The Role of Differentiation Strategy in Local Telecommunication Entry and Market Evolution: 1999-2002

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Abstract

We examine the role of differentiation strategies with regards to entry behavior and the evolution of the telecommunications market. Our study is distinctly different from prior literature, which has used models of interaction among homogenous firms to analyze local telecommunication competition. We construct a detailed data set of Competitive Local Exchange Carriers' (CLECs) market structure in nearly 1,200 U.S. cities in 1999 and 2002, before and after a valuation crash affecting firms in this industry. We exploit recent developments in the analysis of entry and competition among differentiated firms to test and reject the null hypothesis of homogeneous competitors. We also find strong evidence that differentiated CLECs account for both potential market demand and the business strategies of competitors when making their entry decisions. Finally, the degree of product heterogeneity in markets as of 1999 helps predict how the structure of markets evolved through 2002. These findings suggest that firms' incentives to differentiate CLEC services should contribute to the policy debate for regulation of local telecommunications.

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I. Introduction and Overview

By the end of the 1990s many cities in the United States 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 (New Paradigm Resources Group [hereafter NPRG] 2000). The 1996 Telecommunications Act [also termed the Telecom Act] is partially responsible for this experience. Though it went through multiple court-tests and regulatory reviews in its first decade of existence, it provided a new national legal framework for interconnection and competition between ILECs and CLECs.

Several studies have examined why some locales experienced more entry than others; in this paper we analyze whether differentiation among service offerings explains CLEC entry behavior across markets after the Telecom Act. Although some research analyzes how CLECs compete with an ILEC after entry, we fill a gap in competitive analysis by highlighting how CLECs compete with each other. Focusing our study on differentiation addresses one motivation behind the Telecom Act, namely, to encourage variety in the services available in competitive local telecommunication markets.

Heterogeneity in CLEC offerings can take several forms. For example, during the late 1990s several national CLECs offered their services to multi-establishment buyers in many cities around the country, while most ILECs were precluded from doing so by regulation. In addition, while both ILECs and most CLECs offer enterprise communications services, not all CLECs and ILECs offer the same services. They may differ in their efficiency and reliability or sometimes in their basic functions, such as the services offered by billing departments or maintenance departments. Similarly, while telephone dial-tone and voice services are the core of an ILEC's business, these may be only a part of a larger portfolio of a CLEC's offerings; CLECs may offer a different bundle or potentially offer other data services, networking services and other activities affiliated with operating communications at a customer's premises.

Many CLECs claimed in their marketing literature that these differences in quality, performance, and portfolio of services were important to potential customers. While market analysts have debated the consequences of such differences, their claims

often are based on idiosyncratic examples. Our study provides important contributions to the literature by introducing statistical rigor into this debate, placing emphasis on measuring what firms do and making inferences from observed outcomes. Specifically, we ask, Does the entry behavior of CLECs suggest that differentiation is an important strategic consideration for firms in this industry? Consequently, do some locales get more or less entry because CLECs differentiate from each other?

Our empirical analysis employs the entry model in Mazzeo's (2002) study. The model statistically tests a null hypothesis of homogeneous competitors against an alternative that measures the differential impact of heterogeneous competitors. In addition, the model isolates implications of differentiation that can be stated as two propositions:

1. Similar firms compete directly for the same customers, while differentiated firms do not compete as directly. Hence, otherwise similar economic markets (e.g., in terms of scale of economic opportunity) can support a greater number of differentiated firms than similar firms.
2. Different types of firms may earn different returns even when pursuing similar opportunities. Hence, the incentive to pursue a particular economic opportunity differs between firms that differentiate from each other.

Our research strategy is to isolate market situations in which behavior consistent with the two propositions is most transparent, if it arises at all. This choice leads us to measure the effects of cross-city differences in the microeconomic determinants of entry at a level of detail never previously done. We develop a near census of entry across as many markets as possible, extending the census into many medium and small cities. We trade off our extensive detail about every city with coarseness in the label for differentiated behavior. We cannot use the publicly available FCC (Federal Communications Commission) data about CLECs, which describes entry but omits the identity of the entrant due to confidentiality concerns. We also cannot use data about firms that make their data publicly available in 10Ks, which results in only partial samples. Instead, we construct a data set derived from NPRG, which publishes a biannual census on CLEC activity. These reports track CLEC entry at the city level (which is the appropriate market definition, since CLECs typically compete in geographically focused areas) and describe

the strategy of each CLEC in some detail. Ultimately, even these data only allow for systematic labeling of a rather coarse distinction among firms – namely, whether their service footprints are "local" or "national."[1] In recognition of its coarseness we place emphasis on demonstrating the feasibility and meaningfulness of this measure of differentiation. If when using such a measure, we find that product differentiation is important, then it is highly likely that differentiation occurs when CLEC heterogeneity strategies are specified at a more precise level of detail.

The volatile financial performance of CLECs raises challenges for our research goals. Our approach is to examine behavior just before and just after the period commonly known as "the telecom meltdown." We expect differentiating behavior to change over time in response to changes in economic determinants. Between 1999 and 2002 there were notable changes in (1) regulatory rules, (2) the opinions of investors about the presence of demand in particular locations and the viability of different modes of differentiation and (3) the stock market value of publicly traded firms in this market. We assess whether our conclusions about differentiation are sensitive to these changes in financial markets and investor beliefs, as well as to change in regulatory decisions over interconnection prices. We also ask whether differentiation in 1999 appeared to shape entry in 2002, if at all, and whether that influence is consistent with the premises of our model.

Our results demonstrate a central role for differentiated behavior. First, we reject the null hypothesis of homogenous product competition in entry behavior. We find that otherwise similar markets support more CLECs of different types than CLECs of a similar type. Second, we also find that different types of firms react differently to similar economic determinants of entry, such as regulatory incentives and demographic composition of demanders. These findings are important and robust: Heterogeneous services are as responsible for market entry as other demographic and regulatory factors. In addition, these quantitative results arise in 2002 as well as in 1999, despite the industry upheaval during the intervening years.

[1] In an earlier working paper (Greenstein and Mazzeo 2003), we also examined business-only versus business and home provision. Because we obtained similar qualitative evidence in favor of differentiation, we restrict attention to one dimension of difference and examine it over time and test for robustness.

Our study is primarily statistical in focus, but it also does inform policy. While our findings have no direct implication for rules about the interconnection between CLECs and ILECs, our finding confirm that these rules are significant for entry decisions and can have the scope to encourage or discourage the entry of particular types of CLECs into medium-sized and smaller cities. Furthermore, we conclude that the FCC's practice of measuring competitiveness by merely counting the number of firms can be grossly misleading. Our results provide implications about how entrants can differ and how and where consumers would value variety. Thus, a more appropriate checklist for measuring local competition should incorporate the types of services offered by each of the CLECs.

Finally, despite the considerable size and comparative novelty of CLECs, as well as the policy interest in understanding the consequences of the Telecom Act, there are few studies that document the competitive behavior of CLECs. We believe this scarcity is due to the inherent challenges of mastering the details of institutional settings, collecting relevant data and offering an appropriate framework for interpreting the data. Our research is an important contribution to this area of study, as it both illustrates how to overcome these challenges and yields significant insights into the competitive behavior of CLECs. [2]

II. The Economics of CLEC Market Entry

An empirical analysis of CLEC entry has three basic elements: (1) the size of local market demand, (2) the costs of entering and operating, including potential economies of scope across markets and (3) how demand and costs (elements 1 and 2) interact with the regulatory setting. A model of differentiation has those three elements, plus two additional insights: (4) when differentiation is possible, firms may prefer to enter in markets where their competitors offer different types of services; and (5) heterogeneous firms do not necessarily respond the same way to the same economic opportunities. In this section, we describe the implications of each of these elements. Because differentiation in offered services has not been addressed explicitly in prior

[2] These challenges are also quite distinct from the challenges found in applications elsewhere. For contrast, see Mazzeo (2002) on the motels industry, Dranove, Gron and Mazzeo (2003) on HMOs, and Danis (2004) on equity options markets.

empirical CLEC studies, we explain why it is an important consideration, while drawing connections with previous work.[3]

II.i. Local Market Demand for Vertically Disintegrated Firms

We follow the spirit of the New Empirical Industrial Organization on entry (Bresnahan and Reiss 1991, Berry 1992) and continue in the footsteps of Zolnierek, Eisner and Burton's (2001) study on CLEC entry. We hypothesize that CLEC entry behavior is shaped by the presence of fixed costs in the provision of local telephone service. Whether CLECs build their own facilities or lease part of their network from the ILEC, CLECs incur costs to set up and maintain the infrastructure needed to offer services. These fixed costs range from engineering costs to marketing expenses to costs associated with negotiating interconnection agreements. While some of these expenses may vary with the long-term size of the revenue stream, every CLEC incurs substantial fixed costs associated with initiating a previously unknown firm and maintaining the operations of an ongoing business.

