

Differentiation Strategy and Market Deregulation: Local Telecommunication Entry in the Late 1990s

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Abstract

This paper examines the role of differentiation strategies in the development of markets for local telecommunication services in the late 1990s. Whereas the prior literature has used models of interaction among homogenous firms, our paper is motivated by the claim of entrants that they differ substantially in their product offerings and business strategies. Exploiting a new, detailed dataset of CLEC entry into over 700 U.S. cities, we take advantage of recent developments in the analysis of entry and competition among differentiated firms. We test and reject the null hypothesis of homogeneous competitors. We find strong evidence that CLECs account for both potential market demand and the business strategies of competitors when making their entry decisions. This suggests that firms' incentives to differentiate their services should shape the policy debate for competitive local telecommunications.

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I. Introduction

By the end of 1990s many cities in the U.S. had experience with competitive local telephony. In many locales Competitive Local Exchange Carriers (CLECs) entered into competition with each other and with the Incumbent Local Exchange Carrier (ILEC). In 1999 CLECs accounted for over \$20 billion in annual revenue (NRPG, 2000). Despite their considerable size and their comparative novelty, only a few economics studies have analyzed the competitive behavior of these firms.

In this paper we consider whether CLECs behaved as if they provided homogeneous or differentiated services. This study tests and rejects models that assume homogeneous product competition in favor of models assuming differentiation. We argue that this insight is missing from previous analyses; yet, it is central for understanding the economic and regulatory factors shaping competitive local telephony in this time period. This analysis also sheds light on the umbrella national policy for competitive telephony, as embodied in FCC rule making for the *Telecommunications Act of 1996*.

I.1 Motivation.

We consider two alternative motivations for introducing competition into industries such as local telephony. We label the first motivation "scale-exceeding efficiency." It is the predominant framework used by standard analysis (Woroch, 2001), and, as far as we know, motivates all empirical models of CLEC entry to date.¹ It frames analysis in terms of the costs of providing similar services in either one or more organizations. CLEC prospects depend on their ability to lower costs — lower than an incumbent monopolist currently achieves, with its advantages of scale and/or scope economies. As in any standard model of price competition between otherwise homogeneous services, prices fall when entrants can achieve a level of efficiency exceeding that of the incumbent.

¹ This literature preceded the 1996 Act. Woroch (2001) provides a comprehensive review of the literature with strong emphasis on scale-exceeding efficiencies. Another variant looks at price behavior, where these prices may (or may not) reflect the ability of new entrants to price underneath regulated (i.e., artificially) high prices to business customers (e.g., Wimmer and Rosston [2000]). Another variant estimates a model of market share and assumes the ILEC is first mover in a Stackleberg game with CLECs (Abel, 2002). Crandall's (2001), or Crandall and Sidek's (2001) analysis is more explicit about the role of differentiation, and it informs his interpretation. Yet, these empirical revenue models only partly employ insights about

An alternative motivation for competition is something we label “customer-targeted differentiation.” This alternative is not reflected in existing empirical, nor most theoretical models. According to this view, CLECs have the entrepreneurial ability to identify market opportunities otherwise unmet by the ILEC. These initiatives may reflect different visions about customer needs for service or the ability of entrants to offer innovative services without the obligations — i.e., universal service and reliability — imposed on ILECs by local regulators. It may also reflect the ability of a CLEC to offer a national product on a uniform basis, something expressly impossible for many ILECs to do at this time (Shiman and Rosenworcel, 2002). Price competition arises in the context of the willingness of customers to pay for the heterogeneous services. Competitive entry increases the variety available: CLECs do not pursue the same strategies, and their services are often not the same as those offered by the ILEC.

Pointed disagreements between these alternative views account for sharp differences in policy outlook and recommendation. The first view would emphasize only the number of competitive firms that have entered with assessment based on simple counts of competitors. The latter view argues that models of homogenous consumers and mere counts of firms provide misleading implications where entrants can differ and consumers value this variety. Therefore, a more appropriate checklist for measuring local competition would also incorporate the types of services offered by each of the CLECs. While both views favor interconnection policies that give entrants a market test, the latter would also encourage CLEC strategies that differ from those of the ILEC.

I.2. Synopsis of model, data, and results.

We build on the empirical literature that analyzes entry in concentrated markets and competition among differentiated firms. As in Zolneirek et al (2001), our analysis examines cross-sectional differences in an area's ability to support CLECs; i.e., the number of firms that can profitably operate. As in that study, we also measure this ability as a function of economic factors, such as demand and cost differences across markets, economies of geographic scope, and regulatory stringency. We tailor our estimation to

differentiation.

small and medium-sized cities for three reasons. First, many large cities had already experienced competitive entry by the early 1990s, but it was new to medium sized cities after the passage of the 1996 Telecom Act. Second, prior studies that used broader geographic market definitions provide potentially misleading insight about the extent of competition.² Third, this focus allows us to isolate the role of differentiation, if there is any. For reasons we explain below, this economic effect is difficult to measure unambiguously in large cities.

To focus the analysis on differentiated entrants, we employ an empirical framework found in Mazzeo (2002) that measures entry by firms with different product types. To the extent that it results in less tough price competition, differentiation may increase the number of firms that are able to operate in individual markets. Parameters in the model measure whether entrants behave as if competition from a similar type of firm hurts profits more than competition from one that is different. These parameters statistically test a null hypothesis of homogeneous competitors against an alternative that incorporates the differential impact of heterogeneous competitors. Applying this statistical test to the market for CLECs is the central contribution of our study.

The econometric model requires finely grained data. We employ a dataset derived from the New Paradigm Resources Group (NPRG), a Chicago-based consultancy, who publishes an annual census on CLEC activity. The NPRG report tracks CLEC entry at the city level, which is the appropriate market definition since CLECs often compete block-to-block in geographically focused areas. The NPRG report also documents differences between the strategies of the various CLECs. This provides the data for studying the differentiation and competition hypothesis described above. The differences used in our study are quite simple to measure and use in policy evaluation, so we will place emphasis on demonstrating their feasibility and meaningfulness. This demonstration is another contribution of our analysis.

We use data from 1999, the last year of unambiguously optimistic growth prospects for CLECs. By 1999 there was no question that most major cities could support some CLECs in addition to the ILEC. Yet, even by the end of the 1990s competition was

² The FCC reports, as well as Zolneirek, et al. (2001) count the number of firms in each LATA, a wide geographic area that typically contains several cities large enough to support entry of individual CLECs. Two CLECs operating in different cities within the same LATA would not be competitors in our data.

not widespread in many small and medium-sized cities. Because competition arose in some of these cities and not in others, data from this year expose those factors that facilitate the advance of competition in local telephony.

Finally, there is interesting data included in the NPRG report on the cities where CLECs have announced plans to enter but are not yet operating. We use the planned entry data to infer whether any market conditions in 1999 may have suggested or facilitated the subsequent shakeout in the CLEC industry by 2001-02.

Our results are quite stark. We reject the null hypothesis of homogenous product competition. We also find that the provision of heterogeneous services is as important as other demographic and regulatory factors in predicting market structure. We argue that these results support a change in the analysis for competitive behavior and interconnection in local telephony, elevating differentiation to central importance.

II. The Economics of CLEC Market Structure.

A model of scale-exceeding efficiencies has three basic empirical elements: how economies of scale at the organization influence a city's ability to support many entrants, how economies of scope influence costs of entry and operating, and how these interacted with the regulatory setting. A model of customer targeted differentiation has those same elements, plus more. In this section, we outline these elements — ultimately focusing attention on differentiation. Because differentiation has not been addressed explicitly in prior empirical CLEC studies, we explain why it is an important consideration, while drawing connections with previous work (e.g., Crandall, 2001; Crandall and Sidek, 2001; Zolneirek, et al, 2001; Abel, 2002). We turn to data in the next section.

II.1. Local market demand for vertically disintegrated firms

Most cities are not large enough to support more than a few CLEC entrants. This is due to the presence of fixed costs in the provision of local telephone service. First, there were engineering and management costs associated with setting up and maintaining the infrastructure needed to offer services. In some locations competitive firms built their own facilities. In other locations entrants leased parts of their infrastructure from the incumbent, usually under regulatory oversight. In either case the entrants negotiated an

interconnection agreement with the local incumbent (and also, typically others, such as long-distance firms). These interconnection agreements were often regarded as costly to negotiate, manage and update. Second, CLEC entrants had costs associated administration and marketing. While such expenses may vary with the size of the revenue stream in the long run, every firm incurred fixed expenses associated with managing a workforce that marketed services of a (sometimes previously unknown) firm and maintaining operations of an on-going business.

