How State Governments Implement Federal Policies:

The Telecommunications Act of 1996

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This paper examines the rates set by state public utility commissions (PUCs) that competitors must pay to access the local loop of the largest incumbent U.S. telecommunications suppliers (RBOCs). Employing a unique data set and dynamic panel data regressions, the results indicate that the rates are influenced by factors beyond local costs. Specifically, rates in the smaller states in each RBOC region are strongly influenced by the largest state in the region. Rates are lower in the period immediately before the RBOC applied for Section 271 approval in the state and where the level of competitive entry is lower, while they are higher in states where the governor is a Republican. The analysis suggests that this cornerstone of the Telecommunications Act of 1996 may been applied inconsistently across states and information spillovers should be considered when state agencies are charged with implementing federal policy.

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1. Introduction.

The Telecommunications Act of 1996 (TA96) was heralded as a watershed moment in telecommunications regulation. As the Senate Commerce Committee (1995) report on the bill stated:

> The bill is likely to stimulate tremendous economic growth and investment by the private sector. The potential to stimulate jobs, investment, and export opportunities for the American economy is immense. (p 16)

One of the primary means by which TA96 was to create this economic windfall was by introducing competition in the local telephone market. Given the size of the market and its importance to the economy, it was believed that competition would create large efficiency gains for the economy. Quoting again from the Senate Commerce Committee report, "A competitive local exchange is likely to produce increased economic activity and investment." (p 16)

Potential entrants pronounced they would become major players in this newly opened market. Then-AT&T chairman Robert Allen on the day the bill was signed, "… vowed that his company would try to offer local telephone service in every state and pledged to capture one-third of the business now controlled by the regional Bell companies" (Andrews, 1996).

One of the more controversial mechanisms by which competitors were to enter markets was by leasing unbundled network elements (UNEs). The legislation decreed that competitive local exchange carriers (CLECs) could lease certain segments of the RBOC's (regional Bell operating company's)[1] network[2], thus allowing for competition where it would otherwise be unprofitable or infeasible. Obviously, the rates at which CLECs could lease the UNEs would play an important role in the degree of entry observed.[3] The only rate-setting guidance offered

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[1] RBOCs are the "baby Bell" companies that were created in the break-up of AT&T in 1984.

[2] The question as to which segments the RBOC should be forced to lease has been litigated extensively (see Lichtman and Picker, 2003).

[3] As discussed in Lichtman and Picker (2003, pp 22-23), excessively low rates can discourage CLEC investment in their own networks and foster excessive reliance on UNEs. Conversely, exceptionally high rates may encourage inefficient investment by CLECs. The effect of the rates on RBOC investment is ambiguous.

by TA96 was that the rates were to be priced at cost plus possibly a reasonable profit, determined without reference to a rate-of-return proceeding, and set by the state public utility commissions (PUCs).[4]

Given the ambiguity in how the UNE rates were to be set, the Federal Communications Commission (FCC) interpreted TA96 as giving it the authority to proscribe the methodology the states should use in determining the rates. The FCC decided that the rates should be based on total element long-run incremental costs (TELRIC), the hypothetical costs of implementing the least-cost network given the current locations of the incumbent's wire centers.[5]

The PUCs were left with the unenviable task of operationalizing the vague "TELRIC" notion. Figure 1 depicts UNE loop rates for three pairs of arguably comparable states: New Hampshire and Vermont; Kentucky and Tennessee; and Wyoming and Utah. The charts suggest that the state commissions operationalized the TELRIC concept differently over time. For example, when the Wyoming and Utah PUCs first set rates in 1997, the UNE rate in Utah was only $2.00 less than the rate in Wyoming. By 2003 that difference had increased five-fold. This type of variability across states and over time is representative of the experiences in many states and suggests state PUCs varied a great deal as to how they implemented the TELRIC methodology.[6]

Previous studies have analyzed the determinants of UNE rates. De Figuerirdo and Edwards (2004) examine the UNE rate in place in the three two-year election cycles from 1998 through 2002. The authors find that states with Democratic state legislatures and relatively large political contributions by entrants have lower UNE rates. Further, elected PUCs are found to set

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[4] 47, USC § 252(d).

