PRICING AND COMPETITION IN LOCAL TELEPHONE MARKETS
UNDER PRICE-CAP REGULATION

DISSERTATION

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the Degree Doctor of Philosophy in the Graduate
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By

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Deregulation and technological innovation are drastically changing the structure of traditionally regulated industries. Most notably, this change can be traced to two driving forces: the emergence of competition in markets once shielded from entry and an across the board public policy experiment with alternative forms of regulation designed to provide competitive incentives to regulated firms. This research analyzes the initial phase of the structural transition occurring in the local telephone industry.

The theoretical model developed in this dissertation extends the traditional dominant firm-competitive fringe model of market structure to include the presence of price-cap regulation — a popular form of incentive regulation in the local telephone industry. Contrary to the predictions of the traditional model, this research demonstrates that the presence of fringe competition need not reduce the price charged by a dominant firm. This is because effective competition is prevented from materializing when tightly binding price-cap regulation is adopted — an outcome similar to those predicted by models of limit pricing and entry deterrence. This theoretical model then serves as a framework upon which two empirical studies of the local telephone industry are built.

To test the hypotheses generated by this model a panel data set (1994-1997) is constructed using observations from local telephone markets in the United States. The first
empirical study analyzes dominant firm pricing under price-cap regulation and fringe competition. Empirical results show that price-cap regulation has provided a downward and binding constraint on the prices charged for local telephone services. However, no effect attributable to fringe competition is found. This implies that state public utility commissions have systematically adopted tightly binding price-cap regulation within their jurisdictions and suggests that doing so has stifled the development of competition in local telephone markets.

This insight is confirmed in the second empirical study which analyzes the determinants of fringe competition in the local telephone industry. Empirical evidence shows that competition has developed at a slower pace and that competitive fringes are smaller in local telephone markets with price-cap regulation than without. Thus, this research puts forth and empirically supports an alternative explanation for the sluggish development of local telephone competition. Finally, a political economy explanation detailing how state public utility commissions have benefitted from slowing down the development of competition within their states is provided and supported with empirical evidence to reconcile this surprising conclusion.

JEL Classification: D4, L13, L43, L51, L96
To my parents,
Joseph and Bonnie Abel
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CHAPTER 1

INTRODUCTION

The economic deregulation of American industry is progressing at a rapid pace.\(^1\) According to Winston (1993), 17 percent of the United States’ GNP was produced by regulated industries in 1977. By 1988 that number had fallen sharply to 6.6 percent of GNP. This trend of deregulation and increased competition has continued as we now move into the new millennium, forever changing the structure of traditionally regulated industries and the role of federal and state regulators. Nowhere has this been more obvious than in the industries comprising the public utility sector of the economy (e.g., electric power, natural gas and telecommunications).

Like many of the traditionally regulated industries, the local telephone industry is currently undergoing a series of important changes in its transition from an industry of regulated monopoly to one consisting of a more competitive market structure. Most notably, since divestiture on January 1, 1984, firms operating in local telephone markets have

\(^1\) Following Stigler (1981), I interpret economic deregulation as the state’s withdrawal of its legal powers to direct the economic conduct (e.g., pricing, entry, exit) of nongovernmental bodies. Although an industry’s regulatory status is commonly characterized as either regulated or deregulated, in fact neither characterization is ever completely accurate (Winston 1993). The current status of the local telephone industry is a good example of this point. Therefore, the term partial deregulation better describes the current position of this industry in transition.
experienced a movement away from traditional rate-of-return regulation toward the implementation of various incentive regulation plans. These incentive regulation plans were largely designed to provide regulated monopolies with competitive incentives under the assumption that true competition was impossible. Advances in technology, however, have made competition feasible in this industry once thought to exhibit the properties of natural monopoly.

With the passage of the Telecommunications Act of 1996, local telephone markets once shielded from entry have now been opened to competition. As a result, a hybrid market structure consisting of both economic regulation and competition has been created. These two potentially binding constraints are driving many of the structural and behavioral changes observed in today’s local telephone industry. Therefore, a better understanding of the hybrid market structure created by partial deregulation is needed at this time.

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For a thorough discussion of the incentive regulation plans used in the telecommunications industry since divestiture, see Sappington and Weisman (1996, p. 71-91). For a complete documentation of the regulatory transition occurring within each state since divestiture, see Abei and Clements (1998).

3 From an academic standpoint, the impetus for this regulatory change can be traced to the seminal piece by Averch and Johnson (1962) in which they identify several ways productive inefficiency will arise because of this cost-plus form of regulation. Among these include a capital input bias, cost padding, cost shifting and inefficient entry into unregulated markets. Incentive regulation as a whole has been designed to mitigate these inefficiencies.

4 A natural monopoly exists if a good, or set of related goods, is produced most efficiently by a single firm. Economists typically define a natural monopoly in terms of cost structure. If a cost structure has the property of subadditivity, then a set of commodities is produced most cheaply by a single firm. The technical condition that must be met is: \( C(x_1 + ... + x_n) < C(x_1) + ... + C(x_n) \) for any set of product vectors \( x_i \), where \( C(\bullet) \) is a firm’s total cost function. This concept is commonly used to define natural monopoly.

This dissertation begins to fill this void by providing a theoretical and empirical analysis of the initial phase of the structural transition occurring in the local telephone industry. To model this newly created hybrid market structure, I extend the traditional dominant firm-competitive fringe (DF-CF) model of market structure to include the presence of price-cap regulation—a widely used form of incentive regulation in the local telephone industry. This model demonstrates that price-cap regulation and competition are largely substitute (and perhaps redundant) constraints on the pricing behavior of dominant firms. This implies that, at any given time, only one of these constraints will actually be effective in constraining the pricing behavior of a regulated dominant firm. This theoretical insight reconciles the polar findings common in the existing empirical literature measuring the impact of competition and economic regulation on realized prices in the telecommunications industry (e.g., Kaestner and Kahn 1990; Tardiff and Taylor 1993; Edelman 1997; Blank, Kaserman and Mayo 1998; Ai and Sappington 1998) and will improve the design and interpretation of future empirical studies of this nature.

Furthermore, the model developed in this dissertation provides insight into the development of effective competition in partially deregulated markets. In particular, it demonstrates that the adoption of tightly binding price-cap regulation may actually stifle the development of effective competition in markets recently opened to competition. This

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6 Theoretically, price-cap regulation can be defined as a price ceiling above which a regulated firm cannot price, but downward pricing flexibility is allowed. Because the price is set ex-ante, rather than ex-post, of a regulated firm's cost realization, this form of alternative regulation provides incentives similar to those of a competitive market by breaking the explicit link between the regulated price and costs.

7 Effective competition implies that the competition existing in a market will have a measurable effect on various outcomes linked to market performance (e.g., price).
theoretical insight provides a new explanation for the sluggish development of local telephone competition and increases our understanding of the initial phases of the deregulation process.

Finally, this model provides a framework upon which two empirical studies about the structural transition occurring in the local telephone industry are built. I construct a panel data set (1994-1997) consisting of observations from local telephone markets in the United States to test the hypotheses generated by the model developed in this dissertation. This data set represents the most recent compilation of data describing the local telephone industry and is the only data set known to use local telephone markets, rather than states, as the unit of observation.

The first empirical study analyzes the pricing behavior of dominant firms in local telephone markets subject to both price-cap regulation and fringe competition. Empirical results show that price-cap regulation, rather than fringe competition, has provided a binding constraint on the prices charged by dominant local telephone companies for their services. Within the framework of the extended DF-CF model, this suggests that, on average, price-cap constraints have been set tightly by state public utility commissions in the United States. Thus, evidence implying that an important relationship between the development of competition and the adoption of price-cap regulation is found.

This notion is supported by the second empirical study which analyzes the determinants of fringe competition in local telephone markets. Empirical evidence shows that fringe competition has developed at a slower pace and has subsequently resulted in smaller competitive fringes in local telephone markets with price-cap regulation than
without. To reconcile this surprising result, I put forth and support with some empirical
evidence a political economy explanation detailing how state public utility commissions have
benefitted from slowing down the development of competition within their states. Thus, this
research also highlights the strategic nature of selecting regulatory regimes in traditionally
regulated markets that are no longer shielded from competitive entry.

This dissertation is organized as follows. In Chapter 2, I briefly discuss the
background and policy implications of the research undertaken. In Chapter 3, I present the
theoretical model used to gain insight into today’s local telephone industry and outline two
empirical tests to verify the predictions it offers. Then, the proposed empirical tests are
carried out in the next two chapters. In Chapter 4, I provide an empirical analysis of
dominant firm pricing in local telephone markets. An empirical analysis of the determinants
of fringe competition in the local telephone industry is contained in Chapter 5. Finally, a
short conclusion in Chapter 6 completes the research.
CHAPTER 2

BACKGROUND AND POLICY IMPLICATIONS OF RESEARCH

2.1 Introduction

The telecommunications industry of today is as much a product of regulatory reform as it is of advances in technology. Shifts in technology have often led to the emergence of potential competitors for the provision of telecommunications services. However, these potential competitors have become actual competitors only when the explicit barriers-to-entry imposed by economic regulation have been removed. These two forces have moved hand-in-hand through time to shape and mold the structure, conduct and ultimately performance of the telecommunications industry.

Broadly defined, the telecommunications industry currently consists of three distinct, but related, markets: the long-distance market, the local toll market, and the local telephone market. Each has been shaped, and to some extent created, by changes in technology and regulation; and each is in a different phase of the transition process. Understanding how the telecommunications industry as a whole has evolved is necessary before one can fully understand the current economic and public policy issues in the local telephone industry.
2.2 The Structural Evolution of the Telecommunications Industry

At one time, AT&T existed as a virtual monopoly provider of all telecommunications services in the United States. Over time, however, competitive forces made their way into this once protected industry, drastically changing its evolution. The long-distance market was first to feel the pressures of competition. Although actual competition in the long-distance market was delayed by the rent-seeking behavior of AT&T, the competitive forces unleashed by technological innovation ultimately prevailed.¹ This sparked regulatory changes that would forever alter the structure of the telecommunications industry.

In 1974, fearing that AT&T would take anti-competitive actions made possible by having operations in both regulated and unregulated markets, the Department of Justice filed an antitrust suit against AT&T seeking divestiture of this telephone monopoly.² Nearly eight years and several million dollars later, AT&T agreed to divest its local telephone companies (known now as Regional Bell Operating Companies or RBOCs) in exchange for reduced regulation of its long-distance operations.³ This decision separated the telecommunications industry into two components: local and long-distance.

¹ See Brock (1994) for a comprehensive review of the history behind the competitive transition observed in the telecommunications industry.

² See Brennan (1987) for a detailed discussion of the major issues involved in this antitrust case.

³ Regional Bell Operating Companies are the most common of all the incumbent local exchange carriers (ILECs) today. Originally, the RBOCs consisted of seven separate holding companies having operations in every state except Alaska, Connecticut and Hawaii. However, due to recent merger activity in the local telephone industry, only five RBOCs remain. In total, the RBOCs serve over 77% of all local telephone customers in the United States (FCC, 1996, Table 2.3). Thus, without loss of generality, the terms ILEC and RBOC are often interchangeable.
Cross-subsidization from one telephone service to another is a strategy employed by regulators to keep local telephone prices (especially for residential customers) artificially low. By keeping local telephone prices low, regulators believed that they could encourage higher levels of subscription to the telephone network and fulfill universal service obligations. Before the divestiture of AT&T, earnings from long-distance services were used to cross-subsidize foregone earnings from local telephone services. However, this cross-subsidization scheme could no longer be maintained once independent companies provided these telephone services. Regulators sought to develop a new method of cross-subsidization to fulfill their universal service obligation. Once again, regulation would play a large role in shaping the structure of the telecommunications industry.

As part of the Modification of Final Judgement (MFJ) handed down by Judge Harold Greene in 1984, 161 Local Access and Transport Areas (LATAs) were created. LATAs are geographic boundaries that define the service territories within which Regional Bell Operating Companies can operate, and can therefore be used to define local and long-distance telephone markets. To preserve the cross-subsidization of local telephone services

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4 See, for example, Kaserman, Mayo and Flynn (1990) or Kaserman, Mayo, Blank and Kahai (forthcoming) for particularly good empirical studies about the use of cross-subsidization in the telecommunications industry.

5 Universal service is a regulatory initiative designed to provide all citizens of the United States access to basic telephone service at affordable rates.

6 In the language of the telecommunications industry, telephone calls staying within a LATA are called intralATA calls and telephone calls crossing LATA boundaries are called interLATA calls. All interLATA calls are considered long-distance calls, whereas a distinction is made at the local level. For the most part, consumers pay a flat monthly fee for telephone calls made within a LATA (i.e., local telephone calls). However, a toll charge is applied to some telephone calls staying within a LATA (i.e., local toll or local long-distance calls) and to all calls crossing LATA boundaries (i.e., long-distance calls). Finally, interLATA calls can be within or across state boundaries, but intralATA calls (except on the rare occasion) do not cross state boundaries.
in place before divestiture, an artificial market was created within each LATA known as the local toll (or local long-distance) market. Creating this additional market allowed the RBOCs to use revenues from local toll services to cross-subsidize foregone revenues from their local operations. Originally, the RBOCs were allowed to carry, as a monopoly provider, all telephone calls originating and terminating within the same LATA, but were prohibited from carrying calls moving across LATA boundaries.\(^7\)

It was not long before the forces of competition began to enter the local toll market. The regulatory distortion created in the name of universal service drove the price for local toll calls far above their marginal cost. This and further technological innovation made this market ripe for competitive entry. Many of the long-distance providers (e.g., AT&T, MCI) in the telecommunications industry began to lobby state commissions for permission to offer these services. Almost immediately, individual states began to allow competition for local toll services.\(^8\) Today, both the long-distance and local toll markets can accurately be characterized as imperfectly competitive oligopoly markets.

As the telecommunications industry became more competitive, changes in the economic regulation employed by federal and state regulators followed. In particular, traditional rate-of-return regulation was replaced by alternative forms of regulation designed to overcome the inefficiencies associated with this traditional method of regulation and to provide more flexibility to incumbent firms facing competition for the first time.

\(^7\) The RBOCs continue to be banned from entering long-distance markets today. However, the Telecommunications Act of 1996 contains provisions under which an RBOC may be allowed to offer in-region interLATA service.

\(^8\) Blank, Kaserman and Mayo (1998) indicate that as many as five states began allowing competition for local long-distance services in 1984. By 1991, that number had increased to 27.
At the federal level, price-cap regulation was implemented from 1989-1995 to constrain the long-distance telephone operations of AT&T. Conventional wisdom suggested that this form of incentive regulation would work best in markets already facing some competition. Regulators believed implementing price-cap regulation in the long-distance market would protect consumers from abusive market power, while affording AT&T the flexibility to meet competitive challenges through price cuts. In 1995, this form of economic regulation was replaced in favor of the competitive forces that had developed in the long-distance market.

The choice of economic regulation at the state level has tended to be more cautious and less uniform than at the federal level. Beginning shortly after divestiture, state public utility commissions began experimenting with various incentive regulation plans. Initially, the incentive regulation plans chosen were very similar to traditional rate-of-return regulation (e.g., banded rate-of-return or earnings sharing plans). However, through time, new and innovative methods of regulation have been implemented. Today, some form of price-cap regulation has been adopted in 70 percent of the states (Abel and Clements 1998).
2.3 Today's Local Telephone Industry

The local telephone industry was the last to succumb to the forces of competition. This should come as no surprise once the cost of building a network is taken into consideration. Resale-based competition posed the initial threat to incumbent local exchange carriers (ILECs). Resellers typically own very little, if any, of their own network facilities. Instead, they attempt to arbitrage incumbent firms by buying their services at wholesale and selling them to final consumers at an intermediate price. The actual amount of competition generated by these companies is questionable since the incumbents control the price at which their services are sold to resale competitors.

Additionally, competitors can enter a local telephone market by leasing portions of the incumbent’s network to carry their own local traffic. This method of entry is referred to as purchasing unbundled network elements (UNEs). Firms purchasing UNEs pose a more serious competitive challenge to ILECs than resellers, but still rely heavily on the incumbent firms.

The emergence of facilities-based competition poses a more natural threat to the incumbents operating in local telephone markets. Competitive Access Providers (CAPs) were the first facilities-based competitors to emerge. CAPs began as companies offering large business customers the opportunity to bypass the local loop by directly connecting them to long-distance providers. Over time, they have evolved into competitors that offer most

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9 See Craner (1994) for an early assessment of local telephone competition. For a more recent discussion of the policies adopted in promoting local telephone competition, see Harris and Kraft (1997) or Vogelsang and Mitchell (1997).
of the services provided by ILECs. CAPs that have undergone this transformation and other new local exchange carriers entering the local telephone industry have come to be known as competitive local exchange carriers (CLECs).

As the local telephone industry has become more competitive, the form of economic regulation used to constrain incumbent firms in this market has also changed. As was previously done at the federal level, state regulators began to implement price-cap regulation within their jurisdictions. Table 2.1 shows the trends in adopting price-cap regulation for RBOCs and the allowance of competition in the local telephone industry.