Some provisions in the 1996 Act tried to make entry easier for new CLECs, such as those involving compulsory licensing of unbundled network elements (Crandall and Sidek, 2001). Such provisions may raise these fixed costs or lower them.³ For our purposes, we will consider the hypothesis that there was variety across states regulators in the enforcement of these rules, which induced differences in fixed costs across localities. We say more about this below.

Zolneirek, et al, 2001, following the spirit of the NEIO on entry (Bresnahan & Reiss 1991; Berry, 1992), hypothesize that the need to cover these fixed costs limited the number of entrants in specific locales. That is, because of the presence of fixed costs in each location where they provided services, CLECs required a sufficient number of customers to generate revenue in excess of their fixed expenses, given their operating profit margin. As a result, cities varied in their ability to support entrants.⁴ Large cities generated sufficient revenue to support more entrants than small cities.

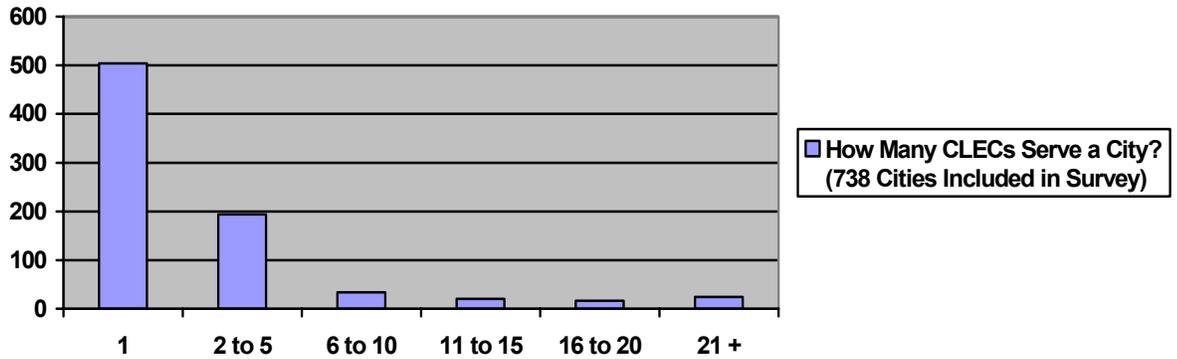
Figure 1 illustrates the key empirical insight on an intuitive level. It shows competitive situation in 738 cities that have at least one actual or planned CLEC providing service as of 1999 (We precisely define "city" below). To construct the most optimistic assessment possible, the Figure includes "planned" installations that were not yet operational in 1999 (We also precisely define "planned" below). Competitive environments have arisen in a few locations, but not everywhere. Figure 1 shows that 504

³ We recognize that there is considerable theoretical debate comparing the fixed costs of entry with the present set of rules with the fixed costs under no such rules. We view it as an argument about what would happen to an actual fact under a hypothetical alternative. We view this as important, but essentially untestable.

⁴ This also assumes that there are decreasing returns to scale — otherwise, only one firm would enter. Product differentiation may also expand the opportunity for profitable entry. We will discuss this in detail below.

of these cities have only one provider, 642 cities have 3 or fewer and 698 cities have 5 or fewer. Only 51 cities have ten or more CLECs, and only 15 have twenty or more.

Figure 1



As expected, only the largest US cities have been able support many CLEC entrants. To illustrate, Table 1 gives several examples of the cities that fall into each category. It is not surprising that large cities in the US have the greatest number of entrants and small cities the fewest. Indeed, even a cursory examination shows that the number of entrants is strongly correlated with the size of city population, as the most basic theory would predict.

Table 1a: Sample of Cities with specific number of CLECs operating or planned

Cities with 20 or more CLECs	New York, Dallas, Chicago, Boston, Atlanta San Francisco, Washington, DC	Average population size: 1,438,877
Cities with between 10 and 19 CLECs	Cleveland, St. Louis, New Orleans, Cincinnati, Tucson, Norfolk	Average population size: 573,492
Cities with between 5 and 10 CLECs	Little Rock, Knoxville, Fresno, Madison, Omaha, Tallahassee	Average population size: 226,934
Cities with either 3 or 4 CLECs	Bakersfield, Gainesville, Santa Barbara, Des Moines, Reno, Waco	Average population size: 158,210
Cities with 2 CLECs	Biloxi, Fargo, Kalamazoo, Naperville, Wellesley, Wichita Falls	Average population size: 84,259
Cities with 1 CLEC	Bangor, Bismark, Champaign, Dubuque, Pleasanton, Redding, Yonkers	Average population size: 43,639

II.2. Economics of geographic scope

A variety of scope economies may exist between market activities in two neighboring cities. For example, two neighboring cities may share similar economic bases that use similar types of communications services. Something learned in one city — about interconnecting with the incumbent, about negotiating agreements, or about a host of other demand factors — could make it less costly to enter and operate nearby. That is, the costs of entry and operation for CLECs may be lower in contiguous cities.

We hypothesize that scope economies in the US should take a particular form. The largest cities in the US — such as New York and Chicago — received entry first, many prior to the 1996 Act (Woroch, 2001). Hence, if scope economies lower costs to entrants, then medium cities next to the largest metropolitan areas will benefit. They receive more entry than medium sized cities that are located geographically further from any central city.

Scope of economies cannot be illustrated in a simple table. However, they are possible to estimate in a regression that controls for city size. We do this below and defer the precise definition until then.

II.3. Economics of the local regulatory environment

The 1996 Telecom Act prescribed pro-competitive regulatory rules designed to foster market-oriented decision-making for investment in local data and voice services. In practice, entrants faced one of several situations. As Mini (2001) carefully documents, CLECs had distinct experiences depending on whether the entrants were interconnecting with RBOCs, with GTE (renamed Verizon after its merger), or with another independent telecommunications firm.⁵ To the extent that such differences create different entry costs for CLECs, a location may be more or less attractive for CLEC entry.

The Telecom Act of 1996 anticipated that entrants would either build their own facilities or sign resale contracts with the incumbent for access to unbundled network

⁵ RBOCs developed interconnection with entrants as part of a quid-pro-quo with the FCC, which sought to disallow entry into long distance market until RBOCs complied with a series of tests for opening their markets (Shiman and Rosenwerfel, 2002). In contrast, most local independent firms simply made deals under the guidance of their local state regulators.

elements of the ILEC's network. Both required regulatory approval. As it turned out, however, by 1999 resale voice services were not a high-margin opportunity in most cities, nor were most resale opportunities. Almost all major CLECs had already abandoned strategies to build customer bases via resale, except as a transitional strategy for supporting geographic expansion (See NPRG, 2000, Crandall, 2001). Only a few based their entry on it alone.⁶ That is, resale was already transforming into an adjunct service to facilities-based operations in expanding and new markets.

This pattern did not diminish the importance of local regulatory environments. Some state regulatory agencies made providing services to business more (un)attractive through their policies for re-averaging prices between high business and low residential rates (Rosston and Wimmer, 2001). Related, state agencies also made it easy/difficult to interconnect with the incumbent by mandating wholesale prices in some areas that were more/less expensive (Gregg, 2002). Related, other state regulatory agencies made it easy/difficult to become a seller or value-added reseller of services related to DSL. Hence, a working hypothesis is that a friendly/stringent state regulatory agency can turn a city with a moderately attractive set of economic conditions into a more attractive or less attractive city for CLECs. That is, not only can the regulator shape the fixed costs of entry and operations, as noted above, but the regulator can also shape the variable costs of operating.

These regulatory influences cannot be illustrated in simple table, but they are possible to estimate in a regression that controls for other factors, such as city size. Once again, we do this below, so we defer our precise definition of “friendly” and “stringent.”

II. 4. Customer targeted differentiated services

The net effects of differentiation are familiar from many models: it pays for firms to differentiate if customers value the differences enough to pay more to the firm that more closely serves their particular needs. Of course, the success of these strategies depends on how much a consumer values variety. To be clear, this study focuses on

⁶ See Crandall's 2001 analysis, in particular, for further detail on this point. He argues that such entry strategies were largely unappealing to customers and unprofitable for the firms in the long run. He does argue, however, some firms used this approach for purposes of taking advantage of rules for reciprocal compensation.

measuring firm behavior affiliated with providing variety and not on measuring user valuation of the variety once it is provided.

Table 1b gives examples of types of differentiation strategies commonly discussed in the trade press during the late 1990s (see NPRG, 2000, for a summary). To be sure, no matter how it is deployed, every CLEC has something in common. Every CLEC offers phone service and related data carrier services that use the same network resources — e.g., lines, central switches, local switches, etc. In spite of such commonalities, there are many claims in the contemporary press and in CLEC marketing literature that these differences produce value for end users. The table summarizes how CLEC services might be tailored to customer needs.