[5] The FCC's decision was challenged numerous times in the courts, both regarding whether the commission had the authority to dictate the rate-setting methodology and also whether the TELRIC methodology was consistent with the Act. The Supreme Court eventually decided both issues in favor of the FCC. (AT&T v. Iowa Utilities Board (1999), Verizon, et al v. FCC, et al (2002))

[6] Further, the Department of Justice rejected applications by some incumbents for permission to sell interLATA service on the grounds that the state PUCs had not correctly calculated TELRIC rates (e.g., see Department of Justice (1997, 1998, and 2000)).

higher rates, while states in which the PUC has imposed retail price caps tend to have lower UNE rates. Lehman and Weisman (2000) explore UNE rates set immediately following the implementation of TA96. They also find that elected commissions set higher rates while price caps lead to lower rates. Beard and Ford (2004) test whether the UNE rates for certain combinations of network elements in 2002 are correlated with the rates proposed by RBOCs or CLECs. They find that the rates set by state PUCs can be explained as splitting the difference between the preferred rates of the two parties. Eisenach and Mrozek (2003) regress the observed UNE rate against a cost estimate produced by the FCC Hybrid Cost Proxy Model (see further description of the HCPM in Section 4.2) and find that costs explain only half of the variation in UNE rates.[7]

This paper extends these studies in several important directions. First, the present analysis is based on a unique data set that contains the UNE loop rates for each state since TA96 was enacted and when those rates were ordered. Further, unlike previous studies, it is known whether the rate was the result of a voluntary reduction by the RBOC. Second, the analysis examines the potential for information spillovers across states.[8] Given the ambiguity of the TELRIC notion and the lack of experience PUCs had with the concept, it is possible if not likely that many PUCs looked to other PUCs for guidance. Specifically, the influence of the rates set by the PUC in the largest state in each RBOC region (the "leader") on the other states in the region (the "followers") is tested. Third, whereas in previous papers the form of retail rate

[7] Another area in which state PUC telecommunications regulation has been analyzed is how retail rates are set. Donald and Sappington (1995) find that state commissions are more likely to choose incentive regulation where the RBOC can gain more, rates are especially high, and elected state leaders are churned by voters. Smart (1994) observes that retail rates are lower in states where the PUC commissioners are elected and that control of the governorship and state legislature only has an impact on prices when the offices are held by different political parties.

[8] There is a large literature regarding strategic interaction between governments, especially in the areas of environmental, welfare, and tax policy (see Brueckner (2003) for a survey). However, the information spillovers in UNE rates do not appear to be strategic, i.e., the PUCs do not appear to take into consideration the reactions of other PUCs when setting their own UNE rates.

regulation was assumed to be exogenous, the analysis corrects for the potential endogeneity of this variable. Fourth, the impact of the level of entry on UNE rates is measured.

Four primary conclusions emerge from this research. First, less than 50% of a change in the estimated cost of providing a UNE is reflected in the UNE rate two years later. Second, a $1 increase in the leader state's rate results in a roughly $0.75 increase in the rates of the follower states two years later. Conversely, a state's rate does not appear to be affected by changes in the rates of the follower states. Third, applications for permission to sell long-distance services and lower levels of competitive entry tend to put downward pressure on rates. Fourth, Republican leadership in a state is associated with higher UNE rates.

The paper is organized as follows. Section 2 presents background information on how UNE rates are set. Section 3 describes the hypothesized UNE rate determinants. Section 4 details the econometric methodology and the data used. Section 5 discusses the estimation results, while Section 6 provides conclusions and areas for further research.

2. Background information on UNE rate proceedings.

2.1. Steps involved in setting UNE rates.

Before reviewing the formal analysis, consider how UNE rates have been determined by the PUCs.