The need to cover these fixed costs limits the number of entrants in individual markets. That is, because of the presence of fixed costs in each location where they provide services, CLECs require a sufficient level of variable profits — quantity of customers times operating margins — to cover their fixed expenses. Cities vary most notably in their size, which affects the demand for CLEC services. Operating margins may also be different across markets, particularly in cases where variable cost rates are influenced by local regulators. The level of competition within markets likely affects operating margins as well.

More precisely, if CLECs choose to enter by judging whether they expect variable profits to exceed entry costs, prices also must come into play. Standard models predict prices will be lower in markets with more competitors — this suggests that the market size (quantity) necessary to support additional CLECs will increase as the number of operating firms increases. Bresnahan and Reiss (1991) find such a pattern between entry

[3] Prior empirical work on CLEC entry includes Crandall's (2001), Crandall and Sidek's (2001) and Abel's (2002) studies, as well as the series of FCC (various) reports described above that provide counts of operating firms.

and market size in their study of several homogeneous service industries. Zolnierek, Eisner and Burton (2001) find similar evidence for CLEC entry.

Using our data set of CLECs, Table 1 illustrates a key part of this logic. Among the 716 cities where CLECs entered or made plans to enter as of 1999, over 400 have just one CLEC and over 600 have fewer than five; on the other hand, only 56 cities have ten or more CLECs and only 18 have twenty or more.[4] As expected, cities with larger populations have the largest number of potential entrants whereas smaller cities have the fewest.[5]

While suggestive, Table 1 alone is insufficient for understanding cross-city differences in entry. Market size differences based on population are augmented by measures of business activity. There are also differences across cities in the costs of providing CLEC services, including both fixed and operating costs. One source of such differences may relate to economies of scope. If two neighboring cities share economic infrastructure or have similar telecommunications demand, costs incurred by a CLEC entrant may be shared between the neighboring markets. For example, medium-sized cities near large metropolitan areas may experience more entry than do similar markets located further from a major urban hub.

More direct differences in costs may result from the regulatory environments in which CLECs enter and operate. Although the 1996 Telecommunications Act prescribed pro-competitive regulatory rules designed to foster market-oriented decision making for investment in local data and voice services, individual markets varied in how implementation of the rules affected competition between ILECs and local entrants. For example, Mini (2001) carefully documents that CLECs had distinctly different experiences depending on whether they were interconnecting with (1) Regional Bell Operating Companies (RBOCs), (2) GTE (renamed Verizon after its merger), or (3)

[4]Including CLECs that are planning service in particular cities constitutes the most optimistic assessment of CLEC entry possible. (We will subsequently precisely define *planned*.)

[5]In Table 1, average population size is calculated over all the cities within a category, that is, it includes all 18 cities with twenty or more entrants, all 38 with between ten and nineteen, and so on.

another independent telecommunications firm.[6] To the extent that such differences create different entry costs for CLECs, a location may be more or less attractive to CLECs.

There is also considerable evidence of differences in the way state regulators enforced prescriptions in the 1996 Telecommunications Act. For example, state agencies set varying wholesale prices within and across states that affected variable costs of interconnection. Other state regulatory agencies made it easy or difficult to become a seller or value-added reseller of services, such as those related to offering DSL. We work with the hypothesis that a state regulatory agency can make entry in particular cities more or less attractive for CLECs by affecting the fixed costs of entry as well as the variable costs of operating.

II. ii Entry, Competition and Product Differentiation

The previous discussion highlights a series of market conditions that potentially influence CLEC entry, either through market size or by raising or lowering costs. So far, however, the discussion has implicitly presumed that all CLECs offer the same services. If CLECs follow a model of customer-targeted differentiation, the competitive effects of additional entry could be altered. Prices will not fall as quickly with additional entry if CLECs offer differentiated products and if customers value the differences enough to pay more to the firm that more closely serves their particular needs.[7]

The differentiation between national and local CLEC illustrates this general principle. By 1999, the CLEC industry had two distinct types of firms on this dimension: Some CLECs entered in cities spread throughout the entire country, while others concentrated their operations in a more limited, local area. While the distinction between local and national CLECs is clear from examining the list of cities where they operate, these distinctions only provide meaningful product differentiation to the extent that

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[6] The RBOCs developed interconnection with entrants as part of a quid-pro-quo with the FCC, which sought to disallow entry into the long-distance market until the RBOCs complied with a series of tests for opening their local markets (Shiman and Rosenwercel 2002). In contrast, the non-RBOC incumbents simply made deals under the guidance of their local state regulators.

[7] In complementary work, Economides, Seim and Viard (2004) find evidence that CLEC customers pay a higher price than necessary given their calling plans and their *ex post* usage behavior. The authors interpret this as being partially the result of product differentiation among the CLECs — consumers are willing to pay more because they find particular CLECs to have higher quality for them.

customers find the two types of firms to be imperfect substitutes. In Table 2, we provide some examples of how local and national CLECs might differ in the minds of customers. In Column 1, we list and briefly describe important product characteristics of CLECs that have been highlighted by market analysts. In Columns 2 and 3, we provide examples of how the offerings of local and national CLECs might vary in terms of these characteristics; and we then indicate which kind of customer would be attracted to these offerings.

No matter how it is deployed, every CLEC has something in common with every other: Each offers telephone and related data carrier services, and, by definition, competes with the ILEC. In spite of these fundamental commonalities, CLECs and industry analysts cite particular features of firms that produce value for certain end users. In Table 2, we suggest ways that CLEC services might be tailored to customer needs and why local and national CLECs would potentially differ in the minds of consumers. To the extent that these chosen services generate a higher willingness to pay from their targeted customers, the differentiated CLECs would earn higher revenues. This in turn could affect market structure — there might be enough demand to support one CLEC aimed at large business users and another aimed at smaller business users in a city that could not support two identical CLECs.

To be clear, we are not interested in evaluating the veracity of the detailed service claims made by any CLEC in any particular city, nor in providing extensive detail about heterogeneity among local firms, or among national firms. In fact, our focus on differentiation *per se* is not novel. Academic studies and market analysts have highlighted a wide array of ways firms attempted to gain competitive advantages over rivals. For example, some CLECs chose to build their own facilities while others chose to rent from the ILEC at regulated rates and resell their lines to users (perhaps temporarily). As another example, some CLECs enter with a brand name and reputation developed locally in other services, while others enter with a brand name and reputation enhanced by national advertising or an existing distribution and servicing network. It is not our aim to describe a complete taxonomy of all potential strategies, since market analysts have already made considerable strides in doing so (see e.g., NPRG 2000, 2003).