Through the 1990s, price-cap regulation has become the most popular form of alternative regulation in the United States. As seen in Table 2.1, in 1998 35 of the 51 state public utility commissions use some form of price-cap regulation to constrain the dominant telephone companies operating within their jurisdictions. Over the same time period, the allowance of competition in local telephone markets steadily increased on a state-by-state basis. Finally, with the passage of the Telecommunications Act of 1996, all explicit state and local regulatory barriers-to-entry to the local telephone industry have been removed. The purpose of this analysis is to gain a better understanding about the interaction of these two powerful and potentially binding constraints.
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<td>31</td>
<td>51(^a)</td>
</tr>
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<td>1997</td>
<td>35</td>
<td>51(^a)</td>
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<tr>
<td>1998</td>
<td>35</td>
<td>51(^a)</td>
</tr>
</tbody>
</table>

Note: A state is classified as having adopted price-cap regulation if a price-cap plan was in effect during the year for incumbent local exchange carrier (RBOC) services. Price-cap plans with initial rate freezes are included; however, plans specified as rate freezes are not. A state is classified as allowing competition if it allows partial or full competition for any services provided by incumbent local exchange carriers. The Telecommunications Act of 1996 requires all states plus the District of Columbia to open local telephone markets to competition. [a] indicates years for which this applies.


Table 2.1: Trends in Adopting Price-Cap Regulation for Dominant Local Telephone Companies and Allowing Competition in Local Telephone Markets by State Public Utility Commissions
2.4 Policy Implications of this Research

This research addresses important public policy issues regarding the impact and implementation of the regulatory transition underway in the local telephone industry. First, as demonstrated in Table 2.1, price-cap regulation has become the most common method of economic regulation used to constrain incumbent firm behavior. However, no theoretical consensus currently exists about the pricing behavior of firms subject to price-cap regulation relative to firms subject to traditional rate-of-return regulation and conclusive empirical research on the subject is scant.\textsuperscript{10} As a result, theoretically motivated empirical research studying the prices realized under this popular form of incentive regulation is necessary at this time to help regulators make informed decisions about the regulation (if any) they choose to implement.

Secondly, passage of the Telecommunications Act of 1996 was intended to encourage competition in both the long-distance and local telephone markets. Specifically, Section 253 of the Act removes state and local government imposed entry barriers to local telephone markets\textsuperscript{11}, and Section 271 of the Act describes the necessary conditions that, once satisfied, permit the RBOCs entry to long-distance telephone markets. However, before the Federal

\textsuperscript{10} See, for example, Braetigam and Panzar (1993), Pint (1992) and Liston (1993) for theoretical studies comparing the properties of price-cap regulation and rate-of-return regulation. In addition, Cabral and Riordan (1989), Brennan (1989), and Clemenz (1991) provide theoretical studies describing the cost reducing incentives and welfare implications created under price-cap regulation. See Kridel, Sappington and Weisman (1996) and Berg and Foreman (1996) for comprehensive surveys of the existing empirical literature on the use of incentive regulation in the telecommunications industry.

\textsuperscript{11} Specifically, Section 253(a) of the Act states that “No state or local statute or regulation, or other state or local legal requirement, may prohibit or have the effect of prohibiting the ability of any entity to provide any interstate or intrastate telecommunications service.”
Communications Commission will grant an RBOC permission to enter an in-region long-distance market in a state, effective competition in the originating local telephone market must be demonstrated.\textsuperscript{12} Therefore, the stipulations outlined in Section 253 of the Act must be met before satisfying the requirements of Section 271 become possible.

Although competition for local telephone services appears to be intensifying, some have been critical of the pace at which it has developed.\textsuperscript{13} The most common explanations for the sluggish development of local telephone competition typically center on the incumbent’s dominant position in local telephone markets. Some point to the alleged ability of ILECs to prevent competitors from entering their markets through the direct use of strategic behavior. Others claim that these markets are not technologically able to support real competition. Although plausible, these may not be the primary reasons local telephone competition has been slow to materialize.

\textsuperscript{12} Specifically, Section 271(c)(1)(A) of the Act states that “A Bell operating company meets the requirements of this subparagraph if it has entered into one or more binding agreements that have been approved under Section 252 specifying the terms and conditions under which the Bell operating company is providing access and interconnection to its network facilities for the network facilities of one or more unaffiliated competing providers of telephone exchange service to residential and business subscribers.” It should also be noted that, although final permission for an RBOC to enter interLATA long-distance markets is granted by the FCC, state commissions and the Department of Justice play an advisory role in this process. Section 271(c)(1)(B) contains provisions that allow RBOC entry into interLATA long-distance markets in the absence of facilities-based competition. However, this relies upon state commission verification that no such competitor has sought access or interconnection.

\textsuperscript{13} According to a recent State Telephone Regulation Report survey, the number of CLECs has grown more than 250% in the last year. For the first time in history, the number of authorized CLECs has surpassed the number of ILECs in the United States. This growth signifies the increased intensity of competition expected in local telephone markets. However, this fact is a bit misleading because the actual number of CLECs operating is far lower than the number certified. Certification is only the first step a CLEC must take to become active. Additionally, a company must secure an interconnection agreement with an incumbent telephone company, have numbering codes assigned to it, and may have to file a tariff. At this point, however, the company can begin to serve customers free from regulatory scrutiny. See Kirchoff (1998) for more information about the current status of local telephone competition.
This research offers an alternative (and less obvious) explanation for the sluggish development of local telephone competition. My analysis suggests that the adoption of tightly binding price-cap regulation has stifled the development of effective local telephone competition. Taken to its logical conclusion, this finding also implies that entry to the long-distance market by RBOCs has been delayed by the actions of state regulators. Because of the economies of scope thought to exist in the provision of local and long-distance telephone service, these regulatory actions have prevented an efficient potential competitor from becoming an actual competitor.\textsuperscript{14} Thus, economic regulation continues to play a large role in shaping the structure of the telecommunications industry.

\textsuperscript{14} Economies of scope exist if it is less costly to produce separate goods jointly than separately. The technical condition that must be met is: $C(x_a, x_b) < C(x_a, 0) + C(0, x_b)$, where $x_a$ and $x_b$ are different goods and $C(\cdot)$ is a firm's total cost function. In this context, efficiencies due to joint production are highly likely because local telephone service is an input in the production function of long-distance telephone service.
CHAPTER 3

DOMINANT FIRM-COMPETITIVE FRINGE MODEL OF MARKET STRUCTURE
WITH PRICE-CAP REGULATION

3.1 Introduction

A market structure can be characterized as having a dominant firm if it contains one
firm that serves at least 50 percent of the market (White 1981). Since the ILECs operating
today typically serve over 90 percent of the customers in their service territories, this
threshold is easily surpassed in the local telephone industry (FCC 1998a). Thus, today’s
local telephone industry can be portrayed as one having a dominant firm (i.e., ILECs)
competing against small fringe rivals and potential entrants (i.e., CLECs). However, to
model accurately the behavior of dominant firms now operating in the local telephone
industry one must develop a model that includes the presence of both price-cap regulation
and fringe competition. A natural place to begin building this model is the traditional (static
equilibrium) dominant firm-competitive fringe (DF-CF) model of market structure.

In this chapter, I extend this popular model of market structure to include price-cap
regulation — a widely used form of incentive regulation in the local telephone industry. This
model demonstrates that price-cap regulation and competition are largely substitute (and
perhaps redundant) constraints on the price selected by a dominant firm. Therefore, extending this model to include price-cap regulation changes the fundamental conclusions of the traditional DF-CF model. In particular, I show that the presence of a competitive fringe need not reduce the price charged by a regulated dominant firm because effective competition can be prevented from materializing when tightly binding price-cap regulation is adopted.

This surprising result implies that the adoption of tightly binding price-cap regulation in nascent competitive markets can produce outcomes similar to those predicted by models of limit pricing and entry deterrence. Thus, an alternative explanation for the sluggish development of local telephone competition is offered by this theoretical analysis. In addition, this model generates testable hypotheses about both the pricing behavior of dominant firms and the development of fringe competition in markets when price-cap regulation is present. Therefore, the model developed in this chapter also serves as a framework from which two empirical studies of the local telephone industry are built.¹

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¹ Because the DF-CF model tractably captures the size asymmetry between established incumbents and new entrants, this model is well suited for analyzing industries beginning their transition from regulated monopoly to more competitive market structures. For example, this model has been used as a framework to analyze other portions of the telecommunications industry in which competition has been allowed to develop. See Kahai, Kaserman and Mayo (1996) for an analysis of long-distance markets and Blank, Kaserman and Mayo (1998) for an analysis of local toll markets. However, no theoretical extension to the traditional model is provided in either paper. Therefore, the model developed here will grow in importance as other traditionally regulated industries (such as cable, electric power, and natural gas) follow the path of the telecommunications industry.
3.2 Background and Extensions of the Traditional Model

The traditional DF-CF model of market structure was first developed by Forchheimer in 1908, and has remained a standard part of industrial organization theory ever since.\(^2\) However, it was Stigler's 1940 formulation that provided the modern day neo-classical version of the DF-CF model. Therefore, this model is usually (but not necessarily correctly) attributed to Stigler (1940).

One weakness of this simple model is its failure to recognize that there is nothing to prevent the dominant firm's position from eroding as the firms comprising the competitive fringe gain market share. Worcester (1957) recognizes this inconsistency and demonstrates the instability of market structures characterized as having a dominant firm. He shows that such industries will evolve to an alternative market structure as the firms in the competitive fringe expand. Therefore, this may be a unique opportunity to analyze the local telephone industry from a DF-CF perspective.

However, this evolution to oligopoly may not occur if dominant firms are able to use their market power to strategically limit or deter entry to their markets. Bain (1949) argues that a dominant firm may strategically select a lower price than the price determined in the static equilibrium if, by doing so, it is able to limit the competitive pressure it will face. Gaskins (1971) expands this idea by adding a dynamic element to the model to demonstrate

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\(^2\) Modern industrial organization scholars have recently begun to use this model as a way to motivate empirical research analyzing the conduct and performance of industries dominated by large firms. To date, for example, the traditional DF-CF model has been used to motivate empirical studies in industries such as U.S. steel and iron (e.g., Stigler 1965 and Yamawaki 1985), aluminum (e.g., Suslow 1986), physician supply (e.g., Noether 1985), deregulated airlines (e.g., Borenstein 1989), as well as U.S. fresh salmon (e.g., Bjorndal, Gordon and Singh 1993).
how a dominant firm can maximize the net present value of its profits by optimally controlling the rate of entry to its market. Thus, by incorporating strategy and/or dynamics in the model, the dominant firm can take actions to maintain its position in the market.

When a regulated monopoly becomes a dominant firm due to partial deregulation, I argue that the adoption of price-cap regulation can produce the same results as those shown to exist in models of limit pricing and entry deterrence. This outcome is facilitated by setting the price-cap constraint at the price that would limit (or deter) entry to the dominant firm's market. Additionally, the regulated dominant firm may be able to take advantage of its increased pricing flexibility to make downward adjustments in price to optimally control the rate of entry to its market. Thus, this form of incentive regulation provides a strategic instrument through which regulated dominant firms can maintain their position in nascent competitive markets. However, using regulation to accomplish this strategy provides two additional advantages; namely, institutional commitment not to raise price and protection from antitrust authorities. Therefore, this form of regulation can be a potent way to retard the growth of competition.

3.3 The Model

I begin this analysis by presenting the traditional DF-CF model of market structure. This serves as a comparison point for the extension made and as a way to introduce the assumptions, terms and concepts used throughout this analysis.
3.3.1 The Traditional Dominant Firm-Competitive Fringe Model

Two key assumptions are maintained throughout this analysis. First, I assume that firms in the competitive fringe have costs similar to those of the dominant firm.\(^3\) However, the assumption that the dominant firm possesses some cost (e.g., a switching cost) or production advantage is maintained. Second, I assume competitive entry into the dominant firm’s market is not instantaneous (i.e., the aggregate fringe supply function is upward sloping).\(^4\)

The traditional DF-CF model is provided in Figure 3.1. The panel on the right represents the Dominant Firm and the panel on the left represents the Competitive Fringe. Throughout this analysis, \(D(P)\) represents the market demand facing both the competitive fringe and the dominant firm, \(MC_f\) represents the marginal cost of a typical fringe competitor, and \(S(P)\) represents aggregate fringe supply. Finally, \(MC_d\) represents the dominant firm’s marginal cost of production.\(^5\)

When a dominant firm faces a competitive fringe it can no longer reap the benefits of being an unconstrained monopolist. However, it remains the price leader in the market.

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\(^3\) If this were not true, the uninteresting case of no fringe entry due to cost inferiority would arise. In this case, the model resorts to that of monopoly.

\(^4\) This assumption is justified because CLECs must become certified by individual state commissions before they are allowed to enter a particular local telephone market.

\(^5\) In accordance with the traditional DF-CF model, I assume an upward sloping marginal cost curve for the dominant firm. Although local telephone markets have historically been viewed as a natural monopoly, this assumption is justified by recent findings contrary to this view. Gabel and Kennet (1991) conclude that local telephone markets do not exhibit the properties of natural monopoly (i.e., subadditivity), especially in densely populated areas such as metropolitan areas. This conclusion is expanded and supported by Shin and Ying (1992). Adding further support, in their estimate of the total cost function of local exchange carriers, Shin and Ying (1993) report a positive marginal effect for the variable measuring local telephone calls.
Figure 3.1: Dominant Firm with Competitive Fringe
It is assumed that each fringe competitor is a price-taker and that there is perfect information in the market. Although, the dominant firm must take the actions of the competitive fringe into consideration, the fringe does not present a strategic threat to the dominant firm since its behavior is easily predicted.

Given this set up, the dominant firm allows the fringe to produce as much as it wishes at the dominant firm determined price, while the dominant firm serves, as the monopoly provider, the remaining portion of the market. Formally, the dominant firm prices as a monopolist based on its residual demand curve.⁶

Constructing the dominant firm's residual demand is a simple task in the traditional model. Consider the following thought experiment. At the price P or below, the competitive fringe would exit (or never enter) the market. Thus, the dominant firm would supply the entire market in this case. Therefore, for prices at or below P, the dominant firm's residual demand coincides with market demand. At the other extreme, where S(P) intersects D(P), the market is served solely by the fringe. Finally, a linear combination of points connecting these hypothetical extremities maps out the remaining portion of the dominant firm’s residual demand curve, D₁(P).

Once the residual demand curve is identified, the dominant firm’s pricing behavior in this market structure is straightforward. The dominant firm maximizes profit by selecting its output such that MRₙ = MCₙ. The resulting output is denoted Qₙ. Once output is selected,

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⁶ A residual demand curve can be defined as the demand curve facing a particular firm in an industry, calculated by subtracting the quantity supplied by rival firms from market demand for a schedule of all possible prices. In this example, the residual demand facing the dominant firm can be described by the following equation: D₁(P) = D(P) - S(P).

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the dominant firm selects the highest supportable price based on residual (not market) demand, denoted \( P^d = P^* \). Finally, the firms in the competitive fringe take as given the price selected by the dominant firm. A typical fringe firm then chooses output such that \( P^f = P^* = MC_f \), denoted \( q_f \). Summing horizontally across each fringe firm’s output at \( P^* \) gives the aggregate output produced by fringe competitors, denoted \( Q_f \).

The traditional DF-CF model provides a powerful result — it is always true that the presence of a competitive fringe forces the dominant firm to charge a lower price than it would if it were an unconstrained monopolist. The intuition here is simple — the existence of a competitive fringe reduces the demand facing the dominant firm, thus observed price must fall. The question now becomes, does this result hold once the model is extended to a hybrid environment of competition and regulation?

3.3.2 An Extension of the Traditional Model to Include Price-Cap Regulation

Operating in an environment of regulatory constraint, specifically that of price-cap regulation, changes the fundamental conclusions obtained by the traditional DF-CF model. This is because a price-regulated dominant firm cannot select a price from the entire set of prices corresponding to market demand. Instead, the set of prices available to a price-regulated dominant firm is truncated at the maximum allowable price set by regulators. Therefore, effective demand, \( D_e(P) \), is used to guide the business decisions of a price-
regulated dominant firm. This means that dominant firm pricing decisions will depend heavily on the difference between effective demand (rather than market demand) and residual demand over the relevant range of production when price-cap regulation is present.

My analysis proceeds by considering three distinct cases in which a price-cap constraint is set to allow different levels of dominant firm pricing flexibility. By considering these three specific cases, it becomes possible to identify ranges of expected price and fringe production behavior created by the addition of regulatory constraint. Throughout this analysis, the maximum allowable price determined by the price-cap constraint is denoted $P^{\text{cap}}$.

Case #1: No Entry ($P^{\text{cap}} \leq P$)

A simple case arises if the price-cap constraint is set at or below the shut down point of the competitive fringe. The case where the price-cap constraint is set equal to $P$ is modeled in Figure 3.2. In this case, no entry to the dominant firm's market would occur since the resulting price is not high enough to induce entry by fringe firms. More formally, since the competitive fringe never enters the market, there is no difference between effective demand and effective residual demand facing the dominant firm. Obviously, the competitive fringe would not impact the pricing decision of the price-cap constrained dominant firm since one never results.

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7 In this context, I define the effective demand curve to be the actual demand curve resulting once the regulatory constraint has been set. Further, effective residual demand is defined as the demand facing a single firm calculated by subtracting the quantity supplied by rival firms from effective demand for a schedule of all feasible prices.
Figure 3.2: Dominant Firm with Competitive Fringe and Price-Cap Regulation (Case #1: No Entry)
Instead, this case reduces to one of constrained monopoly pricing. The effect of the price-cap constraint is to flatten demand until the constraint intersects market demand. Over this range of the effective demand curve, demand and marginal revenue coincide. Therefore, when the dominant firm maximizes profit it selects the output where \( P^{\text{cap}} = MC_d \), denoted \( Q_d \). In this case, the dominant firm is the sole supplier in the market (i.e., \( Q_d = Q \)) and the model indicates that excess demand results (i.e., \( Q < Q^* \)).

There are two insights gained from this benchmark case. First, the resulting price in this market is determined solely by the price-cap constraint. Second, it demonstrates the potentially stifling impact on competition of price-cap regulation. If the price-cap constraint is set tight enough, the regulation itself deters entry to the dominant firm’s market. It is clear that the observable pricing and entry behavior predicted here differs markedly from that predicted by the traditional DF-CF model of market structure.

