Paragons of Virtue? Competitor Entry and the Strategies of Incumbents in the US Local Telecommunications Industry

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Abstract

The Telecommunications Act of 1996 has opened hitherto closed markets to competitive local exchange carriers (CLECs). While a recent Federal Communications Commission (FCC) report on local competition documents vigorous entry during the past years, the market share of the entrants is insubstantial. We investigate whether the presence of new competitors influences the behaviour of incumbent local exchange carriers (ILECs) with respect to pricing, advertising and the extent of diversification that they engage in. This issue is explored empirically, using data for the major US local exchange carriers for the years 1994 to 1998. Our results indicate that the threat provided by market entrants has notably influenced the strategic behaviour of ILECs. The findings show that the incumbent US local operators, particularly the larger ILECs, aggressively protect their profit streams from traditional business. The evidence demonstrates that the ILECs have responded to the Telecommunications Act 1996, and to the threat of market entry it has created, through entry deterrence. This strategic behaviour has been successful in providing ILECs with protection of their monopolistic markets so far.

1. INTRODUCTION

The Telecommunications Act of 1996 has opened up hitherto closed local exchange markets to entry by competitive local exchange carriers (CLECs). Vogelsang and Mitchell (1997), in documenting the potential of CLECs to enter local telecommunications markets, suggest that these entrants have good prospects to gain extensive footholds in local markets. They can be strong competitors to the incumbent local exchange operators (ILECs). A recent Federal Communications Commission (FCC) report on local competition has further documented vigorous market entry during the past years. Yet, the market share of the entrants remains insubstantial. According to the FCC (1999) their presence was less than 5% of the local market, and the erstwhile monopolists still dominate their territories.[1]

The issue of how incumbent firms behave when faced with entry threats has attracted attention both in the economics[2] and management literatures.[3] For the communications sector there is no evidence of what firms do, and that is reasonable as the sector has only recently become competitive. We study what the US ILECs do when faced with potential entry threats. Specifically, we evaluate their reactions to the possibility of entry by CLECs. Do they

[1] In fact, the Telecommunications Act of 1996 provides a list of conditions that the regional Bell operating companies (RBOCs) need to meet in opening their markets before they can enter long-distance markets in their own region. This list of requirements has been meant to facilitate entry by CLECs to the local markets. However, the FCC has found this approach inefficient, since by December 1999 only one regional Bell company had met those conditions (Economic Report of the President, 2000). Since then, Verizon has been allowed to enter the long distance market in New York and Southwestern Bell Corporation has been allowed to enter the long distance market in Texas.

[2] A number of theoretical models (for example, among others, Dixit, 1980; Fudenberg and Tirole, 1984) as well as empirical studies (for example, a non-exhaustive list is: Bunch and Smiley, 1992; Schmalensee, 1978; Smiley, 1988; Thomas, 1999) describe firms' strategic behavioral patterns that can be adopted to deter entry.

[3] In that portion of the management literature dealing with issues of entry (See Swaminathan, 1998) an empirical stream of work has addressed the question of what motivates firms, both new and old, to enter particular industries or venture into new geographies? This stream of work has dealt with issues of scale, timing and choice of entry mode.

adopt deterrence strategies to preclude new entering CLECs from making a success of their endeavours? Or do their postures show a willingness to live and let live?

We explore the above questions empirically, using data for the major US local exchange carriers for the five years between 1994 to 1998. Prior to the 1996 Telecommunications Act most US local markets had zero or very few competitive entrants. Since 1996 there has been an explosion in the number of new entrants. Their number within the local exchange sector is increasing all the time. While the market share of new entrants is low, their increasing presence can influence erstwhile local monopolists' behaviour. We use data that cover periods both before and after the 1996 Telecommunications Act went into effect, and the context is appropriate in assessing ILECs' strategies.

The paper is organised as follows. In section 2 we discusses the context and some of the issues related to potential entry. In the next section 3 we provide details of the empirical analyses. We introduce the data, the variables and the econometric model. Thereafter, in section 4 we present results. In the final section, 5, we conclude the paper.

2. CONTEXT

2. 1 The Emerging Scene

The 1996 Telecommunications Act and the 1996 FCC Report and Order leads firms to enter the local telecommunications market in three ways. First, CLECs can purchase local service at wholesale rates and re-sell it to the end users. These CLECs can be classified as resellers. Second, they can lease various unbundled elements of an incumbent's network through co-location. These CLECs can be classified as service providers. Third, they can set up their own networks. This is facilities based competition, and these CLECs are classified as infrastructure providers.

We observe the following trends. Accessing the incumbent's network as a reseller has been a minor way to enter the local markets. Only 1.7 % of the total lines installed by ILECs

was subject to reselling at the end of 1998. Even less leasing of unbundled local loops has taken place, as only 0.2 % of the ILECs' loops have been leased. Conversely, the CLECs have concentrated on network building so as to provide infrastructure-based competition.

Take the case of fiber infrastructure building. These form the primary backbone over which local exchange competition is to take place, as the requirements for bandwidth increase because of increasing demands for voice and data applications. Also, the likelihood of media application increasing is very high. This provides a further impetus to broadband deployment. Between 1994 and 1998, the CLECs have increased their investments in fiber from 0.4 million to 3.1 million miles. Incumbents have increased their fiber network size from 9 to 16.1 million miles in the same period. The proportion of CLECs' fiber miles to ILECs' fiber miles has risen from 4.2 % to 16.1 %. The proportion has risen four times in four years.[4]

2. 2 Entrants' Strategy

In classifying CLEC entry strategies we use the niche width concept. Because major structural changes within an industry, such as the passage of the 1996 Telecommunications Act, lead to the creation of niches to be exploited by incumbents and entrants, it is useful to classify strategies based on the width concept. The term refers to the degree to which an entrant spreads its resources across the industry environment. If resources can be spread broadly across segments, so as to serve a mass market, then that is a generalist approach. There is the potential to eventually take on an incumbent head-on. If an entrant or a firm exploits only a narrow segment, then that approach is specialist (Freeman and Hannan, 1983).

[4] Other than competitive service providers, such as CLECs, that help make connections between customers and also provide access to the ILECs' networks, a number of other potential entrants can challenge ILECs' existing market dominance. These are: cable operators, electricity, gas and water utilities and railway systems that can help replicate both the trunk and local loop connections. These types of firms can provide two-way access that can lead to the eventual exacerbation of local competition, since the ILECs' hold over the last-mile bottleneck can be reduced. In fact, the acquisition by AT&T of its various cable assets is precisely predicated by this strategic rationale.

By and large, resellers and service providers that are entering the market can be construed as following specialist strategies. Resellers may not be offering new services, per se, since they buy ILECs' local services at a price lower than the final retail price and sell it to the ultimate customer. Their specialist strategy revolves around creating differentiated marketing packages that are targeted to specific segments. Correspondingly, infrastructure providers engaging in facilities-based competition that rely on the building of fiber optic networks adopt a generalist approach. The networks that are being put in place can be leveraged to provide a wide range of services to a large variety of markets.

These CLEC investments are still small compared to the total size of the US local telecommunications sector that consists primarily of copper-based facilities. Additionally, the building of fiber infrastructure is very costly. Thus, high cost levels impede the speed of infrastructure roll out. Yet, the ratio of CLECs' fiber capacity to that of the ILECs and the four-fold rate of increase in the magnitude of this ratio, show that the CLECs could become significant competitors in the future. If the fiber roll out patterns of the CLECs, rather than installed base size, are jointly considered along with future voice, data and media volume growth expectations we can construe that CLECs' strategic intent is to follow a generalist approach. This approach can help them compete across the product spaces that make up the telecommunications sector. Investments in physical networks are also potentially irreversible, and signal CLECs' commitment to the sector.

