

Bits of Power: The involvement of municipal electric utilities in broadband services
by

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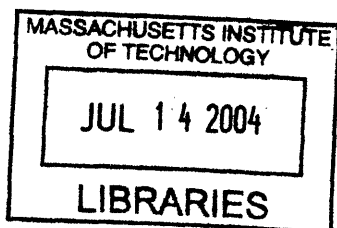
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Abstract

Municipal electric utilities have been increasingly involved in telecommunications during the last decade. This research investigates why, with three hypotheses. First, the probability of MEUs involvement in telecommunications responds to technology-based economies of scope from internal services deployed to support their power business. Second, MEUs' likelihood for offering telecommunication services decreases in presence of restrictive regulatory framework and low levels of local discretionary authority (LDA). Third, MEUs involvement in telecommunications decreases in the presence of competitive alternatives. The hypotheses are tested using quantitative response models, controlling for deployment cost and demographic characteristics.

Results confirm the existence of a technology-push generated by economies of scope between internal services supporting the power business and offering external telecommunication services. One reason for this, as qualitative analysis supports, would be the uniqueness of MEU communities as resulting from historical and technological path-dependence, which makes the MEU phenomenon unlikely to be repeated by local governments in non-MEU communities. Additionally, results support that MEUs' likelihood for offering telecommunication services is reduced by regulations explicitly prohibiting it, but shows that low LDA, as measured by Dillon's Rule, does not have a significant effect.

Results show a complex effect for competition. MEUs likelihood for offering telecom services in residential markets decreases with cable modem competition, but their activity in business market increases with competition from DSL. This suggests that MEUs' services substitute for cable television companies', but are non-redundant relative to telephone companies. Results support the need for further research, especially in competition and deployment dynamics and their effects.

Based on these results, the recent US Supreme Court decision on *Nixon vs. Missouri Municipal League* and stakeholder analysis suggest various policy implications. First, APPA and MEUs need to build a broader coalition for active lobbying the US Congress for clarification on Section 253(a) of the Telecommunications Act of 1996, and states' legislatures for passing explicit authorizations for MEUs' involvement in telecommunications. Second, states and MEUs need to assess how banning MEUs from telecommunications would affect the reliability of power distribution and underserved areas. Finally, states, MEUs and private parties would need to

better understand, evaluate and innovate in policies and public-private collaborative initiatives for taking advantage of the mutual potential benefits existing between power distribution and telecommunication services.

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*To Magdalena,
for her love, patience, strength and support during the development of this thesis,
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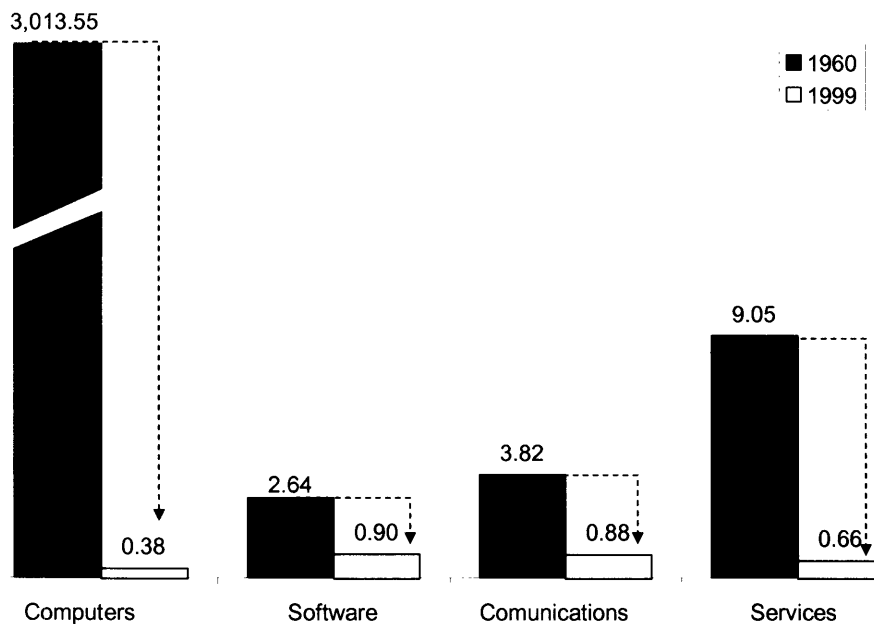
1 Introduction

This chapter presents a picture of broadband adoption in the United States, and a brief analysis comparing it to other OECD countries. It later introduces the general objectives and justification of this research and, given this, presents a literature review. Finally, it presents an overview of the different chapters, and summarizes the major findings and recommendations.

1.1 The Relevance of the Broadband Question and the Municipal Role

In his Presidential Address to the American Economic Association, Jorgenson (2001) addressed the reasons for the increasing effect that information and communication technologies are having on productivity and American economic growth. His analysis shows, among other things, a high decrease in the relative price of computers during the last four decades, compared to software, services and communications.

Figure 1: Change in Relative Price of IT, 1960-1999

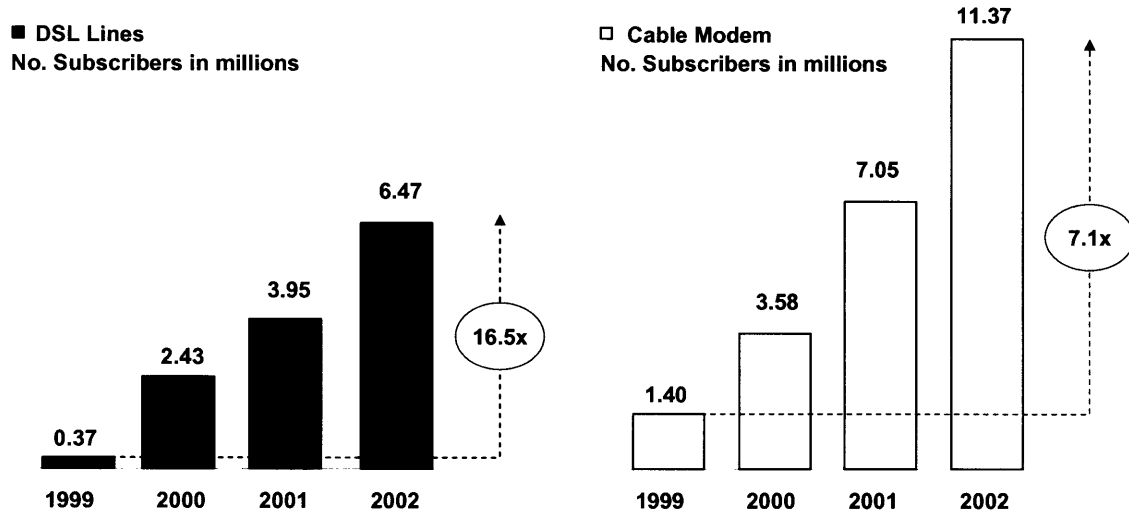


Source: the author, based on Jorgenson (2001)

As Figure 1 shows, the relative cost of computers has decreased by more than 8,000 times, while the relative cost of communications by only four times. In this context, however, high-speed Internet access is expected to show little economic effect so far given it is affordable option only since the mid of the nineties, but there is growing consensus about its potential effect on economic growth (NRC 2002, OECD 2003 and Crandall, Hahn and Tardiff 2002). Litan and Rivlin (2001), for instance, have estimated an annual direct effect from broadband to business efficiency of between \$100 and \$250 billions.

Broadband access technologies have been rapidly adopted in the United States, mostly among households and small firms. In aggregated terms, DSL and Cable Modem lines in the US have skyrocket since 1999; with growth of more than 16 and 7 times respectively (See Figure 2). Thus, America has been among the leading OECD (2003) nations in broadband adoption.

Figure 2: Growth of DSL and Cable Modem in the United States, 1999-2002



Source: the author based on FCC (2003)

Cable modem subscribers are relatively more important than DSL, almost doubling them by 2002 as reported by FCC (2003), which main reason can be found in the earlier availability of cable modem.

Despite the rapid diffusion of broadband in the US, its penetration is still very heterogeneous. According to Nielsen/NetRatings, in 2001, 45% of all broadband users were concentrated in ten metropolitan areas¹. Figure 3 helps illustrate this point, as well as the relatively fast penetration of high-speed operators by ZIP Code in the United States between 1999 and the end of 2002. The areas in the maps are shaded whether the number of providers is between one and three, between four and six, or above seven.

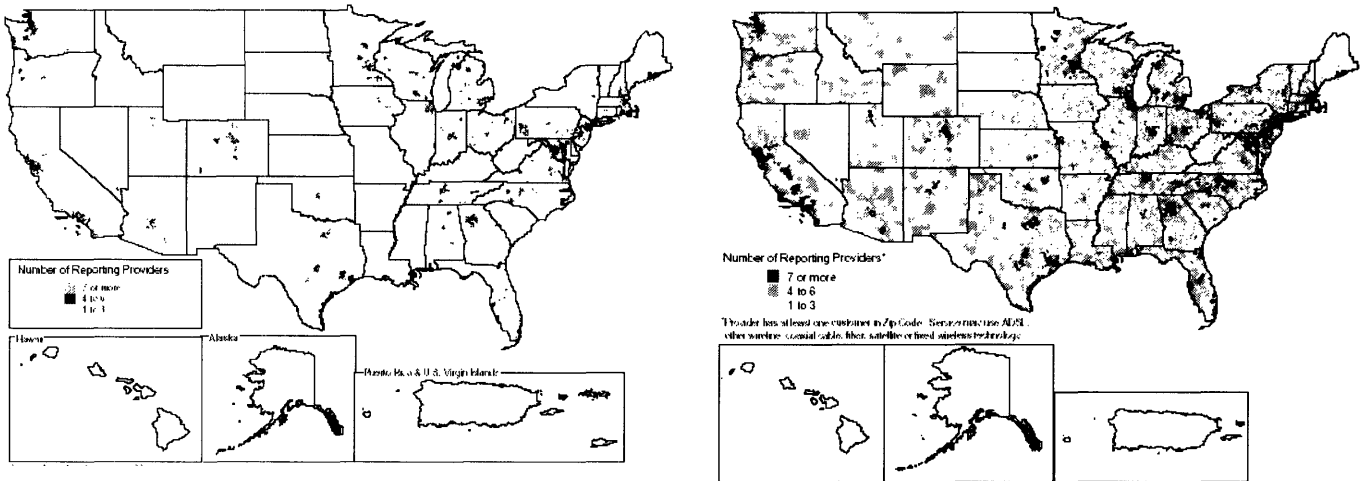
In 1999, the Intermountain West, and Northern and Central Plains, in the Midwest, were the areas with lower availability of high-speed lines providers. At that time, competition was also very low as most of the US had between one and three providers per ZIP Codes, when available. By the end of 2002, the Midwest continues to seem underserved and competition has

¹ See http://cyberatlas.internet.com/markets/broadband/article/0,,10099_766351,00.html. The ten cities were New York, Los Angeles, San Francisco, Boston, Seattle, Dallas, Chicago, Philadelphia, San Diego and Detroit.

shown to be located only in certain places. In terms of competition, the greater changes are perceived in the Southern Pacific, low Southeast, and New England.

The maps show great heterogeneity in competition. The areas do not show number of operators but ranges on these numbers, which is extremely relevant one considering the competitive difference between one and three providers. As such, it is fair to assume that heterogeneity is underrepresented on these maps and on the data made available by the FCC.

Figure 3: Number of High-Speed Providers by ZIP Code, 1999 and 2002



Source: FCC (2000 and 2003)

Thus, one would like to take closer look to the determinants of such heterogeneity, which requires getting down to the community level. A quick analysis on cross-state differences show that municipal electric utilities (MEU) are important in explaining broadband penetration (See Chapter 5). This relationship is established under different control variables.

Why would MEU be relevant for broadband deployment? There are three possible reasons for this. First, from a historical perspective, MEUs have a tradition of supporting and being involved in local economic development. From a political perspective, this results from the way in which public organizations respond to collective action. Second, by the nature of their functions, MEUs have right of way to a large extent of the buildings of a community, lower coordination costs, and economies of scope to run to additional network utility services. Third, and as consequence of the heterogeneity issue previously mentioned, MEU can play a role in providing broadband services where there is lack of competition.

1.2 Objectives of Research

Since the late nineties there is evidence of an increasing involvement of municipal electric utilities in telecommunication services. According to data from the American Public Power

Association, the number of MEUs offering any type of broadband services by the end of 2001 was of 450 and increased to 570 by the end of 2003.

The central objective of this research is to examine what factors have led to this trend. More explicitly, it aims to study whether it has resulted from lack of competitive alternatives, regulatory, political reasons, demographic or economic reasons.

Analyzing deployment of advanced telecommunication services at a national or state level is inherently different from studying its local evolution and, as such, there is no one-size-fits-all policy approach. Even Newbury's (1999) approach for introducing competition into network utilities fails to recognize the particularities when the studied system is, for instance, a rural town of 2,000 inhabitants. There is some agreement that solutions for broadband availability at the local level should look for the combination of public and private initiatives, which is equivalent to find "where the dividing line is drawn between public and private responsibility" (Clark, Gillett, Lehr, Sirbu and Fountain, 2002.)

In this context, Strover and Berquist (1999) posed the question of "...discover[ing] the policies, regulations, and practices that lead to advanced telecommunication infrastructure serving the...population equitably". This question leads the motivation for this research, followed by the increasing number of public initiatives of deployment of telecommunication services, and collision between federal, state and local policies on telecommunications.

There is need for ubiquitous broadband Internet access and other advanced telecommunication services, and some municipal electrical utilities (MEU) have started offering them. The relevance of this question is based, among other things, on evidence showing that private companies delay the deployment of telecommunications infrastructure due to expected decreasing costs, and threats of entry by competitors (Riordan 1992). In this context, several authors have proposed that demand is not being met, and there are strategic reasons for speeding up its deployment by active involvement of local governments (Strover and Berquist 1999; Shultz and Sukow 2000; and Gillett, Lehr and Osorio 2003, among others).

1.3 Overview and Summary of Sections

The research is presented in four chapters. Chapter 2 presents the most common technology options for providing broadband services, specifying aspects such as per-user available bandwidth, typical target customers, costs, and advantages and limitations and some of the variables affecting their deployment and adoption. Additionally, it briefly describes the two most common information technology-based systems used by electric utilities: Automatic Meter Reading (AMR) and Supervisory Control and Data Acquisition (SCADA). This chapter described the ways in which telecommunication business models converge with support activities core to the business of transmitting and distributing power. It also discussed evidence that electric utilities would have started to create value by taking advantage of economies of scope among AMR, SCADA and the provision of telecommunication services.

Chapter 3 presents a brief historical perspective on public power utilities, and highlights the new landscape for local government's involvement in telecommunications by Section 253(a) of the 1996 Telecommunications Act. It presents a literature review and discussion of the different issues involved in public and private provision of telecommunication services, discussing the relevance of local governments' discretionary authority, and highlighting the collisions among federal, state and local policy. It discusses some possible implications of the recent ruling of the U.S. Supreme Court in the case of *Nixon, attorney general of Missouri vs. Missouri Municipal League, et al.*

Chapter 4 takes the previous points and frames the research question, presents the major hypotheses, variables and methods for the analysis. There are three central hypotheses. The first states that the probability of MEUs for offering advanced telecommunication services increases when they have deployed internal services of voice, automatic meter reading (AMR) and supervisory control and data acquisition (SCADA) for enhancing reliability of their power distribution system. This results from economies of scope between their internal services and offering external telecommunication services.

The second hypothesis proposes that MEUs' likelihood of offering telecommunication services is reduced by the existence of (i) laws and regulations explicitly restricting their involvement in telecommunications, and (ii) general regimes reducing local discretionary authority (LDA), such as Dillon's Rule. The third hypothesis states the chance for MEUs involvement in telecommunications decreases in the presence of private competition.

This chapter also presents and summarizes data availability, discusses how it might affect the validity and extensions of this research, and presents an introduction to Logit, Probit and Multinomial Logit qualitative response survey methods.

Chapter 5 presents the results from regression and sensitivity analysis. Regression results support the hypotheses, raising interesting questions for further research. First, results show the probability of MEUs for offering advanced telecommunication services increases in the case the electric utility has deployed networks for running internal services of voice, AMR, or SCADA. Testing supports the statistical significance of the hypothesis.

In terms of the effect of regulatory framework, results support the hypothesis that the chance that MEUs have for offering telecommunication services is reduced by the presence of regulations explicitly formulated to restrict the involvement of utilities in telecommunication services. In the case of Dillon's Rule as proxy for LDA, however, results show it does not have a significant effect on reducing MEUs' probability for getting involved in telecommunications.

The competition hypothesis presents interesting results. Probit regression results support the hypothesis that MEUs' likelihood for participating in telecommunications decreases with the availability of a cable modem operator, but not with the presence of a DSL provider. While this result can be driven by noisy DSL data and not considering competition dynamics, which requires time-series analysis, it can also be due to issues that are more complex.

First, technology options offered by MEU and cable television operators are similar and can be thought as substitutes due to technology and market reasons. In the case of telephone companies, however, technology deployed by MEU can be perceived as non-redundant and a valid competitive alternative. Second, there is a sort of market segmentation as cable television operators target mostly the residential market and business needs for advanced telecommunication services are sought among telephone companies.

These two issues are explored by Multinomial Logit regression, by analyzing the hypothesis in the context of the probability of MEU for offering advanced telecommunication services only to residential customers, only to businesses, to business and residential customers, or not entering the telecommunication industry.

Analysis from chapter 2 and 3, as well as results from chapter 5 support that the recent decision of the U.S Supreme Court in *Nixon vs. Missouri Municipal League* might have important impact as it grant to the states the authority to prohibit or allow its political subdivisions for entering the telecommunications market.

Besides affecting competition in telecommunications, however, this decision could present serious problems for the reliability of electric power. Modern public strategic management calls for maximizing creation of public value that, among other things, requires public organizations to benchmark some private sector practices towards reaching high efficiency in the resources. The presence of economies of scope between transmitting and distributing power and offering telecommunication services is a potential source for gains in efficiency, which results from a stock of idle capacity for transmitting voice and data. Restricting the ability of MEUs from using this capacity would go against the premise of efficient use of public resources, which could have financial negative effects on the deployment of internal support services for power distribution and transmission.

The most pressing options for the MEU community should include an active lobbying at the U.S. Congress and state legislatures, focusing not only on the effects of the U.S. Supreme Court's decision in competition of telecommunications, but also on its effect on reliability and security of electric power. As a medium term option, however, MEUs would require evaluating alternatives of public-private partnerships that would make legally and financially feasible to continue offering advanced telecommunication services.

Finally, chapter 6 provides a summary of the qualitative discussion along with a discussion of the empirical results and major conclusions. It also presents policy recommendations and broad analysis of the position of the major stakeholders involved on the issue, their strengths, weaknesses, opportunities and threats, and options at national and state level. It also presents a framework for analyzing the merits of MEU entry to telecommunications, in terms of its effect in competition and the effects of technology-based economies of scope on public interest.

In broader terms, this framework allows identification of situations where MEU entry in telecommunications would not be desirable and others that would require either cost or context-specific analysis of MEU entry. It also allows for identifying situations where MEU

would like to consider leasing networks to private providers, and cases that present clear merits for a MEU role in telecommunications. From an additional perspective, however, the scenarios of this framework support the argument that MEU involvement in telecommunications is complex and that, despite the lack of analysis and research, policymakers are adopting strong and varied policies that constrain their entry. These policies may be premature in the absence in the absence of evidence of whether such constraints generate overall positive or negative effects.

The analysis proposes five policy options. First, lobbying the U.S. Congress for clarifying whether MEU are included by section 253 (a) of the Telecommunications Act of 1996, and cannot be preempted by state governments to offer telecommunications services. Given the political environment, however, this initiative is unlikely to succeed. Second, lobbying the state legislatures in order to obtain explicit regulations prohibiting MEU to offer telecommunications (from the side of private operators), or allowing it (from the MEU perspective). These two alternatives are closely related, as the outcome of Congressional clarification could lead to judicial challengers and different actions at the state level.

The third option calls MEUs for broadening the scope of the political agenda of MEU involvement in telecommunications, by including the effects of technology-based economies of scope on reliability and security of electric power. Fourth, the analysis proposes the stakeholders to evaluate the merits for MEUs that have deployed networks for running AMR and SCADA for leasing their networks to private operators. This could lead to innovative policies and public-private partnerships not considered before. Finally, it proposes for all stakeholders to build their cases for areas with no current available service as well as low levels of service, in order to evaluate their merits and decide upon them.

This thesis concludes with several questions for further research, and lays the foundations for continuing research that could provide valuable insights not only for broadband policy and for better understanding of the industry's competitive dynamics, but also to good regulatory policy and the proper role of local governments in communications policy.

2 Technology

This chapter presents the technology context of the research question. The first section introduces a working definition for broadband and presents a description of the most common technology options for delivering broadband Internet services as well as a summary of the technology available options. As result of the analysis, one perceives the increasing available options for delivering high-speed Internet services as well as decreasing costs over time.

Cost, reliability and quality of service are important and interrelated issues in all options. For this reason, choosing a technology option depends of the type of customer, willingness to pay, intensity and type of use. For example, the fiber optic option promises "future-proofing" with regard to new applications and uses, at the cost of expensive fiber deployment and customer premises equipment (CPE).

The second section briefly introduces Automatic Meter Reading (AMR) and Supervisory Control and Data Acquisition (SCADA) technologies. These are two network-based applications used by electric utilities to increase performance and reliability of their power transmission and distribution systems. AMR is utilized for theft detection, outage management, customer energy management, load management, on/off services, and distributed automation, among others. SCADA is used for controlling and managing the grid.

The points of convergence between electric utility and telecommunication services are clear for many reasons.

First, system reliability and monitoring have gained importance in the last years as consequence of the problems on electric power generation and distribution and homeland security. As result, there is increasing attention to functions of supervisory and control on electric power transmission and distribution.

Second, and as consequence, securing critical infrastructure have increased agreement that these systems need to operate separate from other utility systems and under total control of the utility. There are security, technical and economic reasons for not outsourcing network services. From a security perspective, there is a founded perception of increased risk in outsourcing network services over which the power utilities have no control. From the perspective of homeland security and cyber-threats, outsourcing imposes important information security challenges affecting the reliability of critical infrastructure in general and electric power in particular (Riptech 2001, U.S. DoE 2003).

Technology developments and decreasing cost of infrastructure, by other hand, have increased the cost/quality ratio of alternatives superior to the traditional telephone networks,, such as fiber optics and hybrid fiber coax, allowing more secure and less noisy voice and data transmission for MEUs requirements.

The argument supporting investments in own infrastructure has also gained support from an economic perspective both at the organizational and local level. At the organizational level,

Increasing security and reliability by deploying new networks raises investment costs, but also provides separate revenue streams generated by economies of scale between AMR and SCADA that allows providing services of advanced telecommunication. At the local level, these investments are expected to boost economic development, which has been among the major arguments for municipal deployment of advanced telecommunications services in general, and broadband in particular (See chapter 3).

Thus, MEUs offering of cable television and high-speed Internet services, among others, to residential and business customers have helped to finance the required infrastructure for enhancing security and reliability of transmitting and distributing power.

2.1 Broadband: definitions and options of service

As heterogeneity and complexity are everywhere, broadband is difficult to define. According to Owen (2002), the term is poorly defined and usually understood in terms of the context and final objectives of the person or organization using it².

The National Research Council (2002), however, has found that broadband “should be defined in a dynamic and multidimensional fashion”³. Broadband is defined in terms of speed or bandwidth, latency and jitter, symmetry between upstream and downstream capacity, always-available connection (made possible by flat rate pricing), possibility for connectivity sharing, addressability and, among other dimensions, the demand for bandwidth. Defining broadband, according to NRC, should be beyond considering a bandwidth threshold and understood in terms of “future proofing”. In other words, the performance of communication services should (i) not constrain the demand for bandwidth and (ii) open possibilities for developing new services and applications.

For the purpose of this paper and in the terms of the NRC, broadband is broadly defined for options above dial-up maximum capacity. The current options for broadband deployment are digital subscriber line (DSL), cable modem, fiber optics and wireless (terrestrial and satellite). In the case of business customers, other options include leased lines of different capacities.

As a natural result of the way in which businesses deploy services responding to increased demand by minimizing costs, most high-investment broadband technologies are available in large metropolitan areas (as the cost per passing is lower given large density). The telecommunications industry investment in fiber optics and deployment of other broadband networks has been mainly done in these areas, which also would have more competition. Thus, when one moves far from large metropolitan areas (especially beyond suburbs), the availability of competition and infrastructure supporting delivering advanced telecommunication infrastructure is expected to be lower. This responds to the decreasing density, which means

² Indeed, the Chilean company VTR offered a 64Kbps service under Broadband Light through Hybrid Fiber Optic Coax (HFOC). See <http://www.vtr.net/internet/anchalight.htm>

³ NRC(2002), pp. 10.

higher investment and per-unit costs of deployment, lower affordability (in most cases), and lower demand.

Table 1: Summary Broadband Technology Options

Technology	Capacity per user (Mbps)	Advantages	Limitations	Target Customers
xDSL	<ul style="list-style-type: none"> • 6-8 downstream • 1.5 upstream 	<ul style="list-style-type: none"> • Uses the (ubiquitous) telephone network 	<ul style="list-style-type: none"> • Addressability depends on distance and number of DLCs in the loop. • Service not adequate for large business • Highly sensitive to electric interference 	<ul style="list-style-type: none"> • Residential and SMEs
Cable Modem	<ul style="list-style-type: none"> • ~1 downstream, • 0.1-0.5 upstream 	<ul style="list-style-type: none"> • High adoption rate • Uses CATV networks 	<ul style="list-style-type: none"> • Data rates not adequate for large and medium business • Some security concerns • User data rate inversely depends on number of users 	<ul style="list-style-type: none"> • Residential and limited to SMEs
Fiber-to-the-Home	<ul style="list-style-type: none"> • From a few hundreds to 1,000 	<ul style="list-style-type: none"> • Highest speed • Not affected by electrical interference • Need fewer amplifiers 	<ul style="list-style-type: none"> • High cost of fiber, construction and CPE • Reliability issues by need of local power for active nodes 	<ul style="list-style-type: none"> • Large business • High-tech SMEs with proximity to fiber • Residential customers
Wireless-MMDS	<ul style="list-style-type: none"> • Comparable to DSL 	<ul style="list-style-type: none"> • No need for cables on last mile • Cell radius up to 30 miles 	<ul style="list-style-type: none"> • Blocking of signals from third parties (buildings, trees, etc.) • Reliability affected by geography and weather conditions 	<ul style="list-style-type: none"> • Residential and SMEs not covered by DSL or cable modem
Wireless-Unlicensed Free	<ul style="list-style-type: none"> • Maximum rate for 2.4 Ghz of 11Mbps 	<ul style="list-style-type: none"> • Usage of unlicensed free spectrum • Alternative last-mile technology to DSL and Cable Modem 	<ul style="list-style-type: none"> • Problems/cost for obtaining reliable coverage • Interference • Problems for site acquisition and antenna location 	<ul style="list-style-type: none"> • Residential and SMEs (specially where no DSL or cable modem available)
Wireless-Satellite	<ul style="list-style-type: none"> • 0.15-0.40 downstream • 0.04-0.12 upstream 	<ul style="list-style-type: none"> • Low investment relative to geographic signal coverage 	<ul style="list-style-type: none"> • High cost of CPE and human resources • Latency problems 	<ul style="list-style-type: none"> • Residential and SMEs in rural areas • Large corporations (for high-end VSAT)
Broadband over Power lines (PL)	<ul style="list-style-type: none"> • Varies up to a maximum of 2 Mbps in best cases 	<ul style="list-style-type: none"> • Use of installed power lines makes it potentially disruptive 	<ul style="list-style-type: none"> • Radio frequency problems generated by PL • Security and reliability problems by using shared networks • Limited capacity compared to other wireline options 	<ul style="list-style-type: none"> • Areas with high number of customers per substation • Places with low cost-effective DSL or cable modem

Source: the author based on Dodd(2002), NRC(2002), Newmann (2003), and McKinsey(2002)

In these cases, it would be possible to have a public response to market failure.

