The
Cambridge-MIT
Institute
Electricity Project

14.23 Government Regulation of Industry

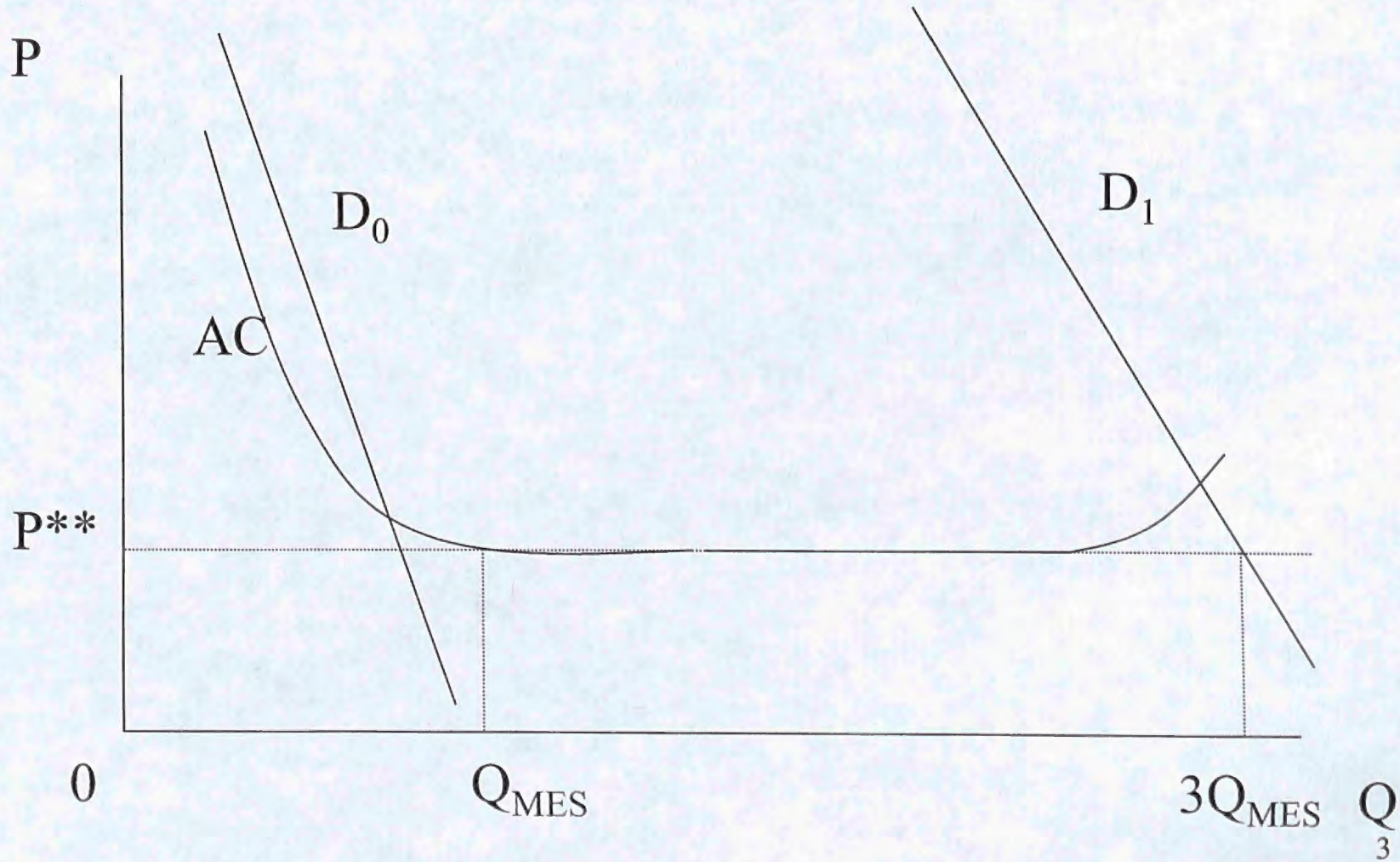
Class 9: Dynamic Issues in Natural Monopoly Regulation

MIT & University of Cambridge

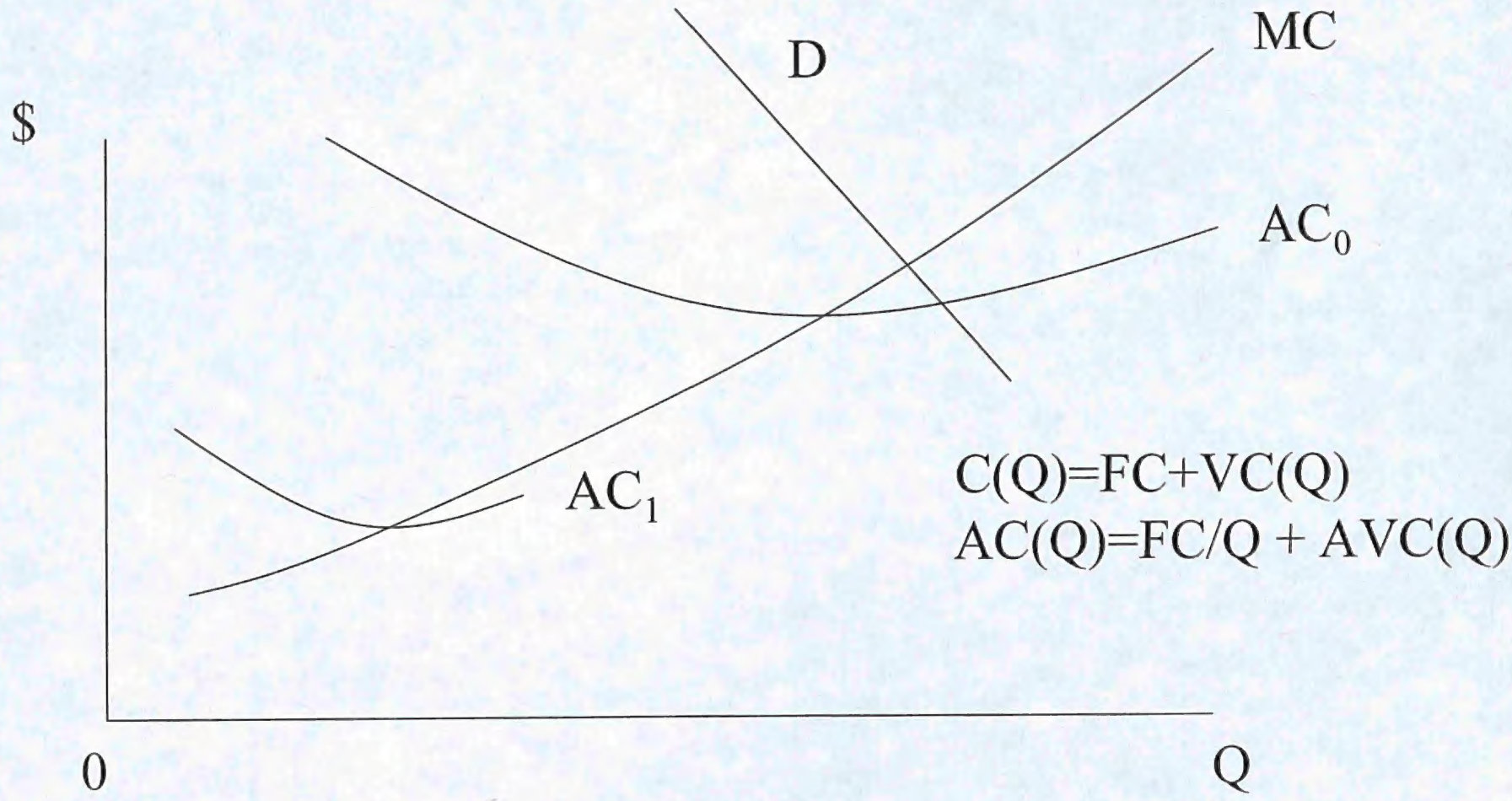
Outline

- When is a natural monopoly no longer a natural monopoly?
- Telecom regulation in the US
- Technological change and regulation
- The break-up of AT&T
- Regulated Competition
- The Separations issue
- An alternative development path?

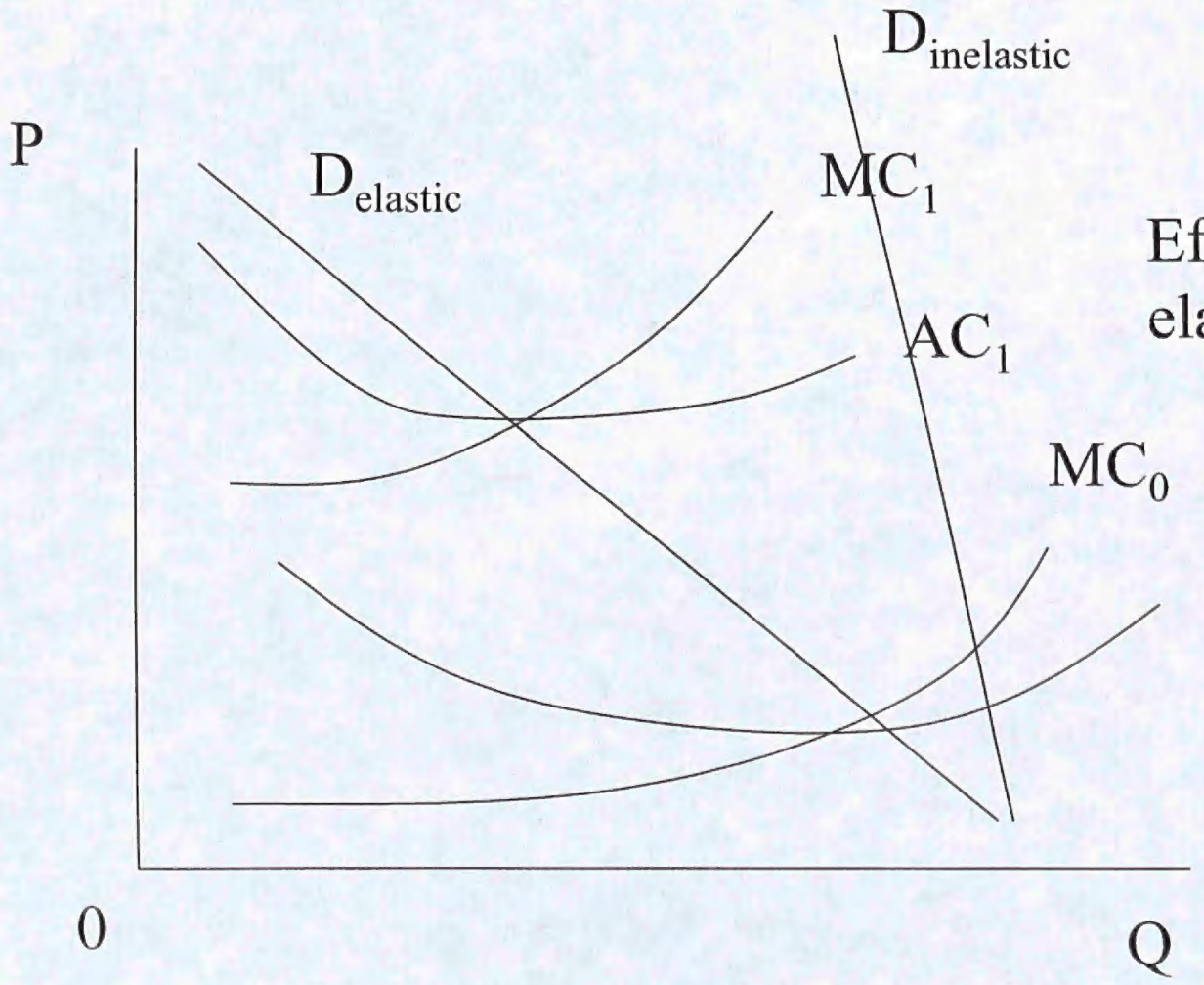
Demand Changes



Reduction in Fixed Costs



Rise in Variable Costs



Effect depends on elasticity of demand.

Policy Responses to effects of time on nature of market

- 1. Continue with price and entry regulation of all market segments.
- 2. Fully deregulate all markets.
- 3. Partially deregulate some markets restricting the behaviour of incumbent monopolists in competitive market.
- Issue is complicated by vertical relations where part of the service is provided by a monopolist which is needed by firms in the competitive segments e.g. access to local phone network required by long distance providers.

Asymmetric Regulation

- This occurs when regulation treats incumbent and entrants differently in market.
- Incumbent is multi-product firm with a universal service obligation. If you are recovering fixed costs disproportionately from one customer group. It may be possible for entrant to come in and sell more cheaply to this group (even though their costs are higher). For example Postal Service.
- This is wasteful because, cheaper to have one incumbent. Also such cross subsidy is not Ramsey pricing.

Telecommunications Example

- 3 basic services in the intercity telecommunications market (ITM):
  - Message Toll Service (MTS) or long-distance phone calls.
  - Wide-area telephone service (WATs) or interconnection services between networks.
  - Private line service (PLS) is a circuit that connects two or more points to meet specific user needs.

History of Telecom

- 1876: Alexander Graham Bell patents telephone.
- 1894: Patents expire and competitors to American Bell Telephone (RoR=46%) enter. AT&T is successor to this firm which included Bell operating companies, Western Electric (equipment manufacturing company) and Bell Labs (R+D organisation).
- Bell retained dominance after patents due to price competition and purchase of rivals.
- 1910: American Bell market share below 50% (RoR= 8%). AT&T embraces regulation and universal service. State control and regulation traded for financial protection.
- Existing market structure stabilised. Price structure unregulated. Complicated to regulate due to related companies.

History of Telecom Regulation

- 1910: Interstate long-distance service placed under jurisdiction of the Interstate Commerce Commission.
- 1934: FCC takes over this regulation.
- No formal restriction on new entry but none occurred.
- A lot of the industry appeared to be a natural monopoly but some parts e.g. equipment manufacturing clearly were not, however this was protected by ownership and contractual limitations.

Competition in the Equipment Market

- 1940s: Hush-a-phone introduced. A device which could be put on phone to protect privacy of conversation. AT&T prohibited attachments to their equipment. FCC supports AT&T. Court of Appeals rules in favor of Hush-a-phone as long as device is not 'publicly detrimental' it should be ok. AT&T resist implementation of this ruling.
- 1940s: Carterfone connects telephone network and mobile radio telephone. This violates AT&T tariff but not Court ruling.
- 1949: DOJ file suit against AT&T on grounds that Western Electric has unregulated prices.
- 1956: AT&T agrees to only operate in regulated services. AT&T barred from entering computer industry.

Technological Changes

- 1947: NY and Boston first microwave relay station, this represents *fall in fixed costs*.
- Computers and rising income *shifts demand outwards* for telephone use.
- TV and microwave transmission technology threatened AT&T's monopoly of long distance.
- Microwave had no patents associated with it because it was developed for national defence. Thus there were few entry barriers due to the new technology.

Interstate Competition

- 1948: FCC rules that permanent frequency assignments should be reserved for common carriers (AT&T).
- 1949: FCC AT&T not required to interconnect other common carriers, with permanent access to spectrum. Thus entry barred.
- 1956: FCC reviews earlier decision. It opens up spectrum to any private user (ABOVE 890). It allocated frequencies above 890 Mhz for microwave use.

Changing Economies of Scale

- Strong economies of scale up to 240 circuits, moderate to 1000, insignificant above this. Between NY-Philadelphia the required capacity was 79,000 circuits in late 1960s.
- Fixed costs large.
- AT&T offered no volume discounts to large customers.
- They had an incentive to enter.

AT&T and MCI

- 1963: Microwave Communications Inc. (MCI) filed for common carrier status to offer service between St Louis and Chicago. This was to be a PLS but wanted common carrier status.
- 1969: MCI application approved.
- 1971: FCC flooded with requests and allows free entry into PLS (specialised common carrier competition).
- 1974: MCI sues AT&T. MCI cannot get fair terms for local connection to AT&T.
- 1983: MCI wins against AT&T.
- 1975: Entry extended to business MTS by MCI, FCC does not allow entry into consumer long distance market.
- 1978: DC Court of Appeals overrules FCC and MCI allowed in. Free entry throughout ITM.

Partial Regulation

- From 1969, FCC regulates AT&T long distance and local rates such that long distance subsidises local service. This prevents predatory pricing.
- However this lays it open to cream-skimming. What does theory predict prices should do?
- AT&T complains about cream skimming.
- MCI complains about quality of connection and the need for more access numbers.

AT&T Break-up

- US vs AT&T: Anti-trust case concludes in 1982.
- 22 Telephone operating companies placed into 7 holding companies (Regional Bell operating companies, RBOCs).
- These divided into 161 Local Exchange and Transport Areas (LATAs).
- RBOC not allowed to provide long distance and equipment manufacturing and required to offer access to any long distance or data service.
- AT&T keeps labs and manufacturing against better judgement of DOJ.

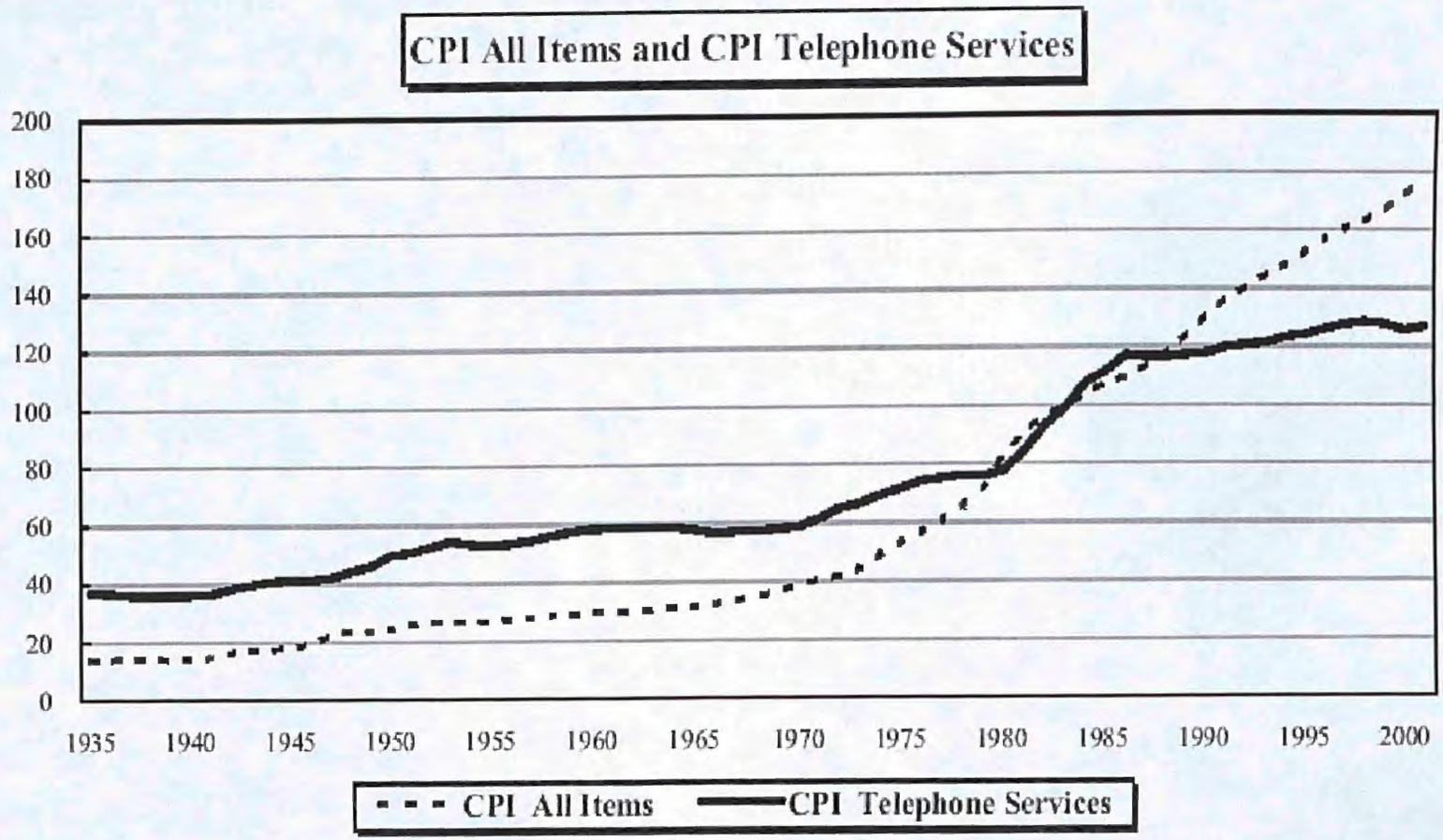
Regulated Competition

- AT&T still regulated after break-up. Required to serve all customers, file tariffs for new services and limited price discrimination.
- MCI, Sprint etc. can serve who they want.
- AT&T market share of long distance less than 40%. Prices have fallen.
- Prices of local calls have increased over 1998-2001 (but quality may be rising?).

Separations Issue

- By late 1970s: AT&T in local, long distance and manufacturing and faces different types of regulation in each (regulated monopoly, regulation competition and unregulated.)
- Should a regulated company be restricted in competitive segments?
- Benefits of separation:
  - Prevents price discrimination to win market share.
  - Prevents vertical foreclosure or quality degradation.
- Costs of separation:
  - Reduces economies of scope if these exist.
  - Eliminates a potential competitor from the competitive segment.

Prices of Telephone Services in the US



Source: *Trends in Telephone Service*, www.fcc.gov/wcb/stats, FCC (2002)

Competition in Long-Distance

Share of Total Toll Service Revenues
All Long Distance Toll Providers 1/

Year	AT&T	WorldCom	Sprint	All Other Long Distance Carriers	Regional Bell Operating Companies	Other Local Telephone Companies
1984	68.3 %	3.4 %	2.1 %	2.0 %	17.7 %	6.6 %
1985	67.1	4.3	2.0	4.4	16.5	5.8
1986	63.5	5.9	3.3	4.9	16.7	5.7
1987	60.2	6.7	4.4	5.2	17.5	5.9
1988	56.6	7.8	5.4	6.1	17.0	7.1
1989	52.3	9.5	6.5	9.1	16.0	6.5
1990	50.7	11.3	7.5	8.4	15.8	6.2
1991	50.2	12.5	7.8	9.0	14.7	5.9
1992	49.3	14.6	7.9	9.3	13.5	5.4
1993	47.5	16.0	8.2	10.1	13.1	5.2
1994	46.0	17.3	8.4	11.7	11.8	4.8
1995	44.9	21.4	8.5	12.0	9.6	3.7
1996	42.1	22.4	8.5	15.0	8.5	3.5
1997	39.2	22.9	8.5	18.8	7.1	3.6
1998	38.7	21.1	7.6	22.4	6.5	3.6
1999	36.9	21.7	9.0	23.7	5.7	3.0
2000	34.8 2/	20.6	8.3	28.1	5.5	2.7

1/ Includes independent local exchange carriers and competitive local exchange carriers.
2/ For year 2000, AT&T's market share does not reflect revenues from their share of Concert Global Networks USA, LLC. (See Table 10.1, footnote 7.)

Source: *Trends in Telephone Service*, www.fcc.gov/wcb/stats, FCC (2002)

Finland's Wireline Example

- Finland has among the cheapest fixed line calls in EU.
- Finland has a population of 5m and 46 local telephone companies (1960=201 companies).
- A national telephone company, providing long distance, existed along side regional companies.
- Finland has long had a competitive equipment market. Finland is home to the world's largest mobile phone company (Nokia) who entered the market as a supplier of network equipment.
- Productivity improved rapidly state carrier responded to competitive threat of ROCs and mobiles in the run up to de-regulation.

Conclusions

- Competition is desirable where it is possible.
- Regulation does tend to limit competition.
- AT&T was obviously too large from the beginning:
  - No national natural monopoly in local telecoms
  - No natural monopoly in equipment manufacture.
- Regulation extremely slow to adapt to change in technology and demand once put in place.

Next

- *Spectrum Auctions and Competition in Telecom*

- *Read:*

Council of Economic Advisors (2000), *The economic impact of third-generation wireless technology. Appendix 2: 'Case study of Finnish wireless cluster'* http://www.wireless.co.il/whitePapers/3geconomic.pdf

Klemperer, P. (2002), How (not) to run auctions: The European 3G telecom auctions, *European Economic Review*, Vol.46, No.4-5, pp.829-845.

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UNNATURAL MONOPOLY: CRITICAL MOMENTS IN THE DEVELOPMENT OF THE BELL SYSTEM MONOPOLY

Adam D. Thierer

Congress finally began the long-needed process of comprehensive telecommunication deregulation in 1994, exactly 60 years after their last major legislative effort, the Communications Act of 1934, was enacted. Legislators appear to finally realize what has been evident to many industry leaders and analysts for years--regulation is impeding the growth of new technologies, jobs, and exports, while simultaneously denying consumers the benefits of competition. Unfortunately, in an attempt to remedy the inefficiencies created by nearly a century's worth of regulation, Congress crafted a reform package that was anything but deregulatory. Both the House and Senate bills were over 200 pages long, contained 50 new regulatory powers, and included protectionist manufacturing requirements. Largely as a result of this pro-regulatory baggage, the bill finally died in the Senate in mid-September of 1994.

Before Congress makes any rash decisions on how to manage competition within the industry, legislators should review how the old Bell monopoly developed. Most legislators, academics, and many others believe the telephone industry is a natural monopoly that was privately monopolized by the aggressive actions of the American Telegraph and Telephone Company (AT&T). That was hardly the case. Although AT&T undoubtedly encouraged the monopolization of the industry, it was the actions of regulators and federal and state legislators that eventually led to the creation of a nationwide telephone monopoly.

In this paper I shall argue that the reason competition did not arise within the industry earlier this century is because it was not allowed to. Specifically, three forces drove the monopolization process:

1. The intentional elimination of what was considered wasteful or duplicative competition through exclusionary licensing policies, misguided interconnection edicts, protected monopoly status for dominant carriers, and guaranteed revenues for those regulated utilities;

2. The mandated social policy of universal telephone entitlement, which implicitly called for a single provider to easily carry out regulatory orders; and

3. The regulation of rates (through rate averaging and cross-subsidization) to achieve the social policy objective of universal service.

The combined effect of those policies was enough to kill telephone competition just as it was gaining momentum. Hopefully, by understanding exactly how those policies encouraged the growth of a telephone monopoly, policymakers can craft more pro-competitive legislation in the future.

The Bogus Natural Monopoly Model

For many decades, economic textbooks have held up the telecommunications industry as the ideal model of natural monopoly. A natural monopoly is said to exist when a single firm is able to control most, if not all, output and prices in a given market due to the enormous entry barriers and economies of scale associated with the industry. More specifically, a market is said to be naturally monopolistic when one firm can serve consumers at lower costs than two or more firms (Spulber 1995: 31). For example, telephone service traditionally has required laying an extensive cable network,

constructing numerous call switching stations, and creating a variety of support services, before service could actually be initiated. Obviously, with such high entry costs, new firms can find it difficult to gain a toehold in the industry. Those problems are compounded by the fact that once a single firm overcomes the initial costs, their average cost of doing business drops rapidly relative to newcomers.

The telephone monopoly, however, has been anything but natural. Overlooked in the textbooks is the extent to which federal and state governmental actions throughout this century helped build the AT&T or "Bell system" monopoly. As Robert Crandall (1991: 41) noted, "Despite the popular belief that the telephone network is a natural monopoly, the AT&T monopoly survived until the 1980s not because of its naturalness but because of overt government policy."

Indeed, a chronological review of the industry's development produces an indisputable conclusion--at no time during the development of the Bell monopoly did government not play a role in fostering a monopolistic system. Adherents to the old school of thought correctly point out that AT&T attempted to restrict competition throughout this century. Yet, this fact is irrelevant. Every business logically tries its hardest to exclude competitors. What is more important, and widely ignored, is exactly how federal and state government actions encouraged the Bell monopoly to develop during the early years of this century. Once the government allowed this monopoly to develop with its assistance, AT&T's strength could not be matched by any competitor, resulting in a monopolistic market structure that survived well into the 1980's.

AT&T's Patent Monopoly, 1876-94

When Alexander Graham Bell patented the telephone on March 7, 1876, few people realized just how important his new invention would become for American commerce and society in general. America was still in love with the telegraph and saw little immediate use for the telephone. Mark Twain even likened investment in the new technology to "wildcat speculation." Western Union, the most powerful telegraph company of the era, actually passed up the opportunity to buy the Bell patents for $100,000 believing the device was nothing more than a passing novelty.

Unfortunately for Western Union, the telephone turned out to be anything but a passing fad. Use of the device slowly gained acceptance, primarily among business users. Yet, compared to later decades, this Bell patent monopoly era was characterized by limited growth of service. From 1880 to 1895, average daily calls per 1,000 of population rose from only 4.8 to 37. Contrasting this 15-year patent monopoly period with the competitive period that followed the expiration of the Bell patents in 1894, average daily calls per 1,000 people jumped from 37 in 1895 to 391.4 in 1910. The number of telephones per 1,000 people also showed much more dramatic expansion during the competitive period after patent expiration than before. Telephones per 1,000 people rose from only 1.1 in 1880 to 4.8 in 1895, but skyrocketed to 82 by 1910. (See Table 1.)

Clearly, the Bell patent monopoly period was not as beneficial for the extension of service as the competitive period that would follow. Yet, by the end of its patent monopoly period, the Bell System had grown large enough to pose a formidable challenge to Western Union, the same company that had failed to buy up the original patents just 20 years earlier. But, with the expiration of their crucial patents between 1893-94, the Bell system faced an uncertain future. Although Bell had filed over 600 patent infringement suits to defend its 900-plus patents during this period, the company had no choice but to try its hardest to fend off the many new firms that were waiting for a chance to gain access to this lucrative new market. The Bell monopoly was, at least temporarily, dead.

Table 1

Spread of Telephone Service, 1880-1920

Year	Average Daily Calls Per 1,000 Population	Telephones Per 1,000 of Population
1880	4.8	1.1
1885	13.3	2.7
1890	23.0	3.7
1895	37.0	4.8
1900	103.6	17.6
1905	258.7	48.8

1910	391.4	82.0
1915	446.0	103.9
1920	486.5	123.9

SOURCE: Hyman, Toole, and Avellis (1987: 93).

