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# HISTORICAL PERSPECTIVES ON COMPETITION AND INTERCONNECTION BETWEEN LOCAL EXCHANGE COMPANIES: THE UNITED STATES, 1894-1914<sup>1</sup>

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## 1. INTRODUCTION

Innovations in communications technology and state and federal regulations are currently dismantling the last vestiges of the Bell monopoly. Cellular service, for example, may soon afford a competitive alternative to the traditional voice and data communications services, carried along the wire plant of local exchange companies. At the same time, state and federal agencies are requiring local companies to open their networks to competitors, initially those providing access to interexchange carriers but eventually to companies offering local service as well.

This turbulent period is placing unusual strain on regulatory agencies. Facing the threat of entry for the first time in almost a century, local companies are requesting greater flexibility in setting rates to meet competition. Competitive prices, these companies claim, should reflect the cost of providing service and would undoubtedly raise rates on residential and rural customers. Actual and potential entrants, in turn, maintain that to compete effectively, they must have access to incumbents' networks at competitive prices, by which they mean prices based on cost.

Arguments on both sides suggest that competitive and cost-based pricing are one and the same. Certainly, economic theory implies that under specific conditions prices in competitive markets will gravitate to the marginal cost of production. Yet, economic theory also identifies a host of conditions, under which marginal cost pricing is neither feasible nor optimal.<sup>2</sup> Unfortunately, much of the recent policy debate has been conducted at the theoretical level with little attention devoted to empirical studies of competition in the telecommunications or other network industries. Admittedly, there have been few cases of competitive markets in the former, at least until recently. Yet, as in other areas of applied economics, history offers a "natural" experiment, one that dates from the very origins of the telephone industry in the United States.

In 1894 Bell operating companies lost their monopoly over local service, based on patent protection, and faced entry in their rural and urban markets. Our examination of this

formative case questions the prevailing assumption, equating competitive and cost-based pricing. During the brief period of free entry into the local exchange market, we find instead that rival companies developed elaborate schemes of price discrimination to increase their market share.<sup>3</sup> In particular, competition resulted in a widening differential between business and residential services, a finding that contradicts the common assertion that value of service pricing is an artifact of regulated, monopoly markets.

Our study also questions the long-term effect of interconnection on competition. Whether through consolidation under the Bell System or mandated by state regulation, interconnection agreements after 1907 orchestrated a division of the market between Bell and independent companies. Consequently, it weakened the pressure for each to compete by extending their subscriber base and network.

Our argument is developed in six parts. In section 2 we briefly recount the early history of competition in the U.S. telephone industry and state our central hypothesis about the relationship between competition and interconnection. Section 3 describes the hierarchy of demands for telephone service, which underlies our analysis of firms' pricing policies under competition in section 4. Unlike today, firms competed by forming rival networks, and only subsequently acceded to some form of interconnection. Section 5 analyzes the shift in their strategies, and the impact of private interconnection agreements under the Bell standard.

In section 6 we review the history of mandated interconnection in Wisconsin.<sup>4</sup> Although Wisconsin was not the first state to mandate physical interconnection, its Railroad Commission was the first regulatory body to exercise this authority. Consequently, as in other areas of regulation, Wisconsin served as a laboratory for the rest of the country, showing how regulators implemented interconnection and its impact on the evolution of rival networks.<sup>5</sup> The concluding section draws out the implications of our case study for the contemporary dilemma, facing regulatory agencies.

## **2. COMPETITION AND INTERCONNECTION**

Until 1894 the American Bell Telephone Company and its licensed operating companies enjoyed a complete monopoly over the markets for telephone equipment and service (Aronson, 1977, pp. 16-19, 27-28). Protected by Bell's original patents, the company reaped substantial rents by charging high prices for service and in turn restricting supply mainly to business and affluent residential customers in larger urban centers. Bell's marketing strategy reflected the myopic vision of its executives and engineers, with a few notable exceptions. Conceiving the telephone as simply a substitute for the telegraph, they narrowly focused on the demands of businessmen, whether at the office or at home.

With the expiration of Bell's patents, independent companies quickly entered the industry and eroded the incumbent's dominant position in equipment and service markets. Independent manufacturers often matched Bell's own standards in station apparatus and deployed new technologies, such as the handset and the automatic switch, which greatly enhanced service quality and reduced operating costs. Independent operating companies developed new markets, even within large urban centers, by tapering service quality and prices to the varied demands of residential and business customers. They would even contest Bell's control over the lucrative business market in many metropolitan centers.

In response to actual and potential competition, Bell operating companies sharply cut their rates for local service and improved service quality. Between 1894 and 1910 the average price of Bell's local service fell by more than one-half, from over \$70 to only \$31.3 (see Figure 1).<sup>6</sup> Average costs also fell sharply, but almost one-half of these savings represented lower rental payments on equipment paid to the parent company.

Lower rates, higher service quality, and more aggressive marketing campaigns by Bell and independent companies spurred demand growth. The pace of market development, measured by the number of telephones per thousand people, accelerated after 1893. The annual growth rate averaged 23.7 percent between 1894 and 1907, as compared to only 9.7 percent in the preceding decade. Independents, moreover, made sharp inroads into Bell's monopoly and by 1907 accounted for almost one-half of all telephones (see Figure 2).<sup>7</sup>

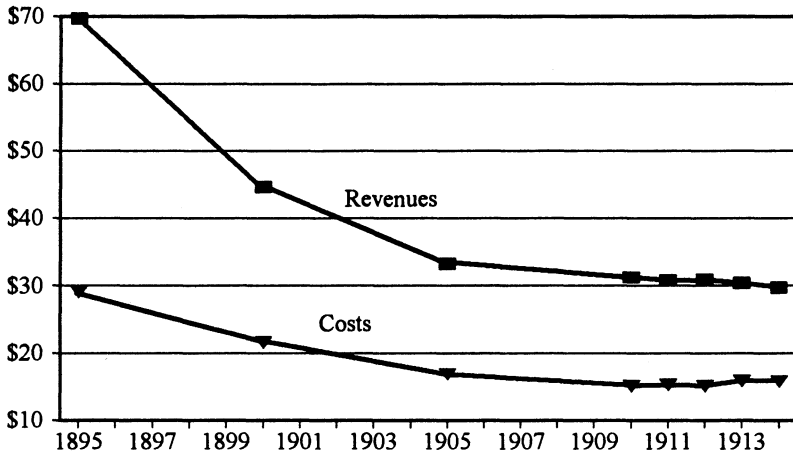
After 1907, however, the benefits of competition abated rather abruptly. The downward trend in prices and costs gradually leveled off, and after 1910 both remained virtually unchanged. Telephone development, moreover, slowed to only 5.1 percent per year, less than the average growth rate under the Bell monopoly. The Bell System also began to reassert its dominance in markets throughout the country. As shown in Figure 2, Bell's market share reversed its previous decline and by 1914 reached 55 percent. Over the same period, the share of the Bell System, including sublicensed independent companies, jumped from 63 to 85 percent.<sup>8</sup>

This turning point coincides with a dramatic shift in the marketing strategies of AT&T and other telephone companies. With the return of Theodore Vail, AT&T promoted "universal" service through a single, integrated telephone network.<sup>9</sup> Independent companies also offered customers more extensive service through various forms of interconnection. Significantly, this shift responded to the demands of business customers and regulators, who became increasingly critical of competition between rival networks.

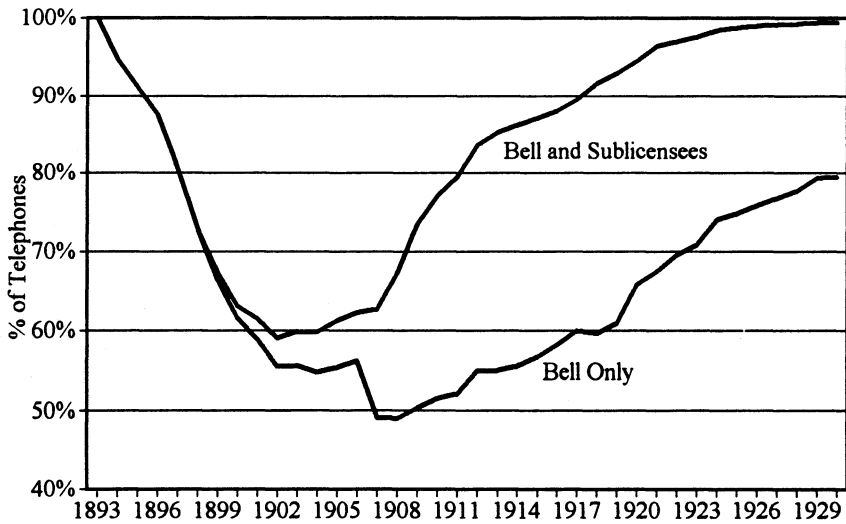
This transition can be interpreted in two ways. In terms of the industrial life-cycle, it represents the maturation of a relatively novel technology and a corresponding shift from extensive to intensive market development. The limited diffusion of telephone service under the Bell monopoly had created a large, pent-up demand for service. The formation of new exchanges prior to 1907 filled in these gaps and so foreclosed the option of developing fresh territory after this date. Moreover, rapid demand growth began to strain the limited capacity of manual switching facilities, and put mounting pressure on costs and prices.

With the greater penetration of telephone service, customers assimilated the new technology into their daily routines and issued additional demands for service. Businesses, in particular, desired more extensive connections to coordinate their internal operations and mediate their external transactions with suppliers and customers. Eager to cultivate this potentially lucrative market, both Bell and independent companies sought to integrate their local networks into larger territorial systems.