Immediately following the passage of TA96, state PUCs were forced to arbitrate interconnection agreements between RBOCs and CLECs without having the luxury of completing a TELRIC study. To prevent the delay of interconnection agreements, the PUCs often decided on a UNE rate based solely on the proposed cost studies and testimony submitted by the two sides. When the PUC completed its own cost study, the rates from the study replaced the temporary placeholder rates in the existing interconnection agreements.[9]

[9] Note that some states were able to complete a TELRIC cost study quickly enough so that they did not have to implement the placeholder rates.

Following the initial cost study, the state PUCs had complete discretion as to when to review the UNE rates, if at all. Most interconnection agreements between RBOCs and CLECs last three years, so the PUCs often revise the UNE rates to coincide with the expiration of the agreements. However, sometimes PUCs revise the rates before of the end of this three-year cycle, while on other occasions they review the rates less frequently.

While practices differ to some extent, most PUCs follow the same procedures when modifying UNE rates. First, the PUC announces that it will review the UNE rates and that hearings will be held. Before these hearings take place, the RBOCs and CLECs submit their own cost models and expert testimony. Following the hearings, the PUC reviews the material and testimony and sometimes will ask for further information from the parties. After this stage, the PUC announces its decision on a cost model and the proper inputs for it. This decision will often include what it thinks the resulting UNE rates are, but it will ask the RBOC to run the model chosen by the PUC with the prescribed inputs and report the resulting rates to the PUC. A CLEC often will challenge the rates calculated by the RBOC. The initial PUC decision regarding the model and inputs may also be appealed. (The PUC typically has discretion as to whether it will allow an appeal to be heard.) This process can last as long as two years.

The cost studies performed by the PUCs involve decisions on many parameters, ranging from labor costs to the costs of telephone poles. In its most general form, the TELRIC studies consider three types of costs: operating costs, depreciation costs, and the cost of capital.

2.2. Influence of neighboring states.

As described above, the TELRIC methodology that the FCC ordered the PUCs to follow to set UNE rates is both complicated and vague. The PUCs are forced to estimate the costs that a provider of the loops would incur if they were to build the network today using an efficient technology. Specifying the efficient technology is a daunting task in itself. In addition, the PUC must determine the hypothetical cost of installing the efficient technology throughout the RBOC's service area. Such an analysis requires considerable resources, and can be particularly

burdensome for states that have relatively small PUC staffs and budgets. Given these challenges, it is not surprising that smaller states look to larger states for guidance in setting UNE rates.

The PUCs of the states in an RBOC's region share a working relationship that is conducive to collaboration in setting UNE rates. For example, regional associations of state PUCs that are carved almost exactly on RBOC regional lines meet annually or semiannually.[10] The meetings typically include working sessions where PUC staff members that work in telecommunications discuss current issues and listen to RBOC and CLEC representatives present their views on upcoming regulatory matters. The potential for information spillovers among states was further highlighted in a recent survey by the National Association of Regulatory Commissioners (NARUC) of state PUCs. When asked if states would be interested in working with other state PUCs in a matter closely related to UNE rates, many of the states indicated that they believed such coordination would be useful and has been useful in the past (NARUC TRIP Task Force, 2003).[11]

Figure 2 provides additional evidence that information spillovers are common within RBOC regions. The charts show for each state in January 2001 the UNE rate set by the PUC and an estimate of the TELRIC loop cost using a cost model developed by the FCC known as the Hybrid Cost Proxy Model (HCPM). While the ability of the HCPM to accurately calculate TELRIC costs has been hotly disputed, the model provides a consistent measure across states and over time of the relevant TELRIC cost, under specified assumptions. For most states, the UNE rate set by the state PUC is lower than the HCPM estimate. However, the difference varies

[10] The Qwest PUCs comprise of the Qwest Regional Oversight Committee, the BellSouth PUCs are part of the Southeastern Association of Regulatory Utility Commissioners, the Verizon PUCs are members of either the New England Conference of Public Utility Commissioners or the Mid-Atlantic Conference of Regulatory Utilities Commissioners, while all but two of the SBC states are members of the Mid-America Regulatory Conference.