The Development of Competition, 1894-1913

Despite AT&T's rapid rise to market dominance, independent competitors began springing up shortly after the original patents expired in 1893 and 1894. These competitors grew by servicing areas not served by the Bell System, but then quickly began invading AT&T's turf, especially areas where Bell service was poor. According to industry historian Gerald W. Brock (1981: 112), by the end of 1894 over 80 new independent competitors had already grabbed 5 percent of total market share. The number of independent firms continued to rise dramatically such that just after the turn of the century, over 3,000 competitors existed. Illinois, Indiana, Iowa, Missouri, and Ohio each had over 200 telephone companies competing within their borders (Brock 1981: 111). By 1907, non-Bell firms continued to develop and were operating 51 percent of the telephone businesses in local markets. Prices were driven down as many urban subscribers were able to choose among competing providers. AT&T's profits and prices during this period began to shrink due to increased competition. Whereas AT&T had earned an average return on investment of 46 percent in the late 1800s, by 1906 their return had dropped to 8 percent (Hyman et al. 1987: 78). As Brock (1981: 122) noted, this competitive period brought gains unimaginable just a few years earlier,

> After seventeen years of monopoly, the United States had a limited telephone system of 270,000 phones concentrated in the centers of the cities, with service generally unavailable in the outlying areas. After thirteen years of competition, the United States had an extensive system of six million telephones, almost evenly divided between Bell and the independents, with service available practically anywhere in the country.

Industry historians Leonard S. Hyman, Richard C. Toole, and Rosemary M. Avellis (1987: 90) summarize the overall effect of this period by saying, "It seems competition helped to expand the market, bring down costs, and lower prices to consumers."

The rapid ascendancy of competition casts doubt on the natural monopoly model of this industry. It appears AT&T's only claim to monopoly power prior to this period could be attributed to their numerous patents, not superior economies of scale as the natural monopoly theorists believed. In fact, as J. Maurice Clark concluded in his famous 1923 *Studies in the Economics of Overhead Costs*, "Telephone companies . . . show no signs of economy with increased size, but rather the opposite" (1923: 321). Hence, the most important justification for regulation of the telephone industry--that it was a natural monopoly with rapidly declining costs as its size increased--was not present during this era. Yet, as we shall see later, that fact would not stop AT&T and government regulators from arguing to the contrary.

Economies of scale constitute only part of the natural monopoly equation; high barriers to market entry constitute the other half. Yet, despite the large costs associated with telephone service initiation, new competitors were entering the market easily during this period. Hence, the barriers to entry were not so high as to exclude immediately new competitors. To explain the rapid demise of competition that would take place over the next few years, some other type of entry barrier had to develop. That new impediment would take the form of both subtle and blatant government intervention throughout the next decade.

Theodore Vail, Nationalization, and the End of Competition, 1913-21

Before examining exactly how the legal barriers to competition developed within the telephone industry, it is important to review the significance of a single man--Theodore Newton Vail. On April 30, 1907, Vail returned to AT&T as president,[1] marking the beginning of [cl12.25]the end of telephone competition. His return to the firm changed its fundamental focus from competition to consolidation. Vail's most important goals upon taking over AT&T were the elimination of competitors, the befriending of policymakers and regulators, and the expansion of telephone service to the general public. Reflecting Vail's belief in the superiority of a single telephone system, AT&T adopted a new corporate slogan as part of an extensive advertising campaign: "One Policy, One System, Universal Service." In AT&T's 1910 Annual Report, Vail summarized his belief in a single system saying, "Effective, aggressive competition, and regulation

and control are inconsistent with each other, and cannot be had at the same time." To achieve this vision, Vail began acquiring a number of independent telephone competitors, as well as telegraph giant Western Union. However, the government made it known quickly that such activity was suspect under existing antitrust statutes.

Wisely realizing the government was considering action to break up the growing firm, Vail decided to enter an agreement that would appease governmental concerns while providing AT&T a firm grasp on the industry. On December 19, 1913, the "Kingsbury Commitment" was reached. Named after AT&T Vice President Nathan C. Kingsbury, who helped negotiate the terms, the agreement outlined a plan whereby AT&T would sell off its $30 million in Western Union stock, agree not to acquire any other independent companies, and allow other competitors to interconnect with the Bell System.

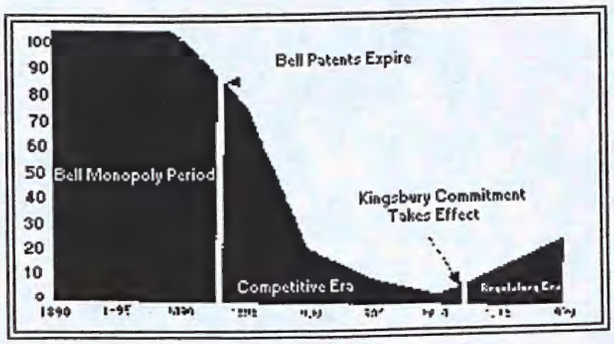
The Kingsbury Commitment was thought to be pro-competitive. Yet, this was hardly an altruistic action on AT&T's part. The agreement was not interpreted by regulators so as to restrict AT&T from acquiring any new telephone systems, but only to require that an equal number be sold to an independent buyer for each system AT&T purchased. Hence, the Kingsbury Commitment contained a built-in incentive for monopoly-swapping rather than continued competition. Brock (1981: 156) noted, "This provision allowed Bell and the independents to exchange telephones in order to give each other geographical monopolies. So long as only one company served a given geographical area there was little reason to expect price competition to take place."

Ironically, the move toward interconnection, while appearing in the independents' favor, actually allowed AT&T to gain greater control over the industry. Brock (1981: 156) found that "interconnection reduced the Bell's ability to drive the independents out of business but also eliminated the independents' incentive to establish a competitive long-distance system." Michael K. Kellogg, John Thorne, and Peter W. Huber (1992: 16-17) concluded:

The government solution, in short, was not the steamy, unsettling cohabitation that marks competition but rather a sort of competitive apartheid, characterized by segregation and quarantine. Markets were carefully carved up: one for the monopoly telegraph company; one for each of the established monopoly local telephone exchanges; one for the Bell's monopoly long-distance operations. Bell might not own everything, but some monopolist or other would dominate each discrete market. The Kingsbury Commitment could be viewed as a solution only by a government bookkeeper, who counted several separate monopolies as an advance over a single monopoly, even absent any trace of competition among them.

Hence, AT&T's short-term deal to steer clear of government regulation, would have long-term gains exactly the opposite of those the government supposedly desired. This was the beginning of the end for telephone competition (see Figure 1). Although it is impossible to say exactly what would have happened if AT&T had not been pressured into the Kingsbury Commitment, it is not outrageous to hypothesize that competition would have continued to flourish.

Figure 1
Percentage of Telephones Owned by Bell, 1800-1920



At this point, more explicit government actions began to have a deleterious impact on the industry. Despite the fears of many public officials that AT&T could become a ruthless monopolist, a contradictory notion began to develop that monopoly was inherently "natural" within this industry. Numerous federal and state officials began arguing quite openly that the telephone industry would function most efficiently if unified as one system. Legislators began referring to competition in the same terms as Vail--"duplicative," "destructive," and "wasteful." A Senate Commerce Committee hearing in 1921 stated that "telephoning is a natural monopoly." And a House of Representative committee report noted, "There is nothing to be gained by local competition in the telephone business" (quoted in Loeb 1978: 14). A Michigan

Public Utilities Commission report (1921: 315) from that same year also illustrates this prevailing sentiment, "Competition resulted in duplication of investment. . . . The policy of the state was to eliminate this by eliminating as far as possible, duplication." Many state regulatory agencies began refusing requests by telephone companies to construct new lines in areas already served by another carrier and continued to encourage monopoly swapping and consolidation in the name of "efficient service" (Lavey 1987: 184-85). Kellogg, Thorne, and Huber (1992: 17) sum up the prevailing sentiment: "To judge by actions, then, rather than words, government officials had no strong objection to monopoly telephone service. This was especially true for state regulators. For them, a local telephone monopoly was both welcome and convenient."

Not surprisingly, Vail's vision of "one system" that would provide "universal service" to everyone, began looking more attractive to many in public office. Richard H.K. Vietor (1994: 172) of Harvard University argues, "Vail chose at this time to put AT&T squarely behind government regulation, as the quid pro quo for avoiding competition. This was the only politically acceptable way for AT&T to monopolize telephony. . . . It seemed a necessary trade-off for the attainment of universal service." As AT&T's 1917 Annual Report noted, "A combination of like activities under proper control and regulation, the service to the public would be better, more progressive, efficient, and economical than competitive systems."

Industry historian Robert W. Garnet (1985: 130) provides further support for Vietor's findings:

> Regulation played a crucial role in Vail's plans. Astute enough to realize that the kind of system he proposed--universal integrated monopoly--would stand little chance of gaining public approval without some form of public control, he embraced state regulation. In doing so, he broke with the company's long-standing opposition to what [AT&T] management had traditionally regarded as an unwarranted intrusion on its prerogatives. But after years of unfettered competition, during which the firm's financial strengths had been sapped and its efforts to build an integrated system had been dangerously undermined, regulation became a much-preferred alternative. Thus, Vail obviously saw government regulation as the way to eliminate competitors: the one-way ticket, not only to universal service, but also to monopoly profits.

World War I and Nationalization

The stage was then set for the complete monopolization of the industry by AT&T. The regulatory treatment AT&T received was facilitating their take-over of the industry while, at the same time, allowing them to state publicly that they were under strict government control. Yet, despite the fact that the tables were certainly tilted in AT&T's favor in most areas, competition persisted in some regions. It was World War I, the nation's first global crisis, that would provide the government with a convenient excuse to forcefully gain control over communications and forever change the structure of the telephone industry. On August 1, 1918, in the midst of World War I, the federal government nationalized the entire telecommunications industry for national security reasons.

At first, AT&T executives became nervous when it was announced that Postmaster General Albert S. Burleson, a long-time advocate of nationalizing the telegraph and telephone industries, would assume control of the market. But, once the benefits of nationalization where made evident to Vail, his anxieties disappeared. Industry historian George P. Oslin (1992: 278) notes when Vail expressed concern over the plan to Western Union President and close personal friend Newcom Carlton, Carlton reassured Vail that the plan was in his interest: "It's your salvation. The government will be able to raise your rates and get you new money." As Oslin (252) argues, "That was what happened. Burleson appointed Vail, rated by Carlton as a genius, to manage the telephone, and Carlton to operate the telegraph."

Noobar R. Danielian (1939: 248) concurs: "There is evidence that Vail appreciated the advantages of Federal control . . . he was not in much of a hurry in the early part of 1919 to have his System back from nominal government control." This attitude should not be at all surprising since shortly after the industry was nationalized, AT&T's proposed contract establishing the terms of government ownership and compensation was accepted by the postmaster general. Danielian (1992: 252) summarizes the deal as follows:

> The federal government . . . agreed to pay to AT&T 4 1/2 percent of the gross operating revenues of the telephone companies as a service fee; to make provisions for depreciation and obsolescence at the high rate of 5.72 percent per plant; to make provision for the amortization of intangible capital; to disburse all interest and dividend requirements; and in addition, to keep the properties in as good a condition as before. Finally, AT&T was given the power to keep a constant watch on the government's performance, to see that all went well with government operation, by providing that the books of the Postmaster General

> would be at all times open for inspection. One might well wonder where the real control was lodged. Needless to say, the contract was eminently satisfactory to the Bell System.

In addition, once the nationalized system was in place, AT&T wasted no time applying for immediate and sizable rate increases. High service connection charges were put into place for the first time. AT&T also began to realize it could use the backing of the federal government to coax state commissions into raising rates. Vail personally sent Postmaster General Burleson studies that displayed the need to raise rates. By January 21, 1919, just 5 1/2 months after nationalization, long-distance rates had increased by 20 percent. In addition to being much greater than returns earned during more competitive years, the rates established by the postmaster during the year of nationalization remained in force many years after privatization. Consequently, AT&T's generous long distance returns continued to average near or above 20 percent during the 1920s.

By the time the industry was returned to private control on August 1, 1919, the regulatory route to competition elimination had paid off handsomely for Vail and AT&T. Of the estimated $50 million in rate increases approved by the postmaster general during nationalization, approximately $42 million, or 84 percent went to AT&T. Additionally, the government cut AT&T a $13 million dollar check at the end of the period to cover any losses they may have incurred, despite the fact that none were evident.

The Importance of Rate Regulation

The year of government nationalization was the nail in the coffin of competition. However, the favorable regulatory treatment AT&T received during government ownership was only partially to blame for the death of competition. Of much greater importance, according to Hyman, Toole, and Avellis (1987: 81), was the initiation of extensive rate regulation:

> During this period of government ownership, the decision was made to set standard long-distance rates throughout the country, based on average costs. In other words, subscribers calling from large cities would pay above costs in order to provide a subsidy to those in rural areas. So, early in the century cross-subsidization began, embraced by the industry, which rarely question the premise behind [fn5]the arrangement that the ability to communicate with subsidized subscribers was of value to the subsidizing subscribers. As long as the telephone industry had a monopoly and regulators approved of the arrangement, it did not matter what subscribers wanted. They had no choice.

The intention of this action was obvious--Vail's vision of a single, universal service provider was being adopted and implemented by the government through discriminatory rate structuring.

The decision to initiate rate averaging is vitally important to understanding exactly how the telephone monopoly developed for three reasons. First, rate regulation in the pursuit of universal service objectives virtually demands a single monopolistic provider in order to be truly effective. Few firms would ever have the ability to adequately fulfill universal service obligations unless they were already sufficiently large to use revenues from one segment of their business to subsidize the extension of service to citizens that policymakers wanted covered. In addition, regulators favor monopolies or cartels to carry out such social polices since they find it easier to control their actions rather than the actions of multiple competitors. Hence, in the quest to achieve social policy goals, regulatory commissions end up depending upon one, or a handful of firms to provide all industry output. Consequently, competition is made difficult, if not impossible. In the words of regulatory economist Alfred E. Kahn (1971: 12),

> When a commission is responsible for the performance of an industry, it is under never completely escapable pressure to protect the health of the companies it regulates, to assure a desirable performance by relying on those monopolistic chosen instruments and its own controls rather than on the unplanned and unplannable forces of competition.

Second, the initiation of extensive federal rate regulation is important because it propelled state regulatory commissions to follow suit by greatly extending the scope of their authority. By 1922, 40 of 48 states were regulating telephone rates (Noll 1991: 180). The public utility commissions at the state level immediately began to mimic federal policies established during World War I. Businesses and urban subscribers were charged more than rural customers to help extend service to distant locations. Likewise, long-distance rates were averaged to ensure a company could not charge more for toll calls of the same distance. Robert Garnet (1985: 152) describes this state-based rate regulation: "Statewide rate averaging would eventually become a distinguishing feature of Bell System subscriber charges and would be embraced

by regulators as a strategy for promoting the extension of telephone service to areas of marginal earnings potential." And that is exactly what happened. By 1925 not only had virtually every state established strict rate regulation guidelines, but local telephone competition was either discouraged or explicitly prohibited within many of those jurisdictions. [2]

Third, by averaging rates geographically to artificially suppress rural rates, policymakers and regulators created a serious disincentive to local telephone competition. Few firms, after all, will seek to enter a market and offer service if they realize it is difficult, if not impossible, to undercut the subsidized service of the incumbent carrier.

After reflecting on the overall impact of the introduction of regulation during this period, Brock (1981: 159-61) maintained,

> The combination of state and federal regulation stabilized the industry and ended the rate wars that had occurred during the early period of competition. Regulation increased the difficulty of new entry. . . . By accepting regulation voluntarily, Bell reduced the risk that unfavorable regulation would be imposed. The system of competing federal and state regulation, together with the complex Bell structure, prevented real regulatory control while providing the protection and legitimacy of a regulated utility. . . . The acceptance of regulation was a risk-reducing decision. It substituted a limited but guaranteed return on capital and management freedom for the uncertainty of the marketplace. It gave the Bell system a powerful weapon to exclude competitors and justification for seeking a monopoly, as well as reducing the chances of outright nationalization or serious antitrust action.

Hence, universal service, the final element of AT&T's strategy to eliminate competition, was in place thanks to the explicit actions of both federal and state legislators and regulators. Once AT&T's motto was adopted as the nation's *de facto* regulatory policy, no other firm was in a position to adequately extend service in accordance with the new federal and state mandated social policy. The Bell monopoly was here to stay.

The FCC and Telephone Entitlement

A few years later, this new unwritten law of the land was codified as the raison d'etre of the Federal Communications Commission (FCC) with the passage of the Communications Act of 1934. The commission was created, "for the purpose of regulating interstate and foreign commerce in communication by wire and radio so as to make available, so far as possible, to all the people of the United States a rapid, efficient, Nation-wide, and world-wide wire and radio communication service with adequate facilities at reasonable charges."

In effect, every American was henceforth found to be entitled to the right to telephone service, specifically cheap telephone service. To carry out this difficult policy objective, the FCC was given sweeping powers. Beside its powers to regulate rates to ensure they were "just and reasonable," the FCC was also given the power to restrict entry into the marketplace. Potential competitors were, and still are required to obtain from the FCC a "certificate of public convenience and necessity." The intent of the licensing process was again to prevent "wasteful duplication" and "unneeded competition." In reality, it served as a front to guard the interests of the regulated monopoly and the FCC's social agenda.

The overall hostility to competition by the FCC and the drafters of the legislation that gave birth to it is best illustrated by a 1988 Department of Commerce report on the development of the telecommunications industry. The report notes, "The chief focus of the Communications Act of 1934 was on the regulation of telecommunications, not necessarily its maximum development and promotion. [T]he drafters of the legislation saw the talents and resources of the industry presenting more of a challenge to the public interest than an opportunity for national progress" (164).

Over time the FCC would come to see the Bell System simply as the implementor of its agenda. Consequently, it would continue to use its power in favor of AT&T when potential competitors threatened the firm's hegemony. Their bureaucratic mismanagement of the radio spectrum (which was nationalized under the Radio Act of 1927) meant the most capable competitor of the era would never be given a chance to compete. Despite the fact that wireless technologies would be greatly developed in the near future, the possibility of serious wireless competition rising up to meet the Bell challenge in the first half of this century became less likely once government forces, instead of market forces, controlled how the spectrum was allocated. Just as the wireline technologies where subject to blatant political manipulation, the wireless spectrum became the tool of regulatory and special interests; competition was again dealt a severe blow.

Thomas Hazlett (1990) has proven that the nationalization of the radio spectrum was a special interest fiasco that was totally unnecessary. Property rights within the spectrum were developing and could have become the norm if not for the intervention of federal regulators at the request of industry leaders. Kellogg, Thorne, and Huber (1992: 19-20) have also pointed out the anti-competitive nature of the 1927 Radio Act:

> A gentlemanly agreement, reached under political pressure, had once again replaced competition with complementary monopolies. It reaffirmed the general prohibition on "monopoly" of the airwaves--meaning that competition over the airwaves was prohibited, at least if it came from Bell. The Act forbade cross-ownership of telephone companies and broadcasting stations, and flatly rejected the operation of radio stations as `common carriers.' None of this could have concerned top officials at RCA or Bell very much. Congress merely cemented and strengthened a division of markets and territories that the parties had already voluntarily embraced.

Likewise, when the cable industry appeared on the scene several years later, it was restrained from entering other market segments. Finally, as mentioned, in those intrastate markets the FCC did not have jurisdiction over, state commissions protected local monopolies by restricting entry and guaranteeing their revenues.

Needless to say, by World War II, the communications industry had become a good old boy network. Regulators and the regulatees realized they had something to gain by allying in opposition to the forces of competition. Alfred Kahn (1971: 46) recognized the cozy nature of the regulator-regulatee relationship: "Responsible for the continued provision and improvement of service, [the regulatory commission] comes increasingly and understandably to identify the interest of the public with that of the existing companies on whom it must rely to deliver goods."

Hence, owing to a federal policy that placed higher value on immediate universal service than competition, the Bell monopoly was solidified.

The Lessons for Today's Legislators

The belief that government intervention substantially decreased competitive opportunities within the telecommunications industry is borne out by the historical record. The actions of legislators and regulators, both deliberate and accidental, led to the creation of the Bell monopoly. The demise of competition within the industry was brought about by three primary forces:

> 1. The removal of "wasteful" or "duplicative" competition through exclusionary licensing policies, misguided interconnection edicts, protected monopoly status for dominant carriers, and guaranteed revenues for those regulated utilities;
>
> 2. The mandated social policy of universal telephone entitlement, which called for a single provider to easily carry out regulatory orders; and
>
> 3. regulation of rates (through averaging and cross-subsidization) to achieve the social policy objective of universal service.[3]

The combination of these government-induced policies, which were introduced in rapid succession, was enough to kill telephone competition just as it was gaining momentum.

Despite this evidence, many economists still argue that in the absence of government control, a monopoly would have developed and consumers would have been exploited to a greater extent in the process. Such an outcome is questionable. Even if the assumption is granted, it is arguable that such an outcome would have proven as disastrous as the monopoly theorists believe. Such a suboptimal market setting would have invited entrepreneurial solutions to the monopolistic practices, encouraging the development of competitive technologies to satisfy consumer demands. [4] This entrepreneurial activity might have taken place much sooner had government not erected legal barriers to competition throughout the industry. Once the government rigged the rules of the game to favor one firm over all others, competition was virtually impossible.

A review of the historical record of American telephony, considered to be the prime example of a natural monopoly

industry, serves as an excellent starting point for a fundamental reassessment of the validity of natural monopoly theory. Some economists have challenged the notion that monopolies are in any sense natural. James R. Nelson (1966: 3) claimed:

> One of the most unfortunate phrases ever introduced into law or economics was the phrase "natural monopoly." Every monopoly is a product of public policy. No present monopoly, public or private, can be traced back through history in a pure form. "Natural monopolies" in fact originated in response to a belief that some goal, or goals, of public policy would be advanced by encouraging or permitting a monopoly to be formed, and discouraging or forbidding future competition with this monopoly.

Hazlett (1985: 21) has also weighed in by refuting many of the obsolete notions upon which natural monopoly theory is based:

> The economists' analysis of the inefficiency of unregulated natural monopoly markets did not spring from a scientific or particularly scholarly research program but in response to "a growing clamor for more government." Indeed many of the early natural monopoly writers had attacked the problem because of personal ideological agendas; their politics preceded their studies.

Finally, economists with allegiance to the Austrian School of economics, such as Dominick T. Armentano (1990), F.A. Hayek (1948), and Israel M. Kirzner (1973), believe that not only are answers to the questions about natural monopoly wrong, the questions themselves are improperly formulated. Competition, these scholars insist, is a dynamic process of constant entrepreneurial adjustment to market signals. The market is never at rest; today's monopoly could be tomorrow's competitive market. A truly competitive marketplace, therefore, will be free of any artificial restraints or barriers to entry that interrupt this dynamic adjustment process. Hence, when examining the development of the telephone market through an Austrian paradigm, it should be obvious that the only "failure" was not of the market, but of legislators and regulators who failed to allow entrepreneurial solutions to develop.

The most important lesson legislators can draw from this study is that government intervention need not be explicit or massive to have serious long-term and deleterious effects on competition within an industry. In the case of telecommunications, the government's simple stipulation that rates be artificially set to reflect certain social policy objectives was the crucial factor that led to the creation of the AT&T monopoly. Other factors, such as interconnection requirements, also illustrate how good intentions can often have disastrous results. In this case, interconnectivity provided a disincentive to built competing systems, tilting the market in AT&T's favor.

Still, legislators demand specific answers for many difficult questions. First, there is the question already addressed briefly above--would not a free market for telecommunications be privately monopolized or oligopolized anyway? To answer this more succinctly, there is no doubt that all businesses would like to capture an entire market for themselves and receive exorbitant profits from the goods and services they produce. But, the beauty of the free market is that it tames such tendencies through competition and entrepreneurship. Every time a producer ignores the needs of consumers, entrepreneurs see the opportunity to step in and fill the market's need. General Motors and IBM can both attest to the truth of this phenomenon. At one time they both sat atop their respective markets, only to find their perfect worlds shattered by innovative competitors. Ironically, both GM and IBM were once targets of federal antitrust investigations. Would the automobile or computer industry be any more competitive today had the government broken up either of these companies? Likewise, would consumers have been better off if either firm was granted the status of a government-regulated monopolist? It would be hard to argue that that would be the case--both industries are now vigorously competitive precisely because the market was allowed to work; consumer power took precedence over arbitrary regulatory power.

But what about universal service? Would a telecommunications free market have guaranteed everyone access to a telephone? At first, definitely not. Competition would have taken time to develop to the point were everyone was provided access. But, just as virtually every American gained access to a radio and television (and many to a video cassette recorder) through free-market competition, telephones would have eventually become ubiquitous without government mandates. The demand for telephone service is too inelastic to image the opposite being the case. Quite likely, innovative products would first have been introduced into lucrative business markets and then slowly spread out to rural, residential areas as consumer demand grew. Thus, the extension of telephone service probably would have progressed much as television and computers have. Competitors would have eventually formulated appropriate interconnection charges to ensure that a spontaneous universal system developed. It would have become virtually impossible for a firm to survive if it did not agree to interconnect with others. As for those citizens in far-off rural areas

that legislators most fear would be forgotten, wireless systems would have eventually arisen to accommodate their needs. Although such service would not have been cheap initially, it would have been available.

Yet, instead of patiently allowing competition to develop within the telecommunications industry, arrogant legislators thought they better understood how to order the marketplace, and intervened to conduct their experiment. Their hastiness allowed AT&T to monopolize one of the most important industries in existence. Their mistakes should make us question the validity of any statements by today's legislators that they better understand how to make the marketplace competitive.

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Notes

[1] He had previously served as president from 1885-87.

[2] Many such prohibitions and restrictions still exist today. According to the National Association of Regulatory Utility Commissioners' Summary of Competitive Status by Population, 19 states still have substantial legal barriers to competition, and another 20 only allow partial competition. When population is taken into account, roughly 70 percent of Americans live in a state that either allows only partial or no competition.

[3] This list closely resembles Warren G. Lavey's outline of the "five major public policies which accounted for much of the transition to regulated monopolies." His list is as follows: "(1) efficient supply of services; (2) reasonable revenues; (3) extension of service to remote areas; (4) averaged rate structures; and (5) below-cost pricing for residential services" (Lavey 1987: 171).

[4] This is exactly what began to happen under the government-regulated market anyway as new wireless and computerized inventions gradually eroded the Bell System's technological advantages. Yet, various bureaucratic gaffes and outright regulatory prohibitions continued to limit the extent to which new technologies could have a substantial

impact on industry-wide competition. The result was minor gains for rivals in new market segments, such as microwave communications and resale, but little else in the way of a serious challenge to AT&T's hegemony.

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The Story So Far: The Telecom Industry

Charlie Brown, Bill Baxter, Harold Greene and Bill McGowan break up giant AT&T, which continues to tear itself apart.

News Story by Mitch Betts

JANUARY 20, 2003 (COMPUTERWORLD) - It was a cold, clear day in Washington on Jan. 8, 1982, when Charlie Brown and Bill Baxter held a noon press conference to announce an antitrust trial settlement that would break up AT&T Corp. and stop Ma Bell's dominance of the telecommunications industry. (It was a busy day: A few hours later, the government dropped its long-running antitrust case against IBM.)

Brown, AT&T's chairman, had concluded that, with his company faring poorly in U.S. District Judge Harold Greene's courtroom, AT&T needed a fresh start so it could compete with upstart MCI Communications Corp. for business customers and enter Information Age markets without burdensome regulations.

Baxter, the Reagan administration's antitrust chief, wanted to deregulate the telecommunications business. He figured competition would flourish in the long-distance market if it was separated from the local monopoly.

Together they struck a deal to end the U.S. government's mammoth antitrust lawsuit against AT&T by splitting off the local telephone companies and leaving AT&T with long-distance service and the Western Electric equipment business. The deal also freed AT&T from a 1956 consent decree so it could get into the computer business.

How did they get to the point of dismantling what was by all accounts the greatest telecommunications system on the planet? Three factors:

• **AT&T's arrogance had turned policymakers against it.** For years, AT&T's army of lobbyists and hardball tactics had squashed would-be competitors and prevented anyone from connecting non-AT&T devices, such as fax machines or answering machines, to the Bell network.

• **Creeping competition, encouraged by the Federal Communications Commission.** It started with the Carterfone decision in 1968, which allowed other businesses to attach telephones, equipment and

hush a phone

business switchboards to the Bell network. A year later, the FCC gave an embryonic company called Microwave Communications Inc. (later MCI) permission to provide private lines between Chicago and St. Louis for big business customers.

Then, without quite realizing what it had done, the FCC approved MCI's Execunet service, which essentially provided the first competitive long-distance service for U.S. businesses.

• **Bill McGowan.** Trying to keep his tiny company afloat, the feisty MCI chief worked the government process. He lobbied Congress, filed a private antitrust lawsuit against AT&T, planted the seeds of the government's antitrust lawsuit and got the FCC to approve the "experimental" intercity services that competed with AT&T's.

The AT&T divestiture on Jan. 1, 1984, produced seven regional "Baby Bells" and intense competition among AT&T, MCI and Sprint Corp. in the long-distance market, with millions of dollars spent on campaigns to get people to switch long-distance carriers.

But the breakup also produced its share of unintended consequences. For example, it was widely assumed at the time that AT&T would be a formidable competitor against IBM in the converging computer and communications businesses. AT&T came out with minicomputers and PCs, controlled Unix and made a hostile takeover of NCR Corp., but it eventually backed out of the computer industry.

And the 1984 breakup turned out to be just the first of several for AT&T. In the mid-1990s, AT&T spun off its crown jewels, Western Electric and Bell Labs, as Lucent Technologies Inc. and then divested NCR at a huge loss. AT&T restructured again in 2001, spinning off its wireless company and selling its huge cable TV assets to Comcast Corp.

The irony is that the Baby Bells, which everyone assumed got the raw, unprofitable end of the deal, are relatively healthy and are seeking regulatory approval to enter the long-distance business. Megamergers have turned them into four conglomerates with odd names like Verizon and Qwest.