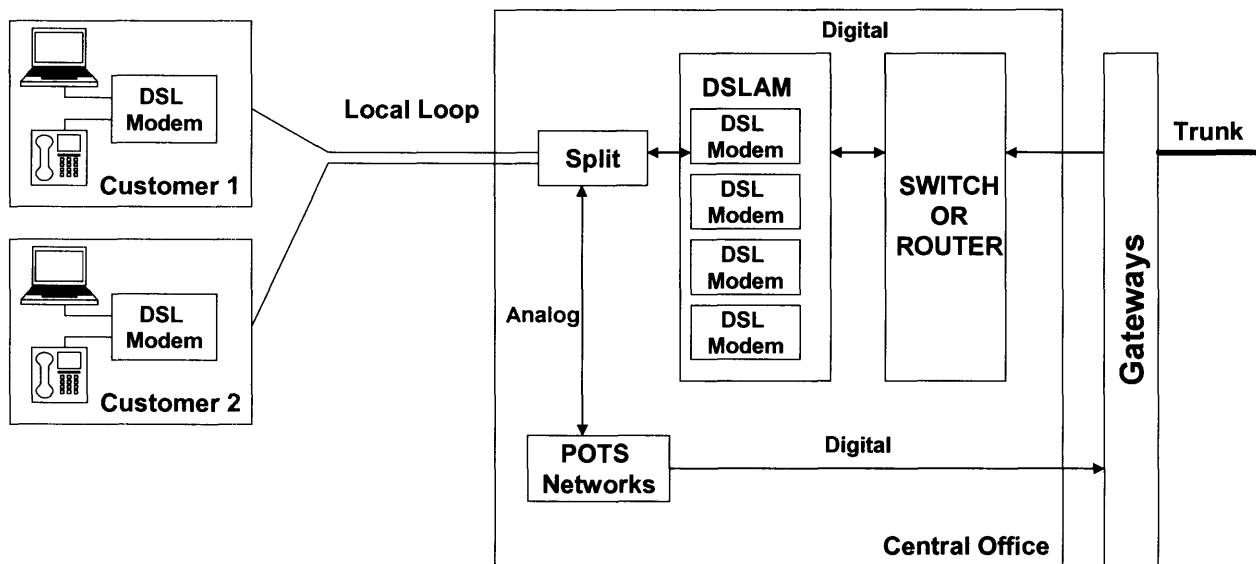
Table 1 presents a summary of the advantages, limitations and target costumers for different technology options for delivering broadband Internet access. The options show a high degree of heterogeneity in cost, data transmission rate, and sensitivity to the density of expected demand. In the case for non-metropolitan areas, the majority of the United States, the problem is in last-mile options for broadband delivery. The analysis does not considers wireless local area networks (WLAN) as these hot-spots are deployed as back-end networks that, in a first place, require some type of high-speed connectivity.

As demand for bandwidth increases, telephone and cable television companies are increasingly deploying fiber to increase quality of service, making of Fiber-to-the-Home (FTTH) and Fiber-to-the-Curve (FTTC) two interesting “future-proofing”, but still costly, alternatives.

2.1.1 Digital Subscriber Line (DSL)

DSL is a dedicated high-speed option for delivering data over the twisted pair copper wires connecting every household and company to the telephone company⁴. Thus, DSL is the natural broadband offering of telephone companies. The major difference between dial-up and DSL connections are (i) a split at the user’s premises (except for DSL Lite) and (ii) an additional modem at the telephone company⁵.

Figure 4: Digital Subscriber Line



Source: the author, based on Dodd(2002), NRC(2002), and Newmann (2002)

⁴ There are different options for twisted pair copper wires according to the type of application and maximum data rate demanded (from CAT 1 to CAT 7) according to ANSI/EIA/TIA standard 568.

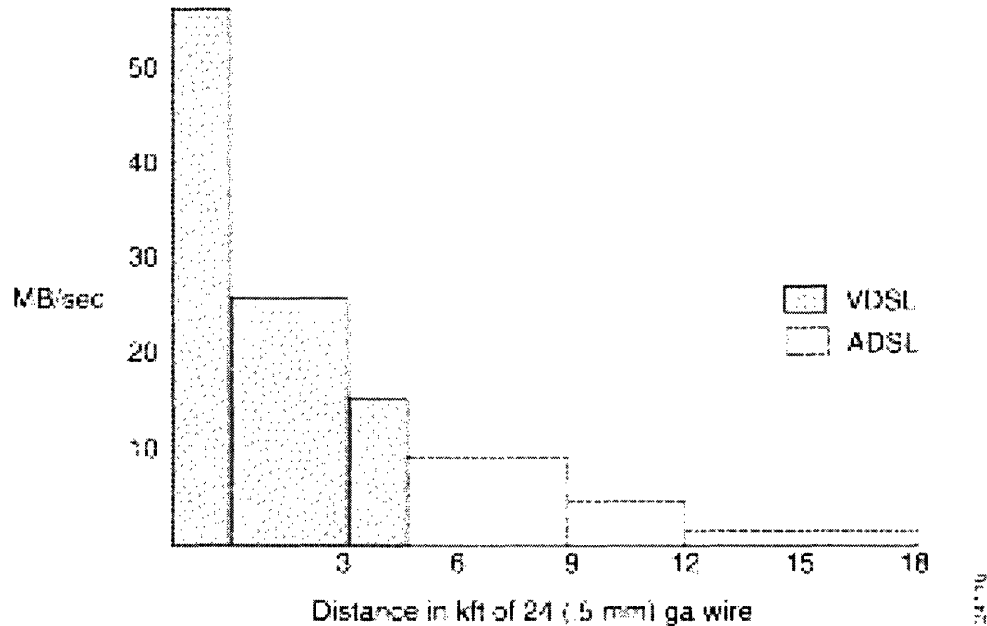
⁵ See Dodd (2002), NRC (2002)

Starting from the customer premises, DSL modems split the connection between the customer's telephone and the customer premises equipment (CPE) that connects his or her personal computer. They send data over copper wires, encoding and compressing it at the same time that correcting, routing and monitoring performance of the connection.

There, the wires reach a splitter that separate the plain old telephone service (POTS) from digital signals. The digital signals are received by asynchronous DSL modems (in the case of ADSL) a DSL access multiplexer (DSLAM) and, then, the connection from different DSL subscribers are sent into a single asynchronous transfer mode (ATM) line at rates of gigabits by a router or digital switch⁶.

Although currently most available DSL services correspond to ADSL, there are at least the general options ADSL, DSL Lite, High-Bit-Rate DSL, Symmetric DSL, and Very-High-Bit-Rate DSL.

Figure 5: Transfer Rates of ADSL and VDSL as function of distance



Source: http://www.cisco.com/univercd/cc/td/doc/cisintwk/ito_doc/adsl.htm

Among the most important DSL characteristics one found that, while it can use existing telephone lines, the data rate decreases importantly as function of the customer's distance from the central offices, which also differs with the type of service. Figure 5 shows the difference in

⁶ The DSLAM could connect with ATM, frame relay or any Internet Protocol network, depending of the product. See <http://www.intel.com/design/network/solutions/dslam/> for explanation on architecture and functionality on DSLAMs.

speed for ADSL and VDSL as function of the customer's distance to the switch. No service can be provided beyond a distance of 18,000 feet from the switching node (Newmann 2002).

For ADSL, for instance, the upstream and downstream data rates vary, respectively, from 640 Kbps and 7.1 Kbps at a top distance of 12,000 feet from the CO to 176 Kbps and 1.54 Mbps at no more than 18,000 far from it (Dodd 2002). Thus, this option is not very effective for providing services where distances tend to be long, such as in rural areas.

One solution, though expensive, for addressing this problem has been investing in Digital Loop Carriers (DLC). In DLCs, the DSLAM is bundled to the capacity to convert digital signal (from T-1 or E-1 lines between customers and DLC) to optical signal (from fiber cable between the DSLAM and central office). Thus, telephone companies are connected with fiber between their central offices and the DSLAM-DLC bundle, and twisted pair between there and DSL customers, increasing the availability of DSL beyond 18,000 feet.

2.1.2 Cable Modem

Cable television (CATV) providers currently serve their market over lines of hybrid coax fiber (HFC). This infrastructure can deliver a large number of telecommunication and information services, including voice, up to analog and digital channels, high-speed Internet access, and customer-requested digital services⁷.

Here, data is delivered at speed rates of 128 kbps to 500 kbps upstream and 1 mbps to 3 mbps downstream through one of the many digital channels used for video. Old coaxial cable offered a one-conduit for multiple channels option, and suffered from transmission losses that required amplification of radio frequencies to minimize losses over long distances.

Cable system required amplifiers by segments that can vary from hundred to a thousand feet apart, requiring large number of amplifiers (which had theoretical limits in order to maintain a minimum bandwidth and quality of service).

The development of HFC architecture allowed the old coaxial tree-and-branch architecture to evolve towards a large system of smaller sub-systems. Thus, cable providers are segmenting their markets in clusters of 200-2,000 homes in arrangements mixing fiber and coax cable (Signals fade less over fiber optic cables than in coaxial, thus requiring lower number of amplifiers to enhance signals).

Each computer is connected through 10BaseT Ethernet Card to a cable modem, which shares the same cable with the television equipment by using a splitter. The customer, however, would require a set-top box in order to receive more than just the basic analog TV cable.

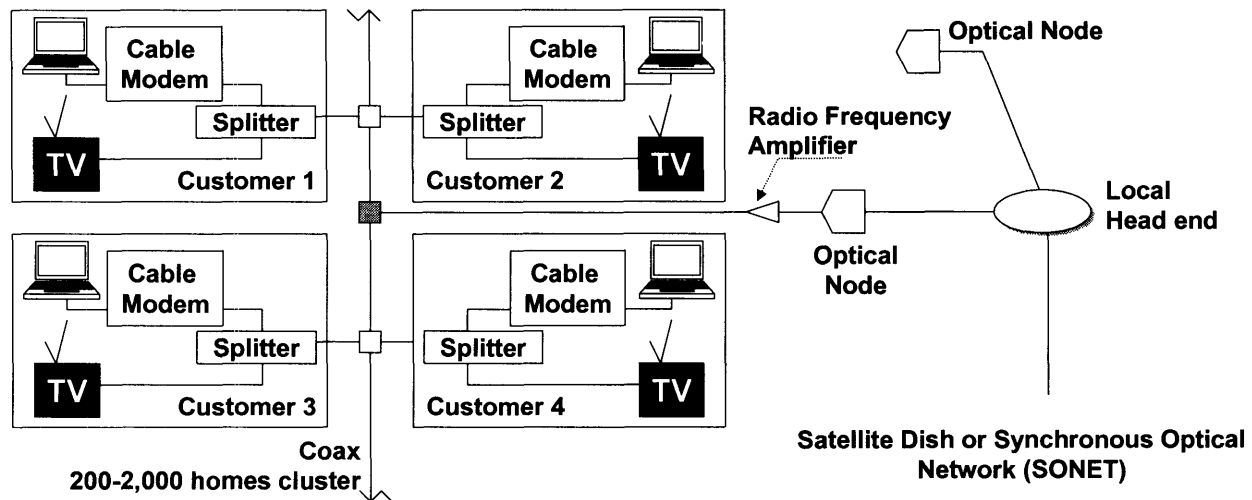
In the new architecture, a cluster of customers have access to high-speed Internet through a coax cable connected to an optical node (ON). Each ON is connected to a local head end, which is the facility of the cable company distributing CATV services, including high-speed Internet.

⁷ See <http://www.intersil.com/design/comm/hfc.asp>

The head-end can be connected to a satellite dish or, in the case of business customers in metropolitan areas, to a synchronous optical network (SONET) through a regional or metropolitan data center⁸.

The cable modems at the user's premises and head-end use a "handshake" to authenticate, but also correct signal distortion and power fluctuation, signal modulation, and managing delays, among others.

Figure 6: Cable Television for data communications at residential locations



Source: the author based on NRC(2002) and Dodd(2002)

2.1.3 Fiber Optics

Fiber-to-the-Premises (FTTP) presents important improvements to the previously mentioned options⁹. As presented by Dodd (2002), as data in fiber optics cables are transmitted by light pulses, they are not affected by electromagnetic interference and, thus, there is no noise. It presents higher bandwidth than twisted pair and coaxial cable, with capacities from 20 Mbps to 10 Gbps.

Currently, however, it also presents some major problems. First, it is too expensive both in terms of the fiber and the CPE required at residences. Second, installing fiber optics demand labor that is more expensive than for DSL and cable modem options. Third, in the case of active star architecture (see Figure 7) requires local electrical power that, being in MEUs control (the provider), decreases vulnerability to the system.

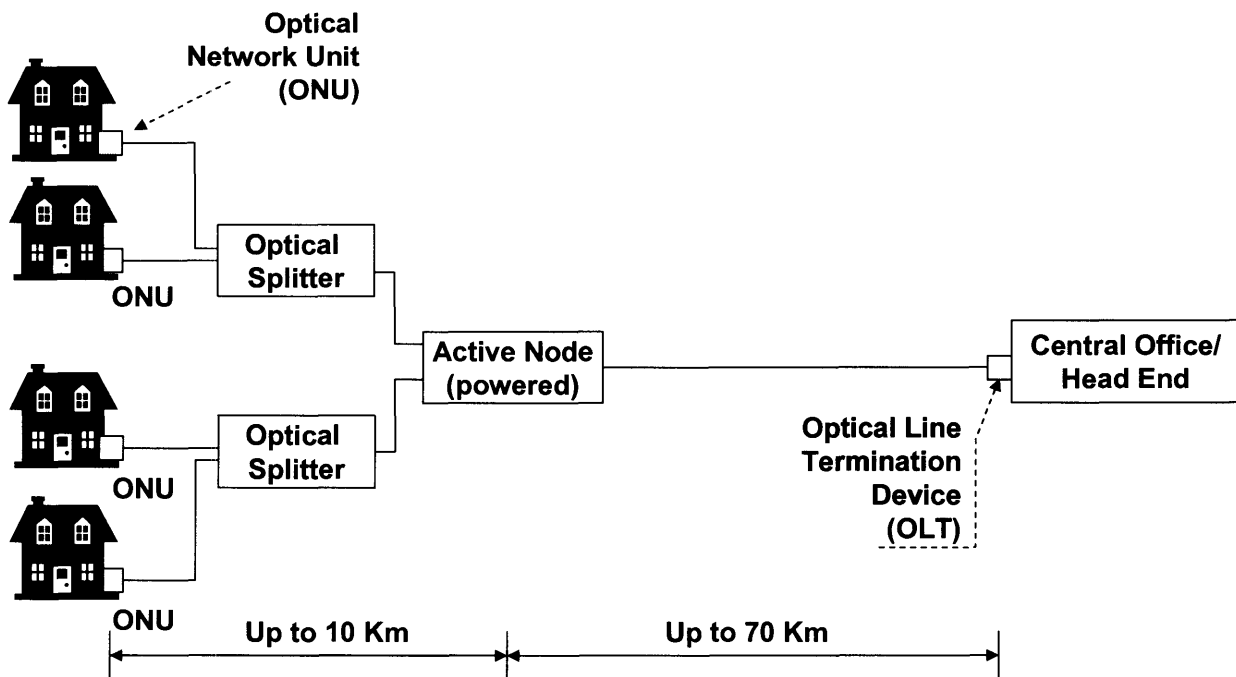
⁸ SONET, also called synchronous digital hierarchy (SDH), is the standard for interconnection of digital networks. Common transfer rates reach about 10Gbps and, in the future, are expected to reach 20Gbps.

⁹ FTTP is used as general term to account for different architectures such as Fiber-to-the Home, Curb, or Business, FTTH, FTTC and FTTB respectively.

The central idea of FTTH is extending the reach of fiber until reaching the customer premises. The most common architectures are passive optical network (PON), active node star and hybrid of the two approaches.¹⁰ Regardless of the architecture, the fiber option provides higher bandwidth and lower interference than DSL or cable modem options.

Figure 7 shows a simple diagram for a hybrid active star configuration. First, the central office or head end (CO/HE) send data over the fiber by an optical line termination (OLT) device that is connected to a powered active node. Depending of various factors, this node can be located as far as 70 km from the CO/HE.

Figure 7: Fiber-to-the-Premises (Active Star Architecture)



Source: the author based on Dodd(2002), FTTH Council

Then, the active node is linked to a series of optical splitters generating several back-end PONs (that is why it is called hybrid) and providing service to residences as far as 10 km. Depending mainly on distance, splitting loss, and wavelength, each split can vary from 4 to 64 customers.

¹⁰ PON shares fiber strands for distribution and uses optical splitters to manage the signal (separate and aggregate). PON architecture only requires power at the end (PON is also called point-to-multipoint). In active node architecture, customers have a dedicated fiber strand using powered active nodes for managing signal distribution. Hybrid architecture is a combination of the two previous. The wavelengths used are of 1310, 1550 and 1490 μm .

Besides the possibilities of FTTP for providing bundled telephone, data and video in areas with no DSL or HFC service, some options allow getting fiber optics closer to the customers in relatively dense areas and, thus, increasing data speed rates for DSL and HFC¹¹. It can also reduce the loop length for the former, and the number of customers per node for the latter.

2.1.4 Wireless

The options for wireless access to broadband Internet services are varied, among which one finds Multipoint Multi-channel Distribution Service (MMDS), Local Multipoint Distribution Service (LMDS), Free Space Optics (FSO), unlicensed fixed wireless, wireless Mesh and satellite access. LMDS and Wireless Mesh are not covered here due relative lower cost and advantages of other options such as MMDS and unlicensed fixed wireless (Also, LMDS presents a limited radius of transmission of 3-5 miles compared to about 30 miles of MMDS)¹². Mobility, however, has an inverse relation with available bandwidth over large geographical areas¹³.

FSO is also not included. This point-to-point technology uses lasers to provide high-bandwidth optical connection, and for cost considerations is used mostly by businesses. According to FreeSpaceOptics.com, for each customer premise costs can vary from \$4,500 in low end to more than \$25,000. While it achieves rates comparable to fiber optics, its reliability strongly depends on weather, topography, foliage and signal might be interrupted by passing objects.

Unlicensed wireless is a low-cost alternative that uses unlicensed portions of the spectrum (ISM 2.4 GHz or UNII 5.8 Ghz)¹⁴. This option is a low cost alternative for last-mile for small Internet Service Providers (ISP), compared to cable modem and ISP. While spectrum is unlicensed, locating antennas for obtaining continuous presents a challenge. In the case of 2.4 Ghz, which has an available bandwidth of about 80 MHz, also presents many source of interference from Bluetooth, radio broadcasting, and cordless telephones.

There are two major approaches: wireless local area network (Wireless LAN) and wireless wide area network (Wireless WAN). Wireless LAN allow connectivity at the local level within an indoors radius of about 300 ft (about 100 meters) using 802.11x (or WiFi). It allows maximum data rates of 11Mbps or 54Mbps if using 2.4 or 5 GHz radio bands, respectively. As coverage is limited, organizations that would like to cover a wide area would have to, necessarily, place wireless access points (WAP) covering all the target area.

¹¹ The idea described here corresponds to Fiber-to-the-Curb.

¹² See <http://www.wcai.com/mmds.htm> and <http://www2.conterra.com/images/inside/FixedBroadbandWirelessPrim.pdf>

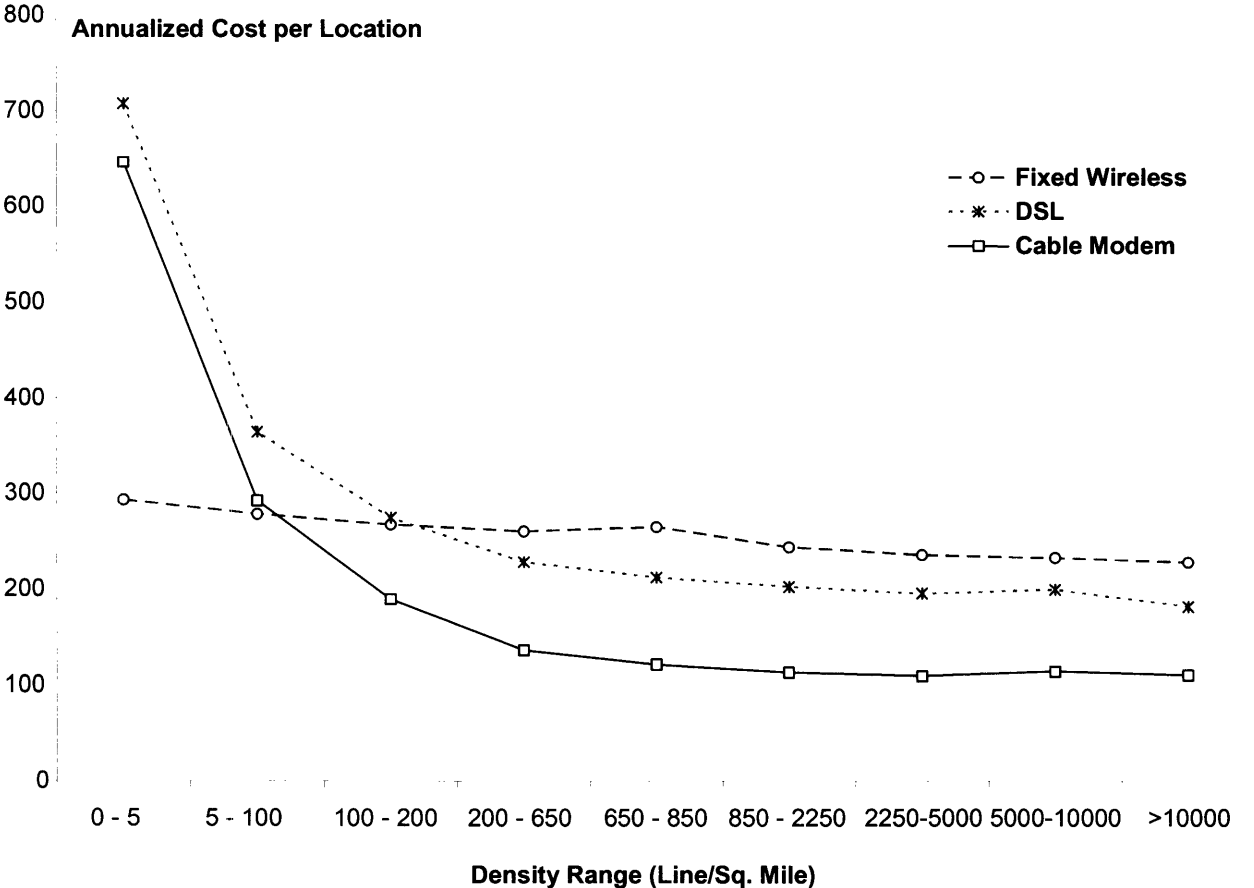
¹³ NRC (2002) pp.284.

¹⁴ ISM stands for industrial, scientific and medical radio bands as defined by the ITU, and UNII stands for Unlicensed National Information Infrastructure. See http://www.itic.org/policy/2003/fcc_030902.pdf for a detail on unlicensed spectrum.

Wireless WAN, by other hand, are designed to cover larger areas using cellular networks that, using today deployed systems, allow relative low speeds with a maximum of 50 kbps and 70 kbps for GPRS and CDMA2000 (or 3G), respectively¹⁵. Wireless WAN, however, present higher security features and allow higher mobility.

New developments, however, introduce changes to the landscape and add attractiveness to Wireless WAN with 802.16a, or WiMax. 802.16a works in both unlicensed and licensed spectrum options¹⁶. It is designed for metropolitan or areas up to about 31 miles (50 kilometers), and a maximum speed of 64 Mbps, assuming 14Mhz channel. In terms of security, 802.16a supports triple-DES (128-bit) and RSA (1024-bit) encryption systems, maintaining its security above Wireless LAN's. It is still in development while some wireless operators still focus in 802.11x and 3G.

Figure 8: Annualized Cost per Location by Density Range



Source: the author, based on data from Wanichkorn and Sirbu (2002)

¹⁵ GPRS: General Packet Radio Services, CDMA-2000: Code Division Multiple Access, third generation solution based on IS-95, the standard for CDMA, also known as TIA-EIA-95.

¹⁶ See <http://www.wimaxforum.org/news/downloads/WiMAXWhitepaper.pdf>

The original purpose of MMDS was delivering video, but currently it is also used to deliver Internet, mainly for households and small business. Each customer premises requires a moderately expensive CPE compared to its performance¹⁷. While reliability and service quality depends on the actual number of users by cell, line-of-sight and access to rooftop installation, current CPE could allow up to 2 Mbps down and 256 Kbps up, and a theoretical radius of 20-30 miles per cell.

In terms of cost, Wanichkorn and Sirbu (2002) suggest that while fixed wireless would be an economic alternative in low-density areas, it hardly competes with DSL and cable modem when line density rises above 100 per squared mile (See Figure 8). According to their results for the state of Delaware, most of the decreasing costs per location for increasing density come from SONET ring and cell site, which are very low compared with CPE and base station network equipment.

Internet access via satellite is an additional option that has gained attention due to the ubiquity of satellite signals over large geographical areas through Geosynchronous (GEO) or Low Earth-Orbiting (LEO) satellites¹⁸. GEO satellites orbit in fixed orbits at 22,300 miles altitude allowing them to cover very large areas, but also generate a small delay on data transmissions (DirectTV operates with GEO).

LEO satellites are non-stationary and might be found between 435 and 1,500 miles altitude, which decreases the delay but also their coverage, requiring a larger number of units to cover a comparable geographical area. There is an additional advantage: as LEOs are lower, the devices for accessing the LEO's services require lower power.

Satellite Internet access; however, require expensive CPE that can reach the \$1,000 value, including the company's subsidy.

2.1.5 Broadband over Powerlines

The idea of using powerlines for communications goes back to 1899, when the first patent was issued¹⁹. Although, only since the beginning of the nineties this option has become relevant as an option for delivering two way data communication services at speeds that could be defined as competitive with DSL and cable modem²⁰. Broadband over powerlines (BPL) architecture aims to take advantage of low-cost last mile technology with deployed in-house networking generated by the ubiquitous electrical power network.

Power cables were designed to transmit electricity at high voltages at low frequencies of 50 or 60 Hz. This low frequencies did not imposed significant requirements for shielding the wires

¹⁷ See <http://www.tmcnet.com/bizwatch/articles/102401c.htm>

¹⁸ There are also Middle Earth-Orbiting (MEO) satellites, orbiting between 6,000 and 13,000 miles. GPS services use MEO satellites.

¹⁹ Dhir (2001)

²⁰ According to ACA (2003), the historic data rates has been below the 500 Kbps.

which means that, today, they are not equipped to prevent radiation of radio frequency energy. The central idea of BPL is to transfer data at very high frequencies, ranging between 1 and 30 Mhz, compared to earlier 9-525kHz in old low-data rate PLC, which creates two problems of using powerlines for transmitting data. First, higher frequencies over unshielded cable generate significant interference that, in some cases, can be perceived until a mile far from the source (ACA 2002, NAAR 2004)²¹. Second, high frequencies mean the signals present higher attenuation along the cables, which leads to shorter effective distances between repeaters, or “universal information box” (UIB)²².

There is “In-House” and “Last-Mile” BPL. In-House BPL refers to using the power network of a building instead of deploying a new network, so devices can be used only by plugging into the AC. In this paper, we are more interested in Last-Mile or access BPL, which is the one likely to offer a third cable reaching customer premises.

Sakai (2003) describes four architectures presenting different degrees of integration between fiber, powerlines and wireless technologies. At one extreme, there is Fiber-to-the-Premises (home or business). In this case, electric utilities that have connected transformers and substations by fiber networks running internal services, such as SCADA and others, decide extend the reach of the fiber to the user’s premises. This would enable connectivity at the highest bandwidth possible nowadays, but at a very high cost.

