing. The Commission in June subsequently limited consideration to nine of discrete proposals, requiring 13 others to be consolidated into a single investigation. By November 1988, most of the parties settled with each other, agreeing to three new proposals. The first of these, the Iroquois Gas Transmission System, L.P., was eventually awarded a certificate by the FERC in

1990.⁵⁶ It entered service on January 28, 1992, more than five years after the original inquiries regarding the need for more capacity and after millions of dollars expended by many parties in litigation before the Commission.

V. The Third Era: *Contractualization*

Once the gas pipeline industry had accepted the transition to transportation contracts instead of implicit contracts for delivered gas, the FERC moved to strengthen the rights of shippers to purchase gas supplies competitively and to separate the economic rent inherent in existing capacity at cost-based rates from the price of newly constructed capacity.

A. The Market in Contractual Rights

The interstate gas transmission business at this time represented about \$50 billion dollars worth of un-depreciated pipeline assets that tied thousands of gas producers to about 200 sizeable state-regulated gas distribution companies (as well as many other electricity producers and industrial companies). There were a number of features that made such a market uniquely possible for this particular energy network in the United States.

First, the gas pipeline industry involved traditionally regulated utilities under a single federal jurisdiction. Second, gas pipelines were unique in the nature of their sunk costs. Before the interstate gas transmission companies could finance their pipeline projects, they wrote those implicit delivered gas contracts with gas distributors for essentially all interstate capacity in the country—contracts that could readily be transformed into firm transportation contracts. Those gas transmission contracts existed from the very beginning because, regulation notwithstanding, capital markets required that gas distribution company buyers commit to a very long string of payments before the market provide the capital to build the pipe. Third, the gas shipped on these pipelines was by that time a deregulated market. Further, modern technology made it possible to track a shipper's gas through the network in real time. Fourth,

⁵⁶ See: FERC, *Iroquios Gas Transmission System L.P.*, Docket No. CP89-634-000 *et al*, Order Making Preliminary Determination and Establishing Procedures, 52 FERC 61,091, at 61,344 - 61,345 (July 30, 1990).

electronic bulletin boards, mandated by the FERC, provided comprehensive market information to buyers and sellers of capacity rights.

Given these existing features of the gas pipeline industry, the market could readily accept an efficient market in the rights to transmission services. Buyers held clear contractual rights to practically all existing interstate capacity. The FERC ratemaking formula for pipelines was longstanding and well known. Re-selling pipeline capacity (on a temporary or permanent basis) was allowed on interstate pipelines. The market was well informed, with no particular information barriers. There were no artificial barriers to creation of new capacity.

Professor Coase would recognize these as prerequisites for an efficient market in rights on the existing interstate gas pipeline network.⁵⁷

B. Protecting Basic Contractual Property Rights

Like many significant changes in federal regulation, the interested parties initiated considerable litigation surrounding the creation of a market in transport rights. The gas pipeline companies, for example, were generally strongly opposed to a number of provisions that would have speeded its arrival. These problems generally all involved the precise definition of contractual rights for pipeline shippers, the ability of those rights to retain their value, and the ability to re-sell those rights to others at unregulated prices.

First, the FERC would not for some time permit secondary market prices to rise to a market level.⁵⁸ This introduced a considerable distortion into the market for capacity. Those who valued the capacity could not get it, and those who would provide competing services confronted unduly cheap competition from existing pipelines. Second, it took years for the FERC to rule-out the prospect of

⁵⁷ The Coase Theorem is generally stated as follows: Given well-defined property rights, low transactions costs, perfect competition, complete information and the absence of wealth and income effects, resources will be used efficiently and identically regardless of who owns them. See: Coase, R. H., "The Problem of Social Cost," *Journal of Law and Economics*, Vol. 3 (October 1960), pp. 1-44.

⁵⁸ That is, the FERC initially limited secondary market prices to the level of the maximum FERC-approved tariff.

diminishing the value of existing capacity rights by allowing the cost-of-service of longstanding capacity to be “rolled-in” with the cost of newly constructed capacity. That is, the issue was whether to add new capacity costs to the same pool of costs out of which rates are made for those holding long-time capacity. The pipeline companies fought for roll-in, while their shippers fought against it.⁵⁹ After some early indecision and confusion at the FERC regarding this issue, the agency decided that incremental capacity on gas pipelines would reflect incremental costs—essentially putting all new gas pipeline projects on a competitive basis.⁶⁰ Henceforth, the market would decide whether an incremental project is financially viable, standing on its own.