Meanwhile, MCI, the company that brought down Ma Bell, was swallowed up by WorldCom Inc., which is now trying to emerge from bankruptcy proceedings amid a painful downturn in the telecommunications industry.

And now, on with the story ...

1972: MCI, led by CEO Bill McGowan, begins offering point-to-point private-line service between Chicago and St. Louis.

1939

1956: In an antitrust settlement, AT&T gets to keep Western Electric but can't enter the computer business.

1956: In an antitrust settlement, AT&T gets to keep Western Electric but can't enter the computer business.

1968: The government's Carterfone decision allows the connection of customer-owned devices to AT&T's network. Microwave Communications Inc. (later MCI) is incorporated.

1972: MCI, led by CEO Bill McGowan, begins offering point-to-point private-line service between Chicago and St. Louis.

1974: The U.S. Justice Department files an antitrust lawsuit against AT&T; the case is assigned to U.S. District Court Judge Harold Greene.

1982: AT&T and the Justice Department sign a settlement that ends the government's antitrust trial and requires divestiture of the local exchange companies.

1984: The AT&T divestiture takes effect Jan. 1.

1974: The U.S. Justice Department files an antitrust lawsuit against AT&T; the case is assigned to U.S. District Court Judge Harold Greene.

1996: AT&T spins off Western Electric, which becomes Lucent Technologies.

1984: The AT&T divestiture takes effect Jan. 1.

1997: Bell Atlantic and Nynex merge. So do SBC Communications and Pacific Telesis Group. WorldCom swoops in to buy MCI.

1999: WorldCom, led by CEO Bernard Ebbers (foreground), proposes an audacious merger with Sprint (led by William Esrey, background), but it's nixed by the Justice Department. SBC acquires Ameritech.

2000: Bell Atlantic and GTE merge into Verizon Communications. Qwest Communications International absorbs US West.

2002: WorldCom makes the largest U.S. bankruptcy filing ever.

1999: WorldCom, led by CEO Bernard Ebbers (foreground), proposes an audacious merger with Sprint (led by William Esrey, background), but it's nixed by the Justice Department. SBC acquires Ameritech.

Introduction to Telecommunications

Unit 1
The Telecommunications Industry

We will begin this course by tracing the development of the telecommunication industry from the early Bell monopoly to today's competitive marketplace. We will explore how regulatory rulings, the Telecommunication Act of 1996, and changing market demands have affected both telecommunication carriers and consumers.

Lessons

1. Telecommunications History
2. Elements of the Telecommunications Business
3. Telecommunications Business Trends

Terms

Bandwidth—Bandwidth is the total information-carrying capacity of a network or transmission channel. In an analog network, it is the difference between the highest and lowest frequencies that can be transmitted across a transmission line. Bandwidth is measured in Hz for analog networks and bps for digital networks. See hertz (Hz) and bits per second (bps).

bits per second (bps)—The number of binary bits transmitted per second is measured in bps. For example, common modem speeds are 28,800 bps and 54,000 bps. Another way of writing 28,800 bps is 28.8 Kbps, because "kilo" means 1,000.

central office (CO)—A CO is the telephone facility where telephone users' lines (local loops) are joined to switching equipment that connects telephone users to each other.

co-location—Co-location refers to a physical and business arrangement to connect the network of a CLEC (pronounced "see-lek") to that of the ILEC (pronounced "eye-lek"). To do this, a CLEC usually installs interconnection equipment at the ILEC's central switching office.

common carrier—A common carrier is a company that must offer its services to all customers at the prices and conditions outlined in a public tariff.

competitive access provider (CAP)—A CAP is a company that provides fiber optic links to connect urban business customers to IXCs, bypassing the LEC. Once these fiber optic links are in place in major metropolitan areas, CAPs can begin to expand their service offerings.

competitive local exchange carrier (CLEC)—CLECs are telecommunications resellers, or brokers, who sell data services, Internet access, and local toll calling to businesses and residential customers. Some CLECs route calls over a mix of their own fiber optic, wireless, and copper lines, as well as over facilities they lease at a discount from LECs.

consent decree—A legal judgement that is first negotiated between the main parties, then ratified by the court is referred to as a consent decree. Because the parties first come to an agreement, a consent decree is similar to a contract. However, once accepted by the court, a consent decree has the same legal weight as any other court decision.

copper pair—Two copper wires that carry voice or data signals to a customer are referred to as a copper pair. See local loop.

divestiture—The breakup of AT&T and the Bell System by the U.S. Justice Department in 1984 is an example of a divestiture. To end an illegal monopoly, AT&T was ordered to separate itself from its 22 local Bell operating companies, which were reorganized into seven RBOCs. AT&T was then restricted to long-distance business, while the RBOCs were limited to local (intraLATA) service. See Regional Bell Operating Company (RBOC).

fiber optic—Fiber optic cable is a transmission medium typically used for high-speed digital transmission. It consists of a flexible clear glass or plastic core surrounded by a reflective plastic cladding layer and protected by a thin jacket or sheath. A signal is transmitted by focusing a light source into the core, and then switching the source on and off. Light is reflected off the cladding layer, so that nearly all of the light radiated into one end of the cable reaches the other end. By using fiber optic transmission, digital signals can travel for long distances with a high degree of accuracy.

hertz (Hz)—Analog signals are measured in cycles per second, or Hz. One cycle per second is 1 Hz; 1,000 cycles per second is 1 kHz; and 1 million cycles per second is 1 MHz.

incumbent local exchange carrier (ILEC)—An ILEC is the same as a LEC or RBOC.

interexchange carrier (IXC)—An IXC is a long-distance company, such as AT&T or MCI, that provides telephone and data services between LATAs.

interoperable—Systems that can work together are referred to as interoperable. To ensure interoperability, hardware and software manufacturers develop common standards to define the way devices connect and programs exchange information.

local access and transport area (LATA)—LATAs are the geographic calling areas within which an RBOC may provide local and long-distance services. LATA boundaries, for the most part, fall within states and do not cross state lines. However, one state may have several LATAs.

local exchange—A geographical region and group of subscribers served by a single CO is referred to as a local exchange.

local exchange carrier (LEC)—A LEC is a company that makes telephone connections to subscribers' homes and businesses, provides telephone services, and collects fees for those services. The terms LEC, ILEC, and RBOC are equivalent.

local loop—A local loop is the pair of copper wires that connects a customer's telephone to the LEC's CO switching system. The physical facilities that connect the subscriber's premises to the CO may include twisted copper pairs, fiber optics, coaxial cable, electronic equipment, or even radio waves.

microwave—Microwaves are high-frequency radio waves, commonly used for wireless telephone transmission. Although broadcast radio stations usually transmit between 535 and 1,605 kHz (550 to 1,600 kHz is AM radio, 88 to 108 MHz is FM radio), cellular phone systems operate in bands of 824 to 849 MHz and 869 to 894 MHz. See hertz (Hz).

provisioning—Provisioning is the process of allocating transmission lines, switching capacity, and central programming to provide telecommunications service to a customer.

Regional Bell Operating Company (RBOC)—An RBOC is one of seven companies formed from AT&T's 22 local telephone companies during the breakup of the Bell System. The original seven RBOCs were:

- Ameritech
- Bell Atlantic
- Bellsouth
- New York New England Telephone Company (NYNEX)
- Pacific Telesis
- Southwestern Bell Communications
- U S WEST

The terms RBOC, LEC, and ILEC are equivalent.

slamming—Slamming is the illegal practice of switching a customer's long-distance service from one IXC to another, without the customer's knowledge or permission.

unbundled service—Unbundled service refers to a communications channel leased to a CLEC by the ILEC. "Unbundled" means that the ILEC provides only the transmission service, while the CLEC provides management, provisioning, repairing, and billing.

virtual office—The business practice of forming workgroups by connecting multiple home-office workers via remote network access and e-mail is referred to as a virtual office.

Lesson 1—Telecommunications History

Today's telecommunications system is the result of a long and steady evolution. Therefore, before we can consider where the industry is going, we must first understand how we got to where we are today. Most of the early industry milestones may seem mundane, but each one was an important step on the path to the creation, then breakup, of one of the largest corporate monopolies in history.

Objectives

At the end of this lesson you will be able to:

- Describe the evolution of the U.S. telecommunications industry up to the Telecommunications Act of 1996
- Describe how the industry operates after the Telecommunications Act of 1996
- Define a LATA

Key Point

The evolution of the telecommunications industry was shaped by changing public priorities.

Invention of the Telephone

In 1872, a Scottish immigrant, by the name of Alexander Graham Bell, worked a two-month stint at the Connecticut Asylum for the Deaf, then became a professor of vocal physiology at Boston University. It was there, while trying to develop a system to help deaf people "feel" and "see" sounds, and thus imitate them, that the professor took a close look at how the human eardrum worked. He ultimately succeeded in finding a way to make a vibrating membrane generate an electric current that would, in turn, vibrate another membrane. The contraption Mr. Bell invented was the telephone.

1885: American Telephone and Telegraph

The Bell Telephone Company was founded in 1877. It created the first telephone exchange, connecting all 21 telephones in New Haven, Connecticut. By 1884, the company had grown to establish long distance connections between Boston and New York City.

In 1885, American Telephone and Telegraph (AT&T) was formed to build long distance telephone networks. As time passed, the conglomeration of AT&T and its 22 local Bell Telephone Companies became known as the Bell System.

1893: Initial Competition

The expiration of Bell's basic patents in 1893 and 1894 was the start for open competition. Independent telephone operating companies sprang up throughout the country. By the turn of the century, there were approximately 6,000 independent companies, providing service to some 600,000 subscribers. Through the years, mergers and acquisitions have reduced this number, and approximately 1,500 local exchange carriers (LECs) operate today.

Unfortunately for the general public, these telephone networks were not all interconnected or interoperable. Therefore, it was necessary for a subscriber to have two or three telephone instruments (each connected to different networks) to communicate with the total population of a city.

1908: Government-Approved Consolidation

By the turn of the century, the loss of its original patents and the acquisition of new ones had shifted AT&T's business focus from local to long distance service. However, AT&T's new president, Theodore Vail, still held the vision of universal service. He and AT&T began a two-part strategy to make that vision a reality.

The first part of the strategy was public relations. Beginning in 1908, AT&T pursued a national advertising campaign under the slogan "One Policy, One System, Universal Service." The current system of so many local telephone companies was portrayed as costly to consumers and an impairment to universal service. Public policymakers began to accept the notion of telephony as a natural monopoly, and embraced the idea of universal service.

In the second part of the strategy, AT&T simply provided equipment and high-quality long distance service only to its own local companies. No other local carriers, even noncompeting ones, were allowed to interconnect with AT&T's long distance network. Under

this intense business disadvantage, most independent telephone companies were acquired by the Bell System or went bankrupt.

AT&T and the Bell System eventually evolved into a powerhouse that controlled:

- Equipment—The Bell System manufactured, provided, installed, and maintained central office (CO) switching systems. It leased telephones and telephone systems, and all related equipment to subscribers.
- Local service—Local Bell Telephone Companies provided local telephone service in almost every major city in the United States.
- Long distance service—AT&T controlled intrastate (within a state), interstate (between states), and international long distance circuits, and provided long distance telephone service nationwide.
- Directories—Each Bell Telephone Company produced, printed, and distributed its area's individual (white page) and business (yellow page) telephone directories.

The Interstate Commerce Commission (ICC), an agency of the federal government, acted as the regulatory body for interstate telecommunications. Intrastate telecommunications were regulated by individual state governments.

By 1934, a few small independent competitors, such as General Telephone and Electronics (GTE), served non-Bell areas. However, AT&T owned four of every five telephones in the country, its long distance network tied together the country's telephone systems, and a Bell Telephone Company served nearly every major city.

1934: Federal and State Regulation

In 1934, the radio broadcast industry was also rapidly evolving. Because the number of radio frequencies is finite, governmental policymakers realized that some sort of centralized control would be necessary to assign frequencies to broadcasters. Therefore, the U.S. Congress passed the Communications Act of 1934, establishing the Federal Communications Commission (FCC) to regulate both the telephone and broadcast industries "in the public interest, for convenience and necessity."

The creation of the FCC also established, as a matter of public policy, the goals of affordable, universally available telephone service for all Americans. The Act of 1934 essentially validated the tele-

phone monopoly by allowing AT&T to continue doing business with government oversight. In other words, the Act officially prioritized access to services, and affordable price, over consumer choice and business competition.

Individual state governments gradually formed agencies to regulate their public utilities, including telephone service. These Public Utilities Commissions (PUCs), or Public Service Commissions (PSCs), maintained a regulatory environment that provided safe and reliable utility services to the state's citizens at affordable prices. At the same time, the commissions worked to ensure that the utilities could receive a reasonable return on their investments.

Federal and state governments began to require telecommunications services providers to provide tariffs for the services they offered. A tariff is a schedule of rates and regulations set by the telecommunications services provider, and approved by the appropriate federal and state regulatory agencies. A tariff contains the official list of charges, terms, and conditions governing provision of a specific communications service. It functions in lieu of a contract between the subscriber (or user) and the supplier (or carrier). In other words, federal and state agencies would negotiate a tariff with the monopoly service provider on behalf of citizens who had no choice.

1956: The Hush-a-Phone Decision

Even while government support was helping to strengthen the Bell monopoly, a small company began a process that would eventually break up the giant system.

In 1920, the Hush-a-Phone Company invented a simple cup-like device that attached to a telephone mouthpiece. It reduced background noise by shielding the mouthpiece, but also made the speaker's voice softer and less distinct.

When AT&T finally discovered the Hush-a-Phone in 1948, it asserted that the device was an illegal "attachment" to its network. In a complaint to the FCC, AT&T demanded that the Hush-a-Phone device be prohibited. Hush-a-Phone sued AT&T, and argued that the device affected only the two parties to the call, and had no effect whatsoever on AT&T's network.

In 1956, the U.S. Court of Appeals finally ruled that telephone customers had the right to use their telephones in a way that is "privately beneficial without being publicly detrimental." In other words, consumers could use Hush-a-Phone devices.

This decision was the first case to successfully challenge AT&T's monopoly. It created a legal distinction between equipment connected to the network (commonly known as customer premises equipment [CPE]) and the telephone network itself. It also paved the way for other companies to offer devices that could be connected to the AT&T network.

1956: The Consent Decree

In 1949, the U.S. Department of Justice filed an antitrust suit against AT&T, claiming AT&T and its Western Electric manufacturing arm had violated the Sherman Antitrust Act by conspiring to restrain trade in the telephone equipment business. In its suit, the Justice Department sought to separate Western Electric from AT&T.

Through its powerful political influence, AT&T kept the case in district court until 1956. By then, the company had managed to negotiate an agreement with the Justice Department that was more favorable than the complete divestiture the government originally wanted. In this consent decree, which was ratified by the courts in 1956, AT&T agreed to restrict its activities to common carrier communications services, and pledged to stay out of the computer business. Western Electric agreed to focus on manufacturing equipment. However, AT&T was not required to divest itself of Western Electric.

1968: Carterfone Decision

Thomas Carter developed a coupling device that permitted mobile telephones to be connected to the telephone network. In 1968, he applied to the FCC for permission to continue marketing his product after AT&T said his devices were illegal attachments to their system (AT&T claimed the Hush-a-Phone Decision did not apply). In its resulting Carterfone Decision, the FCC ruled that AT&T's prohibition was illegal.

The FCC still allowed telephone companies to require "protective coupling arrangements" (often costly) to protect their system against technically harmful devices. However, the Commission made it clear that competition in the equipment industry was a national policy goal. The Carterfone Decision further clarified the distinction between the telephone network and CPE attached to the network, which had been outlined in the Hush-a-Phone Decision.

1969: Competition From MCI

While the Hush-a-Phone and Carterfone Decisions challenged AT&T in the CPE area, AT&T was also being attacked on the long distance service front. In the mid-1960s, Microwave Communications Inc. (MCI) built a microwave transmission system linking Chicago and St. Louis. In 1967, the FCC licensed MCI to provide limited communications services between those markets, marking the first meaningful intrusion on AT&T's monopoly in the long distance arena.

Even though MCI was licensed to provide service between Chicago and St. Louis, telephone calls had no way to leave or enter the MCI network without connections from local telephone companies. MCI had no access to the customers it wanted to serve, because the local telephone companies were owned by the very organization, AT&T, with which MCI was attempting to compete.

In 1969, the FCC ruled that MCI could connect its equipment (network) to AT&T's network, provided AT&T's network was not damaged. This decision opened the long distance market to MCI and other AT&T rivals.

1984: Breakup and Divestiture

As time passed, other potential competitors filed complaints with the Justice Department about AT&T's lack of cooperation in supplying connections to its local Bell Telephone Company networks. By 1974, so many complaints had been lodged that the Justice Department filed an antitrust suit against AT&T, stipulating that the company's monopoly gave it an unfair competitive advantage in the telecommunications industry. This suit was fought in and out of the U.S. court system for most of the next decade.

The Justice Department and AT&T finally reached a compromise agreement and filed a settlement on January 8, 1982. On August 24, 1982, Judge Harold Green approved and handed down what was referred to as the Modified Final Judgment (MFJ), which became effective on January 1, 1984. The MFJ mandated that AT&T be split, a process that became known as the Divestiture.

The Economics of the Film Industry

The Economics of Film Distribution

Which Six Firms Dominate Film Industry Distribution?

- Disney [share=20% ('99) 23% ('95)]
- Time Warner [share=18% ('99) 23% ('95)]
- Universal [share=14.5 ('99) 13% ('95)]
- Paramount [share=11% ('99) 10% ('95)]
- 20th Century Fox [share=11% ('99) 8% ('95)]
- Sony [share=10% ('99) 13% ('95)]

The Market Stucture of Film Distribution

- Oligopoly
  - There are few enough firms that they recognize their mutual interdependence.
  - HHI = 1305 ('99) & 1335 ('95) (e.g., moderate to high concentration).
  - 4-firm concentration ratio = 63.7% ('99) & 64.1% ('95)

Why Film Distribution Is Oligopolistic

- Very high structural barriers to entry stemming from:
  - Significant Economies of Scale
  - Fickle Consumer Demand
  - Vertical Integration
  - Conglomerateness
  - Product Differentation

Film Distribution Economies of Scale

- Large economies of scale connected with national & international distribution
  - Quantity Dimension #1 => The number of regional/international distribution offices
    - Serving almost 37,396 U.S. (as of 2000) movie screens requires 20 to 32 regional offices
    - Offices all around the world

Film Distribution Economies of Scale (cont.)

- Quantity Dimension #2 => The number of films released annually
  - E.g., Major distributors typically release 14 to 35 films per year.
  - The box office success of the films released annually has a significant impact on this quantity dimension.
  - The high average cost of the average movie released (i.e., very high first copy costs) results in significant economies of scale.
    - $54.8 million (2000) plus $27.3 million for national marketing/advertising (2000)

Fickle Consumer Demand

- Consumer Taste is unpredictable and ever evolving.
  - So, consumer demand is difficult to predict.

Fickle Consumer Demand (cont.)

- Due to the high cost of the average movie released by the major distributors, individual films are very risky
  - $54.8 million (2000) plus $27.3 million for national marketing/advertising (2000)
  - 2-year lead time to produce and release a film
- Distributors need a diversified portfolio of films to control their financial risk.

How Film Distribution Companies Reduce Risk

- Distribute multiple films annually (i.e., a diversified portfolio)
- Hiring movie stars, directors, & writers who have achieved significant box office success.
- Co-productions with foreign investors and/or financially backed independents
- Production of sequels

Film Distributors' Vertical Integration into Exhibition (cont.)

- Vivendi Universal (Universal Studios)
  - Loews Cineplex Entertainment (26%)
- Sony Corp. (Columbia Pictures & TriStar)
  - Loews Cineplex Entertainment (51%) (460 locations /2,600 screens)
- Viacom (Paramount)
  - National Amusements (118 locations/1,072 screens)

The Advantages of Vertical Integration into Exhibition

- All box office dollars flow to the vertically integrated distributor.
- Distributor has complete control over
  - admission prices, and
  - film release patterns.

Film Distributor Conglomerateness

Distributor Conglomerateness

- AOL Time Warner (#1media conglomerate)
  - Warner Brothers Pictures,Castle Rock Entertainment, New Line Cinema, Telepictures Productions, Fine Line Features
- Walt Disney Co. (#2 media conglomerate)
  - Buena Vista Filmed Entertainment, Miramax Films, Touchstone Films, Walt Disney Feature Animation, Buena Vista International

Distributor Conglomerateness (cont.)

- Vivendi Universal (#3 media conglomerate)
  - Universal Pictures, Working Title Films(50%), Universal Pictures International, United International Pictures (50%), Canal+, Le Studio Canal+
- Viacom CBS(#4 media conglomerate)
  - Paramount Pictures, Nickelodeon Movies, MTV Films, United International Pictures (33%)
- News Corp. Ltd. (#5 media conglomerate)
  - 20th Century Fox, Fox 2000, Fox Studios, Fox Searchlight, Fox Animation Studios

Distributor Conglomerateness (cont.)

- Sony Corp. (#7 media conglomerate)
  - Sony Pictures Entertainment, Columbia TriStar Motion Picture Group
- Metro-Goldwyn-Mayer Inc. (>#25 media conglomerate)
  - MGM Pictures, MGM Distribution, Orion Pictures, United Artists Pictures, G2 Films

Advantages of Conglomerateness

- Deep corporate pockets
  - Resources for capital expansion
  - access to venture capital/production loans
- Successful ideas can be exploited across other conglomerate exhibition windows.
  - Creating synergies across the conglomerate
  - Books, movies, network TV shows, etc.

Product Differentation Factors for Individual Films

- Type of movie
- Notoriety of director
- Notoriety of actors/actresses
- Publicity/Advertising Campaign
  - Amount Spent
  - Creativity
- Importance of long run, large scale publicity campaigns for films distributed

How Major Studios Maintain Their Market Power

- Cross-subsidization
  - Taking profits from one area to subsidize another area which is losing money
- Reciprocity
  - Tying the sale of popular movies to an agreement to use/purchase other conglomerate products
  - e.g., Carriage of a Paramount hit movie and cable shelf space for the VH-1 Network

How Major Studios Maintain Their market Power (cont.)

- Horizontal integration
  - Purchase of successful minor distribution companies (e.g., Miramax, New Line, etc.)
- Vertical integration
  - Purchase of TV networks, cable systems, book publishing companies, newspapers, magazines, etc.

How Major Studios Maintain Their market Power (cont.)

- Price discrimination through multiple exhibition windows
  - Exploitation of all possible revenue streams for hit films
- Unique worldwide market access to distribute films

Movie Distributor Revenue Streams

- Home Video/VCRs/DVDs (1997)
  - 47.4% of total revenue (24.9% Domestic/22.5% International)
- Theatrical Exhibition (1997)
  - 27.3% of total revenue (14.4% Domestic/12.9% International)
- Total Television (Pay & Ad Supported) (1997)
  - 25.3% of total revenue (13.5% Domestic/11.8% International)

The Economics of Film Exhibition

Largest U.S. Theater Chains (1998)

- Regal (5,347 screens/727 locations)
- Carmike Cinemas Inc. (2,720 screens/540 locations)
- Sony Corp./Loews Cineplex Entertainment (2,600 screens/460 locations)
- AMC (2,117 screens/226 locations)
- Cinemark USA (1,754 screens/193 locations)
- United Artists Theatres (1,599 screens - 2001)

Largest U.S. Theater Chains (cont.)

- General Cinema (1,059 screens/189 locations)
- National Amusement (Viacom) (1,072 screens/118 locations)
- Total U.S. Screens in 1997 – 31,640 screens at 7,480 theaters
- Total U.S. Screens in 2000 – 37,396 at 7,421 different theaters

The National Market Structure of Film Exhibition

- Monopolistic Competition
  - Many firms
  - Selling products which are close, but not perfect substitutes (i.e., heterogeneous products)
  - Low barriers to entry
  - Wide range of firms sizes & types.
- HHI < 500; 4-firm CR=26%; 8-firm CR=40% (1995) so unconcentrated market

Theater Chain Local Market Structure

- Locally, market structure is generally oligopolistic
  - Smaller markets are monopolistic.

Theater Chain Local Market Competitive Strategies

- Different local market strategies focus on increasing theater traffic
  - The "Mall Strategy"
    - Locational competitive strategy
  - The "Destination Theater Strategy"
    - Multiplex palace strategy (e.g., AMC 24)
  - The "Art House Strategy"
    - Product differentation strategy (large markets, college towns)

Theater Chain Local Market Competitive Strategies (cont.)

- The "Low Cost Strategy"
  - Second run strategy ($1 to $2 houses)

Price Discrimination Strategies

- Definition of Price Discrimination
  - A market situation in which sellers find it possible and profitable to separate two or more markets for their product or service and charge a different price in each market.

Film Distribution Price Discrimination Strategies

- What is the price discrimination strategy of film distribution companies?
  - To generate multiple revenue streams through use of a window system of distribution
  - Consumers purchasing in the 1st window (theatrical distribution) pay the highest price, followed by 2nd window purchases (2nd run theater exhibition), by 3rd window (VCR Sales, by 4th window (VCR rental), by 5th window (PPV/NVOD), by 6th window (Pay cable), etc.)

1st Run Exhibition Price Discrimination Strategies

- "Prime Time" prices are highest
- Discounts for:
  - "Twilight" showings,
  - Senior citizens,
  - Children,
  - Students,
  - etc.

Motion Picture Box Office Attendance

- Overall, movie attendance has risen moderately over time (1970-2000).
- Movie attendance has declined steadily on a per household/per person basis due to increased population (1970-2000)
- Over 50% of movie goers are 30 or older.

Motion Picture Admission Prices

- Motion Picture Average Admission Prices have been very steady for the last decade.
- In real terms, average motion picture admission prices declined 20% from 1990 to 1994.
- Since motion picture admissions increased by only 8% in spite of a 20% decline in average price, demand is inelastic.

What Film Distribution Through Theaters Can Accomplish Best

- It can create blockbuster hits that can be exploited in other media.
- Why is it the best form of distribution for this?

Motion Picture Industry Revenue Flow

- Stage 1 -- Exhibition
  - The Theater Exhibition Company revenue equals => "House" expenses + 10% of Gross Box Office Revenues - "House" expenses.
  - The remaining revenue here is called "Gross Rentals."

Motion Picture Industry Revenue Flow (cont.)

- Stage 2 -- Distribution
  - Distribution Company revenue equals => Advertising & Print Expenses + 35% of "Gross Rentals" (its distribution fee).
  - The remaining revenue here is called "Gross Profits."

Motion Picture Industry Revenue Flow (cont.)

- Stage 3 -- Production
  - The Production Company gets to cover its loan and interest payments/expense before distributing profits => "Gross Profits" minus loan and interest payments/ expense.
  - The remaining revenue here is referred to as "Net Profits for Distribution."

Motion Picture Industry Revenue Flow (cont.)

- Stage 4 -- Equity Participants
  - "Net Profits for Distribution" are used to pay:
    - deferred payments to creative people,
    - investors,
    - the distributor (usually 50% of Net Profits).
  - Once everyone else gets paid, anything that's left, called the "residual," belongs to the producer.

1999 U.S. Domestic Film Distribution Summary[a]

Film Distribution Company	No. of Films Released	Box Office Share	Av. Cost/ Film (millions)	No. Profitable	No. Break-Even	No. Unprofitable
Disney	28	20.3%	$36.4	12	6	10
Warner Brothers (AOL Time Warner)	25	17.9	39.3	8	5	12
Universal (Vivendi)	22	14.5	39.5	8	6	8
Fox (News Corp.)	17	11.0	35.6	3	4	10
Paramount (Viacom)	14	10.9	31.5	10	3	1
Columbia (Sony)	23	10.2	31.6	7	1	15
MGM	8	4.3	39.4	3	1	4
Totals/Av.	137	89.1%	$36.2	51	26	60

[a]Source: "Company Town: Company Film Profit Report," Los Angeles Times, various articles throughout 1999.

Mackinac Center for Public Policy

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II. A Brief History of Telecom Regulation

By **Theodore Bolema**,
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The Early Years

Alexander Graham Bell patented the telephone on March 7, 1876. During the course of the next 20 years, the average number of daily calls per 1,000 population grew relatively slowly, from 4 to 37.**[8]** But once the Bell patents expired in 1894, thousands of competitors began wiring the nation, increasing the daily calling average per 1,000 people from 37 in 1895 to 391 in 1910. By 1907, Bell rivals controlled 51 percent of local service.**[9]**

Michigan's first local telephone company emerged in 1877, when an Upper Peninsula businessman strung a line between his inland office and the Lake Superior port at Ontonagon.**[10]** By the century's turn, some 200 telephone companies were providing service in the state.

In response to the burgeoning competition, American Telephone and Telegraph (AT&T) began buying up rivals. But AT&T's acquisitions troubled federal authorities, who began mulling antitrust action. This prompted company officials to propose what subsequently became known as the "Kingsbury Commitment." On Dec. 19, 1913, AT&T agreed to sell $30 million of its Western Union stock and to allow competitors to interconnect with its network. The company also pledged that for every new local system acquired, it would sell an equal share of lines to rivals.

This arrangement was wholly in keeping with the brilliant strategy of AT&T's then-President Theodore Newton Vail, who aggressively promoted telephone service as a "natural monopoly." Public officials, eager to regulate the nascent industry, embraced Vail's motto of "One Policy, One System, Universal Service."

Of course, as the nation's dominant service provider, AT&T had the most to gain from government raising the regulatory barriers to market entry. The more difficult it was to launch competitive service, the more secure was the company's market share.

Congress first vested federal regulatory authority over telephone services in the Interstate Commerce Commission, under the Mann-Elkins Act of 1910. This followed the practice of local franchising initiated by states and municipalities to control rates and service quality.

The theory of "natural monopoly," now widely questioned, presumed that redundant telephone infrastructure was economically inefficient. Monopoly power could simply be tempered through regulation. In hindsight, competition might well have yielded new technologies and applications that instead took decades to achieve.