Table 1b: Sample of differentiation strategies

<i>Source of differentiation</i>	<i>Description</i>
<i>Build out.</i>	Facilities may be built out in a variety of ways for a variety of purposes – to enhance reliability, to ease servicing big clients in specific locales, or customize service to specific users needs, such as large data transfers.
<i>Geographic coverage.</i>	Scope of offerings may be tailored to multi-establishment users or to users in many different locations.
<i>Vision of services.</i>	Services are tailored to bring value from new technology (e.g., the Internet, DSL).
<i>Service quality.</i>	The CLEC has invested in superior after sale services or related services in network maintenance activities. The CLEC may offer single contracts for network emergencies or contracts for bundles of voice and non-voice activities.
<i>Non-price norms.</i>	The CLEC may employ labor practices that result in receptionists who smile, repair people who hustle, and accounts receivable employees who quickly correct billing errors.
<i>Regulatory affairs.</i>	The supplier is savvy about working with local government – such as, procuring right-of-way permits for broadband deployment.

We are agnostic about the veracity of the detailed service claims made by any CLEC in any particular city. For this study, the open question is whether firms acted as if their asserted product offerings affected their entry behavior. If so, then we infer that these claims reflected valuable economic differences between firms.

II.5. Customer targeted differentiation vs. scale exceeding efficiencies

Customer targeted differentiation alters the analysis of the three elements that comprised scale-exceeding efficiencies. First, the presence of successfully differentiated CLECs alters the ability of cities to support entrants. If CLECs successfully differentiate, they can earn higher revenues serving the same number of customers. As a result, two differentiated firms may be able to profitably operate in an area that might not support two identical firms.

The differentiation between business and residential customers illustrates the general principle. By 1999, the CLEC industry had expanded from solely one about voice services. It had also expanded into services affiliated with carrying data traffic. These latter services were potentially valuable to business customers, but of more limited value to residential customers. CLECs could vary their portfolio of services to target these distinct sets of customers. To the extent that these chosen services generate higher willingness-to-pay from their targeted customers, the differentiated CLECs can earn higher revenues. This in turn could affect market structure — there might be enough demand to support one CLEC aimed at business users and another aimed at residential users in a small city that could not support two identical CLECs.

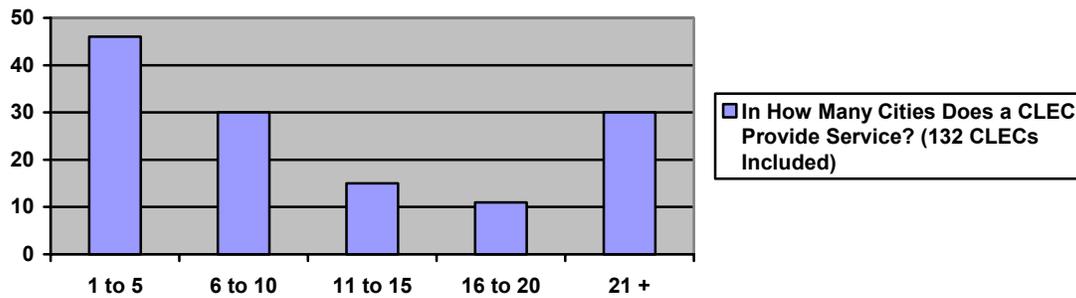
Differentiation can also alter the interpretation of geographic economies of scope. Geographic expansion may reflect lower costs, as noted. If firms are differentiated, then geographic reach also reflects different abilities to identify customer needs, transfer unique engineering skills, or diffuse a particular branding approach. To be sure, this type of differentiation is hard to see without a fine microscope of each transaction between firm and customer. We can empirically examine, however, whether it affects entry behavior and market structure.

As partial illustration of these observations, Figure 2 provides a summary of the geographic presence of 132 CLECs who provided service in least one city in 1999.⁷ TCG (now a division of AT&T) and MFS (now a division of WorldCom) provide service in all large metropolitan cities (and comprised almost half the revenue in the industry until recently). What about firms who entered after 1996? Most CLECs are geographically focused. That is, 46 provide service in 5 cities or fewer, 76 in 10 cities or fewer, and 102

⁷ This graph employs a definition for “city” which we will further explain below.

CLECs provide service in 20 cities or fewer. Only 30 CLECs provide service in over 20 cities. This suggests that CLECs are differentiated in their geographic reach; we will have more to say about how this may affect individual cities below.

Figure 2



Differentiation also opens questions about the asymmetric influence of regulatory behavior on differentiated CLECs. For example, in some locales a state regulatory agency might favor the business users. These agencies use the introduction of competition to undo cross subsidies, encouraging new entrants to price underneath regulated (i.e., artificially) high prices to business customers (e.g., Rosston and Wimmer [2001]). Such a regulatory environment would comparatively favor CLECs with a business focus, but not necessarily those with a residential focus. As another example, the passage of the 1996 Act altered the regulatory framework for dispute resolution between ILEC and CLEC, particularly shifting responsibility for documenting ILEC competitive (mis)behavior to state regulators. It is an open question who this change comparatively favored. Did it favor the local/regional firm with local business connections with the state regulator? Or did it favor the national firms with larger in-house legal experience in local regulatory proceedings?

II.6. The economics of speculative entry during a period of growing demand

We will infer the importance of differentiation from firm behavior consistent with it. To be sure, behavior is also sensitive to many other local economic factors. It is also sensitive to industry-wide perceptions about the state of demand today and expectations about that state for the near future by contemporary actors. We need to acknowledge the

role of these perceptions in the CLEC market in the late 1990s, and discuss their role in our analysis.

A few years after the millennium it became apparent that some CLECs had been “optimistic.” More precisely, some CLECs did not realize revenues sufficient to cover the debts incurred building their facilities and marketing their new services. The trade press dates the beginning of the decline of optimism at the spring of 2000, when financial support for dot.coms collapsed. It reached a nadir in fall 2001, after the September 11 terrorist attack shook business confidence in long term investments. This low continued as the WorldCom financial scandal became publicized in the spring of 2002. Consequently, some CLECs curtailed expansion plans they announced in 1999 and previous years. Others left the market altogether.

This informs our analysis of 1999 in some ways and not others. We operate with the premise that expectations about demand growth beyond 1999 were optimistic, but only in retrospect were they too optimistic. We presume that contemporary actors made entry decisions based on the best available information, and we ask whether their behavior is consistent with the presence of scale-exceeding efficiencies or customer-targeted differentiation. We acknowledge that deviations from a common perception about the anticipated growth of the level of demand could alter the number of CLECs a city can support. Conceivably, realized deviations from a common perception about the anticipated success of CLECs that pursue particular forms of differentiation could alter the CLEC types that survive in any market structure. In the empirical work, we assume and condition on the presence of such common perceptions. Note that, in particular, perceptions cannot be systematically different across areas of the country, since our identification strategy is based on cross-sectional differences in market structure. Our framework will focus on measuring the incentive to differentiate from a rival in the same location, as perceived at the time.

We also can (ex post) check for behavior consistent with these assumptions using CLECs’ announced plans (as of 1999) to expand. Such announcements arise for a variety of reasons, as when a CLEC has published its “growth strategy” as part of its marketing campaign or has begun filing license requirements with a state agency for anticipated

geographic expansion. These announcements provide partial roadmaps about a CLEC's anticipated expansion into new cities.

An interpretation of planned growth as "overbuilding" may derive from the particular pattern of planned entry in the cross-section. We observe planned entry announcements into new geographic areas *as well as* areas in which there is already robust supply. That is, we find planned entry into cities that had heretofore not experienced any and into cities that had already experienced plenty. We also examine whether expansion plans are sensitive to differentiation behavior. We will present a more precise specification to these hypotheses below.

III. Data

Our modeling approach use three types of information:

- ✓ We require cross-sectional information about CLEC entry. A census of CLEC firms operating in cities across the United States come from the 1999 CLEC Report, provided by New Paradigm Resources Group.
- ✓ We also require cross-sectional information about the economic conditions at specific localities. Information about the economic conditions in cities comes from the most recent US Census data.
- ✓ Finally, we require cross-sectional information about the regulatory environment of specific localities. Information about the regulatory environment comes from Abel and Clements (1998).

III.1. Sample construction

We analyze product differentiation and competition among CLECs by studying the structure of a cross-section of markets. We attempt to distinguish between as many different local markets as we can, while taking care to define markets in such a way that the set of firms in the market all compete with each other (at least to some extent) and that no firms outside the defined market are competitors.