The principal reason that such problems arose is that the questions associated with the re-sale of regulated property rights was new for regulators. The FERC had to sort out a number of questions. First, they had to sort out the difference between *economic rent* and *monopoly profit*. Such regulators have always seen themselves as regulators of monopoly profits. However the FERC was confronted with the task of determining who could capture the economic rent in such a network (that is, the difference between a pipeline’s cost of service and its value in the market). It took years for the FERC to settle into its role as the regulator of economic rents associated with valuable existing capacity.

Second, the FERC had to judge whether the secondary market for capacity rights would be competitive. Whether new pipeline capacity could be built competitively, and whether there was a competitive market for services that compete with pipeline capacity (gas storage, for example) were questions that had not confronted before.

⁵⁹ It is easy to see why the pipeline companies would favor roll-in. The major pipelines systems were held on the books of the pipeline companies at original cost, and were partially depreciated. Capacity on those lines was far less expensive than new capacity. With roll-in, existing pipelines could propose new projects at prices far below their construction costs, making up the difference through higher prices for their pre-existing customers. Such a manifest subsidy for new pipeline construction would allow existing pipeline companies to substantially under-bid all entrant rivals to serve expanded load, regardless of whether their projects were the least costly.

⁶⁰ The FERC finally imposed incremental pricing in July 2000. See: Federal Energy Regulatory Commission, *Policy Statement on Determination of Need*; 1902-AB86, FERC Docket No. PL-3-000.

Third, the FERC had to decide which actions on the part of holders of capacity rights might be seen as anticompetitive, and which were merely ways to best capitalize on valuable capacity in the market. Not surprisingly, the FERC showed reluctance to give up its jurisdiction over prices in the secondary market.

C. Making Complete Contractual Property Rights

Even with such a start, re-defining property rights with respect to the re-sale of gas contractual rights was a lengthy challenge. The FERC opened up an investigation (the Order No. 637 ruling) which lasted until 2000. In this ruling, FERC incorporated a number of important modifications to its initial contract carriage rulings. Among the most important elements in this ruling for defining capacity rights with sufficient clarity were the following: (1) the removal of the price cap on short-term capacity releases (less than one year) for a two and a half year period; (2) a requirement on pipelines to modify their scheduling procedures so as to eliminate disadvantages for released capacity relative to pipeline-controlled capacity; thus allowing released capacity to compete on a comparable basis; (3) a requirement for pipelines to permit shippers to “segment” capacity (that is, into sequential sections consistent with accepted operating procedures and metering) to make the released market more flexible; (4) a revision in penalty policies so that pipelines provide greater imbalance management services and establish incentives minimize operational disruptions of contract rights; and (5) orders to expand, modify and consolidate interstate pipeline reporting requirements to improve price transparency.

With these additions and changes to the nature of pipeline services, the FERC essentially completed the meticulous job of defining the features of a well-functioning market in those rights.

D. US Gas Pipelines Today

For gas pipelines in the United States today, existing regulated monopoly networks remain essentially unchanged, with their owners receiving the familiar NGA-regulated cost of service for the facilities they operate for their customers. Vigorous competition among the contract holders determines who uses and expands the networks. Table 4 shows the pipelines constructed since 2000 under explicit

gas long-term gas transportation contracts. The shippers on those pipelines (nowadays a mix of local distribution companies, electric generators and gas marketers) purchased essentially perpetual capacity rights in those lines, at a cost determined by traditional FERC ratemaking methods. In coming years, those ratemaking methods are to be periodically updated as the pipeline companies update their cost-based tariffs. But with original cost accounting, the prospect for all of them is that by the time it comes to renew, the pipelines will be worth more in the market (perhaps very considerably more) than the cost-of-service commitment to the pipeline company that will allow shippers to retain their ownership of transport capacity rights.