The case of MCI highlights our point. Even if the entrant starts operating in only a small part of the network as a specialist, as MCI did in the St. Louis to Chicago corridor in the 1960s, the capabilities are being built up so as to challenge the incumbent across the entire network. For example, MCI Worldcom has now evolved into a major player that can take on all competitors head-on. The present position of MCI Worldcom vis-à-vis AT&T is clear

evidence of this attribute. If it is necessary, MCI Worldcom on its own is able to serve the entire long-distance demand in the United States.

3. EMPIRICAL ANALYSES

3. 1 Model and data sources

In the light of the entry patterns displayed by CLECs, we expect that incumbents telecommunications carriers can respond strategically in at least three ways: (i) by appropriate pricing strategies, (ii) by advertising spending, and (iii) by changes in diversification patterns. Variations in these responses can either signal entry deterrence or accommodation. Accordingly, using three-stage least squares procedures, we estimate the following models to evaluate ILECs' reactions to CLECs' entry in their markets.

(1) $ACCESS\ PRICE_{it} = \alpha_0 + \alpha_1 ENTRY_{it} + \alpha_2 SIZE_{it} + \alpha_3 FIBER_{it} + \alpha_4\ DIGITAL_{it} + \alpha_5 TOLL\ SHARE_{it} + \alpha_6 ACCESS\ COST_{it} + \alpha_7 LABOUR_{it} + \alpha_8\ BELL + \alpha_9 YEAR + \varepsilon 1_{it}$

(2) $ADVERTISING_{it} = \beta_0 + \beta_1 ENTRY_{it} + \beta_2 SIZE_{it} + \beta_3 FIBER_{it} + \beta_4\ DIGITAL_{it} + \beta_5 BELL + \beta_6 BUSINESS\ LINE_{it} + \beta_7 YEAR + \varepsilon 2_{it}$

(3) $DIVERSITY_{it} = \gamma_0 + \gamma_1 ENTRY_{it} + \gamma_2 SIZE_{it} + \gamma_3 FIBER_{it} + \gamma_4 DIGITAL_{it} + \gamma_5 BELL + \gamma_6 BUSINESS\ LINE_{it} + \gamma_7 YEAR_{it} + \varepsilon 3_{it.}$

The empirical analyses are based on firm-level micro data from over 40 key US local operating companies for the years 1994 to 1998. These companies account for over 90 percent of the telephone lines installed in the United States. The key data sources are the FCC Statistics of Communications Common Carriers, the *Federal-State Joint Board Monitoring Reports*, and the report on *Competition in the Telecommunications Industry*. The *Statistics of*

Communications Common Carriers contain annual data on the financial and operating results of the key Class I telephone companies in the United States.[5]

The variables are described in table 1.

********** INSERT TABLE 1 HERE **********

3. 2 Strategy Variables and Expectations

We use three dependent variables to capture the strategic behaviour of US local telecommunications operators. These variables are: the relative level of access revenues earned by ILECs (ACCESS PRICE),[6] the relative level of advertising expenditures incurred by ILECs (ADVERTISING), and the relative extent of ILECs' diversification into other areas (DIVERSITY).

Access Price: There are no consistent statistical data concerning access prices available charged by the ILECs to CLECs for the time period. Therefore, we construct a proxy access price variable (ACCESS PRICE). This is the ILEC's access revenues divided by the inter-exchange carriers' (IXCs) total inter-lata access minutes terminated on an ILEC's network.[7] This serves as a proxy for the access charge rates that the ILECs are able to obtain from those seeking interconnection to their networks.

[5] The *Federal-State Joint Board Monitoring Report*, used for prior work (Majumdar, 2000), is now issued annually, from 1988 onwards to assess the implementation and impact of various regulatory changes that are taking place within the United States telecommunications industry. A report on the state of competition is now periodically prepared by the FCC. This report, *Competition in the Telecommunications Industry*, documents the rate of entry of new competitors in various segments of the telecommunications industry, and particularly provides details of what is happening in the local exchange sector.

[6] ILECs' retail prices to consumers are regulated. In a network industry setting, however, access to the final customer is critical. Since ILECs own the primary physical network capacity with bottleneck characteristics, entry can be deterred by the ILECs increasing the relative level of access charges. These charges are the prices that the CLECs have to pay to connect to the ILECs' networks to obtain connections to the ultimate customers.

Access charges paid by CLECs to ILECs, and vice-versa, are based on negotiations between each individual carrier. If agreements are not reached then the LECs are subject to arbitration proceedings by the state public utility commissions. Otherwise, there is no regulatory involvement in the price setting for access between ILECs and CLECs by either the FCC or state-level public utility commissions.[8] Conversely, access charges paid by inter-exchange carriers (IXCs) are subject to regulation by the FCC. There is a price band with a price cap that sets the ceiling for an ILEC's access price as well as a price floor. The existence of a price band allows the ILECs flexibility in setting of access prices to IXCs for the IXCs' calls to terminate on ILECs' networks.

Rationale for Proxy Use: The use of the access price charged by ILECs to IXCs serves as a proxy for strategic signalling to CLECs. While the ILECs have the ability to manage the regulatory process, the federal process dominates. For federal versus state regulation, the overriding principle is that of federal pre-emption. This says that the FCC can pre-empt state regulators, whenever inter-state communications are involved. State regulation can therefore only escape pre-emption either if the FCC does not want to pre-empt or if the intrastate part of communications is separable from the interstate part.

A number of boundary issues between federal and state regulation are dealt with in Federal-State Joint Boards, such as the one on Universal Service or one on cost separation. Any Federal-State Joint Boards (including those required by law) have only advisory functions, so that their recommendations do not bind the FCC. In spite of Federal-State Joint Boards, the division of labour between federal and state regulation has been contentious.

[7] Billed access minutes are based on bills sent to the interexchange carriers, and include total originating and terminating access minutes of use, including call set-up time, holding time, and conversation time.

[8] There is no mandated publication of access prices charged by the ILECs to of local service competitors CLECs and vice-versa unlike the publication of access tariffs for inter-exchange connections.

Most recently, this came out when a number of states sued the FCC's Local Competition Order, among others, for imposing costing rules for interconnection and for defining unbundled network elements. The U.S. Supreme Court, in 1999 [in AT&T Corp. v. Iowa Utilities Board], sided with the FCC on the matter of jurisdiction, stating that the 1996 Act gave the FCC special powers on matters of local competition. This meant that the FCC jurisdiction was extended by the 1996 Act to include some purely intrastate matters. [9]

Based on the above facts, a high access price obtained in the face of federal regulation can signal to CLECs that ILECs will charge as high a price as feasible, subject to the price band, to a CLEC or an IXC that wants to terminate calls on an ILECs' network. An ILEC can thereby use its current market power. It is an indication of how a local monopolist is currently behaving, and is likely to behave with other firms. A high access price in the face of entry is construed as non-accommodative. Conversely, a low access price charged to IXCs in the face of entry can be construed as accommodative.

Alternatively, because a CLEC provides an identical substitute service relative to the ILECs' service to an IXC, the CLEC could conclude that a high access price charged by an ILEC to an IXC is indicative of accommodative behaviour. Such behaviour also allows the CLEC to charge higher prices to an IXC for the IXC's calls to terminate on its network.

As Laffont and Tirole (2000) point out, all LECs are local monopolists in respect of their customers. Even if the customers have a choice of LECs with which to sign up, they normally sign up with one LEC. If a CLEC were to charge its customers a higher final retail price, because it has to pay higher access charges itself, then it could lose customers back to the ILEC or to another CLEC. Thus, a CLEC has the possibility of charging IXCs a high access price because the ILEC does so. Yet, the possibilities of charging its residential customers a

[9] We are grateful to Ingo Vogelsang for providing us these insights in a personal communication.

higher retail price is lower in spite of the CLEC being a local monopolist. Hence, a relatively higher price charged to an IXC by an ILEC will be a signal to a CLEC of entry deterrence behaviour by the ILEC.