For CLECs, the most appropriate geographic market definition is at the level of individual cities. Though jurisdictional boundaries for cities do not always correspond with economic market boundaries in many industries, cities best approximate markets for

CLECs. The services CLECs provide are inherently locally focused — the firm must establish a presence in a city in order to connect customers or businesses residing there. This makes most small and medium-sized cities geographically distinct market areas, even when they are suburbs in large metropolitan areas. We avoid the potential concern of distinct submarkets within cities because we do not include larger cities in our analysis. This difficulty is most serious in places such as Los Angeles or New York City.⁸

Related, the total size of the sample involved some tradeoffs. We constructed a sample of every city in the US with at least one *actual* CLEC entrant as of 1999, dropping a few for incomplete information. We also wanted to include cities that are candidates for entry but that have not yet experienced it, because it helps identify the margin between any entry and none. For this purpose, we also included every city in the US in which any CLEC expressed any *announced plan* to enter, even when these plans were several years in the future. This approach yielded over 250 cities with no actual entrants as of 1999. Also, this provided us with a convenient stopping rule, since there is little statistical benefit from including each of the thousands of small isolated cities in the U.S. with little economic base for supporting CLEC entry. This stopping rule does not bias our estimates in any meaningful way, since we estimate a threshold model for actual entrants, not planned entrants.⁹ Our procedure includes all the observations relevant to the threshold we are interested in analyzing.

Table 2 provides a summary of actual and announced entry in the cities in the dataset. After eliminating observations with incomplete data, we identified a total of 718 cities in which at least one CLEC was operating, or was planning to begin operations, as of 1999. The number in each box in Table 2 indicates the number of cities that have the corresponding number of operating and planned CLECs. Of the 718 cities, all but 260 had at least one firm operating as of 1999. A total of 261 cities had just one firm

⁸ Our dataset reflects this issue directly; for example, some CLECs reported operating in "New York City" while others said they offered services in "Manhattan." From these descriptions, it was impossible to discern whether the firms were competitors. Cities with potentially overlapping submarkets were removed from the final dataset.

⁹ This does, however, preclude us from estimating a threshold between cities where entry is at least planned and those with no CLEC activity at all. This threshold may also be of some policy interest, but is beyond the scope of this paper.

operating, with the numbers getting smaller through 10 or more firms operating. In the planned category, no new CLECs were planning to enter in 250 cities, while 316 had one planned entrant (most of these were among the 260 cities with no operating CLECs). Again, the number of cities with CLECs in the planned category decreases rapidly moving across the table. There is considerable planned entry in markets of all sizes; however, the markets with the largest number of operating firms also have the largest number of planned entrants. There is less planned entry in markets with just one or two operating firms.

Table 2: Histogram of Cities: Number of Operating and Planned CLECs in the Market

	Planned								
<i>Operating</i>	<i>0</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6-9</i>	<i>10+</i>	<i>Total</i>
<i>0</i>	—	238	17	4	1	0	0	0	260
<i>1</i>	203	38	14	5	0	0	0	0	261
<i>2</i>	36	21	13	5	2	1	0	0	78
<i>3</i>	6	9	12	4	2	0	2	0	35
<i>4</i>	4	6	1	2	1	5	2	1	22
<i>5</i>	1	1	1	1	2	0	4	1	11
<i>6-9</i>	0	3	0	1	5	5	10	4	28
<i>10+</i>	0	0	1	0	0	1	10	11	23
<i>Total</i>	250	316	59	22	13	12	29	17	718

III.2. Firm characteristics and the endogenous variable

We classified firms into discrete categories based on their business strategies and product offerings.¹⁰ First, CLECs vary in the geographic extent of their operations. Some CLECs have ambitions to be providers of telecom services in cities across the country, while others focus on a more limited geographic region. Local firms may better

¹⁰ Thos analysts who do acknowledge CLEC differentiation draw these distinctions similarly. Crandall and Sidek (2001), for example, emphasize the differences between a focus on business and residential customers as we do below. Crandall (2001) also emphasizes the build-out strategies of firms and difference between building facilities and relying too much on rental of unbundled network elements; however, we were not able to obtain comprehensive data on these strategies and do not analyze them here.

respond to the needs of consumers in particular markets, while national CLECs may have scale economies in building reputation and can potentially offer consumers located in multiple cities a common telecommunications vendor.

From the NRPG data, we observe the complete set of cities into each CLEC has entered. We labeled CLECs as "local/regional" if they operate completely within one city or a small number of contiguous states. CLECs operating in cities from multiple regions of the country are labeled "national."

In Table 3, we present the breakdown between national CLECs and the local/regional firms in each of the individual markets in the dataset (note that this table only includes the cities with at least one operating firm). Here we see that the cities with fewer operating CLECs typically contain predominately local and regional firms — for example, among the markets with one firm operating, that firm is a local/regional CLEC in nearly 80 percent of the cases. As the total number of firms increases, however, there is a greater tendency for cities to be differentiated, with the same or close number of each type of firms as opposed to all or almost all of one type. Nearly half of the two CLEC markets have one local/regional firm and one national firm. This general pattern holds in markets with 3 or 4 CLECs as well. Over all, this table strongly hints at the presence of differentiated entry.

Table 3: Number of National and Local/Regional CLECs per City

	<i>National CLECs</i>				
<i>Local/Regional CLECs</i>	<i>0</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4+</i>
<i>0</i>	N/A	69	5	3	1
<i>1</i>	214	35	10	3	2
<i>2</i>	38	11	9	3	1
<i>3</i>	12	6	4	1	5
<i>4+</i>	4	2	8	6	2

From the NRPG data, we also observe that individual CLECs differentiated themselves by tailoring their service offerings to appeal to particular groups of customers. The most distinct division was between business and residential customers. While every CLEC provided service to some business customers, we could distinguish between those

that also targeted residential users and those that stuck to business consumers only. Table 4 displays our markets for CLECs broken down between these two customer focus categories.

Table 4: Number of Business Only and Some Residential CLECs per City

	<i>Business Only</i>				
<i>Some Residential</i>	<i>0</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4+</i>
<i>0</i>	N/A	144	15	5	6
<i>1</i>	139	52	21	8	7
<i>2</i>	11	8	8	4	7
<i>3</i>	2	2	1	2	4
<i>4+</i>	1	1	1	3	3

Again, we observe markets that are differentiated. Table 4 demonstrates that 52 out of the 78 two CLEC cities has one firm that targets its offerings to businesses and one firm that also serves residential customers. These raw data strongly suggest some underlying pattern of entry in which differentiation is optimal — if the business-only and some-residential CLECs were equally likely to enter the market under all circumstances, we would expect as many as 52 of 78 markets to have exactly one firm of each type only 0.1 percent of the time. These patterns continue in markets with a larger total number of CLECs as well.

Tables 3 and 4 show how CLECs with different classifications sort themselves into markets of various sizes. The basic empirical fact in these tables portend the main findings of the paper: the CLECs acted as if differentiated services provided additional profitability and facilitated entry into local markets in the late 1990s. A pair of CLECs in the same market most likely was differentiated in their service offerings.

III.3. Testing the dimensions of differentiation

We measure whether firms acted as if their own product type and their competitors' product types shaped their entry decisions. Our product classification

system raises two questions. First, how are these two dimensions of differentiation related, if at all? Second, what are we assuming when we test for homogeneity of output?

As answer to the first question, Table 5 summarizes the pair of characteristics for the individual CLECs operating in 1999.¹¹ We found no apparent correlation between the customer focus and the geographic scope of individual CLECs. In other words, a national CLEC was as likely to maintain a business versus a residential focus as a local/regional CLEC.

Table 5: Number of Business Only and Some Residential CLECs

	<i>Business only</i>	<i>Some residential</i>	<i>Total</i>
<i>Local/Regional</i>	31	44	75
<i>National</i>	16	13	29
<i>Total</i>	47	57	104

Had we found an obvious correlation, we would have been able to assess both aspects of product differentiation simultaneously. Since we do not, we analyze each axis of differentiation separately. In other words, we do not try to identify substitution or complementarity between the choice of business/residential focus and the choice of local/regional/national focus.¹²

As answer to the second, it is appropriate to think of our classification as a maintained assumption. We will not measure whether our classification of differentiation corresponds with success at executing the strategies identified in Table 1b, nor do we measure how much users valued particular types of CLECs. To be sure, we can speculate about how the claims about sources of differentiation in Table 1b correspond with the

¹¹ Of the 132 CLECs highlighted in Figure 2, 28 have only planned service. Since several of these CLECs in the planned only category have not fully anticipated their strategies in terms of detailed business versus residential offerings, we only include the CLECs with at least one operating location in Table 5.

¹²Even if we found a correlation, it is not clear that we even have sufficient data to identify complementarity or substitutability. Athey and Stern (1998) detail the strict data requirements necessary to identify complementarities in a cross-sectional study such as this. Even if complementarities were assumed to be zero, a very large dataset would be required in the case where competing firms could choose among four potential options (one of each type from two categories) simultaneously.

dimensions of differentiation we classify. This speculation does help us interpret the statistical estimates, as we describe below.