Table 4. Gas Pipelines Over 250 Miles Built Under Complete Long-Term Capacity Contracts, 2000-2005

Name of Company	Miles of Main Line	Field of Supply	Principal Destination	Diameter (inches)	Date of Completion
Alliance Pipeline LP	887	Saskatchewan County, SK	Cook County, IL	36	2000
Kern River Transmission Co	922	Wyoming	Kern Country, CA	36	2001
Energy Transfer Co	264	Anderson County, TX	Georgia	42	2001
El Paso Natural Gas Co.	1088	McCamery (Town) County, TX	Border County, CA	30	2002
Questar Pipeline Co	405	San Juan County, NM	California	16	2002
Gulfstream Natural Gas System	560	Jackson/Mobile County, MS	Polk County, FL	36, 30	2002
Kern River Transmission Co	716	Wyoming	Kern Country, CA	36	2003
Williston Basin Interstate PL	253	Carter County, WY	Dunn County, ND	16, 8	2003
Colorado Interstate Gas Co.	380	Weld County, CO	Kiowa County, KSM	36	2004
Kinder-Morgan Energy Partners	254	McCamey County, TX	Travis Country, TX	24	2005

Source: Filings with the Federal Energy Regulatory Commission and press releases

The role of FERC regulation is substantially different from the time when MacAvoy estimated they were spending tens of millions of dollars per year (in 1960 dollars) dealing with litigation over the cost of gas in delivered gas implicit pipeline contracts.⁶¹ First, certification battles are now comparatively

⁶¹ There were a number of spin-offs to this litigation, one of them being NERA itself. The firm was created from a firm called Boni, Watkins, Jason & Co. Along with Professor Alfred Kahn at Cornell University, NERA's full-time founders (Jules Joskow and Irwin Stelzer) had formed a considerable business representing gas distributors in this litigation. With 17 staff member working on gas matters, they formed NERA in 1961 simply by partitioning

perfunctory before the FERC. If a pipeline developer (either a new venture or an existing line looking to expand) comes with a list of commitment letters from shippers, the FERC generally considers that sufficient “economic need” to certify a new project (in addition to the normal operational and environment due diligence it must do). Second, the once hard fought pipeline rate cases have become perfunctory as well, as the regulated tariff structures for existing capacity increments have long-since been worked out. Given a thorough examination of the cost of service, the tariff structure is a *fait accompli* for the various incremental projects and pipeline customers find little reason to fight over cost allocation or tariff design.

VI. Summary and Conclusion

It is not possible to assess the gas pipeline industry in the United States today without being struck by the unexpected contrast with its close centenarian oil pipeline industry cousin. These two old cousins were both constructed with investor funds under the expectation that they would pay. Investors required solid assurance both of the adequacy of the fuels, the robustness of the markets and the competitive advantage of pipeline transport in the markets they would serve. In the 21st century, both networks operate competitively and reasonably efficiently. One indeed cannot tell them apart just by looking. They are similarly indistinguishable by the economic principles driven by pipeline technology: both exhibit manifest economies of scale, spatially separated “origin” and “destination” markets and relationship-specific investments. Occasionally, pipelines in the oil business will even be converted to gas, and give versa. Yet, these two networks have nothing in common in industry structure, ownership or price regulation.

These stark differences reflect an evolutionary split rooted in comparatively ancient legislative constraints. The prescribed evolutionary path for oil pipelines is exactly a century old—the 1906 Hepburn Act, which addressed the monopoly problem though common carriage. For the past century, the

the existing office space. See: Joskow, J., *NERA: A Somewhat Personal History*, National Economic Research Associates (November 1990), pp. 4-6.

oil pipeline industry in the United States evolved around that constraint. It is today largely an industry of joint ventures—an integral part of a highly vertically-integrated industry in reasonable equilibrium. There is certainly no movement afoot to change the governance of its vertical relationships.

Congress chose public utility regulation for gas pipelines with the NGA in 1938, whether because of the wish of its owners to be the “tollgate lying athwart the trade route” or for less colorful operational reasons associated with the uniqueness of the fuel and the particular needs of the longstanding gas distribution utilities. With utility regulation of such an extensive supply network came almost inevitable disequilibrium. Regulating the acquisition of adequate and efficient quantities of gas, under competitive conditions and with the most efficient pipeline facilities, was well beyond the competence of federal regulation in the 1940s and 1950s, when the gas pipeline industry grew six fold. This is not to criticize the FPC—to be sure, open access regulation of utility networks of any sort was decades away. However, the oil and gas producing industry was generally competitive since the breakup of Standard Oil by the Supreme Court in 1911.⁶² In a broadly competitive market for energy, particularly a volatile one, regulating either the delivery of pipeline-owned gas or determining the public interest in new pipeline construction was never going to be efficiently done by such an agency, even one set upon such a firm foundation of accounting and due process. Indeed, deliberative due process was bound to be part of the problem in dealing with such a market.