Rather, our contribution to the literature is in examining whether differences in service offerings make any difference to entry behavior and quantifying that effect. For that purpose, we highlight one specific difference in service, namely, the geographic scope of offerings. This is an axis of differentiation that correlates with many other differences between firms and appears to be meaningful to employees, employers and regulators. Moreover, our methods are not rich enough to consider multiple axes of differentiation simultaneously.[8] Our goal is to show that differentiation matters for this specific axis; we cannot rule out that heterogeneity within the product types we define may also shape entry.[9]

Finally, product heterogeneity also elicits questions about the asymmetric influence of demand, costs, and the regulatory setting on differentiated CLECs. For example, different components of total market size may provide demand to one type of CLEC over another. Depending on their preferences, regulatory agencies might pass rules that result in lower costs or better opportunities for some CLEC types. It is an open question as to what firms such rules would comparatively favor — local firms with (pre-existing) business or political connections with the state regulator or national firms with larger in-house legal experience in regulatory proceedings. Our empirical framework will allow us to compare the effect of the various market characteristics that determine CLEC entry on the different types of firms.

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8 Nor it is clear to us that there is much to gain from considering multiple axes simultaneously. For example, local firms differ in whether they focus primarily on customers in dense urban settings or smaller "rural" settings, and each of these strategies differ in their competition-avoidance/confrontation behavior with national firms. Among the rural firms, moreover, more than half come with experience in rural telephone service in a nearby area, a form of branding with potential value, but only over a limited geographic range. Most of the national firms, in contrast, focus on urban environments only. Both national and local firms also differ in their bundling strategies, depending on their other lines of business. A small number of national and local CLECs, for example, also offer cable television. They propose to migrate their reputation into telephone markets and bundle bills for telephony with the cable bill.

[9]Our earlier draft also explored the difference between firms that focused exclusively on business and those that focused both on business and residential customers. While we also found evidence of differentiation along this dimension for entry in 1999, our findings for the difference between local and national were stronger and more robust. Hence, for exploring changes over time, we focus only on this axis of differentiation.

II.iii Inferences about Competition and Entry in a Period of Growing Demand

We infer the importance of differentiation from cross-sectional differences in entry behavior across geographically distinct local markets. This approach follows the modeling approach of empirical predecessors (starting with Bresnahan and Reiss 1991) who make equilibrium inferences from such a cross-section. As with these predecessors, sunk costs and changing expectations challenge the assumption of market equilibrium. In the CLEC market such challenges are particularly acute. Expectations and sunk costs may shape the exit and entry patterns of firms in ways that may interfere with unambiguous inferences. Though our approach follows prior literature, we must tailor it to the events that are specific to CLEC entry during the time periods we are examining. We now discuss the historical events and our specific approach.

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 in 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. This low continued through 2001 as the September 11 terrorist attack shook business confidence in long-term investments and into the spring of 2002 as the WorldCom financial scandal became publicized. Consequently, some CLECs continued their expansion, but with less publicity and fanfare. Others curtailed expansion plans they announced in 1999 and previous years. There were a number of publicized bankruptcies among national firms, as well as scores of exits by smaller firms, which led to transfers of assets between hands. All these events, including those in the CLEC market, were popularly known as the "telecom meltdown."

The fortunes of particular firms did not necessarily track those of the distinct local markets. Total revenues for CLECs continued to grow between 1999 and 2002, even while the financial markets provided (dramatically) lower valuations for those firms that were publicly traded. In addition, as we show below, entrants continued to spread to a greater number of new geographic areas than the number they exited from. Thus, the number of cities experiencing at least one CLEC entrant after 2002 was greater than that in 1999. While the number of CLECs did not necessarily increase, the amount of competition between CLECs and ILECs increased by every other available measure.

Such a heterogeneous set of experiences raises many more questions than can be answered in one article. Hence, our goals are specific. We begin the empirical section by focusing on differentiation in the cities that experienced entry. To increase confidence in our results, we analyze data from both 1999 and 2002, just before and somewhat after the meltdown. We examine each year's data to detect whether product differentiation – along the local versus national axis – shaped entry. If we had done such an exercise for a single cross-section (especially for CLECs in 1999) there might have been concern that miscalculations about the anticipated success of CLECs and the potential of pursuing particular forms of differentiation could influence the CLECs that enter and operate in the short run. In addition, our modeling approach requires that perceptions not be systematically different across areas of the country, since our identification strategy is based on cross-sectional differences in market structure. Either way, by revisiting the cross-section in a later period we can be more certain that our inferences are not based on transitory factors.

We conclude the empirical section with a brief analysis of how the market structure of cities changed over time. While most of the determinants of CLEC entry are stable over this short period, regulatory rulings and state decisions about interconnection pricing did change in many locales. Hence, we document these changes, and measure the sensitivity of entry and differentiated competition to them. Indeed, we find that these changes do affect entry behavior in important ways. Furthermore, we show that the sensitivity of entry to these changes cannot be understood properly without accounting for differentiated responses. In other words, regulatory rulings, differentiated competition and entry behavior are all interconnected, but the connection between these factors changes from 1999 to 2002. We examine not only how each factor affects the other, but also how their interaction changes over time.

Finally, if firms of one type prefer competition with those of a different type more than with the same type, then our modeling approach forecasts that market forces will give competitors incentives to respond. The response can take several forms, such as exit, change of type, or new entry. Here, we are interested in both *how* markets have changed and *whether* markets changed in a manner consistent with the importance of differentiated entry. For example, we find that markets with less differentiation in 1999

are less likely to be able to support as many operating CLECs by 2002, which provides further evidence of the long-term importance of product differentiation.[10]

III. Data

Our modeling approach uses two types of information:

1. We require cross-sectional information about CLEC entry. A census of CLEC firms operating in cities across the United States come from the 1999 and 2002 CLEC Reports, provided by NPRG (2000, 2003).
2. We also require cross-sectional information about the economic conditions for CLECs at these cities. Information about market demographics comes from the most recent U.S. Census data. Various studies of telecommunications regulation provide information about the regulatory environment CLECs face in each location.

III.i Sample Construction and the Endogenous Variables

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. Although 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. Indeed, our data indicate that CLECs have chosen to provide service in some cities within particular Metropolitan

[10] We leave to later work the task of specifying and estimating a fully dynamic model that examines why firms chose one type of mechanism – new entry, exist, or sale of assets to another – in some markets and another mechanism in another. Such a model is well beyond the scope of our research goals for this paper.

Statistical Areas (MSAs) and not others. 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.[11]

Similarly, the total size of the sample involves some trade-offs. We construct a sample of every city in the United States with at least one *actual* CLEC entrant in either 1999 or 2002, while dropping a few cities due to incomplete information. To help identify the margin between any CLEC entry and none, we include cities that were candidates for entry but had not yet experienced entry. For this purpose, we also include every city in the Untied States in which any CLEC expressed any *announced plan* to enter, even when these plans were several years in the future. This approach yields an additional set of cities with no actual operating CLECs in either year. Also, this provides us with a convenient stopping rule, since there is little statistical benefit from including each of the thousands of small isolated cities in the United States with little economic base for supporting CLEC entry.[12] As shown in Table 3, our sample construction guidelines generate a total of 1,183 city observations in the data set.

In Part A of Table 3, we summarize the firm counts in 1999 for 1,183 cities. The number in each box indicates the number of cities that have the corresponding number of operating and planned CLECs. Of the 726 cities with no operating CLEC, 467 also had no planned CLECs, which left 259 cities with only a planned CLEC entry. A total of 260 cities had just one firm operating, with the numbers getting smaller through ten or more firms operating. In the planned category, there was one planned CLEC in 315 cities (most of these were among the 259 cities with no operating CLECs) and the number of cities with CLECs in the planned category decreases rapidly across the table.

Part B of Table 3 contains similar data for 2002. It is clear from these data that despite the well-publicized market declines and bankruptcies in the period between 1999

[11] Our data set 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 data set.

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

and 2002, there was substantial expansion of the geographic reach of CLEC markets. By 2002, the number of cities with no operating CLEC had reduced to 317. Of these, there were only 263 cities with also no planned firms. In addition, the cities that had at least one operating CLEC had increased to 866. Many of these were cities experiencing new entry between 1999 and 2002, as 572 cities had one operating CLEC in 2002 (compared to 260 cities in 1999). This pattern continues as the number of operating firms increases. There were also more cities in 2002 as we compare the last column reading down in the two panels. We subsequently both analyze each year's sample separately and attempt to draw some inferences about the transitions of markets between 1999 and 2002.