The "natural monopoly" theory gained widespread currency. For example, a 1921 report by the Michigan Public Service Commission concluded that "Competition resulted in duplication of investment," and that states were justified in denying requests by rivals to deploy new lines.**[11]** A report that same year from the U.S. House of Representatives likewise concluded that, "There is nothing to be gained by local competition in the telephone business."**[12]**

The drawbacks to the regulated monopoly approach are now more widely recognized. Firms that enjoy government protection from competition, and for whom rates of return are guaranteed through regulation, face less financial pressure to innovate or operate efficiently. Moreover, bureaucrats often became so committed to the regulatory structure that they regard competition as a threat rather than as a potential solution to the very structural conditions that led to the adoption of regulation.

By 1925, telecom rate regulation was in effect across most of the nation, and competition was either discouraged or explicitly prohibited. The regulatory structure was finalized when Congress created the Federal Communications Commission in 1934.

In enacting the Communications Act of 1934, Congress authorized the new agency to impose telecom service requirements at regulated rates. Any deviations in product or service required government approval. Odd as it may seem, these regulatory strictures still partially persist even as Moore's Law — the predicted doubling of data density every 18 months — accelerates the pace of technological change.

But as noted by a 1988 Department of Commerce report: "The chief focus of the Communications Act of 1934 was on the regulation of telecommunications, not necessarily its maximum development and promotion. (T)he drafters of the legislation saw the talents and resources of the industry presenting more of a challenge to the public interest than an opportunity for national progress."**[13]**

Thus, with the cooperation of state and federal officials, AT&T secured its dominance over telephone service for decades to come, controlling more than 80 percent of all telephone lines and assuming family status as "Ma Bell."**[14]**

The Breakup of the Bell System

Challenges to AT&T's protected standing arose in the 1970s, prompting the FCC to allow limited entry into long distance services as well as into enhanced applications such as computer processing. Local service, however, remained off limits to competition. This regulatory disconnect continues today despite technological advances that have rendered obsolete any distinction between local and long distance calling.

In the mid-1970s, the U.S. Justice Department filed an antitrust lawsuit against AT&T based on complaints by MCI and other long distance service providers. The lawsuit went unresolved for eight years. In 1982, the company settled with the government under conditions ordained by Judge Harold H. Greene, of the Federal District Court for the District of Columbia.

The landmark settlement required AT&T to divest its local operating companies, and to restrict its services to the long distance market. Thus, in 1984, Michigan Bell became Ameritech Michigan, one of seven regional "Baby Bells" that assumed control of local calling services. AT&T was allowed to keep its equipment operations. (These were later spun off as Lucent Technologies.) Judge Greene retained jurisdiction over the case for more than a decade, effectively elevating himself as the nation's telecom czar. Virtually every major business decision required approval by both the judge and the FCC.

A subsequent series of mergers and acquisitions reduced the number of regional operating companies from seven to four: SBC, Verizon, BellSouth and Qwest. In Michigan, Ameritech was acquired by SBC in 1999, and Verizon acquired GTE, another Michigan carrier, in 2000.

Competition in long distance service yielded dramatic consumer benefits. As shown in **Chart 1**, average revenues per minute for interstate and international calls originating in the United States dropped from 62 cents per minute in 1983 to 10 cents per minute in 2001. In many instances, calling across state lines and even international borders cost less than toll calls within a single state.

The 1996 Telecommunications Act

The artificial distinction between local and long distance services created by the Bell breakup produced regulatory upheaval as new technologies and services developed. Would Internet access be classified as a long-distance service? Would the Baby Bells be permitted to provide voice messaging and other "information services"?

Congress sought to calm the chaos with passage of the Telecommunications Act of 1996. Cognizant of the benefits realized through long distance competition, lawmakers effectively declared an end to the monopoly franchise system governing local calling.

Congress also presumed that the Federal Communications Commission could manage the transition to local competition better than the market. But as noted by John Thorne, senior vice president and deputy general counsel of Verizon, "Regulators sometimes make massive mistakes, especially when they cling to traditional approaches that have been overtaken by profound changes in technology and markets."**[15]**

In fact, as documented by the data in Section III of this report, the onerous and costly regulations imposed by the FCC have actually inhibited competition in local wire line services and contributed to a massive loss of investment.

The principal problem was the regulatory seizure of private property, which invariably skews investment incentives. Congress forced incumbent local telephone companies to share their facilities with rivals at regulated rates. By lawmakers' reasoning, competitors would need to establish market share before they would build independent facilities with which to compete.

Congress delegated to the FCC the authority to determine which facilities should be shared, and how various parts of the network, called "unbundled network elements" (UNE), as well as the entire network platform (UNE-P) would be priced. However, lawmakers did establish an eligibility baseline for this subsidized access. It was not intended to be an entitlement. Eligibility was supposed to be based on whether a competitor would be "impaired" from competing if they were denied access.

Section 251(3)(2)(B) of the 1996 act directs the FCC to "consider, at a minimum, whether … the failure to provide access to such network elements would *impair* the ability of the telecommunications carrier seeking access to provide the services that it seeks to offer." (Emphasis added.)

The FCC established a pricing formula for network elements, called "Total Element Long-Run Incremental Cost" (TELRIC), based on the cost of building and operating a hypothetical maximum-efficiency network. The rates subsequently calculated by most states cover an irrationally broad range, and most have proven to be economically unsustainable.

As explained by Verizon's John Thorne, the TELRIC rates bear no resemblance to market realities. "The regulatory discount for ordinary resale is typically 20-25 percent; the UNE-P typically prices out at a discount of closer to 60-65 percent. UNE-P serves no purpose whatsoever, except to permit a game of regulatory arbitrage, conducted by companies that have built nothing in the way of a network at all."**[16]**

From a plain reading of the 1996 act, there can be no doubt that Congress intended to restrict regulated network access. Yet the FCC crafted eligibility standards that effectively granted access subsidies to any and all competitors for the asking. This disregard of congressional intent was recognized by the U.S. Supreme Court, which struck down the FCC regulations in 1999 and ordered the agency to rewrite the access rules.**[17]**

Admonishing the agency for regulatory activism, the court reminded FCC officials that "[If] Congress had wanted to give blanket access to incumbents' networks, [it] would simply have said (as the Commission in effect has) that whatever requested element can be provided must be provided."

Far from being humbled by the highest court in the land, the commission subsequently produced another set of overbroad access regulations. The so-called "impairment standard," which was supposed to limit eligibility for subsidized access, was crafted in language only a handful of telecom lawyers could actually interpret — and which gave the FCC the widest possible latitude:

> "(T)he failure to provide access to a network element would 'impair' the ability of a requesting carrier to provide the services it seeks to offer if, taking into consideration the availability of alternative elements outside the incumbent's network, including self-provisioning by a requesting carrier or acquiring an alternative from a third-party supplier, lack of access to that element materially diminishes a requesting carrier's ability to provide the services it seeks to offer."**[18]**

This second set of impairment standards was also struck down as unconstitutional in May 2002 by the U.S. Court of Appeals for the District of Columbia, which accused the agency of indulging in "lofty abstractions" and "differentials so broad, we have no way of assessing the real meaning."**[19]**

The Triennial Review Order

The FCC's third attempt to craft lawful regulations debuted on Aug. 21, 2003. On August 22, the newsletter of equity research firm Jefferies & Company, Inc., featured the headline: "FCC's Big Order Finally Out — So Let The Lawsuits Begin!" Dana Frix, a telecom lawyer with the New York law firm of Chadbourne & Parke, told the International Herald Tribune: "Every word will be challenged. My children will go to college on this stuff. This is a lawyer's dream."

Indeed, within days of release, numerous telecom companies and trade associations had filed constitutional challenges to the so-called Triennial Review Order.

The contentiousness was not limited to the courtroom. The FCC itself was deeply divided, having approved the order by a vote of 3-to-2. Commission Chairman Michael Powell, who joined Commissioner Kathleen Abernathy in dissent, publicly excoriated the majority for "taking a politically expedient course instead of the right course."

"The decision," Powell said, "will prove too chaotic for an already fragile telecom market. In choosing to abdicate its responsibility to craft clear and sustainable rules ... the majority has brought forth a molten morass of regulatory activity that may very well wilt any lingering investment interest in the sector."

What so displeased Powell and much of the telecom industry was the decision by the commission majority to foist upon states the responsibility for determining whether market conditions justify subsidized access, rather than crafting a federal impairment standard as Congress intended. If allowed to stand, the Triennial Review Order will require 50 state utility commissions to issue 50 sets of standards for determining whether competitors are eligible for subsidized network access. The resulting regulatory nightmare exemplifies why the Founders vested in Congress authority over interstate commerce.

The commission majority defended its action by asserting the need for a more "granular" analysis of impairment than could be accomplished from Washington.

Powell and his supporters, however, declare other motives at play. "Make no mistake," he said in his dissent, "the role of the states dominated this proceeding solely because states are perceived as a more favorable venue for preserving the status quo of aggressive [subsidized access] rights. ... The record was beside the point. The goal was to keep [subsidized access] in place. In so doing, the Majority's decision substantially repeats the errors of our past approaches."

Powell's sentiments were echoed by Wall Street analysts such as Bernstein Research Call, which predicted that giving states such broad regulatory latitude would "... result in 'gaming' on the part of the state commissions predisposed to insuring the perpetual availability of [subsidized access]."

This text is part of the larger publication:
Crossed Lines: Regulatory Missteps in Telecom Policy

Return to **standard version**.

IMS Home Page

The Telephone Industry

When the telephone was first invented, not everyone appreciated its importance. In fact, Western Union was at first offered the patent to this invention--but refused it. As Bell started to commercialize this invention, others began to see its potential. However, Theodore Vail, the President of American Telegraph & Telephone (AT&T), sought to avoid competition by establishing a new principle: that of a natural monopoly. He argued that it would be unwise to allow competition in the deployment of telephone networks, and permit a number of independent telephone systems to develop in the same city, each competing with each other: both for customers and for space to string their wires. The idea he proposed--that of a natural monopoly or *public utility*--was that there should be only one telephone company and that, since it would be a monopoly, it would be regulated by the government in order to protect the consumer.

Thus, although the actual service would be provided by a private company, the rates and practices in the industry would be regulated by the government. The company would apply to the government, who would then set rates for services and rules as to how the industry could function. This idea was accepted by the government.

On the federal level, the Interstate Commerce Commission and the Post Office Department (for the telegraph) first handled this, but in 1934 the Federal Communications Commission was established, and--among other things--was assigned the task of regulating telephone service at the national level. On the state level, public utility commissions (PUCs) were established to regulate state and local telephone service. The idea basically was to avoid duplication of effort, to encourage the orderly growth of the industry, and--through regulation--to protect the consumer.

As time went on, AT&T became not only the major industry player in the United States, but in fact, the largest company in the world. It was the only telephone company in most areas, and in those few areas where other telephone companies had come to exist, problems were often experienced with the interconnection of services, with equipment, and with other matters as well.

Through its monopoly control, AT&T came to dominate the three major areas of telephone service: local service, long distance service, and equipment. AT&T did not sell its telephones; it rented them. Both the long distance, or Long Lines, division of AT&T and the local telephone companies bought all their equipment from the AT&T subsidiary, Western Electric; they did not purchase equipment from any other manufacturers. AT&T did not allow its customers to attach devices to its network, such as extension phones, answering machines, or paging devices. Everything had to be rented from AT&T. As the electronics industry developed after World War II, people were still not allowed to attach these devices physically to the telephone network, but had to use a technology known as the induction coil to transfer signals to and from the telephone network electromagnetically.

In 1949, the government sued Western Electric and AT&T charging that they had monopolized the manufacture and sale of telephones and equipment (Civil Action No. 17-49). What the government

A Novel Conference: The Origins of TPRC

Bruce M. Owen

The twenty-fifth annual Telecommunications Policy Research Conference (TPRC) provides an opportunity to reflect on the origins and achievements of TPRC. An objective of TPRC has been to provide not merely a forum for communication policy researchers to exchange ideas, but also a channel for policy-relevant research to reach regulators and other government officials, and for the latter to convey their research needs to academics. Therefore, any discussion of the history of TPRC should be placed in the context of evolving government policy.

TPRC arose, not coincidentally, at the beginning of an extraordinary period in the history of telecommunications policy and regulation. Before the early 1970s, for example, it was unlawful for anyone but AT&T to offer public long distance service; there was no domestic satellite industry; it was unlawful for cable systems to import any but a limited number of distant signals; it was unlawful for any broadcaster or cable operator to offer pay-TV service consisting of entertainment series, sports events that had been on TV in the last four years, or movies less than two or more than four years old; and it was unlawful for customers to attach a "foreign"—i.e., any—device to the telephone network. More generally, it was the mainstream view that the telephone business was and ought to be a regulated monopoly, and that broadcasters were and ought to be protected from excessive competition in order to promote their ability to offer public service and especially local programming.

Further, and even more generally, the 1970s was a unique period in American economic history: one in which the validity of the notion of natural monopoly and the virtues of regulation came into question. During these years academic skepticism or even cynicism about regulation, emanating especially from the Chicago School, spilled over into public debate. The result was not just communication policy reform but intercity bus, airline, trucking and railroad deregulation, the beginnings of related reforms in the securities and financial services industries, and other deregulation initiatives. A dramatic change illustrative of the growing currency of economics took place at the Department of Justice Antitrust Division, which today employs four or five dozen Ph.D. economists. Before 1974 the Antitrust Division had *no* permanent staff of such economists. Similar changes occurred at the FTC. Many other countries have followed the U.S. intellectual lead in these matters, in some cases showing greater courage in implementing regulatory reform.

TPRC arose also during a period of extraordinary growth and change in telecommunications technology. Remote terminals of mainframe computers, geosynchronous satellites, fiber optic transmission lines, electronic switches, digital transmission and compression, the Internet, and many other advances created pressures for regulatory reform and facilitated reform.

TPRC beginnings

The institution of TPRC was neither the beginning of academic interest in communications policy nor the first time academics—lawyers, political scientists, engineers, and economists—had a direct impact on communications policy. Modern academic interest in communication policy can be traced to Ronald Coase's (1959, 1962) famous property rights papers on spectrum

allocation, and to such theoretical work on utility regulation as the well-known Averch and Johnson (1962) paper.

Those unfamiliar with the field will wonder what is meant by "communication" or "telecommunication" in the present context. What is meant, roughly, is those activities historically subject to the jurisdiction of the Federal Communications Commission. This usage is curious, since telephone regulation has much more in common with electricity or natural gas regulation than with broadcasting. If industry research were focused on firms with basic similarities in their products and technologies, we would have separate conferences on mass media and on public utilities. That the same research community, and even the same individual researchers, focused on the legal jurisdiction rather than the more natural economic classifications illustrates the important influences that government has on policy research.

While important and relevant research existed, the government appeared to remain ignorant of it until the late 1960s, when Lyndon Johnson convened the President's Task Force on Telecommunications Policy, headed by undersecretary of state Eugene V. Rostow (President's Task Force, 1968). The Task Force was established in part to hold back a rising sea of political pressure that had begun to lap at the White House gates. The pressure arose from the desire of potential entrants to arbitrage the growing gap between prices and costs or between actual and best-practice technologies, and from those incumbents who relied on government to protect economic rents. These pressures were manifest chiefly in controversies involving long distance telephone service, domestic communication satellites, and the import of distant TV signals by cable systems.

Rostow assembled a talented staff. For example, Richard A. Posner was seconded from the Justice Department and Walter Hinchman from Commerce. Leland L. Johnson came from RAND. More than 30 academic consultants were retained, including William J. Baumol, William F. Baxter, William Capron, William K. Jones, Charles J. Meyers, Monroe E. Price, and Lester D. Taylor. Government agencies sent representatives, such as Roger G. Noll from the Council of Economic Advisors. The Task Force, its consultants, and its research contractors, well aware of relevant academic research, produced a report that was cautiously progressive, suggesting for example an "open skies" policy for domestic communication satellites, and a greater role for competition in telephony. The staff and contractors also produced several innovative papers on marketable spectrum rights. Finally, the Task Force recommended establishment of an executive branch agency to formulate and coordinate telecommunication policy. More important than the specific recommendations, however, the Task Force implicitly validated the notion that there was such a thing as "telecommunications policy," that it was susceptible to analytical policy research and analysis, and that there existed a newly self-aware community of scholars interested in such research.

Establishment of the Office of Telecommunications Policy

When President Johnson did not run for reelection, his Task Force lost its constituency. Politics notwithstanding, however, the incoming Nixon administration picked up on and sought to implement many of the Task Force recommendations. Clay T. (Tom) Whitehead, a Special Assistant to the President assigned to communication matters, perhaps because he had a Ph.D. from MIT (in political science), pushed to implement both the satellite open skies policy and the establishment of an executive branch policy agency. The resulting Office of Telecommunication Policy (OTP) was created by Executive Order as part of the Executive Office of the President in 1970. Tom Whitehead became the first director of the agency, reporting at least in theory directly to the President.

OTP inherited the frequency management and emergency preparedness roles formerly exercised by the defunct Office of Telecommunications Management (OTM), along with many of OTM's staff. Whitehead added only a small number of new professional staff. Among them were general counsel (now Justice) Antonin Scalia, and legislative and press relations officer Brian Lamb (later to found C-SPAN). I was the first economist at OTP, initially as a Brookings Economic Policy Fellow, and later as chief economist. Other early OTP economists included Stanley M. Besen, Ronald Braeutigam and Gary Bowman.

OTP tended to see itself, not indefensibly, as a beacon of reason adjoining an ocean of bureaucratic backwardness. Lacking significant political power (President Nixon and his senior staff did not accord much priority to telecommunications policy even before Watergate), line authority or political experience, Whitehead was reduced chiefly to issuing position papers, making speeches, and writing policy letters to the FCC chairman, which were mostly ignored. This was of course frustrating to those of us aware of the enormous gap between the implications of academic research and the actual state of communications policy in the United States.

The 1972 conference

Several influences led to the convening of the first telecommunications policy research conference. First, it seemed that exposing other policy makers to academic ideas might eventually make them more susceptible to OTP's positions. Second, OTP had a research budget to spend, and a conference appeared to be a sensible use of research funds. Earlier expenditures had sometimes produced embarrassing results, such as studies whose conclusions were at odds with OTP's positions. Third, since academic research appeared to be the major positive factor on OTP's side of most issues, OTP wanted to promote more of it. Giving academics a live audience of policy makers seemed likely to stimulate interest among policy scientists and their students.

Finally, to those of us with academic backgrounds the Washington telecommunications policy community in the early 1970s was a lonely and inhospitable place. It is not an overstatement to say that ideas like "selling the spectrum" or "breaking up *the* telephone company," or even allowing competition with it, were treated with derision and contempt by responsible officials at all levels. A policy research conference would be good for morale—a booster shot for the OTP staff and the few "enlightened" analysts in other agencies.

The first telecommunications policy research conference was held on November 17-18, 1972 in the New Executive Office Building. The audience consisted of federal government employees from OTP, the FCC, and the Departments of Justice, Commerce, and Defense, among others. Papers were presented and discussed by 15 academics (13 economists and 2 lawyers). Among the most luminous academics were Ronald Coase and William Baumol. (The 1972 program is appended.) The research papers were published by OTP (Owen, 1972).

The topics discussed at the first conference are for the most part still on the policy agenda. There were, for example, papers on cross subsidization, financing public broadcasting, spectrum markets, and cable television regulation. There were also papers on subjects that have not been much addressed in subsequent conferences, such as democracy in the newsroom, and one paper analyzing the effect of policy research on FCC decision-making. The first conference was regarded as a success by most of the participants, and there developed a consensus that it would be useful to have an annual conference.

An annual event

Although I conceived and organized the 1972 OTP conference, arguably the true beginning of TPRC was at Airlie House on April 16-19, 1974. (The program of the 1974 conference appears as an Appendix in Owen, 1976.) Although OTP provided partial funding, this was the first independently organized meeting. The 1974 conference was organized by a group of academics (Donald A. Dunn, Stanley M. Besen, Gerald Faulhaber, Leland Johnson, and Ithiel de Sola Pool).

In later years funding came from government agencies such as OTP, the Federal Communications Commission, the National Telecommunications and Information Administration, and the National Science Foundation, as well as from private foundations and programs that either sponsored TPRC directly or funded research that was presented at TPRC. These institutions included the Markle Foundation, the Kettering Foundation, the Sloan Foundation, the Ford Foundation, and the Aspen Institute.

It was the practice of organizing committees in the early years to appoint their successors, with little or no overlap from year to year. Also, it was usual for the organizing committee to include representatives from those few organizations with concentrations of telecommunications policy researchers, such as the RAND Corporation, Bell Labs, and Stanford University. Each organizing committee had to manage funding as well as the program and other administrative arrangements. Because the conference had no permanent home for purposes of funding and administrative services there were frequent difficulties. By the early 1980s many established participants felt that TPRC had drifted away from its original character and goals. Accordingly, in 1985, the conference was reorganized in such a way as to separate program responsibility from fund raising and administrative concerns. Administrative matters were undertaken by a Board of Directors, whose self-perpetuating members have overlapping terms. The Board also has the duty to appoint the annual organizing committee, which has responsibility for the program and local arrangements. Since 1989 Economists Incorporated has provided administrative services to TPRC at cost; in practice this work has been organized by Dawn Higgins.

TPRC is, if not unique, certainly unusual in being a long-running event with no single individual or organization continuing in charge. Conferences like TPRC are more typically organized by learned societies. TPRC has been fortunate in having attracted such a long string of interested and capable organizing committee members. Continuing interest is no doubt also stimulated by the cataclysmic events that have shaken the communication industries since the early 1970s.

TPRC is unique in another respect: the participation of industry researchers. From the beginning, researchers from organizations such as Bell Labs have been an integral part of TPRC Nevertheless, in the early years there was much debate, which continues, about the participation of industry "lobbyists."

Influence of TPRC

It is difficult to say what influences TPRC has had on the development on government policy and on academic policy research because we lack a "control" world with no TPRC. Some of what we are inclined to attribute to TPRC may be due simply to the technological changes that led to revisions in telecommunications industry structure and regulation. But in celebrating TPRC's 25th anniversary, perhaps we should not demand too much analytical rigor on this point.

One obvious and demonstrable change on the input side is the growth in the number of economists and other professionals with similar training now employed by the FCC and other agencies responsible for telecommunication. In 1970 the FCC had no more than three or four Ph.D. economists; today there are many dozen, and an even greater number employed by regulated firms and consulting firms. Any given bureau of the FCC today is likely to employ more economists specialized in communications than there were in the nation in 1970. Further, FCC lawyers and other staffers who are not economists have adopted much of the language and many of the precepts of economics.

On the output side, changes have been revolutionary. No important FCC policy statement issues these days without explicit attention to its economic welfare effects. It is true that similar strides have been made in other areas. One is struck, for example, that at the 1997 Tokyo summit meetings on the environment, one of the United States' principal goals was the establishment of tradable emission rights. Nevertheless, communications was undoubtedly the first of the major regulatory fields to be thus reformed, and has progressed the most. TPRC facilitated this in two ways. First, by increasing academic interests in the field, it increased the supply of interested graduate students and relevant dissertations. Second, the private and government lawyers who have always been central participants in the policy process heard at TPRC a whole new set of arguments and principles that transcended the usual motifs of legal argument. Lawyers are always competing to win arguments, and TPRC supplied them with new and more effective ammunition. Further, many academic lawyers became interested in communications policy research, often as part of interdisciplinary teams.

A cynic might say that a great portion of what has changed is that the same old vested interests now feel compelled to make their public interest arguments in terms acceptable to scholars, without necessarily leading to any change in outcomes. But such cynicism cannot explain how the pre-existing industry structure was transformed into entirely new "vested" economic interests, such as IXCs, RBOCs, CLECs, DOMSATs, and PCS licensees. Under the old regime these would all have been departments of AT&T, or would not have existed at all.

TPRC's unique contribution, in the end, was the creation of what Stan Besen calls an "invisible college" or virtual community of communication researchers scattered at different institutions and agencies. However characterized, TPRC promoted both academic collaboration and the delivery of relevant policy analysis to government agencies, phenomena previously unknown in the communication world.

Note

I am grateful to many of those mentioned by name herein for reviewing the manuscript and pointing out at least some of the errors.

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Coase, Ronald. The Federal Communications Commission. 2 J. Law & Econ 1 (1959).

Coase, Ronald. The Interdepartmental Radio Advisory Committee. 5 J. Law & Econ. 17 (1962).

Organizing Committee Members 1972-1985

The First 10 Years

1972

Bruce M. Owen

1973

No conference.

1974

Stanley M. Besen

Donald Dunn

Gerry Faulhaber

Leland Johnson

Ithel Pool

1975

Kan Chen

Walter S. Baer

Elizabeth E. Bailey

Kas Kalba

Bruce M. Owen

1976

[Information missing]

1977

Shiela Mahony

Paul Bortz

Ronald Breautigam

Forrest Chisman

Deen Gillette

Bridger Mitchell

Weston Vivian

Debbie Mack

1978

Lawrence Day

Herbert Dordick

Aimee Dorr

Henry Goldberg

Carol Keegan

Harvey Levin

William Lucas

Rhonda Mange

Robert D. Willig

1979

[Information missing]

1980

John Clippinger

Robert E. Dansby

Charles M. Firestone

Heather Hudson

Jorge Schement

Marvin A. Sirbu

Leonard Waverman

1981

Barry Cole

Timothy Haight

Hudson N. Janisch

Wilhelmina M. Reuben-Cooke

William E. Taylor

Armando Valdez

Larry White

1982

[Information missing]

research topic: U.S. Telecommunications Policy

Telecommunications Policy (U.S.) - Selected Resources

1. **Telecommunications Policy: Have Regulators Dialed the Wrong Number?**
   by Donald L. Alexander. 176 pgs.
2. **A Communication Theory Perspective on Telecommunications Policy, in Journal of Communication**
   by Edward M. Lenert. 21 pgs.
3. **Competition, Regulation, and Convergence: Current Trends in Telecommunications Policy Research**
   by Sharon Eisner Gillett, Ingo Vogelsang. 336 pgs.
4. **Keeping Up with Telecom: Convergence, Broadband, and Access, in Public Management**
   by Tom Bennett. 6 pgs.
5. **Telecommunications Policy and Economic Development: The New State Role**
   by Jurgen C. Schmandt, Frederick Richard Williams, Robert H. Wilson. 299 pgs.
6. **American Regulatory Federalism and Telecommunications Infrastructure (Part II "State Policies and Actors")**
   by Paul Teske. 170 pgs.
7. **Making Universal Service Policy: Enhancing the Process through Multidisciplinary Evaluation**
   by Barbara A. Cherry, Steven S. Wildman, Allen S. Hammond. 263 pgs.
8. **The Making of Energy and Telecommunications Policy**
   by Georgia A. Persons. 196 pgs.
9. **Access to the Information Age: Fundamental Decisions in Telecommunications Policy, in Policy Studies Journal**
   by Frank G. Bowe. 10 pgs.
10. **Telephony, the Internet, and the Media: Selected Papers from the 1997 Telecommunications Policy Research Conference**
    by Jeffrey K. MacKie-Mason, David Waterman. 302 pgs.
11. **The Internet and Telecommunications Policy: Selected Papers from the 1995 Telecommunications Policy Research Conference**
    by Gerald W. Brock, Gregory L. Rosston, Telecommunications Policy Research Conference. 324 pgs.
12. **Telecommunications Policy for the 1990s and Beyond**
    by Walter G. Bolter, James W. McConnaughey, Fred J. Kelsey. 438 pgs.

13. **Liberalization Without Deregulation: U.S. Telecommunications Policy During the 1980s, in Contemporary Policy Issues**
by Robert W. Crandall. 12 pgs.

14. **The Democracy Gap: The Politics of Information and Communication Technologies in the United States and Europe**
by Jill Hills. 222 pgs.

15. **New Directions in Telecommunications Policy, Vol. 2 (1989)**
by Paula R. Newberg. 348 pgs.

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- Put exact phrases in quotation marks. Do not put single words in quotation marks.

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- **Telecommunications**
- **Telecommunications Deregulation**
- **Federal Communications Commission**
- **Satellite Communications**
- **Internet and Communications**
- **International Telecommunications**

The Telecommunications Regulation Database

Authors: Luke Haggarty, George Clarke, Rosario Kaneshiro, Rc Mary M. Shirley, Scott Wallsten, and Lixin Colin Xu

Year(s) 2001-02

Pub. Date: April 21, 2004

Documentation: New Tools for Studying Network Industry Reforms in Countries: The Telecommunications and Electricity Re Database
Credit Information Infrastructure and Political Econor in South Africa

Topics: Infrastructure, Private Sector Development

Access the dataset: MS Excel Spreadsheet, 364 KB

Dataset Description:

The database of telecommunications regulations includes 178 variables on regulatc governance and content in 45 countries.

OECD TELECOMMUNICATIONS DATABASE **1999**

ON CD-ROM

9 789264 067684

OECD TELECOMMUNICATIONS DATABASE **1999**

Technical Documentation

March 1999

◆ GENERAL DESCRIPTION

The Telecommunications Database 1999 on diskette or CD-ROM is produced in association with the biennial publication OECD Communications Outlook. The Database provides time-series data covering twenty-nine OECD Member countries. It contains both telecommunication and economic indicators.

The data are provided for the years 1980 to 1997, where available.
Further information about the OECD's work on telecommunications is available at:
http://www.oecd.org/dsti/sti/it/cm/.

◆ BEYOND 20/20

Beyond 20/20 is Windows-based software that allows the user to select the series, years, and countries desired to produce tables, graphics and maps. Users can easily move the series, country, and time period elements to the axis of their choice. Beyond 20/20 allows users to save a table to the clipboard or to save tables as TXT, comma delimited text, WKS, Aremos, or DBF files.

For detailed instructions on how to use Beyond 20/20, a QuickStart Guide is provided. This product also has an on-line help feature.