If we accept the null hypothesis of competition between firms with homogeneous services, we do so either because firms do not differentiate from their local competitors or because we have inappropriately classified the dimensions in which they differentiate. If we reject the null hypothesis, then we accept the alternative hypothesis that CLECs enter local markets in such a way as to differentiate along the dimensions we classify.

III.4. Economic data about localities

Cities will differ in their ability to generate the necessary demand to support the profitable entry of CLECs. To account for these differences, we collected demographic data from each city. Market "size" was the most important of these characteristics — here, we are interested in both the resident population of each city and its "business population," since CLEC services are often particularly valuable to business customers. Information from the U.S. Census's *Zip-Code Business Patterns* database was compiled to represent the number of employees, establishments, and the annual payroll of all firms operating in each city. As documented in the following sections, these business population variables do a very good job in explaining the overall number of CLECs in each city.

Our first three variables represent the potential demand for CLEC services across the markets in the dataset. CPOPN is each city's population and CPCI represents the average income of the city's residents. Because firms are major consumers of telecommunication services — and specific targets of CLEC entry — we also wanted to include a measure of business activity in the empirical analyses. The variable CTANPAY measures the annual payroll of workers employed in the city; as such it combines both the overall level of business activity and the wages earned by workers. Summary statistics for all of the explanatory variables are included in Table 6.

Finally, we expect that CLECs are able to share costs (such as marketing, administration, and initial costs associated with interconnection) among nearby cities (even if separate facilities are built). It is possible, therefore, that a small city within a larger MSA may be less expensive for a firm to serve than a more isolated city of an

equal size. We include dummy variable TOP10MSA to represent those cities that are within the boundaries of one of the ten largest urban areas in the U.S. We confirmed that the dummies were plausibly related to our proposed interpretation of scope economies by inspecting the CLECs that entered the TOP10MSA cities. Of the 381 CLEC observations in these cities, 333 of them also operated in the MSA's corresponding central city.¹³

III.5. Regulatory influences

We expect the local regulatory environments to affect the propensity for CLECs to enter individual city markets. There is not an obvious relationship between environment and the attractiveness of an area. On the one hand, regulators had choices over de-averaging the differences between business and residential rates. The cities with large differences were usually attractive places for CLECs to enter. In addition, CLECs might have lower entry costs in areas where progressive regulators had experimented with alternative (to rate-of-return) compensation, particularly if these areas had liberal interconnection rules and if dispute-resolution favored entrants. It is also possible that local incumbents that had been weaned off of rate-of-return may have consequently reduced capital investments, making them more attractive targets for competitive entry.

We experimented with a number of summary measures of regulatory stringency that could be compared across markets and for each incumbent carrier within the state. Abel and Clements (1998) provide an analysis of the regulatory regimes pursued within each state.¹⁴ We observe a time series of regulatory rules; this enabled us to assess both whether alternatives had been tried and for how long they were in place. The summary measure REGEXP is a coarser version of the variable FRACPYR, which indicates the number of years (of the previous 16) that either a rate freeze or cap had been imposed on

¹³ We explored several other demographic variables as well. Since the facilities-based CLECs must make capital investments in equipment to link their customers, cities with more geographically concentrated residential neighborhoods and business centers may provide CLECs with customers that are less expensive to serve. The population census provides detailed information on density, including the number of housing units in residential structures. We also constructed business concentration indices for each city, using the distribution of businesses across the zipcodes within cities. While attractive theoretically, none of these factors was strong enough empirically to affect the market structure thresholds across our dataset.

¹⁴ Regulators often have different rules for each incumbent carrier within its state. These rules apply to all the areas within that state where the particular incumbent operates. Therefore, it was necessary to match each market to both its incumbent and its state regulator to determine the status of the incumbent competitor.

the incumbent operating in that market. The mean value of FRCAPYR is 4.7, with just 18 percent of markets having no experience with either alternative regime. REGEXP is set to zero for FRCAPYR equal to zero; to one for FRCAPYR between one and four; and to two for FRCAPYR of five or more.

Specific provisions in the 1996 act required incumbents to provide interconnection access to CLEC competitors; however, the incentives to comply with this directive differed across firms. Specifically, RBOC firms that wanted to enter the market for long distance services were precluded from doing so until regulators were satisfied that the RBOCs had been sufficiently cooperative with CLECs attempting to interconnect and provide service in their local areas. Incumbents that were not RBOCs did not have this incentive to facilitate CLEC entry. Following on the results of Mini [2002], we included an RBOC dummy variable to control for the differing incumbent incentives across the markets in the dataset.

Table 6: Explanatory Variables — Summary Statistics

	<i>Definition</i>	<i>All Cities (n=718)</i>		<i>Small/Medium-Sized Cities (n=675)</i>	
		<i>Mean</i>	<i>Standard Deviation</i>	<i>Mean</i>	<i>Standard Deviation</i>
<i>CPOP</i>	City population	137,143	357,890	85,270	110,244
<i>CTANPAY</i>	Annual payroll of city employees	2,196,817	6,544,441	1,247,663	1,802,501
<i>CPCI</i>	Per capita income of city residents	14,542	5,376	14,517	5,518
<i>TOP10MSA</i>	Dummy Variable = 1 if city within Top 10 MSAs	0.252	0.434	0.244	0.430
<i>RBOC</i>	Dummy variable = 1 if ILEC is an RBOC	0.726	0.447	0.720	0.449
<i>REGEXP</i>	Regulatory stringency variable (described in text)	1.152	0.687	1.147	0.687
<i>LOOPRATE</i>	Interconnection rate set by state regulatory agency	16.22	6.24	16.44	6.30

Finally, regulators prescribed the costs which CLECs were required to pay ILECs for interconnection. These rates vary by state and within each state; typically they were set lower in more densely populated areas. Using data from Gregg (2002) and Rosston and Wimmer (2001), we were able to assign the variable LOOPRATE. While still somewhat preliminary, this variable is our best approximation of the interconnection costs borne by CLECs across jurisdiction.¹⁵

IV. Statistical Analysis of CLEC Entrants

We begin our empirical analysis by estimating probits predicting CLEC entry and ordered probits whose dependent variables are the numbers of operating CLECs. The explanatory variables highlight the foundations of scale-exceeding efficiencies — local market demand, geographic scope, and regulatory environment. These estimates provide a useful comparison with previous work that had a similar empirical strategy (e.g., Zolneirek, et al, 2001). Unlike the previous analysis of CLEC entry, however, we examine city-level markets.¹⁶ The finely grained data should yield insight about the precise relationship between local economic factors and entry levels. These estimates also provide a useful benchmark against our later estimates that account for differentiation.

Tables 7 and 8 present the results from two estimations — in the first the dependent variable is AOPERATE, a dummy variable that equals one if any CLECs are currently operating within that market.¹⁷ We also present an ordered probit estimation, where the dependent variable OPERATE is a count of the number of CLECs doing business in the market.

All three demographic variables are positively correlated with CLEC entry, with CPOP and CTANPAY being particularly significant. A city's ability to support CLEC entry is positively affected by both the demand generated by consumers that live in the

¹⁵ The LOOPRATE typically differs across three or four density zones within each state — we are still working out the precise matching between cities and density zones. As such, we include this variable in some but not all of the empirical analyses.

¹⁶ Recall that prior studies of CLEC entry used individual LATAs as the unit of observation. Each LATA contains several individual city markets, as defined in our dataset.

¹⁷ Recall that our set of markets that have zero operating firms, by construction, have at least one CLEC that is planning to enter. This method of sample construction ought to bias the coefficients in Table 7 downward, as compared to a sample that also included cities where no CLECs had plans to enter.

city and by businesses that operate within the city. Interestingly, these two variables have somewhat greater predictive value in the OPERATE ordered probit. This suggests that AOPERATE is a relatively coarse measure, at least as far as approximating CLEC demand. We also see that the TOP10MSA dummy is positive in both estimations, but more significant in the AOPERATE probit. There appears to be some evidence of scope economies, since CLEC entry is more common in small and medium-sized cities within larger MSAs, all else equal.