[11] The Kansas PUC replied, "The Commission believes it would be especially beneficial and cost effective for the five original Southwestern Bell Telephone Company states to coordinate efforts." The Rhode Island PUC stated, "RI has a very small staff and would be interested in coordinating logistics with other states in Verizon's territory…" The Wyoming PUC response included, "The Commission is considering the possible benefits of a regional approach such as participating in a coordinated effort of the Qwest ROC (Qwest Regional Oversight Committee)."

considerably by RBOC. For instance, the UNE rates in the Ameritech states are roughly half of the HCPM cost estimate, while in the Qwest states the UNE rates are typically roughly equal to the cost estimate.

It is unlikely that all states within an RBOC's region have an equal influence on each other. Within each RBOC region there appears to be a leader state that other states in that RBOC region look to for guidance in their UNE rate proceedings. The leader state not only has the most resources available in that RBOC region to conduct a UNE rate study[12], but it may also have been the first state in which the RBOC applied for permission to sell long-distance services in its territory[13]. The FCC encouraged smaller states to use the information provided by leader states in their UNE rate cost studies:

> We recognize that many states lack the extensive resources that were dedicated to the process by New York and Texas, as detailed in our orders in those states…
>
> We encourage states with limited resources to take advantage of the efforts devoted by New York and Texas in establishing TELRIC-compliant prices, by relying where appropriate on the existing work product of those states. (FCC, 2001, p 40)

There is considerable evidence that follower states look to the leader states for guidance. For example, in the BellSouth region, it was reported that the Kentucky PUC closely monitored the UNE rate proceeding in Florida and even discussed Florida's findings with the Florida

[12] An appropriate measure of the resources available would be the number of PUC employees or the PUC's budget. However, PUCs are organized differently across states and state comparisons of these measures are problematic. For example, Arizona's PUC is part of the state's Corporation Commission, which also handles issues regarding securities and insurance. Data on the number of employees and budget for the Arizona PUC are available only for the state corporation commission. As a proxy for state PUC resources, the number of telephone access lines is used.

[13] Under Section 271 of TA96, in order for an RBOC to receive permission to sell long-distance services in a state it had to file an application with both the FCC and the state PUC that demonstrated that the local telephone service market was open to competition. One of the criteria by which the application was judged was whether the UNE rates were based on TELRIC estimates.

commission and its staff (Caldwell, 2002, paragraph 131). In the SBC region, the Kansas PUC recently suggested that they delay their UNE proceeding in order to wait until the ongoing Texas study was completed (Kansas Corporation Commission, 2000, p 2). In Nevada, the PUC approved a stipulation among RBOCs and CLECs that set UNE rates based on the proceedings of the California PUC (Public Utility Commission of Nevada, 2002). According to a recent trade press article, follower states in Verizon's region halted their UNE rate cases to see how the New York PUC would decide its rate (*State Telephone Regulation Report*, 2004).

The influence of a leader state's rate on rates in follower states may be influenced by RBOC behavior. To illustrate, RBOCs have encouraged the influence of leader state rates by benchmarking follower states' rates to them during the Section 271 application. For instance, in 2002 Qwest voluntarily lowered their UNE rates in eight states in order to benchmark them to the rates set by the Colorado PUC (FCC, 2002).[14] The RBOCs also urge follower state PUCs to base their rulings on decisions by the leader states. For example, in an Alabama UNE rate case BellSouth urged the Alabama PUC to adopt the Florida PUC's position regarding the timing of UNE rates, while in Georgia BellSouth argued for the approach that the Florida PUC adopted to allocate costs between regular telephone service and data service.

3. Hypothesized UNE rate determinants.

If the states followed the TELRIC methodology to the letter, the TELRIC cost would perfectly determine the UNE rate. However, as described above and demonstrated in Figures 1 and 2, it does not appear that costs alone explain the UNE rates. Therefore, other variables are included in the model to account for the variation in rates.

[14] Specifically, Qwest voluntarily lowered the rates to the level in Colorado adjusted for the difference in average costs according to the FCC's cost model.