The Access Pricing Variable and Expectations: A high level of access charges can reduce the ability of the future ability of CLECs to fund new investments in facilities or infrastructure. Conversely, if higher levels of access revenues are generated by an incumbent ILEC, if the CLECs do pay higher access charges, then these are expected to provide that ILEC with the wherewithal to fund new infrastructure investment (Laffont and Tirole, 2000). But, high access charges can have the effect of increasing new entrants' costs of the operations necessary in supplying services to final customers (Salop and Scheffman, 1982). Hence, new entrants' may not be able to lower prices to the ultimate consumer.

In a network setting where new entrants in local markets have very little share, as in the United States, high access prices are going to generate very limited cash flows for incumbents. Such a strategy by an incumbent does allow the entrant to not suffer access deficits, as more calls terminate on the entrant's network than are made from it. But this is at the cost of the loss of outgoing call volume that helps the entrant generate market share.

On the other hand, incumbents may wish to accommodate entrants, so as to gain revenues through increased calls passing through the system. Thus incumbents may set low access prices.[10] From the incumbent's perspective there are likely to be net access revenue gains. However, more important are the consumption externalities engendered when greater call

[10] In this sector, however, such an accommodative strategy with an emphasis on low price is contrary to the limit pricing model (Gaskins, 1971). According to that framework, a lower price might be intended to signal to potential entrants that incumbents are rivals with a cost advantage that gives them the ability to charge lower future prices. Given the availability of data with respect to ILECs costs, it is unlikely that there is any extant secrecy about the nature of cost advantages that they possess. Thus, a limit pricing strategy is not sustainable.

volumes flow through the networks. Indeed, a socially optimal access price encourages both incumbent and entrant to build market shares (Laffont, Rey and Tirole, 1998).

The Advertising Variable and Expectations: The ADVERTISING variable measures the annual advertising expenditures of the local telecommunications operators. The ILECs' access pricing strategies can be implemented in conjunction with marketing and service scope strategies. These strategies, again, may be either accommodative or deterrent in nature. High advertising and marketing costs are an indication of entry deterrence because that creates entry barriers by signalling high product quality, whereas changes in the extent and scope of activities carried out might indicate either deterrence or accommodation.

With respect to a high level of advertising and marketing costs, a large literature has evolved. The general proposition is that where a market is becoming presumptively competitive, from having earlier been monopolistic, there are significant spillover benefits to advertising. The benefits of advertising accrue to both the incumbents and entrants, as advertising tends to expand the size of the market. Concomitantly, in mature markets advertising by one firm will diminish the sales of another (Roberts and Samuelson, 1988).

As suggested by Sutton (1991), the following effect can take place. First, the fixed costs of operating an industry can rise for a new entrant, as it has to match expenses to generate volumes. Second, there are likely to be loyal repeat customers (Bunch and Smiley, 1992). Rather, in the telecommunications sector, where customer switching is relatively easy, there are likely to be customers who do not switch from one network to another rapidly. In other words, advertising can be used to strengthen loyalty or the bond between service providers and customers. The impact of this is to reduce the price elasticity so that ILECs' own customers are not swayed by competitors' price offerings. The literature provides empirical evidence supporting this type of strategic behaviour (Thomas, 1999).

The Diversity Variable and Expectations: We settle for measuring the extent of activity diversification of the ILECs as the ratio of miscellaneous revenues to total revenues (the DIVERSITY variable). This measure does not capture the extent of diversification that either an RBOC or a non-RBOC may undertake at the corporate level. It, however, does provide with us the necessary information as to how concentrated the ILECs are in their traditional telephony services area vis-à-vis venturing out into the allied areas of the telephony business they are permitted to under the present legislative dispensation.

As the number of firms within an industry environment grows, there is competition for increasingly scarce customers and resources, that then allows only the best suited to survive. Where competitive pressures increase as a result of increasing population density, an incumbent faces pressures to diversify. Conversely, as markets are progressively opened to competition existing firms can feel that they possess the skills required to operate in allied areas where they can leverage existing resources (Chatterjee and Wernerfelt, 1991). Thus, notwithstanding the competitive density increases which threaten the existing businesses of ILECs, increased diversification is a potentially useful strategy in the light of enhanced opportunities generated by the opening up of markets after the passage of the 1996 Telecommunications Act.[11]

The expansion by an incumbent into new areas can signify that other parts of the market also available to a new entrant will be made less profitable to enter in the future (Schmalensee, 1978). By making the move into a new area, the incumbent pre-empts future entry into that area. The incumbent also attempts to preserve its share of overall industry

[11] We would use the concept of changes in product space (Schmalensee, 1978) if that was feasible. For the period that we study, there are restrictions on the ILECs' ability to offer any services other than local and intra-LATA long distance telephony services. Thus new telephony service offerings are not a feasible strategic option. Hence we use the ILECs' ratio of non-telephony to total revenus as a measure of diversification. Heavier regulation restricts

profits, provided it cannot withdraw its new products easily (Judd, 1985). If the incumbent can do so, then the signal to protect its new area of activity is not strong.

On the other hand, the ILECs may want to aggressively protect their primary profit streams, which still generate substantial rates of return, by concentrating on the traditional telephony businesses. Increasing densities of competitors require that attention is paid to market preservation. These activities require additional resources. Given additional resources required, diversification activities can be truncated to retain the necessary resources. While first mover advantages can accrue to ILECs contemplating diversification, there are also the costs of pioneering for the incumbent contemplating such a strategy. The possibility of incurring such costs can lead to a cut back on diversification efforts and a retreat to the core.

3.3 Explanatory Variables

The primary explanatory variable we are concerned with is ENTRY. This variable describes the number of local service competitors identified in the market area of an operator. In the case of the ILECs operating in several states we calculate a weighted entry variable as follows: (Σ S*number of competitors in state *i*)/number of states where an ILEC operates, where S = total revenues in state *i*/total revenues.

The identification of local service competitors is based on the assignment of numbering codes in each state. A company with a reserved code does not necessarily compete as yet with the incumbent operator. However, if a company that has reserved a numbering code does not activate it within one and a half years, it will forego the reservation. Thus, for practical purposes the possession of a reserved code signifies intent on the part of a local service competitor to compete. Given that the market share of entrants has remained

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diversification possibilities for the RBOCs. They are not allowed, for instance, to enter the market as Internet service providers.

insubstantial, this variable describes the threat of entry rather than the actual extent of competition that is taking place.

3. 4. Firm Level Controls

Size: The first key control variable is for firm's size. The log of total revenues, as in much of the literature, measures firms' size (the variable SIZE). Firms' size is an important variable (Chhibber and Majumdar, 1999) and the SIZE variable enters each of the three equations for a variety of conceptual and empirical reasons. First, size can be construed as a correlate of market power. Therefore, it is important to assess whether the relatively larger ILECs seek to encourage or retard entry by using access pricing as a strategic weapon.

Next, since the advertising variable is not expressed in relative terms, the SIZE provides a scaling factor for advertising expenditures in equation (2). Larger firms have a greater pool of capabilities and resources that can be profitably deployed in other areas. Therefore, given received wisdom in the area of diversification research, the larger ILECs may seek to diversify away from their core telephony business since there may well be excess resources that can support such a strategy. This issue needs to be empirically ascertained.

Technology: The stage of technological development of an incumbent's network critically affects its business strategies. We use the following two variables to measure ILECs' technological advancement. These are: (i) the number of main digital access lines (DIGITAL) and (ii) the kilometres of fiber optic cables deployed by the operator (FIBER). These technological factors affect not only the costs of providing services, and thus access pricing, but they also critically influence the types of services that can be provided via the communications network.