Table 4 contains the raw data related to the CLEC market transitions between 1999 and 2002. The rows indicate the number of operating firms as of 1999 and the columns represent the transitions. For example, for the 78 cities with two operating CLECs in 1999, 22 had exactly two operating in 2002 as well, 27 had fewer and 29 had more. There is substantial movement in both directions – particularly considering the entry into and exit from the data set. These tallies do suggest that any inference made about a single cross-section would be more convincing to the extent that it were true in both time periods. While much of our analysis will focus on each cross-section separately, we will also attempt to find explanations for the market structure transitions over time.

To study differentiation among CLECs, we classify firms into discrete categories on the basis of how they vary in the geographic extent of their operations.[13] As was previously discussed, product characteristics associated with a CLEC's geographic footprint may attract different types of customers.[14] The NPRG data lists the complete set of cities into which each CLEC has entered. We label CLECs as *local/regional* if

[13] Analysts who have studied CLEC differentiation have also distinguished between CLECs that focus on serving business and residential customers (e.g., Crandall and Sidek 2001). We made similar inferences regarding product differentiation along this axis in previous working paper, but do not show it here. We also investigated differences between firms who also offer cable services and those who do not, but (in contrast to the attention it generated in the popular press) found such a strategy in less than 10 percent of the CLECs studied. Moreover, offering cable is orthogonal to the geographic extent of operations, so it simply goes into our error term and does not alter any inferences.

[14] We investigated differences in the strategies among local firms, with some focusing mostly on urban environments and others on rural environments. A high fraction of the latter had experience in providing telephony in regions near those where they entered. We inquired whether this heterogeneity among local CLECs was correlated with entry behavior vis-à-vis national CLECs, and found no large differences (except for the practically tautological point that local rural CLECs are in small towns and not large metro areas), so we do not highlight this below.

they operate completely within one city or a small number of contiguous states. Those operating in cities from multiple regions of the country are labeled *national*"[15]

In Table 5, we present the breakdown between national CLECs and the local/regional firms in each of the individual markets in the data set. (Note that for each year we only include the cities with at least one operating firm.) Here we see that the cities with fewer operating CLECs in 1999 typically contain predominately local/regional firms — for example, among the markets with one operating firm, that firm is a local/regional CLEC in about 75% of the cases. By 2002, there is more balance, as slightly more than half of the one-CLEC cities have a national as their one firm. As the total number of CLECs per city increases, however, there is a greater tendency for cities to be differentiated, with the same or close to the same number of each type of firm 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 in both years. This general pattern holds in markets with three or four CLECs as well. Overall, these data strongly hint at the presence of differentiation within markets in both 1999 and 2002. Our econometric model will allow us to explore the importance of product differentiation in the entry decision of CLECs during these two periods.

III.ii Economic Data about Localities

Cities will differ in their ability to generate the necessary demand to make CLEC entry attractive. 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 and measures of business activity, since CLEC services are often particularly valuable to business customers. *Population* is each city's population and *per capita income* represents the average income of the city's residents. The variable *payroll* 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.

[15] Note that national firms are much more likely to be larger publicly traded firms whose plans may have been influenced by the crash of the stock market bubble after 1999. Nevertheless, some firms that we label as *national* are smaller firms that only operate in the very largest cities, but they do so throughout the country.

Note that we obtained data for these demographic variables from the 2000 Census. Annual data are not available at this level of detail, and we would not expect the year-on-year changes in these variables to be large enough to appreciably affect entry decisions.

As was previously described, we hypothesize that CLECs may be 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 equal size. We include the dummy variable *city in a top-ten MSA* to represent those cities that are within the boundaries of one of the ten largest urban areas in the United States.[16]

We also examine differences across cities in the local regulatory environment. Abel and Clements' (2001) study provides us with a time-series of regulatory rules that states have used on ILECs under their jurisdiction.[17] For each state/ILEC combination, we counted the number of years (through 2000) that either a rate freeze or price cap had been imposed. Our summary measure of *regulatory stringency* is a collapsed version of this year count — regulatory stringency equals 0 in areas where these alternatives had never been used, 1 if they had been tried for between one and four years, and 2 if a freeze or cap was in place for more than five years. We hypothesize that a higher value of regulatory stringency indicates a regulatory environment in which there is a friendlier attitude toward experimenting with competition with the ILEC. This would translate into lower costs to an entering CLEC.

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[16] We confirm that the dummies were plausibly related to our proposed interpretation of scope economies by confirming that CLECs typically also operated in the central city of the suburbs they entered. Of the 381 CLEC observations within a top-ten MSA as of 1999, 333 of them also operated in the MSA's corresponding central city. We explored demographic variables related to density as well. Because 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. However, the density measures that we calculated (both residential and for businesses) did not provide additional explanatory power. It may be that density differences affect where CLECs operate within cities but not entry decisions across cities.

[17] 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.

Specific provisions in the 1996 Telecommunications Act require incumbents to provide interconnection access to CLEC competitors; however, RBOC firms that wanted to enter the market for long-distance services were precluded from doing so until regulators were satisfied that they 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 (2001), we include an RBOC dummy variable, *incumbent = RBOC,* to control for the differing incumbent incentives *vis-à-vis CLECs* across the markets.

Finally, local regulators prescribed the costs that CLECs were required to pay for access to the ILEC's infrastructure that was necessary for CLECs to provide service. Depending on the manner in which the CLECs operated, they would need different pieces of the ILEC's networks; regulators responded by setting separate piece-by-piece prices for so-called Unbundled Network Elements (UNEs). In many states, regulators experimented with UNE rates over this period; as a result, this is the one explanatory variable for which we use different values in the different years.[18] Specifically, we use the *UNE-Loop rate,* as this is the one UNE rate that is typically geographically de-averaged within states. The UNE-Loop rate is usually set lower in more densely populated areas — in fact, the differences within individual states is comparable to the difference across states — so using this proxy is necessary to isolate how costs may differ for CLECs on a city-level basis.[19] Our choice to employ this rate differs from other studies that have looked at entry and operational differentiation (facilities-based vs. resale). These studies have made comparisons at the state level, which permits more distinctions among the price of particular UNEs.[20]

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[18] A biannual survey by Gregg (2001, 2003) was used to determine the UNE rates over time. The survey's initial release was not until early 2001 – this is the best proxy we can use for the 1999 data. For the 2002 sample, we use the January 2003 release. Approximately 60 percent of the UNE rates were altered over this period.

[19] In Gregg's survey dated January 2002, the variance in the lower rate across the fifty states ($15.77) is only slightly higher than the average difference between the lowest and highest rates across the states ($15.15). The UNE-Loop rate is used as a proxy for CLEC costs in other studies, including Crandall, Ingraham and Singer's (2004). The density zones used for geographic de-averaging vary by state; data were matched to cities in the data set with help from Rosston and Wimmer (2001) and by inspection of ILEC websites.

[20] For example, Wood, Zarakas and Sappington (2004) find that the ratio between UNE-L and UNE-P

IV. Empirical Models of CLEC Entry

The empirical modeling approach we utilize fits into the series of "multiple-agent qualitative-response" frameworks introduced into industrial organization to evaluate entry strategies and market competition. Using a cross-section of markets as data, the econometrician infers the economic factors that contribute to the generation of the observed market structure. Firms' strategies can be represented by discrete decisions (e.g., enter/do not enter a particular market) that are made by evaluating the potential alternatives. Estimation is complicated by the fact that the decisions of competing firms may affect the returns to potential alternatives — for example, entry may be less attractive if other firms also have entered the market. A game-theoretic behavioral model is used to infer the factors influencing individual firm decisions from an observed market structure outcome, which is determined by the choices made by interacting agents.