Case #2: Entry with No Impact on Price (\( P < P^{\text{cap}} \leq P^* \))

Now suppose that the price-cap constraint is relaxed to allow the dominant firm more pricing flexibility. However, assume the constraint is still set below the price an unregulated

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\( ^8 \) In a traditional market setting, the existence of excess demand typically results in observable non-price rationing. In the telecommunications industry, non-price rationing may surface as lower quality telephone service or as a persistent busy signal. Ai and Sappington (1998) find that delays in resolving service problems are more pronounced under price-cap regulation, thus lending some support to this idea. However, due to the installation of advanced switching technology to reduce network congestion, it is not likely that one would observe persistent busy signals, except perhaps on holidays such as Mother’s Day.
dominant firm facing a competitive fringe would choose. The outcome when the price-cap constraint is set above $P$, but below $P^*$ is modeled in Figure 3.3.⁹

Again, when the dominant firm is subject to a price-cap constraint its effective demand curve is kinked at the point of intersection with the market demand curve. Over the horizontal range, marginal revenue corresponds to effective demand. Because $P^{\text{cap}}>P$, fringe competitors will now become active in the market and it becomes possible to map out the dominant firm’s effective residual demand curve taking into consideration both the price-cap constraint and entry by a competitive fringe. This is represented graphically by the double-kinked curve labeled effective residual demand, $D_{e}(P)$. This curve represents the demand faced by a price-regulated dominant firm in the presence of fringe competition.

Notice that, in this case, entry by the competitive fringe does not change the effective demand curve at the intersection of $MC_d$ and $MR_e = D_{e}(P)$. Therefore, the dominant firm maximizes profit by selecting quantity such that $P^{\text{cap}} = MC_d$, denoted $Q_d$. The next step is to select the highest supportable price based on effective residual demand, denoted $P^d = P^{\text{cap}}$. Following the traditional DF-CF model, a typical fringe firm takes this price as given and chooses to produce $q_f$ units. Since the price set by a constrained dominant firm is less than that set by an unconstrained dominant firm, a typical fringe firm produces less than it would in an unconstrained environment. Because of this, the amount of output contributed by the competitive fringe, denoted $Q_f$, is less than would be predicted using the traditional DF-CF

⁹ $P^*$ is the price that results in the traditional dominant firm-competitive fringe model.
Figure 3.3: Dominant Firm with Competitive Fringe and Price Cap Regulation (Case #2: Entry with No Impact on Price)
model. Finally, although partially relieved by the presence of fringe competitors, excess demand continues to remain in the market (i.e., \( Q < Q' \)).

Two important implications arise from this analysis. First, when the price-cap constraint is set below the price an unconstrained dominant firm would choose, the competitive fringe has no impact on the price selected by the dominant firm because the price-cap constraint remains binding in the presence of fringe competition. Second, tightly binding price-cap regulation limits the size of the competitive fringe and prevents effective competition from materializing to the level predicted by the traditional DF-CF model.

Case #3: Entry with An Impact on Price (\( P^* < P^{\text{cap}} \leq P^M \))

Finally, suppose the price-cap constraint is set to allow the dominant firm even greater pricing flexibility than before. Although the following analysis holds for the case of a non-binding price-cap constraint (i.e., \( P^{\text{cap}} > P^M = \) the monopoly price), I assume a binding price-cap constraint (i.e, \( P^{\text{cap}} < P^M \)). The outcome, assuming the price-cap constraint is set below \( P^M \), but above \( P^* \) is modeled in Figure 3.4.

Using the same analysis as in the previous case, it is clear that the effective residual demand curve, \( D_{e}(P) \), differs significantly from the effective demand curve, \( D_{e}(P) \), facing the dominant firm. Notice, effective residual marginal revenue, \( MR_{er} \), is downward sloping

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10 If I assume that each fringe firm can only produce one unit of output and that a distribution of cost functions exists from which each fringe firm draws before deciding to produce (i.e., enter the market), then \( q_e = n \) and \( Q_e = N \). Under this interpretation of the model, the outcome above indicating that tightly binding price-cap regulation can act to limit entry and reduce total fringe size becomes more transparent.
Figure 3.4: Dominant Firm with Competitive Fringe and Price-Cap Regulation (Case #3: Entry with Impact on Price)
and below effective residual demand over the relevant range of production. In this case, the existence of fringe competitors makes an otherwise binding price-cap constraint become non-binding. Essentially, the competitive fringe itself becomes the dominant firm's only constraint in selecting a price to maximize profit. In this case, the model reduces to the traditional DF-CF model and results in the same outcome that would occur in an environment free from regulatory constraint.

Following through with this theoretical analysis provides two more insights about this hybrid market structure. First, as the traditional model predicts, it is still possible for entry by a competitive fringe to impact the dominant firm's pricing behavior. However, this is true only if entry by the competitive fringe can materialize to the level predicted by the traditional DF-CF model. Second, this condition will occur only when the price-cap constraint is set to allow the dominant firm a wide range of pricing flexibility. In this case, however, competition is more effective in constraining the dominant firm's pricing behavior than price-cap regulation.
3.3.3 Summary of Theoretical Results

The basic results of the model can be summarized as follows:

**RESULT 1:** *Fringe competition will have no impact on a price-regulated dominant firm's pricing behavior when the price-cap constraint is set such that* \( P^* \geq P_{\text{cap}} \geq P \). *In this case, the price-cap constraint remains binding when entry occurs. Effective competition is prevented from fully materializing due to the presence of tight price-cap regulation, and possibly eliminated if the price-cap constraint is set at the shut down point of the competitive fringe.*

**RESULT 2:** *Fringe competition will act as a constraining force on a price-regulated dominant firm's pricing behavior when the price-cap constraint is set such that* \( P_{\text{cap}} > P^* \). *In this case, the price-cap constraint becomes non-binding with fringe competition.*

Unfortunately, as long as some entry is observed, the predictions of this extended DF-CF model are theoretically ambiguous. Therefore, a sound understanding of this hybrid environment becomes an empirical matter.
3.4 Implications for Empirical Research

Fortunately, the potential scenarios predicted by this model are distinguishable through an empirical analysis of the determinants of dominant firm pricing and the development of fringe competition in the local telephone industry. The specific tests are described below.

3.4.1 An Empirical Test Using the Determinants of Dominant Firm Pricing

Result 1 indicates that the price-cap constraint would remain binding with fringe competition. Empirically, this would imply that the price set by the dominant firm would be constrained by price-cap regulation, but not the presence of fringe competitors. On the other hand, Result 2 indicates that the price-cap constraint would become non-binding in the presence of fringe competition. Empirically, this would imply that the price set by a dominant firm will be constrained by competition, but not by the price-cap constraint. This predicted difference in statistically significant price determinants is the basis for the first empirical test to distinguish between the theoretical results developed in this chapter.

3.4.2 An Empirical Test Using the Determinants of Fringe Competition

Result 1 indicates that the price-cap constraint remains binding with fringe competition. Empirically, this would imply that the competitive fringe would be smaller in
markets with price-cap regulation than without. However, this is not true in Result 2. In fact, since the price-cap constraint becomes non-binding with a competitive fringe one should expect no relationship between the development of fringe competition and the adoption of price-cap regulation. This predicted difference in the impact of price-cap regulation on the development of fringe competition is the basis for an additional empirical test to distinguish between the theoretical cases developed in this chapter.

3.5 Summary

The fundamental results of the traditional DF-CF model do not necessarily hold once price-cap regulation is introduced in the model, rather they are dependent upon the pricing flexibility permitted to the dominant firm. In instances where the price-cap constraint is set tightly, the presence of a competitive fringe does not impact the pricing decisions of the dominant firm. Furthermore, I have demonstrated that the adoption of tightly binding price-cap regulation can produce outcomes similar to those predicted in models of limit pricing and entry deterrence. On the other hand, if the price-cap constraint is set loosely, the price-cap constraint becomes ineffective since it is non-binding in the presence of a fringe competition. This chapter concludes by identifying two empirical tests that will serve to distinguish between the theoretical cases developed in this chapter.
CHAPTER 4

DOMINANT FIRM PRICING WITH PRICE-CAP REGULATION AND FRINGE
COMPETITION: AN EMPIRICAL ANALYSIS OF LOCAL TELEPHONE PRICING

4.1 Introduction

The local telephone industry is currently undergoing a series of important changes
in its transition from an industry of regulated monopoly to one resembling a more
competitive market structure. Since divestiture, dominant firms operating in local telephone
markets have experienced a movement away from traditional rate-of-return regulation toward
the implementation of price-cap regulation. This kind of economic regulation is now widely
used by the state public utility commissions in the United States to constrain the operations
of dominant local telephone companies operating within their jurisdictions (Abel and
Clements 1998).

This popular form of incentive regulation was designed to provide competitive
incentives to regulated monopolies in the absence of true competition. However, advances
in technology have made competition feasible in this industry once thought to exhibit the
properties of natural monopoly. With passage of the Telecommunications Act of 1996, local
telephone markets once shielded from entry are now opened to competition. As a result of
this partial deregulation, a hybrid market structure consisting of both price-cap regulation and fringe competition has developed in the local telephone industry. Therefore, empirical research aimed at gaining a better understanding of firm behavior in this type of market structure is needed at this time.

In this chapter, I begin to fill this void by providing an empirical analysis of dominant firm pricing behavior with price-cap regulation and fringe competition. To do so, I construct a panel data set (1994-1997) consisting of observations from local telephone markets in the United States. This analysis accomplishes two objectives. First, I provide estimates of the size and direction the presence of price-cap regulation and fringe competition have had on local telephone prices. Second, this analysis serves as an empirical test to distinguish between the theoretical results of the extended DF-CF model developed in Chapter 3. I find that price-cap regulation provides a downward and binding constraint on local telephone prices, but that the presence of fringe competition does not.¹ Thus, empirical support for the extended DF-CF model and an alternative explanation for the sluggish development of local telephone competition is provided.

¹ Sappington and Weisman (1996) identify several pitfalls into which empirical studies estimating the impact of incentive regulation in the telecommunications industry have fallen. At the top of their list is what they refer to as the Competition Effect Pitfall. This pitfall can be defined as attributing an observed effect (e.g., lower prices) to incentive regulation, when the effect is really caused by increased competition. Avoiding this empirical pitfall requires the researcher to control for the presence of competition when estimating the impact of incentive regulation plans on industry performance. Although controlling for both potentially binding constraints is important, the model developed in Chapter 3 suggests that the Competition Effect Pitfall is not a serious problem when studying pricing behavior.
4.2 Empirical Studies of Local Telephone Pricing

Very little empirical research exists about the pricing behavior in local telephone markets. To date, only three other studies have considered the effect of incentive regulation and/or competition on local telephone pricing. Tardiff and Taylor (1993) provide the first attempt to measure the impact of incentive regulation on local telephone prices, but fail to consider competition in their analysis. However, given the time period under consideration, excluding competition from their analysis may not pose a serious problem. They find no measurable effect of incentive regulation in general, or price-cap regulation in particular, on local telephone prices.

Knittel (1997) provides the first attempt to measure the impact of competition on local telephone pricing, but fails to control for the presence of economic regulation. He finds a negative relationship between local telephone prices and whether or not state public utility commissions allow, or have considered allowing, local telephone competition. Thus, he concludes that actual and potential competition have caused residential local telephone prices to fall. However, without accounting for the effect of regulation in his analysis, Knittel may be attributing to competition an effect caused by regulation. Thus, he falls prey to a reverse Competition Effect Pitfall.

\footnote{Empirical studies of this nature are more common for other portions of the telecommunications industry. For example, see Mathios and Rogers (1989) and Kaestner and Kahn (1990) for empirical research on AT&T’s pricing behavior in the intrastate long-distance market, see Edelman (1997) for an empirical study of AT&T’s pricing behavior in the interstate long-distance market, and see Mathios and Rogers (1990) and Blank, Kaserman and Mayo (1998) for empirical research on the pricing behavior in the intraLATA toll market.}
More recently, Ai and Sappington (1998) update the original study of local telephone markets by Tardiff and Taylor to control for competition. To do so, they use the percentage of telephone lines held by Competitive Access Providers (CAPs) in each state. Ai and Sappington find that the presence of price-cap regulation leads to lower residential local telephone prices, but find no relationship between competition and local telephone prices. However, the variable they use to measure competition may not accurately portray the degree of competition within actual local telephone markets since it is measured at the state rather than the LATA level.

This empirical analysis improves upon the current literature in several important ways. Most importantly, this research is firmly grounded in economic theory. Having a theoretical framework helps to design the empirical analysis and provides a basis for interpreting the estimation results. Second, I estimate the impact of both price-cap regulation and fringe competition on local telephone pricing behavior. Including both potential constraints is necessary to accurately portray today's local telephone industry. Finally, the data employed in my analysis more accurately describes current local telephone markets by using LATAs, rather than states, as the unit of observation and by including observations that predate and postdate passage of the Telecommunications Act of 1996.³

³ Because the number of LATAs within a state varies, it is particularly important to measure the impact of competitive entry on local telephone pricing in this way. Consider the following stylized example. Suppose State A has 5 LATAs and 10 competitive entrants and State B has 1 LATA and 4 competitive entrants. Conducting the analysis at the state level would indicate that more competition is present in State A than in State B (10>4). However, without knowing the distribution of competitors across LATAs in State A, one cannot safely come to this conclusion. It may be the case that each LATA in State A contains only 2 competitive entrants. In this case, more competition is present in State B than in State A (4>2). This potential problem is avoided by conducting a LATA-level analysis.
4.3 An Econometric Model of Local Telephone Pricing by a Dominant Firm

To capture the underlying determinants of dominant firm pricing in local telephone markets, a general empirical model is provided to bridge the theoretical and empirical sections of this research. This model is similar to one developed by Blank, Kaserman and Mayo (1998), but differs in three important aspects. First, the model presented below explicitly derives the dominant firm's residual demand curve. Second, in this model I specifically consider price-cap regulation, rather than incentive regulation as a whole. Third, this model explicitly accounts for the political nature of local telephone pricing.

I begin by specifying the aggregate market demand function facing both the dominant firm and competitive fringe:

\[ D = f(P_D, P_f, W) \]  \hspace{1cm} (4.1)

where \( f \) is the aggregate demand function for the homogeneous service produced by the firms in this market, \( P_D \) is the price charged by the dominant firm, \( P_f \) is the price charged by each of the fringe firms, and \( W \) is a vector of other factors influencing market demand. Without loss of generality, let \( P_D = P_f = P \approx \) the realized market price, since the price set by the dominant firm is taken as given by each firm in the fringe when the service provided is homogeneous. Therefore, equation (4.1) can be reformatted as:

\[ D = f(P, W) \]  \hspace{1cm} (4.2)
Aggregate fringe supply, $S_F$, can be represented by the following expression:

$$S_F = \sum_{i=1}^{N} q_i (P, X), \quad i = 1, ..., N \quad (4.3)$$

where $q_i$ is the output of the $i^{th}$ fringe firm calculated by equating price and marginal cost, and $X$ is a vector of other cost factors common to all firms in the market. Assuming identical fringe firms, the aggregate fringe supply function becomes:

$$S_F = Nq_i (P, X), \quad i = 1, ..., N \quad (4.4)$$

where $N$ represents the number of entrants to the competitive fringe. If entry to a local telephone market is restricted by the regulatory authority having jurisdiction, $S_F = 0$ because $N = 0$. Due to passage of the Telecommunications act of 1996, this applies only to years prior to 1996. However, $N = 0$ is possible in years before and after passage of the Act if entry to a particular market had not occurred.

It is now possible to specify the residual demand function, $Q_d^r$, facing the dominant firm in the market. This function is calculated by subtracting aggregate fringe supply (4.4) from market demand (4.2) for the range of all feasible prices the market will support and is represented by the following expression:

$$Q_d^r = D - S_F \quad (4.5)$$
Substituting (4.2) and (4.4) into (4.5) gives:

\[ Q_{D}^i = f(P, W) - Nq_i(P, X) \quad i = 1, ..., N \]  \hspace{1cm} (4.6)

With the residual demand curve facing the dominant firm specified in (4.6), a regulated dominant firm's profit maximization problem can be represented by the following expression:

\[
\begin{align*}
\text{Max } \Pi &= P_D Q_{D}^i - C_D(Q_{D}^i, X) \\
\text{st: } P_D &\leq \Gamma(Y, Z)
\end{align*}
\]  \hspace{1cm} (4.7)

where the dominant firm's cost, \( C_D \), is a function of its output, \( Q_{D}^i \), and other factors that influence cost, \( X \). The function \( \Gamma(Y, Z) \) describes the regulatory bounds on firm behavior. In this general framework, \( Y \) is a vector of political factors that contribute to the regulatory environment in which a dominant ILEC operates and \( Z \) is a vector of regulatory policy arguments that generally vary across state jurisdictions. The regulatory environment captured by \( \Gamma(Y, Z) \) reflects the presence and efficacy of various interest groups, political biases, as well as the regulatory constraint employed by state regulators. Without loss of generality, the price a dominant firm selects can be regulated by explicitly setting a maximum price (i.e., price-cap regulation) or by implicitly setting a price that will result in a specified profit level (i.e., rate-of-return regulation).
The dominant firm's equilibrium price, $P^*_D$, solves the maximization problem in (4.7) and can be stated as:

$$P^*_D = G(N, W, X, Y, Z).$$  \hspace{1cm} (4.8)

Equation (4.8) is the fully reduced-form price equation\(^4\) for the regulated dominant firm facing a competitive fringe expressed in terms of exogenous variables.\(^5\) With a theoretical and empirical framework firmly set, it is now possible to estimate the impact of price-cap regulation and fringe competition on the prices charged by dominant firms in the local telephone industry.