Those incumbents owning extensive and modern network facilities can employ different business strategies relative to other local companies. When this is the case, we expect that the fiber optics and digital line variables, the advertising expense variable and the diversity

variable be substantially correlated with each other. The DIGITAL and FIBER variables are also endogenous because they directly depend on the local operators' strategic decisions as to the investments that they make in new technologies. In estimating our econometric model we take this endogeneity into account (see the subsequent discussion on this topic in section 3.7).

3. 5 Context Related Factors

Regulatory Issues: There are a number of context-related control variables that we need to incorporate. First, access prices can be a function of the relative importance of inter-state long-distance calls as an income source and thus the tightness of federal regulation. The TOLL SHARE variable that denotes the share of inter-state long-distance calls to total calls controls for this aspect.

We expect the TOLLSHARE variable to be negatively related to the ACCESS PRICE variable. The rationale is as follows. Toll calls made by ILECs' customers cross both inter-sate and intra-state boundaries. Inter-state calls are subject to FCC jurisdiction while the intra-state calls are subject to the jurisdiction of the state public utility commissions. The access price, captured by the ACCESS PRICE variable that we use as our strategy variable, is subject to FCC jurisdiction. The expectation is that if the level of an ILEC's inter-state toll calls is higher, then federal level regulation is likely to be tighter. This will result in a lower level of access prices.

Cost Issues: Next, we expect that the relative costs of access incurred by an ILEC and costs of labour compensation are important factors influencing relative access prices. The relative level of access costs paid by the ILECs themselves for interconnection is going to influence ILECs in their attempt to generate greater access revenues. The largest amount of controllable costs incurred by ILECs are on employee compensation. Where these are relatively high then ILECs will attempt to generate greater relatively access revenues so that cash flows are readily available to meet expenditures. These two constructs are measured,

respectively, by the variables ACCESS COST, which is measured as access expenses incurred by the ILECs divided by the number of access lines, and the variable LABOUR which is measured as total labour compensation paid divided by the number of employees.

Demand Issues: We also control for the relative importance of business customers to an ILEC by the BUSINESS LINE variable. This variable is ratio of the number of business lines to the total number of telephone lines. It is a potentially important variable since the composition of demand can influence advertising and activity extent choices of the incumbent operators. The larger the number of business customers in the network, who are the most susceptible to bypass efforts by CLECs, the greater the promotion efforts that will be undertaken to hold on to these customers. Additionally, the exogenous growth that takes place in call volumes can lead to the level of relative diversity either getting smaller over time or staying stagnant. The BUSINESS LINE variable helps control for some of the exogenous growth that can affect the DIVERSITY variable.

Other Issues: The other control variables used in the estimated system of equations comprise a dummy variable for the Bell operating companies (the variable BELL) and a dummy variable for each sampled year, except the base year 1994 (that is, for the years 1995 to 1998). The time variable is also of considerable importance in our empirical assessment. Since 1996 there has been a structural break in the institutional environment of the ILECs. Thus, the magnitude, sign and significance of the coefficients preceding the year 1996, as well as thereafter, shed insights as to how behaviour changes as a consequence of the institutional changes that are in progress.

3. 6 Econometric Issues

Simultaneity and Endogeneity: There are several issues that arise in the estimation of the relationships. First, the strategy choices that the ILECs make are likely to be made in conjunction with each other. Access pricing considerations at the ILEC level are subject to

considerable regulatory constraints. Regulatory constraints retard revenue growth. Other means are necessary to lessen this constraint on revenues. Thus, advertising and service diversity issues figure in the ILECs' menu of choices as factors that can help lessen this regulatory constraint.

Access pricing, advertising and diversification decisions are not made independently of each other. Concomitantly, there are likely to be various unobserved firm-specific features of ILECs, their competitive environment and consequent strategies that are related to each other at each point in time. Hence, it is quite plausible that the error terms of the equations for the price strategy and non-price strategy choices are correlated with one another. Therefore, to achieve efficient estimates, it is necessary to estimate the equations for the three dependent strategy variables simultaneously and allow the error terms for each of these equations to be correlated with each other.

Next, while technology quality is an explanatory variable influencing ILECs strategies, technology investment decisions are inherently strategic. Firms can compete on price and non-price variables. We factor in non-price variables such as advertising and diversity in our empirical models. In the literature, competition via the use of capacity is one of the two classic stylizations of firms' behaviour, the other way to compete being through the use of prices. Since the augmentation of ILECs' networks through fiber-optic and digital technologies reflect the enhancement of capacities, there is a clear necessity to take into account possible endogeneity effects for the technology variables. Thus, the FIBER and DIGITAL variables are input market factors that are treated as endogenous in our estimation.

Instruments: We use all the predetermined and exogenous variables, and the constant term, as instrumental variables in the system of estimated equations. The ACCESS COST, LABOUR and TOLL SHARE variables, that are used as exogenous variables only in the access price equation, also serve as instruments in the equations for advertising and diversity.

This is reasonable as the cost and demand structure of an ILEC can have an indirect influence also on its non-price strategies.

However, the ACCESS COST, LABOUR and TOLL SHARE variables may imperfectly measure ILECs' cost and demand structure. The instrumental variable measuring the relative importance of business customers used as an exogenous variable in the advertising and diversity equations may further capture demand and cost variations. This may reduce the potential bias of the estimates caused by the imprecise measurement of costs and demand. Thus, the BUSINESS LINE variable serves as an instrument in explaining variations in access prices. In addition, we use an additional instrument variable for each of the equations. This is a dummy variable taking on the value of 1 if the market of an ILEC has one entrant or more, and 0 otherwise; that is, if there are no entrants. This variable captures a critical factor influencing ILECs' strategic behaviour, whether or not its market area has been entered.

Estimation: The above empirical complexities motivates the use of a simultaneous three-stage least squares (or 3SLS) instrumental variable method, in which part of the explanatory variables may be pre-determined and all the parameters of the model are estimated jointly (see Berndt, et al., 1975). These 3SLS estimates are consistent and asymptotically normal, and these asymptotic properties are equivalent to that of the full information maximum likelihood estimator (Judge, Hill, Griffiths, Lutkepohl and Lee, 1988).

The 3SLS estimation method first involves a procedure similar to two-stage least squares method and each equation of the system is estimated separately. This means that in the first stage, the two endogenous variables of a system of three simultaneous equations, DIGITAL and FIBER, are regressed as a function of the matrix of instrument variables (see discussion about instruments above). Then, the DIGITAL and FIBER variables are replaced by their fitted values that are received from the first-stage regressions and each equation is then

estimated by OLS. The third step of the 3SLS method is the GLS estimation of a multivariate regression (i.e. SUR estimation).

The instrumental variables are common to all of the equations presented above. We employ the White heteroscedasticity correction procedure (White, 1982). This allows us to make the necessary corrections for heteroscedasticity of disturbances that are of an unknown form. Serial correlation of the disturbances across years is taken into account by estimating the model with the first-order autoregressive or AR(1) disturbances.

4. RESULTS AND DISCUSSION

The descriptive statistics for the important variables are given in table 2. The primary 3SLS estimates for each of the three dependent variables are given in table 3. Secondary estimates are given in table 4. We initially discuss the patterns that are displayed by the descriptive statistics.

********** INSERT TABLE 2 HERE **********

4. 1 Descriptive Statistics

The data in columns (1) and (2) of table 2 show substantial variation among the key variables of interest. The coefficients of variation for the ACCESS PRICE, ADVERTISING, DIVERSITY and ENTRY variables are 0.451, 1.598, 0.584 and 1.405 respectively. That the variations in the ACCESS PRICE and DIVERSITY variables are not as substantial as the variation in the ADVERTISING variable is understandable. There is regulatory oversight over the activity dimensions these two variables capture. Conversely, where ILECs have greater discretion in undertaking their activities, as in advertising, the variation between firms is greater. Also of considerable interest is the fact that the entry threats facing ILECs, as captured by the variation in the ENTRY variable, vary a great deal.