To control for information spillovers across states, the rates of the other states in the same RBOC region are included in the model.[15,16] To test for the effect of the leader state on the follower states, the model includes the rate of the leader state interacted with a dummy variable that equals one if the state is a follower state. This variable will capture how the follower states respond to changes in the leader's rate. If the coefficient on this variable is statistically significant, one can conclude that the rates in the follower states are influenced by the leader state's rate.

However, it may be the case that the follower states also are influenced by the rates in the other follower states. Therefore, also included in the regressions is the weighted average[17] of the follower states' rates interacted with a dummy variable that equals one if the state is a follower state. If there are information spillovers between the follower states, the coefficient on this variable will also be statistically significant.

It may also be the case that the leader states are influenced by the rates in the other states in the RBOC region. To test for this, the weighted average of the follower states' rates is interacted with a dummy variable that equals one if the state is a leader. Thus, any influence of the follower states on the leader states is captured in this variable.[18]

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[15] The regions are muddled somewhat by the mergers that have taken place among the RBOCs. For instance, Pacific Telesis and Ameritech were acquired by SBC in 1998 and 1999, respectively, while Verizon (formerly Bell Atlantic) acquired NYNEX in 1997. Given their geographic locations and the timing of the acquisitions, Pacific Telesis and Ameritech are treated separately from SBC while the former Bell Atlantic and NYNEX are treated as one entity.

[16] The identification strategy employed to capture information spillovers is closely related on the strategic interaction literature cited above. Specifically, the lagged rates of neighboring states are interacted with dummy variables in order to isolate the effects of interest. See Fredriksson and Millimet (2002), Fredricksson, List, and Millimet (2004), and Hayashi and Boadway (2001).

[17] The weights are based on the number of switched access lines per state. The results do not change when weights based on population are used.

[18] The analysis in this paper focuses on the influence of neighboring states within the RBOC region. It is possible that some PUCs might have influence that extends beyond their RBOC region. However, given the limited degrees of freedom available, it is not possible to simultaneously control for nation-wide influences of all of the leader states. Initial estimates that test for the influence of one national leader state at a time suggest that such effects may be present. However, the qualitative conclusions reported below persist in settings that admit national leadership patterns. As stated in the conclusion, further analysis of this issue is warranted.

Characteristics of the PUC may also influence UNE rates. Under the theory of regulatory capture, the longer a commissioner has served, the more amenable s/he might be to setting a rate favorable to the incumbent. Applied to UNE rates, this theory suggests that the longer the commissioners have served the higher the UNE rates will be. There may also be an influence due to the political affiliation of the commissioners. However, it is unclear as to the direction of this influence. One may surmise that Republicans generally favor less regulation and less aggressive (i.e., higher) UNE rates. Conversely, it may be the case that Republicans are sympathetic towards small businesses, and therefore may favor lower UNE rates to benefit both small-business consumers of telecommunications services and start-up CLECs. Prior studies have debated whether states that enact incentive-based retail rate regulation enact lower UNE rates[19]. Further, the RBOC's retail rates may influence the level of UNE rates, as PUC commissioners may regard the retail rate as an upper bound on what a CLEC could afford to pay for a UNE. Finally, UNE rates may systematically differ if they were set in an arbitration case immediately following the enactment of TA96.

Beyond the state PUC, there may be state-specific influences that vary by time. For instance, the political affiliation of the governor or the state legislature may influence how the state PUC sets UNE rates. Not only can the governor and state legislature have a direct influence on the PUC through appointments and budgetary powers, but their political affiliation may be a proxy for the political sentiment of the citizens and reflect the general regulatory environment in the state. As described in the previous paragraph, the direction of this effect is ambiguous.

The RBOC's federal regulatory status may play an important role in how UNE rates are set. As noted above, the FCC and state PUCs had to certify that the RBOC's UNE rates were TELRIC-based before the RBOC was allowed to sell long-distance phone service. Therefore, one might expect that the UNE rates in the period immediately prior to the FCC's decision were

[19] Lehman and Weisman (2000) argue that state commissions can unfairly shift risk to incumbent firms by enacting a retail price cap and setting a relatively low UNE rate.

lower than they would have otherwise been. Some RBOCs also voluntarily lowered their UNE rates during the Section 271 application process in the hope of securing permission to provide long-distance service. If the RBOCs were in fact lowering their UNE rates below the rates that would have prevailed otherwise, one would expect these voluntary reductions to result in lower UNE rates. However, the RBOCs might have made voluntary reductions that were not as drastic as would otherwise have been ordered by the state PUC during the Section 271 application process. If so, the RBOCs might have been able to secure a more favorable UNE rate by pre-empting action by the state PUC. In such a case, the marginal effect of the voluntary reduction could be positive.