4.4 Empirical Estimation of Local Telephone Pricing

The empirical model derived in Section 4.3 indicates that the price set by a regulated dominant firm depends on several variables. Most notably, consideration must be given to the degree of fringe competition facing a particular dominant firm, the regulatory and

\(^4\) In contrast to previous studies employing the DF-CF model to motivate empirical work, I am not concerned with estimating market power. Instead, I am estimating the impact of price-cap regulation and fringe competition on dominant firm local telephone pricing behavior. Therefore, the reduced-form price equation (4.8) above provides the appropriate foundation for my empirical analysis. See Blank, Kaserman and Mayo (1998) or Emmons and Prager (1997) for papers using a similar approach.

\(^5\) The number of fringe firms in a local telephone market, $N$, is treated as an exogenous variable in the derived reduced-form price equation used in this analysis. In theory, fringe competition ($N$) and the dominant firm's price ($P_D$) may be endogenously determined. However, the null hypothesis of no endogeneity between the number of fringe competitors and the price for local telephone service could not be rejected using a Hausman Specification test.
political environment in which it operates, as well as the basic demand and cost conditions of the market it serves. In this section, I estimate the effect of price-cap regulation and fringe competition on the prices charged by dominant firms in the local telephone industry. Additionally, this empirical analysis will determine which of the theoretical cases developed in Chapter 3 holds in practice, and will serve to validate the extension made to the traditional DF-CF model of market structure.

4.4.1 Data

To conduct an accurate empirical analysis of local telephone pricing, I constructed a data set at the LATA level. The first step in this process was to identify the local telephone markets in the United States by locating the LATA boundaries within each state. To accomplish this task, I used LATA maps located in Notes on the BOC IntraLATA Networks to determine how the LATAs were distributed within each state. Once the local telephone markets were identified, the next step of the process was to gather data that would accurately represent each LATA.

For this analysis it is important to match local telephone prices, the number of fringe competitors, and the regulatory regime for each LATA. The Federal Communications Commission (FCC) records the prices charged for local telephone services in 95 cities located in the United States. Therefore, I used Rand McNally's 1990 Road Atlas to match the LATA corresponding to each available metropolitan area for which local telephone prices are recorded. Due to data limitations, and to make the use of a LATA-level analysis
meaningful, observations corresponding to the Regional Bell Operating Companies comprise the vast majority of the data set.\textsuperscript{6} Restricting the sample to these telephone companies decreases the available observations to eighty-four. I use the telephone prices recorded in each city as a representative price for its corresponding LATA. The Federal Communications Commission (FCC) also keeps track of the number of new entrants by state and LATA. Therefore, matching the number of reported entrants to the eighty-four LATAs in the sample is an easy task. Finally, state public utility commissions select, on a firm-by-firm basis, the form of economic regulation used. Therefore, there is meaningful variation in regulatory regimes across states and firms. I use this variation in regulatory policy to determine the regulatory regime in each LATA. To round out the data set, information about the political environment of a market corresponding to the characteristics of each state public utility commission is also collected.

Unfortunately, LATAs do not conform to any pre-established state or local government boundaries. Therefore, I have to approximate much of the demographic information used as control variables in the analysis. For the most part, the best approximation of a particular LATA is the primary metropolitan area it contains.\textsuperscript{7} Therefore, 

\textsuperscript{6} There are no RBOC operations in Alaska, Connecticut or Hawaii. For Connecticut, information for Southern New England Telephone (SNET) is used. Alaska and Hawaii are dropped from the sample. Additionally, Cincinnati Bell and Rochester Telephone are included in the data set. Unfortunately, information about the operations of other ILECs such as GTE is incomplete or not available. However, the telephone companies included in this analysis serve over 77\% of all the local telephone customers in the United States (FCC, 1996, Table 2.3). Therefore, without loss of generality, this analysis accurately portrays today’s local telephone industry.

\textsuperscript{7} For single-LATA states (e.g., New Mexico) and for LATAs that cover a very large portion of the state (e.g., the Grand Island LATA in Nebraska), the best approximation is at the state rather than metropolitan area level. These adjustments are made when appropriate. Since these variables are included to control for differences across LATAs, capturing the relative difference between LATAs is important. Constructing the data set in this fashion accurately does this.
I use information corresponding to the primary metropolitan areas within each LATA to develop a set of control variables for each LATA in the sample.

To add richness to the data set, and to capture the transition underway in the local telephone industry, I collect this data over the time period 1994-1997. Selecting this time period for the analysis is justified on several grounds. First, it is the most recent compilation of data available to study the effects of price-cap regulation and fringe competition on local telephone company pricing behavior. Second, this data set includes information from before (1994-1995) and after (1996-1997) passage of the Telecommunications Act of 1996. This feature provides detailed information about the development of local telephone competition in the United States. Finally, this data set covers the time period in which the majority of state public utility commissions decided to adopt price-cap regulation for the telephone companies under investigation. This feature makes accurately estimating the impact of this popular form of incentive regulation on dominant firm pricing possible. In full, this data set is a balanced panel of 336 observations, by LATA and year, taken from local telephone companies operating in thirty-six states plus the District of Columbia.

4.4.2 Description of Variables for Empirical Analysis

A brief definition and data source for each of the variables used in this empirical analysis is provided in Table 4.1. However, a more complete description of these variables follows below. For convenience, each variable is grouped according to the category that fits with the econometric model of dominant firm local telephone pricing derived previously.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUSP</td>
<td>a representative price charged to business customers for monthly single-line, one party local telephone service in LATA i during year t.</td>
<td>[a]</td>
</tr>
<tr>
<td>RESP</td>
<td>a representative price charged to residential customers for monthly single-line, one party local telephone service in LATA i during year t.</td>
<td>[a]</td>
</tr>
<tr>
<td>PCREG</td>
<td>a binary variable equal to 1 if the state uses some form of price-cap regulation to constrain incumbent local exchange carrier operations in LATA i during year t and 0 otherwise.</td>
<td>[b]</td>
</tr>
<tr>
<td>COMP</td>
<td>the number of fringe competitors (comprised of CLECs) holding telephone numbers in LATA i during year t. This variable equals 0 if no competitors hold telephone numbers in a LATA or if competitive entry to local telephone markets is not permitted in the state (before 1996).</td>
<td>[c]</td>
</tr>
<tr>
<td>PCXCP</td>
<td>an interaction variable equal to PCREG x COMP.</td>
<td>[b&amp;c]</td>
</tr>
<tr>
<td>POP</td>
<td>population for LATA i during year t.</td>
<td>[d&amp;e]</td>
</tr>
<tr>
<td>GROW</td>
<td>population growth rate for LATA i during year t.</td>
<td>[d&amp;e]</td>
</tr>
<tr>
<td>INC</td>
<td>per capita income for LATA i during year t.</td>
<td>[d&amp;e]</td>
</tr>
<tr>
<td>DEN</td>
<td>population density for LATA i during year t.</td>
<td>[d&amp;e]</td>
</tr>
<tr>
<td>WAGE</td>
<td>average hourly wage for the manufacturing sector of LATA i during year t.</td>
<td>[f]</td>
</tr>
<tr>
<td>BUSLINE</td>
<td>a measure of the business special interest in each state, calculated by dividing business lines by total lines in the state during year t.</td>
<td>[g]</td>
</tr>
<tr>
<td>ELECT</td>
<td>a binary variable equal to 1 if the state commissioners with jurisdiction over operations in LATA i during year t are elected and 0 if appointed</td>
<td>[h&amp;i]</td>
</tr>
<tr>
<td>POLIT</td>
<td>an index ranging continuously from 0 to 1 measuring the political sentiment of the state commission with jurisdiction over LATA i during year t. Scores closer to 1 represent a Republican sentiment and scores closer to 0 represent a Democratic sentiment.</td>
<td>[h&amp;i]</td>
</tr>
</tbody>
</table>


Table 4.1: Definition and Data Source of Variables for Local Telephone Pricing Analysis

47
Dependent Variables

- Local Telephone Prices ($P_D$)

Local telephone companies are multi-product firms. I focus on two important products provided by local telephone companies: business and residential local telephone service. Therefore, I estimate two separate reduced-form equations in this analysis. The dependent variables selected are the monthly price for single-line, one-party telephone service paid by business and residential customers in LATA $i$ during year $t$, denoted $\text{BUSP}$ and $\text{RESP}$.

Local telephone competition is in an early stage of development. To date, entry by fringe competitors has occurred primarily to serve business customers. There are at least two reasons competition has progressed more quickly for business customers than for residential customers. First, it is less expensive to build a network to serve business customers located in densely populated areas such as central business districts. Second, the price-cost margins for business services are expected to be greater than available for residential services due to cross-subsidization. Therefore, one would expect competition to have a larger impact on business services than residential services.
Explanatory Variables

- Regulatory Environment (Z)

The form of economic regulation used to constrain the operations of a dominant firm will influence the price it selects. Of particular interest in this analysis is the impact of price-cap regulation on local telephone prices. **PCREG** is a binary variable that takes on the value of 1 if the ILEC operating in LATA i during year t is subject to price-cap regulation and 0 otherwise.

The expected sign of this variable is theoretically ambiguous. If price-cap constraints are set tightly, the model developed in Chapter 3 predicts that this variable will have a negative effect on local telephone prices. However, if the price-cap constraint is set to provide the dominant firm with a wide-range of pricing flexibility, no measurable effect attributable to price-cap regulation is predicted in the presence of fringe competition because the price-cap constraint will become non-binding.

- Fringe Competition (N)

The DF-CF model of market structure indicates that the presence of fringe competition may impact the price set by incumbent local telephone companies. Therefore, I develop a measure of fringe competition to fit the DF-CF model. **COMP** is the raw number of CLECs holding telephone numbers in LATA i during year t, and represents the presence of a competitive fringe. Prior to 1996, the decision to allow local telephone competition was made at the state level. Therefore, this variable takes on the value of 0 if the state did not
permit local telephone competition in year t (before 1996) or if no competitors held numbers in a particular LATA (throughout the time period).

Although this is not a perfect measure of the actual competition taking place in a local telephone market, it represents the closest one can come given the data resources currently available. Additionally, because a firm holding telephone numbers is just a customer away from being an actual competitor, this market-based measure of competition is superior to alternative measures of competition used in the academic literature. Therefore, this variable measures both real and potential competition in a particular local telephone market.

Again, the impact of fringe competition on local telephone prices is theoretically ambiguous in the presence of price-cap regulation. This variable is expected to have a negative impact on local telephone prices if price-cap constraints are set to provide the dominant firm with a wide-range of pricing flexibility. However, the model developed in Chapter 3 predicts that this variable will have no measurable effect on local telephone prices if the price-cap constraint remains binding with fringe competition.

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8 Measures of competition tend to be either rule-based (e.g., a dummy variable indicating whether or not local competition is permitted in a state) or market-based (e.g., the number of firms certified to provide local telephone services in a particular state). Market-based measures have several advantages over rule-based measures. First, one might expect that the decision to allow competition may be dependent on the form of regulation selected by regulators. Using a market-based measure removes the explicit link between these regulatory decisions. Second, in markets where competition is allowed, distinguishing between the ones with and without entry is possible. Finally, meaningful variation in the degree of competition remains even after the Telecommunications Act of 1996 was implemented. Additionally, since being certified is one step removed from actually holding numbers in a market, this measure best reflects the focus of my analysis.
• Demand Conditions (W)

To properly isolate the effect of price-cap regulation and fringe competition on local telephone prices I control for variation in demand characteristics across LATAs over time. POP is a measure of population and GROW is a measure of the population growth rate for the metropolitan area corresponding to each LATA i in year t. Higher levels of population represent the presence of more potential customers for both business and residential telephone services within a market. Additionally, the latter variable provides some indication about the relative health of a particular local telephone market which may impact the location decisions of businesses and capture shifts in general population trends. Therefore, markets with higher levels of growth may signify a stronger customer base in the present, as well as more potential customers in the future. Finally, to control for variation in income across LATAs, I include the variable INC to measure the per capita income for the metropolitan area corresponding to each LATA i in year t. Each of these three variables acts to change the demand for local telephone service across LATAs. Because economic theory suggest that prices will, ceteris paribus, depend on shifts in demand, a positive relationship is expected for each of these variables.

• Cost Conditions (X)

Controlling for variation in the cost characteristics across markets is also important in properly isolating the impact of price-cap regulation and fringe competition on local telephone prices. Ideally, a measure of each incumbent firm’s marginal cost would be included as an explanatory variable. However, due to the proprietary nature of this
information and difficulties in measuring this variable, these data are not available. Instead, I include the variables DEN and WAGE to control for cost variation in the sample.

DEN is a measure of the population density for the metropolitan area corresponding to each LATA i in year t. Because it is less expensive to construct a telephone network in more densely populated areas, production costs and population density should have an inverse relationship. WAGE is the average hourly wage paid in the manufacturing sector of the metropolitan area corresponding to each LATA i in year t. This variable controls for variation in the cost of labor and is directly related to production costs. Economic theory suggests that changes in production costs, ceteris paribus, will impact pricing decisions through shifts in supply. Therefore, I expect population density to have a negative relationship with the price charged for local telephone services and the wage paid for labor to have a positive relationship with the price charged for local telephone services.

- Political Environment (Y)

It is important to control for the political environment of regulated markets because of the potential distortions created by serving political interests. In particular, it is important

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9 Recent research suggests that the inclusion of political economy variables in empirical studies of this nature is important to accurately portray the telecommunications industry. Smart (1994) finds that states with elected commissioners have lower local telephone prices than states with appointed commissioners, but finds no evidence of price differences corresponding to the political party controlling government offices (e.g., legislative and executive branches of government). Donald and Sappington (1995, 1997), however, find that the political party controlling government offices does make a difference in the selection of incentive regulation by state public utility commissions. My analysis builds on these studies by explicitly considering the effect on price of special interest groups, the method of commissioner appointment, and the political biases of the actual state commissions governing the pricing decisions of local telephone companies.
to control for the presence of special interest groups and for characteristics of the state public utility commissions having jurisdiction in a particular local telephone market.

**BUHLINE** is the percentage of total telephone lines in a particular state used to serve business customers during year t. It is used in this analysis to control for the presence of business (and inversely residential) customer special interest groups. Assuming that special interest groups can influence the regulation adopted in a particular state through lobbying efforts, it is important to control for this aspect of a regulated market. All things equal, I expect a larger presence of business customers to result in more favorable treatment to that group. Therefore, I expect this variable to be negatively related to the local telephone prices paid by business customers and positively related to the local telephone prices paid by residential customers.

Two important features of a state public utility commission are whether its commissioners are elected or appointed and its political bias. One might believe that elected commissioners would act differently than appointed commissioners since they are more vulnerable to the political whims of the people they serve. This, in turn, may influence the flexibility given to incumbent local telephone companies operating within its jurisdiction. Therefore, it is important to control for differences in how commissioners are selected. **ELECT** is a binary variable equal to 1 if the commissioners in the state are elected and 0 if they are appointed.

Additionally, the political sentiment of a state public utility commission will likely influence the treatment of incumbent local telephone companies and other aspects of the regulatory process. For example, one might suspect that Republican commissions would
have more sympathy for a free-market approach in their jurisdiction than their Democratic counterparts. To control for these political biases, I develop an index of political sentiment for each state public utility commission. This variable ranges continuously from 0 to 1, with scores closer to 1 indicating a Republican bias and scores closer to 0 indicating a Democratic bias. The variable POLIT represents the political sentiment of each state public utility commission in the sample. Without more theoretical guidance, no clear a priori prediction about the impact of these last two political environment variables on local telephone pricing can be offered. The expected relationship between local telephone prices and the explanatory variables described above is summarized in Table 4.2.

4.4.3 Estimation Approach

Panel data can be analyzed using either a random-effects or fixed-effects approach. The inclusion of LATA and year fixed-effects variables in this estimation will produce asymptotically consistent estimates of the explanatory variables if permanent or highly serially correlated LATA or time effects, not accounted for by the explanatory variables, are present in the data. Since this possibility is highly likely, I employ a fixed-effects approach to estimate the following reduced-form price equations for business and residential local

---

10 Each state has between 3 and 7 commissioners. The following method was employed to calculate the index of political sentiment for each state commission. A value of 1 was assigned for each Republican commissioner, 0.5 for each independent commissioner, and 0 for each Democratic commissioner in a state. Then, these numbers were summed and divided by the number of commissioners in that state. From this process, a continuous variable ranging from 0 to 1 was produced for each state public utility commission for each year in the sample.
<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Business Price</th>
<th>Residential Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regulatory Environment (Z)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCREG</td>
<td>(-) or no effect</td>
<td>(-) or no effect</td>
</tr>
<tr>
<td><strong>Fringe Competition (N)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMP</td>
<td>no effect or (-)</td>
<td>no effect or (-)</td>
</tr>
<tr>
<td><strong>Demand Conditions (W)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POP</td>
<td>(+)</td>
<td>(+)</td>
</tr>
<tr>
<td>GROW</td>
<td>(+)</td>
<td>(+)</td>
</tr>
<tr>
<td>INC</td>
<td>(+)</td>
<td>(+)</td>
</tr>
<tr>
<td><strong>Cost Conditions (X)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEN</td>
<td>(-)</td>
<td>(-)</td>
</tr>
<tr>
<td>WAGE</td>
<td>(+)</td>
<td>(+)</td>
</tr>
<tr>
<td><strong>Political Environment (Y)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUSLINE</td>
<td>(-)</td>
<td>(+)</td>
</tr>
<tr>
<td>ELECT</td>
<td>(?)</td>
<td>(?)</td>
</tr>
<tr>
<td>POLIT</td>
<td>(?)</td>
<td>(?)</td>
</tr>
</tbody>
</table>

Table 4.2: Expected Relationship Between Explanatory Variables and Local Telephone Prices
telephone services, where $\gamma_i$ is modeled as a fixed-effects variable for each LATA in the data set and $\kappa_i$ is modeled as a fixed-effects variable for each year in the data set.

\[
\text{BUSB}_{it} = \alpha + \beta_1 \text{PCREG}_i + \beta_2 \text{COMP}_i + \beta_3 \text{PCXCP}_i \\
+ \beta_4 \text{POP}_i + \beta_5 \text{GROW}_i + \beta_6 \text{INC}_i + \beta_7 \text{DEN}_i + \beta_8 \text{WAGE}_i \\
+ \beta_9 \text{BUSLINE}_i + \beta_{10} \text{ELECT}_i + \beta_{11} \text{POLIT}_i + \gamma_i + \kappa_i + \varepsilon_{it} \quad (4.9)
\]

and,

\[
\text{RESP}_{it} = \alpha + \beta_1 \text{PCREG}_i + \beta_2 \text{COMP}_i + \beta_3 \text{PCXCP}_i \\
+ \beta_4 \text{POP}_i + \beta_5 \text{GROW}_i + \beta_6 \text{INC}_i + \beta_7 \text{DEN}_i + \beta_8 \text{WAGE}_i \\
+ \beta_9 \text{BUSLINE}_i + \beta_{10} \text{ELECT}_i + \beta_{11} \text{POLIT}_i + \gamma_i + \kappa_i + \varepsilon_{it} \quad (4.10)
\]

where, $i \equiv \text{LATA}$, $t \equiv \text{year}$, and $\varepsilon_{it} \equiv \text{disturbance term (i.i.d. \text{N}(0, \sigma^2))}$.