Table 7: Probit of CLEC Entry — Dependent Variable = AOPERATE

	<i>Small/Medium Sized Cities</i>			<i>All Cities</i>		
	<i>Coef.</i>	<i>Std. Error</i>	<i>Z</i>	<i>Coef.</i>	<i>Std. Error</i>	<i>Z</i>
<i>Constant</i>	-0.635	0.316	-2.01	-0.627	0.316	-1.98
<i>CPOP</i>	3.29e-6	1.48e-6	2.23	3.31e-6	1.48e-6	2.24
<i>CTANPAY</i>	3.17e-7	1.13e-7	2.81	3.23e-7	1.13e-7	2.85
<i>CPCI</i>	2.56e-5	1.54e-5	1.67	2.55e-5	1.54e-5	1.66
<i>TOP10MSA</i>	0.254	0.168	1.51	0.250	0.168	1.48
<i>RBOC</i>	0.288	0.126	2.30	0.283	0.125	2.26
<i>REGEXP</i>	0.302	0.087	3.47	0.300	0.087	3.44
<i>LOOPRATE</i>	-0.033	0.010	-3.43	-0.033	0.010	-3.44

Note: Cities with seven or more operating CLECs were excluded from the left-hand panel, for an easier comparison with the following analysis. There are 675 observations, with 718 in the full dataset of cities.

The regulatory variables RBOC, REGEXP and LOOPRATE are all significant and have the expected sign. It appears easier for CLECs to enter and compete in areas where RBOCs are the incumbent local service providers; this is consistent with the prediction that the regulatory incentives would make areas with RBOCs less hostile toward potential entrants. CLECs are also more common in areas where the regulators had experimented away from traditional rate-of-return systems for longer periods of time and where interconnection rates are set lower. These results suggest that regulatory environment can have both a long and a short-term effect on markets.

Table 8: Ordered Probit of CLEC Firm Counts — Dependent Variable = OPERATE

	<i>Small/Medium Sized Cities</i>			<i>All Cities</i>		
	<i>Coef.</i>	<i>Std. Error</i>	<i>Z</i>	<i>Coef.</i>	<i>Std. Error</i>	<i>Z</i>
<i>CPOPN</i>	4.40e-6	7.75e-7	5.68	1.65e-6	5.23e-7	3.15
<i>CTANPAY</i>	1.55e-7	4.79e-8	3.24	2.08e-7	3.29e-8	6.32
<i>CPCI</i>	1.70e-5	9.55e-6	1.78	1.40e-5	9.22e-6	1.52
<i>TOP10MSA</i>	0.138	0.117	1.18	0.059	0.112	0.53
<i>RBOC</i>	0.206	0.102	2.02	0.253	0.098	2.58
<i>REGEXP</i>	0.160	0.068	2.34	0.172	0.066	2.62
<i>LOOPRATE</i>	-0.029	0.008	-3.56	-0.035	0.008	-4.35

Note: Cities with seven or more operating CLECs were excluded from the left-hand panel, for an easier comparison with the following analysis. There are 675 observations, with 718 in the full dataset of cities.

V. Modeling a city's ability to support differentiated entrants

We now outline the modeling approach for examining differentiated entry. The model estimates the extent to which firm differences influence observed entry behavior.

V.1. Statistical method

The modeling approach we utilize fits into the series of "multiple -agent qualitative-response" frameworks introduced into the industrial organization literature to evaluate entry strategies and market competition. The econometrician infers parameters of individual firms' profit functions by analyzing a cross-section of market outcomes. Firms' strategies can be represented by discrete decisions (e.g., enter/don't enter a particular market) that are made by evaluating the profitability of the potential alternatives. Estimation of the profit functions is complicated by the fact that the decisions of competing firms may affect the profitability of the potential alternatives — for example, entry may be less profitable if other firms have also entered the market. A game-theoretic behavioral model is used to infer individual firm profitability from an observed market structure outcome, determined by the choices made by interacting agents.

To illustrate this approach, consider first the case of a homogeneous product industry. Assume that in each geographic market there are an infinite number of identical potential entrants. The entry decision of these firms depends on a profit function like the following:

$$\pi_m = X_m\beta - Z_m\gamma - N_m\theta + \varepsilon_m$$

where m denotes the geographic market in question. These markets may differ in the cross-section in X -characteristics affecting demand for the firms' products or in Z -characteristics that affect the firms' market-specific costs. N_m represents the number of firms that have entered the market; θ indicates the competitive effect on profits of additional market participants. The ε_m term represents the components of firm profits that are unobserved to the econometrician.

The parameters of this profit function can be estimated using a cross-section of market structure observations. For example, we may observe two firms operating in market m . This implies the following profit function inequalities in market m :

$$\pi_m = X_m\beta - Z_m\gamma - (2)*\theta + \varepsilon_m > 0$$

$$\pi_m = X_m\beta - Z_m\gamma - (3)*\theta + \varepsilon_m < 0$$

The profit function parameters are determined by maximizing the likelihood that the inequalities implied by the observed market structures (assuming a distribution for the market level error term) hold.

This approach can be extended to analyze firms in heterogeneous markets as well. Suppose that each market could have firms of two types, label them A and B. Now, market structure is represented by an ordered pair (N_A, N_B) indicating the number of observed firms of each type. In addition, there will be type-specific profit functions for these firms:

$$\pi_{Tm} = X_m\beta_T - Z_m\gamma_T - N_{mT}\theta_T - N_{-Tm}\theta_{-T} + \varepsilon_{Tm}$$

in which the cost and demand effects can be type-specific and where we can allow the effects of competitors to vary based on whether they offer the same or different product types. N_{Tm} indicates the number of same type firms in the market and N_{-Tm} is the number of firms of the other type. Therefore, the difference between the estimated θ_T and θ_{-T} parameters captures the extent to which product differentiation may limit the effects of

additional competitors on firm profitability. The unobserved part of profits, ε_{Tm} , is assumed to be different for each product type at a given market.

With multiple product types, the set of inequalities that corresponds to each market outcome is necessarily more complex. A market observed with a structure of (A,B) implies that the following inequalities hold:

$$\begin{array}{lll} \pi_A(A, B) > 0 & \pi_A(A+1, B) < 0 & \pi_A(A, B) > \pi_B(A-1, B+1) \\ \pi_B(A, B) > 0 & \pi_B(A, B+1) < 0 & \pi_B(A, B) > \pi_A(A+1, B-1) \end{array}$$

Again, we estimate the profit function parameters by maximizing the likelihood that the inequalities corresponding to each observed outcome hold across the markets in the dataset. For further details, see Mazzeo [2002].

V.2. Identification

This approach identifies the profit function parameters using cross sectional differences in the determinants of entry. It is best suited for analysis of small and medium sized cities that do not have a large number of competitors. In larger cities with many firms, the marginal effect on variable profits of additional competitors is likely very small.

Consequently, we focus on measuring the key differences between small and medium cities that may become substantially more competitive with additional entry — places such as Buffalo and Little Rock and Fresno. We believe that for policy purposes, these markets are most interesting; larger cities will likely be competitive under almost any set of local and national regulations for CLECs (Woroch, 2001).

Intuitively speaking, identification of differentiation comes from comparing otherwise similar markets with different structures or from comparing different markets with otherwise similar structures. Two markets with the same number of firms may not be otherwise equal — if the firms are more heterogeneous in one market, their differentiation may accompany a smaller population. A particular market with insufficient demand to support two homogeneous firms may have enough demand for two firms that differentiate.

V.3. Estimation and testing

We allow for up to three firms of each product type in the market — therefore, the endogenous market structure variable can take on one of 16 possible values. The information in Tables 3 and 4 capture the variation in the dependent variable across all the markets in the dataset.¹⁸ The profit function to be estimated contains parameters that capture the effects of competitors and their product types. For each firm type and market configuration, a set of dummy variables is defined, and the corresponding θ -parameters represent the incremental effects of additional competitors on the profits of firms in the market.

The reported estimates reflect the following specification of the competitive-effect dummy variables:¹⁹

θ_{RR1} = effect of first some-residential CLEC on some-residential profits

θ_{RR2} = effect of second some-residential CLEC on some-residential profits

θ_{RB} = effect of business-only CLECs on some-residential profits

θ_{BB1} = effect of first business-only CLEC on business-only profits

θ_{BB2} = effect of second business-only CLEC on business-only profits

θ_{BR} = effect of some-residential CLECs on business-only profits

The estimated parameters can be used to evaluate the null hypothesis of homogeneous output competition. A strict test of that property is $|\theta_{RR1}| = |\theta_{RB}|$ and $|\theta_{BB1}| = |\theta_{BR}|$. We can reject the null in favor of a model of differentiated competition if we find $|\theta_{RR1}| > |\theta_{RB}|$ and $|\theta_{BB1}| > |\theta_{BR}|$. There are similar tests for homogeneity/differentiation with respect to geographic ambition. Notice that in the absence of within-type heterogeneity, we would expect to find $|\theta_{RR1}| > |\theta_{RR2}|$ and $|\theta_{BB1}| > |\theta_{BB2}|$.