Lastly, the level of observed UNE entry may affect the UNE rates. If the PUC views the level of entry as relatively low, certes paribus, it may be inclined to lower UNE rates to encourage additional entry. Thus, one would expect a positive coefficient on this variable.

4. Model specification and data used.

4.1. Model specification.

As noted above, UNE rates changed infrequently in some states. Consequently, UNE rates often exhibit a high degree of stationarity. However, relatively frequent data are required to capture the exact timing of the rate decisions. To allow for frequent data and the stationarity of the lagged dependent variable, the lagged rate is included as an explanatory variable.[20]

Including the lagged dependent variable as an explanatory variable in a panel data regression complicates the econometric analysis. When an OLS fixed-effects estimator is used, a negative bias of order 1/T is introduced in the coefficient on the lagged dependent variable (Nickell, 1981). OLS estimation of the model in first differences partially corrects the bias, but does not entirely alleviate the endogeneity of the lagged dependent variable. Arellano and Bover (1995) and Blundell and Bond (1998) derive a generalized methods of moments estimator

[20] In the econometrics literature this is referred to a dynamic panel data model.

(known as system GMM) that simultaneously estimates the model in levels and first differences. Blundell and Bond (1998) perform Monte Carlo simulations that demonstrate the system GMM estimator is superior to both the OLS fixed effects and GMM estimations using first differences only. Further lagged values of the levels and first difference of the dependent variables are used as instruments for the lagged dependent variable.[21] The system GMM estimator is appropriate when the coefficient on the lagged dependent variable is 0.8 or greater. For this estimator to be valid, the lagged dependent variable must have a constant correlation with the state effects and be uncorrelated with present and past values of the error term. Further, it is assumed that the error terms have a mean of zero and are not serially correlated. Robust standard errors that are consistent in the presence of heteroskedasticity and autocorrelation within states are used in calculating t-statistics.

4.2. Data used.

Summary statistics of the data used are provided in Table 1. The sample is comprised of quarterly data. The date in which a state enters the sample is determined by the date the PUC in that state and the corresponding leader state ordered its initial UNE rates. That date ranges from April 1997 to October 1997. Data for all states included in the analysis run through the end of 2003. Correlation coefficients between the non-UNE rate explanatory variables are provided in Table 2.

The dependent variable in the analysis is the statewide average recurring rate for the local loop in a quarter.[22,23,24] The local loop consists of the wires that connect a customer's premises

[21] In the estimations that follow, the previous four quarters of the level of the lagged dependent variable are used as instruments in the first differences equation, while one lag of the first difference of the lagged dependent variable is used as an instrument in the levels equation.

[22] Specifically, it is weighted average of the monthly rate for the 2-wire copper in the various density zones in the state. The weights are the number of lines in each density zone.

[23] Another option is to use the rate set for the loop in the densest areas of the state, known as the urban zone rate. However, many states did not de-average rates by zone until 2000 and did so at differing times. Thus, to be able to model rates since TA96 was implemented, statewide average rates must be used.

to the RBOC's wire center. The local loop is the network element that is the most costly to replicate, and so is the element that entrants would most likely lease from the incumbent.[25] The rates used in the study were obtained primarily from state PUC orders and RBOC documents. Unlike data sets used in earlier studies, the exact date on which the rate was ordered is known and will be integral in examining the issue of interstate interdependence