Alternatively, the shift in strategy represents a new phase in the relationship between Bell and independent companies, one characterized by accommodation rather than competition. In its initial refusal to interconnect with adjacent independent companies, American Bell's managers challenged its rivals to build an entirely separate network. To expand their subscriber base and enhance the value of their network to business customers, Bell and independent companies pursued aggressive pricing and investment strategies



**Figure 1: Exchange Revenues and Operating Costs per Subscriber Station in the Bell System, 1895-1914**



**Figure 2: Bell's Market Share, 1893-1930**

aimed at more marginal users, what Milton Mueller (1989b, pp. 187, 195-97) calls access competition.

After 1907, however, each side would admit the futility of this stance, albeit for different reasons, and seek some kind of interconnection agreement with the other. Under Vail AT&T embraced consolidation, and through acquisition and sublicensing would impose its private standard on the industry. This policy shift can be seen in the large increase in the share of connecting telephones after 1907 (see Figure 2). Independents, which did not or could not join the Bell System, turned to the federal and state governments and sought regulations mandating interconnection.

These alternative interpretations are not mutually exclusive. Access competition, our argument suggests, fueled the extensive development of the telephone industry between 1894 and 1907, as both independent and Bell companies sought a critical mass of subscribers to enhance the value of their networks. Rapid expansion, however, strained Bell's financial resources, while it reduced the independents' competitive advantage in providing local exchange and toll services. Through interconnection, both sides sought to preserve the value of their networks by satisfying the demands of business customers. From this perspective, the call for interconnection represented a retreat from, not the basis for, competition between telephone companies.<sup>10</sup>

### 3. THE HIERARCHY OF DEMANDS

Writing in 1887, AT&T's Edward Hall specified the telephone's distinct "field of usefulness," the transmission of non-standardized information through the give and take of discourse.<sup>11</sup> As he and other telephone managers discovered, this demand for access comprised a bundle of characteristics including the volume, range, immediacy, and quality of connections. In general, customers' valuation of these characteristics were closely correlated and defined distinct market segments, hierarchically ordered according to (e.g.) the volume and range of desired connections. Depending on their position in this hierarchy, customers could purchase party-line service or demand a private branch exchange with a direct trunk line to the central office.

From the very onset, telephone companies differentiated between business and residential customers, although in practice the dividing line between them was often blurred.<sup>12</sup> Core customers were drawn from larger enterprises in trade and transportation, finance, and manufacturing, which conducted business on a regional and national scale. Typically located in the central business district, they demanded telephone connections to keep in touch with distant facilities (such as a branch plant or warehouse) and customers within their trade area. Given the value of the information transmitted, they placed an obvious premium on the immediacy, clarity, and reliability of these connections.

The demands of residential and small business customers differed by a matter of degree. For most households, telephone service augmented local, personal relationships and so was more dispensable. Neighborhood businesses—grocers, drug stores, doctors—attached limited value to access as well. Like their customers, they used the telephone infrequently and called within a narrow geographic range except to place orders. In the 1920s, however, many stores integrated telephone service into their marketing and inventory policies, and demanded greater access. Economic elites such as corporate

managers, by contrast, often used their home telephones for business-related transactions and so valued more extensive connections (Pool et al., 1977, p. 142; and Fischer, 1992, pp. 40-42).

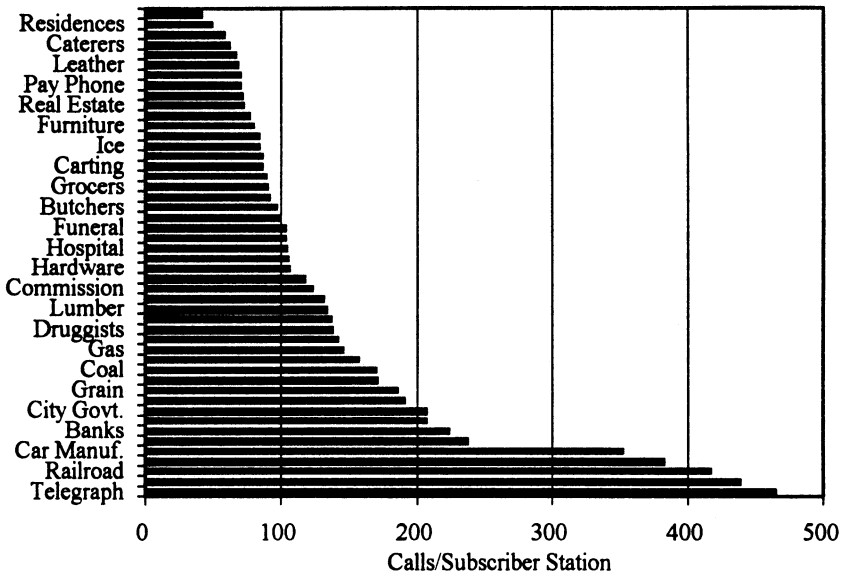
At Bell's Switchboard Conference in 1892, Hall presented detailed quantitative data on calling patterns in Buffalo, which clearly evidences this hierarchy of demands.<sup>13</sup> The graph in Figure 3 arrays "business classes" and residential customers in ascending order according to the average number of local calls per subscriber station during the month. At the top, households including doctors' offices made the fewest calls, less than 50 per month or barely two a day. They were followed by a variety of local enterprises—carriage builders, caterers, stables, stationers, and the like. At the opposite end were firms engaged in long distance communications and transport and manufacturing for the national market. They made more than 350 calls per month or at least 10 per business day. Newspapers, banks, hotels, and a variety of specialized wholesale merchants serving the metropolitan region also generated large demands for local service. Although only 15.4 percent of the subscriber stations in Bell's Buffalo exchange, these classes accounted for 37.8 percent of local traffic.

The data, graphed in Figure 4, show the distribution of customers by the number of different stations which they called during the month, and so indicate the size of their calling circles. Like today, the majority of Bell's customers in Buffalo had rather narrow communities of interest (Mayer, 1977, pp. 226-29). One quarter called fewer than 20 different numbers during the month, and the median calling circle embraced less than 30 subscribers, or 1.6 percent of the total subscriber base. At the other end of the distribution, only 7.8 percent of telephone users called at least 100 different stations, and so had a community of interest that likely spanned the entire city.

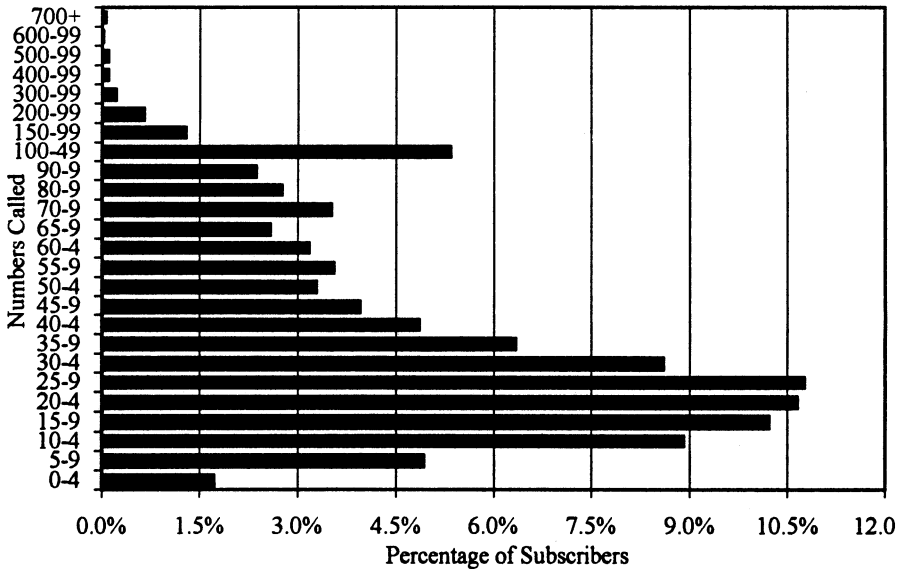
Throughout the period, businesses constituted the principal source of demand for long distance service. In the Buffalo exchange over one-half of business customers made at least one toll call in the month as compared to only 17 percent of households, including doctors. Not surprisingly, then, demands for long distance and local service were highly correlated. For example, the top 15 percent of long distance users accounted for almost 40 percent of toll calls. They included firms in transport and communication (e.g., telegraph companies, railroads, shippers, and newspapers), banking, and national market production.

A 1914 investigation into New York City telephone rates furnishes quantitative evidence on the spatial dimensions of the demand hierarchy.<sup>14</sup> For each zone of the city, the data indicate the differentiated demands of business and residential customers for local service, and where applicable, the volume of toll traffic between zones.<sup>15</sup> Based on this information, we delineate the segments of the metropolitan telephone market by their location relative to the central business district.

The graphs in Figure 5 depict the cumulative distributions of business customers by their demand for measured service.<sup>16</sup> The largest users were concentrated in Manhattan (zone 1). Only 20 percent of business customers purchased minimum service (of 6 thousand calls annually), and an equal share demanded the maximum, over 20 thousand calls per year. As Edward Bemis, who conducted the investigation for the Public Service Commission observed, Manhattan generated the greatest volume of local traffic in the metropolitan area, and within the borough, the financial district constituted the largest market segment.<sup>17</sup>



**Figure 3: Monthly Usage by Business Class in Bell's Buffalo Exchange, 1891**



**Figure 4: Distribution of Subscribers by Local Stations Called in Bell's Buffalo Exchange, 1891**

In the outlying zones of the Bronx, Brooklyn, and Queens (zones 3 and 7 to 9) business customers demanded more limited kinds of service. They typically made fewer calls, and a small fraction actually shared an access line. In districts bordering on Manhattan—Staten Island (zones 10 and 11), the south Bronx (zone 2), and the western portions of Queens and Brooklyn (zones 4 through 6)—the distributions fell in between these extremes. Yet, even in these areas, many firms opted for two-party service.