As in the probit estimations, the appropriate X-variables to include are either correlated with CLEC demand or entry costs in each market. The profit function

¹⁸ For example, there are 11 markets whose dependent variable is (2,1) in the geographical ambition model — two local CLECs operating and one national CLEC operating (cf. Table 3). Cities with more than three firms in each category are treated as if they have exactly three in the category.

¹⁹ The goal is to make the specification of the competitive effects as flexible as possible, while maintaining estimation feasibility. More flexible parameterizations of these effects did not yield further economic distinctions.

specification also allows the effects associated with the X-variables to vary by product type. To ease estimation, the data for the X-variables are transformed to the log of the actual value for that market divided by the sample mean of that X variable across all the markets in the dataset. Consequently, a value of X equal to the sample mean is transformed to zero, a value above the mean becomes positive and a value below the mean becomes negative.²⁰ This also eases interpretation because it puts all variables on the same scale and allows for a quick comparison of the economic importance of competing variables. For example, an exogenous variable's effect on profits can be compared to the amount profits decline from competition with the first entrant. Similarly, we can say that differentiation is "economically important" if it is as large as the variance in other exogenous variables, such as city size and income, which are known to shape the number of entrants overall.

V.4. Estimates and results

The results are presented in Tables 9 and 10. Table 9 is for residential/business, while Table 10 is for local/national.

In Table 9, the estimated parameters indicate the relative profitability of the some-residential and the business-only CLECs depending on market conditions and the competitors they face. For example, the relative value of the constants indicates that if we hold market characteristics constant, operating a single business-only CLEC is slightly more attractive than operating a single some-residential CLEC ($C_B = 0.9204$ vs. $C_R = 0.8597$).²¹ Factoring in market conditions can change this relationship. For example, consider the per-capita income variable — the parameter estimate for both product types is positive, indicating higher profitability for both types of CLECs in cities with higher incomes, all else equal. However, the estimated parameter in the profit function for the some-residential CLECs is higher than for the business-only CLECs.

²⁰ The transformation is done solely to facilitate estimation of the model. The estimation routine converges more easily if the ranges of the independent variables are similar to each other.

²¹ All the figures presented in this section represent predicted profits. The comparisons between profits to operating as each product type assume that values of the unobservable part of profits for both types are at their mean — zero. Directly evaluating the probability that one type's profits are greater than the other's requires the standard errors of the parameters, as well as an assumption about the variance of the profit function errors for each type.

This indicates that as the income of the residents in a city increases, the relative profitability of CLECs that provide services to residential customers increases as well. To illustrate this, suppose that in market m , per-capita income is ten percent higher than the sample mean, TOP10MSA, RBOC and REGEXP are set to zero, and the other X-variables are at their sample means. With no competitors, profits from operating a some-residential CLEC are on average higher ($\pi_R = 0.8597 + (0.095) * (1.0846) = 0.963$) than for a business-only CLEC ($\pi_B = 0.9204 + (0.095) * (0.2965) = 0.949$).²²

**Table 9 — Profit Function Estimates from Two-Type Product Choice Model
"Some-Residential" and "Business-Only" CLECs**

<u>Parameter</u>		<u>Estimate</u>	<u>Standard Error</u>
<u>Effect on Profits for Some-Residential CLECS</u>			
Constant	C_R	0.8597	0.0697
Some-Residential Competitor #1	θ_{RR1}	-1.5435	0.0875
Some-Residential Competitor #2	θ_{RR2}	-1.6928	0.0323
# of Business-Only Competitors	θ_{RB}	-0.0000	0.0000
Population	β_{R-POP}	-0.0008	0.1464
Payroll	β_{R-PAY}	0.3358	0.1155
Per Capita Income	β_{R-INC}	1.0846	0.0578
City in a Top-10 MSA	β_{R-MSA}	0.5977	0.0174
Incumbent = RBOC	β_{R-RBOC}	-0.5531	0.0427
Regulatory Stringency	$\beta_{R-REGEXP}$	0.1150	0.0089
<u>Effect on Profits for Business-Only CLECS</u>			
Constant	C_B	0.9204	0.1666
Business-Only Competitor #1	θ_{BB1}	-1.2610	0.0588
Business-Only Competitor #2	θ_{BB2}	-1.3232	0.0277
# of Some-Residential Competitors	θ_{BR}	-0.4245	0.0067
Population	β_{B-POP}	0.3352	0.0220
Payroll	β_{B-PAY}	0.4003	0.0347
Per Capita Income	β_{B-INC}	0.2965	0.0121
City in a Top-10 MSA	β_{B-MSA}	0.5442	0.0126
Incumbent = RBOC	β_{B-RBOC}	-0.4750	0.0115
Regulatory Stringency	$\beta_{B-REGEXP}$	0.1325	0.0041

²² With per-capita income ten percent above the sample mean, the parameter estimate for income is multiplied by $\ln(1.1) = (0.095)$, to compute the predicted payoffs. The transformed value of an X-variable at its sample mean is zero; therefore, the other variables do not contribute to the predicted profits.

The key result in Table 9 comes from the estimated competitive effects on CLEC type, as captured by the θ -parameters. The estimates indicate that the effects of competitors on profitability come predominately from same-type CLECs. For both product types, the presence of a similar competitor cuts baseline profits substantially ($\theta_{RR1} = -1.54$; $\theta_{BB1} = -1.26$), while the presence of competitors of the other product type have a much smaller impact on profits ($\theta_{RB} = -0.00$; $\theta_{BR} = -0.42$). This provides strong evidence that the CLECs enter markets in a pattern consistent with large returns to product differentiation. In the context of the profit function hypothesized here, customer-targeted differentiation appears to insulate CLECs from lower margins that typically result from reduced competition in homogeneous product markets. These results clearly reflect the same implications as the raw data in Table 4 — since firms prefer to differentiate, there are more markets with an even distribution of some-residential and business-only CLECs. A similar pattern holds in Table 10, which includes parameters from the analysis of the second dimension of differentiation, local/regional CLECs versus national CLECs. Again, the θ -parameters indicate a strong preference to differentiate their products.

Comparing the β -parameters between the upper and lower panels of the two Tables illustrates how certain demographic variables and market conditions support one CLEC type more or less than the other. Consider the geographic scope hypothesis that was embedded in the TOP10MSA variable. The probit estimates indicated that cities within MSAs were more attractive for entry; the differentiated products analysis in Table 10 suggests that the local/regional CLECs find entry in such areas more attractive ($\beta_{L-MSA} = 0.33$). National CLECs, in fact, opt to be inside these suburban locations less often. Instead, they prefer to expand from the largest central cities (that are not included in the dataset) to the downtown areas of smaller cities in different metropolitan areas ($\beta_{N-MSA} = -0.13$). The effect of regulatory environment can also differ by product type, as the local/regional CLECs get a positive boost in areas where the regulators have been more progressive in the past. The national CLECs are sufficiently large and powerful on their own; they likely need less assistance from local regulators to execute on their preferred entry strategies.

**Table 10 — Profit Function Estimates from Two-Type Product Choice Model
"Local/Regional" and "National" CLECs**

<u>Parameter</u>		<u>Estimate</u>	<u>Standard Error</u>
<u>Effect on Profits for Local/Regional CLECS</u>			
Constant	C_L	0.6795	0.0144
Local/Regional Competitor #1	θ_{LL1}	-1.1719	0.0150
Local/Regional Competitor #2	θ_{LL2}	-0.8642	0.0111
# of National Competitors	θ_{LN}	-0.0000	0.0000
Population	β_{L-POP}	-0.0014	0.0001
Payroll	β_{L-PAY}	0.3597	0.0279
Per Capita Income	β_{L-INC}	-0.0771	0.0131
City in a Top-10 MSA	β_{L-MSA}	0.3330	0.0119
Incumbent = RBOC	β_{L-RBOC}	-0.4793	0.0116
Regulatory Stringency	$\beta_{L-REGEXP}$	0.0501	0.0016
<u>Effect on Profits for National CLECS</u>			
Constant	C_N	0.1967	0.0113
National Competitor #1	θ_{NN1}	-0.6551	0.0073
National Competitor #2	θ_{NN2}	-0.7895	0.0092
# of Local/Regional Competitors	θ_{NL}	-0.2665	0.0030
Population	β_{N-POP}	0.0947	0.0113
Payroll	β_{N-PAY}	0.4310	0.0115
Per Capita Income	β_{N-INC}	1.4403	0.0112
City in a Top-10 MSA	β_{N-MSA}	-0.1278	0.0142
Incumbent = RBOC	β_{N-RBOC}	-0.0084	0.0042
Regulatory Stringency	$\beta_{N-REGEXP}$	-0.0012	0.0006

Taken together, these results strongly suggest that the differentiation strategies of CLECs up through 1999 precipitated entry in many local markets. The results in Tables 9 and 10 indicate profit function parameters consistent with the notion that variable profits would be higher for differentiated CLECs than for CLECs whose service offerings were homogenous. In fact, the entry patterns displayed in Tables 3 and 4 suggest that the benefits of product differentiation guided CLEC behavior as competitive markets for local telecom developed. Whether differentiated demand would continue to be anticipated by firms is a question that we will take up in the next section.