A second option is Fiber and Low-Voltage (F-LV) architecture. This option presents a less expensive solution that Sakai (2003) defines as Fiber-to-the-Poles. Here, power companies following idea behind HFC architecture for cable modem and deploy fiber until a optical-electrical converter located before each transformer and, from them on, use low-voltage power lines to reach customer premises. F-LV is less expensive than FTTP in that it does not need to reach fiber to each customer premises, but it still an expensive option in the United States and Japan, as the average number of customers per transformer is low. According to the NRC (2002), the average number of households per secondary transformer is about 4, compared to 50 in Europe. Also, F-LV presents a maximum bandwidth of 3 Mbps, which is low compared to cable modem and xDSL.

A third option is a combination of medium- and low-voltage powerlines, in what could be defined as a pure broadband over powerlines. Analogous to the previous case, each distributing substation provides power to various transformers, but now uses the medium-voltage powerline for sending data to a bypass-transformer device, which is connected to the customer premises by using low-voltage powerline. This architecture, however, produces high level of radio frequency interference from powerlines, and presents obstruction of signals between medium- and low-voltage lines at distribution transformers (These transformers are designed

²¹ Communications over Powerlines are regulated in Part 15 of the FCC Rules and Regulations.

²² The UIB is the device connecting the customer premises to the BPL network, and connecting the next devices on the premises. As the location of these devices depend of the customer’s needs, the UIB can be either a repeater, interface or modem depending on the situation.

for frequencies of 50 or 60 Hz, which imposes constraints for frequencies in the 2-30 MHz). In terms of cost, a bypass-transformer can vary between \$4,000 and \$8,000, which makes the number of customers per transformer a relevant issue²³.

A fourth architecture is hybrid between medium-voltage and wireless. Here the utility transmit data all the way through medium-voltage powerlines between the substation and the pole closest to the customer premise. This allows for transmission of higher quality than in low-voltage lines (due to lower disturbance) until a service antenna²⁴. This approach, however, presents two problems: (i) the cost of antenna, and (ii) decreasing bandwidth per subscriber (Each medium-voltage powerline connects several low-voltage (LV) lines and, thus, all broadband users in those LV lines would have to share bandwidth).

Why would an electric utility choose an option other than those described here for delivering high-speed Internet access? Part of it responds to the maturity of powerline carrier technology at the time of deployment of MEUs' current services. A definite answer, however, requires a deeper analysis of timing and investments made in deploying internal command and control services such as automatic meter reading (AMR) and supervisory control and data acquisition (SCADA), and their involvement in business outside power distribution (such as cable television).

Answering this question is out of the scope of this research, but very interesting, and the analysis gives leads for future research. The next section presents a qualitative analyzes of why an electric utility would deploy networks other than power line carrier, and chapter 5 provides insights for additional questions.

2.2 information and communication technologies in power distribution

This section presents the convergence between telecommunications and power distribution, and its effect for the involvement of municipal electric utilities in delivering advanced telecommunications services.

As in every industry, electric utilities increasingly use information and communication technologies. While most electric utilities enjoy the benefits of natural monopolies, they face several problems likely to be addressed by an adequate use of information and communication technologies (ICT): monitoring variations in demand and load usage, electric power theft and reliability and security of their grid, which have gained in importance since the August 2003 Blackout.

²³ Costs for Symmetra bypass transformers.

²⁴ Some types of disturbance are voltage variation, interruptions, transient over voltages, and voltage dips, among others. Medium voltage lines have lower disturbances than low-voltage lines. See Ferracci (2000) and Sakai (2003).

There are two solutions for addressing these issues: Automatic Meter Reading (AMR) and Supervisory Control and Data Acquisition (SCADA)²⁵.

2.2.1 Automatic Meter Reading

The technology behind AMR is available since the early sixties, when AT&T carried out trials in partnership with Westinghouse and some utilities (Tamarkin 1992). AMR are used for many purposes, including theft detection, outage management, customer energy management, load management, on/off services, distributed automation, in that order according to Johnston (2003).

In general, AMR systems have three major components: the meter interface unit (MIU), communication system, and central office system. The meter interface unit (MIU) collects data from the meter, controls electronics and manages communications. The communication interface allows two-way data transfer. If needed, the MIU might share capacity among different types of demand reading (electricity, gas, or water). The MIU takes the readings from meter dials and transform them into digital format.

The communication system is responsible for data transmission between central office and MIU. The options for data transmission are telephone networks, HFC, fiber, wireless and powerline. Unfortunately, there is no best option for setting up the communication system.

The third component is the equipment required for the central office systems (COS). COS requires modems, receivers and data concentrators, controllers, host upload links, and hosts (servers, routers and personal computers). Their function is to assist the central billing computer and other data or connectivity "clients" in providing the data they need from the installed user base. Here one understands "client" as any other application or service that requires users' information or connectivity.

In the cases of cable television and fiber optics, however, there are economies of scope that can generate strong revenue streams for the utilities by delivering content and access to high-speed Internet access. The first gain in efficiency by implementing AMR, however, is reduction of errors, elimination of estimated-based billing, and elimination of manual meter reading (Black and Ilic 2001).

2.2.2 Supervisory Control and Data Acquisition

As its name indicates, SCADA focuses on supervisory functions of an electric utility information system. As a result of the terrorist attacks of September 2001 and the August 2003 blackout, SCADA has gained increasing importance to guarantee the reliability of critical infrastructure (Gunnerson 2003 and Symantec 2003).

They work as a remote control process for monitoring, operation and maintenance of energy infrastructure by collecting data from the grid and substations²⁶. They are usually implemented

²⁵ SCADA is also known as System Control and Data Acquisition.

in the high-voltage transmission and distribution levels (Cardell, Ilic and Tabors 1998). There is a Central Monitoring System (CMS) in the central office and, in some cases, remote substations. The objective of CMS is controlling the server and routing communications of the SCADA network.

The substations are equipped with Remote Terminal Units (RTU), a host and modem for managing communications. The RTU works as an input/output device responding to the commands from the CMS, and can also perform programmed control functions allowing local decision-making without the need for checking with CMS. Each RTU is connected to meters, Load Tap Changers (LTC), equipment monitoring, and relays²⁷.

All these devices are nodes in a local area network (LAN) managed by an IP router or a digital circuit access²⁸.

Connection to LTC is critical. The LTC is a mechanical switch in power transformers responsible for regulating the voltage ratio without interrupting load current. As LTCs are the most expensive and vulnerable device in transformers and substations, causing more failures than any other component on a transformer, there is need to closely supervise and control their behavior and performance.

Additionally to substations, the CMS can gather data from field RTUs, reclosers, meters and switch controllers at different places on the grid. This can be done directly to the CMS, or indirectly using a substation as a hub.

In order to gather data, all device and controller must be equipped with an Intelligent Electronic Device (IED) which is any device that included one or more processors that can control and communicate data with a third party. In total, a SCADA system might have between 30,000 and 50,000 data collection points, according to Symantec (2003). This system is so important, that most companies have deployed its network separately from other systems.

As in the case of AMR, the communication network can be deployed on a combination of power lines, wireless, twisted pair, fiber, or cable television. While the natural and most intuitive option is powerlines carrier, there are two reasons for looking for other alternatives. First, SCADA system is as reliable as the state of the grid. Second, power line carrier (PLC) presents distortions from power system harmonics, and has limitations on speed (due to the low PLC frequency). As result, telephone lines, HFC, wireless and fiber optics are valid options.

²⁶ The objective of an electric utility substation is to reduce voltage and protect circuits by a combination of transformers and circuits breakers, respectively.

²⁷ See the IEEE Power Engineering Society (PES) Substation Committee for more information on standards and documentation about the issue at <http://grouper.ieee.org/groups/sub/wgc3/>.

²⁸ See a preliminary version of the working paper on architecture for networked information systems on electric power distribution at http://grouper.ieee.org/groups/sub/wgc3/C3TF1%20Documents/3_24_04/P1615_Chap4_D3.pdf

3 Regulation and Public Policy

This chapter presents the underlying policy context surrounding the involvement of MEUs in telecommunications. First, it analyzes the history of electrical power utilities, and how their social network forces are likely to have affected them in order to offer telecommunication services.

Section 3.1 presents a qualitative analysis of the historical path-dependence of municipal electric utilities. Section 3.2 examines the effect that limits to local discretionary authority can have in constraining the capacity of local governments to pursue initiatives towards fostering local economic development. Section 3.3 presents how the Telecommunications Act of 1996 is colliding with state and local policies and the role of the judiciary on this policy collision. Finally, section 3.4 examines the role of municipal electrics in delivering telecommunication services from the political and policy perspectives of public provision of private goods.

The conclusions of this chapter follow the existence of general reasons for the increasing involvement of MEUs in telecommunications. Two converging issues are the growing evidence about the importance of telecommunications and information technologies for economic development, and MEU's historical role on local economic development.

Thus, and first, MEUs tendency to get involved in issues concerning local economic development comes from institutional embeddedness shaped by geographical, demographic and historical factors particular to their communities. Second, the fact that MEUs are publicly-owned imposes on them an additional obligation towards the local community and creating public value. This organizational sense of duty goes beyond what one would expect from a similar private organization that, given the impact of information technology on productivity, would have led them to treat access to information infrastructure as a public utility. This would explain part of their increasing involvement in telecommunication.

Third, this special path-dependence and particular active role of MEUs are highly likely to create a special adaptation to general constraints to local discretionary authority –as measured by Dillon's Rule- that would have no or little effect of MEUs involvement issues that, as advanced telecommunication services, are relevant to local economic development. In other words, by the very nature of MEU communities and their approach towards local problems, Dillon's Rule would have no or very little effect in limiting their discretionary authority. For the same reason, one would expect to see explicit regulations against their involvement in telecommunications as a more effective constraint. This follows the line of the recent U.S. Supreme Court decision that grants the states total authority to decide whether or not local government entities can own or operate telecommunication services.

Finally, the MEU phenomenon is hardly likely to be repeated in non-MEU communities, not only because of the differences in available infrastructure (discussed in Chapter 2), but because of path-dependence and the different ways in which MEUs face the local challenges for economic development.

3.1 Electric Power Utilities: an historical context

This section presents a qualitative analysis of historical path-dependence of municipal electric utilities. In other words, this section analyzes qualitatively the fact that today's reality in places with active MEUs result from a historical path created by market and economic conditions along decades. Thus, MEU's traditional role for responding to local needs and commitment to economic growth is one explanation for their current involvement on telecommunication services.

Some would argue that the conditions that made them essential fifty years ago would not hold anymore, as some towns have become large enough to attract private providers of services. On the contrary, however, a different argument might support that their actions are needed due to current lack of availability of telecommunication services, their poor quality, or that MEU's role have changed and they need to foster competition in telecommunication. Some others might argue that, no matter the previous reasons, sub-state organizations only can engage in activities explicitly allowed by state legislature.

On July 13 of 1816, the Peale Museum, in Baltimore, was the first public building in America in having gas light. Gas Light Co. of Baltimore, later Baltimore Gas & Electric, provided the service marking the beginning of the energy utility industry in the United States²⁹. About sixty years later, in 1878, Thomas A. Edison founded Edison Electric Light Co. in New York, later General Electric, as the first electric company in the United States. The Pearl Street station opened in 1882 serving little less than 60 clients³⁰.

In 1882, there were four municipal electric systems in operation (Vennard, 1968). In the following decade, the number of privately owned central electric stations increased to more than two thousand and, by 1902, there were more than 3,600 along with additional 847 municipal electrics³¹. This number increased to 1,103 by 1905, about 400 of which will celebrate their 100th anniversary by 2005³² (See Figure 9).

Edison and his associates, especially Samuel Insull, are largely responsible for creating the structure of the industry (Granovetter and McGuire, 1998). Edison believed that electricity should be a commodity sold and distributed by central stations, instead of having each building generating its own capacity by installing independent systems like with heating systems. This approach gained momentum as, in 1886; George Westinghouse successfully generated power at Niagara Falls and distributed it about twenty miles southeast in Buffalo, NY³³.

²⁹ See <http://www.citypaper.com/2002-07-17/charmed.html>

³⁰ See EIA (2000), pp.115, EEI (2004) and Hughes (1983)

³¹ See Granovetter and McGuire (1998), Chung (1997), and Vennard (1968)

³² See <http://www.appanet.org/About/appa/APPAFactSheet.pdf>

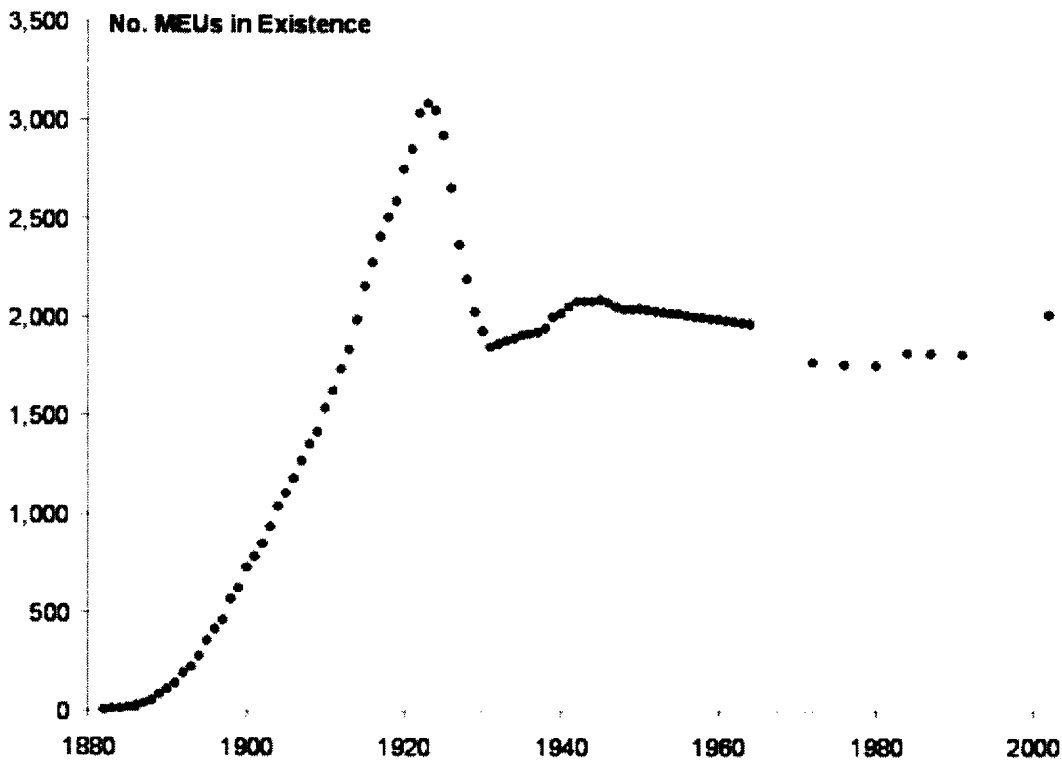
³³ See EIA (2000).

The idea of distribution required municipal permission and franchises for operating due to rights of way, which varied in area and time regarding each locality³⁴.

The construction of power plants and deployment of distribution wires was expensive and, regardless of Edison's efforts, the market for independent systems was increasingly attractive due to increasing demand for electricity, and the value of equipment. As such, many financial institutions, including J.P. Morgan and Co., backed the creation of that market. Those times gave birth to a large number of municipal electric utilities.

Firms using the arc and Edison's incandescent systems, incompatible standards, separated the industry in two groups. From an investor-owned perspective, some firms were members of the National Electric Light Association (NELA, predecessor of the actual Edison Electric Institute), founded in 1885. NELA grouped mostly arc-based systems and was thought to be the non-Edison association, controlling about 90% of total US generation by 1926 (Chung, 1996). The same year, Edison's secretary Samuel Insull created the Association of Edison Illuminating Companies (AEIC)³⁵. NELA became the EEI as result of Edison's, but mainly Samuel Insull's, networking efforts to control both NELA and AEIC.

Figure 9: Evolution Number of Municipal Electric Systems in the US, 1880-1963



Source: the author, based on Vennard (1968), Fox-Penner (1998) and APPA

³⁴ See Granovetter and McGuire (1998) and EEI (2004)

³⁵ See EEI (2004), Chung (1997) and Granovetter and McGuire (1998).

At that time, non-for-profit electric utilities started to be developed in different cities attracting the attention of NELA and AEIC, which acted inside and outside courts and state legislature to limit their action³⁶. As Figure 9 shows, the growth in the number of MEUs was exponential averaging an annual growth rate of 35.12% between 1892 and 1900, and decreasing to a rate of 7.36% between 1900 and 1920, which decreased to negative rates during the Great Depression³⁷. Most MEU activity was dedicated supply for the increasing demand for operating trolley and street lighting and, by the early 1900s, MEU's generation capacity was about 8% of the US total.

One of NELA and AEIC's responses was a proposal that included the creation of regulation of electric utilities by a state authority, the State Service Commission (SSC), in order to safeguard consumers' interest. As result, about 30 states had created their own by 1910³⁸. By then, there were 1,534 municipal electric systems in the US (Vennard, 1968). In a second type of response, however, for-profit companies attacked operating facilities by installing redundant plants and operating them at loss in order to eliminate competition³⁹. Initiatives like this, show how an option can succeed by reasons other than technical superiority.

The Great Depression hit the electric utility industry hard, and especially small communities. Figure 9 shows a marked decrease in the number of MEUs starting the mid-twenties from an historical maximum of 3,084 systems to reach 1,863 by 1932⁴⁰. In that year, less than 12% of rural areas had access to electricity, which later increased as result of the Rural Electrification Act (REA) of 1936⁴¹. Today, rural areas are served as results of the REA and due to the work of cooperatives MEUs are cannot be classified as a rural phenomenon.

The idea of generating electricity at central stations, sell it and distribute it the customers located away was as the standard practice. Thus, interstate electric commerce was a reality and electric power industry grew as a natural monopoly by the ownership system of centrals and the grid⁴². Thus, the policy initiatives at the state level gave pass to the creation of the Federal Power Commission through the Federal Water Power Act of 1920. The importance of this act increased as result of the bankruptcy of some holding companies as result of the Depression. The core ideas of federal regulation were to address the effects of corporate power, better manage the federal hydroelectric resources, and foster economic development.

Devine (1983) and, Ristucia and Solomou (2002) explains and quantify the economic effect of electrification of the United States between 1880 and the first half of the Twentieth Century.

³⁶ See Granovetter and McGuire (1998)

³⁷ Calculations based on Vennard (1968).

³⁸ See EIA (2000) and EEI (2004).

³⁹ Granovetter and McGuire (1998)

⁴⁰ See Vennard (1968)

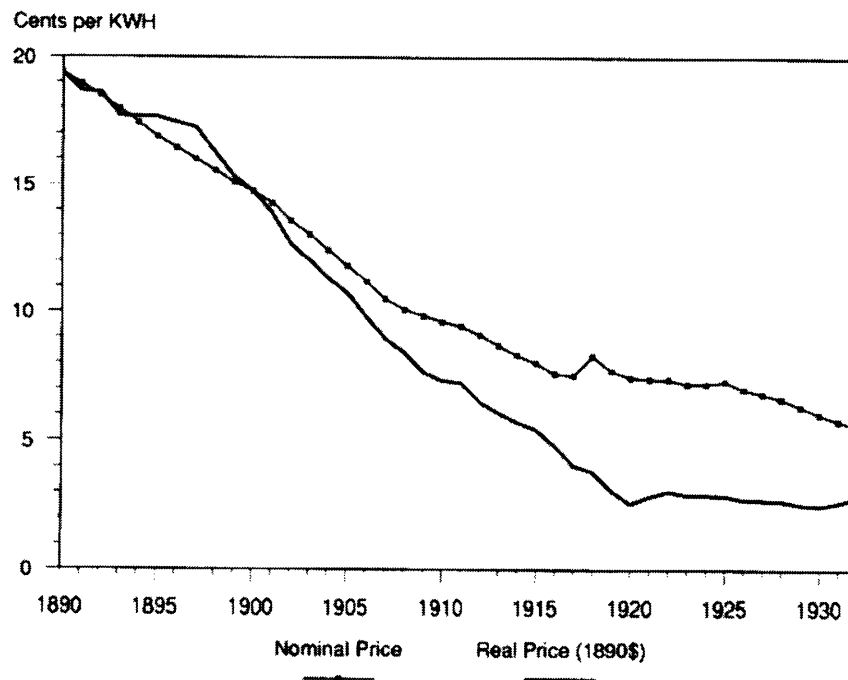
⁴¹ See EIA (2000).

⁴² See EEI (2004)

Indeed, the role of electric utilities increased in its second decade as electricity became the most important resource for driving machinery and, thus, productivity⁴³. According to Nye (1990), independent stations were the only source of electricity in rural areas by 1930.

Municipal competition was not welcomed by investor-owned companies (Vennard 1968). The private sector accused that MEUs access to lower-cost capital and total or partial tax exemptions creating an unfair advantage (Fox-Penner 1998; Vennar 1968). MEUs, however, are object of levels of public scrutiny beyond any private holding and, additionally, have lower economies of scale than large generators and distributors (Emmons 1991).

Figure 10: Average Nominal and Real Price of Residential Electricity 1890-1930



Source: Emmons (1991).

Thus, reality shown that private companies charged “*significantly higher rates than publicly owned ones through pricing strategies unconstrained by regulatory oversight*” (Emmons, 1990). On average, the price charged by private companies was 28% higher than public firms. From this difference, MEU’s advantage in cost of capital was estimated to be in the range of 11-14%, meaning that monopoly rents were about 14-17%⁴⁴. These figures support MEU’s objectives towards fostering competition and enhancing regional economic development. Figure 10 shows the evolution of price for residential electricity between 1890 and 1930. This might be the result from economies of scale, new technology and the increasing public utility competition in some

⁴³ See Devine (1983) and EIA (2000).

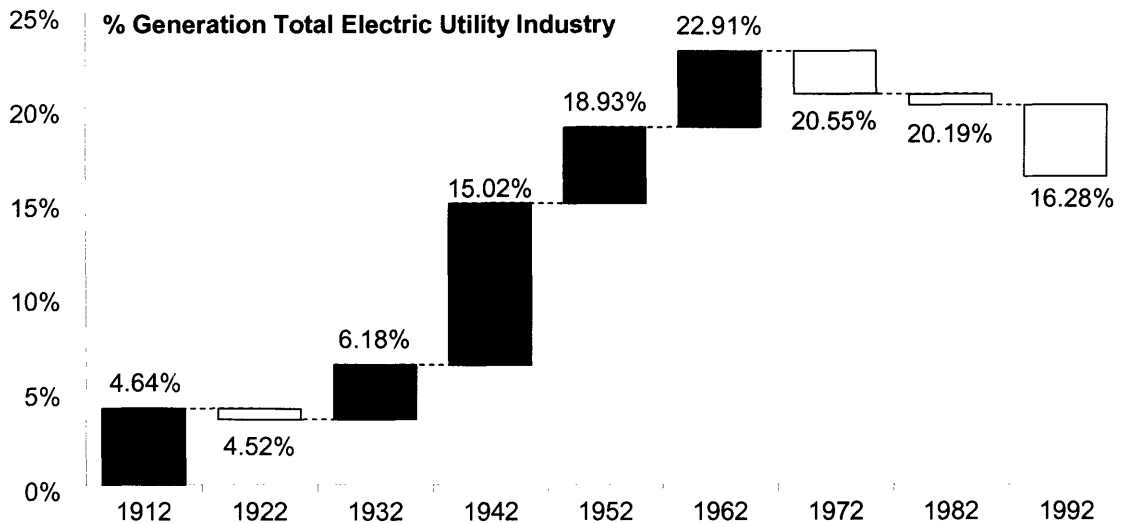
⁴⁴ See Emmons (1991).

areas. The real price of electricity for residential customers fell in more than four times between 1890 and 1932, reaching 2.89 cents per kWh by 1945 (EIA, 2000).

The “Utility Problem”, as Franklin D. Roosevelt called the issue of public utilities competing with private business, was born. Competition and economic development were among the major issues in FDR’s Presidential Campaign of 1932. He supported private action in utilities as general rule *“the development of utilities should remain, with certain exceptions, a function of private initiative and private capital”*⁴⁵. He also stated that, as cited by Emmons, *“where a community...is not satisfied with the service rendered or the rates charged by a private utility, it has the undeniable basic right...to set up, after a fair referendum...its own governmentally owned and operated service”*.

Consequently, he proposed federal regulation, funding for federal power initiatives and support for MEUs. Emmons (1993) showed that state service commissions had little or no impact in affecting electricity prices. Indeed, he shows that public competition and the New Deal’s federal policies were responsible for driving prices down⁴⁶.

Figure 11: Generation of Publicly Owned Utilities as Percentage of Total Industry 1902-1992.



Source: The author, based on EEI (1995)

Public participation in generation of electric power almost tripled between 1922 and 1942, reaching about 23% of the total power generated by the early sixties (See Figure 11)⁴⁷. Municipal electric utilities averaged a contribution of 4.3% between 1912 and 1992, with minimal variation through the years. Currently, there are about 2,000 operating MEUs serving about 14.6% of the

⁴⁵ The New York Times, Sept. 22, 1932, as cited by Vennard (1968).

⁴⁶ See Emmons (1993), pp. 890.

⁴⁷ See EIA (2000), Ch. 2, Table 1.

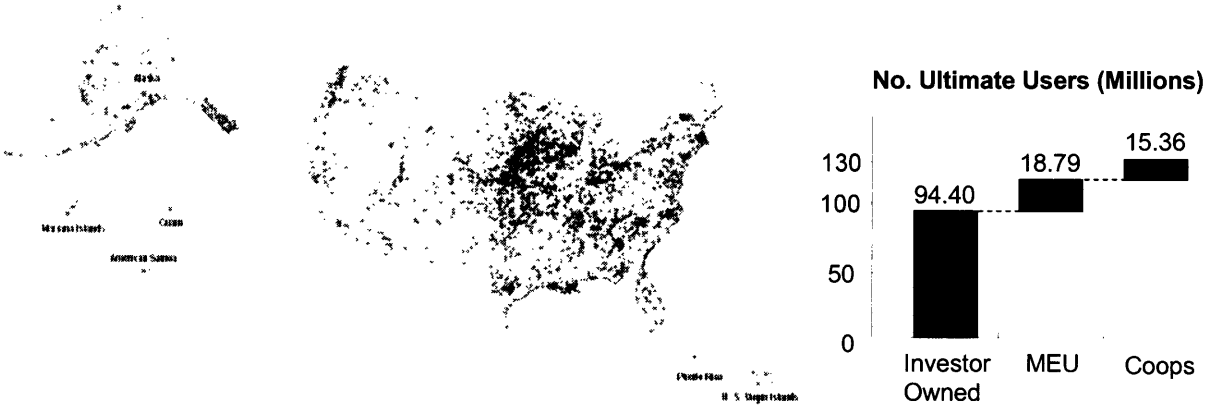
market, measured as final customers⁴⁸. Also, there are a little less than 900 rural cooperatives with 11.9% of the market⁴⁹. From all MEUs, most of them are located in the Midwest, Southwest and Southeast regions (See Figure 12).

The modesty of these numbers and its growth rate appear to confirm that public utilities in general, and municipal in particular, were not born as a big-government dream of someone eager to combat private initiative, as Vennard (1968) appears to suggest, but to address very specific and local objectives. Indeed, the relationship between public utilities and regional economic development appears to be in the very foundations of its role since the adoption of electric power in 1882.

Eger and Becker (2000), in a special report prepared for the APPA, summarizes the MEU approach as an orientation towards helping localities to meet the new demands and challenges that new technologies or economic waves impose in people, business and the public sector.

Organizational behavior and decision-making result from many factors, but especially from their embeddedness in the mix of different structural, cultural and political contexts resulting from their own history. In this way, MEU's own history has shaped their response to today's technology and economic problem of accessing advanced telecommunication services.