For residential customers, the spatial variation in access demand was even greater. Additionally, households, at least those outside of Manhattan, had the option of purchasing less expensive, but lower quality access. In Brooklyn, for example, a majority of residential customers purchased four-party service. Residential customers in Queens and Staten Island paid a very low flat rate for “neighborhood” service, but could call only within a narrow range without incurring an additional toll charge, hence the name.

In the intra-urban toll market the zones of Manhattan, northeastern Brooklyn, and the south Bronx generated 75 percent of all revenues. In fact, the traffic between the first two districts accounted for just over one-half of all local tolls. Additionally, these sections attracted the vast majority of toll calls originating in other parts of the city. In most zones or central offices, 75 percent of the toll calls were destined for stations in either Manhattan or Brooklyn. By contrast, the demand for connections between outlying sections, with the exception of those in the same local area, was scanty.

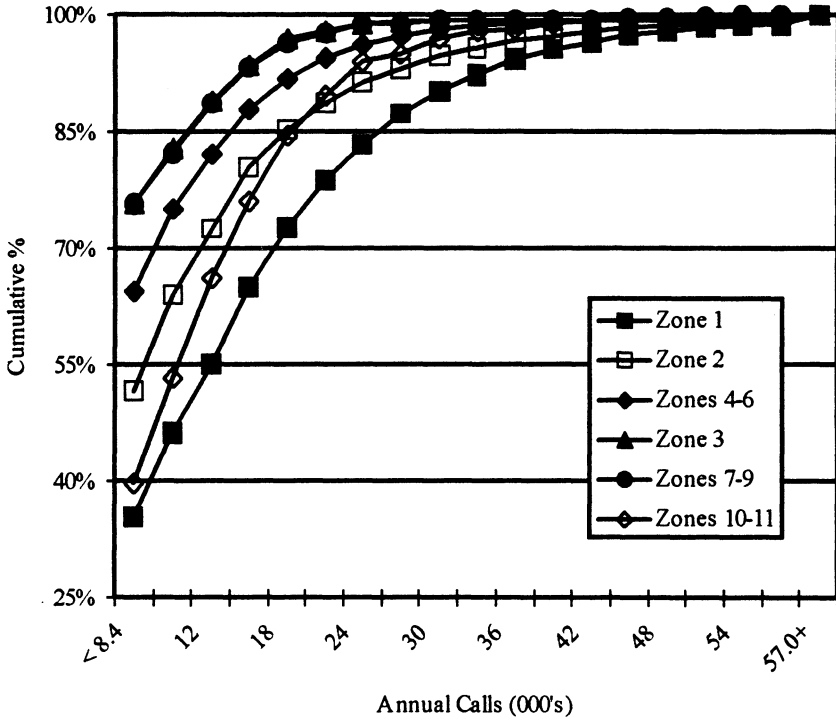
#### **4. THE COMPETITIVE DYNAMICS OF NETWORK DEVELOPMENT**

The hierarchy of demands implies the unequal distribution of benefits from enlarging the size and scope of the telephone network. Core customers highly valued a more extensive network because of their vast community of interest, whereas most households and retail shops derived little if any utility from connections beyond their neighborhood. Although sharply differentiated, customers’ calling circles nonetheless overlapped. These points of intersection represent the mutual economic and social relations that constituted metropolitan communities.<sup>18</sup> They also imply the mutual determination of demand for telephone service.

The challenge to early telephone managers and engineers was to design and operate exchange and toll networks that satisfied these diverse, but interdependent demands. If successful, their investments would generate substantial network externalities and higher returns. In the 1890s Thomas Doolittle of AT&T developed a simple, schematic “model” of the long distance network to illustrate the point.<sup>19</sup> According to his analysis, a well-designed network would connect complementary market segments and increase the flow of traffic along trunk lines, which would yield scale economies. He also recognized that some feeder lines would only generate returns indirectly by inducing demands for related services. To “round out a system,” he recommended “subsidizing” these investments with the profits earned elsewhere.

Doolittle’s model applied to local service as well.<sup>20</sup> The paradigmatic example, targeted by Bell marketing programs in the 1920s, was the chain of commercial transactions in the metropolitan region (Richter, 1925, pp. 291-94; Whitcomb, 1929; Moyer, 1977, p. 363; Lipartito, 1992, p. 15; and Weiman, 1994, pp. 15-16). Through local and toll services, wholesale merchants in central business districts could contact





**Figure 5 Distribution of Business Subscribers by Annual Usage in New York City, 1914**

retailers in their trade area, who, in turn, would use the telephone to conduct transactions with their customers. With the diffusion of telephone service to each market segment, retail merchants could place smaller orders more frequently and so utilize the telephone with increasing intensity. In similar fashion, large department stores provided suburban customers with the equivalent of “800” service to place their orders.

Unlike toll service, expanding the range of local connections resulted in higher costs and longer delays, which could stem demand growth. In the era of manual (and even simple electro-mechanical) switching technology, local service was an increasing cost segment of the industry. As a Bell engineer observed, in “one central exchange . . . the cost of service varies in a rapidly increasing ratio, directly as the number of telephones and resulting number of calls increases.”<sup>21</sup> In cities with multiple central offices, these factors were compounded by the additional capital and operating costs of relaying traffic through interoffice trunk lines and if necessary tandem switches.

In response to competition, Bell companies would elaborate Doolittle’s prescription and devise various schemes of price discrimination (or “subsidization”). Like “penetration” pricing, these marketing strategies were designed to forge a critical mass of subscribers that would enhance the long-term value of their networks (Rohlf’s, 1974, pp. 33-36; Katz and Shapiro, 1986, p. 834; Farrell and Saloner, 1986, pp. 950-51). As a Bell official plainly admitted, local rates were set according to what the market would bear, not simply costs. The “general method,” he elaborated, is to “[fix] rates in various exchanges to produce a high development, fixing them solely with reference to the value of service to the communities and without special regard to . . . the cost of service in a *particular case*.”<sup>22</sup> Even in the absence of actual competition, the policy would enable Bell companies to “cover all parts of the field” and so preempt entry.

#### **4.1 The Residential Discount and Measured Service**

The impact of competition on Bell’s pricing policy is evident in the widening differential between its business and residential rates. From the very outset, Bell operating companies charged business and residential customers differential rates for unlimited local service.<sup>23</sup> Prior to entry, its minimum annual business rate averaged \$68.1, as compared to \$56.0 for residential customers (see Table 1). The slight residential discount, only 18 percent, reflects the parent company’s top-down marketing strategy, which focused on core customers in large urban centers.

Entrants pursued the alternative strategy, best characterized as building networks at the grass roots level.<sup>24</sup> Employing simpler less, costly equipment, they could provide inexpensive, but effective, local exchange and toll services. Moreover, to increase the size and value of their networks, their pricing policies targeted more marginal users. To enlist urban and rural households, for example, independents sharply discounted residential rates. For unlimited local service, the norm was \$24 annually, as compared to \$36 for businesses (Levings, 1909, p. 276; Stehman, 1925, pp. 80-97). In some markets, the residential discount reached 50 percent.

**Table 1** Business and Residential Rates: Before and After Entry

Company	Market Structure	Ave. Minimum Rates		Ratio
		Business	Residential	
<i>Before entry, 1894</i>				
Bell	Monopoly	\$68.10	\$56.00	1.22
<i>After Entry, 1909</i>				
Bell	Monopoly	\$36.00	\$23.75	1.52
	Competitive	\$41.25	\$22.80	1.81
Independents	Competitive	\$37.15	\$23.25	1.60

*Notes:* Ratio equals business rates ÷ residential rates.

*Sources:* Annual Report of the AT&T Company, 1909, pp. 25-28.

To match their competitors, Bell companies slashed residential rates by an average of 60 percent (see Table 1).<sup>25</sup> They also cut business rates, but by only 40 or 47 percent depending on competitive conditions. During the initial phase of competition, then, the residential discount jumped to 34 percent in markets in Bell's monopoly markets and to 45 percent in competitive or dual markets.

Concerned about the reaction of key business customers to the new rate structure, the parent company devoted several pages of its 1907 annual report to explain its pricing policy.<sup>26</sup> Businesses paid higher rates, the report maintained, because they derived greater benefits from telephone service and imposed greater costs on the network. Compared to residential customers, it continued, they originated and received more calls per day, especially during peak periods. They, thus, reaped substantial benefits from access and accounted for network congestion.

As an alternative to straight discounts on the same service, Bell operating companies introduced more sophisticated schemes of price discrimination, furnishing business and residential customers with different qualities of service (or access) at varying prices. The case of measured service is illustrative. Key Bell officials, like Hall, advocated the policy on the general principle that "the true unit of charge is the message."<sup>27</sup> Yet, even he acknowledged the strategic objective of furnishing "smaller users" with inexpensive forms of access without alienating their business customers. Through measured service, Bell companies could reduce or even eliminate the residential discount. Moreover, by adjusting the incremental price of a call, they could regulate usage and so insure that key business customers enjoyed access to a larger subscriber base and efficient service at a reasonable price (Chicago City Council, Committee on Gas, Oil, and Electric Light, 1907, pp. 171-98).

In New York City the Bell operating company aggressively pursued this policy. To deter entry, Metropolitan Telephone in 1894 introduced measured service in the core boroughs of the city.<sup>28</sup> Rates for minimum service (e.g., 600 calls annually) substantially lowered the annual cost of an access line from \$240 to \$150. Residential customers continued to enjoy a small discount, which decreased with volume. Responding to pressure

from the business community, New York Telephone in 1907 lowered its rates on measured service and eliminated the residential discount.<sup>29</sup> Outside of Manhattan, the company still offered inexpensive, two- and four-party line service to marginal customers.