It was not inevitable that such disequilibrium would be solved by extending regulation to gas, rather than by choosing another regulatory model. But it was highly likely. As Troxel aptly said in 1947 when speaking about American regulatory commissions generally, “[b]eing practical, political-minded people, the commissioners wish a method that is tested by experience rather than by general reasoning.”⁶³ Like the Supreme Court, the FPC chose to ease its concerns about monopoly power (or affiliate interest

⁶² For many years thereafter, the largest 20 oil producers in broad regions of the country accounted for only somewhat more than half the gas production.

⁶³ Troxel (1947), p. 463.

abuse) in gas production by extending cost-based regulation upstream rather than pursuing either an upheaval of the NGA or a novel regulatory idea.

The resulting inescapable battles over regulated gas prices were truly remarkable. They pitted formidable gas producing interests against large consuming interests, represented by the equally formidable—and indeed much older—gas distributors. Economic rent worth billions of dollars was at stake, as well as the position of natural gas in the broader energy market. Dealing with these unending battles, and the apparent gas shortages that resulted in the early 1970s, took Congressional action. But Congress too demurred from overhauling the NGA, deciding to try to phase in higher field prices. Congress essentially agreed with Professor Kahn that the immediate decontrol of gas prices was out of the question. Again, however, the regulatory instruments available to the newly-renamed FERC could not deal with the challenge effectively (nor could they have been expected to). The task was to regulate efficiently the pass-through of the highly varied and volatile prices of gas flowing from fields in various states of decontrol. Regulatory commissions are still divided about how to do this (in modern wholesale electricity markets, for example).

The most extraordinary unintended consequence occurred as a result of phased decontrol of gas prices. The relative rapid transition from apparent shortage to apparent surplus, combined with haphazard buying practices by gas pipeline companies for whom gas was simply a pass-through expense for their customers, gave the FERC a potent and unexpected lever to reform the industry without altering the NGA. That is, with the gas pipeline companies in obvious, looming financial distress, because of their buying practices in this volatile gas market, the FERC could extract concessions that the NGA did not give it the power to impose. Those concessions by gas pipeline companies opened the door to widespread third-party gas shipments in their pipelines.

What remained was the methodical work needed for shippers to consolidate their new-found property rights in gas transport capacity that the pipeline companies had conceded. The job was essentially complete by 2000, at which time the FERC ceased to be particularly visible or critical to the

operation of the gas market, other than in its role of enforcing shippers' property rights and occasionally auditing the cost of service when pipeline companies would petition for a change in their charges.

At all stages of this complicated story, the economics of relationship-specific investments drove investors to form corporate and contractual governance relationships that would preserve the ability of the gas pipeline industry to attract capital. The highly idiosyncratic, cheek-by-jowl nature of gas pipelines and the need for constant operational coordination (with capital-intensive suppliers and customers) required institutional structures that could motivate sufficient investor funds to keep the gas always moving and keep pilot lights burning. Early in the 20th century, vertical integration met the need. That form of governance may well have lasted, but for the obvious financial abuses of the acquisitive and opportunistic utility owners of that era. Later, the regulated utility model seemed a practical form of governance, providing a foundation for investors to be sanguine that their money would be safely repaid during the industry's rapid growth. Later still, when volatile energy markets demonstrated the incompetence of that model, Coase-theorem-like *contractualization*, with its needs for modern technology and extreme operational/contractual precision, has filled the same role. Barring the rise of some source of market power abuse, the equilibrium inherent in this last highly competitive, low-regulatory-maintenance governance model is likely to last. To be sure, however, the development of this highly-evolved form of *contractualization* was probably never truly inevitable in the United States, and it is highly unlikely that it is inevitable in any other gas market (or indeed energy market) that does not share its evolutionary history and unique technology.

Long-term contracts in the energy sector have served early on to provide empirical evidence of transaction cost theory: thus, Joskow (1987, 1988) shows that the duration of contracts in the American coal industry is positively related to the level of asset-specificity. Crocker and Masten (1985) and Masten and Crocker (1988) were the first to test empirically the influence of different regulatory regimes in the US natural gas sector. In the US, the share of natural gas supplies through long-term contracts was reduced from almost 100% to below 50%. The first quantitative analysis of developments in European long-term gas supply was provided by Neumann and Hirschhausen (2004).