An interaction variable of price-cap regulation and competition, \text{PCXCP}, is added to the specification above to test the hypothesis that either price-cap regulation or competition, but not the combination of both together, acts to constrain the pricing behavior of price-regulated dominant firms. The descriptive statistics for each of the variables used in this analysis are provided in Table 4.3 and the results of this multiple regression analysis are contained in Table 4.4.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUSP</td>
<td>42.42</td>
<td>9.27</td>
<td>26.51</td>
<td>75.06</td>
</tr>
<tr>
<td>RESP</td>
<td>19.55</td>
<td>3.55</td>
<td>12.18</td>
<td>31.63</td>
</tr>
<tr>
<td>PCREG</td>
<td>0.649</td>
<td>0.478</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>COMP</td>
<td>2.149</td>
<td>3.107</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>PCXCP</td>
<td>1.830</td>
<td>3.104</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>POP</td>
<td>1663600.0</td>
<td>1797100.0</td>
<td>79100.0</td>
<td>9149800.0</td>
</tr>
<tr>
<td>GROW</td>
<td>0.007</td>
<td>0.012</td>
<td>-0.039</td>
<td>0.068</td>
</tr>
<tr>
<td>INC</td>
<td>24659.00</td>
<td>4874.80</td>
<td>11346.00</td>
<td>42525.00</td>
</tr>
<tr>
<td>DENS</td>
<td>733.71</td>
<td>1287.10</td>
<td>13.70</td>
<td>9311.50</td>
</tr>
<tr>
<td>WAGE</td>
<td>13.14</td>
<td>1.79</td>
<td>8.85</td>
<td>20.65</td>
</tr>
<tr>
<td>BUSLINE</td>
<td>0.309</td>
<td>0.052</td>
<td>0.216</td>
<td>0.683</td>
</tr>
<tr>
<td>ELECT</td>
<td>0.131</td>
<td>0.338</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>POLIT</td>
<td>0.537</td>
<td>0.284</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: For 336 observations. Descriptive statistics for the fixed-effects variables omitted for brevity.

Table 4.3: Descriptive Statistics for Local Telephone Pricing Analysis
### Fixed-Effects Model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Bus Price</th>
<th>(T-Ratio)</th>
<th>Res Price</th>
<th>(T-Ratio)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCREG</td>
<td>-1.2449(^a)</td>
<td>(-4.682)</td>
<td>-1.0459(^a)</td>
<td>(-4.143)</td>
</tr>
<tr>
<td>COMP</td>
<td>-0.1119</td>
<td>(-1.035)</td>
<td>-0.0579</td>
<td>(-0.564)</td>
</tr>
<tr>
<td>PCXCP</td>
<td>0.1303</td>
<td>(1.410)</td>
<td>0.1475(^c)</td>
<td>(1.681)</td>
</tr>
<tr>
<td>POP</td>
<td>-0.00028</td>
<td>(-0.085)</td>
<td>-0.00147</td>
<td>(-0.469)</td>
</tr>
<tr>
<td>GROW</td>
<td>5.8682</td>
<td>(0.605)</td>
<td>-6.1165</td>
<td>(-0.664)</td>
</tr>
<tr>
<td>INC</td>
<td>0.000363(^a)</td>
<td>(2.801)</td>
<td>0.000207(^c)</td>
<td>(1.682)</td>
</tr>
<tr>
<td>DEN</td>
<td>-0.00626(^a)</td>
<td>(-2.761)</td>
<td>0.00651(^a)</td>
<td>(3.023)</td>
</tr>
<tr>
<td>WAGE</td>
<td>0.3119</td>
<td>(0.939)</td>
<td>-0.2490</td>
<td>(-0.790)</td>
</tr>
<tr>
<td>BUSLINE</td>
<td>-29.816(^c)</td>
<td>(-1.794)</td>
<td>-17.200</td>
<td>(-1.090)</td>
</tr>
<tr>
<td>ELECT</td>
<td>0.1611</td>
<td>(0.184)</td>
<td>-0.8836</td>
<td>(-1.065)</td>
</tr>
<tr>
<td>POLIT</td>
<td>0.9533</td>
<td>(1.316)</td>
<td>-1.1267(^c)</td>
<td>(-1.638)</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>38.338(^a)</td>
<td>(4.912)</td>
<td>18.205(^b)</td>
<td>(2.456)</td>
</tr>
</tbody>
</table>

| Adj. $R^2$    | 0.9868    | 0.9190    |

Note: Results for the fixed-effects variables omitted for brevity. \( ^a \) indicates variable significant at the .01 level. \( ^b \) indicates variable significant at the .05 level. \( ^c \) indicates variable significant at the .10 level.

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**Dependent Variable:** BUSP (for Eq. 4.9)  
RESP (for Eq. 4.10)

Table 4.4: Multiple Regression Results for Reduced-Form Dominant Firm Pricing Equations
4.4.4 Discussion of Main Results

Overall, the empirical model performs quite well, explaining over 98 percent of the variation in the price set for business customers and over 91 percent of the variation in the price set for residential customers in local telephone markets. Additionally, the predicted relationship (shown in Table 4.2) holds for seven of the eight variables for which an expected relationship was defined in equation (4.9) and three of the eight variables for which an expected relationship was defined in equation (4.10). The success of the empirical model provides confidence in the general empirical model of local telephone pricing and the selection of explanatory variables in this analysis.

Of particular interest is the estimated effect of price-cap regulation and fringe competition on the prices set by dominant local telephone companies. In both cases, the variable PCREG is significant at the .01 level, while the variable COMP is not significant. Additionally, the interaction variable PCXCP is positive in both cases and significant only (at the .10 level) for the residential price equation.

Taking a first derivative of equation (4.9) and (4.10) with respect to PCREG and COMP and evaluating the expression with mean values allows one to calculate the marginal effect of price-cap regulation and competition on the prices charged by dominant firms for local telephone services. My calculations suggest that the presence of price-cap regulation has significantly reduced both the price charged to business customers by $0.965 (t = -4.012, p = 0.0001) and the price charged to residential customers by $0.729 (t = -3.191, p = 0.0016). Taken as a deviation from the mean price of local telephone service, this represents a 2.28
percent reduction in business prices and 3.73 percent reduction in residential prices for the
time period studied. However, my calculations of the marginal effect of fringe competition
on local telephone prices (-0.027 for business prices (t = -0.473, p = 0.6365) and 0.038 for
residential prices (t = 0.689, p = 0.4914)) indicate that entry by fringe competitors has had
no statistically significant impact on the pricing behavior of dominant local telephone
companies during the time period studied.

These findings imply that price-cap regulation — not the presence of a competitive
fringe — acts as a binding constraint on the price set by dominant firms in the local
technology industry. Indeed, only one of these two potentially binding constraints holds at any
given time for both business and residential services. This fact supplies direct support to the
predictions of the extended DF-CF model developed in this dissertation. Furthermore, this
empirical analysis provides evidence to suggest that the adoption of tightly binding price-cap
regulation may be acting to keep effective competition from developing in the local
technology industry by limiting the size of the competitive fringe (i.e., Case #2 of the
theoretical model developed in Chapter 3) relative to an environment with less stringent
regulation.

The control variables used in the reduced-form business price equation perform well,
however, only the variables measuring income, population density, and the presence of
business customer special interest groups are significant at conventionally accepted levels.

Although insignificant, it is interesting to note that Republican commissions tend to permit
higher prices for business customers than Democratic commissions. Within the framework
of this analysis, this may indicate that Republican commissions, on average, provide more
pricing flexibility to firms operating in their jurisdictions than Democratic commissions. Thus, there is some evidence to suggest that politics is influencing important aspects of the deregulation process in the local telephone industry. Finally, with the exception of income, the control variables in the reduced-form residential price equation do not perform as economic theory would predict. This finding is not surprising given the regulatory distortions targeted towards residential customers in the local telephone industry.

4.5 Summary

This chapter provides an empirical analysis of dominant firm pricing in U. S. local telephone markets when both price-cap regulation and fringe competition is present. To do so, I develop an econometric model that describes the determinants of local telephone pricing. This model provides guidance as to what variables should be included in the empirical analysis. With this direction in mind, I build a panel data set (1994-1997) to estimate the effect of price-cap regulation and fringe competition on the prices charged for local telephone service. Additionally, this analysis serves as an empirical test to distinguish between the theoretical results obtained by extending the traditional DF-CF model to include price-cap regulation.

Empirical results suggest that price-cap regulation, not the presence of a competitive fringe, has provided a binding constraint on the prices set by dominant local telephone companies for business and residential local telephone service. These findings demonstrate that price-cap regulation and fringe competition are in fact redundant constraints and provide
direct support for the extended DF-CF model of market structure. This implies that the adoption of tightly binding price-cap regulation may be acting to limit the amount of fringe competition in local telephone markets. However, more direct research is needed before this conclusion can be taken seriously. Therefore, research aimed at understanding what factors have determined the development of fringe competition in the local telephone industry is warranted.
CHAPTER 5

ENTRY IN REGULATED MONOPOLY MARKETS: THE DEVELOPMENT OF A COMPETITIVE FRINGE IN THE LOCAL TELEPHONE INDUSTRY

5.1 Introduction

With passage of the Telecommunications Act of 1996, explicit state and local regulatory barriers to entry that acted to shield incumbent local exchange carriers (ILECs) from competitive entry have been removed. This legislative change, coupled with advances in technology, has altered the structural evolution of the local telephone industry and forever changed the role of state public utility commissions. Indeed, this industry once served solely by regulated monopoly providers of local telephone service has now become an industry consisting of incumbent dominant firms (i.e., ILECs) facing entry by small fringe competitors (i.e., CLECs).

State regulators have responded to the structural changes taking place in the local telephone industry by replacing traditional rate-of-return regulation with alternative forms of regulatory constraint. Although experiments with alternative forms of regulation have been occurring since divestiture in 1984, it has been only recently that price-cap regulation
has emerged as the alternative regulatory plan of choice by state regulators for this industry. Coincidentally or not, this choice of regulation has occurred in combination with the early stages of the competitive transition underway.

In this chapter, I provide an empirical analysis of the factors that have influenced the development of fringe competition in the local telephone industry. This empirical analysis also serves as a second empirical test of the extended DF-CF model developed in Chapter 3. I investigate how different market characteristics, profit opportunities, as well as political and regulatory environments, have shaped the competitive transition in this nascent competitive industry. Of particular interest is the role the adoption of price-cap regulation has played in the development of local telephone competition. It is largely believed that price-cap regulation was implemented to mitigate the inefficiencies associated with traditional rate-of-return regulation by providing flexibility and competitive incentives to regulated firms. However, my results demonstrate that price-cap regulation has also provided strategic advantages to incumbent firms facing entry by limiting the development of competition within their markets. Therefore, direct support consistent with the predictions of the extended DF-CF model is provided.

Furthermore, I offer some empirical evidence to suggest that slowing the development of competition in this traditionally regulated industry has provided a direct

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1 Indeed, the adoption of price-cap regulation in the local telephone industry has been a recent phenomenon. Although some states began experimenting with this form of economic regulation in the late 1980s, it was not until 1994 that the movement toward the adoption of price-cap regulation began to take wind. Interestingly, it was often the industry itself that requested price-cap regulation rather than it being forced on them by state public utility commissions. This suggests that the incumbent firms believed they could gain from the adoption of price-cap regulation. See MacDonald, Norsworthy and Fu (1994) for an alternative explanation of why states did not select price-cap regulation early on.
benefit to state regulators by both increasing the political support they receive and by providing an inexpensive way to maintain their relevancy in an age of deregulation and increased competition. Taken in full, this research speaks directly to the current public policy debate on the development of competitive markets in the local telephone industry and contributes to the literature analyzing entry.

5.2 Empirical Studies of Entry in Industrial Organization

Understanding the causes and effects of competitive entry has been at the heart of microeconomic theory for centuries. Indeed, it is this important industry characteristic that simultaneously shapes market structure, influences firm conduct, and ultimately determines an industry's performance. Although the economics profession has produced a rich amount of theory analyzing the causes and effects of entry, there have been surprisingly few attempts to empirically examine this important aspect of industry behavior.

Industrial organization economists associated with the Structure-Conduct-Performance (SCP) paradigm set the foundation for empirical research on entry by investigating how differences in the magnitudes of market barriers-to-entry influenced measures of inter-industry performance (e.g., profits or prices). Although this line of research was successful in determining broad thresholds from which one could infer how entry (or the lack thereof) effected market performance across industries, it had little to say

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2 For a comprehensive review of the contributions and drawbacks of the methods developed by the Structure-Conduct-Performance paradigm, see Schmalensee (1989).
about the industry-specific causes of entry or the entry process itself.\textsuperscript{3} By the very nature of the methods employed by proponents of this paradigm, economists interested in the entry process were left with results generated from an aggregation of several, perhaps unrelated, industries that often did not describe the characteristics of specific industry behavior.

Largely in response to the dissatisfaction created by the limits of this type of empirical industrial organization, a new paradigm of empirical research came into fashion during the 1980s. This paradigm, aptly referred to as the New Empirical Industrial Organization (NEIO), deviates from past empirical research by using structural models of market structure to form an empirical framework from which to analyze the behavior of specific industries.\textsuperscript{4}

Research on the entry process arising out of this paradigm has tended to focus on testing theoretical models developed by game theorists. For example, detecting strategic behavior such as entry deterrence or accommodation among oligopoly firms (e.g., Spiller and Favaro 1984; Reiss and Spiller 1989; Bresnahan and Reiss 1990; and Kadiyali 1996), determining the characteristics of a market needed to support new firm entry (e.g., Bresnahan and Reiss 1987, 1991), and using observed entry to infer the profitability of an industry with market power (e.g., Bresnahan and Reiss 1987, 1991; and Berry 1992) have all been rich areas of exploration for economists associated with this new paradigm.

\textsuperscript{3} See Dunne, Roberts and Samuelson (1988) for an example of a study using the methods of the Structure-Conduct-Performance paradigm to analyze entry and exit.

\textsuperscript{4} For a detailed treatment of the methods developed by the New Empirical Industrial Organization paradigm, see Bresnahan (1989).
This research contributes to the NEIO literature by determining empirically what factors have contributed to the development of fringe competition in the local telephone industry.\(^5\) To the best of my knowledge, this research represents the first attempt to provide an explicit empirical examination of the competitive transition taking place in the local telephone industry.\(^6\) Furthermore, this research extends the empirical literature on entry by determining how economic regulation designed to mitigate market power in an industry can be used to influence the entry process. To do so, I build an explicit link between the newly developed NEIO literature and the well established Chicago studies on the political economy of regulation. Therefore, rather than focusing on strategic behavior between the incumbent firm and potential entrants to an industry, this research confirms that strategic behavior by regulators can produce outcomes similar to those arising in models of limit pricing and entry deterrence.

5.3 An Econometric Model of the Determinants of Fringe Competition

To capture the underlying determinants influencing the development of competition in the local telephone industry, I present a general model of fringe competition in markets served by a regulated incumbent dominant firm. This model builds from previous work by Masson and Shaanan (1982) and Blank, Kaserman and Mayo (1998). The entry process is

\(^5\) See MacDonald (1986) for a study about the development of a competitive fringe in U.S. food manufacturing industries using the Structure-Conduct-Performance methodology.

\(^6\) Abel and Clements (1999) examine the impact of asymmetric quality-of-service standards on competitive entry in local telephone markets. However, their use of cross-sectional analysis prevents them from fully describing the factors contributing to the competitive transition in the local telephone industry.
assumed to be recursive: the dominant firm chooses a price that determines its profit maximum in period t-1, then fringe competitors decide whether to enter in period t. This pattern of behavior is updated and then repeated. Therefore, without loss of generality, the model presented below describes a static segment of this dynamic process and, in the spirit of the New Empirical Industrial Organization, provides a structural framework from which a reduced-form expression describing the factors that determine the presence and amount of a fringe competition in markets served by a regulated dominant firm can be derived.