Figure 12: Geographic Dispersion of MEUs and Number of Costumers by type of Utility 2002



Source: APPA

Source: the author, based on APPA

Information and communication technologies are so relevant for the economy because they are general-purpose technologies. As such, they have become central to the operation of the majority of today's engineering systems, including electric power generation and transmission systems. As electric utilities needed a better control of power grids, they started the deployment

⁴⁸ See EEI(2004) and APPA fact sheet at <http://www.appanet.org/About/appa/APPAFactSheet.pdf>

⁴⁹ See <http://www.appanet.org/about/statistics/utilitystatistics2001.pdf>

of fiber optics during the eighties. These networks only required about 3% of their capacity, and there were estimated 40,000 miles of dark fiber laid out by the end of the nineties⁵⁰.

During the same time, the public sector in general -and public utilities in particular- started facing an increasing pressure for performing well given the approach towards privatization (Donahue 1989, Savas 2000). From this perspective, using the unused capacity of their installed infrastructure was not only a logic step towards a more efficient use of resources, but also mandatory by the political environment surrounding public management of resources. The emergence of the Internet and deregulation of the telecommunications industry increased the relevance of, and demand for, advanced telecommunication services.

Besides a more effective use of available infrastructure, three additional factors increased MEU involvement in telecommunication services. First, the effect of the 2000 Recession on investment decisions in telecommunications, and past overinvestment by major telecommunication in old and less effective technologies –e.g. Iridium Project- had an effect on present plans for investment. Second, major telecommunication companies such as WorldCom and Global Crossing have filed for Chapter 11 confirming the alerts that new infrastructure deployments by the private sector might take some time to reach low-density and rural areas. Third, some localities decided to react against high-priced and low-quality services in the provision of cable television⁵¹.

There was, however, a global movement towards achieving higher competitiveness based on strategic use of ICT. Thus, the opportunity for people and businesses in small and rural communities relied on the initiatives taken by local utilities. MEUs, grouped around the American Public Power Association (APPA), approached this problem within the context of their role on local economic development. Thus, it is not surprising that providing telecommunication services had become a major area of business⁵².

As explained later in this document and following Gillett, Lehr and Osorio (2002), at least 445 MEUs offered at least one type of telecommunication service by 2002. The breakdown, in general terms, shows (i) 53% of these providing service to residential and/or commercial customers (53%), almost 5% providing high-speed data connections for municipal governments, and (iii) a little over 42% providing internal services for the MEU itself such as voice, System Control and Data Acquisition (SCADA), or Automated Meter Reading (AMR)⁵³.

The first case of municipal broadband network was Glasgow, Kentucky, in 1989. Since then, many towns, such Palo Alto in California, and Tacoma in Washington, have followed the path. The City of Lompoc in California, for instance, has a municipal electric utility since 1923 that still serves its population of 41,000. The MEU is considering deploying broadband networks in

⁵⁰ See Eger and Becker (2000)

⁵¹ Wall Street Journal (2001)

⁵² See <http://www.appanet.org/legislativeregulatory/broadband/index.cfm>

⁵³ The data for service per MEU has been provided by the American Public Power Association.

order to increase economic development and create a comparative advantage, as stated by Jim Beck, Director of Lompoc's Utilities⁵⁴. Lompoc intends to change its economy from one based on flower seed production, to one focused on high technology in aerospace, by taking advantage of its proximity to Vandenberg Air Force Base.

In a similar effort, Dalton Utilities, Georgia, started deploying a high-speed network around August to 2003 in an effort to increase economic development and support Dalton's objective of becoming the "Carpet Capital or the World"⁵⁵. According to Warren Publishing (2003), there were at least twelve private and municipal electric utilities testing high-speed communications through power line communications in the beginnings of 2003.

3.2 Local Government Discretionary Authority

This section analyzes how the ability of local governments for decision making about issues concerning their constituencies matter in the possibility for creating value from civic mobilization. It also outlines how this ability varies across states and, some times within states, and how this would affect the possibilities for local economic development.

The federalist system assumes that each level has the ability to make decisions without the approval or need of permission of other level⁵⁶. In this manner, it is one of the most efficient ways to distribute power and responsibilities in government. There is not, however, total independence among federal, state or local organizations.

While people elect most local governments, the Constitution of the United States does not mention local governments. Since the beginnings of the Union, towns and cities were created by state legislature, granting a charter for each new locality. As such, state governments have assumed that local government's authority comes directly from the state legislature, and not from the people who elected local officials. This tradition was adopted from English law when 95% of the American people lived in rural areas⁵⁷.

Economic development, increasing municipal corruption, population growth and new technologies, however, changed the face of local communities and their governments started looking for greater levels of authority⁵⁸. This increased the state's involvement on municipal affairs as well as the opposition to state control. In 1865, Judge John F. Dillon's ruled that, in few words, local government could only exercise the powers that were (i) "granted in expressed words", (ii) "necessarily or fairly implied in or incident to the powers expressly granted", or (iii)

⁵⁴ PBI Media (2003)

⁵⁵ Business Wire, August 26th, 2003, on "Dalton Utilities selects Alcatel Fiber-to-the-User System"

⁵⁶ Macmahon (1972) and Hanson (1998)

⁵⁷ Lang (1991) and Elazar (1991).

⁵⁸ Hanson (1998) and Lang (1991)

“essential to the declared objects and purposes of the corporation, not simply convenient, but indispensable”⁵⁹.

Judge Dillon’s rule changed local government’s autonomy and scope of action, limiting their discretionary authority to what was explicitly allowed by state law. This is especially relevant because when interpreted rigorously, according to Hanson (1998), Dillon’s rule can give to the state most of local authority for policymaking. Thus, local self-governance was highly inefficient in some places given that most matters would have to pass through the State capital, regardless of their simplicity.

The objective of creating a new city or town, however, was supposed to follow the people’s desire to create community and manage their own affairs. In the context of Dillon’s Rule, the idea then was generating a state-local relationship that would allow some degree of self-governance and discretion in exercising authority, but subject to state guidelines.

Nearly at the same time, a different vision is born. In 1871, Judge Thomas M. Cooley, from Michigan, ruled in a completely contrary way, nullifying a state law oriented to appoint public officials in Detroit’s Board of Public Works. In *People vs. Hurlburt* (1871) the Michigan Supreme Court found that state law only was allowed to declare whether those officials could be elected, or appointed by the local government⁶⁰.

This rule, known as Home rule, established that local governments had some intrinsic right to self-governance as well as state government had rights to control over its political units. According to Timmons (1993), Home rule involves (i) the autonomy of local governments to manage their local affairs, and (ii) avoid interference from the state.

Home rule might take many forms, and allow latitude in local decision making in different areas and issues (Hanson, 1998). Thus, there is high heterogeneity on levels of local government in the United States. As example, the constitution of the state of Illinois, in section 6 or chapter 7, defines that home rule unit is a “[c]ounty which has a chief executive officer elected by the electors of the county and any municipality which has a population of more than 25,000 are home rule units. Other municipalities may elect by referendum to become home rule units”.⁶¹

Thus, the level of discretionary authority of local governments in the United States varied across states and, in some cases, within states. In any case, either under Dillon’s or Home rule, state law is an active boundary against which local governments exercise their authority. In the case of telecommunication services, there is not black and white between Dillon’s and Home rule with respect to their effect on the possibilities for MEU to engage on broadband deployment. Often both can coexist in the same state (Carlson 1999).

⁵⁹ In Dillon's decision in *Clark v. City of Des Moines* (1865) as cited in Richardson, Zimmerman and Puentes (2002).

⁶⁰ See Richardson, Zimmerman and Puentes (2002).

⁶¹ <http://www.legis.state.il.us/commission/lrb/con7.htm>

Indeed, Richardson, Zimmerman and Puentes (2002) find that many local governments are moving along with low levels of discretionary authority to pursue local development projects. They created a state index of discretionary authority for local governments, presented in Exhibit 2.

The index is a composite of two sub-indices: a first sub-index considering only discretionary authority for cities, and a second sub-index considering counties only. According to them, 39 states adhere to Dillon's Rule limiting the power of local governments (31 of them for all municipal governments, and 8 of them selectively). Interestingly, they point out that 7 out of 10 best-ranked states on this index adhere to the rule, suggesting that Dillon's Rule might not affect local decision-making.

The importance of state-local relationships increased over time resulting from higher citizens' demand for service and efforts for decentralization and deregulation of the federal government. This might be indication of changes in local discretionary authority, but other actors that can also affect it: the federal government and the judiciary.

3.3 The Telecommunications Act of 1996 and State and Local Policy Collisions

There is no doubt about the importance of the Telecommunications Act of 1996 for the development of information and communication technologies. This law, however, was particularly important for public organizations involvement in providing telecommunication services at the local level. Beyond the political discussion about the role of public sector in telecommunication services, a problem arose from the lack of alignment, or collision, among federal, state and local government policy.

At the federal level, the 1996 Telecommunications Act states that “[n]o state or local statute or regulation, or other state or local requirement, may prohibit or have the effect of prohibiting the ability of **any entity** to provide any interstate or intrastate telecommunications service.⁶²” The problem results from the lack of specification about the word “any” by the FCC and the Congress.

Does “any” mean any public or private entity, or just any private entity (or other than public)? The problem arises because everything not explicitly stated in the Act is left to interpretation.

This problem is now trying to be solved in courts. One may agree with Judge James P. Jones, of the U.S. District Court for the Western District of Virginia, in his ruling favoring the municipal utility in the case of the City of Bristol, Va., etc., v. Mark L. Earley, Attorney General, et al. The problem was generated due to a Virginia statute that, as cited on the ruling, provides that:

⁶² U.S. FCC, Telecommunications Act of 1996, Section 253a. Text in bold is included to emphasize the relevance of the word.

“no locality shall establish any department, office, board, commission, agency or other governmental division or entity which has authority to offer telecommunications equipment, infrastructure,...or services...for sale or lease to any person or entity other than (i) such locality’s departments, offices, boards, commissions, agencies or other governmental divisions or entities or (ii) an adjoining locality’s departments, offices, boards, commissions, agencies or other governmental divisions or entities, so long as any charges for such telecommunications equipment, infrastructure and services do not exceed the cost to the providing locality of providing such equipment, infrastructure or services.(Va. Code Ann. § 15.2 1500(B) (Michie Supp. 2000).”

Judge Jones stated, *“I hold that the words **any entity** in the federal statute plainly include a municipality. The issue is not whether allowing local government to compete with commercial providers is good public policy or not. That decision has been made by Congress, and under the Commerce Clause of the Constitution, its decision trumps any conflicting state law.”*

A different issue is whether allowing local government competition in the telecom market is good or bad public policy. As previously mentioned, Riordan (1992) work on technology adoption provides evidence to suggest that, given that costs of technology deployment decrease over time, there would be incentives for companies to slow timing of deployment. These incentives would exist specially in towns located far from large cities (cost of deployment increase with distance), and are likely to be created by the expected perception of competitors entering the market. Thus, companies will decide to serve markets only when not doing so would mean a high risk for losing the market.

This dynamic would explain why some municipal utilities have decided to deploy their own infrastructure as a way to speed-up the process of adopting new high-speed always-on communication technologies. To this respect, Riordan result would support that any “price and entry regulation may slow technology adoption by making preemption strategies less attractive.” Additionally, as presented in section 3.1 municipal electrics have had a traditional and very special role in supporting technologic catch-up and economic development in small localities.

As pointed out in section 3.2, despite the democratic significance legitimacy of local governments, they are not free to decide for themselves in all matters regarding self-governance. Their level of discretionary authority varies across states, and within states, and is subject to state legislature.

Thus, the problem is created by the collision of (i) Section 253(a) of the Telecommunications Act of 1996, (ii) what local governments are doing in telecom business in order to speed-up adoption of new technologies, and (iii) what they can do given the State legislation. This had lead to two major cases now in the Supreme Court, Abilene in Texas and Missouri Municipal League, which have finished with contradictory results. This section will use the Missouri case to illustrate the complexity of the problem, referring to the Abilene case when necessary.

The City Utilities of Springfield, MO, planned offering Internet and telephony services. Missouri statutes, however, states in its section 392.410(7) that:

*“No political subdivision of this state shall provide or offer for sale, either to the public or to a telecommunications provider, a telecommunications service or telecommunications facility used to provide a telecommunications service for which a certificate of service authority is required pursuant to this section”*⁶³

In 1998, the Missouri Association of Municipal Utilities and several municipalities tried to challenge the Missouri statute by asking for a FCC *preemption* of the statute due to violation of Section 253(a) of the 1996 Telecommunications Act⁶⁴. The FCC concluded that, in this case, “any entity” did not include municipalities⁶⁵. The case was brought to the Eighth Circuit of the United States Court of Appeals, which vacated FCC’s decision stating that:

*“... because municipalities fall within the ordinary definition of the term “entity,” and because Congress gave that term expansive scope by using the modifier “any,” individual municipalities are encompassed within the term “any entity” as used in § 253(a)”*⁶⁶

An opposite decision was reached by the DC Circuit of the US Court of Appeals in the matter of the City of Abilene, Texas, versus the Federal Communications Commission. In this case, the city took the case to the Court of Appeals because the FCC denied its petition for declaratory ruling in pro of preemption of the Telecommunication Act of 1996 over the Texas Public Utilities Regulatory Act of 1995. FCC ruled that municipalities were not an entity different from the state (FCC 1997). Thus, there is no uniform application of the 1996 Act across the United States.

After the Missouri decision, in October of 2002, Missouri’s Attorney General filed a petition for a *Writ of Certiorari* to the US Supreme Court in the matter of the ruling of the Eighth Circuit of the US Court of Appeals⁶⁷. The FCC and Southwestern Bell seconded the petition for review,

⁶³ See <http://www.moga.state.mo.us/statutes/C300-399/3920000410.HTM>

⁶⁴ See APPA (2004). Preemption is a judicial principle that declares that federal law is over state legislation about a specific subject.

⁶⁵ See FCC (2001). It states “The Commission has found previously that political subdivisions of a state, such as a municipality, are not “entities” under section 253(a) of the Act”, in reference to the case of Abilene, TX.

⁶⁶ See U.S. Court of Appeals 299 F.3d 949, 2002 WL 1842319 (8th Cir.)

⁶⁷ A Petition for a Writ of Certiorari is a document presented by losing parties of the ruling of a lower court to the US Supreme Court in order to reverse the ruling. According to the rules of the US Supreme Court (Rule 10) the review of such petition is not a matter of right and, as such, the Supreme Court might decide not to review it, in which case the ruling of the lower court stays.

with the support of *Amici Curiae* from Sprint, the US Telecomm Association, Verizon, Bellsouth and CenturyTel⁶⁸.

The Missouri Municipal League opposed to the US Supreme Court hearing and its responding brief to the *Writs of Certiorari* was supported, also by *Amici Curiae*, by the High-Tech Broadband Coalition, Consumer Federation of America, Educause, Local Government Associations, Virginia Municipalities, Texas Municipalities, Lincoln Electric Systems, United Telecom Council, Knology Inc. and Congressman Rick Boucher.

The support to the State of Missouri, FCC and Southwestern Bell by companies that not operate in the region, as well as the broad support for the Missouri Municipalities League, is a signal of the importance of municipal provision of telecommunications services for different actors. It is also evidence of the interest and resources invested in making new law by the decision of the US Supreme Court. More interestingly, however, it is an example about the magnitude of the collision among federal, state and local policy. The hearing was carried out on January 12th of 2004.

In March 24th, the U.S. Supreme Court decided that states governments have the authority to preempt or allow their political subdivisions for offering telecommunication services. The decision stated that FCC faculty to preempt states from prohibiting “*any entity*” to enter the telecommunications business did mean to include political subdivisions of the state in general, and MEUs in particular, in the term “*any entity*”. Thus, Federal can only preempt state and local laws and regulations that limit independent entities from the state and subject to state regulation.

Lubbers (1998) and Zaring (2004) state the general relevance of trial courts for rulemaking. Given this, the core of the issue goes beyond misalignment between federal, state and local policy, but to the extent to which court rulings “*should not interpret a federal statute in such a way that the interpretation intrudes upon an area traditionally regulated by the states without a “clear expression” of congressional intent*”⁶⁹. Interestingly, as previously noted, the language of the Act is very specific when considering the private sector and, in terms of clear expression of congressional intent, maybe “*any entity*” really meant “*any entity*”.

Representative Rick Boucher (D., Va.) and Senator Trent Lott (R. Ms.) and have stated that FCC interpretation of “*any entity*” does not represent congressional intent⁷⁰. Furthermore, Senator Lott’s views are expressed when he says “*I think the rural electric associations, the municipalities, and the investor-owned utilities, are all positioned to make a real contribution in this telecommunications area, and I do think it is important that we make sure we have got the right language*”

⁶⁸ An *Amici Curiae* is the name given to a file for a specific case in a court by someone that is not a party directly involved in the case. This is allowed in case the petitioners believe the court’s ruling can affect their interest.

⁶⁹ See Gregory v. Ashcroft 501 U.S. Supreme Court 452 (1991).

⁷⁰ See <http://www.icoreinc.com/images/novdec2003.pdf> and

to accomplish what we wish accomplished here”⁷¹. Moreover, he thought the Act was “...a framework where everybody can compete everywhere in everything”⁷². Maybe, at that moment, “any entity” was indeed the right language.

There is little discussion that competition is good for the consumers, and there is evidence that MEU involvement in broadband have created competition. One example is Tacoma, Washington, where in 2001 AT&T Broadband charged \$2 more than the local cable company, but 20% less than the same service AT&T offered in Seattle⁷³.

Not all states have made explicit policies about this issue. Iowa and Georgia have authorized municipalities to deploy broadband networks (Carlson 1999), while Arkansas, Florida, Minnesota, Nevada, Tennessee, Texas, South Carolina, Utah, and Washington have laws preventing municipalities for offering telecommunication services⁷⁴. At least temporarily, in the cases of Missouri Municipal League, Lincoln Electric System, Nebraska, and City of Bristol, Virginia, court rulings have found that “any entity” includes municipalities.

The importance of the Missouri case relies in being the first to reach the U.S. Supreme Court, and that its decision left to the states the ability to allow or block local government units for offering advanced telecommunication services. Regardless of the effects of this decision on telecommunications competition and municipal electric utilities, it helps to generate non-uniform federal telecommunications policy in the United States and, as with Dillon’s Rule, also within states.

As Zaring (2004) states “If examined through a wider lens, institutional reform litigation has national, systemic implications, and, indeed, can create uniform federal law. This law is not imposed vertically, by appellate tribunals, but rather spreads horizontally, from trial court to trial court, like nodes in a nationwide network”. In this case, the Missouri case is one that will have important repercussions.

3.4 Examining the Role of Municipal Electrics in Delivering Telecommunication Services

Building on the previous discussions, this section examines the policy, regulatory and political justifications for local government involvement in deploying and providing telecommunication services, with special emphasis on (i) the dualities among private and public roles, ends, and means, and (ii) existence of incentives for private action in the presence, and absence, of active public organizations.

⁷¹ Hearings on S.1822 Before the Senate Committee on Commerce, Science and Transportation, 103d Cong., 2d Sess. (1994), A&P Hearings S.1822 (Westlaw) at *378-379 as cited in NTIA (2001)

⁷² 141 Cong. Rec. S7906 (June 7, 1995) as cited in NTIA (2001)

⁷³ Wall Street Journal (2001).

⁷⁴ See PennWell (2003)

3.4.1 Public Role on Service Delivery

Donahue (1989), Savas (2000), and Stiglitz, et al. (2000), among others, analyze many of the reasons in pro and against public sector involvement in different activities.

Donahue (1989) provides a basic framework to analyze privatization that can be extended for studying public sector initiatives in different areas, by considering the dimensions of financing and performance of initiatives. In terms of financing, the question is whether the good or service to be delivered should be paid individually or collectively. In other words, should each person pay for the good from its own pocket, or by collectively raised funds (e.g. taxes)? In terms of performance, the major question is who should produce or deliver the good.

In this context, Donahue defines a delivery-payment matrix explaining services that are delivered by the public and private sector, and paid collectively and individually. In the context of this research, the most interesting quadrant is the one where goods and services are produced by the public sector, and paid –at least in part- individually (See Figure 13). He points out three general reasons for supporting public spending: (i) the presence of market failure, (ii) moral or philosophical reasons for collective action or decision towards supporting “non-market goals”, and (iii) an “opportunist” view of possible effects of such public spending⁷⁵.

Figure 13: Municipal Telecommunication Services in the Matrix of Public/Private Choice

	Collective Payment	Individual Payment
Public Sector Delivery	<p>Homeland Security, FBI, Public Schools, police departments, etc.</p>	<p>US Postal Service, National Park Service system, NASA (launching satellites) Census Bureau (data), etc. Municipal Electric Utilities <i>Municipal Telecommunication Services</i></p>
Private Sector Delivery	<p>Government procurement, Consulting services to public agencies,</p>	<p>Purely private products</p>

Source: Prepared based on Donahue (1989)

The first reasons –market failure and moral grounds- are of interest for this research. First, as pointed out by Stokey and Zeckhauser (1978), market failure can be caused by many factors. Two of them are (i) transaction costs that are high enough to prevent production or delivery of the good and (ii) excessive market power on demand or supply that can affect adequate pricing.

⁷⁵ Quotes in original version. Donahue (1989), p.17.

Second, moral or philosophical grounds can alter the definition of a “*public good*” making it highly context-dependent.

These reasons can be considered jointly in the analysis of the lack of advanced telecommunications infrastructure:

- 1 High relative investment costs prevents current deployment of advanced telecommunication services, making them unavailable for communities that are far from places where they are currently available of being deployed (Riordan 1992). As such, advanced telecommunications services are commonly available in richer, denser and most populated areas.
- 2 As evidence suggest, the existence of common problems in social groups with high levels of social capital have high likelihood of collective action towards their solution (Woolcock 1998, and Putnam 2001). At the town or community level, part of this collective action is expressed in political activity and mobilization of resources towards the obtaining goals and ends (Hampton and Wellman 2002). Thus, from philosophical grounds, a community can define to act –and pay- collectively for solving a common problem: unavailability of advanced communications infrastructure.

From this perspective, the lack of private provision of telecommunication services is enough to motivate collective action for getting those services. Now, should make a difference if people organize themselves around a public organization, or by creating an NGO or a private company? For practice purposes maybe not but, as previously discussed, local governments do not have full discretionary authority to pursue the desire of their constituencies.

Savas (2000) has a somewhat different position on the public role’s provision of goods and services. His approach considers a more refined definition of goods classifying them into “individual” (or purely private) goods, “collective” (or purely public) goods, and “toll” and “common-pool” goods. Common-pool goods have the characteristics of being non-excludable, hard to charge for its consumption, running the risk of depletion, and having no private provider.

Toll goods are similar to individual goods in the sense that, as expressed by Savas, “exclusion is readily possible” and users have to pay for services. The problem relies in the fact they “present problems that require collective action”. His examples are communication services and network utilities, and his proposed solutions range from purely public to purely private provision or services.

In Savas’ view, toll goods options for “delivery arrangements” are various and consider a variety of dimensions for analysis. Besides the typical of efficiency and effectiveness, size of government, relationship to cost and benefits, among others, three are of interest for the purpose of this research: (i) economic equity, (ii) racial equity, and (iii) responsiveness to government direction. The equity dimension considers the extent to which the “delivery arrangements” fail to serve customers in “fair and equitable manner”, which implicitly includes the failure to provide services due to lack of incentives, or presence of market failure. The

dimension of responsiveness to government action includes a powerful reason for municipal involvement in deployment of advanced telecommunication services: economic development (as a major government function).

Most of Savas' work is oriented towards minimizing public competition in areas where the private sector can play an active role, which is supported by Stiglitz, et al. (2000). They state "[t]he presence of significant private-sector activity generally raises a *prima facie* case against the existence of a public good." The problem still relies in areas where there is no advanced telecommunication services service and no private sector provision, and people's choice is expressed and proposed by collective action through their local government bodies. Eisenach (2001) stress the point of public sector inefficiency in managing productive ventures to make the point that government does not belong in the telecom business. He does not address what to do under lack of availability of advanced telecommunication services.

There is tacit agreement that solutions should look for the combination of public and private initiatives. In terms of Clark, Gillett, Lehr, Sirbu and Fountain (2002), this is equivalent to find "*where the dividing line is drawn between public and private responsibility.*" However, as one might suggest from Savas, this is highly context-specific as the purely private and purely public roles are separated by nine mixed-strategies along this dividing line.

A strong argument against public involvement in service delivery is, in the specific case of municipalities, the financial advantages. In the case of MEU this means the possibility of financing infrastructure development with taxes and bonds, at longer periods. There is, however, a major competitive disadvantage of public organizations with respect to corporate actors: public organizations are subject to compulsory public scrutiny.

While corporations must respond to shareholders, public organizations are bound by total transparency and accountability about their actions and procedures, which some people, companies and non-governmental organizations enforce. It is unlikely that corporate actors could achieve this type of openness responsiveness and, at the same time, continue performing their activities as business as usual.

Finally, analyzing deployment of advanced telecommunication services at a national or state level is inherently different than studying its local evolution and, as such, there is no one-size-fits-all policy approach. Even considering the approach of Newbury (1999) for introducing competition into network utilities fails to recognize the particularities when the studied system is, for instance, a rural town with 2,000 people.

In this context, Strover and Berquist (1999) presented a key open question towards "*...discover[ing] the policies, regulations, and practices that lead to advanced telecommunication infrastructure serving the...population equitably*".

The problem is not whether the public sector should or not compete with private companies in providing telecommunication services, but (i) is there a public role when there is no provision at all, and (ii) can a public actor help to foster competition?

As a result, this research has been motivated by different factors. The increasing number of public initiatives of deployment of telecommunication services, and collision between federal, state and local policies are two of them. The most interesting, however, is the space of unanswered questions on policy reasons and options for collective action, expressed by public agencies, for addressing the lack of availability of telecommunication services, and dealing with issues of equity and economic development.

3.4.2 Brief Comments on Broadband Services

As briefly discussed on the introduction, the importance of ICT for economic development has been established (Jorgenson 2001). There is rising consensus about the importance of Broadband which has said to *"[represent] the next phase in the evolution of the Internet. [It is expected it] will enable applications and services that [will] transform our economy...and usage of broadband will significantly impact the global competitiveness of nations and businesses in the future"* (U.S. Department of Commerce 2002.)

The increasing relevance of the issue started to move things in Congress as well as Senator Lieberman (D-CT) presented the National Broadband Strategy Act (June 6, 2002) under the believe that making "affordable, high speed broadband Internet connections... available to all American homes and small businesses has the potential to restore structural productivity and employment growth."⁷⁶

Broadband deployment, however, is (i) costly, (ii) the telecom companies are not in their best financial shape, (iii) these investments are risky (as depend on demand that does not respond only by having access, but also by having content), and (iv) these investments are sensitive to cost-per-passing and, therefore, to housing density (Owen 2002, and National Research Council 2002).

As result of the previous issues, broadband deployment has been inexistent or slow especially in small towns, rural and sub-urban areas. Private initiatives have failed to deliver quality at affordable prices (Strover and Berquist 1999; Shultz and Sukow 2000).

The response to this problem has been an increased pressure for local communities to act in order to attract investment and business activity, and boost economic development and employment through the deployment of high-speed communication infrastructure. According to the previous issues, and given the discussion in chapter 2 about municipal electrics and broadband technology, it is not clear whether one could expect a purely private solution to the broadband issue (understanding the "issue" includes ubiquitous broadband access outside major metropolitan areas).

If one considers that the 1996 Telecommunications Act has failed to promote competition in rural areas, it is unlikely that prohibiting the operation of MEUs in the broadband arena would

⁷⁶ See <http://www.techlawjournal.com/cong107/lieberman/20020605.asp>

motivate private actors to provide broadband services by eliminating the “unfair” public competition.