◆ SERIES

The Telecommunications Database 1999 on diskette or CD-ROM includes the following series of data:

CODE	Description
ACCESS LINES	Access lines
DIGITAL LINES	Percent of digital access lines
RESIDENTIAL LINE	Access lines for residential use
ANALOGUE MOBILE	Analogue mobile cellular subscribers
DIGITAL MOBILE	Digital mobile cellular subscribers
MOBILE COVERAGE	Percent of population coverage of mobile networks
ISDN BASIC	ISDN subscribers - basic rate
ISDN PRIMARY	ISDN subscribers - primary rate

LINES/100 POP.	Access lines per 100 inhabitants
PAY PHONES	Public pay phones
CARDPHONES %	Percent of public pay phones that are cardphones
PAYPHONE/1000	Public pay phones per 1000 inhabitants
INTERNET HOSTS	Internet hosts
STAFF	Total staff in telecommunications services
MOBILE STAFF	Total staff in mobile telecommunications services
LINES PER STAFF	Access lines per PTO employee
TOTAL REV	Total PTO revenue
TOTAL REV $	Total PTO revenue in US$
TEL SERVICE REV	Revenue from telephone service
CONNECTION REV	Revenue from connection charges
LEASED LINE REV	Revenue from leased lines
LINE RENTAL REV	Revenue from line rental charges
LOCAL CALL REV	Revenue from call charges - local
NATL CALL REV	Revenue from call charges - national
INTERNATL REV	Revenue from call charges - international
MOBILE REV	Revenue from mobile services
REV PER CAPITA	Total PTO revenue per capita
REV PER CAPITA $	Total PTO revenue per capita in US$
REV PER STAFF	Total PTO revenue per employee
REV PER STAFF $	Total PTO revenue per employee in US$
REV PER LINE	Total PTO revenue per access line
REV PER LINE $	Total PTO revenue per access line in US$
REV AS % GDP	Total PTO revenue as a % of Gross Domestic Product
TOTAL EXPEN.	Total PTO operating expenditure
TOTAL EXPEN. $	Total PTO operating expenditure, in US$
DEPRECIATION	Depreciation
TAX PAID	Taxes paid by PTOs
WAGE EXPEN.	Expenditure on wages
TOTAL INVEST.	Total PTO Investment
TOTAL INVEST. $	Total PTO Investment in US$
INV. PER LINE	Total PTO investment per access line
INV. PER LINE $	Total PTO investment per access line in US$
INV. PER CAPITA	Total PTO investment per inhabitant
INV PER CAPITA $	Total PTO investment per inhabitant in US$
INV. % REVENUE	Total PTO investment as a percentage of revenue
INV. % GFCF	Total PTO investment as a percentage of gross fixed capital formation
R&D INVEST.	Investment in research and development

EXCHANGE INVEST	Investment in telecommunication exchanges
TRANS. INVEST.	Investment in transmission infrastructure
MOBILE INVEST.	Investment in mobile infrastructure
CONNECTION WAIT	Waiting time for new connection
O/S APPLICATIONS	Number of outstanding applications for connection
FAULTS PER 100	Number of faults per 100 lines per year
PAY PHONES WKG	Average percent of pay phones in working order
ITEMISED BILL	Percent of subscribers to itemised billing
ITEMISED POSS.	Potential for itemised billing (%)
ASR	Answer Seizure Ratios
OUTGOING MITT	Outgoing Minutes of International Telecommunications Traffic (MiTT)
TRADE BAL 88-97	Trade balance in commnications equipment, SITC Rev 3, 1988-97US$
TOTAL EXP 88-97	Total export of communications equipment, SITC Rev 3, 1988-97, US$
EXP TELSET 88-97	Export of telephone sets, SITC Rev 3, 1988-97, US$
EXP SWITCH 88-97	Export of switching equipment, SITC Rev 3, 1988-97 US$
EXP TRANSM 88-97	Export of transmission equipment, SITC Rev 3, 1988-97, US$
EXP RCVRS 88-97	Export of receiver terminals, SITC Rev 3, 1988-97, US$
EXP TV RCV 88-97	Export of television receivers, SITC Rev 3, 1988-97, US$
EXP RADIO 88-97	Export of radio broadcasting receivers, SITC Rev 3, 1988-97, US$
EXP LINE 88-97	Export of other line telephony equipment, SITC Rev 3, 1988-97, US$
EXP BROADC 88-97	Export of other broadcasting/wireless equipment, SITC Rev 3, 1988-97, US$
TOTAL IMP 88-97	Total Import of communications equipment, SITC Rev 3, 1988-97, US$
IMP TELSET 88-97	Import of telephone sets, SITC Rev 3, 1988-97, US$
IMP SWITCH 88-97	Import of switching equipment, SITC Rev 3, 1988-97, US$
IMP TRANSM 88-97	Import of transmission equipment, SITC Rev 3, 1988-97, US$
IMP RCVRS 88-97	Import of receiver terminals, SITC Rev 3, 1988-97, US$
IMP TV RCV 88-97	Import of television receivers, SITC Rev 3, 1988-97, US$
IMP RADIO 88-97	Import of radio broadcasting receivers, SITC Rev 3, 1988-97, US$
IMP LINE 88-97	Import of other line telephony equipment, SITC Rev 3, 1988-97, US$
IMP BROADC 88-97	Import of other broadcasting/wireless equipment, SITC Rev 3, 1988-97, US$
TRADE BAL 80-87	Trade balance in communications equipment. SITC Rev 2 1980-87, US$
TOTAL EXP 80-87	Total export of communications equipment, SITC Rev 2, 1980-87 US$
EXP LINE 80-87	Export of line equipment, SITC Rev 2, 1980-87 US$
EXP TRANSM 80-87	Export of transmission equipment, SITC Rev 2 1980-87, US$
EXP RCVRS 80-87	Export of receiver terminals, SITC Rev 2, 1980-87, US$
EXP TV RCV 80-87	Export of television receivers, SITC Rev 3, 1988-97, US$
EXP RADIO 80-87	Export of radio broadcasting receivers, SITC Rev 3, 1988-97, US$
EXP BROADC 80-87	Export of other broadcasting/wireless equipment, SITC Rev 2, 1980-87, US$
TOTAL IMP 80-87	Total import of communications equipment, SITC Rev 2, 1980-87 US$

IMP LINE 80-87	Import of line equipment, SITC Rev 2, 1980-87 US$
IMP TRANSM 80-87	Import of transmission equipment, SITC Rev 2 1980-87, US$
IMP RCVRS 80-87	Import of receiver terminals, SITC Rev 2, 1980-87, US$
IMP TV RCV 80-87	Import of television receivers, SITC Rev 3, 1988-97, US$
IMP RADIO 80-87	Import of radio broadcasting receivers, SITC Rev 3, 1988-97, US$
IMP BROADC 80-87	Import of other broadcasting/wireless equipment, SITC Rev 2, 1980-87, US$
EXCHANGE	Average annual exchange rate (local currency per US$)
PPP	Purchasing power parities (in local currency per US$)
POPULATION	Population
GFCF	Gross Fixed Capital Formation
GFCF $	Gross Fixed Capital Formation, in US$
GDP	Gross Domestic Product
GDP $	Gross Domestic Product, in US$
GDP PER CAPITA	Gross Domestic Product per capita
GDP PER CAPITA $	Gross Domestic Product per capita, in US$
HOUSEHOLDS	Households
CPI	Consumer Price Index, 1990=100
NATIONAL EMPLT.	Total national employment

Directorate for Science, Technology and Industry (Home)

- Information and Communications Policy
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- Information and Communication Technologies

Long abstract

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Home: Information and Communications Policy > Publications & Documents > Statistics, Data and Indicators > OECD Telecommunications Database 2001

OECD Telecommunications Database 2001

The OECD Telecommunications Database is a unique source of key indicators on the communications sector in 29 OECD Member countries. It provides over 100 time series of data of indicators on telecommunications such as network infrastructure, revenues, expenses and investment of operators, trade in telecommunications equipment, as well as various economic indicators, such as GDP and national employment. The OECD Telecommunications Database covers the years 1980 to 1999, where available. The Database uses the Beyond 20/20TM browser, a user-friendly, WindowsTM-based software that allows the user to extract and export data, build tables and graphs, and display maps.

Also available in paper form and on line, the OECD Telecommunications Database is produced in association with the biennial OECD Communications Outlook. For more information on major trends in information technology, please consult the OECD Information Technology Outlook, published every other year.

The OECD Telecommunications Database is also available on line at www.SourceOECD.org.

Don't miss

- OECD Work on Digital Content
- Recommendation of the OECD Council on Broadband Development
- Telecom Reports
- Key STI Publications
- Contact Us
- Site Map

Privacy Online: OECD Guidance on Policy and Practice
To assist governments, businesses and individuals in promoting privacy protection online at both national and international levels.

Editor's Choice

OECD Communications Outlook 2003
The most recent comparable data on the performance of the communication sector in OECD countries and on their policy frameworks.

New Guidelines

OECD Cross-Border Fraud Guidelines
Guidelines for Protecting Consumers from Fraudulent and Deceptive Commercial Practices Across Borders

TelcoData.us
Telecommunications Database

Proudly providing data for the US and Canada since 2001! Many thanks to the fine folks at 123.net for donating the hardware and the colocation!

Telcodata Wireless | FAQ

Subscription links: (Subscription not necessary for the basic features)

- Login
- Signup
- Downloads

Lookup by:

- Areacode/Exchange
- CLLI code
- Company Name
- Rate Center

Find:

- 10-10 and 10-15 long distance dialing codes
- Companies, By Areacode
- Companies, By Ratecenter (Find a facilities based CLEC in your ratecenter)
- Switches, by partial CLLI code (ex. PNTCMI finds PNTCMIMNDS0, PNTCMIWSCG0, etc)
- Area codes, by state
- Companies, by state (See who owns number blocks in your state)

Get Details:

- Detailed Switch Information (See all information on a switch at a glance)
- Tandem Search (beta) (Find all switches homed to a specific tandem)
- Central Office Information (beta) (Find information on the central office in general)

Photos:

- My photos (due to recent events, this is a rather abbreviated archive)
- "Secret Pictures of Phone Switches (third-party) (Features the 1AESS, DMS-100, and 5ESS)
- "The Central Office" (third-party) (Photographs of the outside of central offices. Most of them are quite interesting)
- Cell sites of Santa Cruz (third-party)

Consumer Advocacy:

- Resources for Michigan Telephone Users
- Maine Public Advocate Office (see the 'Ratewatcher' section)

- ICB Toll Free (ICB advocates for the toll-free (and domain name) end user. My site can't help you with toll free numbers, ICB's can.)

Documentation:

- Automated Query Interface (This is for machine parseable output. Please use this rather than the html interface if you are writing software)
- Excel Import Tutorial (How to import site results into excel directly)

TELECOMMUNICATIONS DATABASE 2003

Content Documentation

June 2003

TELECOMMUNICATIONS DATABASE 2003

Content Documentation

June 2003

GENERAL DESCRIPTION

The *Telecommunications Database 2003* on CD-ROM is produced in association with the biennial publication *OECD Communications Outlook.* The Database provides time-series data covering twenty-nine OECD Member countries. It contains both telecommunication and economic indicators.

The data are provided for the years 1980 to 2001, where available.

Further information about the OECD's work on telecommunications is available at: **http://www.oecd.org/sti/telecom**

BEYOND 20/20

Beyond 20/20 is Windows-based software that allows the user to select the series, years, and countries desired to produce tables, graphics and maps. Users can easily move the series, country, and time period elements to the axis of their choice. *Beyond 20/20* allows users to save a table to the clipboard or to save tables as TXT, comma delimited text, WKS, Aremos, or DBF files.

For detailed instructions on how to use *Beyond 20/20*, a QuickStart Guide is provided. This product also has an on-line help feature.

SERIES

The *Telecommunications Database 2003* on CD-ROM includes the following series of data:

CODE	Description
STANDARD LINES	Standard access lines
DIGITAL LINES	Percent of digital access lines
RESID LINES	Access lines for residential use
ISDN BASIC	ISDN subscribers - basic rate
ISDN PRIMARY	ISDN subscribers - primary rate
MOBILE SUBS	Mobile subscribers
MOBILE PREPAID	Mobile cellular subscribers using prepaid services
MOBILE COVERAGE	Percent of population coverage of mobile networks
INTERNET SUBS	Internet subscribers
DIAL-UP	Number of Dial-up Internet subscribers
DSL LINES	DSL Lines
CABLE MODEM	Cable Modem Internet subscribers
BB TECHNO	Other broadband access technologies to Internet
PAY PHONES	Public pay phones
TELECOMS STAFF	Total staff in telecommunications services
MOBILE STAFF	Total staff in mobile telecommunications services
ISP STAFF	Total staff employed by Internet Service Providers (ISPs)
WAGE EXPENDITURE	Wage expenditure
TOTAL REVENUE	Total PTO revenue
INSTALLATION REV	Revenue from installation charges
LEASED LINE REV	Revenue from leased lines
LINE RENTAL REV	Revenue from line rental charges
LOCAL CALL REV	Revenue from call charges – local
NATL CALL REV	Revenue from call charges – national
INTL REV	Revenue from call charges – international
INTERNET REV	Incumbent PTO(s)' Internet access revenue
MOBILE REV	Revenue from mobile services
TOTAL INVEST	Total PTO Investment
MOBILE INVEST	Investment in mobile infrastructure
CONNECT WAIT	Waiting time for new connection
FAULTS PER 100	Number of faults per 100 lines per year
FAULTS 24HRS	Percent of faults repaired within 24 hrs
PAYPHONES WRG	Average percent of pay phones in working order
DIR ASSIST	Directory Assistance Charges
OUTGOING MITT	Outgoing Minutes of International Telecommunications Traffic (MiTT)
TRAFFIC NAT	National long distance telephone traffic
TRAFFIC LOCAL	Local telephone traffic
TRAFFIC MOBILE	Cellular mobile traffic
TRAFFIC FIX-MOB	Traffic from Fixed lines to Mobile networks
TRAFFIC MOB-FIX	Traffic from Mobile networks to Fixed lines
ACCESS CHANNELS	Access channels
LINES/100 POP	Standard access lines per 100 inhabitants
CHAN/100 POP	Access channels per 100 inhabitants
PAYPHONE/1000	Public pay phones per 1000 inhabitants

CHAN PER STAFF	Access channels per PTO employee
TOTAL REVENUE $	Total PTO revenue in USD
MOBILE REVENUE $	Revenue from mobile services USD
REV PER CAPITA	Total PTO revenue per capita
REV PER CAPITA $	Total PTO revenue per capita in USD
REV PER STAFF	Total PTO revenue per employee
REV PER STAFF $	Total PTO revenue per employee in USD
REV PER CHAN	Total PTO revenue per access channel
REV PER CHAN $	Total PTO revenue per access channel in USD
REV AS % GDP	Total PTO revenue as a % of Gross Domestic Product
TOTAL EXPEN $	Total PTO operating expenditure, in USD
TOTAL INVEST $	Total PTO Investment in USD
INV. PER CHAN	Total PTO investment per access channel
INV. PER CHAN $	Total PTO investment per access channel in USD
INV. PER CAP	Total PTO investment per inhabitant
INV. PER CAP $	Total PTO investment per inhabitant in USD
INV. % REV	Total PTO investment as a percentage of revenue
INV. % GFCF	Total PTO investment as a percentage of gross fixed capital formation
INTERNET HOSTS	Internet hosts
FIBRE	Optic fiber
CARDPHONES %	Percent of public pay phones that are cardphones
CONNECTION REV	Revenue from connection charges
TOTAL EXPEN	Total PTO operating expenditure
DEPRECIATION	Depreciation
TAX PAID	Taxes paid by PTOs
O/S APPLICATIONS	Number of outstanding applications for connection
ITEMISED POSS	Potential for itemised billing (%)
ITEMISED CHG	Percent of subscribers to itemised billing
TRADE BAL 88-01	Trade balance in communications equipment, SITC Rev 3, 1988-01, USD
TRADE BAL 80-87	Trade balance in communications equipment. SITC Rev 2 1980-87, USD
TOTAL EXP 88-01	Total export of communications equipment, SITC Rev 3, 1988-01, USD
EXP TELSET 88-01	Export of telephone sets, SITC Rev 3, 1988-01, USD
EXP SWITCH 88-01	Export of switching equipment, SITC Rev 3, 1988-01, USD
EXP TRANSM 88-01	Export of transmission equipment, SITC Rev 3, 1988-01, USD
EXP RCVRS 88-01	Export of receiver terminals, SITC Rev 3, 1988-01, USD
EXP TV RCV 88-01	Export of television receivers, SITC Rev 3, 1988-01, USD
EXP RADIO 88-01	Export of radio broadcasting receivers, SITC Rev 3, 1988-01, USD
EXP LINE 88-01	Export of other line telephony equipment, SITC Rev 3, 1988-01, USD
EXP BROADC 88-01	Export of other broadcasting/wireless equipment, SITC Rev 3, 1988-01, USD
TOTAL IMP 88-01	Total Import of communications equipment, SITC Rev 3, 1988-01, USD
IMP TELSET 88-01	Import of telephone sets, SITC Rev 3, 1988-01, USD
IMP SWITCH 88-01	Import of switching equipment, SITC Rev 3, 1988-01, USD
IMP TRANSM 88-01	Import of transmission equipment, SITC Rev 3, 1988-01, USD
IMP RCVRS 88-01	Import of receiver terminals, SITC Rev 3, 1988-01, USD
IMP TV RCV 88-01	Import of television receivers, SITC Rev 3, 1988-01, USD
IMP RADIO 88-01	Import of radio broadcasting receivers, SITC Rev 3, 1988-01, USD
IMP LINE 88-01	Import of other line telephony equipment, SITC Rev 3, 1988-01, USD
IMP BROADC 88-01	Import of other broadcasting/wireless equipment, SITC Rev 3, 1988-01, USD
TOTAL EXP 80-87	Total export of communications equipment, SITC Rev 2, 1980-87 USD
EXP LINE 80-87	Export of line equipment, SITC Rev 2, 1980-87 USD

EXP TRANSM 80-87	Export of transmission equipment, SITC Rev 2 1980-87, USD
EXP RCVRS 80-87	Export of receiver terminals, SITC Rev 2, 1980-87, USD
EXP TV RCV 80-87	Export of television receivers, SITC Rev 3, 1988-01, USD
EXP RADIO 80-87	Export of radio broadcasting receivers, SITC Rev 2, 1980-87, USD
EXP BROADC 80-87	Export of other broadcasting/wireless equipment, SITC Rev 2, 1980-87, USD
TOTAL IMP 80-87	Total import of communications equipment, SITC Rev 2, 1980-87 USD
IMP LINE 80-87	Import of line equipment, SITC Rev 2, 1980-87 USD
IMP TRANSM 80-87	Import of transmission equipment, SITC Rev 2 1980-87, USD
IMP RCVRS 80-87	Import of receiver terminals, SITC Rev 2, 1980-87, USD
IMP TV RCV 80-87	Import of television receivers, SITC Rev 3, 1988-01, USD
IMP RADIO 80-87	Import of radio broadcasting receivers, SITC Rev 3, 1988-01, USD
IMP BROADC 80-87	Import of other broadcasting/wireless equipment, SITC Rev 2, 1980-87, USD
EXCHANGE	Average annual exchange rate (local currency per USD)
PPP	Purchasing power parities (in local currency per USD)
POPULATION	Population
ASR	Answer Seizure Ratios
GFCF	Gross Fixed Capital Formation
GDP	Gross Domestic Product
GDP $	Gross Domestic Product, in USD
HOUSEHOLDS	Households
CPI	Consumer Prices index
NATIONAL EMPL	Total national employment

The Futron Space Launch & Satellite Database: A Complete Solution

Futron's database of worldwide commercial and government space launch and satellite activity is the most comprehensive database available today. Updated daily, it provides data solutions for industry professionals, including satellite operators, launch service providers, spacecraft manufacturers, insurance providers, and financial and market analysts. Futron delivers customized data solutions ranging from single queries to large-scale customized databases. We also provide analytical expertise to answer all your industry questions.

Database Highlights

- Over 800,000 data items
- All space launches and satellites since 1957
- Announced (future) launches and satellite orders
- In-depth launch vehicle information
- Complete satellite information
- Detailed transponder information including regional coverage and usage
- Comprehensive operator information
- Continuously updated from an extensive list of public services

Multiple Uses

What can you do with this database? The possibilities include:

- Analyze trends such as historical market share and transponder availability
- Forecast industry developments, including global launch rates and industry revenu
- Project industry direction, including satellite mass projections and spaceport usage
- Analyze historical industry data such as launch vehicle reliability and operator buyi patterns
- Determine and assess future satellite and launch vehicle market opportunities

Flexibility

Futron can deliver the information to you in a format that meets your needs:

- Customized data summaries
- Data exports for your own analysis
- Custom databases
- Targeted, high-quality analysis

Futron's Space Launch and Satellite Database can deliver the data you need quickly, effectively, and accurately. No other database even comes close.

DAMATA, JASON

From: DAMATA, JASON
Sent: Sunday, February 13, 2005 9:10 AM
To: 'tom@cwx.com'
Cc: DAMATA, JASON
Subject: Sifting Through History--Box #3

Importance: High

Some of this stuff is fascinating! You are missing out on a good time!
Here is what I sorted through so far

Pre-OTP

1. Executive Branch and Spectrum Management
   Materials dating back to the Eisenhower administration on the establishment of an Advisory Board.

2. Comsat

There are documented squabbles over

- Legislation Amending the 1962 Satellite Act.
- Ownership/oversight of the executive board,
- Industry structure and reach
- Oversight jurisdictions
- Domsat issues
- Government Use Issues
- AT&T and the fight over satellite entry into long distance telephony
- Talk of eliminating common carrier ownership of Comsat stock
- DOJ's anti-trust division had taken an interest
-

<u>The players so far are</u>
OTP--CTW, Goldberg
Don Baker-DOJ
Joe Charyk--President of Comsat
John Martin--VP of Comsat
Dean Burch and Bernie Strassburg-FCC
Henry Cartucci--Western Union
Howard White--ITT
Howard Hawkins--RCA
Battle, Ashern, Crosland--AT&T
Sen. Gravel

<u>The most interesting thing to me is</u>
The was a movement to force AT&T to sell its stock and relinquish its stake in Comsat. Meanwhile there is media hype about Comsat becoming a competitor in the long distance market (since the MCI decision). The executive branch appointed 3 seats on the Board of Directors in perpetuity.

DAMATA, JASON

From: Clay T. Whitehead [tom@cwx.com]
Sent: Thursday, February 17, 2005 11:34 PM
To: DAMATA, JASON
Subject: RE: [Norton AntiSpam] RE: CTW fan club

Yes. Ask me tomorrow. Do you have a GMU library card?

From: DAMATA, JASON [mailto:JDamata@c-span.org]
Sent: Wednesday, February 16, 2005 10:33 AM
To: Clay T. Whitehead
Subject: [Norton AntiSpam] RE: CTW fan club

how the heck did you find this? Do you have special access?

-----Original Message-----
From: Clay T. Whitehead [mailto:tom@cwx.com]
Sent: Wednesday, February 16, 2005 10:27 AM
To: Jason Damata
Subject: CTW fan club

FYI, I found this in dissertation abstracts:

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Title: **THE OFFICE OF TELECOMMUNICATIONS POLICY AND BROADCAST ISSUES: A CASE STUDY OF MEDIA-STATE INTERACTION**

Author(s): MILLER, JAMES ROBERT

Degree: PH.D.

Year: 1981

Pages: 00316

Institution: UNIVERSITY OF PENNSYLVANIA; 0175

Source: DAI, 42, no. 11A, (1981): 4635

Abstract: This is a report of an investigation of the U.S. Office of Telecommunications Policy (OTP) in its role as presidential adviser and advocate and national policy planner. study focused primarily upon the OTP's activities pertaining to broadcast-related telecommunications.

At the time the OTP was established, historically stable and favorable relations between dominant broadcasters and federal authorities were being disrupted. The growing complexity and significance of telecommunications, however, demanded cooperative relationship. The expert planning capability represented by the OTP a its prestigious location in the Executive Office of the President constitute an impor instance of attempted cooperation.

Documentary evidence was the principal data source for the study. Four types of documents were examined: published news accounts; federal publications, includi hearings transcripts and reports; OTP staff studies, presentations and press relea and relevant literature from communications and other fields. A second source of information was interviews with knowledgeable informants, including OTP foundin director Dr. Clay T. Whitehead.

After tracing historical events that led to the OTP's establishment, the study prese record of OTP involvement with several broadcast-related issues between 1970 a 1978: regulatory rules for domestic satellites, long-range funding and programmin practices for public broadcasting, regulatory rules for cable television, station licensing, deregulation of commercial radio, prime-time TV reruns, and an increas VHF-TV stations.

The OTP was judged to be ineffective in achieving both its operative goals for the above issues and its official goal of greater stability in relations between broadcas and federal authorities. Five major constraints on OTP effectiveness were identifie the OTP's neglect of planning for comprehensive national telecommunications pol tactical relations with established policy actors, the problematic nature of the OTP' role as presidential advocate, Nixon administration media politics, and the leaders of Director Whitehead.

Desire for an executive advocate and telecommunications policy planner is shown have persisted after the OTP's abolition. The study concludes by noting contradict forces in this desire: tensions and potential controversy inherent in media-state relations and the need shared by telecommunications and governmental elites to f joint policy "in the national interest".

SUBJECT(S)

Descriptor: MASS COMMUNICATIONS

Accession No: AAG8208014

Database: Dissertations

OFFICE OF TELECOMMUNICATIONS POLICY
EXECUTIVE OFFICE OF THE PRESIDENT
WASHINGTON, D.C. 20504

October 29, 1971

INDUSTRY STRUCTURE AND REGULATION

Intermediate (2-5 years)

(1) Allow importation of distant signals under FCC proposed formulas, with compulsory licensing.

(2) Allow cable operators to provide additional programming at their discretion.

(3) Require that cable operators lease excess channels to other program suppliers without discrimination.

(4) Relieve cable operators of all uneconomic burdens (free channels, excess capacity, two-way capability, etc.)

Permanent

Stevens objections

(1) Require that broadband system operators lease all channels to other program suppliers without discrimination, and increase capacity on reasonable demand.

(2) Require that broadband operators connect all who wish to subscribe within their franchise area, at nondiscriminatory rates.

(3) Impose full copyright liability on all channel lessees ~~[except as provided under grandfathered FCC package]~~.

(4) Impose no content regulation on channel lessees, and enforce existing obscenity, libel, slander laws through the courts.

(5) Impose no regulation of rates charged by program suppliers or other channel lessees to their customers.

(6) Leave to the States the right to regulate franchise terms, basic subscriber fees, and channel access fees.

(7) Provide broadcast stations and newspapers the option within their market area of:

(a) owning broadband systems subject to the programming restrictions and other obligations noted above; or

(b) programming any number of channels leased from a nonaffiliated broadband operator.

(8) Encourage the ~~continued~~ availability of ~~carrying service of~~ rural and low-income people by ~~service via one or both of the following means:~~

~~(a) require broadband operators to continue existing service levels within the area affected by their operators, via whatever means they choose;~~

~~(b)~~ providing Federal subsidies for rural and low-income viewers, as for telephone service.

TELEGRAPH TO CYBERSPACE:
Webbed Wires to Wired Webs

Chapter Outline

Introduction: Futures Not to Be; Pasts That Weren't
Prelude (1794–1836): Digital Dawn, Sleepy Time Sunset
Far Writing (1837–1875): "Datanet" High Noon
Far Sound (1876–1913): Analog Adds Auntie
Programmed Audio (1914–1956): That's "Ether-tainment!"
Programmed Video (1957–1977): "And That's The Way (So We Say) It Is…."
Personal Programming (1978–1995): PC Power to the People
Personal Networking (1996–2005): "Reach Out and E-Touch Someone"
Negotiated Networking (2006–2015): Faces and Masks @ cyber-ball.world
Conclusion: Back to the Future & Forward to the Past

This book has three purposes: (1) provide a master "50,000-foot" narrative of the history of communications networking for the intelligent lay reader; (2) offer scholars and professionals a more precise intellectual taxonomy, fully integrating the interplay of computing and communications technologies with regulation and market evolution; (3) give colleges and high schools an educational tool. It will be comprehensible to the lay reader, while enhancing the knowledge of professionals, professors and students.

The lay reader will better understand, after reading this book, why Hollywood is so concerned about digital networks, what societal choices cyberspace will thrust on us, why "digital" is not a synonym for "new" and why regulation so often sacrifices long-term benefits for short-term gain.

This work presents a unique time division: four 40-year periods, two 20-year and two 10-year, closely integrating industry stories. The periods feature newly ascendant technologies; the shortening period spans show the time compression ever more powerful technologies bring.

There have been many fine histories written about telegraphy, telephony, radio, tv, the PC, etc, on markets, technologies and regulation of same. Many discuss one subject in too much detail for the average reader, mentioning parallel stories only in passing. Integrating hitherto parallel narratives provides not only perspective on market evolution, but boosts reader interest. The tale encompasses many wizards (technology), warriors (military & civilian) and wonks (regulators) who decisively influenced the course of network evolution over the past two centuries.

The book presents lessons taught by two centuries of history of communications (telegraph, telephone, broadcasting and computer) networks. It rejects the popular Internet era belief that the Internet created a new paradigm so radically different from prior network paradigms as to make all that went before it obsolete. Rather, there is as much past as future in our future.

Two networked centuries yield certain findings about transformational networking technologies:

- Most inventors fail to foresee the primary use of their inventions;
- New networks often stimulate utopian hopes—ever unrealized;
- Regulation changes remarkably little as network technologies evolve;
- Networks take longer to pay off, but then pay off more than expected;
- Free societies make the most productive use of network technologies;
- New networks are radically disruptive, and work against gradual, predictable change.

The future centers around negotiated networking: authenticity versus authorization—*i.e.*, privacy versus legitimacy. When can one stay anonymous, and when must someone know? Society's critics often desire anonymity, but so do terrorists. Society need not care who buys a pen online at Kinko's but should care who buys an airline ticket online. One face; many masks.

Introduction: Futures Not to Be; Pasts That Weren't

"Futures": Pony Express; Video Phone; George Jetson's air-car
"Pasts": Rome sacked 476 AD; Ma Bell's "monopoly"; Marconi's "radio"

The fabled Pony Express lasted but 6 months, shut down the day after the first trans-Atlantic telegraph cable reached San Francisco. Video phones were the 1970s future, but even today are not accepted in the home. Rome's 476 AD "sacking" did not happen; neither did George Jetson's world. Ma Bell was never the only player: Western Union was the titan of early telephony; Ma Bell covered at its apogee but 40 percent of the CONUS. Marconi invented wireless telegraphy.