Columns (3) to (7) of table 2 show the year-by-year trend among the variables. Several features are of interest. First, the average access price is steadily decreasing over time. It

drops from 6.7 cents per minute in 1994 to 5.7 cents per minute in 1998. Second, the percentage of non-telephony revenues of the ILECs, as captured by the DIVERSITY variable, is also decreasing over time. It falls from 13.634 percent in 1994 to 6.212 percent in 1998.

Third, the ENTRY variable shows a substantial increase in magnitude. In 1994 it is 0.396. It reaches the value of 3.234 by 1996, but jumps to 7.224 in 1997, the year after the passage of the Telecommunications Act 1996, and then attains a value of 9.995 in 1998. Within a short space of time, the ENTRY variable has increased over 10 times in magnitude. These data are evidence that the enhancement of the competitive process in the local telephone sector is having an impact in attracting entrants to the sector.[12]

4. 2 Primary Regressions Results

The primary regression estimates follow next in table 3.

********** INSERT TABLE 3 HERE **********

Access Price Equation: The results for the ACCESS PRICE variable are given in columns (1) and (2) in table 3. As both these columns show, the threat of entry, per-se, as captured by the ENTRY variable, does not significantly influence ILECs to seek either a higher or lower level of access charges. Though negative, the magnitude of the ENTRY variable is just too small to be of any consequence. The magnitude of the variable implies that a doubling (100 percent increase) in the average number of entrants in ILECs' territories will lead to a –0.3 percent decline in the average access price. However, the standard error of the estimate is very high. Therefore, no conclusions are drawn at this stage as to whether entry threat does influence the seeking of higher or lower access prices by the ILECs studied.

What we do note, however, is that the larger ILECs enjoy a higher level of access charges. The magnitude of the SIZE coefficient is large, at 0.470, and it is very highly significant (t statistic 7.505). This result indicates that some of the larger ILECs might exercise power and

enjoy higher prices. The larger ILECs can enjoy scale economies, and these scale economy benefits reflect themselves in efficiencies that help lower prices. Thus the variable ought to be negative. The evidence that some ILECs, instead, seek to enjoy higher access prices can be construed as the outcome of regulatory gaming.

The FCC regulates LEC inter-state access charges, whereas the state public commissions regulate intra-state access charges. However, these two modes of access are alike, and cannot be distinguished even for incoming calls (Vogelsang and Mitchell, 1997). This can provide ILECs an opportunity to leverage the more favourable jurisdiction. Larger ILECs have large economics staffs and can utilize regulatory management competencies to play off state versus federal regulatory authorities in obtaining higher access prices.

Two other significant variables in column (1) of table 3 are FIBER and BELL. The FIBER variable is positive while the BELL variable is negative. A primary investment area for both ILECs and CLECs is in broadband fiber networks. The need for ILECs to invest in these networks reflects itself in a propensity to charge higher access prices. Higher revenues from access charges can generate funds to support high levels of infrastructure investments.

We find that of the other significant variables in the access price equation the TOLL SHARE variable is negatively related to the ACCESS PRICE variable. There are two possible explanations that we advance in respect of this finding. If the level of inter-state calls originating from an ILEC's network is higher than average, then greater attention is likely to be bestowed on the carrier by the FCC. Then, the FCC might influence the ILEC to not raise the level of its own access prices. Second, the higher the level of inter-state toll calls (as denoted by the TOLL SHARE variable) that are made from an incumbent's network, the higher the level of presumptive access charges that an ILEC will itself have to pay for call termination. If the level of such call termination charges increase, the ILEC can incur an

[12] Their share of the market is, however, very small.

access deficit. Therefore, to counter-balance an access deficit it is in the ILEC's interest to seek a lower level of access charges from other firms that seek interconnection with it.

With a lower access charge the final retail price of the call originating carrier is not raised. Given a reasonably high elasticity of demand for services, a lower retail price can generate higher calls from a call originator's network, and this increases the total amount of the access charges that another firm pays the ILEC.

Conversely, we find the ACCESS COST variable to be positively related to ACCESS PRICE. Thus, the ILECs which do actually incur higher access charges seek to recover these from other firms via a higher level of access charges on calls originating from them but terminating on the ILEC's network. The negative dummy variable for the RBOCs is related to the fact that the RBOCs as a group face tighter regulation than the other ILECs. This asymmetry in regulation provides pressure on them to charge relatively lower access charges.

Advertising Equation: The results in respect of the ADVERTISING variable are given in columns (3) and (4) of table 3. For the ADVERTISING variable, we find that the ENTRY variable is positive and significant (t statistic: 2.101). When faced with the threat of entry, ILECs do respond strongly and raise the levels of their advertising expenditures. While the size of the coefficient estimate is 0.040 which suggest that a 1 percent increase in the number of entrants is associated with a 0.04 percent increase in advertising expenditures, the results have to be evaluated with respect to the number of entrants. The average number of entrants in the panel data set is 4.4. Thus, if the average number of the number of entrants were to increase to 9, this would result in a 4 percent increase in ILECs' advertising expenditures.

The higher levels of advertising noted have several implications. By enhancing customer lock-in, increased advertising expenditures can tend to make the market more difficult for the CLECs to enter. Where existing ILEC customers have the propensity to switch networks, given the presence of a number of new entrants, then a higher level of advertising by the

ILECs can make the acquisition of these customers by new entrants difficult as the loyalty threshold of customers is raised. Additionally, as Shaked and Sutton (1982) have suggested, price competition is relaxed when there is product differentiation, and the enhancement of advertising expenditures can help the ILECs to differentiate themselves from the CLECs.

Of course, increased advertising expenditures incurred by the ILECs can increase the size of the total market for both ILECs and entrants as a whole. This process of increasing the market size is useful for the subsequent diffusion of other communications services, as customer education is enhanced. Also, the building of a brand name is useful when the ILECs' enter into the long-distance segment. Nevertheless, the new entrants may have to increase their own levels of advertising expenditures if the loyalty effects are simultaneously strengthened. Thus, new entrants' costs of entering the domain of the ILECs are increased.

Given that we identify new entrants as adopting a generalist strategy, oriented towards infrastructure-based competition, if the resultant costs of entry do go up then market attractiveness for the CLECs diminish. The market expansion possibilities can, however, outweigh such entry cost increases. Whether or not such a phenomenon happens is worth further research. The finding that ILECs raise their advertising expenditures given the threat of new firm entry prima-facie indicates an aggressive stance adopted by the incumbents.

Among the control variables, we find the SIZE variable to be significant as it is a scaling variable in the ADVERTISING equation. But the magnitude of the SIZE variable, at 1.122, is over unity. Thus, the larger ILECs spend proportionately larger amounts on advertising. This result has considerable implications, and has to be reviewed in conjunction with the sign and significance of the SIZE variable in column (1). Taking both sets of results into account, we find that the large ILECs not only attain higher access charges, but spend proportionally more on advertising to retain their customers and market position than a smaller ILEC.

Finally, we observe that the larger an ILEC's fiber optic as well as its digital network, as captured by the FIBER and DIGITAL variables, there is a statistically significant and negative relationship with advertising spending levels. This finding implies that the ILECs possessing a greater installed base of fiber optic and digital networks are less aggressive in advertising.

Advertising and the building of fiber and digital networks are examples of strategies to enhance the capabilities of network operators in an era of open competition. All these activities are, however, long-term investments requiring very large sums of money. The ILECs have built proportionately less fiber capacity than CLECs in the period studied. The ILECs have also other types of investment to make, relative to CLECs who principally build broadband networks. It is likely that advertising expenditures substitute for other items of capital spending at the present time. Since ILECs have larger networks an effective strategy is to enhance customer loyalty so that the large installed base can be better utilized.