From the perspective of private actors with active financial constraints, the U.S. Supreme Court’s reversal of the ruling of the Eighth Circuit of the U.S. Court of Appeals has important implications. It is possible that some MEUs will have to face the sunk costs of broadband infrastructure that will not longer be used. This would present an opportunity for privatization and for telecommunication companies to acquire deployed infrastructure at a fraction of what would have cost.

3.5 Conclusions for an Analytical Framework for Policy: directions for research

The previous sections have delineated some of the most important factors affecting the issue of municipal electrics involvement on telecommunication services. By the very nature of the problem and the availability of data, not all issues are appropriate for quantitative analysis.

Hence, the issues represented by quantitative data are included as variables on the model presented in next section. The issues of qualitative nature, or without available data, are included on the analysis of results.

In this scenario, the best alternative is to start with an empirical analysis of basic hypotheses with the available data, and follow with a sensitivity analysis that could include the effect of qualitative issues in some of the key independent and control variables.

Table 2: Limitations and Issues included in Quantitative and Qualitative Analysis

Quantitative Analysis	Qualitative Analysis	Possible Limitations
<ul style="list-style-type: none"> • Availability of private providers at local level (DSL and Cable Modem) • Discretionary authority of local governments • Local socio-economic characteristics (income, occupation, education, racial characteristics of population) • Cost of investment (proxied by density of local business and housing density) • Urban/Rural dimension, or distance from major metropolitan areas • Effect of state-level telecommunication regulation 	<ul style="list-style-type: none"> • Technology arguments for using MEUs available infrastructure to supply broadband. • Engineering System Embeddedness: historical context of MEUs, and traditional role on economic development. • Collective action and role of local governments • Effect of politics on the interpretation of federal legislation. • Relevance of Supreme Court rulings and Congressional intent for interpreting the 1996 Telecommunications Act • Differences in analyzing competition at regional, state and local level: evidence of effects of local competition 	<ul style="list-style-type: none"> • The number of qualitative issues outside the scope of the empirical model will probably generate a model that, while answering the major research questions, would have omitted variables. • In this context, the analysis of results will include a section discussing alternatives for addressing these issues, and further directions for research on the topic.

Source: the author.

The major objective of this research is testing the effect of local discretionary authority and availability of private provision of services on the MEU involvement in broadband services. Multinomial logit will allow analysis of testing the effect of the previous variables on the probability of MEUs for offering different services in different modes: only for residential customers, both to residential and commercial, only to commercial users, and no services at all.

The next sections present the methodology for empirical analysis of quantitative data, major hypotheses and results. These sections include discussions about the different ways in which the qualitative issues would affect some quantitative variables, and policy recommendations.

Table 2 presents the list of issues included on the quantitative and qualitative analysis, as well as some expected limitations of the research. The next chapter includes a section detailing the sources and description of each quantitative variable.

4 Methodology

This chapter highlights the research questions, data sources, and methodology behind the empirical study. The chapter has four sections. The first section, 4.1, presents an overview of what the study seeks to test, and why. Section 4.2 formalizes the research question and the hypotheses that underlie it. Section 4.3 describes the data used in the analysis and presents some summary statistics. Section 4.4 explains the empirical approach used in the analysis.

4.1 Context of the Research Question

The focus of this analysis is on the factors that influence a municipal electric utility's decision to offer advanced telecommunication services. Earlier chapters provided a qualitative review of likely influences.

First, given the historical context of the existence and evolution of MEUs, the discussion suggests that major drivers behind their involvement in deployment of telecommunications infrastructure could be the lack of availability or lack of competition in provision of advanced services, such as high-speed Internet access. This line of thought would suggest that MEUs would be more likely to take an entrepreneurial role in deploying such infrastructure in places where those services are not available, or where competitive alternatives are limited or unsatisfactory.

A second major factor may be the degree to which state political subdivisions are able to decide and implement publicly funded projects without need of explicit permission from state government. As discussed in Chapter 3 and presented by Richardson, Zimmerman, and Puentes (2003), the presence of Dillon's Rule is likely to explain part of this effect. Other important factors might be the existence of explicit state-level legislation that constrains municipal involvement in telecommunications, which according to Clarke and Gaile (1998) starts happening when cities start to become more entrepreneurial.

There is an additional aspect that could affect MEUs likelihood to enter the telecommunication business. As presented in Chapter 2, Electric utilities have used communication technologies to carry out three functions related to their core business of power generation and distribution: automatic meter reading (AMR), system control and data acquisition (SCADA) and voice, by using wireline or wireless technology options. Moreover, utility demand for enhanced IT-empowered electric power network management capabilities was expected to increase with further deregulation of the electric power industry.

Some MEUs have outsourced these services while others have built in-house capacity looking for long-term savings. In the latter case, the installed capacity for voice and data communication exceeds the needs of the MEU for carrying out its functions and, from an operational perspective, represents a stock that would generate economies of scope. Thus, MEUs involvement in telecommunications would also respond to the existence of

communication overcapacity that could meet local demand by local governments, residents and businesses at very low cost.

The analysis presented here focuses on the impact of market structure, political constraints and technical capabilities on local government on the decision by an MEU to offer advanced telecommunication services, while controlling for the possible effect of other features driving demand, or other forces that might be affecting market structure and local discretionary authority. These include a number of factors that are discussed briefly below.

For instance, the decision by a service provider to offer broadband services is likely to be positively influenced by factors that imply demand for broadband services is likely to be high (NRC 2002; Nie and Erbring, 2000; and Lookabaugh, Savage, and Sicker, 2001) or the costs of providing services low. For example, it is reasonable to expect adoption rates to be higher in communities with higher per capita incomes and educational attainment (Hampton 2003, and NTIA 2000, among others). Use of broadband by industry is associated with intensive use of IT, which has shown to be associated with high-skilled labor, increased college-educated labor force, and higher salaries (Bresnahan, Brynjolfsson and Hitt, 2002; Autor, Levy and Murnane, 2003).

On the other hand, the private sector will not only respond to characteristics of the demand but also to the associated fixed and variables costs of providing the service. Broadband deployment's fixed costs, for instance, depend on the number of units (houses and establishments) passed and their distance to places with already available infrastructure.

Thus, the investment cost for new deployments increases with decreasing density and increasing dispersion (NRC 2002) and, everything else equal, makes a business opportunity less attractive. Thus, through a "market failure hypothesis", one would expect public provisioning in markets that are otherwise less attractive since are under-served by private alternatives. Testing this hypotheses would require measuring private presence and service delivering across towns.

In the same way that broadband provision depends on a variety of issues, the disposition of a public organization to innovate in creating public value depends on different factors as well (Moore, 1995). There is evidence collective action increases in communities of high income, highly educated population and with decreasing levels of urbanity (Hampton, 2003; Putnam, 2001; Fisher, 1982).

All this evidence, when taken together, might present a picture that differs from just looking at the relevance of market structure and discretionary authority of local government. The objective of this research is to analyze the effect of these factors and test the three major hypotheses of (i) availability of competitive alternative, (ii) regulation and local discretionary authority, and (iii) "technology-push", while considering the effects of the other factors. Exhibit 3 presents a summary list and description of all variables used on this study.

4.2 Research Question and Hypotheses

In the context of the previous discussion, the analysis tests the effect on the probability of an MEU offering broadband services, $\text{Pr}(\text{MEU_BB})$ of various right-hand side variables. The regressors include measures of private broadband competition in Cable Modem and DSL, characteristics of the residential and business potential demand (e.g. income, education, salary), level of local discretionary authority (LDA), housing and business density, rural dispersion, and availability of SCADA, and special state regulations about MEU involvement on telecommunications. More formally:

$\text{Pr}(\text{MEU_BB}) = f(\text{DSL}, \text{Cable Modem}, \text{Resident}, \text{Business}, \text{LDA}, \text{density}, \text{Rural}, \text{Internal}, \text{Regulate})$

The question is whether the parameters of these variables are statistically significant and, thus, which variables matter in affecting $\text{Pr}(\text{MEU_BB})$. The previous arguments are represented in terms of the following hypotheses:

H1. The local presence of private service providers of broadband (DSL and Cable Modem) reduces the likelihood of a MEU to offer broadband services. Thus:

$$\Delta \text{Pr}(\text{MEU_BB}) / \Delta \text{DSL} < 0 \text{ and } \Delta \text{Pr}(\text{MEU_BB}) / \Delta \text{Cable Modem} < 0$$

H2. Increased discretionary authority of local governments increases the likelihood of a MEU offering broadband services. Formally, the hypothesis is that:

$$\Delta \text{Pr}(\text{MEU_BB}) / \Delta \text{LDA} > 0$$

Additionally, possible effect of state level telecommunication regulation on MEU's likelihood to offer services. Assuming Regulate is a dummy variable that equals one when there is state legislation prohibiting or making difficult MEUs involvement in telecommunication, we have:

$$\Delta \text{Pr}(\text{MEU_BB}) / \Delta \text{Regulate} < 0$$

H3. The fact that an MEU provides Internal services (AMR, SCADA, and voice) increases the likelihood it will offer services to local residential and business customers. Formally:

$$\Delta \text{Pr}(\text{MEU_BB}) / \Delta \text{Internal} > 0$$

which will be done controlling for, and testing of, variables that account for the following relationships with the dependent variables:

H4. High cost associated with low density of residents and businesses might have a negative effect in whether a locality is served at all. It is not clear, however, at which levels density might affect $\text{Pr}(\text{MEU_BB})$. *Ceteris paribus*, if the density is very low, it is possible that the costs of providing service by an private carrier or the MEU are prohibitive. At the other extreme, if the density is very high, there may be ample private alternatives for broadband service available.

Under such conditions, it is unclear whether an MEU would be more or less inclined to enter (although if entry does occur in such situations, it is not evidence of a market failure rationale). At moderate densities, the likely sign is ambiguous because two countervailing forces may be at work. On the one hand, perception of a “market failure” may make an MEU more likely to offer service when density increases; on the other hand, the implied higher costs of providing service may make the MEU less willing to provide service. Therefore, the expected sign of the probability is ambiguous:

$$\Delta\text{Pr}(\text{MEU_BB})/\Delta\text{Density} ? 0$$

H5.Characteristics of the Demand:

- Income (or wealth) is likely to provide a positive indicator of increased demand. It is not clear, however, on what range of income there is a positive relationship with Pr(MEU_BB). One might find that, for instance, Pr(MEU_BB) tends to decrease for very low and very high income, as high income places are served by competitive alternatives and very low income places are served by cooperatives and have no MEU presence.
- Average salary of the workforce is a proxy for intensity in using IT on the workplace, driving demand of high-speed Internet by business establishments. Following the previous point, it is not clear how this might affect Pr(MEU_BB).
- Higher levels of educational attainment are positively correlated with higher levels of use of IT by companies and, by increasing social capital, to easy of collective action towards common goals (such as mobilizing so the MEU can offer broadband services in absence of availability of competition). So:

$$\Delta\text{Pr}(\text{MEU_BB})/\Delta\text{Education}>0$$

H6.Distance from large metropolitan areas increases the likelihood of having a MEU, but also decrease the probability of having broadband services because they are far away from available networks, and cost of deployment is higher. Thus, there is no certainty about the sign of the coefficient. The basis for this can be found in chapters 2 and 3. Thus, one might expect : $\Delta\text{Pr}(\text{MEU_BB})/\Delta\text{Rural} ? 0$

4.3 Communities, Municipal Electric Utilities, and Telecommunication Services

This section has two parts. The first part describes the sources each major variable and describes the aggregation process data to the place level. The second part presents a descriptive analysis of key variables and identifies outliers, explaining the reasons for taking some cities and towns out of the sample.

Gillett, Lehr and Osorio (2003) present a detailed description of the characteristics of the municipal electric utilities. As matter of summary, the sample used on this survey contains

information on 1,815 from the 2,009 places in the continental United State that have a publicly owned utility.

Heterogeneity is large in many dimensions. The median population of American places is of 1,307 inhabitants and APPA communities more than double that reaching 3,108. The median size of MEUs offering telecom services only to residential customers is of 2,478 inhabitants. Median population increases to 11,628 for places with MEUS offering services to any type of customer (residential or business). The median population of places where MEUs are serving both residential *and* business customers is 12,697, while for those places serving only business customers is of 31,957. See Table 3 for a breakdown of places, average and median population, and Rural/Urban County Continuum Codes (RUCCC)⁷⁷.

This paper follows the U.S. Census Bureau’s definition of a place for treating cities, townships, boroughs, villages and Census Designated Places (CDP)⁷⁸.

Table 3: No. of Places by Type, Population and RUCCC

Type of Place	No. Observations	Average Population	Median Population	Average RUCCC	Median RUCCC
Cities	1,340	21,436	4,370	4.96	6.0
Townships	192	2,882	1,587	4.69	4.5
Borough	43	5,343	3,594	2.36	2.0
Village	202	2,241	1,263	4.77	4.0
C.D.P	38	8,762	4,111	3.89	2.0

Source: the author, based on U.S. Census and USDA.

According to the situation at the end of 2002, there were 445 MEUs offering communication services, representing 24.5% of the sample. Places are classified according to the type of customers served by the MEU’s telecommunication business⁷⁹. The database considers whether a MEU offers leased lines and fiber leasing to business users. The offering for residential users include cable television, local and long distance telephony, wireless communications, digital subscriber line (DSL), dial-up Internet, and video on demand.

Following Gillett, Lehr and Osorio (2003), Table 4 summarizes the number of places according to services offered, and differences in average and median population. While APPA places are slightly larger than the typical American average (or median), those with MEUs

⁷⁷ See subsection 4.4, point 6, for description and distribution of places according to RUCCC levels.

⁷⁸ For more information see U.S. Census (2000).

⁷⁹ APPA collects data from its associated in annual basis according to the categories presented in Exhibit 1. The purpose of this research required aggregating data into four categories, according to whether the MEUs offered services only to residential customers, only to business customers, both to residential and business customers, and whether the MEU had internal infrastructure and being self-reliant in Automated Meter Reading (AMR), System Control and Data Acquisition (SCADA), and voice services.

offering communication services are slightly larger, with the sole exception of places with MEUs serving only residential customers, which are smaller.

As previously pointed out, the analysis addresses the existence of outliers. The previous table, however, includes all observations. For the purpose of this section, the descriptive nature of the sample does not change when excluding places such as Los Angeles, CA; Phoenix, AZ; San Antonio, TX; or Las Vegas, NV. Analysis of influential observations served to identify about 200 observations that did not have values for RUCCC because of small typos in the place name, and lead to identify the entries for Las Vegas, NV, and Kokhanok, AK, as non-representative of the typical MEU included on the database⁸⁰.

Table 4: Census Places with MEUs' Telecommunication Services by Type of Customer

	No. Census Places	Average Population	Median Population
Census Places in the United States	24,861	8,019	1,307
Census Places with Municipal Electric Utilities	1815	16,690	3,180
MEUs only offering business services (no residential)	66	148,522	31,954
MEUs only offering residential services (no business)	69	5,852	2,478
MEUs offering both business & residential services	101	23,668	12,697
Total MEUs serving External Customers	236	53,376	11,628

	No. Census Places	Average Population	Median Population
MEUs offering only Internal Services	187	11,207	2,765
MEUs offering Internal Services, and also serving Residential and/or Business	140	82,856	18,417
Total MEUs with Internal Services	327	53,423	13,178

Source: Gillett, Lehr and Osorio (2003)

4.4 Data for Hypotheses Testing

This subsection presents the data used to account for the effect of the other variables included on the analysis, their sources, and some underlying assumptions and previous research supporting their choosing:

- 1 **Private Telecommunication Service Providers:** (Testing of H1) The existence of private providers of high-speed Internet access is accounted by the availability of DSL and leased lines, and cable modem Internet access in each place, by the two following variables:
 1. **DSL and leased lines:** The data presents the wire centers offering high-speed data services by ZIP Code, according to the Local Exchange Routing Guide (LERG 2002). As most data has place-level aggregation, DSL data was included by matching ZIP Codes to places, using Census data.

⁸⁰ Las Vegas entry was due to Colorado River Commission of the State of Nevada, which does not serve as a typical MEU, and Kokhanok Electric serves 11 business establishments in an area of 21 sq. miles.

As result, the dataset includes the two following variables (i) number of wire centers offering broadband by place, and (ii) a dummy variable that equals 1 if there is at least one private provider of broadband, and 0 otherwise. Table 5 shows the distribution of places, and their differences in average and median population. There is data for 1,801 of the 1,815 observations.

Table 5: Places according to Competition on DSL, Average and Median Population

	No. Census Places	Average Population	Median Population
There is not Private DSL Operator	334	3,029	1,317
There is Private DSL Operator	1,467	19,923	3,770

Source: the author, based on LERG (2002)

2. **Cable Modem Providers:** There are two variables based on the availability of broadband through cable modem: (i) the number of private providers of such type of access, and (ii) a dummy variable equals 1 with the presence of at least one private provider of broadband, and 0 otherwise. The source of data is the Television and Cable Factbook (2003). There is data for 1,802 of the 1,815 observations.

Table 6: Places according to Competition on Cable Modem, Average and Median Population

	No. Census Places	Average Population	Median Population
There is not Private Cable Modem Operator	718	5,375	1,606
There is Private Cable Modem Operator	1,084	24,336	5,367

Source: the author, based on Television and Cable Factbook (2003).

- 2 **Discretionary Authority of Local Governments:** (Testing of H2) Richardson, Zimmerman, and Puentes (2003) provide an excellent source of information and data for different ways to proxy discretionary authority of local governments.

Table 7: Dillon's Rule Application among Places.

Dillon's Rule	No. Census Places	Average Population	Median Population
Apply to All State Subdivisions	1,124	19,975	3,378
Apply to County Level	35	17,819	11,846
Town Level	192	4,604	1,775
All non-home rule municipalities	99	23,735	7,664
Non-Dillon's Rule States	365	10,912	2,253

Source: the author, based on Richardson, Zimmerman and Puentes (2003)

First, it includes the composite and city rankings for local discretionary authority shown in Table 3 of Richardson, Zimmerman and Puentes (2003). It also includes dummy

variables with information on the application of Dillon’s Rule across different levels of state political subdivisions, and for states that do not adhere to Dillon’s Rule (Oregon, Ohio, Alaska, South Carolina, Utah, New Jersey, Montana, Iowa, Massachusetts, and New Mexico in order from lower to higher discretionary authority of cities). See Table 7.

Effect of State Telecommunication Regulation: The regulatory framework of each state is also likely to have a distinctive effect on the telecommunication industry. Some states have taken direct steps against the involvement of municipalities in telecommunication services. Florida, Minnesota, Tennessee and Utah have increased the regulatory burden for municipal involvement in telecommunications by taxes, voting and obtaining majority about it, or increased procedural financial and regulatory requirements. In a second approach, Arkansas, Missouri, Nebraska, Texas and Washington have explicitly prohibited, totally or partially, municipal involvement in telecommunication services. These cases has been coded in a binary variable as 1, and 0 otherwise.

- 3 **Attractiveness of the Local Market (Cost):** (Testing of H4)⁸¹ Following the previous rationale, total land area (in squared miles) is an additional variable to consider in the analysis, as household and business density serve as proxy for how attractive is the local market in terms of cost. The underlying assumption is that, everything else equal, places with high population and business density will be more attractive for private investment than places with low density. The source for area and housing units is the 2000 Census, and the source for number of business establishments is the 2000 ZIP Code Business Patterns, from the US Census Bureau.

Table 8: No. Observations, Average and Median Housing and Business Density.

	No. Census Places	Average Density (1000 units/sq. miles)	Median Density (1000 units/sq. miles)
Housing Density	1,815	0.5453514	0.474199
Business Density	1,785	0.0680346	0.054231

Source: the author, based on 2000 Census and Census 2000 ZIP Code Business Patterns data.

The business data was aggregated by matching ZIP Codes to Census Places, using Census data and Maptitude, and double-checking using Excel.

- 4 **Characteristics of the Demand:** (Testing H5) The socioeconomic characteristics of the demand are included for their likelihood to affect the demand for high-speed Internet access. Krueger (1993), Bresnahan, Brynjolfsson and Hitt (2002), and Autor, Levy and Murnane (2003) have highlighted the effect of information technology on wage structure and knowledge-based workforce, which has increased the demand for labor force with, at least, college education. Additionally, Putnam (2001) and Hampton (2003), among

⁸¹ Data for testing H3 is presented in Table 5.

others, have related education with use of IT and with higher propensity for collective action. Average and median values for the variables are in Table 9.

Thus, the following three variables are included in the database to account for the previous issues:

- i. **Income per Capita:** Average income per capita was included from 2000 Census data, as part of the initial database to which all other datasets were matched. In the context of this research, it is a proxy for affordability and how attractive is the market for private providers of broadband.
- ii. **Salary of Work Force:** This variable is the weighted average between total employees and annual payroll from the U.S Census Bureau’s ZIP Code Business Patterns at the place level. As done with other data aggregated by ZIP Code, each entry were matched to the ZIP Codes of each place for then calculating the weighted average salary by place. Here, salary is a proxy for how IT-intensive is the labor force on each place, under the assumption that drives demand for high-speed Internet access.
- iii. **Educational Attainment:** The variable accounting for educational attainment measures the percentage of population in each place that has at least completed bachelor degree, and have reached a graduate or professional degree. These variables are from the 2000 Census dataset that served as platform for assembling all data.

Table 9: No. Observations, Income Per Capita, Salary, and Educational Attainment.

	No. Census Places	Average Values	Median Values
Income per Capita (in Th\$)	1,815	17.235	16.804
Salary (in Th\$)	1,736	23.040	22.085
% Pop. with bachelor degree	1,815	11.11%	10.09%
% Pop. With graduate or professional degree	1,815	5.56%	4.65%

Source: the author, based on 2000 Census and 2000 ZIP Code Business Patterns.

- 5 **Distance from Existing Infrastructure:** (Testing of H6) The cost of deploying wireline telecommunications infrastructure is especially sensitive to distance, which is particularly true for broadband services. As distance increases, the cost per passing for different technologies increases as function of the effect of distance on their characteristics (NRC 2002).

As result, and given the current financial situation in the telecommunications industry, companies will tend to deploy infrastructure in areas that (i) are closer to their existing infrastructure, and (ii) are higher density of potential costumers.

In this context, distance from urban areas is measured using the Rural/Urban County Continuum Codes (RUCCC) of the U.S. Dept. of Agriculture’s Economic Research

Service (See Table 11)⁸². They are proxy for closeness to existing service areas (major metropolitan areas). Additionally, housing and business density also account for a portion of the costs of deployment, as higher density is related to lower cost-per-passing. See tables 10 and 11.

Table 10: No. Observations, Average and Median Rural/Urban Continuum Code

	No. Census Places	Average Values	Median Values
Rural/Urban Continuum Code	1,799	4.82	5

Source: the author based on USDA.

Some cities and towns are located in more than one county. In most of these cases, there was no difference among the RUCCC across counties.

Table 11: Distribution and Population by Rural/Urban Continuum Code

County Classification	Code	No Places	Population			
			Average	Median	Minimum	Maximum
County in metro area with 1 million population or more	1	244	70,798	10,058	16	3,694,820
County in metro area of 250,000 to 1 million population	2	215	20,223	5,914	208	360,890
County in metro area of fewer than 250,000 population	3	188	17,524	4,871	91	199,564
Nonmetro county with urban population of 20,000 or more, adjacent to a metro area	4	178	8,069	3,723	184	44,405
Nonmetro county with urban population of 20,000 or more, not adjacent to a metro area	5	76	9,629	4,183	244	42,940
Nonmetro county with urban population of 2,500-19,999, adjacent to a metro area	6	351	4,637	3,193	73	22,017
Nonmetro county with urban population of 2,500-19,999, not adjacent to a metro area	7	297	3,464	2,369	73	20,237
Nonmetro county completely rural or less than 2,500 urban population, adj. to metro area	8	80	1,389	1,245	64	5,120
Nonmetro county completely rural or less than 2,500 urban population, not adj. to metro area	9	170	1,226	1,190	32	3,630

Source: the author based on based on USDA

For instance, portions of Columbus, OH, are in Franklin County and Delaware County, both of which have a value of 1 for RUCCC. In the cases of disparity among the RUCCC

⁸² See <http://www.ers.usda.gov/Data/RuralUrbanContinuumCodes/>

for the different counties, the final value correspond to the average of the values, rounded down to the nearest whole number.

4.5 Method of Analysis: regression methods and treatment of influential observations

This section outlines the proposed method of analysis. The research question is in terms of analyzing the ways in which several hypotheses affect the probability of a MEU for offering communication services. As the problem is binary, i.e. whether the service is available or not, theory suggests looking into qualitative response models⁸³.

From the various methods available, this research considers Probit regression analysis for analyzing factors affecting the likelihood of MEUs for offering any type of service, and Multinomial Logit for their likelihood to offer services only to residential customers, only to business, or to any type of customers.

The option of Logit over Probit regression responds to its easier representation in closed form, direct extension to considering multiple outputs, and their equivalence around averages (Amemiya, 1981)⁸⁴. The choosing of Multinomial over Conditional Logit responds to performing the analysis considering changes only on characteristics of the MEUs and not in attributes of the options (i.e. DSL, Cable modem, etc.).

The analysis is performed in STATA⁸⁵. It is important to explain this, because the outputs generated by the software look like the ones for a linear regression model, so they can be written:

$$y_i = \mathbf{X}_i\boldsymbol{\beta} + \varepsilon_i, \forall i \quad [1]$$

where y_i is either 1 or 0, and can take values from 0 to 3, depending if one is considering Logit or Multinomial Logit. So, in the case of Logit, the resulting model can be written as:

$$Pr(\text{MEU_BB}) = P(\mathbf{X}_i) = \frac{1}{1 + e^{-\mathbf{X}_i\boldsymbol{\beta}}} \quad [2]$$

where $\hat{\boldsymbol{\beta}}$ is the vector of estimated parameters (called the Logit estimator). Greene (2000) presents a clear explanation for the extension to Multinomial Logit⁸⁶.

⁸³ See Greene (2000), Kennedy (1998), or Wooldridge (2003) for the theory behind, different models, and the way to proceed with the analysis.

⁸⁴ Amemiya (1981) shows a good approximation method between Logit and Probit estimate of parameters. He suggests those models often give similar results and are statistically similar around average values.

⁸⁵ See Stata Reference Manual, Volume 2, for more details on the way the software handles ML.

⁸⁶ See Greene (2000), pp. 857.

One can now assume $\Pr(\text{MEU_BB})$ can be differentiated among offering broadband only to residential customers, only to business customers, to any external customer, or to none. So, one can assume y_i as taking four values (0, 1, 2, and 3), there will be $P_0+P_1+P_2+P_3=1$.

$$\begin{aligned}
 P_{\text{no BB}} &= P(y = 0) = \frac{1}{1 + e^{X\beta_1} + e^{X\beta_2} + e^{X\beta_3}} & [3] \\
 P_{\text{BB only Residents}} &= P(y = 1) = \frac{e^{X\beta_1}}{1 + e^{X\beta_1} + e^{X\beta_2} + e^{X\beta_3}} \\
 P_{\text{BB only Business}} &= P(y = 2) = \frac{e^{X\beta_2}}{1 + e^{X\beta_1} + e^{X\beta_2} + e^{X\beta_3}} \\
 P_{\text{BB Residents or Business}} &= P(y = 3) = \frac{e^{X\beta_3}}{1 + e^{X\beta_1} + e^{X\beta_2} + e^{X\beta_3}}
 \end{aligned}$$

The existence of influential observations in the sample is discussed on Gillett, Lehr and Osorio (2003) and subsection 4.3.

The identification of outliers and influential observations is important because include them on empirical analysis would lead to biased estimation of parameters and incorrect conclusions. They are, however, important for learning more about the subject of study and, thus, important to remain in the data and be subject of further analysis⁸⁷. Section 4.3 includes results from analysis of outliers⁸⁸.

⁸⁷ Kennedy (1998), pp. 300.

⁸⁸ Hadi (1992, 1994) presents one of the best methods for handling of outliers in multivariate samples, which is included on STATA. Given n observations, the method builds a cluster of r points with the k variables included and measures the distance from the observations to the cluster. The cluster increases in each iteration by adding the $(r+1)$ points that are closest to it, and stops when the points of the cluster reach $r=\text{int}((n+k+1)/2)$.