IV.i Entry Models Assuming Homogeneity

Much of the industrial organization literature, as well as previous empirical papers on CLEC entry, have estimated straightforward limited dependent variable models of market structure. These studies typically estimate ordered probits with the number of firms as the dependent variable. The market factors that determine entry are inferred from a profit function that underlies the entry decision, such as

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

where m denotes the geographic market in question. 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 extent to which additional market participants make entry less attractive. The ε_m term represents the components of firm profits that are unobserved to the econometrician.

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prices explain state-level variation in the ratio of UNE-L to UNE-P access lines in that state. Similarly, limited geographic data on local retail prices prevents us from analyzing the effects of potential margins on entry, as Jamison (2004) does by focusing only on urban areas.

The parameters of this 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 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 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. The parameter values describe the relative importance of demand, cost and competitive factors in determining counts of operating firms.

IV.ii Extensions to Heterogeneous Markets

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), which indicates the number of observed firms of each type. In addition, there will be type-specific profit functions for these firms:

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

where the cost and demand effects can be type-specific and where we can allow the effects of competitors to vary on the basis of 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 entry of each type. 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:

$$\pi_A(A,B) > 0 \qquad \pi_A(A+1,B) < 0 \qquad \pi_A(A,B) > \pi_B(A-1,B+1)$$
$$\pi_B(A,B) > 0 \qquad \pi_B(A,B+1) < 0 \qquad \pi_B(A,B) > \pi_A(A+1,B-1)$$

Again, we estimate the parameters by maximizing the likelihood that the inequalities corresponding to each observed outcome hold across the markets in the data set.[21]

IV.iii Identification and Testing

By using cross-sectional differences in observed market structure, we can identify parameters describing the attractiveness of entry. This approach is best suited for analysis of small and medium-sized cities, because with many firms the marginal effect of additional competitors is likely to be very small. Consequently, we focus on measuring the key differences between cities that may become substantially more competitive with additional entry — places such as Buffalo, Little Rock, and Fresno. We believe that for policy purposes, these markets are quite interesting. Moreover, the costs of dropping a few larger cities from our data set are small. By our measures these cities will be very competitive no matter what the regulations for CLECs are (Woroch 2001).

Intuitively speaking, identification of differentiation comes from comparing otherwise similar markets with different structures or, conversely, 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. In other words, a particular market with insufficient demand to support two homogeneous firms may have enough demand for two firms that differentiate.

Recall that a conceptual profit function underlies the market structure observations—even though firms may have uncertainty about whether variable profits will exceed their costs of entry. To the extent that markets are not in equilibrium at the times of our analysis, we are more precisely measuring firms' expectations about profitability and how these expectations are affected by competition and differentiation. By separately estimating the market structure equilibrium before and after the valuation crash we can be more confident that our inferences are based on successful entry decisions rather than on misguided expectations about what would determine profits in this industry.

[21] Mazzeo (2002) provides proofs of the existence and uniqueness of the equilibrium that underlies the likelihood function for estimation.

Finally, it is appropriate to think of our classification as a maintained assumption. The framework does not measure whether our classification of differentiation corresponds with success at executing the strategies identified in Table 2, nor does it measure how highly users valued particular types of CLECs. Our null hypothesis is that firms enter without regard to the product type of their competitors; if we fail to reject the null hypothesis, we do so either because firms do not differentiate from their within-market competitors or because we have inappropriately classified the dimensions on which they differentiate. Such a failure to reject could arise, for example, if the distinction between resale and facilities-based CLECs is the only type of differentiation that matters *and* it is orthogonal to the classifications we do analyze. If we reject the null hypothesis, then we accept the alternative hypothesis that CLECs enter cities in such a way as to differentiate along the dimensions we classify.[22]

V. Empirical Results

To provide a comparison with earlier work, we begin our empirical analysis by estimating ordered probits whose dependent variables are the numbers of operating CLECs. Unlike the previous analysis of CLEC entry, however, we examine city-level markets. 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.[23]

V.i Baseline Results: Homogeneous Products

In Table 7, we present the results from two ordered probit estimations — one each for 1999 and 2002 .[24] The dependent variable, OPERATE, is a count of the number of

[22] Consistent with our earlier remarks about the potential presence of multiple axes of differentiation, to the extent that we reject the homogenous-competitor hypothesis here, we are likely to have a conservative estimate of the total market differentiation when ILECs are considered as well.

[23] As was previously mentioned, prior studies of CLEC entry used individual LATAs as the unit of observation. Each LATA may contain several individual city markets, as defined in our data set.

[24] This method of sample construction results in a wide array of cities – many with populations under 50,000 and some in otherwise low-density rural areas. Still, this is a fully random sample in the exogenous variables, so this method will bias the coefficients in Table 7 slightly downward, as compared to a sample that also includes even tinier cities in which no CLECs had plans to enter. Note also that our sample size

CLECs doing business in the city for each year. Note that we pool the data from the two years to constitute the sample, so that cities with zero entrants in 1999 include both the cities that have at least one planned entrant in 1999 as well as those cities that do not appear until the 2002 sample.

Starting with the 1999 markets, we see that population and the business variable, payroll, are positively correlated with CLEC entry, but the residential variable, per capita, income is not. These results are certainly consistent with the idea that initially CLECs were demanded more by business customers; in fact, CLECs may be an inferior good as far as local residential communications is concerned. We also find some evidence for geographic scope economies, as the dummy variable (city in a top-ten MSA) is positive and significant: In 1999, for an otherwise similar city, more CLEC entry occurred if the city was a suburb of a major city than if it were in an outlying location. The remaining parameter estimates relate to the regulatory variables. Contrary to expectations, additional CLEC entry was not more likely in areas where the incumbent firms were RBOCs – despite the potential benefit associated with facilitating competition in their service territories. The other regulatory variables did predict entry as expected, with more firms entering in cities where regulators had experimented with nontraditional forms of regulation for a longer period of time. In addition, the effects of the costs of interconnection were significant, as more CLECs were present in 1999 in cities where the UNE-Loop rate was lower. This result suggests the role that policy makers can play in inducing CLEC entry — a ten percent reduction in the UNE-Loop rate (from the mean) reduced the population needed to support an additional CLEC by just over 10,000.[25]

The results for the 2002 ordered probit indicate that the effect of most of the explanatory variables are the same as in 1999, with more CLECs entering cities with higher populations, with more business activity and in states with more friendly regulators and lower interconnection costs. The effect of per capita income is not statistically different from zero in 2002. There are two major differences in the analyses, however, both of which are striking. First, CLECs appear to have changed their strategy

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declines from 1,183 to 1,140, because we drop the very largest cities in the data set from our analysis.

[25]Using the data from Table 6 along with the estimates from Table 8, we compute: (0.026)*(1.63)/(3.62e-6) = 11,700.

regarding entering in suburbs of metropolitan areas, as the effect of the MSA dummy is now negative. Thus, CLEC entry occurs in cities in an outlying location just as often, if not more often, than in cities in a top-ten MSA. Additionally, entry has by 2002 responded as legislators had hoped with respect to the incentives for RBOCs to facilitate competitive entry. The positive and significant sign on the RBOC dummy indicates more CLEC activity in an otherwise similar city whose incumbent is an RBOC.

V.ii Product Heterogeneity Estimates

In the heterogeneous products analysis, 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 sixteen possible values. The information in Table 5 captures the variation in the dependent variable across all the markets in the data set.[26] 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:[27]

θ_{LL1} = effect of first local/regional competitor on local/regional CLECs,

θ_{LL2} = effect of second local/regional competitor on local/regional CLECs,

θ_{LN} = effect of national competitors on local/regional CLECs,

θ_{NN1} = effect of first national competitor on national CLECs,

θ_{NN2} = effect of second national competitor on national CLECs, and

θ_{NL} = effect of local/regional competitors on national CLECs.

The estimated parameters can be used to evaluate the null hypothesis of homogeneous competition. A strict test of that property is $|\theta_{LL1}| = |\theta_{LN}|$ and $|\theta_{NN1}| = |\theta_{NL}|$. We can reject the null in favor of a model of differentiated competition if we find $|\theta_{LL1}| > |\theta_{LN}|$ and $|\theta_{NN1}|$

[26] For example, there are eleven markets whose dependent variable is (2,1) in the 1999 data — two local operating CLECs and one national operating CLEC (Part A, Table 5). Cities with more than three firms in either category are treated as if they have exactly three in that category.