The cost variable is a measure of the monthly cost of the loop. Beginning in 2000 the FCC published annual HCPM estimates. As noted above, while parties have debated whether the model over- or under-estimates costs, it does provide a reference over time and across states. However, these data are not available prior to 2000. Therefore the cost variable used here is constructed from two different data series. For the period prior to 2000 the cost variable equals the embedded, or historical, cost of the loop as reported by the National Exchange Carrier Association regarding universal service funding. For 2000 forward, the cost variable is the estimate from the HCPM. While the variable is not ideal, it should capture the factors that account for the discrepancies in costs, such as population density, wire center locations, and local cost levels.[26]

As explained in Section 2, UNE rate proceedings are often lengthy. As such, it takes time for commissions to incorporate new information in their cost studies. Further, state PUCs may not learn the results of proceedings in other states for some time or may be in an earlier stage of their UNE rate study. Therefore, it is appropriate to model with a lag the influence of the rates of the other states. However, as the number of lags included in the model increases, the number of

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[24] Data for Alaska and Hawaii are not included as they are not part of any of the major RBOC regions. Arkansas is also not included because the commission in that state ruled that it did not have the authority to conduct a cost study to set UNE rates. Rates in the District of Columbia are not included, as the focus is on rate setting by state PUCs. Rates for Connecticut are not included as it is geographically surrounded by Verizon states but the RBOC in the state is owned by SBC.

[25] Some entrants serving large business customers built their own networks and therefore did not have to rent any network elements from the incumbent.

[26] The results do not change substantially when embedded costs are used for the entire period.

explanatory variables increases quickly[27], thus limiting degrees of freedom. With this constraint in mind, the model is estimated using two different lag structures. The first includes the neighbor states' rates over each of the last four quarters, thus spanning one year. The second structure includes the neighbor states' rates from each of the last four half-years, thus spanning two years.[28]

As described above, characteristics of the PUCs may also influence UNE rates. To control for the length of time commissioners have served, the average tenure of the commissioners is included. The political ideology of the commission is captured in the fraction of commissioners that describe themselves as Republican. The effect on UNE rates of the form of retail rate regulation is captured in a dummy variable that equals one if the state employs rate of return regulation on either residential or business services.[29] However, this variable may be endogenous, as unobserved factors may be jointly determining the form of retail rate regulation and the UNE rate. To correct for this endogeneity, variables that measure customer satisfaction as reported by the FCC's ARMIS database are used as instruments.[30] The average retail rate for the RBOC is calculated using FCC ARMIS data and is lagged one year to account for the

[27] For each lag of other states' rates that is included in the estimation, three explanatory variables are added (the weighted average of the neighbor rates interacted with the leader and follower dummy variables and the leader's rate interacted with the follower dummy variable).

[28] Given the rates of other states enter the model with a lag, they are treated as exogenous from the perspective of the PUC setting current rates.

[29] Retail rate regulation schemes are quite complex, as some plans can have price caps on some services and another form of incentive regulation on other products. By using a dummy variable that reflects whether the PUC employs rate-of-return regulation on either residential or business basic services, the complications posed by the idiosyncrasies of the various incentive-based regulation plans are avoided. As this variable takes a value of one when rate-of-return regulation is used, the expected sign of the coefficient of this variable is positive given Lehman and Weisman's (2000) analysis.

[30] These variables are used as instruments because while UNE rate proceedings typically pit RBOCs against CLECs, retail rate regulation proceedings tend to be disputes between the RBOC and consumer groups. Therefore, while these satisfaction variables affect the form of retail rate regulation, they do not affect the level of UNE rates. The econometric evidence supports this logic, as the tests of joint significance indicate that the instruments are correlated with the form of retail rate regulation while the C-statistic values indicate they are not correlated with UNE rates. See Section A2 for details.

information delays in UNE rate proceedings outlined above.[31] Finally, a dummy variable is also included that takes the value of one if the rate was set during an arbitration case immediately following the passage of TA96, and zero otherwise.[32]

Two explanatory variables are employed to account for the political sentiment of the state's elected officials and its citizens. A dummy variable is included that equals one if the governor is a Republican and zero otherwise. Another variable is included that equals the percent of the state legislators that are Republican. To determine the potential interactive effects between the ideology of the PUC and the governor, the product of the two variables is included as an explanatory variable.