5 Analysis of Results

The motivation of this study is to understand better the reasons for the increasing involvement of municipal electric utilities (MEUs) in the offering of advanced telecommunication services. This chapter presents the analysis of results for testing the hypotheses behind the overall research questions.

In the context of the research question, the three major hypotheses explore the effect of the regulatory framework, technology-push and competition, as explained in Chapter 4 (See Table 12 for a summary and description of the hypothesis).

Table 12: Summary of Hypotheses

Hypothesis	Description
Control variables (cost, and demographic characteristics)	The probability of MEUs for offering advanced telecommunication services increases in places that, everything else being equal, present lower income per capita, lower density or are located far from major metropolitan areas.
Regulatory framework	The probability of MEUs offering advanced telecommunication services decrease with the existence of laws and regulations designed to restrict or prohibit MEUs involvement in telecommunications, or to diminish local government's local discretionary authority.
Technology-Push	MEUs are more likely to offer advanced telecommunication services if they have deployed networks to run internal services, such as internal voice, Automatic Meter Reading, or Supervisory Control of Data Acquisition.
Competition	The probability of MEUs for offering advanced telecommunication services decreases with the presence of a local competitive alternative.

The results show that, as expected, the control variables for cost and demographics are relevant for MEUs deployment of advanced telecommunication services. Additionally, the analysis of the hypotheses about the importance of regulatory framework, technology-push, and competition suggest these are also important in determining MEU actions.

Results show that MEUs are less likely to offer advanced telecommunication services in states that have enacted laws and regulations restricting, or totally prohibiting, MEUs' involvement in telecommunications.

Additionally, the analysis supports the technology-push hypothesis suggesting that, everything else being equal, the probability that MEUs will offer external advanced telecommunication services increases in the cases they have already deployed networks to run internal services of voice, AMR, and SCADA. This hypothesis recognizes technology-based economies of scope between support activities for transmitting and distributing electric power and the offering of advanced telecommunication services.

Finally, preliminary results show that, while the probability of MEUs involvement in advanced telecommunication services decreases with the presence of competitive alternatives,

the effect of competition appears more complex and, because of measurement issues, results are tentative. Results from Probit regression show that presence of competitive cable modem services *decreases* likelihood of MEU offering telecom services, while presence of DSL competition is not generally significant and, when it is, it shows to be positively associated with MEU activity in advanced telecommunication services.

Several reasons could explain this: (1) the DSL data may be noisy; (2) DSL and cable modems may be imperfect substitutes, with cable modems offering a more relevant alternative to MEU-provided services; or, (3) MEU and DSL services are directed at different customer-market segments.

5.1 Results and Hypothesis Testing

The analysis is performed by using two complementary methods -Probit and Multinomial Logit, as detailed in Chapter 4. Probit regression allows for analyzing if the probability of MEUs offering telecommunication services is likely to be affected by the different variables used for testing the hypotheses (See Table 13 for Results)⁸⁹. Multinomial Logit is performed as response to more detailed analysis.

5.1.1 Control Variables: cost and demographics

The deployment of advanced telecommunication services in general, and broadband in particular, responds largely to the investments needed to deploy the networks and the characteristics of the demand.

The hypotheses for the control variables are, as stated in Chapter 4, that MEUs would be less likely to offer advanced telecommunication services as they have less educated population, but it is unclear about what would happen as they become more rural, less dense, and present lower average income per capita.

Results confirm these hypotheses. Coefficient estimates by Probit regression, in Table 13, show that MEUs' likelihood for offering advanced telecommunication services increases in places where there is more population that is educated. This is shown in Table 13, as the estimated coefficient for the percentage of people with bachelor degree (dedba) is statistically significant different from zero at a confidence level little above 5% (5.7%)⁹⁰.

⁸⁹ A complete list of Probit regressions performed is presented in Exhibit 4, and available for the reader who would want to have more detail.

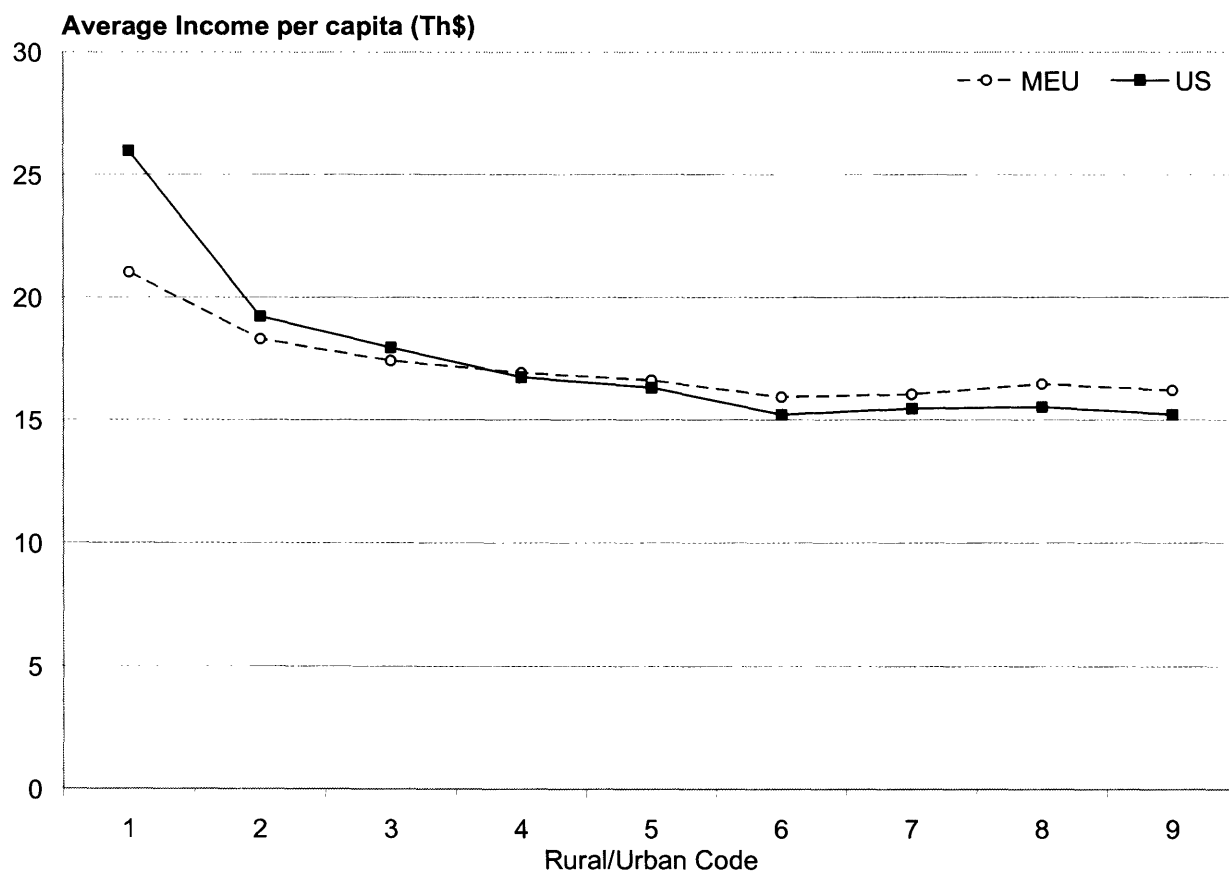
⁹⁰ The term "statistical significance" at a X% means that the finding (value of the coefficient) has a X percent chance of not being true, or a 1-X% percent chance of being true. While the common base case in econometrics is 5%, values of 10% are accepted as good. These tables show significance of 1%, 5% and 10% so that the reader can take his or her own conclusions about the robustness of the model.

Results also confirm the hypothesis that the probability of MEUs to offer advanced telecommunication service is unlikely to be significantly affected by income per capita (dincpc1 in the regressions). The rationale for this is explained as follows.

First, one would expect that high-income places would be more likely to be served by telecommunication services (Autor, Levy and Murnane 2003, Putnam 2001, and Hampton 2003).

Second, we have found evidence of path dependence for places with MEUs in their deployment of energy infrastructure and also likely for rollout of telecommunication networks. Previous chapters have pointed out MEUs neither as a rural nor as a metropolitan phenomenon. Furthermore, rural areas has been served by electric cooperatives and the Rural Electrification Act of 1936, creating a type of natural self-selection over the years.

Figure 14: Income per Capita versus Rural/Urban Code: US and MEU comparison



Source: the author, based on data from US Census, APPA and USDA

Third, available data for all places in the United States shows a negative and statistically significant correlation between income per capita and the urban/rural index (-0.350), indicating that income per capita decreases when a place is more rural and far away from large metropolitan areas. MEUs, however, are largely located in areas where the index is above 3 and below 7, i.e., neither too urban nor too rural (See also Table 10 and 11). For these values, the

correlation between income per capita and the urban/rural index decreases to 0.138. Figure 13 shows the differences on average income per capita per each value of Rural/Urban code for MEU communities and the entire United States. From RUCCC between 4 and 6 there is almost no variation for MEU communities, which would support the following statement.

While a definite conclusion would require further analysis, there is evidence suggesting that income per capita does not affect MEUs likelihood for offering advanced telecommunication services if it is above and below certain threshold. This can result from the fact that (i) high-income metropolitan areas are already being served by private companies and have shown little presence of MEUs, and (ii) low-income rural areas have shown an analogous case of self-selection (few MEUs) and being too expensive for anyone to serve, including public organizations.

Table 13: Probit Model

Variables	Model	Description
Dep.: External		= 1 if MEU offers any external telecommunication service, 0 otherwise
Internal	1.289765*** (.0960285)	= 1 if MEU offers internal services of voice and data (internal voice, AMR, and SCADA), 0 otherwise
CaMod Competition	-.2978421*** (.09681)	= 1 if there is at least one private provider of Cable Modem broadband services, 0 otherwise
DSL Competition	.2897722** (.1230172)	= 1 if there is at least one private provider of DSL broadband, 0 otherwise
Regulate	-.3717504*** (.0941736)	= 1 if State regulations difficult or explicitly prohibit MEUs for offering telecommunication services, 0 otherwise
cbcity	.7790375*** (.13249)	= 1 if MEU is located in a city, 0 otherwise
Rurc_corr	-.0489999*** (.0189951)	Rural/urban code. Ranges from 1=County in metro area with 1 million population or more, to 9= Nonmetro rural county or less than 2,500 urban population, not adj. to metro area ⁹¹
dedba	1.894469* (.9946202)	% Population with bachelor degree
dincpc1	-.0215926 (.0146549)	Average Income per capita (in \$1000).
_cons	-1.730416*** (.2934547)	Constant
N	1801	No. observations
Pseudo R ²	0.2230	

Note: * Significant at 10% confidence level, **: significant at 5%, ***: significant at 1%. Robust standard errors are in parenthesis

As explained in Chapter 4, the Rural/Urban County Continuum Codes (RUCCC) were used as proxy to distance of places to major metropolitan areas (Rurc-corr in Table 13)⁹². Results

⁹¹ See Table 12 for definition of each code.

⁹² RUCCC was available for only 1473 places, so the variable was corrected using a common technique: the 342 missing values were replaced with the median value of RUCCC and an additional dummy variable was created to account for missing values. The dummy variable was included in the analysis to

show that the probability of MEUs offering broadband services decreases when their markets are more distant from places with already available infrastructure (i.e. when RUCCC increases). While MEUs are more likely to be active in small and not-so-urban places (See Table 4), investment costs play an important role in the deployment of telecommunications infrastructure. Everything else being equal, one would expect that potential markets that are close to places with available infrastructure are more attractive because they have lower incremental cost of connection.

As MEUs operate locally, they do not own networks outside their local markets, and so the investments needed to bring advanced telecommunication services to a place increases with its distance to already available infrastructure. Thus, one can perceive that towns where MEUs are not offering telecommunications business present a median RUCCC of 6, while towns with active MEUs in telecommunication present a median RUCCC of 4.

This result is interesting because supports the idea of path-dependence in MEU communities and that MEUs are not a special rural phenomenon. This also support the idea that rural communities are more likely to be served by rural cooperatives and have no MEUs and, as result, to be excluded from the sample in the same way that major metropolitan areas are excluded.

Thus, this result would suggest important backhaul costs for MEUs but are also likely to be created by sample selection bias, as result of only analyzing MEU communities. This issue needs to be addressed in further research about the relevance of backhaul costs for MEUs.

Now, at the local level, cost of network deployment is sensitive to the number of users passed, so the cost per user decreases as user density increases. In terms of how MEUs likelihood for offering telecommunication services is affected by density, as proxy for cost per passing, results that while housing and building density show a positive effect, this is not significant (Not shown in Table 13). The reason for this is that housing and business density are highly correlated with income, RUCCC, and availability of competitive alternatives.

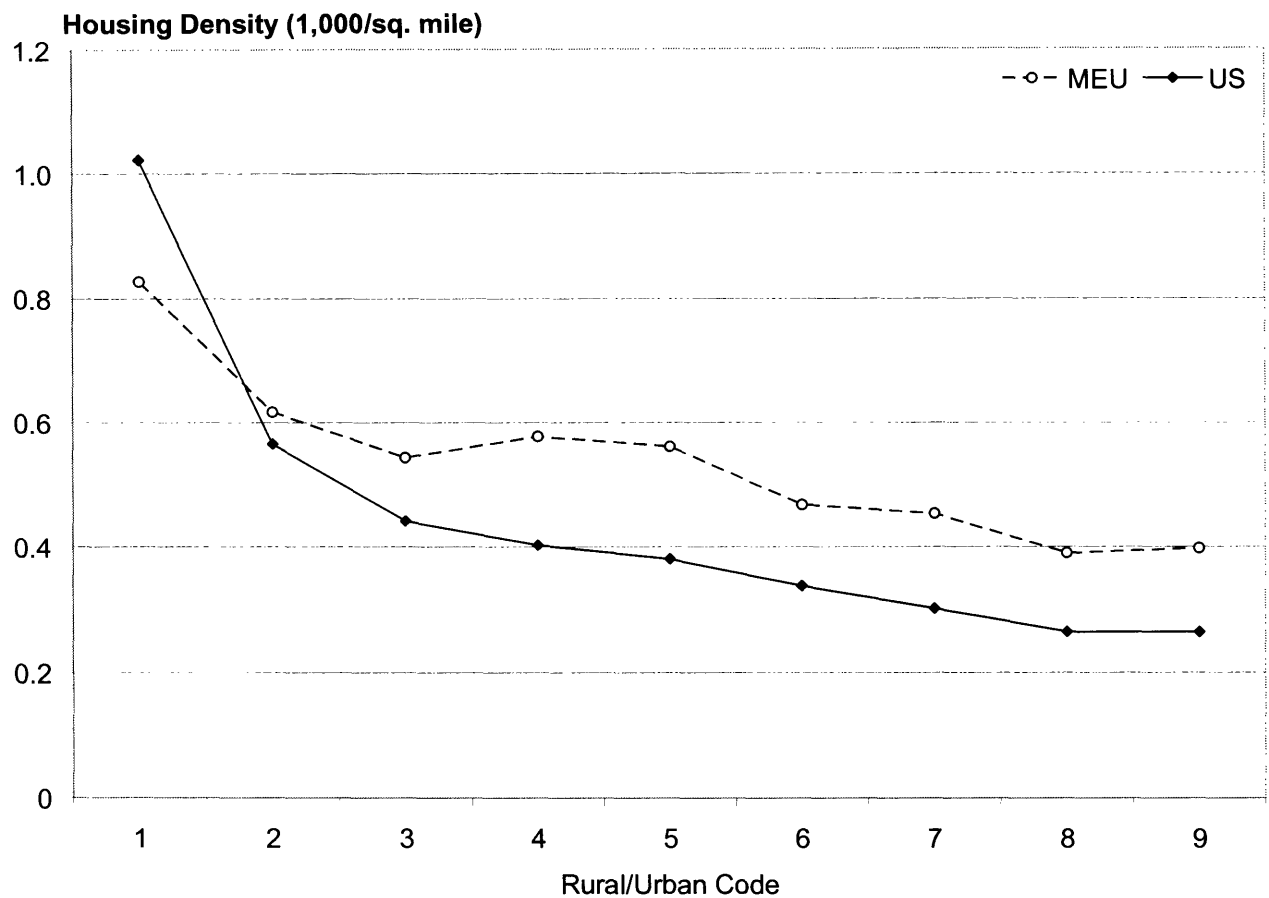
A Probit regression of MEUs' likelihood for offering advanced telecommunication services only against housing density shown that, indeed, density presents a significant effect. This sensitivity of this effect, however, disappears for two reasons. First, it is affected by the inclusion of other variables such as income per capita and rural/urban index.

Second, and more interestingly, analogous to the case of income per capita, density presents ambiguous results that would suggest the presence of density thresholds (See Figure 15). While high density would mean lower deployment costs and higher demand, it is likely that would also mean presence of competitive alternatives. Low density, by the other hand, would mean that deployment costs would be so high that not even MEUs would serve the market. Indeed,

test the significance of the missing variables and, as show no statistical significance, was later dropped from the final regression.

Figure 15 shows that, compared to the United States average, MEU communities present lower density in highly urban areas and higher population density in more rural areas.

Figure 15: Income per Capita versus Rural/Urban Code: US and MEU comparison



Source: the author.

The available data does not allow for analyzing this effect, which suggests an additional opportunity for further research.

The previous analysis for control variables suggest the behavior of variables traditionally used to analyze shifts in demand and supply are complicated by the combined effect of the nature of MEUs (historical path-dependence) and the major hypotheses (technology-push, competition, and regulatory environment). This created a sample selection issue that requires further research.

5.1.2 Regulatory Framework

The regulatory framework hypothesis states that the probability of MEUs for offering external telecommunication services decreases with the existence of general restrictions to local

discretionary authority (LDA) and, more specifically, with the presence of special regulations restricting or prohibiting MEUs involvement in telecommunications.

The state's adoption of Dillon's Rule is used as proxy for local discretionary authority (not shown in Table 13). Additionally, places that have been chartered as cities present institutional and political capacities that allows them to function in a more independent way that places without constitution. Thus, cities are coded by including a variable (cbcity) that equals 1 when they are such, and 0 otherwise⁹³ Finally, there is a dummy variable capturing states with special regulatory constraints against MEU involvement in telecommunications (variable "regulate" in Table 13).

Regression analysis shows that MEUs likelihood for being involved in telecommunications is not as affected by the existence or not of Dillon's Rule as it is by the existence of laws and regulations specially directed against their participation in telecommunications, and for the existence of political and institutional infrastructure that support local availability of decision-making, public services, and policy implementation.

Everything else being equal, one can analyze the joint effect of these variables on MEUs likelihood of offering telecom services and find that, while correct in sign, Dillon's Rule loses significance and can be thought as not relevant⁹⁴. This results support Richardson, Zimmerman, and Puentes (2003) when they state that Dillon's Rule does not affect local government's growth management.

These results, however, present a measurement issue, are subject of further research and deserve additional comments. First, the Dillon's Rule indicator is a statewide variable accounting for a state's general approach towards local governments' discretionary authority rather than the specificity of each place. In particular, it does not account for places that, while located in Dillon's Rule states, might be exempted from the rule. For instance, Alabama, California, Colorado, Illinois, Indiana, Kansas, Louisiana, and Tennessee apply Dillon's Rule only to certain towns (Richardson, Zimmerman, and Puentes 2003).

Second, the dummy for cities is more locally specific, but not necessarily a good proxy for local discretionary authority as it also might account for other issues that differentiate cities from towns, villages, and other types of places. Furthermore, as almost 50% of the MEUs are over 100 years old, and 1,340 from the 1,815 MEUs are located in cities, this variable is likely to be path-dependent. Analyzing these issues in more depth would require additional data and further investigation.

⁹³ See Chapter 3 for discussion about Dillon's Rule, and Exhibit 4 for regressions including the estimates and statistical significance for it. The variable in the regressions was included as noDillon, which equals 1 if the state does not adhere to Dillon's Rule and 0 if it does.

⁹⁴ In econometric terms, this means that both the dummies for city constitution and regulatory framework are significant at 1% confidence level, but the variable for Dillon's Rule only is statistically significant different from zero at levels of 14%.

5.1.3 Technology-Push

The technology-push hypothesis states that the probability of MEUs for offering external advanced telecommunication services increases when the utility has deployed networks for running internal services such as voice, automatic meter reading (AMR), or supervisory control and data acquisition (SCADA). Regression results strongly support the hypothesis.

The availability of internal services, as shown in Table 13 by the coefficient of the variable “Internal”, is very significant and one can rule out the possibility that it does not affect MEUs’ likelihood for offering advanced telecommunication services⁹⁵.

Chapter 2 explains the presence of technology-based economies of scope between networks used to run AMR and SCADA systems for enhancing quality and reliability of the power business, and using them to offer services of voice and data to residential and business customers. The existence of these networks -deployed separately from power lines⁹⁶- have created a stock of overcapacity for transmitting data that represent a potential revenue stream for MEUs, which face pressure at different levels for taking advantage of this potential.

First, the increasing public pressure for efficiency of public organizations requires them to operate close to what one would expect from private actors, while maximizing the creation of public value. Second, in terms of creating public value, it responds to the increasing importance of availability of advanced telecommunications infrastructure, especially broadband, as source of local economic development. How important is the effect of this variable? Besides being able to rule out the possibility of having negative or no effect, results show its inclusion on the analysis can more than double the fitness of the model⁹⁷.

This presents what one could call technology path-dependence resulting from the historical path-dependence of MEU communities. MEUs focus mainly in power. This focus in transmitting and distributing power is driving electric utilities to invest in information and telecommunication technologies to enhance the quality, security and reliability of their electric power business as a way to face the changes in the industry. This is the source of technology-based economies of scope of MEUs, and what makes the MEU experience hardly replicable in non-MEU places.

This issue requires further research and collection of time series data on the availability of services. Jointly with considering the effect of competitive alternatives (see following section),

⁹⁵ It presents statistical significance lower than 1% confidence, with $P > 0.000$.

⁹⁶ This redundancy in infrastructure responds, as explained by Gunnerson (2003) and Symantec (2003), to the increasing concerns about reliability of critical infrastructure.

⁹⁷ Exhibit 4 show regression results without including the variable for internal services. While not a relatively important indicator as compared to the t-statistics, one can see that Pseudo-R2 increases from about 0.1 to more than 0.22.

one would like to analyze whether choice for offering internal and external services results from joint or successive decisions.

There is a question that still remains somewhat unanswered: why MEUs would choose options other than powerline carrier for delivering advanced telecommunication services? Addressing it would require detailed time-series data on the availability of different internal and external services and their architectures, in order to analyze the (i) causality between architectures deployed for offering internal and external services, and (ii) dynamics of the decisions for doing so.

5.1.4 Competition

The competition hypothesis presented in Chapter 4 states the probability of MEUs for offering advanced telecommunication services would decrease with the presence of competitive alternatives.

Results from Probit regression shows that competition indeed matters, but its relationship with MEUs likelihood for offering advanced telecommunication services is complex. As Table 13 shows, the probability of having MEUs'-based telecommunications services decreases with the presence of cable modem operators (CaMod Competition), but appears to increase with the presence of DSL providers (DSL Competition).

This result challenges the hypothesis on the effect of competition, raising the interesting questions about why cable modem and DSL have different effects.

There are two types of explanations. The first type has to do with the type and quality of available data, while the second is related to the relationship among MEUs offering of advanced telecommunication services and the availability of cable modem and DSL services.

In terms of type and quality of data, one explanation is having noisy data. This could be the case for DSL estimates, as LERG data might present problems especially in relation to disaggregating different services by wire center and correctly classifying DSL. This would require further research, and would benefit from data on number of users, besides local availability.

Additionally to noisy data, a second issue is timing and lack of time series data to analyze the dynamics of competition between private alternatives and MEUs. A question yet to be studied is who comes first in the local market, if MEUs or private providers. In the case of DSL, assuming the data is not noisy enough, the positive sign might mean that DSL are followers to MEUs offering to broadband services. This question, however, would require further research.

A second type of explanation can be found in the differences of customers targeted by each available technology and, thus, type of provider. According to the description of broadband alternatives presented in Chapter 2, cable modem targets residential customers while telephone companies have traditionally served business customers. Additionally, part of the MEU

involvement in telecommunications has been due to dissatisfaction with service quality of cable television companies.

Thus, one can suggest two interesting reasons for the different ways in which the probability of MEUs offering advanced telecommunication services is affected by cable modem and DSL. First, one can argue that technology characteristics and market acceptance have made of cable modem and DSL two non-totally substitute services. Second, and as results of this, the technologies options deployed by MEUs have generated redundancy in infrastructure with cable television operators but not with telephone companies.

Table 14: Multinomial Logit Model

Variables	Model			Description
	Residential	Business	R + B	
Dep. Bbserv				= 0 if MEU offers no external telecom service, = 1 if only serves residential customers, =2 if only serves business, and =3 if serves residential <i>and</i> business
Internal	1.244815*** (.3192991)	2.645089*** .3197859	2.780288*** .2679565	= 1 if MEU offers internal services of voice and data (internal voice, AMR, and SCADA), 0 otherwise
CaMod Competition	-1.168283*** (.2743841)	.1089707 .3753981	-.0539604 .295708	= 1 if there is at least one private provider of Cable Modem broadband services, 0 otherwise
DSL Competition	.3784731 (.338911)	2.171881** 1.033404	.2158168 .3397299	= 1 if there is at least one private provider of DSL broadband, 0 otherwise
regulate	-.557114** (.2732251)	-.5292472* .3167554	-.8413658*** .2470894	= 1 if State regulations difficult or explicitly prohibit MEUs for offering telecommunication services, 0 otherwise
cbc city	1.028529*** (.3626638)	1.935535*** .676578	1.878092*** .4574575	= 1 if MEU is located in a city, 0 otherwise
rurc_corr	-.0299635 (.0593281)	-.226419*** .0622349	-.0906471* .0531007	Rural/urban code. Ranges from 1=County in metro area with 1 million population or more, to 9= Nonmetro rural county or less than 2,500 urban population, not adj. to metro area
dedba	2.494784 (3.209809)	3.827258 2.579273	2.339696 2.621597	= 1 if MEU is located in South Atlantic Division of South Region (Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida), 0 otherwise
Dincpc1	-.094565* (.050716)	-.0084517 .0401785	-.0298001 .0287049	= 1 if MEU is located in Pacific Division of West Region (Washington, Oregon, California, Alaska), 0 otherwise.
_cons	-2.31309** (.993112)	-7.321082*** 1.437035	-4.704056*** .7126791	Constant
N	1801			No. Observations
Pseudo R ²	0.2098			

Note: * Significant at 10% confidence level, **: significant at 5%, ***: significant at 1%. Robust standard errors are in parenthesis

Thus, one would expect that cable modem companies will present competition to MEUs in the residential market (with redundant or perfect substitute technology), while telephone companies will do so in the market segment of business customers (with a non-redundant or non-totally substitute option). Based on these arguments, one can hypothesize that MEUs likelihood for offering broadband services would:

- decrease with the presence of cable modem companies in the residential market segment, and
- increase with the presence of DSL providers in the business market segment.

Multinomial regression results support this hypothesis as presented in Table 14.

The dependent variable (“Bbserv”) now is changed to account for those markets where there is no available telecommunication services offered by MEU, markets where MEUs serve only residential customers, only business customers, and markets where they serve both residential and business customers⁹⁸.

The results show that, in places where MEU target exclusively residential customers, they are less likely to active in the telecommunications market when there is a cable modem provider. One can also see that, however, the presence of a DSL provider is of no major significance⁹⁹.

In the case of places where MEUs only target business customers, results show that the presence of cable modem operators made no significant effect¹⁰⁰. On the other hand, the presence of a private DSL operator is significant, confirming the hypothesis above about its effect on MEU activity in telecommunications. In cases where MEUs target both residential and business customers, their probability of offering advanced telecommunication services appears not to be affected by the presence of competitive alternative of cable modem or DSL provider.