Diversity Equation: Columns (5) and (6) of table 3 show that both the ENTRY and SIZE variables are negatively and significantly related to the DIVERSITY variable in the equation. The higher the presence of potential competitors and the larger the firm, the greater is the reduction in non-telephony activities. Again, these are important findings implying that in the face of entry threats ILECs protect their core business area. The magnitude of the ENTRY variable implies that a doubling in the average number of entrants is associated with almost a 5 percent drop in the diversified activities ratio of the ILECs. Similarly, the magnitude of the SIZE variable implies that for every 10 percent increase in the size of an ILEC there is 1 percent drop in the ratio of non-telephony revenues to total revenues from other activities.

Given the prospective voice, data and media uses that networks can be put to, the ILECs might perceive that the opportunities in their traditional line of business can be quite substantial. Therefore, the core business areas need protection from competition. Hence, faced with increases in competitive density that CLECs' presence can bring about, the ILECs

are behaving aggressively. By cutting back on diversification efforts ILECS are signalling intent to protect their primary area of business activity.

The negative sign of the SIZE variable merits a further comment. Received wisdom in the field of diversification research (Chatterjee and Wernerfelt, 1991) suggests that larger firms have greater stocks of capabilities that can be profitably deployed in other areas. These diversification efforts lead to the acquisition of further capabilities. Their benefits can be leveraged back into the original business activity. Therefore, diversification efforts may turn out to be beneficial for the firm as a whole. The benefits are commensurately greater for a larger firm.

Our data suggest that the opposite effect is at play. By cutting back on diversification efforts, the larger ILECs are signalling that their capabilities are best deployed in their core business where the profit opportunities are likely to be higher than in the other new business areas. Again, given the years we are studying, this is indicative of aggressive turf protection by the ILECs in the face of emerging competitive threats. It serves as a signal to new entrants that the ILECs' efforts to withdraw into the core business area can lead to efficiency enhancements.

Next, we find that the DIGITAL and BELL variables are positively and negatively related to the DIVERSITY variable. A greater variety of services can be offered with the possession of a digital infrastructure. Commensurately, those firms that possess relatively more digital infrastructure can diversify more. The RBOCs face greater constraints on their non-telephony activities. Thus, the finding of a negative BELL coefficient is consistent with reality (Waverman, 1998). We find that the BUSINESS LINE variable is also positive and significant. Higher-spending business customers need greater variety of services that a digital infrastructure permits. With the on-going enhancement of network functionalities, this trend may change as residential customers also seek service variety.

The signs of the various YEAR variables in the equation are also interesting. The magnitude, sign and significance of these variables are to be compared to the base year 1994. The YEAR 1995 variable is positive and significant. The YEAR 1996, YEAR 1997 and the YEAR 1998 variables are not only negative and significant, but the magnitude of each of these variables is changing over time. It is –0.449 in 1996, –0.645 in 1997 and –0.660 in 1998. These results imply that after the passage of the Telecommunications Act in 1996 the ILECs have become pro-active about protecting their core local telephony business by aggressively concentrating on their primary activity areas.

4. 3 Findings from Secondary Estimations

We carry out additional estimations to ascertain the robustness of our primary estimates. The results of these secondary estimations are given in tables 4 and 5.

Results Excluding Ownership Issues: Columns (1), (3) and (5) of table 4 provide the estimates for a regression model where we exclude the BELL variable from the equation to evaluate whether results change if ownership effects are ignored. The issue of ownership is critical in the sector, since the RBOCs are more stringently regulated relative to the other ILECs. As such, these asymmetries in regulation can influence the behaviour of firms. Once we exclude the BELL variable from the equation, then the ENTRY variable is positive in the ACCESS PRICE equation [see column (1)]. However, it is significant only at the 10 per cent level.

If we compare these results with the results obtained from our primary estimation of the ACCESS PRICE equation, as given in column (1) of table 3, then we equivocally conclude that ILECs seek to obtain higher access prices if feasible. The estimates presented in column (1) of table 3, on the other hand, show that the BELL variable is negative. Thus, we find that the non-RBOCs among the ILECs seek to obtain higher access prices. Asymmetries in

regulation ensure that RBOCs are more stringently monitored. Conversely, the non-RBOCs seem to have the wherewithal to use access prices to raise barriers to entry.[13]

As shown in column (2) of table 4, we find that if the BELL variable is excluded from the ADVERTISING equation, then, other than the DIGITAL variable which becomes insignificant, all other variables retain their signs and levels of significance. Similarly, for the DIVERSITY equation, column (3) of table 4 shows that the exclusion of the BELL variable does not change the sign and significance that are obtained for the other explanatory variables when the BELL variable is retained in the equation [please see column (5) of table 3].

********** INSERT TABLE 4 HERE **********

Results Excluding Size Effects: To evaluate how our results change when the SIZE variable is excluded we estimate another set of regressions. These results are displayed in columns (1), (3) and (5) of table 5. In the ACCESS PRICE equation, after excluding the SIZE variable [column (1)], the ENTRY variable is positive but not significant. As we saw, the relationship between the SIZE variable and the ACCESS PRICE variable was significant when no variables in the model were excluded [see columns (1) and (2) in table 3]. The exclusion of the SIZE variable does not impact the way we assess the results for the ENTRY variable. The BELL variable stays negative and significant. The overall conclusion then is that the RBOCs do not seek to obtain higher access prices in the face of entry threats.

Interestingly, we find in the primary estimates that when all variables are included, the BELL variable is positive but not significant for the ADVERTISING equation [see columns (3) and (4) of table 3]. Now, as shown in column (3) of table 5, when the SIZE variable is

[13] There are several negative attributes attributed with asymmetric regulation. In the UK, Mercury has benefited from in regulatory asymmetries, while in the US MCI and Sprint have benefited from asymmetric regulation (Laffont and Tirole, 2000).

excluded from the ADVERTISING equations, the BELL variable turns out to be substantial in its magnitude (1.442) and very highly significant (t statistic: 5.538).[14]

Several implications follow from these results. The RBOCs are not, prima-facie, seekers of higher access prices. On the other hand, they are the more significant advertisers in the local telephony sector. As Bagwell (1990) suggests, product differentiation via informational means can also create barriers to entry. Whether such high levels of advertising create a brand name for each of the RBOCs that then leads to sustainable and strong market advantages is an open empirical question. For the ADVERTISING and DIVERSITY equations, as given in columns (3) and (5) of table 5, we find that the exclusion of the SIZE variable from the equation does not change the sign and significance of the ENTRY variable.

********** INSERT TABLE 5 HERE **********

4. 4 Summary of Key Findings

Our results indicate that entry threats influence the strategic behaviour of ILECs. We find that, taking the results as a whole, ILECs tend to neither deter nor accommodate entry of their potential competitors by access pricing. This finding is consistent with Geroski's (1990) point, based on studies of entry, that prices are not usually used by incumbents to block entry. But, if the effect of regulatory asymmetries and ownership effects are taken into account, the non-RBOC ILECs tend to seek higher access prices in the face of CLECs' entry.[15]

We find that the bigger ILECs benefit from higher access prices than the smaller ILECs. While the RBOCs as a group do not benefit from higher access prices, the larger

[14] However, the R^2 value for the ADVERTISING equation drops from 0.90 in the ADVERTISING equation in table 4 to 0.26. Thus, we find that the SIZE variable is also very critical in explaining cross-sectional variations in the ADVERTISING variable.

[15] Nevertheless, we do not strongly state that these non-RBOCs seek to use access pricing to deter entry. Also, it is likely that the RBOCs among the ILECs are not able to use access prices to deter entry because of heavy regulation. RBOCs account for 80 percent of revenues in the local telephone sector. Hence, firms that might use possibly use access pricing as an entry deterrence strategy contribute a fifth of the revenues within the sector.