I begin by specifying the market demand function facing both the dominant firm and competitive fringe:

\[ D = f(P_D, P_F, W) \]  

(5.1)

where \( f \) is the aggregate demand function for the homogeneous service provided by the firms in this market, \( P_D \) is the price charged by the dominant firm, \( P_F \) is the price charged by each of the fringe firms, and \( W \) is a vector of other factors influencing market demand. Without loss of generality, let \( P_D = P_F = P = \) the realized market price, since the price set by the dominant firm is taken as given by each firm in the fringe when the service provided is homogeneous. Therefore, equation (5.1) can be reformatted as:

\[ D = f(P, W) \]  

(5.2)
Aggregate fringe supply, $S_F$, can be represented by the following expression:

$$S_F = \sum_{i=1}^{N} q_i(P, X) \quad i = 1, ..., N \quad (5.3)$$

where $q_i$ is the output of the $i^{th}$ fringe firm calculated by equating price and marginal cost, and $X$ is a vector of other cost factors common to all firms in the market. Assuming identical fringe firms, the aggregate fringe supply function becomes:

$$S_F = Nq_i(P, X) \quad i = 1, ..., N \quad (5.4)$$

where $N$ represents the number of entrants to the competitive fringe.

Using this functional relationship, it becomes possible to explicitly specify the residual demand function, $Q_{D}^r$, facing the dominant firm in the market. This function is calculated by subtracting aggregate fringe supply from market demand for the range of all feasible prices the market will support and is represented by the following expression:

$$Q_{D}^r = D - S_F \quad (5.5)$$

Substituting equations (5.2) and (5.4) into (5.5) gives:

$$Q_{D}^r = f(P, W) - Nq_i(P, X) \quad i = 1, ..., N \quad (5.6)$$
With the residual demand curve facing the dominant firm specified in (5.6), a regulated dominant firm’s profit maximization problem can be represented by the following expression:

$$\begin{align*}
\text{Max } \Pi &= P_{D'} - C^D(Q_{D'}, X) \\
\text{st: } &\Pi \leq \Gamma (Y, Z)
\end{align*}$$

(5.7)

where dominant firm cost, $C_D$, is a function of output, $Q_{D'}$, and other factors that influence cost, $X$. The function $\Gamma (Y, Z)$ describes the regulatory bounds on firm behavior. In this general framework, $Y$ is a vector of political factors that contribute to the regulatory environment in which the dominant firm operates and $Z$ is a vector of regulatory policy arguments that generally vary across markets. The regulatory environment captured by $\Gamma (Y, Z)$ is included to reflect the presence and efficacy of various interest groups, political biases, as well as the form of regulatory constraint employed by state public utility commissions. It is assumed that $\Gamma$ operates by restricting profits of the dominant firm to a level no greater than predetermined by regulators. Without loss of generality, this can occur by restricting the price charged by the dominant firm (e.g., price-cap regulation) or by directly setting a target profit level (e.g., rate-of-return regulation).

The dominant firm’s equilibrium price, $P_D^*$, solves the maximization problem above and can be stated as follows:

$$P_D^* = G (N, W, X, Y, Z)$$

(5.8)
Equation (5.8) is the fully reduced-form price equation for the regulated dominant firm. Evaluating equation (5.7) with this price provides the maximum level of profits, $\Pi^*$, available to the regulated dominant firm. Therefore, $\Pi^*$ can be considered a predetermined endogenous variable and will subsequently be treated as exogenous. Invoking the implicit function theorem and incorporating the dominant firm's predetermined profit maximum, it is possible to specify the following reduced-form fringe competition equation in terms of exogenous variables:

$$N^* = H(\Pi^*, W, X, Y, Z)$$  \hspace{1cm} (5.9)

Equation (5.9) suggests that $N$, the number of fringe firms in a particular local telephone market, depends on $\Pi^*$, a vector of variables measuring the predetermined profit opportunity in a market; $W$, a vector of demand determinants in a market; $X$, a vector of cost determinants in a market; $Y$, a vector of variables measuring aspects of the political environment of a market; and $Z$, a vector of variables measuring the regulatory environment of a market.

5.4 Empirical Estimation of the Determinants of Fringe Competition

The general model of fringe competition derived in Section 5.3 indicates that I must explicitly account for differences in the demand, costs, regulation, politics, and profit opportunity across local telephone markets and over time to accurately explain the
development of a competitive fringe in the local telephone industry. The passage of the Telecommunications Act of 1996, and subsequent across-the-board removal of state and local regulatory barriers to entry, provides a unique opportunity to explore the factors that have led to the emergence of fringe competition in markets comprising today’s local telephone industry. In this section, I empirically examine the determinants of net fringe entry and cumulative fringe size in the local telephone industry. Additionally, this empirical analysis demonstrates that the choice of economic regulation by state public utility commissions has played an important role in the competitive transition underway. In particular, the presence of price-cap regulation in a market has had a stifling effect on both net fringe entry and cumulative fringe size.

5.4.1 Data

For the most part, local telephone markets are defined by geographic boundaries known as Local Access and Transport Areas (or LATAs). Therefore, I constructed a data set at the LATA level to conduct an accurate empirical analysis of the determinants of fringe entry. The first step in this process was to identify the local telephone markets in the United States by locating the LATA boundaries within each state. To accomplish this task, I used LATA maps located in Notes on the BOC IntraLATA Networks to determine how the LATAs were distributed within each state. Once the local telephone markets were identified, the next step of the process was to gather data that would accurately represent the essential characteristics of each LATA.
The Federal Communications Commission (FCC) keeps track of the number of new CLEC entrants by state and LATA. The challenging task is to match this information with the appropriate demand, cost, profit, political, and regulatory information. Unfortunately, LATAs do not conform to any pre-established state or local government boundaries, however, they rarely cross state boundaries. Therefore, I have to approximate much of the demographic information. Without loss of generality, the information corresponding to the primary metropolitan area within a LATA is the best approximation for that particular LATA. This is especially true for this analysis since almost all CLEC entry has occurred in densely populated areas such as cities. Therefore, I use *Rand McNally’s 1990 Road Atlas* to match metropolitan areas and LATAs. I then use the information corresponding to the primary metropolitan area to control for relative differences in demographic characteristics between LATAs.\(^7\)

Due to data availability limitations, and to make the use of a LATA-level analysis meaningful, observations corresponding to local telephone markets served by RBOCs comprise the vast majority of the data set.\(^8\) The Federal Communications Commission (FCC) records the financial aspects of these ILECS. From this, it is possible to make a crude calculation of the overall profitability for the ILECs serving these markets. Finally, state public utility commissions approve, on a firm-by-firm basis, the form of economic regulation used to constrain ILEC operating behavior. Therefore, there is meaningful variation in regulatory regimes across states and firms. I use this variation in regulatory policy to

\(^7\) See *supra* note 7 in Chapter 4.

\(^8\) See *supra* note 6 in Chapter 4.
determine the regulatory regime in each LATA. To round out the data set, information about the political environment of a market, which corresponds to the characteristics of particular state public utility commissions, is also collected.

To add richness to the data set, and to capture the competitive transition underway in the local telephone industry, I collect this data over the time period 1994-1997. Selecting this time period for the analysis provides detailed information about the development of a competitive fringe in the local telephone industry. Prior to the passage of the Telecommunications Act of 1996, the decision to allow competitive entry to local telephone markets was made at the state level. Therefore, for the years 1994 and 1995, observations corresponding to states that did not permit competitive entry were omitted from the data set since it would be impossible to observe entry in these markets. However, once the Telecommunications Act of 1996 was passed, all states plus the District of Columbia were required to open their local telephone markets to competitive entry. Thus, one should reasonably expect to see CLEC entry to all local telephone markets in the years 1996 and 1997. This legislative shock, which occurs in the middle of the data set, makes identifying the determinants of fringe competition in the local telephone industry possible.

In full, this data set is an unbalanced panel of 262 observations, by LATA, taken from twenty-five states plus the District of Columbia in 1994, thirty-one states plus the District of Columbia in 1995, and thirty-six states plus the District of Columbia for 1996 and 1997. In constructing the data set in this fashion, an effort is made to include observations free of explicit regulatory barriers to entry.
5.4.2 Description of Variables for Empirical Analysis

A brief definition and the data source for each variable used in this empirical analysis is provided in Table 5.1. However, a more complete description of these variables follows below. For convenience, each is grouped according the category that fits with the econometric model of fringe competition derived previously.

**Dependent Variables**

- Number of New Entrants and Cumulative Fringe Size (N):

  To measure the development of fringe competition in the local telephone industry, I employ two dependent variables that capture the competitive transition underway. Both measures rely on the number of CLECs holding numbers in a particular LATA in year t. Data on the number of CLECs in operation does not exist, however, the Federal Communications Commission (FCC) records the number of CLECs holding numbers by state and LATA. Although not a perfect measure of firm entry or fringe size, this measure represents the closest one can come given the data resources currently available. Because a firm holding telephone numbers is just a customer away from being an active competitor, this market-based measure of competition is superior to alternative measures of competition previously used in the academic literature.⁹

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⁹ See supra note 8 in Chapter 4. Since I am interested in explaining the development of a competitive fringe, a rule-based measure is unsatisfactory. Additionally, since being certified is one step removed from actually holding numbers in a market, I believe the measure employed here best reflects the focus this analysis.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRSIZE</td>
<td>the raw number of fringe competitors (comprised of CLECs) holding telephone numbers in LATA i during year t.</td>
<td>[a]</td>
</tr>
<tr>
<td>ENTRY</td>
<td>the raw number of new fringe competitors (comprised of CLECs) holding telephone numbers in LATA i during year t.</td>
<td>[a]</td>
</tr>
<tr>
<td>PCREG</td>
<td>a binary variable equal to 1 if the state uses some form of price-cap regulation to constrain incumbent local exchange carrier operations in LATA i during year t and 0 otherwise.</td>
<td>[b]</td>
</tr>
<tr>
<td>PROFIT</td>
<td>profit per telephone line for the ILEC serving each LATA i during year t-1.</td>
<td>[c&amp;d]</td>
</tr>
<tr>
<td>∆PROFIT</td>
<td>the change in profit per telephone line for the ILEC serving each LATA i during year t-1.</td>
<td>[c&amp;d]</td>
</tr>
<tr>
<td>POP</td>
<td>population for LATA i during year t.</td>
<td>[e&amp;f]</td>
</tr>
<tr>
<td>GROW</td>
<td>population growth rate for LATA i during year t.</td>
<td>[e&amp;f]</td>
</tr>
<tr>
<td>INC</td>
<td>per capita income for LATA i during year t.</td>
<td>[e&amp;f]</td>
</tr>
<tr>
<td>DEN</td>
<td>population density for LATA i during year t.</td>
<td>[e&amp;f]</td>
</tr>
<tr>
<td>WAGE</td>
<td>average hourly wage for the manufacturing sector of LATA i during year t.</td>
<td>[g]</td>
</tr>
<tr>
<td>ELECT</td>
<td>a binary variable equal to 1 if the state commissioners with jurisdiction over operations in LATA i during time t are elected and 0 if appointed.</td>
<td>[h&amp;i]</td>
</tr>
<tr>
<td>POLIT</td>
<td>an index ranging continuously from 0 to 1 measuring the political sentiment of the state commission with jurisdiction over LATA i during time t. Scores closer to 1 represent a Republican sentiment and Scores closer to 0 represent a Democratic sentiment.</td>
<td>[h&amp;i]</td>
</tr>
</tbody>
</table>


Table 5.1: Definition and Data Source of Variables for Development of Fringe Competition Analysis
The first dependent variable I employ, **ENTRY**, is the number of new competitive local exchange carriers (CLECs) holding telephone numbers in a particular LATA during year $t$. This variable is calculated by taking the difference between the number of CLECs holding numbers in year $t$ and year $t-1$. Therefore, this variable directly measures the amount of net fringe entry occurring on a yearly basis. The second dependent variable employed, **FRSIZE**, is the raw number of CLECs holding numbers in a particular LATA during year $t$. This variable measures cumulative fringe entry over the time period and is used to provide a measure of fringe size.

*Explanatory Variables*

- **Regulatory Environment (Z):**

  One might predict that the regulatory environment of a market will affect both the amount of entry and cumulative fringe size in a market, especially if the regulatory regime selected is a strategic response by regulators to endogenous (e.g., industry) or exogenous (e.g., technological) pressures. Of particular interest in this analysis is the impact of price-cap regulation on the development of fringe competition in local telephone markets. **PCREG** is a binary variable that equals 1 if the state in which the LATA is contained employs price-cap regulation to constrain the operations of the ILEC in year $t$ and 0 otherwise.
The extended DF-CF model developed in Chapter 3 coupled with the empirical results in Chapter 4 demonstrate that the adoption of tightly-binding price-cap regulation by state public utility commissions may be responsible for the sluggish development of effective fringe competition in the local telephone markets. This condition can occur because tightly binding price-cap regulation can keep prices at a level that reduces the fringes’ aggregate share of the local market relative to a market share predicted with less stringent regulation. Furthermore, price-cap regulation may provide some strategic advantages to an incumbent. For example, one might expect that incumbent firms subject to economic regulation designed to provide competitive incentives, such as price-cap regulation, would be in a better position to challenge new entrants than those subject to traditional rate-of-return regulation. Additionally, one might suspect that alleged inefficiencies brought about by traditional rate-of-return regulation would make incumbent firms under this form of regulation more susceptible to competitive entry. Therefore, due to the regulatory distortions caused by price-cap regulation, I expect a negative relationship to exist between the presence of price-cap regulation and the development of fringe competition in the local telephone industry.

- Profit Opportunity (Π’):

Economic theory suggests that the opportunity to make a profit will drive much of a potential entrant’s decision to enter a market. Therefore, to accurately explain the development of fringe competition in local telephone markets it is important to control for
differences in the profit levels across LATAs and over time. To do so, I include two profit opportunity measures in the model. First, I include a measure of profit-per-line, denoted PROFIT, for the ILEC serving each LATA in the sample during year t-1. This variable directly measures the profitability of a new entrant’s most potent competitor and is expected to relate positively with the development of fringe competition. In addition, I include a variable measuring the change in profit-per-line for year t-1 as an explanatory variable in the model. This variable, ΔPROFIT, is included to reflect the dynamics of the entry process and is also expected to relate positively with the development of fringe competition.

However, it is well known from the Structure-Conduct-Performance studies that many difficulties arise when using profit measures derived from industry accounting records (Schmalensee 1989). For example, these measures can be biased by the use of different accounting practices across industries and do not actually measure economic profits. Since this analysis focuses on a single industry in which regulators require each incumbent to report financial activities, the variance in accounting methodology, while still present, is likely to be kept in check. Also, while it remains true that any calculated measure of profit does not reflect actual economic profits, there is good reason to believe that the relative differences in profitability across markets are still signaled by these calculations. More

10 Similar to Ai and Sappington (1998), the profit measures used in this analysis are derived from the FCC’s ARMIS 43-01 Reports. They are calculated by subtracting Total Operating Expenses, Federal Taxes, and Other Taxes from Total Operating Revenues and Other Operating Revenues for the operations of the ILECs in the sample. Due to data limitations, the most disaggregated classification available for these variables is at the state rather than LATA level. To overcome this difficulty, I normalize the ILEC’s profits calculated in each state by the number of telephone lines it holds in the state. This normalization controls for a possible large state effect and results in a profit per line measure. Although not a perfect measure of profit opportunity, including variables of this nature will provide some indication of the relative profit opportunity in the markets served by particular ILECs.
importantly, these measured profits are observable to both potential entrants and researchers. Therefore, while these concerns are noted, the inclusion of a profit measure in this study is warranted.

In addition, the inclusion of measured profit variables in a regression equation with either of the dependent variables described above is likely to be problematic. For example, one could argue that the relationship between the number of entrants or fringe size and measures of profit is endogenous. However, following the econometric model developed in Section 5.3, predetermined measures of incumbent profitability are employed to maneuver around this potential statistical problem.\footnote{Masson and Shaanan (1982) employ a similar technique in their empirical analysis of limit pricing.}

- **Demand Conditions (W):**

  To properly examine the development of fringe competition in local telephone markets, I include measures of the demand characteristics that vary across LATAs over time. \textbf{POP} is a measure of population and \textbf{GROW} is a measure of the population growth rate for the metropolitan area corresponding to each LATA in the sample. Higher levels of population indicate the presence of more potential customers for both business and residential telephone services. Bresnahan and Reiss (1987, 1990, 1991) show that the size of a market is an important determinant of the number of firms operating in that market. Additionally, the latter variable provides some indication about the relative health of a market. Markets with higher levels of growth may signify a stronger customer base in the present and more potential customers in the future. Finally, economic theory suggests that
income and demand for a normal good are positively related. Thus, the development of a competitive fringe may be influenced by income through shifts in market demand. To measure the variation in income across LATAs and over time I include the variable INC to measure the per capita income for the metropolitan area corresponding to each LATA in the sample. Because economic theory suggests that the amount of entry in a market will be driven by differences in demand, I expect all three of these variables to be positively related to the development of a competitive fringe.

- Cost Conditions (X):

  Including measures of the cost characteristics of a market is equally important to this analysis. Prior to the passage of the Telecommunications Act of 1996, state public utility commissions could influence the amount of competition within their jurisdictions by explicitly deciding whether or not to allow entry. With passage of the Telecommunications Act of 1996, this explicit control over entry was no longer possible. However, the Telecommunications Act of 1996 affords state public utility commissions the power to set the terms and conditions of interconnection agreements between ILECs and entrants to local telephone markets. These agreements are typically negotiated between each new entrant and the ILEC having operations in a market, but are subject to final approval by the state commission having jurisdiction. In cases when the two parties cannot reach a mutual agreement, the state commission is responsible for establishing the terms and conditions of interconnection through a series of arbitration proceedings. Therefore, state public utility
commissions have considerable power over the cost of entry to local telephone markets through the interconnection agreements.