#### **4.2 Neighborhood and Dual Service**

In New York, Chicago, and Philadelphia Bell companies offered a limited version of flat rate service for as little as \$18 to \$24 annually. Through “neighborhood” exchanges, households and in some cases businesses could purchase unlimited access within a narrow area, usually the domain of a central office. The policy was feasible in large metropolitan centers because of their spatially segregated, close-knit residential neighborhoods.<sup>30</sup> Under these conditions, the company could employ lower cost exchange facilities and operating methods, and provide less efficient, toll service for the trickle of calls to and from other parts of the city. In other words, neighborhood exchanges were operated like a branch exchange of the metropolitan network.

In competitive markets, dual service represented yet another form of price discrimination. Competing companies covered largely distinct market segments, and so could provide more efficient, lower cost service to most customers, who rarely called outside of their exchange area. To reach the entire urban market and the toll facilities of both companies, core customers purchased dual service, that is service from both companies.

Core business customers criticized dual service because of the duplication in the subscriber base, which ranged from 15 to 20 percent in large urban markets. Subscribers with dual service, they insisted, subsidized access to other users, who could purchase cheaper local service from the independent and still reach many businesses (Merchants’ Association of New York, 1905, pp. 15-16). Yet, then as today, it was not uncommon for businesses to furnish access to their customers by (e.g.) advertising in several newspapers or leasing a storefront on a main thoroughfare.<sup>31</sup> The latter analogy is, in fact, rather apt. Paralleling the rent gradient between the central business district and a neighborhood shopping center, the rate of dual service in one city varied from almost 100 percent for large-scale enterprises operating at the wholesale level to under 15 percent for neighborhood shops and residences (Mueller, 1989b, pp. 255-61).

In fact, dual service resembled Bell’s neighborhood exchange service. Both plans segmented the metropolitan market according to the distinct communities of interest of marginal users. In this way, local companies could satisfy their limited demands more efficiently. Core customers, in turn, could purchase “extended area” service, but paid a higher price in terms of out-of-pocket expenses and slower, more roundabout connections. The main difference, of course, was that the neighborhood exchange furnished direct access to the metropolitan calling area through an integrated network, whereas dual service required customers to negotiate between two separate networks. As we show below, in mandating interconnection between rival urban networks, regulatory authorities in Wisconsin essentially replicated Bell’s neighborhood exchange service.

## 5. BRIDGING THE GAPS

After 1907 both Bell and the independents retreated from the competitive strategy of building parallel networks. First Bell and later the National Independent Telephone Association advocated physical interconnection to satisfy the mounting “public” demand for greater access. Not surprisingly, their proposals differed markedly.<sup>32</sup> Bell favored consolidation through acquisition and sublicensing. The independents, by contrast, sought mandated, universal interconnection under the watchful eye of neutral state regulators.

In calling for interconnection, rival companies were largely responding to the demands of business customers for local and long distance connections. Having adapted their practices and even organizations to exploit telephone service, business users sought less costly, more convenient access, whether to another borough of the city or region of the country. In turn, they harshly criticized the fragmentation of the telephone network, especially dual service because of the higher cost—in cash and in kind—of greater access.

Telephone officials acknowledged that only a small fraction of their total traffic and an even smaller share of their subscriber base required interconnection. Yet, they were eager to satisfy this market segment. Although their demand for basic access was less elastic than that of households, core business customers utilized telephone services more intensively and expressed greater interest in more profitable services, such as intra- and inter-urban toll connections. Recognizing the inherent limits to their extensive growth, rivals sought to cultivate this potential and very lucrative source of demand.

### 5.1 Consolidation under the Bell Standard

In 1907 Vail announced AT&T’s more conciliatory stance by expressing an increased interest in sublicensing.<sup>33</sup> Sublicense agreements specified the terms for the interchange of toll traffic between Bell and independent companies. By insisting on a strict division of territory and exclusive access, they also orchestrated a cartel under Bell control. Sublicensed independents companies were limited to a “small and compact” area, which did not “infringe” on the territory of any Bell division.<sup>34</sup> Moreover, they were explicitly prohibited from connecting with other long distance companies or forming their own toll networks. Hall, who drafted AT&T’s sublicensing policy, even recommended separate, staggered contracts for contiguous or otherwise affiliated exchanges to prevent the formation of rival networks.<sup>35</sup>

Through sublicensing, the parent company also sought to regulate or more accurately to raise the rates of independent companies. Hall perceived a potential conflict, if operating companies allowed independents to retain “unsuitable” rates, meaning those far below the prices for comparable Bell service. These disparities, he observed, would incorrectly “educate the public in the belief that such low rates must be paying rates,” and so ultimately “prove as much of an embarrassment to the licensee as if *actual competition existed*.”<sup>36</sup>

Although AT&T did not have the power to stipulate rates, it exerted influence indirectly by regulating the other terms of the contract. As earlier experience demonstrated, a combination of higher technical standards, inflated rental fees on equipment, and “fair” commissions on toll services would increase the independent’s costs and so force the necessary adjustment in prices. Bell operating companies even assisted independents in

negotiating higher rates, usually by furnishing desired toll connections or guaranteeing their local monopoly against potential entrants.<sup>37</sup>

In larger urban centers, strategic considerations overruled the potential benefits of sublicensing. AT&T permitted no concessions over these pivotal locations, which would anchor any rival toll network. Consequently, Hall sanctioned Bell's aggressive, if not predatory, tactics to eliminate actual or potential competition in these markets.<sup>38</sup> Bell companies would eventually achieve this goal, but often through the political process. By lobbying municipal governments or state regulators, they forced independents to sell their properties or procured exclusive franchises.

Core business users figured significantly in these campaigns. To achieve more efficient universal service, they sided with the Bell operating company and provided the necessary political support for its "natural" monopoly over local service (Weiman and Levin, 1994, sect. 5). In return, business customers insisted on some form of rate regulation. These administrative contracts would check Bell's market power and so institutionalize some of the gains from competition. As important, regulated, as opposed to competitive, rates would curb price discrimination and thereby shift the fixed costs of the network onto more marginal users.

## 5.2 The Independent Movement for Interconnection

Independent companies reversed their earlier opposition to mandatory interconnection, as their prospects of constructing a nationwide network dwindled (Bornholz and Evans, 1983, pp. 27-28; Langdale, 1978, pp. 154-55). In 1907 they experienced a series of setbacks, when city officials and courts in Boston, New York, Chicago, and Milwaukee imposed conditions delaying entry into these markets. The outcome in New York City was especially damaging, because this market was universally regarded as the "keystone" of the Bell System and of any national toll network (Latzke, 1906, p. 12).

Independents were dealt a second, equally severe blow in 1909, when AT&T acquired the United States Telephone Company. United States operated the largest system of independent exchanges in Ohio and Indiana. Equally important, it had taken the lead in forming a nationwide independent toll network, providing trunk line service. United's successful inroad into the toll market had cut into Bell's profits. In response, AT&T conducted a war of attrition by slashing its toll rates until United relented and sold its properties (Gabel, 1994, pp. 555-60).

The case of United States Telephone illustrates the problems faced by independents in forming an integrated national network. Independents cemented their toll networks through exclusive, long-term contracts, which prohibited defections even if a party joined the Bell network. These arrangements, however, proved to be less effective than common ownership. The contracts were costly to enforce, and in some venues judges considered the arrangements to be an illegal restraint of trade.<sup>39</sup> Thus, when an independent like United States sold out to Bell or signed a sublicense agreement, it often terminated the connection with impunity.

Thwarted in their efforts to build a rival toll network, the leaders of the Independent movement sought relief through the political arena. In late 1908 their national organization lobbied the U.S. Justice Department and state Attorneys General to sue Bell for violating anti-trust statutes.<sup>40</sup> A little more than two years later, the independents began to focus on

obtaining toll interconnection through either negotiations with Bell or legislation, as is evident in the increasing number of states mandating interconnection.<sup>41</sup>

## 6. MANDATORY INTERCONNECTION IN WISCONSIN

Between 1901 and 1909 Bell and independent companies in Wisconsin successfully blocked proposed measures mandating interconnection. In 1911, as was true elsewhere in the country, the independents reversed their previous stance at least in part, and supported a bill requiring interconnection for toll calls. Fearing the loss of goodwill in their local systems, independent companies continued to oppose mandatory interconnection for local traffic.