[27] 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.

$> |\theta_{NL}|$. Notice that in the absence of within-type heterogeneity, we would expect to find $|\theta_{LL1}| > |\theta_{LL2}|$ and $|\theta_{NN1}| > |\theta_{NN2}|$.

As in the probit estimations, the appropriate *X*-variables to include are either correlated with CLEC demand or entry costs in each market. The 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 data set. Consequently, a value of *X* equal to the sample mean becomes zero, a value above the mean becomes positive and a value below the mean becomes negative.[28] 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, we can say that differentiation is "economically important" if its effect on entry is as large as the effect of variance in other exogenous variables, such as city population and payroll, which are known to shape the number of overall entrants.

We present the results from the heterogeneous products analysis below and in Table 8. The estimated parameters indicate the impact on entry of each type of CLEC depending on market conditions and the competitors they face. For example, the constants indicate the baseline attractiveness of entry for each type. Each of the constants is below zero in Part A of Table 8 (because so many of the markets have no entrants as of 1999), but the relative value of the constants indicates that, all else being equal, a local/regional CLEC would be more likely to enter before a national CLEC, since $C_L = -0.4174 > C_N = -0.7391$.[29] These estimates reflect the entry data from the Part A, Table 5, where entry is weighted toward the local/regional firms. Since population and payroll have positive coefficients, larger values of these variables will offset the negative constants and predict entry. The relative size of these coefficients will affect the predicted product-type configurations.

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[28] 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.

[29] All the figures presented in this section represent predicted values. The comparisons between product types assume that values of the unobservables for both types are at their mean — zero. Directly evaluating the probability that one type's entry is more likely than the other's requires the standard errors of the parameters, as well as an assumption about the variance of the errors for each type.

For example, consider the population variable — the parameter estimate for both product types is positive, which indicates that larger cities attract more CLECs of either type. However, the estimated parameter is higher for the national CLEC than that for the local/regional CLEC. This indicates that as the population in a city increases, the relative attractiveness of entry for national CLECs increases as well. To illustrate how this can change market structure, suppose that in market *m*, the population is four times the sample mean. In addition, suppose that city in a top-ten MSA, RBOC and regulatory stringency are all set to zero, and the other *X*-variables are at their sample means. With no competitors, operating a national CLEC is now feasible and more attractive [π_N = -0.7391 + (1.386) *(0.6054) = 0.100] than operating a local/regional CLEC [π_L = -0.4174 + (1.386)*(0.2574) = -0.061].[30] As the value of each explanatory variable changes, entry becomes more or less attractive depending on the sign of the coefficient; and the more attractive product type will depend on the relative value of the coefficients. While the effects of the explanatory variables are relatively similar across types in 1999, it is interesting to note the strikingly different responsiveness of the two types to the interconnection rates in 1999.

The key result in Table 8 comes from the estimated competitive effects on CLEC type, as captured by the θ-parameters. The estimates indicate that the effects of competitors come predominately from same-type CLECs. We observe that the presence of a similar competitor makes entry unattractive (θ_{LL1} = -1.02; θ_{NN1} = -0.91) as compared to the presence of competitors of the other product type (θ_{LN} and θ_{NL}), which are estimated to be very close to zero. In addition, the second same-type competitor has a comparatively smaller effect than the first for both the local/regional (θ_{LL1} = –1.0222 < θ_{LL2} = –0.6047) and national (θ_{NN1} = –0.9704 < θ_{NN2} = –0.7885) CLECs. Lower margins typically result from lower market concentration; however, differentiating on the basis of geographic footprint appears to insulate CLECs from the effects of additional competitors. In fact, comparing the values of the θ and β parameters gives an idea of the market size trade-offs associated with product differentiation. A considerably larger

[30] With payroll four times the sample mean, the parameter estimate for income is multiplied by ln(4) = (1.386) to compute the prediction. The transformed value of an *X*-variable at its sample mean is zero; therefore, the other variables do not contribute to the prediction.

market — a standard deviation above the mean of the two main market size variables, population and payroll—is needed to support two national CLECs as opposed to one national and one local, for example.[31]

To assess the robustness of these findings to the recent industry upheaval, we performed the same analysis on the 2002 data, with the parameter estimates in Part B of Table 8. Notice first that the value of the constants is larger (since fewer cities have zero firms by 2002) and that their relative value is now skewed toward the national CLECs (mirroring Part B, Table 5). Most important, the patterns of the θ parameters have remained the same, namely, the effect of the first same-type firms is roughly double that of the second same-type firm, while the effects of different-type competitors is relatively negligible. The results for 1999 and 2002 taken together strongly suggest that entry was consistently more attractive for differentiated CLECs than for CLECs whose offerings were homogeneous. These findings are consistent with the baseline patterns that demonstrate a balance between the entry of each type in most cities.

Finally, it is interesting to note how the various market-level explanatory variables have changed between the 1999 and 2002 estimates. As was suggested by the ordered probit results, the estimates for population, payroll, and income were relatively stable. The reduction in the effect of city in a top-ten MSA was similar across the two types. Interestingly, the regulatory stringency variables appear to have a relatively greater impact on the national CLECs in 2002 than in 1999. This result appears both in the RBOC dummy variable – where the positive sign only appears for 2002 national firms – and for the UNE-Loop rate. Whereas in 1999 low rates tended to attract local/regional CLECs, by 2002 only the national CLECs see a negative and significant effect on this proxy for costs paid to ILECs. This has potentially interesting policy implications for regulators who want to attract particular types of firms and encourage more entry in general.

[31] Using the data from Table 7, we compared the value of the relevant θ coefficient with the sum of the two β coefficients times X-values of one standard deviation above the mean for population and payroll:$|-0.9703| < |(1.107)*(0.6054) + (1.468)*(0.2436)|$.

V.iii Evolution of CLEC Markets

We conclude this section with a brief look at the city-level transitions between our two time periods. While we analyzed the data from each year in the previous tables, we looked at each time period in isolation without making direct connections between 1999 and 2002 in individual markets. Here, we explore how the structure of CLEC markets has changed between 1999 and 2002. To avoid issues of selection, our analysis is limited to those cities where at least one CLEC was planned as of 1999. We classify these markets into three categories on the basis of the gross transitions: -1 if there were fewer operating CLECs in 2002 that in 1999, 0 if the number of operating firms is equal in the two years, and 1 if there was an increase in operating CLECs between 1999 and 2002. In Table 9, we present an ordered probit on this market structure change variable.

The first six variables in the table are the same market characteristics as were used in the previous analysis. The results are not surprising: Most have little impact on market structure change, because they affected the number of CLECs operating in each time period similarly. Only two of these variables seemed to influence transitions in market structure, namely, payroll and city in a top-ten MSA. There are increases in CLECs for more business-oriented markets and decreases for metropolitan area suburbs. Since we use updated data in the 2002 analysis, we are able to infer how regulatory changes in rental rates affected CLEC market structures. Most interestingly, the coefficient on the change in UNE-Loop rate is negative and significant, thereby indicating that cities where regulators lowered these rates over time saw growth in the number of operating CLECs as compared to cities where these rates remained the same or increased.

The remaining three explanatory variables in Table 9 are intended to capture how the condition of the 1999 markets affected the 2002 market structure. First, we found that stated entry plans predicted market growth (such plans appear to have been followed up) despite the industry upheaval between 1999 and 2002.

We also looked at predictions from the model by including the residual for each city from the 1999 ordered probit. A negative value of this variable indicates that the actual number of CLECs operating in 1999 was smaller than predicted and such cities were more likely to see additional CLEC entry by 2002. The results in Table 9 show the

forecast prediction. Markets that were out of equilibrium in the amount of entry – according to the model's estimates in 1999 – had a correction in the forecast direction.