Futures not to be reflect either linear extrapolations undone by transforming events—Parson Malthus's population/food catastrophe undone by the Industrial Revolution (similar Malthusian fears a generation ago undone by the Green Revolution), or forecast transformations that succumb to mundane reality—supersonic air travel meets oil price hikes and an insoluble sonic boom problem. Some miscast futures cause investors to take a financial bath, but leave the larger economic climate little changed—supersonic air travel, for instance. But the Internet boom, bubble and bust showed that widespread faith that spurred massive investment not only impoverished many investors, but brought the entire economy to a screeching halt.

Pasts that weren't rewrite history. Sometimes the myth is harmless, as with Rome's mythical sacking when the Western Roman Empire fell, but no real harm done; Rome was, after all, sacked in 410 and 455—and several more times, last in 1527. The image of a great civilization's end is far more vivid if barbarians storm the gates, than if the last Roman emperor sends a missive to his Constantinople counterpart in the Eastern Roman sphere, simply saying that the Roman Empire's future lies in the East. Yet the fact that Rome was sacked within 21 years of 476 is, as they say in Washington, DC, close enough for government work.

Nor would it matter much if Americans thought of Lee DeForrest as the "Father of Radio," rather than Marconi, save perhaps to their respective linear descendants. But some *faux* pasts do genuine harm. Seeing Ma Bell as a single giant holding the entire nation in its grip, with other companies unknown to many Americans, contributed to the adverse political climate the Bell System confronted as, a generation ago, it fought for its corporate life, a fight ultimately lost with momentous consequences for telecommunications and the economy. Believing that the FCC carefully considered possible long distance competition is reassuring; learning that the FCC fought MCI's entry, only to see MCI use trickery and a friendly appellate court to push the FCC aside and win entry, is sobering. Sundering long distance from local service stymied deployment of new networks thereafter by foreclosing the vast economic benefits of vertical market integration.

False futures teach painful lessons; false pasts are more treacherous in one sense: lessons "learned" will be, if the past is wrongly understood, the wrong lessons. The chance of policy mistakes in the future increase. This happened in telecommunications over the past quarter-century, with fateful consequences for America. Seeing the former Bell companies as monopolists in the tradition of their former parent steered federal policy towards punitive anti-incumbent policies that blocked powerful companies from investing early in newer networks.

Coupled with the regulatory Caesarism of the Clinton-era FCC and massive fraud at WorldCom, this led to the failure to capitalize on the stock market boom to fund early deployment of a broadband digital infrastructure for the 21st century. We will pay the piper for that failure over the next decade at least. Already, Asia's "tigers" are far ahead of America in deploying new broadband services, a lead that will persist for years.

The first Internet cycle taught its troubadours that cyberspace will not be a cyber-utopia. Policy choices made in the next decade must avoid cyber-dystopia as well. Learning the right lessons from the past will be indispensable for success.

Prelude: **Digital Dawn, Sleepy Time Sunset (1794–1836)**
Networks: Official Networking
Wizards: Chartered Invention
Warriors: Networked Militaries
Wonks: Expansion of Control

Early networks were limited by line-of-sight, not radically different from the heliograph in ancient times. Claude Chappe and Abraham Edelcrantz spurred military leaders to apply networked communications to military campaigns. Networking inaugurated the modern era of expanding government control, by empowering bureaucracies to monitor distant events and performance.

The chief limiting factor in the Digital Dawn was technology. Manual means of conveying signals could neither economically accommodate large volumes of traffic nor send them across continents efficiently. But electricity, though the efforts of such scientists as Michael Faraday, was emerging from its cocoon, just in time to lead communications networks into the Industrial Age.

Communicating over vast distance was a challenge confronted by societies all the way back to the ancient civilizations. The world's first example of what modern communications mavens call "error correction" was provided in the Kingdom of Sumer. The great Sumerian king Sargon of Akkad (ruled 2334 – 2279 BC) gave homing pigeons to his messengers. If en route to their destination they were attacked they were to release the pigeons. A returning pigeon meant Sargon's message might not have gotten through, and to re-send a dispatch.

The ancient Greeks combined torch beacons with a pre-set code to enable manually-run telegraphic-style communication that may have been used at Carthage 2,200 years ago. Nothing of consequence changed from then until the 17th century AD.

During the 17th century the great English scientist Robert Hooke (1635–1703) became the first to describe a telegraphic system which featured separate codes for control signals—network management messages that verified acknowledgement of message receipt, error correction and the like.

But it was not until the arrival of the Enlightenment that telegraphy's true dawn came. Frenchman Claude Chappe persuaded the French Revolutionary government to issue him a royal charter in 1794 for his optical telegraph. Sweden's Abraham Edelcrantz followed with his design in 1796. The first half of the 19th century saw optical telegraphy spread across Scandinavia and continental Europe, America and Australia.

But the optical telegraph's heyday was short-lived. In the 1830s developments in electrical science had come far enough to make the electro-magnetic telegraph feasible. Optical networks were too slow and limited in capacity to compete.

The introduction of networks that could communicate nearly instantaneously beyond line-of-sight and vastly more efficiently than a series of line-of-sight signals triggered what ultimately became a quantum acceleration in the pace of civilizational life. News that had taken months, even years, to travel across an continent or ocean became near-real-time. Whereas the great majority of his countrymen never saw Abraham Lincoln, or heard the sound of his voice, Presidents became a part of extended public community—Teddy Roosevelt via telegraph, FDR via radio, JFK via TV and now online communities have sprung to life. Communications networking is the foundation. Sleepy time has been replaced by Internet time—"24/7" time makes last month's news seem as distant as the death of the Roman Emperor Marcus Aurelius (180 AD).

Far Writing: "Datanet" High Noon (1837–1875)

Networks: Creation; Community
Wizards: Entrepreneurial Invention
Warriors: Frontier Free-for-All
Wonks: Frontier Expansion

The invention of the telegraph inaugurated the era of truly far-flung networks, changing politics, economics and culture. Business expansion was driven by railroads and telegraph. The first undersea telegraph cable was laid across the Atlantic. Prospective international cultural intercourse stimulated hopes to foster world peace. Early electric transmission technology created the first network communities—primarily business-based. The industrial age scientist-inventor joined the machine shop, linking inventors and skilled mechanics.

In 1862 Congress passed the Homestead Act, to aid land ownership west of the Mississippi. In 1866 Congress passed the Postal Roads Act. The Civil War spurred industrial and stock market growth, and accelerated buildout of nationwide transport infrastructure, as backbone for economic growth. Networks tracked rail.

In the United States the era after construction of the Erie Canal (1825) saw the rise of the entrepreneur, partly due to the emergence of a corporate and contract law system unique to the New World. This coincided with the early electrical technology development to lay the foundation for the electromagnetic telegraph, the first true modern networking system, one which enabled continent-wide communication at affordable rates. Coupled with its twin sister, the mighty railroads, telegraphy would galvanize the American economy and create far-flung communities that would unite the nation as never before. The telegraph started later than did the railroad, but grew faster: the continent was spanned in 1861, 8 years before the Golden Spike was driven. Just two generations earlier Lewis and Clark had taken nearly three years to travel from the Mississippi's west bank in Missouri to the west coast and back. Almost precisely as many years would pass between the transcontinental telegraph and the first transcontinental telephone call.

Driving from this first acceleration in communications was the union of the lone inventor and the skilled mechanic—the so-called "machine shop." Instead of an inventor doing all the work there was for the first time in research a formal division of labor—Adam Smith's great conceptual discovery that drove industrial development transformed to the world of scientific industrial research. Morse had Alfred Vail; telegraphy spurred young inventors like Thomas Edison, Alexander Graham Bell and Bell's chief telephone rival, Elisha Gray. Telegraphy also spawned the first great communications powerhouse: Western Union. Knit together from diverse smaller companies by brilliant corporate chieftain Hiram Sibley, Western Union was a $40 million behemoth by the time the eponymous American Bell came along.

The first trans-Atlantic cable was laid in 1866, but it snapped within a few days. In 1867 the massive Great Eastern, largest ship ever built to that date, accomplished the task—and repaired the 1866 cable as well, enabling two-way communication. Cyrus Field was the motive force behind the success, lobbying intensely in Washington. The great British scientist Sir William Thomson (later Lord Kelvin and discoverer of the electron in 1897) provided indispensable scientific assistance in solving problems of signal amplification and reception. Telegraphy created the first true network communities. During the Franco-Prussian War one mother discovered limits: the local telegraph office could not send to her soldier son in France a plate of sauerkraut. Alas, fiber-optic cables are no better at carrying sauerkraut than telegraph cables.

The first fax was sent in 1843—one year before Samuel F.B. Morse sent a telegraph message 40 miles and exclaimed to Congressional dignitaries, "What hath God wrought?." But it was to be some 140 years before fax matured. In 1865 commercial service was offered over telegraph lines between Paris and Lyons, but price and quality did not meet market requirements. So-

called Group 1 fax machines were introduced in 1966. It was not until the 1980s that the installed base of fax machines topped one million.

Charles Babbage invented two mechanical computers, neither completed or fully operational; Lord Byron's daughter, Lady Ada Lovelace, became the first software programmer, in a manner of speaking, by memorializing in writing the instructions for the machines. In 1854 the mathematician George Boole invented Booelan algebra. This binary logic system would prove, 90 years later, perfectly suited to writing problems for the electronic stored-program digital computer.

Thus by the end of this period the foundation was laid for the advent of analog transmission of the human voice. From the dawn of human civilization to the American Centennial networking had been limited to digital transmission of human-created data. The data world is all digital: created by human ingenuity, a series of distinct states with no fuzzy intermediate areas. In the digital world data either is or is not something: alphabets are digital, as are number systems—a letter is either A, or B, etc.; a number is either 1 or 2; the different states are mutually exclusive—1 or 2, but not both. The three-way light bulb is digital—either 50, 100 or 150 watts, but not 64 or 128.

The analog world is the messy, uneven world we hear and see. A rheostat light switch is analog—a continuum of light from "off" to the maximum brightness the switch permits; there are potentially an infinite number of intermediate states between "off" and the brightest "on" level. The human voice has infinitely fine grades of dynamics—sound intensity, *i.e.*, loud and soft—as do musical instruments. There is an infinite range of intermediate color hues and brightness levels that we see in the world around us.

Analog introduced vast complexity into network communications, creating engineering problems not solved until electronic digital technology made possible transforming analog signals into digital format in the mid-20th century. Signals were hard to amplify sufficiently so as to send them over long distances; receivers had great difficulty separating signals from background noise—think of the static on your car radio as you enter a tunnel.

Far Sound: Analog Adds Auntie (1876–1913)

Networks: Duplication; Fragmentation
Wizards: Inventing Invention
Warriors: Emerging Utilities
Wonks: Contract—Public & Private

From the telephone to World War I the growth of networks can be divided into the Bell patent period (1876–1893) and the independent entrant period (1894–1913). At the turn of the century there were some 6,000 independents. Cities featured duplicate phone systems. Terrestrial copper wire dominated transmission; wireless telegraphy enabled ship-to-ship and ship-to-shore. First-generation telephony and radio enabled limited long distance transmission.

Regulation assumed a new, more prominent role. The first state rate regulation of phone rates was by Indiana, in 1885. In 1887 Congress enacted the Interstate Commerce Act, the first statute to contain the phrase "public interest, convenience and necessity." In 1908 AT&T's Theodore Vail called for "one system, one policy, universal service." In 1910 Congress passed the Mann-Elkins Act, which in part gave the ICC the power to regulate interstate phone rates. In 1913 AT&T agreed with the Justice Department to interconnect competing local providers to its long distance network, stay out of Western Union's business and stop acquiring independents.

The advent of analog technology in Bell's telephone made voice communication over great distance possible. Like the telegraph the telephone was conceived by its inventor as a business communication device. That Auntie might wish to converse with friends and family was not contemplated. Telephone transmission and reception, however, was limited by the inability of devices then extant to carry signals over long distances sufficiently free of distortion and sufficiently strong to make conversation possible. It took the vacuum tube feedback amplifier, initially conceived in 1906 by Lee De Forrest but perfected first by Edwin Armstrong in 1913, to make transcontinental long distance possible.

Telephone equipment was a growing business as well. Gray & Barton, a company formed in 1869, became Western Electric in 1872 and made its first supply deal with American Bell in 1882. But American Bell—which in 1885 was renamed AT&T—was not the sole source of invention. Besides Edison, who contributed the first carbon transmitter in 1878 (which lasted 100 years) there was Almon B. Strowger, a Kansas City undertaker who invented the first automatic mechanical switch in 1892, reducing the need for human operators.

This period saw vigorous competition in telephony, despite Bell winning all 600 patent fights. Independent telephone companies sprang up in rural areas where Ma Bell's corporate writ did not run, and in urban areas as well. Western Union nearly strangled the Bell baby in its crib, but for the unexpected invention of financier Jay Gould, the Michael Milken of his day. Western Union's corporate chief, the astute William Orton, backed Elisha Gray's patent fight with Bell, so WU elected not to purchase the Bell patents for $100,000 in late 1876. With 20-20 hindsight this has been regarded as the greatest failure of management vision in business history. A more plausible explanation is that WU calculated that with its $40 million dollar asset base and far-flung telegraph rights of way it could crush startup American Bell—especially as in those frontier free-for all days there was no regulatory overseer to level the playing field (antitrust was more than a decade away). WU's strategy stood a solid chance of success; that Jay Gould would step in and save Bell's bacon could not reasonably have been foreseen. In retrospect WU management indeed committed history's worst business blunder, but was due to bad luck rather than stupidity.

Rising corporate financial asset size facilitated the rise of the first modern industrial research laboratories, in the electric industry. Thomas Edison took the machine shop of his adult youth and invented invention as a formal continuing process. Many of his 1,093 patents accumulated by "The Wizard of Menlo Park" were for incremental improvements to existing products.

Corporate research enabled settlement of complex patent licensing disputes; the spontaneity of the lone inventor was supplanted by programmed research aimed at addressing complex product innovation. The dynamic George Westinghouse also built a first-generation industrial research laboratory.

Two technological hurdles relegated early radio technology to wireless telegraphy, Marconi's original invention: (1) "spark-gap" transmitter technology could not send voice beyond local distance; and (2) receiver technology did not permit separating signal from noise with adequate clarity. Practical radio telephony was still a decade away as of World War I.

Marconi was a tinkerer, rather than a scientist. After Heinrich Herz discovered radio waves in 1887—electric charges leaping across a gap between two magnetic poles—scientists began searching for ways to communicate through the air—"the ether" in 19th century parlance. The Scottish genius James Clerk Maxwell had explained the fundamental theory of electromagnetic waves—magnetic and electric fields propagating perpendicular to one another through space at the velocity of light. Oliver Lodge laid out a complete theory of radio communication in 1894, but was slow to act on it. Marconi, married into a family that included the head of England's patent office, moved first.

Marconi's wireless telegraph was a primitive device. In 1901 is sent a single "S" across the Atlantic. But it was mostly for relatively short ranges. Its primary use was to help ships in distress at sea. Famously, when RMS Titanic sank in 1912, a young wireless operator for American Marconi, Russian immigrant David Sarnoff, later to become master builder of RCA, was one of the operators who kept in touch from shore (albeit not alone for 72 hours, as Sarnoff later said).

Spark gap radio technology was too crude to permit long distance transmission of sound. It would take "continuous wave" technology to accomplish this feat. In 1901 Reginald Fessenden discovered the "heterodyne" principle (from the Greek "other forces")—that receiving radio signals can best be done by mixing a higher frequency radio signal with a lower frequency tone, which enables separating signals from noise. Radio receivers still apply this technique. Ernst Alexanderson built alternators that sent telegraph signals across the oceans reliably enough to facilitate global radio telegraphy.

At the end of this first analog networking phase came the first market segment apportionment by the federal government, confining Bell to telephony and WU to telegraphy. Market segment dominance was to be a prominent feature of networking industries throughout the 20th century. In the 1913 Kingsbury Commitment (a letter from an AT&T Vice-President, Nathan Kingsbury, to President Woodrow Wilson's second antitrust chief at the Justice Department, James McReynolds) AT&T agreed to: (1) cease acquiring independent telephone companies; (2) "interconnect" lines of non-AT&T companies with AT&T's own network; and (3) stay out of the telegraph business. Western Electric by then had become agent for 97 percent of AT&T's equipment.

Thus on the cusp of World War I there were three network businesses: telegraph, already fully mature; telephony, coming of age; and radio, still embryonic. Western Union was already dominant in the first; AT&T was on its way in the second; and RCA's rise to power was not far away. The growth of radio would be greatly enhanced by another invention of this period: Edison's audio phonograph. Industrial research was ready for its first great leap, driven by wartime exigency.

One final teaser, as it were: in 1880 Bell invented the Photophone, which sent electrical signals optically through the air over distances that eventually reached 700 feet. But commercially viable, mass-market telephonic optical transmission was a century away.

Programmed Audio: "That's Ether-tainment!" (1914–1956)

Networks: Urban Consolidation; Market Confinement
Wizards: Corporatist Invention
Warriors: Corporate Hegemony
Wonks: Sector Socialism

After the war, Bell began again acquiring independents, and in 1945 purchased the last duplicate urban system (Philadelphia). Bell dominated the cities. 4,000 Independents served 60 percent of geographic area & 20 percent of customers. AT&T, RCA & IBM ruled. Radio was made feasible by "continuous wave" transmission and the vacuum tube, which led to the feedback amplifier and super-heterodyne. Radio & later TV-casting brought entertainment into the nation's homes. The mid-century transmission technologies were developed—coaxial cable, terrestrial microwave radio. Lines-of-business concerns led the federal government to bar AT&T from the radio and computer businesses. RCA and IBM prospered. Early advances in computing technology—the von Neumann computer architecture and the transistor, plus the sampling theorem and information theory—laid the foundation for future technology growth. The rise of Bell Laboratories institutionalized telecommunications innovation and basic research in many related fields.

During the Great War the Navy moved to take over nationwide communications under wartime emergency. In 1919 the US Postmaster General ran the Bell System. In 1921 Congress passed the Willis-Graham Act, allowing AT&T to begin again acquiring independent companies. Spectrum policy was sent first to the new Federal Radio Commission, per the Radio Act of 1927. Telephony was added in 1934, when the FRC was supplanted by the Federal Communications Commission (FCC). The Communications Act of 1934 had little initial impact, but the preamble contained language laying the foundation for universal service, via inter-industry financial transfer "separations and settlements/division of revenues" schemes, 1943-1970.

Whereas telephony united friends and family, radio united strangers, too. Listening to "The Perils of Pauline," comedians like Fred Allen and the music of George Gershwin created a nationwide culture; Franklin Roosevelt's "fireside chats" created the first nationwide political community. Lincoln was the first President to use the telegraph, Rutherford B. Hayes first with the telephone, and Theodore Roosevelt was the first President to be confronted with a press corps, in 1902—the year that the wirephoto made its debut. FDR created the first true national conversation, made possible by the first technology, broadcast radio, that could create a community of strangers united by common cultural knowledge. The first radio President's "fireside chats" became a vital tool for shoring up public confidence during America's worst-ever economic crisis.

Radio was the great battlefield for network technology, with RCA's David Sarnoff playing a central role. Sarnoff saw the broadcasting future of radio as early as 1915, just as technology was coming on line to make mass broadcast entertainment practical—in 1920 his vision was realized. His intervention in the epic patent struggle between Lee DeForrest and Edwin Armstrong, over who had the patent rights to the feedback amplifier, was decisive. Armstrong, buoyed by favorable rulings from the US Patent Office and New York lower federal courts, refused to settle with RCA, whose need for the technology led them to back De Forrest. Seeking complete vindication from a legal system that rarely grants it was Armstrong's fatal miscalculation. Sarnoff won court victories to undo Armstrong's early wins. Armstrong, whose super-heterodyne made radio reception commercially viable, would then turn to FM transmission in search of vindication. But Sarnoff, by then CEO of RCA, could not afford to see his AM base made prematurely obsolete by FM, and so delayed FM by getting the FCC to block it. Armstrong later committed suicide, becoming the first of two tragic titans of telecom history. The vacuum tube was the most important electronics invention of the first half of the 20th century.

Computing made real strides for the first time in this period. Prior to the 1920s computers were merely counting machines. What became IBM under Thomas Watson in 1924 was originally the

Tabulating Machine Company founded in 1896 by Herman Hollerith, tabulator of the 1890 US census. In 1911 TMC merged with the Computing Scale Company and the International Time Recording Company to create the Computing-Tabulating-Recording Company, which in 1924 became IBM. Meanwhile, Dr. Vannevar Bush (eventually the first Presidential science advisor, during World War II), pushed analog electronic computing in the late 1920, seeking to solve electric utility problems. The 1930s and early 1940s saw added advances in analog computing.

But it was during the run-up and throughout World War II that enormous technological impetus was given to computing and communications. In 1934 Robert Watson-Watt invented radar, which was further developed by Britain and American scientists over the next decade. Terrestrial microwave transmission was a commercial spin-off, although it was only after the war that microwave made its commercial debut. Coaxial cable made its debut in the early 1930s as well, in telephony; in 1948 the first cable TV station began service. Bell Labs pioneered many other inventions, including motion picture sound recording and transmission of video signals.

The theoretical foundation for the digital era was laid by Bell Labs, with its 1928 "sampling theorem" detailing with mathematical rigor how to "sample" an analog voice channel and turn the analog waveform into digital format for transmission. The theory of digital communications was worked out a decade later at IT&T. Capping digital theory was Claude Shannon's "Information Theory" in 1948: (1) information is the reduction of the recipient's uncertainty as to the contents of the message; (2) to conserve bandwidth, digital encoding must minimize bits used to send a message; (3) to ensure errorless transmission, sufficient error correction bits much be employed, reducing the effective signal capacity accordingly.

The war also saw the final steps in creating the first true stored-program electronic digital computer. Driven by the need for accurate artillery firing tables, which required vast volumes of calculations, computing never quite made the grade. But efforts led to the synthesis, in 1945 by polymath John von Neumann, of the first coherent theory of digital computing, describing an architecture still used by most computers today, including all PCs in use today: (1) an arithmetic logic unit to calculate; (2) data input—via tape then; (3) an output device—printer, screen, etc.; (4) a control program to manage computer resources. The digital PC was self-contained—it could operate without continual human intervention between calculations. In 1947 Bell Labs invented the transistor, which would began the process of miniaturization that would take unwieldy vacuum tubes down the road towards the integrated circuit and the microprocessor.

Regulatory milestones were many. In 1922 the US Department of Commerce, under Herbert Hoover, began allocating spectrum; in 1927 the Federal Radio Commission was created to supervise the radio airwaves. The FRC morphed into the Federal Communications Commission in 1934, bringing telephony under the same regulatory umbrella as radio. In 1949 the Justice Department filed its second antitrust suit against AT&T; it was settled by the Eisenhower Administration's Attorney-General in 1956—on (fittingly) the golf course, no less. 1956 marked the last time that the federal government would endorse without equivocation separation by lines of business; later separations would have large exceptions written in, to the detriment of established companies. Ma Bell would stick to telephony, but her stepchild, Western Electric, would sell equally to all. Broadcast television—whose technology was developed in the 1920s and 1930s—became primarily the province of the three nationwide networks, which began broadcasting in black and white in 1941 and in color in 1953; at the end of this period they began their march to marketplace and cultural supremacy. (Western Electric, notably, was the leading source of studies on the sociology of the industrial workplace—a fertile testing ground for the "time and motion" management theories of Frederick Winslow Taylor, and advances in quality control later adopted by Japanese industry.)

Programmed Video: "And That's the Way (So We Say) It Is...." (1957–1977)

Networks: Core Preservation; Periphery Privatization
Wizards: Inventing the Future
Warriors: Corporate Revolutionaries
Wonks: Protecting the Core

With Ma Bell confined to its own line-of-business, regulators turned their focus to allowing private firms to enter peripheral markets, and end users to attach devices to the network. Technological advances were strongest in computers—the IC, microprocessor, high-level programming languages—but telephone advanced as well—satellite, digital transport, optical fiber, electronic switching. The fundamental regulatory issue—privatizing the network periphery—was settled under the policy mantra "privately beneficial without being publicly detrimental." GTE, Continental Telephone & United Utilities acquired thousands of independents, leaving 1,400. Disruptive technologies—telecom, radio and computer—laid a foundation for the future.

Hush-a-Phone (foreign attachment to phone sets, 1957), *Carterfone* (foreign attachment to public network), *Specialized Common Carrier* (private line LD competition, 1971) and *Execunet* (public-switched LD competition, 1977) drove telecom policy. The AT&T antitrust case was launched (1974). *Computer I* was completed, but initiation of the *Computer II* proceeding augured for inability of the FCC to cleanly separate telephony from data networking.

The postwar period saw an explosion of technology. The transistor appeared in 1947, with the first practical application—smaller, better radios—appearing in the early '50s. 1957 proved a double watershed year. The FCC's *Hush-a-Phone* decision ended Ma Bell's policy of prohibiting attachment of all devices to their network, laying the basis for competition in telephone equipment a decade later. Meanwhile, software—the set of programmed instructions that controls the operation of computer hardware—became far more powerful. The first high-level software programming language, Formula Translator (FORTRAN), brought software programming out of a tiny elite priesthood, and enabled authorship of programs by a broader set. Earlier programmers worked initially with machine language—endless strings of digits in hexadecimal notation (16 digits: 0-9, then A-F)—and then assembly language, which substituted a vocabulary of one-word commands (*e.g.*, load, jump) each of which corresponded to a specified hexadecimal instruction. Machine and assembly languages require the programmer to specify not only what tasks were done but how to do them; programming languages require only the "what," plus a one-time "compiler" or "interpreter" program to provide the "how," which all programmers can use.

The 1950s saw the first development of computer networking. The SAGE computer network—enabling the Strategic Air Command to scan the skies for attacking bombers and track them if necessary, led to the development of timesharing in 1957 – 1958 by John McCarthy of MIT. 1958-60 saw hardware milestones with the silicon chip and the laser. Meanwhile, the FCC opened up microwave transmission to smaller companies in 1959. the 1960s saw the Pentagon take the lead in data networking, under legendary guru J. C. R. Licklider, who envisioned networks much like today's Internet. Paul Baran answered a Defense Department request for a network architecture robust enough to survive a nuclear strike by proposing packet-switching—sending data through an intelligent network where each routing node independently decided where to send the packet on its way, in "hot potato" fashion, thus bypassing damaged nodes. The 1960s also saw the realization of Arthur C. Clarke's 1945 vision of globe-circling communications satellites, with Telstar in 1962. The Communications Satellite Act of 1962 established Comsat as America's "chosen instrument" for international satellite communications. 1962 also saw the introduction of the first mass market office copier, by Xerox.

In 1969 the first four links of a packet-switched network, ARPANET, were turned up; this was the start of what later became the Internet. I972 saw the invention of a powerful software tool for data networking, Unix, and the first e-mail program. By 1973 the future had been invented: Xerox

PARC had a prototype local area network running, the building block of modern networks. Personal computers, with icon-based screen displays controlled by a mouse, were linked over a common data network (Ethernet), with output sent to laser printers. By the end of the period Apple Computer produced the first true mass-market personal computer. In 1974 Robert Kahn and Vincent Cerf authored the TCP/IP communications protocol, which set forth network management rules for Internet transmission. In 1978 the first spam message was sent.

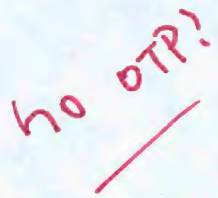
During this period regulation promoted competition while continuing to protect the core of the telephone network. But the years 1973–1977 saw the overthrow of this regulatory model. Ironically, it was in 1973 that AT&T's chairman, John deButts, rallied his company to make a last vigorous defense of monopoly telephony; only four months earlier that year a young engineer, Robert Metcalfe, proposed his Ethernet packet-switching protocol, which would unleash the data communications revolution in the workplace, and sound the death knell for old-line telephony. DeButts would become telecom's second tragic titan, undone by technologies he did not grasp. Data communications revenues, at one percent of Bell's income, were not enough to make Ma Bell aware of the vast potential for data networking growth.

Meanwhile the nation was culturally united as never before by universal television. With 98 percent of Americans—more than the 90 percent who had telephones then and the 95 percent who have phones today—getting mostly the same shows over broadcast TV everyone spoke the same cultural language. The three networks (who entered into an antitrust consent decree in 1972) attracted 90 percent of the prime-time audience. But at the end of this period cable, originally intended merely to import distant broadcast television signals into rural communities, made its first ventures into programming; and Ted Turner created the "superstation"—nationwide satellite broadcast of new programming.

The 1970s gave birth to three other transforming communications technologies: cellular mobile radio, debuting in Scandinavia while the FCC dithered; cable television, originally designed to re-transmit distant broadcast signals into remote communities, began to distribute programming; and optical fiber transmission, which would vastly increase telephone transmission capacity. Also, the VCR made its market debut, freeing viewers from the tyranny of program time schedules.

The election of Jimmy Carter in 1976 brought to Washington an Administration that pushed deregulation on several fronts—airlines, rail, trucking and communications. The first major deregulatory legislation in communications was the Record Carrier Competition Act of 1979—deregulating international telex (telegraph) transmission. Equipment deregulation—given a big push in 1968 with the FCC's *Carterfone* decision allowing an entrepreneur to connect his acoustic coupler to the Bell telephone network for wildcat oil field communications—accelerated, with qualifying equipment legally entitled to interconnect with telephone networks.

The years 1957 – 1978 thus saw the networked computing future being invented in the laboratory, with initial mass-market product rollout in 1977. Meantime the intellectual groundwork for deregulating the network core was laid by bringing competition to the periphery. But the big players had their hands tied: the FCC in 1966 barred AT&T indefinitely from domestic satellite communications, notwithstanding AT&T's pivotal role in developing same. The FCC's action was a harbinger of more such constraints to come; after the Bell System break-up comparable constraints were imposed upon the major local telephone companies. Already in the 1970s the FCC barred phone companies from providing cable to their own local customers.