Wisconsin (Bell) Telephone, by contrast, opposed any form of mandatory interconnection, local or toll. The legislature rejected the firm's appeal and authorized the Railroad Commission to order local or toll interconnection, when required by the "public and convenience." It did, however, respond to the concern of all telephone companies that if not properly priced, interconnection could potentially harm their networks. The legislature required the Commission to insure that interconnection would result in no "irreparable injury" to either side.<sup>42</sup>

The first two major tests of the Wisconsin law occurred between 1912 and 1914. Citizens in La Crosse and Janesville requested the Railroad Commission to order interconnection between the networks of Wisconsin Telephone and their independent company. Petitioners requested only toll interconnection in La Crosse, but both local and toll interconnection in Janesville.<sup>43</sup> Customers in both cities, but especially businesses, justified their request on the basis of public convenience and necessity. In La Crosse, for example, an independent customer, who received a toll call on the Bell network, had to wait an average of thirty minutes to complete the connection. Customers could overcome this obstacle by renting two phones, and 8 percent of the subscribers in the city purchased dual service. Still, physical connection would avoid the expense and nuisance of a second telephone.<sup>44</sup>

In La Crosse the independent company did not object to the petition, whereas the Rock County Telephone Company supported the request of Janesville citizens. In both cases independent firms played a minor role compared to the effort of Wisconsin Telephone.<sup>45</sup> Bell officials denied the "right or authority" of the Commission to order interconnection on the grounds of due process.<sup>46</sup> To support their position, they echoed earlier appeals to the legislature: that connecting to technically inferior facilities could harm their network; that a state agency did not have jurisdiction over interconnection because it might interfere with interstate commerce; and that interconnection would divulge valuable information about customers' demands for toll service, which their competitors could exploit.<sup>47</sup>

Wisconsin Telephone also presented a more novel argument, which the state Supreme Court found "logic[al]," but not compelling. With interconnection, Bell contended, its customers might switch to the "home company" because of their loyalty to small, locally owned enterprises, and not because they offered more efficient service. Furthermore, in La Crosse where only toll interconnection was requested, Bell would lose its strategic advantage in long distance service. Because customers could make toll calls on either network, they would likely switch to La Crosse Telephone, which had a larger subscriber

base. As Wisconsin Telephone vice-president testified, if interconnection were ordered, the subsequent loss of customers would render the firm's plant "useless."<sup>48</sup>

In support of the last argument, Wisconsin Telephone recounted the experience in Canada, after interconnection was mandated in eight cities. The terms of interconnection required Bell's competitors to pay a 15 cents surcharge on calls transmitted along the Bell network. Despite the charge, non-Bell companies continued to enlist new subscribers, whereas the number of Bell stations declined. Bell's toll business, however, flourished, as local companies continued to use its toll facilities.<sup>49</sup>

Before ordering physical connection, the Commission was required to make three decisions: "(1) that the connection is required by public convenience and necessity; (2) that it will not result in irreparable injury to the owner or other users of the facilities of such public utilities; and (3) that no substantial detriment to the service will result therefrom."<sup>50</sup> The Commission found the "term 'public convenience and necessity' . . . indeterminate," but allowed interconnection under the clause, because it would solve the problem of linking customers on the two systems.<sup>51</sup> The Commission also ruled that the facilities of Bell and the independents were technically compatible and therefore that interconnection would not harm either network.<sup>52</sup>

The Commission sought an appropriate charge for interconnection, one that would "preserve the *status quo*" by eliminating any incentive for customers to switch companies.<sup>53</sup> It asked La Crosse Telephone and Wisconsin Telephone to negotiate the rate, but the parties were unable to reach agreement.<sup>54</sup> The Commission, instead, approved a surcharge on originating toll calls based on distance, from 5 cents for calls less than fifty miles in distance to 15 cents for calls over 100 miles. In the case of Janesville it also set a rate of 5 cents per message for local calls requiring interconnection. The revenues from the surcharge would accrue to the company of the called party. These rates, the Commissioners believed, would deter customers with dual service from terminating their contract with one of the companies.<sup>55</sup> Moreover, the arrangement would compensate companies for carrying calls between the two networks and so allayed one of their original concerns.<sup>56</sup>

Recognizing the complexities of the cases, the Commission expressed its willingness to review the rates, if they did not adequately protect the companies' investments. Yet, before the policy even went into effect, Wisconsin Telephone appealed the decision to the state Supreme Court. The court upheld the Commission. In particular, it ruled that "the correctness of this [toll surcharge] should be subjected to the acid test of experience before it is condemned." If it failed that test, then company could appeal the decision to the courts or the Commission.<sup>57</sup>

The data in Tables 2 and 3 reveal the impact of physical connection on the business of Wisconsin Telephone and its competitors. In the La Crosse case the Commission issued its initial decision in May 1913, but only established the terms for interconnection in August of the following year. The two networks were finally linked around November 1914, well before the Supreme Court ruled in 1916 on the constitutionality of the law.

Despite the growth in the La Crosse telephone market during the 1910s, Wisconsin Telephone experienced steady declines in subscribers and market share over the decade. The company blamed early losses on the decision to discontinue its unprofitable annual rate of \$12 per telephone. Yet, after the Commission's decisions in 1913 and 1914, Bell's customers defected at an accelerated pace. Partly in anticipation of greater losses, the firm



in 1915 proposed the sale of its properties to La Crosse Telephone, and concluded the deal in 1918.<sup>58</sup> Thus, in this case, interconnection appears to have fatally weakened Bell's market position. Frank Winter, the initial proponent of interconnection, attributed Bell's decision to exit to its setback in the Supreme Court.

**Table 2** Market Shares in La Crosse Before and After Mandated Interconnection

Year	Number of Subscribers			Market Share	
	Wisconsin	La Crosse	Total	Wisconsin	La Crosse
1910	1855	2996	4851	38.2%	61.8%
1911	1780	3355	5135	34.7%	65.3%
1912	1480	3817	5297	27.9%	72.1%
1913	1384	4201	5585	24.8%	75.2%
1914	1089	4911	6000	18.2%	81.9%
1915	828	5137	5965	13.9%	86.1%
1916	779	5687	6466	12.0%	88.0%
1917	835	6078	6913	12.1%	87.9%
1918	583	6126	6709	8.7%	91.3%
1919	0	6574	6574	0.0%	100.0%

*Sources:* WSHS, Annual Reports of Telephone Companies, series 1337, box 76, 77, 171, and series 1345.

In Janesville, by contrast, mandatory physical connection did not adversely effect the competitive position of either firm. The initial decision, issued in June 1914, went into effect in November of the same year.<sup>59</sup> As the data in Table 3 show, Bell's fear of a massive defection by its customers to the "home" company was unfounded. In fact, at the time Bell had more lines-in-service than the independent, and its subscriber base and market share continued to grow over the rest of the decade. Moreover, the flow of traffic between the two exchanges and so the revenues from interconnection were relatively balanced with the Bell exchange accounting for a slightly larger share of originating toll and local calls (see Table 4). The independent exited the market in 1921, but in this case the decisive factor was public sentiment, which turned against competition and the necessity of interconnection, and not the impact of interconnection per se on the competitive position of the company.<sup>60</sup>

To explain the different outcomes of mandatory interconnection in these Wisconsin cities, we point to two critical factors. First, in La Crosse the Commission only ordered interconnection for toll calls. Once customers with dual service gained access to Bell's toll network, they had little incentive to purchase Bell's local service, unless they made large numbers of toll calls and so would incur additional charges for access.<sup>61</sup> Most, however, switched to the independent, which commanded three-quarters of the local telephone

market. Their defection, in turn, sparked a chain reaction, inducing other Bell subscribers to switch.

**Table 3** Market Shares in Janesville Before and After Mandated Interconnection

Year	Number of Subscribers			Market Share	
	Wisconsin	Rock County	Total	Wisconsin	Rock County
1910	1320	1864	3184	41.5%	58.5%
1911	1390	1905	3295	42.2%	57.8%
1912	1769	1938	3707	47.7%	52.3%
1913	1985	1942	3927	50.5%	49.5%
1914	2189	2043	4232	51.7%	48.3%
1915	2281	2108	4389	52.0%	48.0%
1916	2410	2081	4491	53.7%	46.3%
1917	2398	2026	4424	54.2%	45.8%
1918	2409	1976	4385	54.9%	45.1%
1919	2761	2057	4818	57.3%	42.7%
1920	3133	2147	5280	59.3%	40.7%
1921	5019	2126	7145	70.2%	29.8%
1922	4209	0	4209	100.0%	0.0%

*Notes:* Wisconsin Bell acquired Rock County Telephone on 30 November 1921. The former's 5,019 customers in 1921 includes the 2,126 subscribers of the latter. *Sources:* WSHS, Annual Reports of Telephone Companies, series 1337, box 170, and series 1345.

**Table 4** Interchange of Traffic in Janesville under Mandatory Interconnection

Originating Network	Terminating Network	Total Calls
<i>Toll Calls</i>		
Independent	Bell	156
Bell	Independent	204
<i>Local Calls</i>		
Independent	Bell	839
Bell	Independent	900

*Sources:* AT&TCA, box 31, Sunny/Kingsbury, 16 July 1915.

In Janesville customers had less incentive to change companies, because the Commission mandated both local and toll connections. Still, by switching to one system—either Bell or the independent—customers could have avoided the nickel surcharge on the interchange of local traffic. At the time, however, the two companies had almost equal shares of the local market and evinced considerable staying power. Consequently, consumers could not readily determine which, if either, would prevail. Thus, bolstered by its toll network and large subscriber base, the Bell exchange flourished after mandatory interconnection.

## 7. COMPETITION AND INTERCONNECTION: A HISTORICAL PERSPECTIVE

As the experience in La Crosse attests, interconnection fundamentally altered the terms of competition between rivals. Prior to interconnection, Wisconsin Telephone could leverage the advantage of its parent company in the long distance market to gain rents on local service. As Bell extended and improved its toll network, local exchanges were able to raise rates and still expand their subscriber base. After mandated interconnection, however, customers could choose the more efficient local exchange carrier and still have access to Bell's long distance market.

In this case, then, interconnection promoted a more efficient outcome in the local exchange market by in effect evening the playing field between local carriers. When viewed from a more dynamic perspective, the conclusion is less clear. If adopted nationwide, mandatory interconnection would have forced AT&T to garner the returns on its investments in the long distance network through toll rates *and* the surcharge paid by independent customers, who used Bell toll services. If these rates did not yield a sufficient return, the policy of mandatory interconnection would have tempered Bell's incentive to innovate in this area.<sup>62</sup>

The Wisconsin cases also illustrate the difficult balancing act, which regulatory commissions faced in setting access charges. The Railroad Commission sought a rate that would prevent large numbers of customers from switching companies and thereby induce others to jump on the bandwagon.<sup>63</sup> On the other hand, it did not want to make interconnection prohibitively expensive and so undermine the policy's intended benefits. In La Crosse the Commission stumbled, or as is more likely the case, the conditions of partial interconnection and a dominant firm meant that no such price existed. This very concern, it seems, led Wisconsin Telephone to sell its exchange property. In Janesville the absence of a dominant firm and the broader form of interconnection enabled the Commission to set an access price, which yielded the benefits of interconnection and still preserved the *status quo*.