Finally, we created a dummy variable 1*999 Undifferentiated* to identify markets that were unbalanced in 1999 with respect to the relative number of local/regional and national CLECs operating. For example, in cities with two operating CLECs, this dummy variable equaled 1 for those cities where both CLECs were the same type. All else being equal, we would expect such undifferentiated market structures to be less sustainable because the undifferentiated firms were more competitive with each other. The negative and significant coefficient on this dummy variable in Table 9 conforms with the basic forecast of our model for differentiation in 1999: All else being equal unbalanced markets tended to see fewer operating CLECs in 2002.

While these results fall far short of a true dynamic analysis of CLEC market structure, they do provide additional support for our interpretations regarding the importance of differentiation among CLECs. We show that in addition to shielding CLECs from competition in each period, differentiated CLEC market structures tend to remain more stable. We also find that despite the implosion in CLEC firms' values since 1999, the structure of CLEC markets has evolved in predictable ways over time. There has been more CLEC activity in cities where entry had been planned and where markets have not developed as quickly as expected by 1999. Finally, changes made by regulators have affected CLEC market entry, a factor that should be considered as regulators continue to deliberate over future changes to UNE rates paid by CLECs.

VI. Conclusion

We present strong evidence of a consistent role for product differentiation in building and expanding markets for local telecommunication. Both before and after the valuation crash that disrupted many market participants, CLECs followed entry strategies that resulted in markets with significantly heterogeneous product types instead of markets dominated by firms of one type or another. This pattern suggests that successful CLECs were mindful about the characteristics of their competitors. It also suggests that they entered markets where their types of services were more attractive to consumers (and regulators) and where such factors were important to their success. Indeed, we find that

CLEC heterogeneity shaped firm entry behavior as much as differences in local economic and regulatory conditions.

We conclude that the literature on competitive local telephony should continue to investigate the many issues raised by the demonstrated importance of heterogeneity. While our model has focused on competition among CLECs, it has implications for analysis of competition between CLECs and ILEC. Just after the passage of the Telecom Act, it was common to portray CLECs as a homogeneous group, sometimes as a "fringe" competitor to ILECs. Indeed, the FCC encourages such a portrayal when official reports present "counts" of entrants without distinction between them. This is potentially misleading. Our findings stress that there is no necessary logical connection between use of similar inputs and the similarity of two CLEC's appeal to customers.

In other words, treating all CLECs as homogeneous gives the potentially false impression that CLECs are close substitutes for each other in demand. This is an open empirical issue to be investigated, not a proposition about competitive behavior to be presumed without evidence. Individual CLECs may not be competing for the same sets of demanders. Even if CLECs compete for residual demand from former ILEC customers, these residual customers may have different concerns, encouraging distinct CLEC competitive behavior. Related, the assumption about homogenous competition implies that two CLECs place the same type of pricing pressure on the ILEC. Yet, the price elasticity faced by the ILEC for two sets of marginal users may be quite different if each set of users cares about different offerings from different CLECs.

In sum, our results show that product differentiation can play an important role in expanding competition in previously regulated industries. To this end, we document the value in distinguishing between local and national CLECs. We leave open the question about whether there are several other dimensions on which CLECs can differentiate that are also likely to be important.

Our results have implications for policy discussion. For a variety of reasons, it may be difficult for an ILEC to effectively serve all types of heterogeneous customers equally. By opening up such markets to competition, firms targeting customers may enter and serve these customers better. Our results are consistent with the view that CLECs did just this.

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 makers should not presume they know the formula for commercial success solely on the basis of observing ILECs and counting the number of incumbent CLECs. Instead they should identify CLEC strategies that differ from those of the ILEC and other CLECs, with the intent of encouraging firms that let consumers choose among an expanded array of options.

Table 1: Sample of Cities by Number of CLECs Operating or Planned in 1999

Number of CLECs	Number of Cities	Representative Cities	Average Population Size
20 +	18	New York, Dallas, Chicago, Atlanta	1,152,093
10-19	38	Cleveland, St. Louis, Tucson, Norfolk	633,735
5-9	54	Little Rock, Fresno, Madison, Omaha,	250,661
3-4	77	Bakersfield, Reno, Gainesville, Waco	175,596
2	91	Biloxi, Fargo, Kalamazoo, Naperville	87,727
1	439	Bangor, Bismarck, Champaign, Yonkers	48,835
Total	716	———	140,593

Table 2: Product Characteristics Associated with Geographic Differentiation Strategies and Potential Consumer Preferences

Product Characteristic	*National CLECs*	*Local CLECs*
Location Coverage: *Footprint of offerings may be tailored to multi-establishment users or to users in small number of locations.*	**Example:** Offer national footprint in many major cities and MSAs.*	**Example:** Offer service in local region only.
	Appeals to: Businesses with multiple establishments and offices in major MSAs	**Appeals to:** Users with one or small number of establishments in that geographic region.
Menu of Services: *Offering a specific combination of services may have value to a targeted group of users.*	**Example:** Give one source for all local, long distance and data communication and networking needs.	**Example:** Tailor contracts for local, long distance, and data communication and networking needs to the circumstances faced by the business.
	Appeals to: Geographically diverse business with managers who procure communications services from a single budget. They may need to monitor a standardized operation in many different locations.	**Appeals to:** Small users that (1) want a single local provider to learn their business needs and adapt to them and (2) do not need many extra services associated with running complex operations over diverse geographic locations.
Service Quality: *The CLEC may invest in equipment or maintenance organization for providing after-sale services.*	**Example:** Offer guarantees for communications operations over a large geographic area.	**Example:** Offer 24-hour high-touch service over a small geographic area for all networking needs.
	Appeals to: Large businesses that do not want to invest in in-house employees for this activity, are trying to manage multiple facilities and face large financial losses if its facilities go down.	**Appeals to:** Small businesses that do not want to hire an employee for this operation and that want to phone a trusted source that understands the nuances of its local business if/when urgent needs arise.
Advanced Data Services: *The CLEC may offer data services using many of the same facilities employed for voice services.*	**Example:** Offer Internet access in many places and offer to arrange for data transport between establishments in diverse locations.	**Example:** Offer Internet access at the establishment and arrange for traffic handoff with national ISP.**
	Appeals to: Large businesses that may want a standardized set of access points around the country for mobile national work force.	**Appeals to:** Small businesses that want Internet access from known and local provider with a reputation for high-quality services.
Billing: *Tailor prices to specific needs of customers.*	**Example:** Offer volume discounts for repeated communications between two geographically distant establishments.	**Example:** Explain many options for billing plans. Give the user options to change frequently.
	Appeals to: Large users with common communications demands between establishments.	**Appeals to:** Local users that want a flexible arrangement so they can change it frequently.

* MSA = Metropolitan Statistical Area
** ISP = Internet Service Provider

Table 3: Histogram of Cities: Number of Operating and Planned CLECs in the Market

A. 1999 Data

	Planned									
Operating	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7-9***	***10+***	***Total***
0	467	237	17	4	1	0	0	0	0	*726*
1	202	38	14	5	0	0	1	0	0	*260*
2	36	21	13	5	2	1	0	0	0	*78*
3	6	9	12	4	2	0	2	2	0	*35*
4	4	6	1	2	1	5	2	2	1	*22*
5	1	1	1	1	2	0	1	3	1	*11*
6	0	2	0	1	2	1	0	2	0	*8*
7-9	0	3	0	1	5	5	1	7	4	*28*
10+	0	0	1	0	0	1	1	9	11	*23*
Total	*716*	*315*	*59*	*22*	*13*	*12*	*8*	*21*	*17*	*1,183*

B. 2002 Data

	Planned									
Operating	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7-9***	***10+***	***Total***
0	263	54	0	0	0	0	0	0	0	*317*
1	549	21	2	5	0	0	0	0	0	*572*
2	102	15	1	0	0	0	0	0	0	*118*
3	31	12	1	1	0	0	0	0	0	*45*
4	14	10	1	0	0	0	0	0	0	*25*
5	11	5	3	2	0	0	0	0	0	*21*
6	3	4	1	0	0	0	0	0	0	*8*
7-9	14	16	4	4	1	0	0	0	0	*39*
10+	2	5	13	7	7	2	0	2	0	*38*
Total	*989*	*142*	*26*	*14*	*8*	*2*	*0*	*2*	*0*	*1,183*