ILECs do. It is impossible to distinguish incoming inter-state calls from incoming intra-state calls, with that former ones being regulated by the FCC and the latter ones by the state public commissions. The larger ILECs, by definition, will get greater numbers of incoming calls. They can benefit more from the judicious management of a favourable jurisdiction. They have greater incentives to manage the regulatory system and use access prices for strategic purposes. These details shed light on the nature of local telephony in the United States, but we do not offer judgements on the quality of the regulation of this sector.

Entry threats arise principally from infrastructure-based entrants. These possess broadband networks already a sixth in size as compared to ILECs' own broadband networks. When faced with such threats the ILECs use other means, such as advertising and diversification strategies, to deter entry to their presently monopolistic market areas. Heavy advertising creates substantial entry barriers (Sutton, 1991), and the RBOCs are the heavier advertisers. The RBOCs have the exposure that might help their brand name be leveraged in the market place. Reduction in diversification effort signals turf protection on the part of the ILECs. This trend is pronounced for the larger ILECs. Larger ILECs also have the necessary cash flows and the abilities to engage in non-price competition, and they do so.

Overall, the pattern of ILECs' behaviour is not conducive with an approach of live and let live. Thus, whether the ILECs are paragons of virtues or not is left as an open question. If subsequent research establishes that, in the face of entry of various types of competitors into the local exchange sector, ILECs encourage access to their networks through lower access prices then it might be construed that they are indeed paragons of virtue.[16]

4. 5 Some Implications

[16] Schwartz (2000) discusses potential benefits from entry in both the local and long distance segments of the telecommunications sector. These benefits will, however, be vitiated if the incumbents do not cooperate. Thus regulation or other outside enforcement mechanisms

The issue of an appropriate access price strategy for ILECs is important. First, it is in the ILECs interest to encourage access to their networks through lower access prices. The level of CLEC coverage is insubstantial. It will take a while before CLEC and ILEC networks are balanced, and CLECs can compete on an equal footing. By enabling lower consumer prices to be charged, a lower access charge encourages network usage and connectivity.

Second there are signalling implications associated with ILECs' access pricing strategies. An ILEC's intent to set a high access price can induce bypass by larger business customers. As network competition evolves so that a number of suppliers provide two-way access, high access prices charged by an incumbent can then lead to high call termination prices charged by a CLEC for calls originating on the incumbent's network. Individual customers are locked-in as they have to use either the ILEC or a CLEC, but large businesses do possess the ability to bypass both networks. Thus, value can be destroyed for both ILECs and CLECs.

Given network externalities, a positive effect that results from a lowering of access charges is an enhancement of ILECs' own efficiencies. Costs reduce with new firms joining the network. Network size increases with interconnections and the marginal costs of operating the installed base of ILEC lines get progressively lower as a result. With a larger network and larger volumes associated with size, operating costs are spread over a larger base.

The increasing returns process propels a dynamic effect fuelled by direct network externalities (Rohlfs, 1974). High network density and variety enhances customers' abilities to conduct transactions. Once investments in infrastructure are made by new entrants, customers are likely to use the system more due to an enhancement of network variety and density. Because of consumption externalities, call volumes grow at an increasing rate. Such growth in calling volume helps efficiently leverage ILECs' fixed lines infrastructure.

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are necessary so as to prevent incumbents from degrading various arrangements that encourage and engender competition.

The technical network externality affects the productivity of input usage in a network-based industry because of knowledge spillovers. Because of inter-connectivity between systems and the standardized nature of equipment used several channels for the dissemination of experiences exist. Such information flows can help all operators connected within a network to capitalize on each other's best practices and improve performance.

Also, there are substantial indirect network effects.[17] The presence of a fiber-based infrastructure encourages new service consumption. While voice and high-speed data transfers will remain in demand, the use of interactive media-based services will rise with the availability of broadband facilities. Lower broadband access prices will then spur the diffusion of value added services, as both CLEC and ILEC customers demand these services.

Given indirect network externalities, increased advertising spending can increase the elasticity of demand for new voice and media services. The demand for such services is presently unknown since technological functionalities are still evolving. Creation of demand may necessitate larger advertising budgets on parts of the LECs. In line with the core competency argument, a cut back on diversification can yield efficiencies. These efficiencies can generate resources which fund the advertising expenditures that generate demand for voice, data and media services. The increased demand that is generated can help the ILECs to exploit the various externalities available in the evolving communications market.

5. CONCLUSION

We have examined ILECs' strategic behaviour in the face of entry by CLECs. The ILECs protect their dominant position in their traditional business area. We show that their strategy does not involve aggressive access pricing in the face of entry threats. The ILECs, however, use non-price strategies such as advertising to deter CLECs entry to their market areas.

Simultaneously, they have cut back on diversification so as to focus on telephony operations. Of course, while creating potential entry barriers, advertising helps increase market size as a whole. A cut back on diversification efforts can also help enhance ILECs' efficiency.

The lacklustre use of the pricing weapon is consistent with reality since both access and retail pricing are heavily regulated in the US local telecommunications markets. Our analysis indicates that the larger companies do charge higher access prices. Some large ILECs are, despite regulation, able to enjoy relatively higher access prices. In practice it is impossible to distinguish incoming interstate calls, regulated by the FCC, from incoming intrastate calls, regulated by the state public commissions. This provides some of the ILECs the requisite degrees of freedom to use the regulatory system to their advantage.

Our findings suggest that the ILECs do protect the profit streams in their traditional telephony business. This is, of course, hardly surprising. We provide an explanation for the insubstantial market share so far of the CLECs in the US local telecommunications markets, that has been documented in the recent FCC report *Competition in the Telecommunications Industry*. Our evidence demonstrates that the ILECs have responded to Telecommunications Act 1996, and to the threat of market entry it has created, by adopting aggressive entry deterrence strategies. This strategic behaviour has so far been successful in providing the ILECs protection of their markets.

[17] An indirect network effect arises where the existence of a network provides incentive to customers for consuming allied services that require the network use (Katz and Shapiro, 1985).

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Table 1. List of variables

Variable	Description
ACCESS PRICE	Log of access revenues divided by the number of access minutes billed
ADVERTISING	Log of advertising expenditures.
DIVERSITY	Log of miscellaneous revenues divided by the total revenues.
SIZE	Log of total operating revenues.
FIBER	Log of total fiber kilometres deployed.
DIGITAL	Log of main digital access lines.
TOLL SHARE	Log of inter-state long-distance calls divided by the total calls.
ACCESS COST	Log of access expenses divided by the number of access lines.
LABOUR	Log of labour compensation divided by the number of employees.
ENTRY	Log of number of local service competitors identified.
BUSINESS LINE	Log of number of business lines divided by the total number of lines.
BELL	1 if Regional Bell Operating Company (RBOC); 0 otherwise.
YEAR INDEX	YEAR 1995 (…YEAR 1998) 1 if year is 1995 (1998), 0 otherwise.