Regulatory commissions today are still charged with maintaining the *status quo*.<sup>64</sup> In the current context, however, this criterion would imply an entry-prevention price, reinforcing the dominant position of incumbents in the local exchange market.<sup>65</sup> At the same time, our analysis questions the alternative policy of pricing access according to cost. Such a policy, we find, runs counter to the practice of competitive firms in network industries. To finance the expansion of their networks, firms at the turn of the century

adopted elaborate schemes of price discrimination, through which core users “subsidized” access to more marginal ones. This practice enhanced the value of the network to core users, in effect justifying the higher prices which they paid.

If regulatory commissions set access prices according to incremental cost, they would treat entrants like the incumbents’ marginal users. Such a policy would surely further the goal of competition by furnishing entrants with low-cost access to the incumbents’ core customers. If incumbents respond in kind, they would be forced to shift the fixed costs of maintaining and improving their networks to small marginal users, who by definition derive minimal benefit from their services (Brock, 1993). Consequently, such a policy might lead to the unraveling of local networks, and jeopardize not only the political goal of universal service, but the extensive connections, which core customers demand. It would also lead to rates that do not reflect truly competitive behavior.

## REFERENCES

- Aronson, Sidney H. (1977). "Bell's Electrical Toy: What's the Use? The Sociology of Early Telephone Usage." In Ithiel de Sola Pool, ed., *The Social Impact of the Telephone*. Cambridge, MA: MIT Press, 15-39.
- Barnett, William P. and Glenn R. Carroll (1993). "How Institutional Constraints Affected the Organization of Early U.S. Telephony." *Journal of Law, Economics and Organization* 9, 98-126.
- Baumol, William J. and Robert D. Willig (1992). "Economic Principles for Evaluation of the Issues Raised by Clear Communications Ltd. on Interconnection with Telecom Corporation of New Zealand, Ltd."
- Baumol, William J. and J. Gregory Sidak (1994). *Toward Competition in Local Telephony*. Cambridge, MA: MIT Press.
- Beilock, Richard (1985). "Is Regulation Necessary for Value-of-Service Pricing?" *Rand Journal of Economics* 16, 93-102.
- Borenstein, Severin (1985). "Price Discrimination in Free-Entry Markets." *Rand Journal of Economics* 16, 389-97.
- Borenstein, Severin and Nancy Rose (1994). "Competition and Price Dispersion in the U.S. Airline Industry." *Journal of Political Economy* 102, 653-83.
- Bornholz, Robert and David S. Evans (1983). "The Early History of Competition in the Telephone Industry." In David S. Evans, ed., *Breaking Up Bell: Essays on Industrial Organization*. New York: North-Holland, 8-40.
- Brock, Gerald (1993). "Interconnection Conditions, Access Charges, and Universal Service." Paper Presented at the Telecommunications Policy Research Conference.
- Chicago City Council, Committee on Gas, Oil and Electric Light (1907). *Telephone Service and Rates*. Chicago: n.p.
- Fagen, M.D., ed. (1975). *A History of Science and Engineering in the Bell System: The Early Years (1875-1925)*. N.p.: Bell Telephone Laboratories.
- Farrell, Joseph and Garth Saloner (1986). "Installed Base and Compatibility: Innovation, Product Preannouncements, and Predation." *American Economic Review* 76, 940-55.
- Fischer, Claude and Glenn R. Carroll (1988). "Telephone and Automobile Diffusion in the United States, 1902-1937." *American Journal of Sociology* 93, 1153-78.

- Fischer, Claude S. (1992). *America Calling: A Social History of the Telephone to 1940*. Berkeley: University of California Press.
- Gabel, David (1994). "Competition in a Network Industry: The Telephone Industry, 1894-1910." *Journal of Economic History* 54, 543-72.
- Gabel, Richard (1967). *Development of Separations Principles in the Telephone Industry*. East Lansing: Michigan State University Press.
- Galambos, Louis (1992). "Theodore N. Vail and the Role of Innovation in the Modern Bell System." *Business History Review* 66, 95-126.
- Garnet, Robert W. (1985). *The Telephone Enterprise: The Evolution of Bell's Horizontal Structure*. Baltimore: Johns Hopkins University Press.
- Greenstein, Shane M. (1993). "Invisible Hands Versus Invisible Advisors: Coordination Mechanisms in Economic Networks." Bureau of Economic and Business Research, University of Illinois at Urbana-Champaign, Faculty Working Papers Series 93-0111.
- Katz, Michael L. and Carl Shapiro (1986). "Technology Adoption in the Presence of Network Externalities." *Journal of Political Economy* 91, 424-40.
- Kellog, Michael K., John Thorne, and Peter W. Huber (1992). *Federal Telecommunications Law*. Boston: Little, Brown.
- Langdale, John (1978). "The Growth of Long-Distance Telephony in the Bell System, 1875-1907." *Journal of Historical Geography* 4, 145-59.
- Latzke, Paul (1906). *A Fight With an Octopus*. Chicago: Telephony Publishing Co.
- Levings, S.D. (1909). "The Development Study." *Telephony* 17 (March 6), 275-76.
- Lipartito, Kenneth (1992). "Marketing the Telephone: Bell's Response to the Consumer Society."
- Lipartito, Kenneth (1989a). *The Bell System and Regional Business: The Telephone in the South, 1877-1920*. Baltimore: Johns Hopkins University Press.
- Lipartito, Kenneth (1989b). "Building on the Margin: The Problem of Public Choice in the Telephone Industry." *Journal of Economic History* 49, 323-36.
- MacMeal, Harry B. (1934). *The Story of Independent Telephony*. Chicago: Independent Pioneer Telephone Association.
- Mayer, Martin (1977). "The Telephone and the Uses of Time." In Ithiel de Sola Pool, ed., *The Social Impact of the Telephone*. Cambridge, MA: MIT Press, 225-45.

- Merchants' Association of New York (1905). *Inquiry into Telephone Service and Rates in New York City*. New York: n.p.
- Mitchell, Bridger M. and Ingo Vogelsang (1992). *Telecommunications Pricing: Theory and Practice*. New York: Cambridge University Press.
- Moyer, Alan J. (1977). "Urban Growth and the Development of the Telephone: Some Relationships at the Turn of the Century." In Ithiel de Sola Pool, ed., *The Social Impact of the Telephone*. Cambridge, MA: MIT Press, 342-69.
- Mueller, Milton L. (1993). "Universal Service in the Telephone Industry: A Reconstruction." *Telecommunications Policy* 17, 352-69.
- Mueller, Milton L. (1989a). "The Switchboard Problem: Scale, Signaling, and Organization in Manual Switching, 1877-1897." *Technology and Culture* 30, 534-60.
- Mueller, Milton L. (1989b). "The Telephone War: Interconnection, Competition, and Monopoly in the Making of Universal Telephone Service, 1894-1920." Ph.D. diss., University of Pennsylvania.
- National Civic Federation (1913). "Compilation and Analysis of Laws of Forty-Three States for the Regulation of Central Commissions of Railroad and other Public Utilities."
- New York State Legislature, Joint Committee to Investigate Telegraph and Telephone Companies (1915). *Final Report*. Albany: J.B. Lyon Company.
- Nix, Joan and David Gabel (1993). "AT&T's Strategic Response to Competition: Why Not Preempt Entry?" *Journal of Economic History* 53, 377-87.
- Pool, Ithiel de Sola, et al. (1977). "Foresight and Hindsight: The Case of the Telephone." In Ithiel de Sola Pool, ed., *The Social Impact of the Telephone*. Cambridge, MA: MIT Press, 127-57.
- Richter, F.E. (1925). "The Telephone as an Economic Instrument." *Bell System Quarterly* 4, 281-95.
- Rohlf, Jeffrey (1974). "A Theory of Interdependent Demand for a Communication Service." *Bell Journal of Economics* 5, 16-37.
- Simpson, Floyd Robert (1944). "Monopoly Building Techniques, Costs, Prices and Market Structure in the Telephone Industry." Ph.D. diss., University of Minnesota.
- Stehman, J. Warren (1925). *The Financial History of the American Telephone and Telegraph Company*. New York: Houghton Mifflin.

- Sylla, Richard (1975). "The Development of Telephony and Telephone Regulation in North Carolina—An Analytical Historical Survey."
- Talley, Wayne (1989). "Joint Cost and Competitive Value-of-Service Pricing." *International Journal of Transport Economics* 16, 119-30.
- U.S. Bureau of the Census (1975). *Historical Statistics of the United States, Part 2*. Washington, D.C.: GPO.
- U.S. Bureau of the Census (1910). *Telephones: 1907*. Washington, D.C.: GPO.
- U.S. Federal Communications Commission (1938). *Proposed Report: Telephone Investigation*. Washington, D.C.: GPO.
- Walker, Walker and Jonathan Solomon (1993). "The Interconnection Imperative: 'E Pluribus Unum'." *Telecommunications Policy* 17, 257-80.
- Weiman, David F. (1994). "Planning the Bell System: The Cumulative Dynamics of Urban and Regional Development."
- Weiman, David F. and Richard C. Levin (1994). "Preying for Monopoly? The Case of Southern Bell Telephone, 1894-1912." *Journal of Political Economy* 102, 103-26.
- Whitcomb, Richard (1929). "The Key Town Plan of Selling by Telephone." *Bell System Quarterly* 8, 47-58.
- Winter, Winter (n.d.). "The Fight for Physical Connection of Telephone Systems." *La Crosse County (Wisconsin) Historical Sketches*, Series 4, No. 8 (La Crosse Telephone Company Archives).