Ideally, I would include a measure of the agreed upon interconnection price for each new entrant to a local telephone market. By now, however, there have been thousands of these agreements approved. Additionally, the information in my data set reports only the number of CLECs holding numbers in a market and does not indicate which CLECs they are. Therefore, it is not possible to include a measure of this variety in this analysis. To help alleviate this problem, cross-sectional fixed-effects variables are included in the regression equations to control for unobserved differences (such as the terms and conditions of interconnection) across LATAs not accounted for by the explanatory variables used in this analysis.

Controlling for other likely differences in the cost conditions across markets and over time is possible. Therefore, I include the variable DEN to measure the population density of the metropolitan area corresponding to each LATA in the sample. Because it is less expensive to set up a local telephone network in more densely populated areas, entry may occur first in markets having this characteristic. Therefore, I expect a positive relationship will exist between the density of a market and the development of fringe competition.

---

12 In an analysis of 103 interconnection agreements involving the Regional Bell Operating Companies in thirty-four states, Lehman and Weisman (1998) find that state public utility commissions that have adopted price-cap regulation set systematically lower interconnection prices (i.e., entry barriers) relative to state public utility commissions that maintain traditional rate-of-return regulation. This finding suggests that one should expect to see, ceteris paribus, more rather than less entry in price-cap regulated markets. The fact that this type of behavior is not observed empirically suggests there is more to the story than interconnection prices.
Additionally, local economic conditions will influence the entry decisions of a firm. To control for this, I include the variable WAGE. This is the average hourly wage paid by the manufacturing sector of the metropolitan area corresponding to each LATA during year t. This variable controls for variation in the cost of labor and is directly related to production costs. Economic theory suggests that changes in production costs, ceteris paribus, will impact the production decisions of a firm. Therefore, I expect a negative relationship between the cost of labor and the development of a competitive fringe.

- Political Environment (Y):

Finally, I control for variation in the political environment across LATAs and over time. In regulated markets, this is particularly important because of the potential distortions political pressures can impose.13 In particular, it is important to control for characteristics of the state public utility commission having jurisdiction in the markets under investigation. Two important features of a state commission are whether its commissioners are elected or appointed, and the political bias of the commission. One might believe that elected commissioners would act differently than appointed commissioners since they are more vulnerable to the political process. This, in turn, may influence the level of scrutiny cast by various state commissions and ultimately may have an impact on the rate of competitive

13 See supra note 9 in Chapter 4. My analysis in this chapter builds from previous empirical studies of the political economy of state telecommunications deregulation by explicitly considering the effect on fringe development of the method of commissioner appointment and the political bias of the actual state commissions governing the regulatory decisions in the industry.
entry to a particular market. **ELECT** is a binary variable that takes on the value of 1 if the commissioners in the state are elected and 0 if they are appointed.

In addition, the political sentiment of a particular state public utility commission will likely influence aspects of the regulatory process. One might suspect that Republican commissions would have more sympathy for a free-market approach in their jurisdictions than their Democratic counterparts. To control for these political biases, I develop an index of political sentiment for the state commissions in my sample. This variable ranges continuously from 0 to 1, with scores closer to 1 signaling a Republican bias and scores closer to 0 signaling a Democratic bias.\(^\text{14}\) The variable **POLIT** represents the political sentiment of each state public utility commission corresponding to the LATAs in the sample. I expect the development of a competitive fringe to be positively related with commissions having a Republican bias. However, no clear a priori prediction about the impact of the method of commissioner appointment on the development of a competitive fringe is offered.

A summary of the expected relationship between the variables used to measure the development of a competitive fringe and each explanatory variable used in the analysis is provided in Table 5.2. Additionally, the descriptive statistics for each variable used in the analysis are contained in Table 5.3.

\(^{14}\) See *supra* note 10 in Chapter 4 for an explanation of how this variable was constructed.
<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>CLEC Entry</th>
<th>Fringe Size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regulatory Environment (Z)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCREG</td>
<td>(-)</td>
<td>(-)</td>
</tr>
<tr>
<td><strong>Profit Opportunity (T)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROFIT</td>
<td>(+)</td>
<td>(+)</td>
</tr>
<tr>
<td>∆PROFIT</td>
<td>(+)</td>
<td>(+)</td>
</tr>
<tr>
<td><strong>Demand Conditions (W)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POP</td>
<td>(+)</td>
<td>(+)</td>
</tr>
<tr>
<td>GROW</td>
<td>(+)</td>
<td>(+)</td>
</tr>
<tr>
<td>INC</td>
<td>(+)</td>
<td>(+)</td>
</tr>
<tr>
<td><strong>Cost Conditions (X)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEN</td>
<td>(+)</td>
<td>(+)</td>
</tr>
<tr>
<td>WAGE</td>
<td>(-)</td>
<td>(-)</td>
</tr>
<tr>
<td><strong>Political Environment (Y)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELECT</td>
<td>(?)</td>
<td>(?)</td>
</tr>
<tr>
<td>POLIT</td>
<td>(+)</td>
<td>(+)</td>
</tr>
</tbody>
</table>

Table 5.2: Expected Relationship Between Explanatory Variables and Measures of Competitive Fringe Development
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRSIZE</td>
<td>2.122</td>
<td>3.068</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>ENTRY</td>
<td>1.297</td>
<td>2.010</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>PCREG</td>
<td>0.676</td>
<td>0.469</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>PROFIT</td>
<td>94.85</td>
<td>24.86</td>
<td>17.57</td>
<td>156.86</td>
</tr>
<tr>
<td>ΔPROFIT</td>
<td>1.85</td>
<td>18.39</td>
<td>-58.49</td>
<td>57.52</td>
</tr>
<tr>
<td>POP</td>
<td>1718300.0</td>
<td>1914400.0</td>
<td>79100.0</td>
<td>9149800.0</td>
</tr>
<tr>
<td>GROW</td>
<td>0.007</td>
<td>0.012</td>
<td>-0.039</td>
<td>0.068</td>
</tr>
<tr>
<td>INC</td>
<td>24595.00</td>
<td>4797.60</td>
<td>11346.00</td>
<td>42525.00</td>
</tr>
<tr>
<td>DENS</td>
<td>761.230</td>
<td>1442.20</td>
<td>13.70</td>
<td>9311.50</td>
</tr>
<tr>
<td>WAGE</td>
<td>13.127</td>
<td>1.8219</td>
<td>8.850</td>
<td>20.650</td>
</tr>
<tr>
<td>ELECT</td>
<td>0.122</td>
<td>0.328</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>POLIT</td>
<td>0.553</td>
<td>0.274</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: For 262 observations. Descriptive statistics for fixed-effects variables omitted for brevity.

Table 5.3: Descriptive Statistics for Development of Fringe Competition Analysis
5.4.3 Estimation Approach

It is common to analyze panel data using either a random-effects or fixed-effects approach. The inclusion of cross-sectional fixed-effects variables, $\gamma_t$, in this estimation will produce asymptotically consistent estimates of the explanatory variables if permanent or highly serially correlated LATA effects, not accounted for by the explanatory variables, are present in the data.\(^\text{15}\) Since this possibility is highly likely, I employ a fixed-effects approach to estimate the following reduced form equations explaining net fringe entry (5.10) and cumulative fringe size (5.11) in the sample.

\[
\text{ENTRY}_{it} = \alpha + \beta_1 \text{PCREG}_{it} + \beta_2 \text{PROFIT}_{it-1} + \beta_3 \Delta \text{PROFIT}_{it-1} \\
+ \beta_4 \text{POP}_{it} + \beta_5 \text{GROW}_{it} + \beta_6 \text{INC}_{it} + \beta_7 \text{DEN}_{it} \\
+ \beta_8 \text{WAGE}_{it} + \beta_9 \text{ELECT}_{it} + \beta_{10} \text{POLIT}_{it} + \gamma_t + \varepsilon_{it}
\]

(5.10)

and,

\[
\text{FRSIZE}_{it} = \alpha + \beta_1 \text{PCREG}_{it} + \beta_2 \text{PROFIT}_{it-1} + \beta_3 \Delta \text{PROFIT}_{it-1} \\
+ \beta_4 \text{POP}_{it} + \beta_5 \text{GROW}_{it} + \beta_6 \text{INC}_{it} + \beta_7 \text{DEN}_{it} \\
+ \beta_8 \text{WAGE}_{it} + \beta_9 \text{ELECT}_{it} + \beta_{10} \text{POLIT}_{it} + \gamma_t + \varepsilon_{it}
\]

(5.11)

where, $i = \text{LATA}$, $t = \text{year}$ and $\varepsilon_{it} = \text{disturbance term } (\varepsilon_{it} \sim \text{i.i.d. } N(0, \sigma^2))$. The results of this multiple regression analysis are provided in Table 5.4.

---

\(^{15}\) One estimating procedure for cases of pooled time-series and cross-sectional data is the use of both market and time fixed-effects variables. This technique is employed in Chapter 4. However, an argument against the use of time fixed-effects variables in this analysis is that it would preempt a major portion of independent sample variation in the primary explanatory variables while also resulting in a loss of degrees of freedom. Therefore, I utilize the more conventional fixed-effects approach employing only cross-sectional fixed-effects variables for this portion of the analysis.
### Fixed-Effects Model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Entry</th>
<th>(T-Ratio)</th>
<th>Fringe Size</th>
<th>(T-Ratio)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCREG</td>
<td>-0.7769&lt;sup&gt;b&lt;/sup&gt;</td>
<td>(-2.081)</td>
<td>-0.8225&lt;sup&gt;c&lt;/sup&gt;</td>
<td>(-1.873)</td>
</tr>
<tr>
<td>PROFIT</td>
<td>7.8609</td>
<td>(0.682)</td>
<td>1.9781</td>
<td>(0.146)</td>
</tr>
<tr>
<td>ΔPROFIT</td>
<td>-11.462</td>
<td>(-1.393)</td>
<td>0.9781</td>
<td>(0.101)</td>
</tr>
<tr>
<td>POP</td>
<td>0.01029&lt;sup&gt;a&lt;/sup&gt;</td>
<td>(4.453)</td>
<td>0.01721&lt;sup&gt;a&lt;/sup&gt;</td>
<td>(6.335)</td>
</tr>
<tr>
<td>GROW</td>
<td>-23.162</td>
<td>(-1.642)</td>
<td>-28.903&lt;sup&gt;c&lt;/sup&gt;</td>
<td>(-1.742)</td>
</tr>
<tr>
<td>INC</td>
<td>0.000768&lt;sup&gt;a&lt;/sup&gt;</td>
<td>(7.983)</td>
<td>0.001258&lt;sup&gt;a&lt;/sup&gt;</td>
<td>(11.12)</td>
</tr>
<tr>
<td>DEN</td>
<td>0.001689</td>
<td>(0.519)</td>
<td>0.000859</td>
<td>(0.224)</td>
</tr>
<tr>
<td>WAGE</td>
<td>-1.0205&lt;sup&gt;b&lt;/sup&gt;</td>
<td>(-2.301)</td>
<td>-1.4095&lt;sup&gt;a&lt;/sup&gt;</td>
<td>(-2.702)</td>
</tr>
<tr>
<td>ELECT</td>
<td>0.7202</td>
<td>(0.496)</td>
<td>0.3339</td>
<td>(0.196)</td>
</tr>
<tr>
<td>POLIT</td>
<td>3.2466&lt;sup&gt;a&lt;/sup&gt;</td>
<td>(3.029)</td>
<td>2.1189&lt;sup&gt;c&lt;/sup&gt;</td>
<td>(1.681)</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>-26.309&lt;sup&gt;a&lt;/sup&gt;</td>
<td>(-5.641)</td>
<td>-41.458&lt;sup&gt;a&lt;/sup&gt;</td>
<td>(-7.558)</td>
</tr>
</tbody>
</table>

Adj. R² 0.4452 0.6704

Note: Results for the fixed-effects variables omitted for brevity. [a] indicates variable significant at the .01 level. [b] indicates variable significant at the .05 level. [c] indicates variable significant at the .10 level.

180 Degrees of Freedom

Dependent Variable: ENTRY (for Eq. 5.10) FRSIZE (for Eq. 5.11)

Table 5.4: The Determinants of the Development of Fringe Competition in the Local Telephone Industry
5.4.4 Discussion of Main Results

Overall, the empirical models specified above perform quite well, explaining over 44 percent of the variation in net fringe entry and over 67 percent of the variation in cumulative fringe size in local telephone markets in the sample. Additionally, the expected relationship (shown in Table 5.2) holds for seven of the nine explanatory variables for which an expected relationship was defined in equation (5.10) and eight of the nine explanatory variables for which an expected relationship was defined in equation (5.11). Of these, five are significant at conventionally accepted levels in each equation. The success of these empirical models provides confidence in the econometric model of the determinants of fringe competition developed earlier and in the selection of explanatory variables for this analysis.

As expected, the demand and cost characteristics of a local telephone market explain much about the development of fringe competition. In particular, the population, income and labor costs of a market significantly influence both net fringe entry and cumulative fringe size. For example, the results above suggest that an increase in population of just under 100,000 people or an increase in per capita income of $1,303.50 will attract one additional CLEC entrant to a market. Additionally, a $0.98 increase in the average hourly cost of labor would result in one less CLEC entrant to a market.

This pattern of results also holds when considering the cumulative size of competitive fringes in markets comprising the local telephone industry. However, since the data set captures the very beginning of the competitive transition witnessed in this industry
and since this variable is a cumulative measure of fringe size, smaller changes in the coefficients on the explanatory variables lead to larger changes in fringe size. For example, the results above suggest that the cumulative size of a competitive fringe in a particular market will be one CLEC larger if the size of the market was 58,150 people larger or per capita income was $795.00 higher, and one CLEC smaller if the average hourly cost of labor was $0.71 higher across markets. It should also be noted that, although insignificant, profit-per-line and market density have the expected positive relationship with both net entry and fringe size. In addition, markets characterized as having a profit trend that is increasing have larger competitive fringes, but less net entry.

The results above also suggest that the political and regulatory environment of a market has shaped the structure of the local telephone industry. As expected, state public utility commissions with a Republican bias are, ceteris paribus, associated with significantly more net entry by CLECs than their Democratic counterparts. On average, this has led to larger competitive fringes (by slightly over 2 CLECs) in local telephone markets regulated by Republican commissions. Thus, the free-market orientation often associated with the Republican party is supported here.

Of particular interest is the impact of price-cap regulation on the development of fringe competition in local telephone markets. Taken as a deviation from the mean, these results show that the presence of price-cap regulation in a local telephone market is associated with 59.87 percent less net fringe entry and competitive fringes that are 38.76 percent smaller than local telephone markets subject to other forms of regulation. This finding confirms that the choice of economic regulation in a market can have important
effects on the structural evolution of an industry, and adds direct support to the idea that tightly binding price-cap may be responsible for the sluggish development of local telephone competition.

5.5 A Political Economy Explanation for the Adoption of Price-Cap Regulation by State Public Utility Commissions

A natural question to ask after seeing the results above is: why have state public utility commissions continued to systematically approve the adoption of price-cap regulation even though it has stifled the development of competition in local telephone markets? One answer, of course, is that the decision makers in most state public utility commissions simply do not fully understand the effects of this form of regulatory constraint. However, relying on ignorance as an explanation for the systematic adoption of this form of alternative regulation is likely to be unsatisfactory to most scientists. Therefore, another, more scientific, explanation must exist for this observed pattern of events.

Beginning with Stigler's (1971) challenge to the conventionally accepted Public Interest view of regulation, it has become widely accepted that regulatory decisions are influenced by special interest groups — in particular the industry being regulated. Peltzman (1976) more formally describes the process by which regulatory decision making is accomplished by unifying the Public Interest and Capture theories of regulation to show that the decisions made by regulators maximize their own position by trading off political support from consumer and producer special interest groups. Thus, one could predict that the regulators themselves will always benefit from the outcome of a regulatory decision, while
the benefit received by the industry itself or consumers will be determined by the strength of political support each group can deliver.

To provide a political economy explanation for the behavior in question requires identifying possible gains to state public utility commissions from slowing down the development of competition or allowing the adoption of price-cap regulation in these markets that is not available from a less costly method (Becker 1983). In this section, I sketch out the beginnings of just such an explanation and provide some empirical support to show that this explanation dominates one relying solely on ignorance.

Niskanen (1971) and others since have provided theories of public sector decision making in bureaucracies when simple profit maximization is not the bureaucrat’s objective. An alternative objective proposed in this literature has the bureaucrats making decisions to maximize the bureau’s budget or size. Therefore, I will proceed with the assumption that the primary objective of state public utility commissions is to maximize their size or budget, and interpret their success in meeting this objective as a means to maintain a state public utility commission’s relevancy.16

In an age of deregulation, increased competition, and diminishing state budgets, the relevancy of state public utility commissions has often been called into question. What role will these regulatory commissions have if the traditionally regulated industries they oversee become workably competitive market structures? In this increasingly seamless and worldwide economy, would shifting regulatory oversight to the federal level be appropriate?

16 It should be noted that this assumption does not mean that state public utility commissions do not attempt to protect the public interest. It simply means that they try to do so in ways that maximize the benefits they receive.
And finally, are there more efficient ways to spend the scarce resources generated by state tax dollars if competition were to blossom? These are real questions that state public utility commissions of today confront on a daily basis. Therefore, for their own survival in this changing world, state public utility commissions have a strong incentive to slow down the rate at which competition develops in the primary industries they have jurisdiction. Additionally, doing so would likely win political support from a very powerful special interest group — the incumbent firms.