Table 4: Transitions between 1999 Data and 2002 Data:

City Markets in 1999 Data Set		*Market Transitions by 2002*			*Total*
		1999 Operating > 2002 Operating	*1999 Operating = 2002 Operating*	*1999 Operating < 2002 Operating*	
Zero Operating	*Zero Planned*	——	36	431	*467*
	1+ Planned	——	173	86	*259*
1 Operating		96	102	62	*260*
2 Operating		27	22	29	*78*
3 Operating		7	7	21	*35*
4 Operating		6	0	15	*22*
5 Operating		0	1	10	*11*
6 Operating		3	1	4	*8*
7-9 Operating		4	4	12	*20*
10+ Operating		7	4	12	*23*
Total		*359*	*142*	*682*	*1,183*

Table 5: Number of National and Local/Regional CLECs per City

A. 1999 Data

	National CLECs				
Local/Regional CLECs	***0***	***1***	***2***	***3***	***4+***
0	N/A	63	5	3	1
1	197	35	10	3	2
2	38	11	9	3	2
3	11	6	4	1	6
4+	4	2	8	6	27

B. 2002 Data

	National CLECs				
Local/Regional CLECs	***0***	***1***	***2***	***3***	***4+***
0	N/A	294	44	6	6
1	279	55	18	11	13
2	18	12	8	9	19
3	10	3	1	2	15
4+	2	5	2	3	32

Table 6: Explanatory Variables — Summary Statistics

		Cities with at Least 1 Planned CLEC in 1999 (n = 716)		*Cities with at Least 1 Planned CLEC in 2002 (n = 920)*		*All Cities (n = 1,183)*	
Label		***Mean***	***Standard Deviation***	***Mean***	***Standard Deviation***	***Mean***	***Standard Deviation***
Population		140,593	257,666	122,174	230,621	102,563	207,712
Payroll		2,203,050	6,552,793	1,883,289	5,823,443	1,550,560	5,179,037
Per Capita Income		22,086	8,063	23,342	9,302	22,730	9,090
City in Top-Ten MSA		0.253	0.435	0.250	0.433	0.236	0.425
Incumbent = RBOC		0.726	0.446	0.797	0.402	0.757	0.429
Regulatory Stringency		1.152	0.688	1.198	0.639	1.161	0.674
UNE-Loop Rate		16.34	6.25	13.99	5.08	—	—

Table 7: Ordered Probits of CLEC Firm Counts

	A. 1999 Data			*B. 2002 Data*		
	Coefficient	***Standard Error***	***Z***	***Coefficient***	***Standard Error***	***Z***
Population	3.62e-6	5.74e-7	6.30	3.19e-6	5.54e-7	5.77
Payroll	2.33e-7	3.98e-8	5.86	2.64e-7	3.86e-8	6.84
Per Capita Income	-7.88e-6	4.67e-6	-1.69	3.02e-6	3.99e-6	0.76
City in Top-Ten MSA	0.292	0.094	3.11	-0.234	0.087	-2.67
Incumbent = RBOC	-0.034	0.091	-0.38	0.323	0.082	3.94
Regulatory Stringency	0.109	0.059	1.86	0.075	0.052	1.44
UNE-Loop Rate	-0.026	0.007	-4.01	-0.021	0.007	-2.98
Number of Observations	1,140			1,140		
Psuedo-R^2	0.1763			0.1372		

Note: Cities with seven or more operating CLECs in 1999 were excluded from the estimations for an easier comparison with the following analysis. All of the explanatory variables are the same value in both estimations, except for the UNE-Loop rate.

Table 8: Heterogeneous Products Model

		A. 1999 Data		***B. 2002 Data***	
Parameter		***Coefficient***	***Standard Error***	***Coefficient***	***Standard Error***
Effect on Local/Regional CLECs					
Constant	C_L	-0.4174	0.1167	-0.0605	0.1081
Local/Regional Competitor #1	θ_{LL1}	-1.0222	0.0456	-1.2079	0.0558
Local/Regional Competitor #2	θ_{LL2}	-0.6047	0.0739	-0.4888	0.0594
# of National Competitors	θ_{LN}	-7.10e-6	0.0002	-7.55e-6	0.0003
Population	$\beta_{L\text{-}POP}$	0.2574	0.0429	0.2510	0.0594
Payroll	$\beta_{L\text{-}PAY}$	0.1071	0.0319	-0.0225	0.0428
Per Capita Income	$\beta_{L\text{-}INC}$	-0.3002	0.1464	-0.0400	0.1411
City in a Top-Ten MSA	$\beta_{L\text{-}MSA}$	0.0814	0.0993	-0.5126	0.0995
Incumbent = RBOC	$\beta_{L\text{-}RBOC}$	-0.1173	0.0973	0.0407	0.0868
Regulatory Stringency	$\beta_{L\text{-}REGEXP}$	0.0906	0.0618	0.1145	0.0563
UNE-Loop Rate	$\beta_{L\text{-}LOOPRATE}$	-0.6355	0.1265	0.1430	0.1345
Effect on National CLECs					
Constant	C_N	-0.7391	0.1910	0.2320	0.1136
National Competitor #1	θ_{NN1}	-0.9703	0.0437	-1.303	0.0597
National Competitor #2	θ_{NN2}	-0.7885	0.0867	-0.5205	0.0567
# of Local/Regional Competitors	θ_{NL}	-4.31e-6	1.52e-6	-2.31e-5	0.0011
Population	$\beta_{N\text{-}POP}$	0.6054	0.0646	0.3136	0.0631
Payroll	$\beta_{N\text{-}PAY}$	0.2436	0.0487	0.2153	0.0513
Per Capita Income	$\beta_{N\text{-}INC}$	-0.0481	0.1853	0.1744	0.1387
City in a Top-Ten MSA	$\beta_{N\text{-}MSA}$	0.4129	0.1256	0.0625	0.0934
Incumbent = RBOC	$\beta_{N\text{-}RBOC}$	-0.1905	0.1273	0.2115	0.0962
Regulatory Stringency	$\beta_{N\text{-}REGEXP}$	-0.0721	0.0830	-0.1086	0.0602
UNE-Loop Rate	$\beta_{N\text{-}LOOPRATE}$	0.2510	0.1581	-0.4115	0.1458

Table 9: Market Evolution between 1999 and 2002 — Ordered Probit

	Coefficient	***Standard Error***	***Z***
Population	-3.51e-7	7.50e-7	-0.47
Payroll	2.87e-7	5.85e-8	4.91
Per-capita Income	2.94e-6	6.43e-6	0.46
City in Top-Ten MSA	-0.337	0.122	-2.76
Incumbent = RBOC	0.087	0.103	0.84
Regulatory Stringency	-0.077	0.068	-1.13
Change in UNE-Loop Rate	-0.027	0.011	-2.42
1999 Planned	0.386	0.058	6.66
1999 Operating Residual	-0.297	0.061	-4.84
1999 Undifferentiated	-0.447	0.181	-2.48

Number of Observations	673 total (at least one planned in 1999)
	139 = -1 (# operating '02 < # operating '99)
	307 = 0 (# operating '02 = # operating '99)
	227 = 1 (# operating '02 > # operating '99)		

Psuedo-R^2	0.1352		

Note: *1999 Operating Residual* is calculated using the ordered probit estimates from Part B, Table 7. A negative value indicates that the actual number of operating firms is smaller than the model would predict. *1999 Undifferentiated* is a dummy variable that equals 1 if the market is unbalanced with respect to the number of local and national firms operating. Specifically, if absolute_value (# locals - # nationals) is greater than 1, then *1999 Undifferentiated* is set equal to 1.

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