## NOTES

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2. For example, the presence of fixed costs, network externalities, or other sources of increasing returns may cause prices to deviate from marginal costs. In particular, competitive firms in network industries have an incentive to price their products aggressively, that is below cost, at the onset to achieve a critical mass and earn monopoly rents later on. Moreover, under these conditions, cost-based prices may not maximize social welfare. To address these problems, economists have formulated a plethora of “Ramsey” pricing rules, which specify “optimal” departures from marginal cost pricing; see Mitchell and Vogelsang (1992).
3. For recent theoretical and empirical analysis of price discrimination under rivalry, see Borenstein (1985), Beilock (1985), Talley (1989), and Borenstein and Rose (1994).
4. According to Kellog, Thorne, and Huber (1992), pp. 13-14, 156-57, with the exception of the Kingsbury Agreement, no state or federal agencies mandated interconnection between competing telephone networks before the 1970s. State and federal courts, they argue, required suppliers to provide service without discrimination to end-users, but did not grant similar network access to rival companies. They have overlooked some important regulatory actions taken in the first quarter of the twentieth century. The Courts ruled that although common carrier obligations did not extend to rivals, equal access could be mandated by law; see *Evansville & H. Traction Co. v. Henderson Bridge Co.*, 134 F 973, 978 (1904); *affirmed* 141 F 51 (1905).
5. Winter (n.d.), p. 70; National Civic Federation (1913), pp. 318-325, 593-95. Wisconsin also served as a model for the Bell System. Company officials observed the impact of interconnection on Bell’s operations in Wisconsin and used the experience to formulate policy in other jurisdictions; AT&T Corporate Archives (AT&TCA), box 31, Sunny/Kingsbury, 16 July 1915.
6. The data come from the Annual Reports of the AT&T Company, 1909-1914; see also the Annual Report, 1909, pp. 22-28. On the impact of royalty charges on the costs of Bell operating companies, see Stehman (1925), pp. 26-27; and Bornholz and Evans (1983), p. 121.
7. The data for Figures 2 are taken from U.S. Bureau of the Census (1975), series R1-12. Fischer and Carroll (1988) identify the factors influencing the diffusion of the telephone over time and space.
8. Sublicensed companies were only connected to, not owned by, AT&T.

9. Garnet (1985), pp. 128-54; and Galambos (1992). On the evolution of the term universal service, see Mueller (1993).
10. See the essay by David Balto in chapter 9 of this volume, which makes a similar argument about the impact of interconnection in the credit card market.
11. AT&TCA, box 1259, E.J. Hall, Long Distance Telephone Work, 1887.
12. U.S. Bureau of the Census (1910), pp. 74-75, 80; Aronson (1977), pp. 29-31; Moyer (1977), pp. 357-65; and Fischer (1992), chs. 7-8.
13. AT&TCA, Book Collection, Telephone Switchboard Conference, 15-18 March 1892, pp. 274-82. The evidence may understate the “social” demands of households, because it dates from the period of Bell’s patent monopoly and so reflects the company’s conscious marketing strategy to suppress what they deemed the frivolous use of the telephone. Still, it vividly demonstrates the wide variation in usage among businesses.
14. New York State Legislature, Joint Committee to Investigate Telegraph and Telephone Companies (1915). New York customers selected an exchange pricing plan according to their expected number of annual calls. The data in Figure 5 differentiate subscribers by their anticipated, not actual, usage, but presumably reveal trends in their annual calling.
15. In New York (and other large centers) local service did not cover the entire city. The size of the local calling area varied by zone and type of service. For interexchange calls within the city limits, subscribers paid a toll of 5 or 10 cents depending on the distance. See Merchants’ Association of New York (1905), pp. 24-26; Chicago City Council, Committee on Gas, Oil and Electric Light (1907), pp. 22-23, 172-76.
16. New York was divided into 11 zones: 1) Manhattan; 2) south Bronx; 3) the rest of the Bronx; 4-6) eastern Queens and Brooklyn; 7-9) the rest of Queens; 10-11) Staten Island.
17. New York State Legislature, Joint Committee to Investigate Telegraph and Telephone Companies (1915), pp. 488-89; Richter (1925), pp. 288-89.
18. According to Bemis, the exchange area should encompass the “entire economic life” of city residents by embracing, for example, the commuting range of households; New York State Legislature, Joint Committee to Investigate Telegraph and Telephone Companies (1915), p. 494.
19. AT&TCA, box 1285, AT&T Co., Toll Line Service, 1892-1896, Doolittle/Davis, 4 June 1896. For an analysis of Doolittle’s model and its implications, see Weiman (1994), sects. 1-2.
20. According to Doolittle, demand interdependence was weaker at the local level because of the limited scope of residential demands. Business customers, however, demanded extensive connections within and beyond city limits. See Weiman (1994), pp. 8-12.

21. AT&TCA, box 1309, AT&T Co., *Relation between Population and Rates*, 1906, Smith/Abott, 12 May 1906; and Mueller (1989a), pp. 534-60. To furnish long distance connections, operating companies also had to install higher quality, more costly facilities, such as two-wire copper circuits; Gabel (1967), pp. 31-34; Fagen (1975), pp. 74-103, 233-34, 488-89; and Lipartito (1989a), pp. 69-72.
22. AT&TCA, box 1309, *Relationship between Population and Rates* 1906, Ford/Fish, 24 May 1906 (emphasis added). AT&T did take cost into account. Its engineers and accountants grouped cities according to population or subscriber base, and estimated the cost of a typical city within each group, which they used in setting rates. They did not undertake cost and demand studies for each city within the groupings.
23. Aronson (1977), p. 25; Pool et al. (1977), p. 130. According to Moyer (1977), p. 350, "In some exchanges, there were almost as many rates as subscribers."
24. On the strategy of the independents, see Mueller (1989b), pp. 180-81; Lipartito (1989a), pp. 90-91; Weiman and Levin (1994), pp. 106-08; and Gabel (1994), pp. 546-49.
25. Sylla (1975), p. 33, shows the evolution of business and residential rates in North Carolina between 1893 and 1898. Southern Bell Telephone lowered business rates by one-half and residential rates by 60 percent.
26. Annual Report of the AT&T Company 1907, pp. 19-21; and Moyer (1977), p. 351.
27. AT&TCA, box 1309, E.J. Hall, *Industrial Commission Hearings*, 1901; Garnet (1985), p. 76; and Nix and Gabel (1993), pp. 378-81.
28. AT&TCA box 1285, *Toll Service, 1897-1898*, Doolittle/Hudson, 25 May 1898; Annual Report of the American Bell Telephone Company, 1894, p. 11; 1896, p. 10; 1897, p. 8; Annual Report of the AT&T Company, 1900, p. 9; and *American Telephone Journal* 12 (30 December 1905), p. 45. As Doolittle candidly remarked, "the general adoption of this [measured service], it is claimed, will make the \$240 flat rate appear as a commuted rate and be looked upon as a concession instead of an extortion. This is an exceedingly optimistic view, but it may so work out."
29. Merchants' Association of New York (1905), pp. 51-53; Chicago City Council, Committee on Gas, Oil, and Electric Light (1907), pp. 172-73; New York State Assembly, Joint Committee to Investigate Telegraph and Telephone Companies (1915), pp. 44-48.
30. Chicago City Council, Committee on Gas, Oil, and Electric Light (1907), p. 22. The New York State Assembly, Joint Committee to Investigate Telegraph and Telephone Companies (1915), pp. 36-37, offered a similar assessment: "These flat rates for residences outside of Manhattan have an important place. They encourage the development of the telephone among people who have little use for sending messages many miles from their residences, and who can only afford the low rates which a neighborhood residence service can give."

31. See, for example, U.S. Bureau of the Census (1910), p. 74; Lipartito (1992), p. 15; and Weiman (1994), pp. 15-16.

32. On the relationship between market structure, market share, and the standards-setting process, see, Greenstein (1993), pp. 5-21.

33. Annual Report of the AT&T Company, 1908, p. 19.

34. AT&TCA, box 66, Sub-Licensing Policy, 1907-1908, Hall/French, 16 May 1908. See also Lipartito (1989b), pp. 330-31.

35. In a 1909 report on Southern Bell, Doolittle would take this logic one step further. "As a general proposition," he remarked, "each sublicensed or independent system should be kept separate from every other such system by one or more intervening Southern Bell exchanges." AT&TCA, box 2026, Toll Traffic Matters, 1909, Doolittle/Carty, 14 July 1909.

36. AT&TCA, box 66, Sub-Licensing Policy, 1907-1908, Hall/French, 16 May 1908. Emphasis added.

37. Under Hall's leadership, Southern Bell successfully used sublicensing to consolidate the company's network and to close the gap between its rates and those of the independents. See, for example, AT&TCA, box 1263, SBT&T Co., Sub-License Contracts, Southern Bell Telephone and Telegraph Company, 1898-1899, Easterlin/Wilson, 26 September 1898; Wilson/Hall, 9 February 1899; box 1340, SBT&T Co., Acquisitions and Sale of Exchanges in North Carolina, 1903, Gentry/French, 16 July 1903; SBT&T Co., Sub-Licenses, 1900, Wilson/French, 21 September 1900.