My hypothesis is that the adoption of price-cap regulation by state public utility commissions has been a strategic response in an effort to maintain relevancy in the volatile and uncertain environment in which they now find themselves. I have demonstrated previously that the adoption of price-cap regulation has acted to stifle the development of competition in local telephone markets. I now must identify how the state public utility commissions have realized a benefit from this regulatory decision.

To test this hypothesis, I examine the effect of increased competition and the adoption of price-cap regulation on the absolute size of state public utility commissions. The dependent variable I select for this analysis, STFPLN, is the number of people on a state commission staff normalized by the number of telephone lines in each state. Again, this normalization controls for large state effects not accounted for by the other explanatory variables in the model. The selection of this variable simultaneously captures the notion of size and budget maximization since staff salary and expenses likely comprise a large portion of a commission’s budget. Additionally, one would believe that the number of people on a state public utility commission’s staff would be variable in the short run since it is a labor
input to a state commission's production function. Therefore, this variable is likely to respond to the changing environment observed today and will provide a straightforward test of my hypothesis.

If my explanation for this behavior is correct, two conditions must be met. First, it must be true that the growth of deregulation and allowance of competition in traditionally regulated industries has steadily eroded the size (and relevancy) of state public utility commissions through time. Since the average size of a state commission has fallen from 201 staff members in 1991 to 171 staff members in 1998, some evidence in support of this condition already exists (NARUC 1991-1996, 1997-1998). Second, and more importantly, it must be the case that states adopting price-cap regulation, ceteris paribus, have staff sizes that are larger than states that do not.

To control for other factors that may influence the size of a state public utility commission's staff, I include the demand, cost, and political characteristics modeled in the previous analysis exploring the development of fringe competition. However, the appropriate unit of analysis for measuring aspects of a state public utility commission is the state rather than LATA level. Therefore, the variables used in this part of the analysis are gathered at the state level. To these variables, I add the variable BUSLINE to capture the relative political strength of the business and residential sectors within a state. The addition of this variable is warranted based on the theoretical foundation from which this empirical analysis builds. Finally, to ensure there is consistency between this and the previous section, data from the same time period, 1994-1997, is used.

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A brief definition and data source for each variable used in this analysis is provided in Table 5.5. The descriptive statistics for each of these variables are contained in Table 5.6. Finally, the results from a multiple regression analysis of commission staff size employing a fixed-effects technique are presented in Table 5.7.

Consistent with the political economy explanation put forth, these results suggest that, ceteris paribus and accounting for the normalization employed, state commissions in states adopting price-cap regulation are over 71 staff members larger than state commissions in states that have not.\(^{17}\) Taken as a deviation from the normalized mean of commission staff size, this represents a 25.77 percent larger commission. Presumably, some of this size differential can be explained by the fact that the adoption of price-cap regulation has limited the development of competition in the local telephone markets over which these commissions have jurisdiction. Therefore, this empirical analysis lends some support to my hypothesis and demonstrates how economic regulation can be used as a strategic instrument to shape an industry’s structural evolution while providing direct benefits to the regulators tasked with making these important decisions.\(^{18}\)

---

\(^{17}\) This number is calculated by multiplying the predicted difference in staff per line in states with price-cap regulation (0.000023121) by the mean number of telephone lines per state (3,096,600) to get a normalized prediction of differential commission staff size (71.60).

\(^{18}\) This analysis was also performed using raw staff size as the dependent variable. Estimates from this non-normalized analysis indicate that state commissions that have adopted price-cap regulation are nearly 20 staff members larger than those that have not (t = 1.641, p = .10). In addition, this analysis indicates that state commissions shrink by slightly over 4 staff members for each fringe competitor in the state (t = 1.699, p = .09). Therefore, the qualitative results presented here do not change if the dependent variable is not normalized by the number of telephone lines per state. This provides additional support for the political economy explanation of the adoption of price-cap regulation by state public utility commissions put forth.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>STFPLN</td>
<td>the number of staff members on the state commission normalized by the number of telephone lines (i.e., staff per line) in state i during year t.</td>
<td>[a,b,c]</td>
</tr>
<tr>
<td>PCREG</td>
<td>a binary variable that equals 1 if state i uses some form of price-cap regulation to constrain incumbent local exchange carrier operations in year t.</td>
<td>[d]</td>
</tr>
<tr>
<td>COMP</td>
<td>the raw number of fringe competitors (comprised of CLECs ) holding numbers in state i during year t.</td>
<td>[e]</td>
</tr>
<tr>
<td>POP</td>
<td>population of state i during year t.</td>
<td>[f]</td>
</tr>
<tr>
<td>GROW</td>
<td>population growth rate of state i during year t.</td>
<td>[f]</td>
</tr>
<tr>
<td>INC</td>
<td>per capita income of state i during year t.</td>
<td>[f]</td>
</tr>
<tr>
<td>DEN</td>
<td>population density of state i during year t.</td>
<td>[f]</td>
</tr>
<tr>
<td>WAGE</td>
<td>average hourly wage for the manufacturing sector of state i during year t.</td>
<td>[g]</td>
</tr>
<tr>
<td>BUSLINE</td>
<td>an interest group variable, calculated by dividing business lines by total lines in a state, measuring the presence of business customers in state i during year t.</td>
<td>[c]</td>
</tr>
<tr>
<td>ELECT</td>
<td>a binary variable equal to 1 if the state commissioners in state i are elected and 0 if appointed during year t.</td>
<td>[a,b]</td>
</tr>
<tr>
<td>POLIT</td>
<td>an index ranging continuously from 0 to 1 measuring the political sentiment of the state commission in state i during year t. Scores closer to 1 represent a Republican sentiment and scores closer to 0 represent a Democratic sentiment</td>
<td>[a,b]</td>
</tr>
</tbody>
</table>


Table 5.5: Definition and Data Source of Variables for Size of State Commission Analysis

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<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>STFPLN</td>
<td>0.00009</td>
<td>0.000065</td>
<td>0.000016</td>
<td>0.00039</td>
</tr>
<tr>
<td>PCREG</td>
<td>0.554</td>
<td>0.499</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>COMP</td>
<td>3.047</td>
<td>4.009</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>POP</td>
<td>6568300.0</td>
<td>6151700.0</td>
<td>529000.0</td>
<td>32268000.0</td>
</tr>
<tr>
<td>GROW</td>
<td>0.031</td>
<td>0.033</td>
<td>-0.069</td>
<td>0.218</td>
</tr>
<tr>
<td>INC</td>
<td>20892</td>
<td>3559.90</td>
<td>14994.0</td>
<td>31699.0</td>
</tr>
<tr>
<td>DEN</td>
<td>447.57</td>
<td>1453.3</td>
<td>5.890</td>
<td>9311.5</td>
</tr>
<tr>
<td>WAGE</td>
<td>12.506</td>
<td>1.468</td>
<td>9.410</td>
<td>17.17</td>
</tr>
<tr>
<td>BUSLINE</td>
<td>0.302</td>
<td>0.070</td>
<td>0.216</td>
<td>0.683</td>
</tr>
<tr>
<td>ELECT</td>
<td>0.229</td>
<td>0.422</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>POLIT</td>
<td>0.457</td>
<td>0.294</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Note:** For 148 observations. Descriptive statistics for fixed-effects variables omitted for brevity.

Table 5.6: Descriptive Statistics for Size of State Commission Analysis
### Fixed-Effects Model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Staff Per Line</th>
<th>(T-Ratio)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCREG</td>
<td>0.2312²</td>
<td>(2.980)</td>
</tr>
<tr>
<td>COMP</td>
<td>0.0048</td>
<td>(0.294)</td>
</tr>
<tr>
<td>POP</td>
<td>0.000031</td>
<td>(0.085)</td>
</tr>
<tr>
<td>GROW</td>
<td>0.2659</td>
<td>(0.112)</td>
</tr>
<tr>
<td>INC</td>
<td>0.00614</td>
<td>(1.197)</td>
</tr>
<tr>
<td>DEN</td>
<td>0.00097</td>
<td>(1.564)</td>
</tr>
<tr>
<td>WAGE</td>
<td>-0.2475</td>
<td>(-1.188)</td>
</tr>
<tr>
<td>BUSLINE</td>
<td>-0.9497</td>
<td>(-0.166)</td>
</tr>
<tr>
<td>ELECT</td>
<td>-0.1668</td>
<td>(-0.513)</td>
</tr>
<tr>
<td>POLIT</td>
<td>-0.2385</td>
<td>(-0.824)</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>1.1128</td>
<td>(0.252)</td>
</tr>
</tbody>
</table>

| Adj. $R^2$ | 0.8403        |
| F-Value    | 16.781 (p = 0.000) |

Note: Results for fixed-effects variables omitted for brevity. All coefficients above are multiplied by 10000 for clearer presentation. [²] indicates variable significant at the .01 level.

**98 Degrees of Freedom**

**Dependent Variable:** STFPLN (Staff Per Line)

Table 5.7: The Impact of Price-Cap Regulation on State Public Utility Commission Size
5.6 Summary

Although competition in local telephone markets appears to be intensifying, many have been critical of the pace at which it has developed. Explanations for the sluggish development of local telephone competition typically begin by describing the dominant position enjoyed by incumbent firms in this industry and progress by explaining either the strategic actions firms with market power can take to limit (or deter) entry or the reasons why the technical conditions necessary to support competition have not materialized in the markets comprising this traditionally regulated industry. Therefore, the existing theories of the status of local telephone competition have relied on notions of natural monopoly or the alleged ability of incumbent local exchange carriers to prevent competitors from entering their markets.

By combining the newly developed methods of the NEIO paradigm with the well established Chicago theories of regulation, this research offers an alternative explanation for the sluggish development of local telephone competition by providing empirical evidence of the factors that have influenced the development of a competitive fringe in this industry. In addition to finding that the market demand and cost characteristics predicted by economic theory have played a significant role in the development of fringe competition, this chapter demonstrates that the political and regulatory environments of a market also matter. In particular, this research shows that recent decisions by state regulators to adopt price-cap regulation for the ILECs operating within their jurisdiction has had a stifling effect on the development of local telephone competition. This finding provides direct support for the
ideas developed in Chapters 3 and 4. Furthermore, a shred of empirical evidence is provided
to suggest that state regulators have benefitted from the sluggish development of competition
and the adoption of price-cap regulation by providing a low cost method for state public
utility commissions to maintain their relevancy in the volatile and uncertain environment
they now face.
CHAPTER 6

CONCLUSION AND DIRECTIONS FOR FUTURE RESEARCH

Firms operating in regulated local telephone markets are, for the first time, facing competition from new entrants. The emergence of this threat has created a need to extend traditional models of market structure to include the presence of economic regulation. By doing so, it is possible to gain a better understanding about individual firm behavior, as well as industry performance in these hybrid market structures created by partial deregulation. This research contributes to filling this void by offering a theoretical extension to the traditional DF-CF model to include the presence of price-cap regulation — a widely used form of incentive regulation in the local telephone industry.

Contrary to the predictions of the traditional model, I demonstrate that the existence of a competitive fringe will not always reduce the price charged by a regulated dominant firm when price-cap regulation is introduced in the model. Instead, this depends on the degree of pricing flexibility a regulated dominant firm is afforded. Furthermore, this extended model provides insight into the development of effective competition in nascent competitive markets.
When a price-cap constraint is set tightly by regulators, it remains binding with fringe competition. Therefore, the observed market price is determined solely by the price-cap constraint. Interestingly, effective competition is prevented from fully materializing when this case arises because the competitive fringe never reaches the size predicted by the traditional DF-CF model. This result demonstrates that the adoption of tightly binding price-cap regulation can act to produce outcomes similar to those predicted by models of limit pricing and entry deterrence, and sheds light on the strategic nature of regulatory regime selection.

These important insights are supported by two empirical studies using data gathered from markets in the United States local telephone industry from 1994-1997. In the first empirical analysis, I investigate the pricing behavior of dominant firms to determine which constraint (price-cap regulation or fringe competition) is effective in determining the observed price charged for local telephone service. I find, ceteris paribus, the adoption of price-cap regulation has reduced the price charged for business service by 2.28 percent and the price charged for residential service by 3.73 percent. In contrast, I find no impact on the price charged for either local telephone service attributable to fringe competition. These findings provide support for the extended DF-CF model of market structure and confirm that, on average, price-cap regulation has been set tightly by state public utility commissions in the United States.

In the second empirical analysis, I investigate what factors have determined the development of fringe competition in local telephone markets. Consistent with both the theoretical model put forth and the empirical results regarding dominant firm pricing
behavior, I find, ceteris paribus, the presence of price-cap regulation in a local telephone market is associated with 59.87 percent less net fringe entry, and subsequently competitive fringes that are cumulatively 38.76 percent smaller than in local telephone markets subject to other forms of regulation. Thus, direct support is provided for the idea that the adoption of price-cap regulation can act to limit or deter entry to partially deregulated markets.

Finally, I offer a political economy explanation to reconcile the counterintuitive conclusion that state public utility commissions have systematically adopted a form of regulation that has slowed down the development of competition. In an age of deregulation, increased competition and decreasing state budgets, state public utility commissions have a clear incentive to slow down the growth of competition to maintain their relevancy and ensure their own survival. I find, ceteris paribus, state public utility commissions that have adopted price-cap regulation for the dominant firms within their jurisdictions are 25.77 percent larger than those that have not. Therefore, I provide some evidence to suggest that state public utility commissions have benefitted from the selection of this form of incentive regulation.

Nobody disputes that effective competition has yet to materialize in local telephone markets characterized as having a dominant firm. The unresolved question is, why? One explanation may be that these markets simply cannot support real competition. That is, perhaps deregulation is ahead of technological change, and these markets still reflect the characteristics of natural monopoly. Another explanation may be that the dominant firms currently operating in these markets have taken direct strategic actions to limit (or deter) the entry of real competitors.
This research suggests and supports an alternative explanation to this puzzle. The theoretical model and empirical analysis provided in this dissertation point toward the systematic adoption of tightly binding price-cap regulation in local telephone markets, rather than actions taken directly by dominant firms or inadequate technological innovation, as a major contributor to keeping effective competition from fully materializing. This, in turn, has stalled Regional Bell Operating Company entry into long-distance markets. Indeed, this suggests that deregulation is lagging behind technological innovation, not vice versa.

The policy implications of this analysis are straightforward. If development of effective local telephone competition is truly desired by state commissioners, more flexibility, in the form of less restrictive price-cap constraints, should be given to the dominant local telephone companies currently in operation. This action will protect consumers from unconstrained monopoly pricing, while at the same time provide new competitors the incentive to enter local telephone markets now opened to competition. As the competitive forces now in place take wind, as was previously observed in the long-distance market, one can imagine a local telephone industry free from explicit economic regulation.

It is clear that these hybrid market structures, consisting of competition and regulation, are products of the political system. In fact, there is no economic justification for having both forces simultaneously operating in a particular market. As demonstrated here, price-cap regulation and competition are in fact redundant constraints. However, as the deregulation movement continues to march into uncharted territories, markets such as these

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will continue to exist. Therefore, this research can be viewed as a first step from which future scholars interested in the competitive transition of regulated markets can build.

On a theoretical level, the model used in this analysis only begins to shed light on the workings of partially deregulated markets. Generalizing the model to handle an array of different functional forms and methods of economic regulation would be an obvious improvement to the theory and an immediate direction for future research. Additionally, this research offers no social welfare analysis trading off the adoption of price-cap regulation and fringe competition. However, this crucial information is necessary before sound and thorough policy recommendations can be offered.

As the competitive transition occurring in the local telephone industry matures, the DF-CF framework may no longer describe the structure of this industry. Assuming that some form of economic regulation is maintained throughout this structural transition, theoretical research analyzing the effect of economic regulation in other models of market structure would prove worthwhile. For example, it would be interesting to see how the outcome in standard oligopoly models (e.g., Cournot or Stackelberg) changes when economic regulation is present.

Several worthwhile directions for further empirical research also exist. This research considered exclusively the impact of price-cap regulation, broadly defined, on dominant firm pricing and the development of fringe competition. However, many different types and combinations of economic regulation exist in practice. Therefore, one extension would be to use a finer and more detailed classification of regulation to extend the analysis. For example, does the addition of an earnings sharing component or infrastructure investment
requirement to a price-cap plan matter? Does the length of the plan make a difference? And, is it possible to gain more direct information about how tightly binding the price-cap plans being implemented are set? All of these questions, and many others, can be addressed as the regulatory transition occurring in the local telephone industry moves forward.

This research also only begins to sketch out an explanation for the systematic adoption of a form of regulation that actually limits the development of competition in partially deregulated markets. However, it does make clear the importance of identifying the politics and incentives created by deregulation before a sound understanding of this transition process can be achieved. Extending the analysis to include other measures of state commission size (e.g., actual budgets or percentages of state budgets), as well as other important political influences in a state (e.g., legislatures) may be worthwhile directions to pursue. In any event, providing a more complete and thorough explanation for this phenomenon will provide a challenging and important direction for future researchers to follow.

Finally, the emergence of competition in traditionally regulated markets provides an endless amount of possibilities for future research. By analyzing the initial patterns of entry and controlling for the form of regulation in place one can conduct empirical tests for a variety of distortions regulation creates in theory. For example, Averch and Johnson (1962) demonstrate the inefficiency of firms subject to rate-of-return regulation. However, the empirical literature on the A-J effect is mixed. Assuming that new entrants initially target markets having inefficient firms, exploring the pattern of entry may provide a new test for this age old question.
These are just a few examples of the possibilities for future research growing out of this dissertation. Studying the transition occurring in traditionally regulated industries is exciting and stimulating. Indeed, this is an area of research that can influence and improve future public policy decisions. Conducting this research from an economic perspective is sure to make a lasting contribution to understanding this important process.
LIST OF REFERENCES