Just as a reminder, these results do not address or solve the possible issues of data and timing that might be present. They, however, generate more interesting questions to be addressed in the future, and the need for gathering more and better data.

5.2 Sensitivity Analysis

The results were subject of sensitivity analysis to the presence of outliers, in order to respond to concerns that big cities such as Los Angeles, CA, or Phoenix, AZ, or to the effect of small places such as Kokhanok and Tanakee Springs, AK.

⁹⁸ See Chapter 4 for explanation of the rationale behind Multinomial Logit.

⁹⁹ Here one means significant in a statistical sense, as $p > 0.26$

¹⁰⁰ The results are not statistically significant at a reasonable level ($p > 0.772$), and hypothesis testing about the value of the coefficient allows to accept the hypothesis one can assume it as zero.

The analysis considered different scenarios over the base cases presented in tables 13 and 14, in order to identify changes on the statistical significance and sign of estimated coefficients. Results show that excluding large cities made no major changes to the model. The thresholds were set to consider maximum populations of 1 million, 500, 100, 50 and 25 thousand people, as well as minimum threshold of 500 inhabitants. Additionally, the Hadi method was used for identifying outliers on population size (which dropped 128 observations), and not considering places below 200 inhabitants (dropping 41 cases).

5.3 Areas for Further Research

This research presents interesting results for understanding municipal involvement in advanced telecommunication services. There are, however, a series of issues that need to be addressed in further research, and after collecting more data.

First, data on DSL competition is highly likely to be noisy. Figure two shows higher deployment of cable modem Internet access, but the collected data shows higher availability of DSL (1,467 places) than for cable modem (1,084 places), which could explain the low statistical significance of its coefficient. The LERG data is also showing capacity for offering different services by wire center, which could not be totally disaggregated. The ideal data for this analysis would be number of subscribers, a proxy for it, or cleaner data on DSL competition. Additionally, DSL data was at the ZIP code level and was aggregated to the place level to match most MEU data, which could have affected results in some way.

A second problem to be addressed is the timing of competition dynamic in broadband markets between MEUs and private providers. Thus, the model cannot capture whether (i) MEUs were first in offering broadband services, which induced private telecommunication operators to offer DSL, (ii) DSL was already available when MEU started offering services, and (iii) the likely response or competitive position of cable modem operators. Addressing this problem calls for panel data, which in turn requires continuing gathering data from APPA communities, and building the database back as many years as possible.

Third, the relevance of the technology-push argument requires more data to analyze the relationship between the decisions for implementing AMR and SCADA with the decision of offering external telecommunication services, which could be done by two-stage Probit regression.

Fourth, available data for the effect of Dillon's Rule is aggregated at the state level not allowing for locality-specific analysis of its effect and, probably, generating biased results. More and better locality-specific data on LDA might allow to better understand the effects of limitations to local discretionary authority.

Fifth, the ambiguous effect shown by variables such as income per capita and housing density suggests there are interesting issues that require further investigation. Part of the reasons for this comes from, as discussed, the effects of historical path-dependence. Additional

research would require data on non-MEU rural cooperatives and municipalities that are deploying advanced telecommunication services.

Finally, there is evidence that MEUs historical path-dependence have produced a technological path-dependence that is affecting their involvement in telecommunication services. This also requires additional investigation, especially on questions regarding the timing of decisions towards deploying internal and external services.

6 Conclusions and Policy Recommendations

This chapter presents a brief overview of the thesis, a summary of results, policy guidelines for further action and suggested areas and questions for further research. This research has explored some of the reasons for the increasing involvement of municipal electric utilities in advanced telecommunication services, finding results at different levels. This section presents the qualitative discussion that lead to the hypotheses discussed herein, and the results from empirical analysis of those hypotheses. In addition, a stakeholder analysis is used to examine prospects for policy reform that are likely to further constrain municipal entry into telecommunication services.

This analysis suggests that municipal participation in telecommunications services will continue to expand where it can. Moreover, in light of the US Supreme Court's recent decision¹⁰¹, it further concludes that state-by-state heterogeneity in the regulatory environment facing municipal utilities will continue. While the US Congress could resolve some of this heterogeneity by reforming the Telecommunications Act of 1996 to clearly determine whether the market entry rules also extend to municipal entry, the current political climate, however, makes such a reform unlikely.

This chapter also discusses how MEU involvement in telecommunications can affect competition and the broader public interest, and proposes a general framework for preliminary analysis of the merits of MEU entry. The analysis considers five complementary policy options that could be explored, although they differ with respect to their political feasibility. First, lobbying the U.S. Congress to obtain clarification as to whether section 253 (a) of the Telecommunications Act of 1996 includes MEUs, if not all political subdivisions of the state. Second, private operators lobbying of state legislature in order to obtain explicit regulations prohibiting MEU to get involved in advanced telecommunications services , or MEU lobbying directed towards allowing it.

The third option calls MEUs for including in the political agenda of their involvement in telecommunications the effects of economies of scope on reliability and security of power distribution. Fourth, all stakeholders need to evaluate the merits for MEUs leasing their network capacity to private operators. Evidence suggests that restricting MEU entry is not only a complex issue, but also one that requires clarification. Is any type of restriction a good idea? Are there arrangements or situations that could make some options not only permissible but necessary? For example, is Washington State law that permits wholesale entry but excludes retail entry a good idea? Evaluating the merits needs to include analysis of the effects of different arrangements, such as customer aggregation, anchor tenant, franchising, wholesale by

¹⁰¹ In *Nixon vs. Missouri Municipal League*, the U.S. Supreme Court concluded that political subdivisions of the states are not separate entities from state governments and, therefore, states have the authority to totally or partially limit their actions in telecommunications, given that the language of Telecommunications Act is not explicit enough.

entry of physical facilities, etc. Fifth, policymakers may consider carefully building the case for municipal involvement in areas with limited or no available service.

This chapter concludes with suggested directions for further research in order to better understand and assess the merits for an MEU to get involved in telecommunications, and for state governments to allow or prohibit them for doing so. More explicitly, there is need to better understand the effect of limits to local discretionary authority (e.g., Dillon's Rule). Additionally, there is a need for a deeper understanding of the competitive dynamics between MEUs and cable modem and DSL operators, which could help illuminate the effect of MEU entry on private sector competition. Also, there is a need to include non-MEU communities in order to explore whether the lessons learned for MEU communities also apply to non-MEU communities. In a similar vein, there is a need for expanding the MEU database to include observations over several time periods in order to enhance the understanding of the timing and dynamics between deployment of IT-based support systems for power distribution and telecommunication services. Finally, there is need to explore the merits of economic development as arguments for MEUs' deployment of advanced telecommunication services.

6.1 Summary of Results

This section presents key empirical results from econometric analysis of the MEU data, as well as general conclusions from qualitative analysis.

6.1.1 MEUs in telecommunications: Historical Path-dependence and Technology-Push

The analysis suggests that the likelihood that an MEU is involved in providing advanced telecommunication services is positively related to technology-based economies of scope between distributing electric power and offering telecommunication services. Chapters 2 and 3 discuss the importance of history and the need for electric power in local industrialization for the existence of MEUs. Many MEUs have been in the "local economic development" and "network" businesses for more than a century.

Qualitative analysis in chapter 3 helps to formulate a framework for understanding the involvement of public organizations in delivering private services in general. Analogous to the adoption of electric power more than 100 years ago, the current importance of information technologies for economic development supports the increasing interest of MEUs in providing advanced telecommunications, and more specifically, broadband services. This "pro-development" interest, combined with the economies of scope between electric power and telecommunications, generates a line of argument suggesting two things.

First, for competition and market reasons, MEUs may be encouraged to expand their involvement in local economic development from electric power to telecommunications. This "economic development" rationale (ignoring for the moment the impact of competition) when coupled with the opportunity to take advantage of scope economies, underlies the "technology-push" hypothesis discussed earlier. That is, MEUs that have invested or are planning to invest in advanced IT capabilities in order to better manage their core electric power business, are *more*

likely to also enter telecommunication services. Their commitment to the community is indicated by their desire to upgrade the quality of their power services (hence, investment in advanced in-house IT) and benefits further from the scope economies associated with using the IT infrastructure to serve both power and telecommunications markets.

The “path-dependence” argument has two components: historic and technologic. Thus, second, one would only expect the effect of the technology-push component to exist among investor-owned electric utilities because these are not additionally motivated by the “public service” goal of promoting economic development. Analogously, among municipal governments that do not have MEUs, one would expect only the economic development goal to motivate entry into telecommunication services since such communities lack the opportunity to realize scale economies from shared publicly-owned infrastructure. *Ceteris paribus*, this means that MEUs are more likely to enter telecommunication services than are investor-owned utilities or municipal governments in non-MEU communities.

The data does not allow testing which of the two effects are more important, however, the limited extent of wired-municipal entry by non-MEU communities suggests that the second effect (scope economies and the sunk costs of installing basic infrastructure) are more important than the “economic development” effect. However, the limited entry by investor-owned utilities into telecommunication access networks suggests that the “economic development” effect is also important. The econometric results presented in Chapter 5 provide support for the following general conclusions:

- **Municipal Electric Utilities are more likely to offer external telecommunication services if they have deployed infrastructure for running internal services supporting their power business:** Results from Probit regression shows that MEUs with internal IT-based systems such as Automatic Meter Reading (AMR), Supervisory Control and Data Acquisition (SCADA) and internal voice are more likely to offer advanced telecommunication services than those that do not offer such services. These results remain statistically significant even after accounting for other aspects such as the existence of competitive alternatives, and effect of state regulation, among other factors.
- **The benefits of the technology-push phenomenon of Municipal Electric Utilities (MEUs) are unlikely to be created by local governments in non-MEU communities without collaborating with the local electric utility:** While MEUs have had a history of taking a leading role on local economic development from more than a hundred years this role is not exclusive to them. The increasing importance of information technologies has led many local governments to develop initiatives for taking advantage of their potential for economic development. This research cannot generalize conclusions about all type of municipal involvement, but it can state with certainty that only local governments that have MEUs, or are collaborating with the local electric utility, could take advantage of the “technology-push” for advanced telecommunications. More data and analysis would be required to assess the strength of the path-dependence hypothesis.

6.1.2 Regulatory Framework and Local Discretionary Authority: the power of explicit rules

The qualitative analysis in chapter 3 and 4 suggests that local government initiatives can be constrained by explicit rules and general frameworks limiting the discretionary authority on the public administration of political subdivisions of the states.

In terms of explicit rules, Arkansas, Missouri, Nebraska, Texas and Washington have enacted rules prohibiting involvement of local governments in telecommunications at different levels¹⁰². At a different level, Florida, Minnesota, Tennessee and Utah have increased the regulatory burden for their involvement by imposing taxes, voting requirements with minimum majority, or increasing financial and regulatory requirements. In line with this trend, the U.S. Supreme Court recently decided that states had the authority for explicitly prohibiting, or allowing, their political subdivisions to offer telecommunication services.

In terms of general frameworks limiting discretionary authority (LDA), the qualitative discussion considers the hypothesis stating that low LDA, as measured by Dillon's Rule, would tend to diminish local government involvement in telecommunications.

These ideas are empirically tested by including one dummy variable that includes the existence of explicit rules and one capturing the adherence to Dillon's Rule, both at the state level. The conclusions are as follows:

- **The probability that MEUs would offer advanced telecommunication services decreases with the existence of regulations explicitly restricting or prohibiting them for doing so:** This result comes from regression analysis to the second hypothesis underlying the research question. It states that, one of the key factors limiting MEUs from offering telecommunication services in general, and broadband in particular, is the existence of laws and regulations that have been enacted with the specific purpose of limiting their participation in telecommunications. In this context, the recent U.S Supreme Court decision in *Nixon vs. Missouri Municipal League*, which gives authority to the states to prohibit their political subdivisions for engaging in telecommunication services, will have an important impact in stopping MEUs actions in telecommunications if the states decide to do so.
- **Dillon's Rule has no apparent effect on limiting MEUs involvement in telecommunications:** This result from also testing the hypothesis on the effect of regulatory framework over MEUs offering of telecom services. While it might appear as

¹⁰² The state of Arkansas does not allow municipal entities to provide local exchange services, while Missouri impedes all MEU selling of telecommunications, except for internal uses, education, emergency and health care. Nebraska prohibits MEUs from becoming a common or contract carrier, but allows renting fiber to common carriers imposing restrictions on the use of profits earned by the MEU. Texas is an extreme case, prohibiting MEUs from offering telecommunications services to the public "either directly or indirectly through a private telecommunications provider" (Texas Utilities Code, § 54.201 et seq.) Finally, the state of Washington prohibits public utility districts from providing retail telecom services. See <http://www.appanet.org/legislativeregulatory/broadband/news/GoodBad.pdf>

counterintuitive, regression analysis shows that MEUs located in states not adhering to Dillon's Rule does not show a statistically significant higher probability of offering telecommunication services than those located in Dillon's Rule states. In other words, this result means that particular restrictions over public participation in telecommunications are more effective in limiting MEU scope of action than general constrains to local governments discretionary authority (LDA), such as Dillon's Rule. The application of Dillon's Rule, however, is not uniform across or within states adding more heterogeneity to the problem.

- **MEU communities might present higher levels of institutional capacity than similar non-MEU communities:** Qualitative analysis in Chapter 3 and 4 shows two interesting things. First, as previously discussed, the presence of MEU communities depends on their general historical path of evolution but, in particular, of their active role on municipal electricity. Besides being locally active institutions, MEUs present high levels of decision-making capacity for implementing projects related to energy, and participation in general decisions concerning local economic development, which might have led these communities to a particular growth path. Second, as shown in Table 3, 73.8% of MEU communities are politically constituted as cities. By the nature of public organizations, their expected orientation towards creating public value and delivering public goods, this implies having higher levels of institutional presence (public organizations), and capacity to implement locally relevant decisions, either explicitly delegated or generally granted by the state government. Even considering similar cities, one might argue that, everything else being equal, cities with MEUs might have higher institutional capacity than non-MEU cities.

6.1.3 Effect of Competition: market segmentation and alternative technologies

The analysis shows a complex and interesting effect for the presence of competitive alternatives. Probit regression shows that, on the one hand, MEUs' activity in advanced telecommunication services decreases in the presence of cable modem operators while, on the other, increases in the presence of DSL operators. A closer look at this result shows these relationships are significant only when MEUs serve certain types of customer. Thus, cable modem and MEUs show competition in serving only residential customers, while the effect of DSL is shown in serving only business customers. These results require further investigation, and a special effort to gather more and better data on DSL availability.

- **MEUs, when targeting solely the residential market, are less likely to provide advanced telecommunications services in the presence of cable modem providers:** This result arises from the combination of Probit and Multinomial Logit regression analysis in chapter 5. There are relevant reasons for this. First, cable television companies have focused mainly in residential customers, while business have looked at telephone companies for the provision of their advanced telecommunication services, especially broadband. Second, part of MEU infrastructure for internal services is HFC architecture and, therefore perceived as redundant with cable companies. Thus, their entry might respond to no available cable provider or a response to likely community dissatisfaction with local cable providers.

- **MEUs are likely to compete with telephone companies in providing advanced services in the business market:** Regression results shows that, in presence of DSL providers, the competition hypothesis is not supported by available evidence when MEUs only target business customers. There are three possible reasons for this. First, business customers have supply of advanced telecommunication services mostly from telephone companies, which would explain why cable modem presence is not a significant determinant for MEUs targeting only business. Second, the perception that services delivered through telephone lines in general, and DSL broadband in particular, represent non-redundant infrastructure with respect to the service options deployed by MEUs generate an argument for providing a second alternative for connectivity and service in order to increase competition. Third, the available data for DSL availability is likely to be noisy and, thus, additional research will be needed in order to increase the understanding of this issue. Finally, DSL technology was deployed by the end of 1990s, by when MEUs already were in the market.

6.1.4 Telecommunications Act of 1996 and Heterogeneity: Colliding Public Policies

Federal legislation is an attempt to create a uniform framework for regulating telecommunications markets in the United States. As discussed further in Chapter 3, however, this goal remains unrealized and the current regulatory landscape across and within states is quite heterogeneous. For example, four states have enacted regulations increasing the regulatory burden for municipal involvement in telecommunications, and five others have explicitly prohibited such involvement. One example of the exemptions made within these states is Optinet in Bristol, VA.

The application of these state regulations has been challenged in court with differing results. The cases of *Nixon vs. Missouri Municipal League* and *Abilene, TX*, are explained in detail in chapter 3 and interesting because of their similar merits but opposite decisions reached at courts of appeal. The effect of judicial challenges of public policies is discussed in section 3.3, and is known for adding more complexity to this issue making of telecommunications policy a very dynamic problem. An example has been the recent U.S. Supreme Court decision in *Nixon vs. Missouri Municipal League*. Beyond the specific case, from the discussion in section 3.3, Lubbers (1998) and Zaring (2004) provide evidence of the importance and relevance of courts in rulemaking in the United States¹⁰³.

Meanwhile, local governments exist to create public value according to the needs of their constituencies by delivering public goods, and help catalyze people's needs and concerns (Donahue 1989 and Moore 1995). Thus, it is common to have local initiatives colliding with state and nationwide regulatory initiatives (Donahue 1989 and Zaring 2004).

¹⁰³ A special and interesting case is the case of HB 107, a bill before the Florida legislature, which increases the role of courts in rulemaking by stating that "*judges hearing appeals of agency rules shall not defer, or otherwise give any special weight, to an agency's interpretation of law or a rule*". See <http://www.abanet.org/adminlaw/news/vol24no3/fromstates.html>

In the context of the growing need for access to advanced telecommunication services, and broadband Internet access in particular, the collision of federal, state and local policies create a complex landscape for communities wanting to accelerate the process of getting deployment of such services at competitive prices.

As result, and in terms of the decision on *Nixon vs. Missouri Municipal League*, the previous discussion in chapter 3 allows for the following qualitative assessment:

- **The decision of the U.S. Supreme Court in *Nixon vs. Missouri Municipal League* is very likely to have a strong effect on local government involvement in telecommunications and its effect on competition:** In terms of Zaring (2004), this ruling decision could have had the potential for creating “uniform federal law”. It is important to note this decision does not address the merits of municipal telecommunications, but only to the extent that the term “*any entity*” in section 253 (a) of the Telecommunications Act of 1996 does not include political subdivisions of the state. In general, this implies that state governments have the authority to enact regulations explicitly prohibiting or allowing their political subdivisions for participating in telecommunications. Thus, state government and legislature would face increasing pressure for enacting policy definitions that in the absence of new federal law could lead to a policy landscape that, while uniform at the federal level (i.e. “*any entity*” does not include local governments in all states), will have a rather heterogeneous application across states. This, after all, could be desirable given states’ independence and variety of realities among them.

6.2 Stakeholder Analysis and Policy Recommendations

This section follows the conclusions from empirical and qualitative analysis presented in the previous by presenting a landscape of stakeholders, their major issues, main policy goals, brief analysis of strengths, weaknesses, opportunities and threats, as well as likely actions and proposed analysis for further action.

Simple stakeholder analysis suggests that, regardless of the recent decision of the U.S. Supreme Court on the case of *Nixon vs. Missouri League of Cities*, MEU involvement advanced telecommunication services is likely to continue. There are two principal reasons for this. First, there are issues that go beyond the mere issue of having public organizations acting in telecommunications, but involving homeland security and reliability of the power grid, and the efficient use of public resources. Second, the variety and heterogeneity of stakeholders and interests involved.

6.2.1 Beyond MEUs Involvement in Telecommunications: Public Interest

Public interest and good public management are beyond the involvement of public organizations in telecommunications and, as such, are included in this analysis as underlying guiding principles for policy recommendations. Public interest is expressed, based on discussion in chapter 2 and 3, on ensuring homeland security and ensuring reliable and quality provision of both electric power and telecommunication services. Modern public management

calls for maximizing the creation of public value, which includes efficient use of resources as result of benchmarking public organizations to private organizations. In the case of MEUs in telecommunications, the analysis should consider the complementary following issues:

- **Increasing concerns for homeland security and energy efficiency, along with new developments and decreasing costs, have triggered convergence between power and telecommunications industries:** Mounting pressure for increasing reliability of the power grid have made increasingly necessary the investments on telecommunications infrastructure for running services to monitor distribution and transmission of electric power. Security concerns and technical limitations of power lines for transmitting data have made electric utilities to deploy redundant (to electric) networks for running Automatic Meter Reading (AMR) and Supervisory Control and Data Acquisition (SCADA).
- **Efficient use of public resources would require taking advantage of economies of scope from MEUs deploying networks for running AMR and SCADA:** Investments on these networks have created a stock of capacity for transmitting voice and data that represent immobilized resources and potential revenue streams. Regardless the questions on who and how would use such capacity, good public management calls for an efficient use of these resources, leveling the quality of their operations and management to that of the private sector. This does not necessarily imply that MEUs should be allowed to offer telecommunication services, should forcefully leased their networks to telecommunication operators, or should face prohibition to deploy any network architecture other than pure powerline. It only implies that -in terms of what is accepted as good public management- it would be inconsequent to force any public organization, MEUs in particular, to do not take advantage of potential gains in efficiency present on their main line of business.
- **The effect of public policy collision in telecommunications might have important consequences on the reliability of energy distribution in MEU communities:** This document have discussed the particular characteristics of MEU communities in terms of their strengths and particularities. This, however, might also have a down side. The recent decision of the U.S. Supreme Court in the Missouri case might increase the risks of security and reliability on the energy systems in MEU communities, given that one reason for deployment of telecommunication services has been recovering the costs of investing in AMR and SCADA (the argument made on the previous point). Thus, decisions stopping their involvement in telecommunication might also diminish investments for increasing reliability of the power grid, and endangering critical infrastructure. This would generate important inefficiencies in the use of public resources by not allowing taking the benefit from the economies of scope existent between the power and telecommunication businesses
- **The merits and type of public involvement in telecommunications depends on the context of their impact on demand for telecommunications, effect on private competition, and public interest:** Based on the previous discussion, and from the analysis in sections 3.3 and 3.4, the merit of public involvement in telecommunications depends on the context. On the limit, it should be evaluated case-by-case, considering whether it creates public value

and harms present competition¹⁰⁴. In terms of the level of MEU involvement in telecommunications, one would think in a series of possibilities that goes from no MEU involvement in one extreme, to a very active MEU in other, depending of the situation.

Thus, regardless of regulatory restrictions, one can define two general dimensions for analyzing the merits of MEU involvement in telecommunications:

- *Effect on Public Interest from technology-based economies of scope*: as discussed in the three previous points, the effect of taking advantage of such economies could (i) increase efficiency in use of public resources, (ii) enhance security and reliability of power distribution, (iii) broad effects on homeland security. These effects, for descriptive purposes, could be (a) negative in case of institutional arrangements that would not allow to the benefits, (b) neutral in the presence of difficulties for implementation, or (c) positive¹⁰⁵. This is a simplified version of these affects.
- *Effect on competition*: Analogous to the previous dimension, one could find that MEU involvement in telecommunications could be catalogued, in general terms, as (a) negative when its participation hinders the effects of competition (in terms of price and quality of service), (b) neutral, when it does not make a difference in competition, and (c) positive when its entrance increases the efficiency of the market (and leading to better quality or lower prices, an example is Tacoma, WA). This dimension considers, among other things, the effect of MEUs in targeting customers not served by private providers, responding to unsatisfied demands for increasing quality.

Table 15 illustrate what one would assess based on the consideration of these dimensions, using the case of MEU offering retail telecommunication services to non-public customers (households and businesses). Given the complexities mentioned in the previous sections and chapter 5, this is a simplified presentation for what should be options to analyze in further detail.

The interaction of these two effects suggests a matrix of situations which differ with respect to whether MEU entry is likely to be beneficial, harmful, or ambiguous – and therefore, requiring further context-specific analyses before a conclusion can be reached. Thus, one can perceive there would be situations where there are little merits for MEU operations in retail telecommunication services, while others MEU entrance in telecommunications would be advisable from different perspectives. In between, there are options in which MEU entrance would require further analysis, and consider options for leasing MEUs' networks to private operators. It could also allow to better analyzing the circumstances under which state level

¹⁰⁴ Please note the difference between harming competition and the competitors. The entrance of a second operator in a monopoly would increase competition, while negatively affecting the monopolist.

¹⁰⁵ Fountain (2001) discusses circumstances where technology adoption by public organizations could lead to negative outcomes.

regulations prohibiting or constraining MEU involvement in telecommunications might be justified or misguided.

Table 15: Dimensions for Analyzing Merits of MEUs entry in telecommunication: Is MEU entry in public interest?

		Effect of Technology-Based Economies of Scope on Public Interest		
		Negative (possible but unlikely)	Neutral	Positive
Effect on Competition	Negative	No	Maybe. Perhaps MEU should consider leasing networks to private providers	Maybe. Perhaps MEU should consider leasing networks to private providers
	Neutral	No	Maybe. Need to conduct context-specific analysis	Yes
	Positive	Maybe. Need cost analysis of MEU entry	Yes	Yes

Source: the author

6.2.2 Stakeholder Positions and Policy Alternatives: general recommendations

The effects of the final decision on *Nixon vs. Missouri Municipal League*, and the previous discussion allows for outlining a set of general recommendations. These are presented as follows regardless of their political feasibility, which is discussed later based on stakeholder analysis.

- **Lobbying US Congress to obtain clarification as to whether section 253 (a) of the Telecommunications Act of 1996 included MEUs, if not all political subdivisions of the state, in the term “any entity”:** so that it would be unmistakably clear the Congress’ intent to include, or leave out, municipal electric utilities. This option is likely to be addressed with different arguments by opponents and supporters of MEU involvement in telecommunications. A reform like this is, however, unlikely.
- **Lobbying state legislature in order to obtain explicit regulations prohibiting, or allowing, MEU to get involved in advanced telecommunications services:** so that, depending of the stakeholder perspective, state could ban or allow MEUs to continue getting involved in the provision of advanced telecommunication services. Analogous to the previous option, advocates in pro and against MEU involvement in telecommunications will lobby state legislature.

These two options are related. If U.S. Congress clarifies Section 253 (a) of the Telecommunications Act of 1996 stating that MEUs are excluded from state’s prohibition to

preempt entry in telecommunication services, it is highly likely that state governments will enact new regulations precluding subdivisions of the state to offer telecommunication services, also affecting MEUs' own plans for future deployments. The Congress could declare that MEUs cannot be prohibited by states for offering telecommunication systems, which could be challenged in court.

- **Including in the agenda of MEU involvement in telecommunications the effects of technology-based economies of scope on reliability and security of power distribution:** Supporters of MEUs would benefit from including the importance of economies of scope between electric power and telecommunication services in the political agenda, by making of it a central part of the problem behind MEUs involvement in telecom. This, however, would also give arguments for telecommunication companies to ask state legislatures to prohibit MEU entrance on telecommunications and only allowing, or forcing, them to open their networks to third private parties.
- **Evaluating the merits of MEUs that have deployed networks for running AMR and SCADA for leasing network capacity to private operators:** Depending of the competitive landscape, this option could allow taking advantage of economies of scope, and not affecting private competition by direct MEU involvement. There are cases, however, where the problem will not be competition but actual availability of services.
- **Building the case for "No-" and "Low-Service" areas:** The discussion for assessing whether a public operator harms competition or its competitor is, besides technical, largely political. There are cases where there are no available broadband services (total or partial), which can respond to demographic, geographic or competitive reasons (see discussion in chapters 1 and 3). There are others, however, where companies have deployed low-quality services triggering MEUs involvement in the market (e.g. cable television). This argument is likely to be used to both support MEU entrance due to lack of availability, and oppose it stating that MEU involvement preempts planned future private investments on the area (See Riordan 1992 for analysis of options).

Their suitability and likelihood of success of these options will depend of interest, resources and effectiveness in agenda setting of the different stakeholders, and their ability to achieve their policy goals, as well as of the characteristics of each state's regulatory process.