38. AT&TCA, box 66, Sub-Licensing Policy, 1907-1908, Hall/French, 16 May 1908; box 1340, SBT&T Co., Acquisition of Independent Companies, 1897-1901, Hall/Cochrane, 6 March 1901; Acquisition of Independent Companies, 1902-1911, Gentry/Hall, 13 October 1909; and box 2026, Toll Traffic Matters, 1909, Doolittle/Carty, 14 July 1909.

39. *Union Trust v. Kinloch Long Distance Telephone*, 258 Illinois 202 (1913); and *U.S. Telephone v. Central Union Telephone, et al.*, 202 Fed 66 (1913). Other courts concluded that exclusive toll contracts promoted competition and therefore did not violate state anti-trust laws. See, for example, *U.S. Telephone v. Middlepoint Home Telephone*, 86 Ohio 319 (1912); *Home Telephone Co. v. Sarxocie Light and Telephone Co.*, 236 Mo. 114; *Cumberland Telephone and Telegraph Company v. State*, 100 Miss. 102.

40. *Telephony* 17 (9 January 1909), p. 34; Wisconsin State Telephone Association Archives, (Madison, Wisconsin), J.B. Ware/W.F. Goodrich, 14 November 1908.

41. See the extensive debate in volume 60 (1911) of *Telephony*, especially the 4 March 1911 issue; and MacMeal (1934), p. 186. For evidence on the timing of state interconnection laws, see U.S. Federal Communications Commission (1938), p. 153; and

Barnett and Carroll (1993), pp. 108-09. While most states granted broad regulatory authority to Commissions, there were some exceptions. Commissions in Arizona (Sess. Laws 1912, ch. 90, sec. 40) and California (Stats. 1911, ch. 14, sec. 40) did not have the authority to compel interconnection in the local exchange market. The Michigan statute (Pub. Acts 911, no. 138, sec. 6) was unusual, because it set the price of access: "Any telephone corporation which is required to perform switching service for another telephone corporation under the terms of such an [interconnection] order may demand and receive as compensation for such service the sum of five cents per message in addition to the regular service charge, if any."

42. Chapter 546, *1911 Laws of Wisconsin* (quotation); and *Milwaukee Journal* (9 June 1911).

43. *Frank Winter v. La Crosse Telephone Company and Wisconsin Telephone Company* (hereafter "Winter"), U-317, 11 Wisconsin Railroad Commission Reports 748 (1913); and *E.D. McGowan v. Rock County Telephone Company and Wisconsin Telephone Company* (hereafter "McGowan"), U-500, 14 Wisconsin Railroad Commission Reports 529 (1914). The issues resolved in these two cases, especially the Winter case, established legal and pricing precedents for subsequent cases. See, for example, Wisconsin Telephone/Commercial Club of Ashland, 11 April 1917 in the case file *Commercial Club of Ashland v. Ashland Telephone Company and Wisconsin Telephone Company* (U-1066), 19 Wisconsin Railroad Commission Reports 281 (1917).

44. Wisconsin State Historical Society (WSHS), "Winter," hearings 3 January 1912, pp. 3, 20; and 27 May 1912, p. 13; and "McGowan," p. 537, and hearing 2 July 1913, p. 22-23.

45. WSHS, "Winter," hearings 3 January 1912, p. 3; 20 May 1912; and 27 May 1912, p. 13; and Brief of Wisconsin Telephone Company (n.d.), pp. 3, 7; "McGowan," p. 537, and hearing 2 July 1913, pp. 22-23.

46. The Company argued that "any order made, directing such physical connection to be made [would] deny the . . . Company the equal protection of the law and of trial by jury, and [would] be taking of its properties without due process of law and without due compensation;" Railroad Commission decision in WSHS, "Winter," U-317, p. 2.

47. WSHS, "Winter," Brief of Wisconsin Telephone Company, p. 4; hearing 27 May 1912, tr. 57, 125, and 130.

48. 162 Wisconsin Reports 383, 398, 156 N.W. 614, L.R.A. 1916E 748; WSHS, "Winter," hearing 27 May 1912, p. 33; and 28 May 1912, pp. 135 (quotation), 163; Brief of Wisconsin Telephone Company, p. 27; and "McGowan," hearing 13 July 1914, p. 7. Without local interconnection customers could obtain local universal service only by switching to the same company. Bell anticipated that customers would choose the company with the more valuable local network, that is with the larger subscriber base.

49. WSHS, "Winter," exhibit 106, and hearing 27 May 1912, p. 108.

50. WSHS, "Winter," decision 14 May 1913, p. 9.

51. WSHS, "Winter," decision 14 May 1913, pp. 4-5, 10. When the Supreme Court reviewed this case, it pointed out that physical connection would be convenient to customers, but that convenience does not imply necessity. The court defined necessity as "indispensable," and concluded that physical connection did not meet this criterion. In approving the Commission's decision, however, the court conceded that its rigid construction of necessity would likely rule out any order of interconnection. The court, therefore, "construed necessity to mean not absolute but reasonable necessity." *Wisconsin Telephone Company v. Railroad Commission of Wisconsin and others*, 162 Wisconsin Reports 383, 396 (1916).

52. WSHS, "Winter," decision 14 May 1913, p. 5. Also see the testimony of Wisconsin Telephone engineer L. Killam, hearing 3 January 1912, pp. 36-37; "McGowan," P.B. Turner/Commissioner Roemer, 22 May 1914; and Robert Conner et. al. v. J.C. March and Wisconsin Telephone Company, 6 Wisconsin Railroad Commission Reports, 589, 598-99 (1911).

53. WSHS, "McGowan," p. 538.

54. The Commission specifically rejected Wisconsin Telephone's proposal, made under protest, of 50 cents per month for any customer desiring interconnection plus 15 cents for each originating or terminating toll message. More recently, incumbent and entrants have been unable to reach private agreements on pricing access, and so have found government intervention necessary. See Walker and Solomon (1993).

55. The charge for local interconnection in Janesville was apparently based on the price of a call on a pay station, 5 cents. It had been recommended by Rock County Telephone. WSHS, "McGowan," hearing 23 July 1914, p. 19; "Winter," hearing 13 October 1913, p. 46; and *Winter v. La Crosse Telephone Company and Wisconsin Telephone Company*, 15 Wisconsin Railroad Commission Reports (1913), pp. 36, 39-40. This pricing structure, in which customers paid more for a call that crossed networks than originated and terminated on the same network, was subsequently adopted in the Kingsbury agreement. The Kingsbury agreement only covered toll calls more than 50 miles in length, and required the customer to pay a 10 cents surcharge. See Simpson (1944), citing the U.S. Federal Communications Commission, *Investigation of the Telephone Industry—Control of Independent Telephone Companies*, Exhibit 2096D, pp. 37-41.

56. Dane County Telephone Company Papers, C.W. Twining/J.C. Harper, 22 August 1899; and Harper/Twining, 22 October 1899. See also Annual Report of the AT&T Co., 1910, p. 45.

57. *Winter v. La Crosse Telephone Company and Wisconsin Telephone Company*, 15 Wisconsin Railroad Commission Reports (1913), p. 40; and *Wisconsin Telephone*

*Company v. Railroad Commission of Wisconsin and Others*, 162 Wisconsin Reports 383, 401-02 (1916).

58. La Crosse Telephone Company Archives (La Crosse, Wisconsin), La Crosse Telephone Company/Railroad Commission of Wisconsin, 24 June 1915; and Winter (n.d.), p. 71. As early as July 1913 (before the physical connection of the two plants, but after the Commission had issued its decision in the Winter case), Wisconsin Telephone made plans to sell its La Crosse properties; AT&TCA, box 31, Kingsbury/B.E. Sunny, President of Wisconsin Telephone, 9 July 1913.

59. AT&TCA, box 31, Sunny/Kingsbury, 16 July 1915.

60. WSHS, U-2311, series 1265, Fred Howe/Wisconsin Railroad Commission, 21 January 1921, and Roger Cunningham, City Attorney of Janesville/Wisconsin Railroad Commission, 21 February 1921; and U.S. Interstate Commerce Commission Finance Docket No. 162, 15 November 1921, Joint Application of Rock County Telephone Company and Wisconsin Telephone Company for Certificate that Acquisition Will be in the Public Interest, pp. 2-3, in 70 U.S. Interstate Commerce Commission 636-638; and *Janesville Gazette* (13 May 1921).

61. AT&TCA, box 31, Sunny/Kingsbury, 16 July 1915.

62. The net effect of mandatory interconnection on AT&T cannot be determined theoretically, because the negative impact of higher toll rates and access charges on demand are offset by the positive externalities from increasing the number of telephone users with access to Bell's long distance network. Moreover, interconnection may not deter innovation during a period of rapid technological change. If a firm does not strive to develop and introduce new products, they may quickly lose their market share.

In general, regulators must trade-off the potential dynamic gains of innovation by monopoly, vertically integrated innovators with the dynamic gains from competition. To date, the federal government has concluded that the latter overwhelm the former. This issue was litigated in the 1974 anti-trust case. More recently, the Federal Communications Commission endorsed the gains from rivalry in its decision to approve local interconnection. See U.S. Federal Communications Commission, *In the Matter of Expanded Interconnection with Local Telephone Company Facilities*, CC Docket No. 91-141, Released 19 October 1992, paragraph 2.

63. WSHS, "Winter," decision 14 May 1913, p. 9; "McGowan," p. 538.

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

65. In the current context pricing access on a residual basis or efficient component pricing would lead to the same outcome. See Baumol and Willig (1992) and chapter 6 by Milton Mueller in this volume for a fuller discussion of efficient component pricing.