Personal Programming: PC Power to the People (1978–1995)

Networks: Core Competition; Last-Mile Socialization
Wizards: Applied Invention
Warriors: Entrepreneurial Rebirth
Wonks: Infrastructure Socialism

Competition in public telephony became the order of the day. The FCC adopted rules that ultimately became the foundation for the 1996 Telecom Act. Key policies included accounting separation, market segmentation and infrastructure sharing. New generations of fiber made it the technology of choice for long distance, but costs remained high in the local loop. Cellular and PCS wireless technologies opened up wireless competition. The PC went mainstream, followed by PC office local area networking and the PC & modem foundation for the residential access Internet boom. Semiconductor lasers, optical amplifiers and single-mode fiber transformed fibernets. DBS—Direct Broadcast Satellite—became a viable competitor to broadcast television, and debuted in 1995. The World Wide Web (WWW) made the Internet a true mass-market phenomenon. Personal computing led to networked computing.

The Justice Department sundered AT&T, effective January 1, 1984, but the FCC withheld until 1995 what AT&T had bargained for—non-dominant carrier regulation. Subsidies to AT&T's LD competitors continued into the early 1990s (the "equal charge" rule). *Computer III* tried to re-frame data rules based on economics—whether a service was deemed monopoly or competitive, and remained open. By blocking vertical integration Justice deprived American telephony of scope economies that every other major nation in the world allowed its telecom firms to realize. From 1984 to 1989 LD prices fell, due to reallocation by the FCC of network support costs from LD to local service; from 1990 to 1996 a three-firm LD oligopoly (AT&T, MCI & Sprint) raised prices six times. Indeed, LD rates fell faster on average between 1915 and 1960 than between 1960 and 1990. Only after passage of the Telecom Act and the Internet explosion, plus nationwide cellular flat-rate pricing, did LD prices plummet again.

Spectrum policy saw wireless lotteries, then auctions. But the NAB persuaded the FCC to dedicate a massive block of spectrum, below the microwave frequencies, to High-Definition Television (HDTV), depriving cellular networks of vital capacity and forcing early migration to digital cellular via a technical standard, so-called TDMA, that proved inferior to others later developed—notably, so-called CDMA. This was a major hindrance to digital cellular deployment in the US, as by the time CDMA reached the market TDMA had been widely deployed. Added to still-extant analog (AMPS) systems, plus radio dispatch technology, and American mobile communications was a mess. To compound matters, the US devoted little more than half as much spectrum to mobile telephony as its top overseas rivals.

The personal computer was a hobbyist's curio when this period began; by its end it was in more than 50 percent of American homes, and coupled with the computer modem and Internet browser software, made possible the Internet explosion. Cellular mobile radio was, at the beginning, making its debut in Scandinavia; by the end cellular was no longer for CEOs, but for soccer moms wishing to keep track of their children. Cable television became a major programming force, with original series, sports, specials and movies. The VCR emancipated viewers from the tyranny of program times, and brought Hollywood—which had fought the VCR all the way to the Supreme Court—vast new revenue markets.

The PC revolution spurred an entrepreneurial efflorescence, financed by a resurgent Wall Street and the longest economic expansion in American history. Yet regulators continued to enforce infrastructure socialism—making de facto community property out of incumbent telephone networks and subsidizing entry by smaller competitors.

Meanwhile on January 1, 1983 the Internet, which expanded to include university research centers in the 1970s, adopted as its official communications protocol the TCP/IP networking standard. The National Science Foundation funded deployment of backbone network capacity to link supercomputer centers around the nation, originally at what today is dial-up speed (56 kb/s), then in stages up to gigabit speeds by the late-1990s. When in 1992 NSF changed its "Acceptable Use" policy to allow commercial use of Internet backbone facilities, a major roadblock to commercial development was removed. In 1993, programmers at the University of Illinois's Champaign-Urbana Supercomputer Center developed an Internet browser called *Mosaic*, which in 1995 became *Netscape Navigator*. Coupled with the 28.8 kb/s modem and the Pentium PC, the mass-market Internet took off, bringing web-surfing and e-mail into America's—and the developed world's homes.

As 1995 drew to a close, with passage of a major communications reform act imminent, and the Internet on the launching pad, the sky seemed the limit. But events were to provide more than a few unwelcome surprises in the next decade.

Personal Networking (1996–2005): "Reach Out and E-Touch Someone"
Negotiated Networking (2006–2015): Faces and Masks @ cyber-ball.world

Networks I: Core Erosion & Device Explosion (1996 – 2005)
Networks II: Core Implosion & Last-Mile Explosion (2006 – 2015)
Wizards: Distributed Invention
Warriors: Venture Bubble
Wonks I: Subsided "Potemkin" Competition
Wonks II: Negotiated Networking

1996–2005
Internet boom, bubble and bust. The 1996 Telecom Act incorporated most of what the FCC had adopted earlier, but encouraged intermodal competition. It was a liberal law—hyper-regulatory infrastructure socialism with managed competition overlays—but in adopting existing FCC policies, conservative in temper. Yet competitor welfare remained the FCC standard. Optical switching achieved preliminary viability. IP moved towards full voice capability. The mass market Internet and device explosion led to a cultural split: online cyber-surfers/offline channel-surfers.

NAB got a second 6 MHz block of spectrum for transition to DTV/HDTV by 2007. The FCC took Telecom Act of 1996 and tilted against ILECs, forcing below-cost renting of the entire local network platform (TELRIC/UNE-P) and extorting concessions in return for approving ILEC horizontal mergers. FCC blocked the AT&T/SBC vertical merger. The 1996 Act laid the policy predicate for extending universal service to advanced services, once essentiality is established.

Technological convergence of communications and computing led to the Internet boom; investment excess, outright fraud and regulatory Caesarism burst the bubble, and prolonged the bust phase as well. Network infrastructure socialism was confined to the local loop, with long distance companies freed to enter local markets. But antitrust policy barred vertical mergers between local and long distance companies, and local network competition was "Potemkin"—subsidized at artificially low rates. Yet the Internet became a mass market phenomenon, woven into the fabric of American economic, social and cultural life, reaching more than 50 percent of American homes. Cyber-surfers began to rival channel-surfers.

But Internet cost pressures collapsed the price structure for long distance, as traffic formerly carrier on long distance voice lines migrated to nationwide wireless, fax, and e-mail. Long distance companies that FCC policy aimed to protect became victims of cost pressures, as fiber-optic technology made the marginal cost of transcontinental calling essentially identical to that for calling across the street. Vertical mergers would have saved them from bankruptcy and accelerated deployment of broadband services. Towards the end of this period Internet (VoIP) telephony began to make inroads into telephone services. Rapid growth is universally predicted for the next decade.

This decade also saw introduction of the most successful consumer electronic product ever—the Digital Versatile Disc (DVD—originally the "V" stood for video, but later Versatile became industry parlance). Within five years more than half of America's homes owned one. As Internet bandwidth increased, moreover, video market prospects brightened. As did software that enabled users to share songs and movies without paying copyright fees to Hollywood; record and film companies launched a legal and legislative blitz to stop the tactic, with partial success only. Online distribution became a fact of life in entertainment markets.

Meanwhile, as US broadband policy frustrated efforts to rapidly deploy high-bandwidth services—those capable of more than faster web page loading, Asia's tigers—most notably, South Korea and Japan—surged. The average South Korean enjoyed 40 times as much bandwidth as the typical American by 2004. And by the end of 2004 China had more cell phone users than the total US population. Inexorably the center of telecom gravity began to shift towards Asia.

2006–2015
The optical core/ether tail network will render much in-place plant obsolete and bankrupt major telecom companies. Regulatory policy will have to deal with 3- and 4-firm oligopolies. Key Networking issues will include one "matter/anti-matter clash": Authenticity v. Anonymity; and one complementary pair: Authorization & Acceptance. Optics will hollow out the core of the network. Wireless will fill the last mile, along with fiber. The rise of home networking brings the globe as close as the next room. Technology convergence, with VoIP telephony, bi-directional broadband and Internet growth, will spur a regulatory convergence.

This period will mark a watershed in cyberspace. Networking will increasingly be negotiated on a case-by-case basis, balancing desire for anonymity against need to know. Want to engage in cyber-commerce, and sellers will want to know if your credit is good and if you have authority to engage in the proposed transaction. Want to criticize the government, and you will want anonymity. But child pornographers and terrorists crave anonymity, too.

Users will thus wear many masks on one face in cyberspace. Anonymous for some purposes—both legitimate and illegitimate; with multiple identities. The ultimate direction cyberspace markets take will be guided primarily by the generation now growing up with the technologies, having never known life without them. For them the Net is woven into the fabric of their lives, not a mid-life add-on.

While cyber-war threats are worrisome, the nations who are prime targets are those who pioneered the technologies and markets, and thus their populations are eminently capable of coping with such threats, unless political will is lacking. In the event the major cyberwar threats will come not from terrorists, whose legions lack deep expertise in exploiting advanced networking technologies, but from countries with populations having that expertise. A revanchist China is a cyberwar threat to worry about, should conflict arise.

Conclusion: Back to the Future; Forward to the Past

At the outset of the 21st century telecommunications is poised for yet more quantum leaps in cost/performance, and will yield vast new economic benefits, while triggering new political, social and cultural upheavals. The transition from analog to digital infrastructure amounts to going "back to the future"—telegraph networks were digital—indeed, ALL communications networks prior to analog voice were digital.

At the same time, certain timeless principles apply with equal force in the emerging communications environment. We cannot, *pace* Thomas Paine, "remake the world all over again." We should follow America's cautious yet also radical Framers, and combine the best from the past with the future's promise, rather than discard everything as France's utopian revolutionaries did. In the Second Digital Age we should thus go "forward to the past."

Two centuries of networking over distance yield certain findings about transformational networking technologies:

- Most inventors fail to foresee the primary use of their inventions;
- New networks often stimulate utopian hopes—ever unrealized;
- Regulation changes remarkably little as network technologies evolve;
- Networks take longer to pay off, but then pay off more than expected;
- Free societies make the most productive use of network technologies;
- New networks are radically disruptive, and work against gradual, predictable change.

For much of human history, communications spearheaded extension of community and thereby provided relief from isolation. In an age of 24/7 CNN and Internet it is hard to imagine the isolation of most folks—even in America—just a single century ago. In 1900 the first radio telegraphy transmission across the ocean was one year away; on Millennium New Year a New York City television viewer could usher in 2000 in Tonga at 5 AM, watch the spectacular display of fireworks over Sydney Harbor at 8 AM, later that day watch celebrations in Nara, Japan at the Todaiji Buddha temple, fireworks illuminate soaring skyscrapers in Shanghai, celebrations in Moscow's Red Square and Cairo, then over the Eiffel Tower in Paris and then, 19 hours after Tonga's official world inaugural millennium moment, see the famed balloon descend over Times Square.

And yet the past beckons. Do we all want to be in touch 24/7? Even those in polar regions can communicate instantly. The solitude of life in rural America at the turn of the 20th century had its charms. Not, however, when one needed a doctor. Two centuries of networked communications have brought about what has been called "the death of distance." That is the good news—and the bad news is that such efforts have succeeded perhaps too magnificently.

Human existence at times requires creation of distance. Time off the networked world will remain a human need. And so we have come full circle. While negotiating the terms upon which we network, we negotiate as well our periodic disengagement, a task near as daunting as the search for wider community over the past two centuries.

Appendix: Wizards, Warriors & Wonks

Prelude
Optical, magnetic telegraphs. Wizards, Warriors, Wonks (3W): Chappe, Edelcrantz; Napoleon.

Far Writing
Electromagnetic telegraph, undersea telegraph cable, mechanical computer, fax. 3W: Morse, Wheatley; Sibley, Field, Orton, Thomson, Babbage, Lovelace, Boole; postal rate regulation, Homestead Act.

Far Sound
Telephone, automatic mechanical switch, radio, audion, alternator, audio phonograph. 3W: Bell, Gray, Edison, Strowger, Maxwell, Herz, Lodge, Marconi, Fessenden, Alexanderson, DeForrest; Vail; Hollerith; rate regulation—ICC, PUC, Mann-Elkins, Kingsbury, Copyright Act.

Programmed Sound
Super-heterodyne, FM, TV, coaxial cable, (Black) amplifier, undersea telephone cable ('21), sampling theorem, film, sound recording, LP record, SP record, digital transmission, microwave, transistor, information theory, electronic analog, then digital computer mainframe; machine & assembly languages; electro-mechanical switching. 3W: Hollerith, Armstrong, Farnsworth, Bush, Nyquist, Watson-Watt, Reeves, von Neumann, Shannon, Clarke; Sarnoff, Gifford, Watson, Benn, TV CEOs; WW-I Postal annexation of AT&T; 1927 Radio Act; 1934 Communications Act, lines-of-business, NTSC BW & color.

Programmed Video
IC, laser, semiconductor laser, high-level programming languages (ForTran, COBOL, Ada, Basic, Unix), time-sharing, mini/super-computer, ARPANET, ETHERNET, e-mail, Xerox copier, Xerox PARC (PC-GUI-LAN-laser printer), reel-to-reel tape recorder, cassette recorder, VCR, multi-mode fiber, T-Carrier, electronic circuit switching (analog, then digital), packet switching; satellite, PC; command languages, public key cryptography. 3W: Townes, Kao, Licklider, Baran, Kahn, Cerf, Kleinrock, Tomlinson, Thompson & Ritchie; McCarthy, Noyce, Moore, Turner, Gates, Jobs; CPE, CI-I & II,, SCC, DOJ, Execunet, "Bell Bill," Copyright Act revision, All-Channel Receiver Act, Comsat Act, Record Carrier Competition Act, Kahn, Van Deerlin.

Personal Programming
TCP/IP, WWW, cellular mobile radio, PCS, ISDN, single-mode fiber, optical amplifiers, DWDM, fast dial-up modem, GUI, Internet browser, CD; embedded IC, EFT, portable cassette radio (Walkman); DAT, fast fax, DBS, satellite radio, VisiCalc, DOS, CP/M, Windows, Mac, WordStar, Java. 3W: Berners-Lee; Dell; RCCA, S. 898, H,.R. 5158, divestiture, public-LD entry, co-location, CLECs, Computer III, accounting separation, spectrum auctions/favoritism, '84 & '92 Cable Acts, AT&T non-dominant regulation, TV-RO Satellite Dish Act, '92 Audio Home Recording Act, GW I.

Personal Networking
Negotiated Networking
DVD, US Broadband Lite, home networking, Asian "Turbo" broadband, VoIP, CD-RW, PVR, HDTV, P2P file sharing, PGP encryption; optical switching, broadband wireless tail. 3W: Yang, Bezos, Google; '96 Act (universal advanced service; end Willis-Graham), TELRIC/UNE-P, merger extortion, vertical telecom merger limits, '98 Digital Millennium Copyright Act, spectrum reform, GW II; universal broadband service; SCADA; cyber-weapons.

The Market for Capital and the Origins of State Regulation of Electric Utilities in the United States

WILLIAM J. HAUSMAN AND JOHN L. NEUFELD

We provide evidence that the problem of raising capital in the early days of the U.S. electric-utility industry motivated industry leaders to embrace state rate-of-return regulation in return for a secure territorial monopoly. Utility executives anticipated that this would lead to a reduction in borrowing costs. Using firm-level bond data for 1910–1919, we estimate a model and find that state regulation led to lower borrowing costs but that the magnitude of the reduction was small. We also find evidence that output of electric utilities in states with regulation was higher than output in states without regulation.

The evolution of the electric-power industry in the United States has been heavily influenced by the institutional structure under which it has operated. Beginning in the first decade of the twentieth century, electric utilities in an increasing number of states were subjected to rate-of-return regulation. Today, most privately owned electric utilities in the United States must have the prior approval of state regulatory agencies to build new capacity, to change rates, and (in many states) to seek new financing through the capital market.[1] This type of regulation, based on extensive investigation of each company's particular situation, is unique to the United States.

In many countries around the world, electric-utility industries have recently been restructured or are in the process of restructuring. In the United States there is a similar movement, which seeks to bring substantially more competition to the industry.[2] Because the existing institutional framework

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[1] In 1998 privately owned utilities generated and distributed approximately 68 percent of the electricity in the United States. Publicly owned utilities, cooperatives, federal power agencies, and nonutility generators provided the remainder. U.S. Department of Energy, *Changing Structure*.

[2] The restructuring process was stimulated by passage of the Energy Policy Act of 1992. The fact that policies are only now being implemented is in part due to the need to deal with state regulatory apparatuses. As of February 2002, 17 states had enacted restructuring legislation or issued comprehensive regulatory orders for restructuring. The recent energy crisis in California has caused eight states to either suspend or delay restructuring. The Energy Information Administration maintains data on the status of restructuring in the states (http://www.eia.doe.gov). Information on this process also can be

in the United States is unique, however, the problems faced in moving to a new, competitive framework are distinctive, and proposed changes in the industry need to be considered in light of its history, particularly that of the development of state regulation.[3]

Rate-of-return regulation by states, and later by the federal government, was devised originally to deal with railroads. In fact, some states simply turned responsibility for the regulation of electric utilities over to existing railroad commissions. There has been considerable historical debate over the motivation for the political decision to regulate U.S. railroads.[4] The nature of the railroad debate has largely involved whether regulation was meant to protect consumers (public-interest theory) or to enable railroads to extract monopoly profits from consumers (capture theory). Both sides of the debate focus on pricing in the market for railroad services. Scholars have paid considerably less attention to why electric utilities came to be regulated, but the few studies on the establishment of electric-utility regulation similarly assume that it was designed to affect the market for electricity.[5] In this article we consider another possibility: it was not the market for *electricity* that was the object of regulation but the market for *capital*. We hypothesize that electric-utility executives came to favor the institution of state regulation not out of an expectation that it would enable them to raise rates to consumers or extract monopoly profits, but primarily because regulation would help alleviate their severe financing problems.[6]

The problem of raising capital in the early days of the electric utility industry (prior to the adoption of regulation) was enormous, a condition that may have retarded the nation's electrification, and one that has not been fully appreciated.[7] Regulation reduced the risk of investing in an electric utility, thus making utility bonds and stocks more attractive, increasing the availability of capital, and lowering its price. Consumers benefited as well because increased investment enabled the production of more electricity,

found at http://www.si.edu/nmah/csr/powering/ ("Powering a Generation of Change"). This site, whose purpose is to document the transition process, is maintained by the Division of Information, Technology, and Society at the Smithsonian Institution's National Museum of American History. It also contains a substantial amount of historical information.

[3] In the case of Britain, for example, the government was able to design, in the late 1980s, and implement, in March 1990, a single national policy regarding the industry.

[4] On the history of railroad regulation see, for example, Kennedy, "Statist Evolution"; or Berk, "Adversaries." On state versus federal regulation, see Kolko, *Railroads*, pp. 166, 217–23.

[5] The classic articles on this subject are Stigler and Friedland, "What Can Regulators Regulate?"; and Jarrell, "Demand." For a general account of the rise of electric utility regulation see Anderson, *Regulatory Politics*, Ch. 2; and Hirsh, *Power Loss*, Ch. 1.

[6] Utility executives undoubtedly had mixed motives for advocating regulation. Another motivation for regulation was to forestall the municipal ownership movement. This point was made explicitly by E. W. Burdett in an address to the National Electric Light Association in 1906. Burdett, "Agitation."

[7] By some standards, the spread of electrification was not particularly rapid. As late as 1920 fewer than 50 percent of the nation's urban and nonrural homes were electrified. U.S. Department of Commerce, *Historical Statistics of the United States*, Part 2, p. 827.

which, in an era in which there were substantial economies of scale, lowered its price.[8]

In our investigation of the movement for state regulation and its effect on financing electric utilities, we first document the problem utilities faced in acquiring capital; we then review the public debate that led to the adoption of state regulation, with the object of presenting evidence from that debate that bears on the relationship between regulation and financing; and finally, we conduct an econometric analysis designed to test for the effects of state regulation on financing electric utilities. The quantitative analysis cannot determine why regulation was adopted, but it can tell us if regulation had the expected (positive) effect in the capital markets in which electric utilities operated. We find statistically significant evidence that regulation led to lower borrowing costs for electric utilities, although the decrease in costs was relatively small in magnitude. We also find evidence that the output of electric utilities in states with regulation was higher than ouput in states without regulation.

THE PROBLEM OF CAPITAL ACQUISITION IN THE EARLY DAYS OF THE INDUSTRY

Electric power generation, transmission, and distribution have always been highly capital-intensive endeavors. Table 1 presents data indicating that in the period under discussion, the ratio of the value of capital to the value of output was the highest among a wide array of industries. In the earliest days of the industry, the problem of raising capital was critical for success, a point Thomas Edison dramatically illustrated when he inaugurated his commercial electric service by gathering the press and publicly switching on the lights for the first time in September 1882 in the office of his financier, J. P. Morgan.[9] Sidney Z. Mitchell, who later became one of the most prominent electric utility executives in the country, noted of the early days:

> Money has always been the greatest problem in the electrical industry where an unusually high investment is required to produce one dollar's worth of sales. This ratio has varied between $4 and $8 of investment for each $1 of gross sales. And, when this is added to the growth characteristic of the industry, an annual increase of sales of 6 to 8 per cent compounded each year, one can have some understanding of the additional money continuously required.[10]

By 1902 the roughly 2,800 privately owned electric utilities in existence had invested a total of $483 million in construction and equipment (cumulative since 1882), but were generating annual revenues of only $79 million and profits of roughly $16 million.[11] Yet the industry continued to grow

[8] Figures for the nominal and real price of electricity can be found in Edison Electric Institute, *Historical Statistics*, p. 165.

[9] A detailed description of the events of that day can be found in Jones, *Power History*, pp. 177–79.

[10] Mitchell, *S. Z. Mitchell*, p. 45.

[11] U.S. Department of Commerce and Labor, *Light and Power Stations, 1902*, p. 6.

TABLE 1
RATIO OF VALUE OF CAPITAL TO VALUE OF OUTPUT
(1929 dollars)

Year	Electric Light and Power	Steam Railroad	Telephone	Street and Electric Railway	All Manufacturing	Chemicals	Agricultural Machinery	Motor Vehicles
1890					0.73	2.30	4.08	2.00
1895	17.48	10.17	4.42	5.94				
1900	12.48	6.43	4.12	6.85				
1905[a]	10.24	4.71	2.89	6.30	0.89	2.71	3.49	2.71
1910[a]	10.47	4.35	2.54	5.77	0.97	2.13	3.33	2.02
1915[a]	10.26	4.34	2.23	5.12	1.01	2.30	3.59	1.21
1920[a]	4.51	3.17	1.58	4.01	1.02	1.84	1.72	0.88

[a]One year earlier in the case of all manufacturing, chemicals, agricultural machinery, and motor vehicles.

Sources: Utilities and railways, Ulmer, *Capital in Transportation*, pp. 256–57, 320, 374–75, 405–06, 472–73, 476, 482, 486; manufacturing, Creamer, Dobrovolsky, and Borenstein, *Capital in Manufacturing*, pp. 265–67.

rapidly. Between 1902 (before adoption of state regulation) and 1917 (by which time a majority of states had adopted regulation), the average growth rate in the total value of plant and equipment in the industry was just over 12 percent per annum.[12]

The necessary investment in electric utilities clearly could not be funded out of retained earnings.[13] Capital expenditures had to be financed through issuance of stocks (equity) and bonds (debt), but these securities were notoriously difficult to market for firms in the young electric-utility industry. At this time, utilities were strictly local firms, which did not have national reputations, and the risk to investors was very high. The major manufacturers of electrical equipment devised one way around this problem, with General Electric leading the way. To sell equipment, the electrical manufacturers often accepted payment in the form of their customers' (the operating utilities) capital stocks and bonds. The manufacturers then turned these securities into cash by packaging and marketing stocks and bonds from several different operating companies in the form of an investment trust.[14] Later, other electrical manufacturers, engineering and management-services companies, and investment bankers formed elaborate utility holding companies, which issued

[12] The calculation is based on data in U.S. Department of Commerce, *Light and Power Stations, 1927*, p. 21.

[13] Gross annual investment by electric utilities exceeded total annual revenue (of which earnings is only a fraction) until 1915. Prior to 1910, gross annual investment was more than *double* total annual revenue. Ulmer, *Capital*, pp. 320–21, 476–77.

[14] Charles A. Coffin, vice-president of the Thomson-Houston Electric Company, which merged with Edison General Electric in 1892 to form General Electric, is given credit for originally devising this scheme. Carlson, *Innovation*, p. 214. Carlson argues that even the major electrical manufacturers had difficulty raising capital "because they had become capital-intensive enterprises prior to the development of capital markets suited to large-scale industrial expansion." p. 287.

their own securities as a mechanism to raise funds and to control a number of operating companies that formed a diverse, nonintegrated system.[15]

Leonard S. Hyman has argued that the problem of obtaining financing was a major factor behind the creation of these companies. He noted that profits to the holding companies came primarily from efficient management of operating companies, which raised the value of security holdings, as well as from service fees of various kinds (including fees for arranging financing).[16] *Moody's* 1914 investment manual, the first one in which public-utility and industrial securities were separated from railway securities, paid considerable attention to the role of holding companies. Because they generally controlled regionally diverse operating companies and were regarded as possessing expertise in issues of engineering, management, and finance, the securities of holding companies were considered to be very safe. *Moody's* also argued that these advantages would benefit their operating company subsidiaries.[17]

THE ADOPTION OF STATE REGULATION

The period prior to the turn of the twentieth century was one of considerable turmoil for the young electric-power industry. Vigorous competition for franchises and for territory was the norm, especially in larger cities. In the Manhattan borough of New York alone, for example, 25 nonexclusive franchises were granted between 1882 and 1900. Twenty-four electric utilities, not all of which actually produced electricity, were established in Chicago between 1883 and 1887.[18] Not only did these utilities face competition from each other, but they also faced stiff competition from the self-generation of power by large users of electricity, which denied the utilities the reduced costs that improved load factors and economies of scale would have brought.[19] Technological innovations also came quickly during this period, contributing to capital costs in the industry by making existing equipment quickly obsolete. A notable example was the alternating current system developed by Westinghouse Electric that eventually replaced Edison's direct current system. These conditions led to financial difficulty in the industry. The pioneering firms in the industry were not very profitable as a whole; average return on investment in 1897 was 4.02 percent, about the same as that for far safer railroad bonds.[20] In addition, privately owned utilities constantly faced the prospect of being bought out or taken over by the munici-

[15] For a discussion of the early history of holding companies see United States Federal Trade Commission, *Control*; and Bonbright and Means, *Holding Company*.

[16] Hyman, *America's Electric Utilities*, pp. 76–77.

[17] Moody, *Moody's Analyses of Investments*, 1914, p. 6.

[18] On New York see Hausman, "Light and Power," pp. 673–75. On Chicago see Platt, *Electric City*, p. 55.

[19] Neufeld, "Price Discrimination."

[20] Hausman and Neufeld, "Structure," p 237.

pality they served. In 1902 municipally owned utilities constituted almost 23 percent of the total. They tended to be small, however, and their output was less than 8 percent of the industry total.[21]

Franchise competition, the difficulties of raising capital, rapid technical change, and economies of scale in the industry led to a period of local consolidation between roughly 1900 and 1906. During this era many of the large urban utilities still recognizable today were created.[22] Further consolidation subsequently occurred through the mechanism of holding companies, some of which were created specifically to help deal with financing problems.

The development of the electric utility industry occurred during the Progressive Era, whose reformers initially tended to advocate the ownership and operation of utilities by municipal governments, but soon after the turn of the century moved toward advocating state regulation.[23] Considerable discussion about the relative merits of public versus private ownership of utilities occurred during the era. A number of studies were conducted, including one by the U.S. Commissioner of Labor in 1898, and public ownership of electric utilities became a major issue in several mayoral campaigns.[24] In terms of financing, municipal utilities enjoyed an important advantage over privately owned ones; it was easier for them to raise funds at lower interest rates because they could use the city's taxation powers to secure the debts.

At the turn of the twentieth century, many privately owned utilities also were subject to regulation by the municipality in which they were located.[25] The nexus giving the municipality regulatory power arose from the special franchises utilities needed to obtain in order to use the public streets for power lines. The exact forms this type of regulation took varied over time and across municipalities. Initially, cities were inclined to encourage the development of utilities by granting liberal franchises. With the passage of time, it became clear that a utility franchise had value and that a municipality could extract at least some of that value as a condition for awarding the franchise. One approach was to sell franchises to the highest bidder; another

[21] U.S. Department of Commerce, *Light and Power Stations, 1927*, pp. 7, 24.

[22] On the process of consolidation in New York, see Hausman, "Light," pp. 673–75; for Chicago, see Platt, *Electric City*, ch. 2–4; on Kansas City and Denver, see Rose, *Cities*, ch. 1–2; on Boston, Seattle, and San Francisco, see Jacobson, *Urban Utility Networks*, ch. 3; and on Detroit, see United States Federal Trade Commission, *Utility Corporations*, p. 59.

[23] Many Progressives came to believe that municipal politics was excessively corrupt and changed their views. Richard McCormick argues that years of political experimentation and uncertainty around the turn of the twentieth century culminated in what he called the years of "discovery and resolution" in 1905–1908. He notes, "Regulation by commissions seemed to be an effective way to halt corruption by transferring the responsibility for business-government relations from party bosses and legislators to impartial experts." McCormick, "Discovery," p. 271.

[24] United State Bureau of Labor, *Fourteenth Annual Report*. This included campaigns in cities such as New York, Chicago, Boston, and Atlanta.

[25] No comprehensive modern study of this interesting period in utility regulation has been conducted. The noted economist Martin Glaeser provides one of the best discussions of the forms of municipal regulation and the material that follows draws heavily from this source. Glaeser, *Outlines*, pp. 156–310.

was to demand low rates for street lighting. As pressure developed for municipalities to use their franchise power to benefit the utilities' customers, the awarding of a franchise became a bargain between the municipality and the applicant utility. One historian has suggested that municipal regulation was evolving into the kind of rate-of-return regulation that would be adopted by state commissions.[26] Although there may have been a movement in that direction in some cities, the practice was not widespread. Municipal regulation was a precursor to state regulation by commission, but the latter should be regarded as a major shift in the treatment of electric utilities, one that is less an evolution from municipal regulation than a reaction to its perceived failures.[27]

Two characteristics of regulation by municipal franchise would have been of particular concern to utilities. The first is the fact that the utilities were usually not granted a protected monopoly. Public sentiment favored nonexclusive franchises, and the constitutions of many states prohibited exclusive franchises.[28] Denver, for example, in 1880 granted a general electric franchise to "all comers," and free competition was not uncommon, although it did not persist. Competing utilities apparently engaged in numerous abuses, including use of the power of eminent domain to block construction by rivals or to force them to purchase property at exorbitant prices.[29] Consolidation generally led to a *de facto* monopolist in most cities, but the threat of competition from new, politically connected entrants remained.