To summarize, our findings support two themes. First, we conclude that the diffusion of CLECs into local markets throughout the U.S. operates through economic forces beyond scale-exceeding efficiency. We reject the hypothesis that CLECs entry

behavior is consistent with the presence of homogenous product competition; instead, we find strong evidence consistent with the presence of customer-targeted differentiation. Second, we find that evidence that the motive to differentiation is economically important. Different types of CLECs display distinctly different degrees of sensitivity to local economic conditions and to the local regulatory environment. Moreover, the contribution from the motives to differentiate has an impact on estimated profit similar to the variance contributed from differences in local economic and regulatory conditions.

VI. Anticipated Demand and Planned Entry

In several places above, we make reference to our data on CLEC expansion plans. For each firm in our dataset, we have information on the cities into which entry is *planned* as well as where entry has already occurred. During this optimistic period, we interpret planned entry as an indicator — at least in the forecasts of the CLEC firms — of where future demand would be strong. In this section, we investigate if any regularities between anticipated market growth and planned entry can be identified and whether any hints of the post-1999 industry shakeout can be found.

Just as in section 4 we estimated probits of CLECs counts within cities, here we analyze the number of CLECs that have planned service, city-by-city. Table 10 contains the results of ordered probits whose dependent variables are the number of CLECs that are planning to provide service and the unit of observation is, again, an individual city. Note that the explanatory variables are essentially identical to those in Tables 7 and 8 — we expect the same demand and cost factors that support operating firms to also encourage future CLEC entry. However, entry plans may be deterred to the extent that competing CLECs have already recognized the opportunity in a particular city and have entered there. To control for this, the variable OPERRES was created; it reflects the difference between the number of CLECs currently operating in the city and the number that would be predicted given the demographic data of the city and the parameters of the model estimated in section IV.

The parameter estimates in the left panel of Table 11 provide some evidence consistent with the OPERATE probits: the demand variables CPOP and CTANPAY are positive and significant in predicting the number of CLECs planning to enter in the

cities in the dataset. The geographic scope and regulatory variable, however, support an alternative prediction. It appears that there are fewer CLECs planned in large MSA suburbs and in areas with less regulatory stringency and higher interconnection rates (though the RBOC dummy has essentially no effect). Less future entry of CLECs is planned in these cities, although they did attract entry initially.

Table 10: Ordered Probit of Planned CLECs — Dependent Variable = PLANNED

	<i>All Small/Medium Sized Cities</i>			<i>Cities w/at least 1 operating CLEC</i>		
	<i>Coef.</i>	<i>Std. Error</i>	<i>Z</i>	<i>Coef.</i>	<i>Std. Error</i>	<i>Z</i>
<i>CPOP</i>	3.88e-6	7.86e-7	4.94	5.57e-6	8.72e-7	6.38
<i>CTANPAY</i>	2.21e-7	5.19e-8	4.27	2.30e-7	5.42e-8	4.25
<i>CPCI</i>	-9.93e-6	9.72e-6	-1.02	-1.94e-5	1.14e-5	1.70
<i>TOP10MSA</i>	-0.393	0.125	-3.12	-0.146	0.152	-0.96
<i>RBOC</i>	0.076	0.102	0.75	0.638	0.167	3.83
<i>REGEXP</i>	-0.243	0.069	-3.52	-0.036	0.099	-0.37
<i>LOOPRATE</i>	0.047	0.008	5.78	0.029	0.012	2.43
<i>OPERRES</i>	-0.139	0.048	-2.90	0.303	0.062	4.86

Note: There are 675 observations in the left panel and 415 in the right panel.

The additional control variable OPERRES is negative and significant in the PLANNED ordered probit, indicating that cities are more attractive for planned entry to the extent that they "should" have more CLECs operating but they do not. There appears to be a certain amount of gap-filling, such that CLECs have planned to enter cities that have been overlooked in the past. However, this may be partially due to the sample construction; recall that all of the dataset cities with no operating CLECs (and necessarily a negative value for OPERRES) do have at least one planned entrant. Therefore, in the right panel of Table 11 we repeat the PLANNED ordered probit, leaving out the cities with zero operating CLECs. Here, the opposite result holds — the parameter estimate is positive and strongly significant.

The results from Table 11 suggest CLECs appear to expect demand for their services to spread geographically, making cities that were initially passed over attractive for entry. Demand growth was also anticipated, but more so in the cities where there had

already been entry in the past. We interpret both results as substantially optimistic. In the first case, demand in new cities needed to be high enough to overcome the unattractive aspects of operating in more remote cities with potentially less accommodating economic conditions, regulators and incumbent competitors. In the second case, the supposition was that demand for CLECs would continue to be very strong, particularly factoring in the pressure on margins that could result from entry of several competing CLECs. The optimism of firms revealed in Table 11 may well have been unwarranted, particularly in the context of the industry shakeout after 1999.

In addition to the optimism about demand that Table 11 demonstrates, there is some evidence to suggest that firms were less prone to consider differentiation in their expansion plans than they had in their realized entry decisions through 1999. As an illustration, we focus on the customers served distinction — some-residential versus business-only — and compared the types of CLECs currently operating with the firms that were planning to enter.

In particular, if firms considered differentiation when planning their entry, a some-residential CLEC would be more likely than a business-only CLEC in a city that had only one business-only CLEC currently operating. We looked for cities in the dataset that were not equally balanced between the two types in either their operating or planned firms (92 cities in all) and counted in how many the product type of the planned CLECs would serve to counterbalance the product-types of the operating firms. Surprisingly, the planned CLECs were differentiated from their operating competitors less than half (41 of 92) the time. Table 12 shows that this phenomenon is particularly true in the larger markets. Where just one firm operates, the planned CLECs are intending to differentiate their service from the competitor nearly 60 percent of the time. In the remaining larger markets, however, almost 70 percent of the markets would experience less product differentiation as a result of the planned entry.

It is certainly true that broad trends in the macroeconomy were responsible for the CLEC industry shakeout; explaining the shakeout is well beyond the scope of this analysis. Nonetheless, there is evidence to suggest that the expansion plans of CLECs as of 1999 may well have contributed to the downfall. First, firms expected future demand to grow, both in terms of the viability of untapped markets and the continued potential of

the cities where the largest numbers of CLECs were already operating. In addition, the CLECs that were planning to enter did not appear to be as focused on product differentiation as a source of profitability. To the extent that more firms offered similar products to an optimistically increasing customer base, it may not have been surprising that prices would fall and several firms would be forced to exit the industry.

Table 11: Differentiation of Planned CLECs — Some-Residential vs. Business-Only

	<i>Number of Markets Where Planned CLECs Would</i>	
<i>Number of Operating CLECs</i>	<i>Balance Undifferentiated Cities</i>	<i>Further Unbalance Product Types</i>
<i>1</i>	26	18
<i>More than 1</i>	15	33
<i>Total</i>	41	51

VII. Conclusion

The empirical results in this paper demonstrate a striking pattern of product differentiation among CLEC entrants through the late 1990s. Whether measured on the basis of target customers or geographic scope, CLECs followed entry strategies that resulted in markets that are more often close to evenly split between product types, as opposed to dominated by firms of one type of another. This pattern suggests that CLECs were concerned about competing with each other. It also suggests that tailoring products to meet the needs of consumers appealed to CLECs, as a way to earn higher profits in the burgeoning, unregulated industry.

As such, we reject the hypothesis that deregulation was driven predominantly by the logic of scale-exceeding efficiency. We find evidence consistent with the presence of customer targeted differentiation as well. We also argue that differentiated behavior shaped firm entry behavior as much as differences in local economic and regulatory conditions.

We conclude that the literature on competitive local telephony should begin to investigate the many issues raised by this shift of views. The results demonstrate the role that product differentiation can play in expanding competition in previously regulated

industries. For a variety of reasons, it may be difficult for a monopolist to effectively serve all types of heterogeneous customers equally well. By opening such markets up to competition, firms targeting underserved customers may enter — as they did for CLECs.

Policy makers should account for consumer welfare gains that result from better product targeting *as well as* from lower prices. While all pro-competitive policies for local telephony support putting entrants through a market test, our results identify what ignoring differentiation can miss. Policy making should not presume it knows the formula for commercial success based solely on observing ILECs and incumbent CLECs; instead policy should encourage CLEC strategies which differ from those of the ILEC and other CLECs, with the intent of letting users choose among an expanded array of options.

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