While a complete stakeholder analysis is beyond the scope of this thesis, a brief review of the position of the major players provides some useful insights. This considers their recommended actions at national and state level, and complementary options for future action. It presents a broad overview of the main issues involved by each major stakeholder, their major policy goal, a preliminary analysis of their major strength, weaknesses, opportunities, and threats (SWOT), along with possible actions.

The analysis is based on likely actions based on the U.S. Supreme Court decision on the Missouri case. It explicitly does not include the U.S. Congress and the Federal Communications Commission (FCC) for two reasons. First, the U.S. Congress will be target of collective action

rather than an active participant. Second, while the FCC's position has been stated the Abilene and Missouri cases discussed in chapter 3, the decision of the U.S. Supreme Court on the latter already closed the question for interpretation of Section 253 (a) by the FCC.

Public

The public is not an organized body per se but likely to respond to stimuli from the environment. This stimuli can be generated by low-quality services, mass media advertisement or campaigns, focus groups, etc. As such, it is not subject to a SWOT analysis as the following actors. Additionally, and for the same reason, there are no policy prescriptions likely to be implemented by the public, but to be targeted to it.

- **Main issues at stake:** quality, pricing and reliability on electric power and advanced telecommunication services, especially in areas that are underserved or present lack of competitive alternative to MEUs.
- **Overall Policy Goal:** With the exception of areas with strong an active MEU presence or low cost and high-quality telecommunication services, the public does not have a predetermined policy goal in mind and allows for shaping public mood through the media and open forums

American Public Power Association (APPA)

The APPA is formed by 2006 MEUs that serve about 43 million people, and has been active in fostering municipal involvement in telecommunications, especially in broadband.

- **Main issues at stake:** independence of MEU from state legislature in provision of telecommunications, local economic development, economies of scope between power distribution and telecom services, efficient use of resources.
- **Overall Policy Goal:** obtain MEU participation in telecommunication services independent from state government legislation
- **Preliminary SWOT:**
 - Strengths
 - It has a wide representation of the MEU community and population across the United States, creating a powerful of advocates for MEU involvement in local economic development
 - Its network of MEUs, institutionalized annual survey and easy for accessing and gathering information, allows it to (i) collect data for policy analysis in a relative easy way, and (ii) act through the network of members across the country.

- Weaknesses
 - It has gained a reputation for being too involved on the issue and biased towards the “MEU cause” that can threaten its credibility among more neutral actors.
 - Its knowledge and connections in the telecommunication sector do not parallel those on the energy sector, reason that could make it overestimate their effectiveness in this problem.
 - Nonetheless the size and nature of their national network of actors, it might have difficulties for coordinating efforts across states, if telecommunication companies decide to concentrate efforts simultaneously.
- Opportunities
 - Shaping the debate of MEU involvement in telecommunications beyond the effect on competition, by including the technology-based economies of scope and their effect in reliability of power distribution.
- Threats
 - Economic power, market segmentation and coordination of telecom companies would undermine APPA efforts.
 - Working in on too many fronts (states) at the same time can lower APPA’s effectiveness, and affecting its legitimacy among MEUs.
- Possible Actions:
 - National Level
 - **Lobbying:** Lobbying U.S. Congress for including MEUs in Section 253(a) of the Act. While this initiative is necessary as part of a broad mobilization agenda, it is unlikely to succeed in the near future.
 - **Agenda setting:** It needs to use its available resources for putting in the telecommunications agenda the effects of economies of scope between distributing power and offering telecommunication services, with special emphasis to the effects on security and reliability on electric power.
 - State Level
 - **Lobbying:** Support MEU efforts in state legislature, helping build the case of MEU’s involvement
 - **Agenda setting:** Analogous to the previous issue, it needs to act towards including in the state telecommunications agenda the effects of technology-

based economies of scope on operational efficiency and, particularly, possible effects on local electric power from banning MEUs from telecommunications.

- **Analysis:** APPA needs to help evaluate scenarios where the MEU involvement in telecommunications would generate negative overall effects, and evaluate the merits for open access to MEU facilities.
- Options for future action
 - **Analysis:** Generating roadmap for possible course of action, including possible alternatives and possible scenarios by state. This would allow mapping potential conflicts, better targeting state legislatures, dimensioning possibilities for success, and allocating resources accordingly.
 - **Coalition Building:** APPA needs to engage and mobilize other stakeholders such as industry associations, the media and public, consumers groups and the energy community into the cause.

Individual Municipal Electric Utilities

- **Main issues:** risks, security and reliability of power services, local economic development, efficient use of resources (tech-based economies of scope), independence from state legislature.
- **Main policy goal:** obtaining explicit permission from the respective state government to offer external telecommunication services
- **Preliminary SWOT:**
 - Strengths
 - Local historic trajectory and reputation. Broad local customer base represents capital for mobilization and votes that can be used for exercising pressure on state legislature.
 - MEUs play an important role on electric power in some states, which gives them leverage that can be exercised in lobbying state government authorities.
 - Weaknesses
 - MEUs have limited financial strength relative to telecommunication companies, which requires higher levels of coordination across MEUs within states to face the costs of lobbying, shaping the policy and public debate and, eventually, judicial challenges.
 - Dependence from state government and state's Public Utilities Commission may create a complicated political environment.

- Opportunities
 - Putting “risks to electric power” as part of the agenda, so merits of MEU involvement in telecommunications can consider the associated externalities for banning them from offering telecommunication services.
 - Building case for no- and low-service areas, so they can anticipate telecommunication companies’ arguments about effect of MEUs in competition.
 - Building state-wide block with other MEUs in order to share risks and costs, mobilize a stronger coalition, but also present a more solid case in front of the state’s authorities.
- Threats
 - Economic resources and coordination from telecom companies can create an important opposition that, sustained in the long term, would be likely to win over MEU’s position.
 - The underlying environment and assumption that MEU’s involvement in telecommunications is desirable from a social perspective might hide its possible negative effects on competition and, thus, affecting the strength of their position.
- Possible Actions
 - National Level
 - **Lobbying:** join forces under APPA for lobbying US Congress for inclusion in Section 253(a) of the Act.
 - State Level
 - **Lobbying:** state government for explicit rule allowing their involvement in telecommunication services.
 - **Agenda setting:** including the importance of offering telecommunication services as away to finance the costs of installing AMR and SCADA for increasing reliability of local electric power.
- Options for Future Action
 - **Analysis:** Evaluating effects of opening facilities to private operators, in order to prepare alternative courses of action that would allow re-evaluate positions, benefits and costs in the scenarios of a likely state prohibition to any activity in telecommunications. This should include an analysis of the effect of MEUs offering of telecommunications in competition.

- **Coalition building:** mobilize local resources, customer base and partner organizations for pressing state legislature and government to allow the degree of involvement in telecommunications that has been estimated as appropriated.

Telecommunications Operators

- **Main issues:** unfair competition from public organizations, access to MEU-owned facilities (if existent) for offering last mile access.
- **Main Policy Goal:** obtaining state government prohibition for MEU involvement in (at least) retail telecommunication services.
- **Preliminary SWOT:**
 - **Strengths**
 - Actual networks and levels of influence at different levels of the federal government, the U.S. Congress and state level create an important support network.
 - Economic resources can allow sustained pressure on the states and in court so, in the long term, rule-making process could lead to negotiated agreement or favorable outcome.
 - In cases of regional coverage, it will allow for economies of scale in handling relations with different state governments and, in case there are merits for it, coordinating efforts for addressing them at the same time.
 - **Weaknesses**
 - Relatively lower compromise and interest in local economic development could affect public's perception on the real intentions for blocking MEUs' entrance in telecommunications.
 - **Opportunities**
 - Stopping, or limiting, public competition in telecommunication services.
 - In some cases, there would be the possibility for obtaining access to already deployed networks by MEUs that could be used to deliver high-speed Internet access, diminishing times and costs for telecommunication companies.
 - **Threats**
 - MEU's argument of the effects of economics of scope could complicate things by making of their involvement an issue more complex than public

competition with private enterprise, or creating negative effects on competition.

- **Possible Actions**

- National Level

- **Lobbying:** Lobby U.S. Congress so there is no change to section 253 (a) of the telecommunications act.

- State Level

- **Lobbying:** Pressure state governments and legislatures so they enact regulations explicitly prohibiting MEUs from entering the telecommunications market

- Options for Future Action

- **Analysis:** consider the possibilities created with extra capacity from MEUs as way to expand reach and quality of networks, identifying MEUs that have deployed networks in markets likely to grow or represent interesting markets in the future.
 - **Analysis:** consider the scenarios under which MEU deployment of advanced telecommunication networks could enable future business by creating awareness about services and creating market.

State Governments

- **Main issues:** political subdivisions of the states must be get their power from state government

- **Policy goal:** none a priory. State governments are not necessarily involved in this issue with a unique position, but those that already have enacted regulations that are explicit about MEU involvement in telecommunications. For the same reason, the following points do not include a complete SWOT analysis for state governments.

- **Opportunities**

- Increasing deployment of advanced telecommunication services in sub-urban areas, and assess the impact of MEU involvement both in competition in telecommunications and in the broader public interest.
 - Enhancing security and reliability of the power system, by allowing MEUs to take advantage of efficiency gains from their investments in AMR and SCADA systems.

- **Threats**
 - Not considering the effect of economies of scope between power distribution and provision of telecommunications could lead to misguided policy making.
- **Possible Actions**
 - National Level
 - **Lobbying:** States that have, and have not, passed legislations banning MEUs from offering telecom services would be likely to join telecommunication operators in their lobbying efforts at the U.S. Congress and in courts.
 - State Level
 - **Decision:** prohibition or granting permission for MEU involvement in advanced telecommunication services
 - Options for Future Action
 - **Analysis:** evaluate possible effects from banning MEU from telecommunications on electric power, with special emphasis on the ways in which the technology-based economies of scale could be leveraged by not creating negative effects in competition in telecommunications.

One cannot conclude that MEU entrance into telecommunications is, per se, good or bad policy without further analysis. Therefore, it is premature to determine whether state laws which seek to limit MEU entry are for or against the public interest. The stakeholder analysis suggests the complexity of divergent interests and the need for additional research that would allow the parties involved to have a clearer picture of their respective situation, the likely effect of telecommunications competition, and the distribution of power.

For now, MEU involvement in telecommunications is not likely to stop unless the number of states enacting legislation prohibiting MEU entry significantly increases. For the moment, the best option appears to be learning from the heterogeneous and rich number of cases that are appearing, in order to better assess the merits of the different policy options.

6.3 Directions for Future Research

- **Effect of Dillon's Rule:** This research supports some previous studies on the effect of Dillon's Rule on local government units' growth management (Richardson, Zimmerman, and Puentes 2003). The available data, however, is state rather than locality-specific and likely to generate biased results. As stated in chapters 3 and 4, Dillon's Rule is neither uniform across nor within states. More and better locality-specific data on LDA might allow a better understanding of the effects of limiting local discretionary authority in MEU's involvement on telecommunications.

- **Competitive dynamics between MEUs and cable modem operators:** This study did not address dynamic issues of competition between MEUs and cable modem operators. As such, one cannot answer questions as to whether, for instance, MEUs decision for laying HFC resulted from a purely technical decision, rather than a response to unhappiness with cable television operators. Addressing this issue would require historical documentation of the competitive history between MEUs and cable operators.
- **Competitive dynamics between MEUs and DSL operators:** While DSL data might be noisy and justify additional research, there is a second issue of higher interest to be addressed: competition dynamics. The available data only allows for analysis across MEUs, but not over time. Thus, the analysis cannot capture the effect between deployment decisions between municipal utilities and telephone companies and, for instance, answer who deployed first and who followed. Adequate policy making would require to differentiate whether DSL services followed MEUs decisions to invest in infrastructure to deploy advanced telecommunication services, or if MEUs decided to enter the market in order to increase competition forcing the incumbent to enhance quality of service and decrease price. This would help answering questions about the circumstances under which MEU involvement in telecommunications increases and decreases competition.
- **Expanding the sample to include non-MEU communities:** Discussion in chapters 3 and 5 shows that MEU communities are especially different and, as such, focusing solely in a MEU-specific group of communities generate problems of sampling bias. Part of this bias can be seen in the ambiguous results on the effect of income per capita and density in MEU involvement in telecommunications. Expanding the sample to include rural cooperatives and non-MEU municipal initiatives in advanced telecommunication services would allow to better assess the specificity of the MEU phenomenon.
- **Expanding MEU database to include several periods:** The technology-based economies of scope between distributing power and offering telecommunication services call for additional research in two ways. First, there is need for better understand the dynamic of these decisions and assess to what extent offering telecommunication services comes after MEUs have deployed AMR and SCADA, are deployed before, jointly or are fairly independent. Second, time-series data that includes information on policy decisions in both electric power and telecommunications might help to better understand MEUs' technology path-dependence and externalities on power distribution from limiting MEUs' participation in telecommunications. It would also allow to better understand why, besides the maturity of the technology, MEUs have not chosen powerline carrier to deliver advanced telecommunication services.
- **Effect on economic development:** one of the underlying assumptions for MEU deployment of broadband services has been its impact on economic development. This research opens the door for a more close examination to (i) the dynamics of broadband deployment rather than advanced telecommunication services, and (ii) their effect in local economic

development. This would require disaggregating data from broadband services, backward building the availability of services, and data on growth of local economic activity.

- **Theory of Public Action:** the relationship between technology-push, path dependence, and economic development set the grounds for empirical testing models of public action theory. This could be achieved by using a cross panel model of entry decisions into emerging markets by three types of communities: (i) with MEU entering telecommunications, (ii) without MEU, but with investor-owned entities entering telecommunications, and (iii) without MEU and without investor-owned companies entering telecommunications. Thus, one could control for the relative importance of the positive argument on existence of economies of scope, versus the relevance of the normative argument about deployment in order to foster economic development.

6.4 Final Comments

The aggregated importance of broadband in the economy will continue to grow as information technologies become increasingly relevant for productivity. Part of this relevance is shown by President Bush's recent call, in April 24th of 2004, for ubiquitous broadband by the end of 2007¹⁰⁶.

Local governments in general, and MEUs in particular, have been very active and are likely to increase their involvement in providing advanced telecommunication services, and broadband in particular. They have been leading efforts to deploy new technologies, such as FTTP, and advanced wireless¹⁰⁷.

There is, however, little systematic research that to support a better understanding of the increasing motivations for public involvement in telecommunications, the extent of such initiatives, and whether this phenomenon is good or bad for consumers and the economy.

Regardless of the still unexplained phenomenon of municipal entry in telecommunications and in spite of the lack of good research about its effects and merits, policymakers are adopting strong and heterogeneous policies for constraining municipal involvement in telecommunications before understanding the possible effect of their actions.

The importance of these questions, and potential risks of uninformed policymaking creates an urgent need for research that would allow assessing if such constraints are a good, which types of constraints are more adequate according to the situation, and what are the policy innovations that are needed to address the new policy challenges created by new technologies, if any.

¹⁰⁶ See http://news.com.com/2100-1028_3-5200196.html

¹⁰⁷ One could soon see followers of the municipality of Skellefteå, Sweden, by installing WiMax. See <http://www.welcometovasterbotten.se/default.asp?NewsPages=2004&P=1485&LID=1>

This thesis provides a preliminary contribution to better understanding the MEU phenomena, raising issues and questions in need of further research. Hopefully, it will contribute to help advancing knowledge of these issues, and support more informed and better policymaking.

The analysis shows that municipal involvement in telecommunications, and especially MEUs, is a rather complex phenomenon that depends on demographic factors of local supply and demand, local regulatory environment, existence of private sector alternatives, and presence of economies of scope between distributing power and offering telecommunication services, among other things. The discussion of results and proposed questions show the needs for research and analysis towards understanding and evaluating the benefits and negative effects of municipal entry in telecommunications.

In this context, this thesis provides a foundation for continuing necessary research that will provide answers into policies for broadband, industry competitive dynamics, role of local governments in communications policy, their effect in local economic development, and the effect of contextual dynamics on the performance of engineering systems. It can also provide an empirical framework for testing the validity of normative and positive models from theory in economic and political science regarding the role of public agencies in provision of private goods, the importance and limits for collective action, public choice and local decision processes.

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Exhibit 1: Definition of Advanced Telecommunications Services Provided by APPA¹⁰⁸

- 1 **External Cable TV** - Utility provides the infrastructure for a CATV system. The provision of service may be provided by the Utility or be part of an alliance, partnership, or other contractual relationship with a third party. I.e. Utility provides all physical plant but contracts for operation, maintenance, headend or programming, etc.
- 2 **External Long Distance** - Utility provides and bills for long distance telephone through third party contracts.
- 3 **External Internet Service Provider** - Utility provides Internet service to local or regional customers. This can be dial-up access or high speed access via phone or CATV networks. The ISP service can be a full service offering or any form of third party alliance/contract.
- 4 **External Cable Modem, DSL** - Utility provides connectivity at speeds greater than 200 KBPS, at the customer premises, both directions.
- 5 **External Broadband** - Utility provides a private communication connection to customers at speeds greater than 200 KBPS, at the service site, both directions. I.e. business to business connection.
- 6 **External Dark Fiber Leasing** - Utility provides the fiber on a point to point basis, without providing any electronic components to provide a communication service. I.e. service stops at a patch panel.
- 7 **External Local Phone (CLEC)** - Utility provides Competitive Local Exchange Carrier (CLEC) services to customers through any means. I.e. resells services, collocates, or provides central office switching.
- 8 **External Wireless Network** - Utility provides a radio frequency based commercial service. I.e. PCS mobile phone system, radio operation for a commercial service
- 9 **External Video On Demand** - Utility provides a "video on demand" type service in addition to the standard CATV services.
- 10 **Internal Automated Meter Reading (AMR) System** - Utility has an AMR system installed to read some, or all, commercial or residential electric meters.
- 11 **Internal Municipal Data** - Utility provides a communication link to the Municipal government for high-speed data connections.
- 12 **Internal System Control And Data Acquisition (SCADA)** - Utility provides communication to it's controlled facilities via a fiber optic or other high-speed data network. This classification does not include a Multiple Address System (900 MHz radio based) but would include microwave.
- 13 **Internal Voice** - Utility provides a POTS type service to link its facilities together and bypasses the local telephone exchange for local telephone service. I.e. provides local dial tone from City Hall to Utility building.

¹⁰⁸ Listed as received from Ronald Lunt, Director of Broadband Services, APPA.

Exhibit 2: States Ranked by Level of Discretionary Authority

Rank	Composite (all types of local units)	Cities Only	Counties Only	Rank	Composite (all types of local units)	Cities Only	Counties Only
1	Oregon	Texas	Oregon	26	Florida	Delaware	Wyoming
2	Maine	Maine	Alaska	27	Ohio	New Hampshire	Oklahoma
3	North Carolina	Michigan	North Carolina	28	Alabama	Utah	Michigan
4	Connecticut	Connecticut	Pennsylvania	29	Kentucky	Wyoming	Washington
5	Alaska	North Carolina	Delaware	30	Georgia	Florida	Iowa
6	Maryland	Oregon	Arkansas	31	Montana	Mississippi	New Jersey
7	Pennsylvania	Maryland	South Carolina	32	Washington	Tennessee	Georgia
8	Virginia	Missouri	Louisiana	33	Wyoming	Washington	Nevada
9	Delaware	Virginia	Maryland	34	Tennessee	Arkansas	Tennessee
10	Louisiana	Illinois	Utah	35	New York	New Jersey	Mississippi
11	Texas	Ohio	Kansas	36	New Jersey	Kentucky	New Hampshire
12	Illinois	Oklahoma	Minnesota	37	Indiana	Colorado	Alabama
13	Oklahoma	Alaska	Virginia	38	Rhode Island	Montana	Arizona
14	Kansas	Arizona	Florida	39	Vermont	Iowa	South Dakota
15	South Carolina	Kansas	Wisconsin	40	Hawaii	Indiana	West Virginia
16	Michigan	Louisiana	Kentucky	41	Nebraska	Massachusetts	Nebraska
17	Minnesota	California	California	42	Colorado	Rhode Island	Ohio
18	California	Georgia	Montana	43	Massachusetts	South Dakota	Texas
19	Missouri	Minnesota	Illinois	44	Iowa	New York	Idaho
20	Utah	Pennsylvania	Maine	45	Mississippi	Nevada	Colorado
21	Arkansas	South Carolina	North Dakota	46	Nevada	West Virginia	Vermont
22	New Hampshire	Wisconsin	Hawaii	47	South Dakota	Idaho	Missouri
23	Wisconsin	Alabama	New Mexico	48	New Mexico	Vermont	Massachusetts
24	North Dakota	Nebraska	Indiana	49	West Virginia	New Mexico	---
25	Arizona	North Dakota	New York	50	Idaho	---	---

Source: Richardson, Zimmerman, and Puentes (2002)

Exhibit 3: List and Description of Variables Used

Variable	Description	No. Obs.	Mean	Median	Min	Max	Source
bbserv	Dependent variable for Multinomial Logit (0=no service, 1= only residential, 2=only business, 3=both)	1815	n.a.	n.a.	0	3	Computed based on APPA
Residential	=1 if MEU offers services to residential customers	1815	0.0936	0	0	1	C.B. APPA
Business	=1 if MEU offers services to business customers	1815	0.0920	0	0	1	C.B. APPA
Internal	=1 if MEU offers AMR, SCADA or internal voice	1815	0.1801	0	0	1	C.B. APPA
CaMod Competition	=1 if there is local private cable modem competition	1802	.60155	1	0	1	CATV Factbook
DSL Competition	=1 if there is local private DSL competition	1801	.81454	1	0	1	LERG
noDillon	=1 if State is a non-Dillon's Rule state	1815	.20110	0	0	1	Brookings
Regulate	=1 if state has law prohibiting or impeding MEU to offer telecom services	1815	.31184	0	0	1	APPA, Baller Herbst Law Group
rurc_corr	Rural/Urban code [1..9]. Corrected for missing values	1815	4.8276	5	1	9	USDA
r_metro	=1 if Rural/Urban code <4 Corrected for missing values	1815	.35647	0	0	1	Based on USDA
SAtlantic	=1 is place is located in South Atlantic Regional Division	1815	.11404	0	0	1	US Census Bureau
Pacific	=1 is place is located in Pacific Regional Division	1815	.05564	0	0	1	US Census Bureau
cbc-city	=1 if place is constituted as city	1815	.73829	1	0	1	US Census Bureau
cbcensus	=1 if place is census designated place	1815	.02093	0	0	1	US Census Bureau
dedba	% Population with bachelor degree	1815	.11114	.10088	0	.42963	US Census Bureau
busdens	Business density (1,000s per square mile)	1785	.06803	54.2E-3	.05E-3	1,246E-3	US Census Bureau
hudens1	Housing density (1,000s per square mile)	1815	.54535	474E-3	.76E-3	6,979E-3	US Census Bureau
dincpc1	Average income per capita (\$1,000 per capita)	1815	17.234	16.804	5.727	84.134	US Census Bureau
salary	Average salary per employee (\$1,000 per employee)	1736	23.039	22.0851	4.385	91.936	US Census Bureau

Exhibit 4: Probit Regression

Independent variable: MEU offers service to any type of customer

	Equation 1	Equation 2	Equation 3	Equation 4	Equation 5	Equation 6
Internal	1.354229*** (.090179)	1.36675*** (.090472)	1.391305*** (.0910147)	1.345393*** (.0926207)	1.289875*** (.0940906)	1.283297*** (.0956308)
CaMod Competition	-.1479093* (.088084)	-.1636873* (.0885787)	-.1857866** (.0886579)	-.2395533*** (.0931763)	-.299088*** (.0954596)	-.321036*** (.0978077)
DSL Competition	.3462608*** (.117200)	.354326*** (.1172538)	.3806941*** (.1180999)	.3733708*** (.1187856)	.3005806*** (.1229503)	.2835977*** (.1226548)
noDillon	..	.2128978** (.1015879)	.1573466 (.1029439)	.1737966* (.1034025)	.1733727* (.1060065)	.1788365* (.1089288)
Regulate	..	..	-.2185292** (.0927497)	-.2001482** (.0931431)	-.3187415*** (.0943034)	-.2576267*** (.0954016)
Rur_code	..	..	..	-.0354811** (.0180236)	-.0514217*** (.018836)	-.0367023** (.0193889)
cbc-city	..	..	..	..	.8163144*** (.1355499)	.7925286*** (.1359508)
SAtlantic	..	..	..	..	..	.5183748*** (.1230168)
Pacific	..	..	..	..	..	.4282237*** (.1719636)
cbcensus	..	..	..	..	..	..
dedba	..	..	..	..	..	..
r_metro	..	..	..	..	..	..
busdens	..	..	..	..	..	..
hudens1	..	..	..	..	..	..
dincpc1	..	..	..	..	..	..
_cons	-1.72975*** (.116384)	-1.778248*** (.116973)	-1.717173*** (.1184829)	-1.511281*** (.1511422)	-1.968401*** (.18458)	-2.108947*** (.1952512)
N	1801	1801	1801	1790	1790	1790
Pseudo R ²	0.1812	0.1845	0.1883	0.1879	0.2195	0.2348

Note: * Significant at 10% confidence level, **: significant at 5%, ***: significant at 1%. Robust standard errors are in parenthesis.

Independent variable: MEU offers service to any type of customer (continuation)

	Equation 7	Equation 8	Equation 9	Equation 10	Equation 11	Equation 12
Internal	1.258297*** (.097236)	1.284967*** (.0962282)	1.273968*** (.0976021)	1.307779*** (.0958117)	1.289765*** (.0960285)	..
CaMod Competition	-.331828*** (.099326)	-.3277613*** (.0975674)	-.3396445*** (.0973344)	-.2932046*** (.0979743)	-.2978421*** (.09681)	-.1633856* (.09106)
DSL Competition	.2747093** (.123969)	.2794193** (.1229507)	.2645168** (.1219031)	.2912788** (.1221757)	.2897722** (.1230172)	.2577129** (.1232781)
noDillon	..	..	..	..	..	..
Regulate	-.291356*** (.094374)	-.3011647*** (.0943541)	-.2957219*** (.0949195)	-.3096281*** (.0949076)	-.3717504*** (.0941736)	-.1557423* (.0868968)
Rurc_corr	-.0297993 (.0194816)	..	..	..	-.0489999*** (.0189951)	-.1557423*** (.0868968)
cbcity	.8323456*** (.1489206)	.7803319*** (.1344363)	.7898176*** (.1297863)	.7742621*** (.1348167)	.7790375*** (.13249)	.9173815*** (.1294851)
SAtlantic	.5123936*** (.1226365)	.514338*** (.1190502)	.5316997*** (.1277055)	.4982527*** (.1200124)	..	.5443121*** (.1140218)
Pacific	.4509822*** (.1675968)	.4591483*** (.1681924)	.4664539*** (.1775435)	.46824*** (.1681394)	..	.42695*** (.1583183)
cbcensus	.2212281 (.3531137)	..	..	..	..	..
dedba	.954958 (.7794277)	.9146789 (.7713681)	.8555634 (.8085677)	..	1.894469* (.9946202)	2.414212*** (.6720315)
R_metro	..	.1601669* (.095217)	.1561563* (.0958181)	.1963914** (.0945904)	..	..
busdens	..	..	.0545552 (1.087542)	..	..	..
hudens1	..	..	.0423785 (.1705776)	..	..	..
dincpc1	..	..	..	-.0050656 (.0103274)	-.0215926 (.0146549)	..
_cons	-2.22167*** (.2249879)	-2.381944*** (.1791323)	-2.385477*** (.1756303)	-2.229122*** (.2496479)	-1.730416*** (.2934547)	-2.055048*** (.208105)
N	1790	1801	1785	1801	1801	1790
Pseudo R ²	0.2344	0.2372	0.2371	0.2365	0.2230	0.1068

Note: * Significant at 10% confidence level, **: significant at 5%, ***: significant at 1%. Robust standard errors are in parenthesis.