The second worrisome characteristic of the municipal-franchise system was corruption, of which the utilities were both instigators and victims.[30] A particularly noteworthy example was that of Chicago where, on a number of occasions, a group of aldermen would grant themselves a franchise enabling them to form a utility that would compete with an existing company. The existing utility would then be given the opportunity to avoid the competition by purchasing the new franchise from the politicians. This method had been used successfully against gas and transportation utilities, but the corrupt politicians stumbled badly when they tried extortion on Samuel Insull, the new president of Chicago Edison, one of a number of small electric utilities in Chicago. In 1897 a group of aldermen known as the "gray wolves" granted themselves a 50-year franchise to provide electricity to the entire city of Chicago, preparing to play the familiar game on a new victim.[31] Insull refused to yield, and the extortionists were forced to call his bluff by actually creating an operating competitor. They soon found their

[26] Priest, "Origins."
[27] Glaeser, *Outlines*, pp. 292–99.
[28] Ibid., p. 221.
[29] Ibid., pp. 203–04; and Rose, *Cities*, pp. 21–24.
[30] Glaeser, *Outlines*, p. 232. Rich discussions can also be found in Wilcox, *Municipal Franchises*, vol. 1, pp. 101–32; and McCormick, "Discovery."
[31] This franchise, under the name Commonwealth Electric Company, extended for a substantially longer period of time than that remaining on Insull's franchise for Chicago Edison.

way blocked by a series of agreements Insull had made with every American electrical manufacturer except Westinghouse, giving him nearly exclusive rights to purchase the equipment a utility needed to operate. Insull ultimately bought the 50-year franchise for $50,000, a fraction of the price the aldermen originally expected to get. He then used this franchise to build the first giant, integrated utility serving a large metropolitan area, under the name Commonwealth Edison.[32] Insull went on to become one of the dominant figures in the U.S. electric utility industry.

Samuel Insull became the first leader of a major, privately owned utility to publicly advocate the adoption of state regulation.[33] In his 1898 presidential address to the National Electric Light Association (NELA), the leading organization of electric utilities (and forerunner of the modern Edison Electric Institute), Insull outlined several proposals he felt would be beneficial to the industry, including the adoption of standardized equipment and the use of innovative rate structures to stimulate off-peak business and improve the load curve.[34] He ended his address by presenting his colleagues with the case for submitting to rate regulation in exchange for an exclusive franchise. That case was based primarily on the argument that such a system would improve the industry's access to capital.[35]

Beginning with a discussion of the movement for municipal ownership, Insull used a property-rights argument in favor of private enterprise that would be familiar to modern readers: "We all realize, from the close attention we have to give to our own affairs, that self-interest and the necessity of getting a return on our investment are the first essentials to the economical administration of large enterprises."[36] He argued strenuously that perceived problems in the industry were not due to bad private management: "the claim that municipal operation is the universal cure for all diseases for which electric-lighting companies are supposed to be responsible merely proposes the substitution of political in the place of industrial management." Rather, he saw the fundamental problem in the industry as competition, because "it frightens the investor, and compels corporations to pay a very high price for capital," which "must be reflected in the price paid by public and private users." His solution was to "protect" the monopoly position of

[32] McDonald, *Insull*, pp. 82–90.

[33] A year earlier, however, in a purely political maneuver, Chicago transportation magnate Charles Tyson Yerkes had tried to bribe the state legislature into passing a bill that would have extended his franchises and taken streetcar and elevated-railway regulation out of the hands of the city and vested it in a state commission. The tactic failed. Ibid., pp. 85–88.

[34] The speech is reprinted in Insull, "Standardization," pp. 34–47.

[35] Almost a quarter of a century later, in an address to the Peoria, Illinois, Association of Commerce, Insull commented, "Pioneers in the industry often had struggles that left marks upon all subsequent history of their enterprises. The public had to be educated to use public-utility service. But before there was any service to be used, investors had to be educated to furnish the money with which to build the plants and service facilities: and that was a harder task than educating the public." Insull, *Public Utilities*, p. 227. For some of his own difficulties with financing see Insull, *Memoirs*, pp. 81–87.

[36] Insull, "Standardization," pp. 42–43. Subsequent direct quotes are from pages 43–47.

the utility whose charges would be set by public regulators "to be based on cost plus a reasonable profit." The chief benefit of protection against competition would be realized in the market for capital, not the market for electricity: "The more certain this protection is made, the lower the rate of interest and the lower the total cost of operation will be, and, consequently, the lower the price of the service to public and private users."

Insull's provocative argument has been neglected by most modern students of regulation. His argument is not predicated on the notion that electric utilities are natural monopolies, although he does say "competing companies invariably come together."[37] His major concern clearly was that competition made it difficult for private utilities to pay their bondholders and provide a return on equity to their stockholders.[38] This in turn made it difficult for utilities to raise money, thereby raising interest costs, which substantially increased the total cost of producing electricity. Competition among electric utilities, in his view, is inefficient because of the uncertainty it creates for investors. This effect was particularly strong for electric utilities because of their extreme capital intensity. His colleagues did not immediately embrace Insull's argument, although he was successful in having the NELA create a committee to investigate the issue of regulation.[39]

In addition to the federal government and the industry's major trade association, civic groups also became involved with this issue. The National Civic Federation initiated one of the most influential studies of the issue in 1905. The study was led by a group of prominent leaders, including Insull, future Supreme Court Justice Louis Brandeis, and United Mine Workers president John Mitchell. A 21-member "committee on investigation" was formed, consisting of three equally sized groups that had expressed opinions in favor of municipal ownership, in favor of private ownership, or who were considered to be neutral. The committee set out to investigate utilities both in the United States and in England, and produced a three-volume report.[40]

Much of the material in those volumes was written by individual members and reflects their individual perspectives. Although this makes the overall

[37] Progressive economists, however, relied heavily on this argument as a basis for regulation. See, for example, Adams, "Relation."

[38] As one student of the New York Public Service Commission wrote, "A modern public utility corporation is just as dependent for its existence upon the investing public as upon the consuming public. A man may be practically compelled to patronize a public service corporation which enjoys a monopolistic position, but he cannot be forced in the matter of investing his funds." The author goes on to argue that the purpose of the New York commission was to effect administrative regulation through the control of security issues. Baldwin, *Capital Control*, pp. xix, xxiii.

[39] Some executives did agree with Insull. Ernest H. Davis, a utility executive from Williamsport, PA, in a comment following a discussion of municipal ownership at the 1898 meeting, noted: "The conclusion I have arrived at individually is that investment in electric lighting plants will earn more, be better secured and more stable, if such interests are protected by a properly-regulated state commission rather than by the efforts of individual companies or by the use of statistics." *National Electric Light Association Proceedings*, p. 130.

[40] National Civic Federation, *Municipal and Private Operation*. The report received wide attention. It was summarized in Munro, "Civic Federation Report."

report inconsistent, even contradictory, it is useful in understanding the various positions. One section, written by Charles Edgar, president of Boston Edison, and Walton Clark, vice president of the United Gas Improvement Company, reflects the views of leaders of the privately owned utilities and is particularly germane to our study. The authors were scathingly dismissive of municipal ownership and argued, as Insull did, that regulation was the proper solution: "Manager and investor must have guarantee [sic] that where they have sown they may reap."[41] They attribute the apparent financing advantage enjoyed by municipally owned utilities entirely to reduced risk: "Give a company the perpetual and exclusive franchise enjoyed by the municipality, with reasonable protection and regulation, and its bonds will sell as well as the bonds of the city for money borrowed on plant and franchise."[42]

Given its politically diverse makeup, the committee was, not surprisingly, unable to come to a conclusion on the central issue of municipal versus private ownership. Its members did, however, agree that electric utilities should be permitted to operate as monopolies, that they be required to use uniform accounting rules and to make their records public, and that privately owned utilities should be subjected to regulation of some form. One of the people who worked on the report was the noted economist John R. Commons. Commons used the recommendations of the still-unpublished study to formulate a Wisconsin law, adopted in 1907, establishing state commission regulation of electric utilities.[43] This law, with a similar one passed in New York the same year, served as a model for subsequent state commissions.[44] As the municipal-ownership movement gradually stalled, a number of prominent Progressive politicians advocated the regulation of electric utilities by state commissions, and the movement spread rapidly.[45]

The various committees of the NELA also were moving the industry to embrace state regulation. As the 1907 report of the Subcommittee on Public Regulation and Control put it, "Your committee is of the opinion that the National Electric Light Association should take the position that it is in favor of a proper system of regulation by properly-constituted authorities, provided that hand in hand with the regulation shall go proper and adequate

[41] National Civic Federation, *Municipal and Private Operation*, part 1, vol. 1, p. 426.

[42] Ibid., p. 427.

[43] In his autobiography, Commons stated, "I adopted nearly the whole of the recommendations signed by nineteen of the twenty-one members of the investigating committee of the Civic Federation." Commons, *Myself*, p. 120. He also made it clear that utility executives in the state had a say in construction of the legislation. His chief advisor on the bill creating the commission was a prominent corporate attorney. Ibid., pp. 111, 121–22.

[44] For details of the Wisconsin law see Commons, "Wisconsin Public-Utilities Law" and "How Wisconsin." On the New York law see Dearstyne, "New York Public Service Commission."

[45] Glaeser, *Outlines*, p. 234. In 1907 the Sub-Committee on Municipal Ownership of the NELA reported that the municipal-ownership movement " . . . is losing its vitality and that actual retrogression may be expected to follow." It attributed this in part to " . . . the rapidly-approaching culmination of the idea of public regulation." *National Electric Light Association Proceedings*, p. 20.

TABLE 2
STATES WITH STRONG, WEAK, AND NO REGULATION AND DATES OF ADOPTION

States with Strong Regulation and Date	States with Weak Regulation and Date	States Not Effectively Regulated as of 1920
Massachusetts, 1889	South Carolina, 1910	Louisiana
Wisconsin, 1907	Connecticut, 1911	Kentucky
New York, 1907	Nevada, 1911	New Mexico[a]
Georgia, 1907	Washington, 1911	Delaware
Vermont, 1908	Oregon, 1911	Florida
Michigan, 1909	Rhode Island, 1912	Mississippi
Maryland, 1910	Colorado, 1913	Minnesota
New Jersey, 1910	Idaho, 1913	Iowa
California, 1911	Montana, 1913	South Dakota
New Hampshire, 1911	North Carolina, 1913	Texas
Ohio, 1911	Oklahoma, 1913	Kansas[b]
Arizona, 1912	West Virginia, 1913	Nebraska[c]
Illinois, 1913	Wyoming, 1915	
Indiana, 1913	Utah, 1917	
Missouri, 1913		
District of Columbia, 1913		
Pennsylvania, 1914		
Virginia, 1914		
Maine, 1914		
Alabama, 1915		
Tennessee, 1919		
North Dakota, 1919		
Arkansas, 1919		

[a] towns of less than 10,000 only
[b] limited regulation in towns
[c] only outside towns
Sources: Ruggles, *Aspects of the Organization, Functions, and Financing*, chs. I, IV; Mosher, *Electrical Utilities*, pp. 299–300; and correspondence with utility commissions.

protection for the capital investment in these corporations."[46] Subsequent to this report, individual utility executives occasionally opposed regulation; however, utilities and their executives were frequently in the forefront of advocacy for the establishment of state regulatory commissions.[47] By 1919 the vast majority of states had a utility commission in operation (Table 2).

The reduction of financial risk (with potentially lower interest rates) clearly was an important motivation for those electric-utility executives who

[46] *National Electric Light Association Proceedings*, p. 28. In addition, the smaller Association of Edison Illuminating Companies adopted the position at about the same time. As John W. Lieb, former president of the organization, noted several years later: " . . . we look back with gratification and pleasure on the fact that when the question of public utility regulation was first brought forward that that scheme of governmental supervision and regulation had on the floor of this convention the fullest endorsement, the fullest promise of co-operation by every member company represented in this Association. *Association of Edison Illuminating Companies Minutes*, p. 235.

[47] Anderson, *Regulatory Politics*, pp. 39–47. In California, for example, John Britton, vice-president of Pacific Gas & Electric, initiated the drive for state regulation in 1909 with a lengthy article in the state's leading financial journal. Other California utility executives " . . . led the campaign for state regulation of their firms. They hoped state regulation would end competition between their firms, enhance the value of their companies' stocks and bonds, and allow them to escape continual wrangling with county and municipal authorities." Blackford, *Politics of Business*, pp. 86–87.

LATION AND DATES OF ADOPTION

Peak Date	States Not Effectively Regulated as of 1920
1910	Louisiana
911	Kentucky
	New Mexico[a]
911	Delaware
	Florida
912	Mississippi
	Minnesota
	Iowa
	South Dakota
1913	Texas
3	Kansas[b]
1913	Nebraska[c]
5	

tions, and Financing, chs. I, IV; Mosher, th utility commissions.

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nia, for example, John Britton, vice-president gulation in 1909 with a lengthy article in the executives " . . . led the campaign for state would end competition between their firms, nd allow them to escape continual wrangling *ics of Business*, pp. 86–87.

embraced state regulation. The question is: did state regulation have the intended effect? Were interest rates, and hence the costs of debt financing, actually lower in states where electric utilities were regulated? An affirmative answer would support the position of utility executives that regulation could benefit both a utility's owners and its customers.

THE IMPACT OF REGULATION ON CAPITAL COSTS

The empirical section of this article focuses first on the market for electric utility bonds in the period from 1910 to 1919 using firm-level data.[48] It was during these years that the bulk of the states adopted commission regulation of electric utilities (Table 2).[49] The second part of the empirical section uses state-level data between 1902 and 1927 to examine the relationship between regulation and output, which we interpret as a proxy for capital.

The yield to maturity on a bond is the discount rate that equates the present value of the bond's payments to its price. If a bond pays a periodic coupon rate C, and a payment at maturity of M after T periods, its present value under a discount rate r would be:

$$PV = \frac{M}{(1+r)^t} + \sum_{t=0}^{T} \frac{C}{(1+r)^t}$$

In a market in which bonds trade freely before maturity, the present value of a bond at any point in time will equal the price at which it trades. The coupon payment and payment at maturity are known. The discount rate r can then be determined from an iterative procedure that equates PV with the price of the bond. There are two components to the discount rate: $r = R_f + k$, where R_f is the risk-free rate of return and k is a risk premium which is positively associated with the probability and cost of default. If regulation reduced the risk of default by protecting the utility from competition, the risk premium k would fall, causing r to fall (assuming no change in R_f) and the market price of bonds (PV) to increase. Thus, if the advocates of state regulation of electric utilities were correct, the yield to maturity on bonds should be lower in states with regulation than in states without regulation. In addition, any risk factors specific to the utility issuing the bond or to the characteristics of the bond itself would be reflected in the yield to maturity. We can account for some of these company-specific and bond-specific risks.

[48] In 1912 funded debt represented 44 percent of total capitalization for the industry as a whole, roughly the same proportion as in 1907. U.S. Department of Commerce, *Light and Power Stations, 1912*, p. 64.

[49] Massachusetts is credited with having created the first utility-regulatory commission in 1889. Its powers at first were limited to collecting and publicizing information. Its power to control rates was gradually enhanced over the years and we consider the state to have been regulated in our model.

Some of the bonds in the study were issued by utilities that were subsidiaries of holding companies. As discussed earlier, this was advantageous and these bonds should have a carried lower risk premium than bonds of companies not owned by a holding company. Another company-specific issue of concern during this period was the condition of electric-traction companies. In its 1920 public-utility manual, *Moody's* noted "conditions arising from the war have affected the traction companies with special severity . . . With the ending of the war it seemed that street railway operating companies would become more favorable especially as to labor. Such has not proved the case . . ."[50] In fact, during the next decade the jitney (bus) basically obliterated the street railway industry. Electric utilities that either owned or supplied a substantial proportion of their power to street railway companies should have been perceived by investors to be riskier and their borrowing costs, consequently, would have been adversely affected.

Some of the electric utilities also provided gas and water service. This might have been an advantage to a company by providing economies of scope or simply by reducing interfuel competition. On the other hand, *Moody's* was wary of utilities providing other utility services in addition to electricity in part because of the difficulty of keeping the accounts of the mixed operations separate.[51] Thus, it is uncertain whether utilities that provided more than one service had an advantage over companies that only provided electricity, so that the effect on borrowing costs also is uncertain.

Electric utilities were particularly hard-hit by the First World War and its immediate aftermath. Not only were labor markets tight and wages high, but also coal, a major input in the production of electricity, was in very short supply and became very expensive. In Chicago, for example, the price of a ton of coal went from \$1.80 in 1915 to \$3.45 in 1919.[52] Although some utilities managed to obtain increased rates, Samuel Insull complained that utilities were forced to get through the war mostly without raising prices[53] In fact, the real price of electricity fell during the war.[54] This should be reflected in lower bond prices and a higher risk premium in the electric-utility industry specifically due to the war and its immediate aftermath.

DATA AND MODELS

The data for the empirical investigation were taken from *Moody's Public Utility Investments* manual for the year 1920. This source of financial information contains a retrospective table containing the annual high and low prices of utility stocks and bonds for the years 1910–1919. For years in

[50] Moody, *Moody's Analyses of Investments*, 1920, p. 4.
[51] Moody, *Moody's Analyses of Investments*, 1914, p. 4.
[52] Insull, *Public Utilities in Modern Life*, p. 50.
[53] Ibid., p. 146.
[54] Edison Electric Institute, *Historical Statistics*, p. 165.

which securities were not traded, the bid price on the last day of the year was recorded. From this table we examined every long-term, first mortgage bond with a par value of at least $1 million. In the small number of cases in which a utility had issued more than one series of first-mortgage bonds, we selected only the most recent issue. We eliminated the bonds of the small number of utilities that operated in more than one state (which would have confounded the regulation variable) as well as bonds issued by parent holding companies.[55] This resulted in the selection of 139 bonds, each issued by a different operating utility. Utilities in 38 states are represented in the data. Because some of the bonds selected were issued after 1910, and because price quotes were not available for all bonds in all years, the data comprise an unbalanced panel (pooled cross-section/time series) with 1,185 observations.[56] We recorded the following information for each bond selected: date issued, maturity date, number of years to maturity, par amount outstanding, coupon interest rate, and annual high and low price (or bid price, when the bond was not traded), and state in which the firm operated. Data on the firm issuing the bond included whether the utility was a subsidiary of a holding company, whether it provided electric traction service, and whether it was a combination gas, water, and electric utility.

The mean bond price for a year was calculated as the average of the year's high and low price (or the bid price) and was used to calculate the yield to maturity, the measure we use for r. The average yield to maturity was 5.8 percent (Table 3). To calculate the portion of r consisting of risk premium, k, we used the annual yield on long-term U.S. railroad bonds as the closest standard to the risk-free return, R_f, on bonds with a similar maturity.[57] The yield on railroad bonds was then subtracted from the calculated yield on electric-utility bonds to create an annualized risk premium, the key dependent variable in the study.[58] The average annualized risk premium was 1.2 percent (Table 3).

The critical independent variable in this model is state regulation, which we define several ways. It is not clear how long it took a regulatory commission, following its legislative creation, to become operational and have an effect. Bond markets may have reacted immediately to news of creation of a commission or may even have anticipated creation of a commission. On the other hand, given that there was little experience with this type of regulation of electric utilities, investors may have been quite uncertain about how

[55] Several of the operating companies whose bonds are represented in the sample were subsidiaries of the same holding company. Holding-company bonds were excluded from the analysis because holding companies were exempt from state regulation. We also eliminated from the sample one bond with a 100-year term.

[56] We have data over all ten years for 73 of the bonds.

[57] U.S. Department of Commerce, *Historical Statistics of the United States*, p. 1003. The rationale for using this as proxy can be found in Carty, "Regional Interest Rate Premia," p. 452. All models were also run using the unadjusted yield to maturity.

[58] The yield to maturity (or discount rate, r) was calculated using Microsoft Excel's YIELD function.

TABLE 3
VARIABLE MEANS AND STANDARD DEVIATIONS

Variable	Mean	Standard Deviation
Regulation dummy	0.711	0.453
Regulation+3 dummy	0.508	0.500
Strong regulation+3 dummy	0.420	0.494
Weak regulation+3 dummy	0.088	0.283
Years since regulation	3.24	3.28
Average bond price	$91.18	$9.96
Yield to maturity	0.058	0.010
Risk adjusted yield to maturity	0.012	0.009
Years to maturity	24.68	10.31
Bond amount	$4.99 million	$6.30 million
Holding company dummy	0.530	0.499
Tram dummy	0.473	0.499
Combination dummy	0.552	0.497
$N = 1,185$		
Output in kwh	582,700,492	1,209,885,608
Urban population (1,000s)	890	1,374
Value added in manufacturing	$292,128,182	$584,268,025
$N = 270$		

Note: See the text for descriptions of the variables.

commissions would behave, and there may have been no impact until decisions began to be handed down. We estimate several models. We first use a variable in which regulation becomes effective in the year the commission was established, and then, following George Stigler and Claire Friedland and Gregg Jarrell, use a variable that assumes that it took three years for a commission to become operational (a qualitative variable that takes on the value one three years after state regulation was established and zero otherwise).[59] Finally, we use a variable that is the number of years since the establishment of regulation (and 0 for states with no regulation).

State regulatory commissions also varied in the specific powers they were granted by legislatures. Commissions in model states such as Wisconsin and New York were very powerful, with control over rates, accounting practices, capital expenditures, and capital structures. They had jurisdiction over all privately owned utilities in the state. Some state commissions had more limited jurisdiction, or were limited to controlling rates. A key element was whether or not they could regulate capitalization and the issuance of securities. We have used the existence of this power to split states into two groups, one of which we designate as being strongly regulated and the other as weakly regulated (Table 2). This allows us to see if the effect on borrowing costs differs due to the type of regulation.

We include year dummy variables in the model, primarily to account for the effect of World War I. Finally, state and firm dummy variables are in-

[59] Stigler and Friedland, "What Can Regulators," p. 4. Jarrell, "Demand," p. 282.

cluded in some models to account for fixed effects not captured by the other variables.[60]

RESULTS

When state regulation was considered to have become effective in the year a commission was established, we could find no evidence that the existence of regulation had any impact on risk-adjusted yields to maturity. That is, the coefficient on the regulatory variable was not significantly different from zero and we do not report the results. When regulation was deemed to become effective three years after establishment of a commission, the results (presented in Table 4) are statistically significant. The existence of state regulation did appear to reduce the borrowing costs (risk adjusted yield to maturity) of electric utilities in those states relative to electric utilities in states without regulation.[61] The effect was confirmed when states were divided into those with strong regulation and those with weak regulation, but with the effect much more evident in states with strong regulation (after accounting for state or firm fixed effects). The magnitude of the effect on risk-adjusted yields, however, was not large, ranging from –0.16 percent to –0.22 percent per annum (a reduction of 16 to 22 basis points). This is consistent with the results for number of years since regulation, which ranges from –0.05 percent to –0.06 percent per year. Dividing the range of estimates for any regulation after three years (–16 to –22 basis points) by the mean risk adjusted yield of 1.2 percent indicates that the potential reduction in the risk component of yields in states with regulation ranged from 13 percent to 18 percent. The total bonded indebtedness of the commercial electric-utility industry in 1922 was $2.25 billion. Multiplying this figure by the range of estimates (–16 to –22 basis points) results in potential interest savings in 1922 due to regulation of between $3.6 and $4.9 million per annum. This is not a large amount of money given that total interest payments by commercial electric utilities in 1922 amounted to $126 million.[62]

Neither the holding company nor the combination dummy is strongly significant. There is weak evidence that combination utilities had to pay a slight premium, but contrary to *Moody's* expectation, holding companies did not appear to reduce the borrowing costs of their operating utilities by lowering the risk premium. The *Tram* dummy clearly supports *Moody's* position on the perilous condition of electric tramways. Its coefficient is always positive, statistically significant, and large in magnitude compared to other dummy variables. Of the bond-specific variables, *Years to Maturity* was statistically significant in only one case, indicating a flat yield curve.

[60] We estimate the model in Stata, using White heteroscedastic-consistent standard errors.

[61] Consistent results were found when using the unadjusted yield to maturity as the dependent variable.

[62] United States Department of Commerce, *Light and Power Stations, 1922*, pp. 116, 130.

TABLE 4
REGRESSION RESULTS FOR BONDS
(dependent variable is risk adjusted yield to maturity)

Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Regulation+3	–0.00154*	–0.00223*	–0.00156*					
	(0.014)	(0.002)	(0.002)					
Years since regulation							–0.00063*	–0.00053*
							(0.005)	(0.003)
Strong regulation+3				–0.00132*	–0.00240*	–0.00171*		
				(0.045)	(0.003)	(0.002)		
Weak regulation+3				–0.00283*	–0.00168	–0.00054		
				(0.005)	(0.184)	(0.597)		
Years to maturity	–0.00003	–0.00002	–0.00005	–0.00003	–0.00002	–0.00043*	–0.00003	–0.00011
	(0.263)	(0.389)	(0.453)	(0.244)	(0.382)	(0.000)	(0.255)	(0.168)
Holding company dummy	0.00077	0.00030	–0.00100	0.00071	0.00029	–0.00362*	–0.00003	–0.00059
	(0.166)	(0.617)	(0.364)	(0.196)	(0.634)	(0.001)	(0.959)	(0.675)
Tram dummy	0.00349*	0.00171*		0.00356*	0.00171*		0.00174*	
	(0.000)	(0.007)		(0.000)	(0.007)		(0.004)	
Amount	–0.00012*	–0.00013*		–0.00013*	–0.00013*		–0.00013*	
	(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	
Combination dummy	0.00057	0.00106		0.00054	0.00106		0.00088	
	(0.311)	(0.056)		(0.338)	(0.056)		(0.096)	
1910 dummy	–0.00081	–0.00069	0.00024	–0.00087	–0.00069	0.00175*	–0.00125	–0.00006
	(0.478)	(0.456)	(0.702)	(0.447)	(0.454)	(0.007)	(0.209)	(0.943)
1911 dummy	–0.00131	–0.00147	–0.00076	–0.00137	–0.00147	0.00038	–0.00186*	–0.00099
	(0.201)	(0.076)	(0.187)	(0.183)	(0.076)	(0.517)	(0.037)	(0.169)
1912 dummy	–0.00134	–0.00169*	–0.00132*	–0.00141	–0.00169*	–0.00061	–0.00182*	–0.00137*
	(0.150)	(0.024)	(0.007)	(0.132)	(0.024)	(0.214)	(0.023)	(0.015)
1913 dummy	–0.00153	–0.00174*	–0.00154*	–0.00158	–0.00174*	–0.00116*	–0.00170*	–0.00151*
	(0.099)	(0.017)	(0.000)	(0.088)	(0.018)	(0.008)	(0.027)	(0.001)

Combination dummy	0.00057	0.00106						
	(0.311)	(0.056)		(0.338)	(0.056)			
1910 dummy	–0.00081	–0.00069	0.00024	–0.00087	–0.00069	0.00175*	–0.00125	–0.00006
	(0.478)	(0.456)	(0.702)	(0.447)	(0.454)	(0.007)	(0.209)	(0.943)
1911 dummy	–0.00131	–0.00147	–0.00076	–0.00137	–0.00147	0.00038	–0.00186*	–0.00099
	(0.201)	(0.076)	(0.187)	(0.183)	(0.076)	(0.517)	(0.037)	(0.169)
1912 dummy	–0.00134	–0.00169*	–0.00132*	–0.00141	–0.00169*	–0.00061	–0.00182*	–0.00137*
	(0.150)	(0.024)	(0.007)	(0.132)	(0.024)	(0.214)	(0.023)	(0.015)
1913 dummy	–0.00153	–0.00174*	–0.00154*	–0.00158	–0.00174*	–0.00116*	–0.00170*	–0.00151*
	(0.099)	(0.017)	(0.000)	(0.088)	(0.018)	(0.008)	(0.027)	(0.001)

TABLE 4 — continued

Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
1915 dummy	–0.00156	–0.00164*	–0.00167*	–0.00156	–0.00164*	–0.00200*	–0.00119	–0.00134*
	(0.120)	(0.035)	(0.000)	(0.117)	(0.035)	(0.000)	(0.137)	(0.004)
1916 dummy	–0.00209*	–0.00230*	–0.00222*	–0.00202*	–0.00232*	–0.00299*	–0.00180*	–0.00187*
	(0.027)	(0.004)	(0.000)	(0.032)	(0.004)	(0.000)	(0.031)	(0.002)
1917 dummy	0.00008	0.00019	0.00006	0.00011	0.00019	–0.00107	0.00091	0.00060
	(0.943)	(0.847)	(0.928)	(0.921)	(0.849)	(0.072)	(0.393)	(0.472)
1918 dummy	0.00195	0.00187	0.00188*	0.0020	0.00187	0.00035	0.00308*	0.00275*
	(0.095)	(0.076)	(0.006)	(0.090)	(0.076)	(0.598)	(0.012)	(0.008)
1919 dummy	0.00440*	0.00445*	0.00437*	0.00443*	0.00445*	0.00251*	0.00621*	0.00566*
	(0.0001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.005)	(0.000)	(0.000)
State dummies		Included**			Included**		Included**	
Firm dummies			Included**			Included**		Included**
Constant	0.01158*	0.01300*	0.01170*	0.01166*	0.01305*	0.02962*	0.01205*	0.01584*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.097	0.368	0.738	0.100	0.368	0.741	0.362	0.731

* indicates statistical significance at the 5-percent level
** indicates jointly significant at the 5-percent level.
Notes: $N = 1{,}185$; p-values are in parentheses.