Table 2: Descriptive Statistics

	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Years	**All years**	**All years**	**1994**	**1995**	**1996**	**1997**	**1998**
Variable	**Mean (Standard Deviation)**	**Coefficient of Variation**	**Mean (Standard Deviation)**	**Mean (Standard Deviation)**	**Mean (Standard Deviation)**	**Mean (Standard Deviation)**	**Mean (Standard Deviation)**
Access Price	0.062	0.451	0.067	0.066	0.062	0.059	0.057
(cents)	(0.028)		(0.028)	(0.032)	(0.033)	(0.023)	(0.022)
Advertising	17504.411	1.598	13919.476	15931.023	17634.548	22363.071	17737.750
($mn)	(27971.911)		(18380.074)	(22941.302)	(28578.429)	(37802.705)	(29116.952)
Diversity	9.662	0.584	13.634	14.040	7.807	6.575	6.212
(%)	(5.645)		(4.716)	(5.036)	(4.277)	(4.251)	(4.091)
Entry	4.400	1.405	0.396	1.043	3.234	7.224	9.995
(Number of firms)	(6.182)		(1.164)	(1.853)	(3.389)	(5.670)	(8.640)
Size	2245318.009	1.401	2169276.881	2127413.955	2230389.952	2289477.310	2407904.227
($mn)	(3145120.488)		(2973971.070)	(2987829.655)	(3174973.231)	(3262504.559)	(3439340.652)
Fiber	468093.407	1.607	380009.071	394679.727	452097.048	514648.143	596418.227
(kilometres)	(752470.416)		(655152.113)	(626692.704)	(734609.458)	(816701.335)	(905472.201)
Digital	67265.332	2.517	45629.810	47824.591	57273.905	77224.762	107388.705
(Lines)	(169327.932)		(131437.342)	(144892.336)	(163715.524)	(182195.030)	(211346.308)
Toll Share	0.148	0.345	0.130	0.149	0.152	0.155	0.154
(Proportion)	(0.051)		(0.050)	(0.056)	(0.053)	(0.045)	(0.046)
Access Cost	0.012	0.858	0.0091	0.0096	0.011	0.012	0.017
($ per line)	(0.0103)		(0.0092)	(0.0094)	(0.011)	(0.012)	(0.008)
Labour	50838.830	0.205	43885.120	46081.660	54357.47	53692.560	56150.940
($000)	(10430.480)		(8780.600)	(6575.140)	(9712.520)	(10723.660)	(10080.940)
Business Line	26.924	0.254	26.568	26.956	26.900	27.285	26.910
(%)	(6.842)		(6.846)	(6.877)	(8.023)	(6.722)	(5.932)

Table 3: Primary Estimation Results

	Dependent variable: Access Price		*Dependent variable: Advertising*		*Dependent variable: Diversity*	
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Variable	Estimate (Standard Error)	T statistic	Estimate (Standard Error)	T Statistic	Estimate (Standard Error)	T Statistic
Constant	-2.284	3.926***	-7.777	11.756***	1.134	1.763*
	(0.582)		(0.661)		(0.643)	
ENTRY	-0.003	0.294	0.040	2.101**	-0.047	3.024***
	(0.011)		(0.019)		(0.016)	
SIZE	0.470	7.505***	1.122	40.506***	-0.096	3.817***
	(0.062)		(0.028)		(0.025)	
FIBER	0.105	2.919***	-0.174	1.934*	0.082	1.119
	(0.036)		(0.090)		(0.073)	
DIGITAL	0.009	0.478	-0.087	2.173**	0.099	4.228***
	(0.191)		(0.040)		(0.023)	
TOLL SHARE	-0.469	7.610***				
	(0.062)					
ACCESS COST	0.054	3.430***				
	(0.015)					
LABOUR	-0.010	0.080				
	(0.133)					
BELL	-0.342	7.616***	0.067	0.685	-0.247	2.833***
	(0.045)		(0.099)		(0.087)	
BUSINESS LINE			0.020	0.110	0.923	5.575***
			(0.182)		(0.165)	
YEAR 1995	0.009	0.223	0.127	1.474	0.489	0.934
	(0.412)		(0.086)		(0.052)	
YEAR 1996	-0.097	1.370	-0.017	0.134	-0.449	4.702***
	(0.071)		(0.130)		(0.096)	
YEAR 1997	-0.049	0.694	0.109	0.743	-0.645	6.108***
	(0.072)		(0.147)		(0.106)	
YEAR 1998	-0.094	1.095	0.025	0.168	-0.660	5.716***
	(0.085)		(0.151)		(0.115)	
R^2	0.73		0.90		0.55	
N			220			

*** p < 0.01 (2 tail)
** p < 0.05 (2 tail)
* p < 0.10 (2 tail)

Table 4: Regression estimates – excluding ownership effects

	Dependent Variable: Access Price		*Dependent variable: Advertising*		*Dependent variable: Diversity*	
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Variable	Estimate (Standard Error)	T Statistic	Estimate (Standard Error)	T Statistic	Estimate (Standard Error)	T Statistic
Constant	1.686	1.007	-7.534***	11.120	2.308	3.890***
	(1.673)		(0.677)		(0.593)	
ENTRY	0.019	1.346	0.038	1.880*	-0.030	1.941*
	(0.014)		(0.020)		(0.015)	
SIZE	0.368	5.897***	1.120	40.868***	-0.120	4.820***
	(0.062)		(0.027)		(0.025)	
FIBER	0.150	2.789***	-0.179	2.012**	-0.086	1.171
	(0.054)		(0.089)		(0.074)	
DIGITAL	-0.037	2.296**	-0.019	0.572	0.073	3.502***
	(0.016)		(0.033)		(0.021)	
TOLL SHARE	-0.428	6.857***				
	(0.062)					
ACCESS COST	0.053	3.021***				
	(0.018)					
LABOUR	-0.885	2.332**				
	(0.379)					
BUSINESS LINE			0.072	0.391	0.608	4.255***
			(0.184)		(0.143)	
YEAR 1995	-0.005	0.087	0.021	0.245	0.039	0.742
	(0.056)		(0.087)		(0.052)	
YEAR 1996	0.166	1.994**	-0.245	1.822*	-0.470	4.942***
	(0.083)		(0.135)		(0.095)	
YEAR 1997	-0.013	0.140	-0.011	0.071	-0.725	6.620***
	(0.090)		(0.151)		(0.110)	
YEAR 1998	-0.025	0.248	0.009	0.054	-0.753	6.474***
	(0.100)		(0.157)		(0.116)	
R^2	0.30		0.90		0.54	
N	220		220		220	

*** p < 0.01 (2 tail)
** p < 0.05 (2 tail)
* p < 0.10 (2 tail)

Table 5: Regression estimates – excluding size effects

	Dependent variable: Access Price		*Dependent variable: Advertising*		*Dependent variable: Diversity*	
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Variable	Estimate (Standard Error)	T Statistic	Estimate (Standard Error)	T Statistic	Estimate (Standard Error)	T Statistic
Constant	1.140	0.934	2.702	1.145	0.533	0.866
	(1.220)		(2.360)		(0.616)	
ENTRY	0.018	1.136	0.216	4.193***	-0.058	3.885***
	(0.016)		(0.051)		(0.015)	
FIBER	0.149	2.983***	-0.096	0.387	-0.031	0.421
	(0.050)		(0.247)		(0.074)	
DIGITAL	-0.017	0.924	0.019	0.260	0.079	3.695***
	(0.018)		(0.073)		(0.021)	
TOLL SHARE	-0.059	3.080***				
	(0.019)					
ACCESS COST	0.021	1.438				
	(0.014)					
LABOUR	-0.690	2.596***				
	(0.266)					
BELL	-0.240	5.069***	1.442	5.538***	-0.448	5.659***
	(0.047)		(0.260)		(0.079)	
BUSINESS LINE			1.835	2.630**	0.746	4.077***
			(0.698)		(0.183)	
YEAR 1995	-0.101	1.847*	-0.224	0.979	0.034	0.686
	(0.055)		(0.229)		(0.049)	
YEAR 1996	-0.170	1.651*	-0.782	2.306**	-0.538	5.696***
	(0.103)		(0.339)		(0.094)	
YEAR 1997	-0.102	0.977	-0.909	2.220**	-0.682	6.962***
	(0.105)		(0.410)		(0.098)	
YEAR 1998	-0.096	0.823	-0.936	2.248**	-0.720	6.917***
	(0.117)		(0.416)		(0.104)	
R^2	0.33		0.26		0.57	
N	220		220		220	

*** $p < 0.01$ (2 tail)
** $p < 0.05$ (2 tail)
* $p < 0.10$ (2 tail)