Dummy variables are also used to capture the effects of the status of the RBOC's Section 271 application in that state. A dummy variable is included that equals one if the rate was set during the year prior to the RBOC's application up to the date of the FCC's decision. To measure the marginal impact of the RBOC making a voluntary reduction, a dummy variable is included that equals one if the rate was the result of a voluntary reduction by the RBOC in conjunction with its Section 271 application.

The level of competitive entry in the state is controlled for by the number of lines leased by CLECs. To account for delays in PUCs incorporating information into their decisions, the variable is lagged one year. Endogeneity may be present, as the level of entry is likely determined in part by the future UNE rate, which in turn (given the stationarity of UNE rates) is likely correlated with the present rate. The state unemployment rate lagged one year is used as an instrument for this variable.[33] To allow for meaningful comparisons across states, the number of leased lines is divided by the standard deviation of the variable for that state.

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[31] Given the variable enters the estimation with a lag, endogeneity is not expected to be a concern. A C-test confirms that the variable is not endogenous. See Section A2 for details.

[32] Specifically, the arbitration rates used in this study are those from arbitrations between AT&T and the local RBOC.

[33] The logic behind the use of the variable is that the level of economic activity affects the level of UNE entry but not UNE rates. The econometric results suggest that these instruments are valid. See Section A2 for details.

Finally, dummy variables for each calendar year are included in the analysis to account for shocks common to all states in a given year not captured by the other explanatory variables.

5. Estimation results.

5.1. Coefficient estimates.

Table 3 summarizes the coefficient estimates from the basic model. Column (1) lists the estimates from the lag structure spanning one year, while the estimates corresponding to a lag structure spanning two years are listed in Column (2). The estimation diagnostic tests indicate that the system GMM approach is valid with this data set. The tests for autocorrelation demonstrate that there is first-order autocorrelation in first differences, but no autocorrelation of higher order. This indicates that the error terms are not serially correlated. Further, the specification passes the Hansen tests of overidentification, which tests whether the moment conditions beyond those needed to identify the parameters are valid.[34] Finally, the coefficient on the lagged dependent variable is over 0.8 in both specifications, which confirms that the system GMM estimator is appropriate.

The estimates from both Column (1) and Column (2) indicate that the cost variable is statistically significant, at either a 90% or 95% statistical confidence level depending on the specification. Of the neighbor rates, the leader's rate lagged six months has a statistically significant impact on the followers' rates, while the followers' rates do not have a statistically significant impact on the rates of other followers or leaders.

The dummy variables that capture the effect of the RBOC's application to sell long-distance services are negative and statistically significant. The negative coefficient on the variable that indicates whether the RBOC made a voluntary reduction in the application process suggests that the RBOCs were not engaging in strategic behavior. In the two-year lag specification, the dummy variable that captures the effect of a Republican governor is positive

[34] See Section A2.1 for further details.

and statistically significant. Finally, the level of UNE entry appears to have a statistically significant effect at a 90% confidence level. Somewhat surprisingly, none of the variables that capture PUC characteristics are statistically significant.

5.2. Economic effects.

The presence of the lagged dependent variable as an explanatory variable implies that the coefficient estimates only measure short-run effects. Furthermore, the coefficient estimates do not clearly convey the economic significance of the explanatory variables. Table 4 details the effects on UNE rates from a change in an explanatory variable that lasts two years.[35] The effects reported in Table 4 are based on the coefficient estimates in the specification that includes two years of lagged neighbor UNE rates[36].

According to the estimates, a one-dollar increase in the cost variable on average leads to a $0.40 increase in the UNE rate two years later. This increase is highly statistically significant. However, an F-test as to whether a $1 increase in the cost variable leads to $1 increase in UNE rates is rejected at over a 99% confidence level. Thus, UNE rates do not perfectly reflect changes in cost (as measured by the available variable).[37]

The estimates suggest that UNE rates are significantly affected by changes in the leader's UNE rate. Figure 3 depicts the effect over two years on followers' rates after a one dollar increase in the leaders' rate and the corresponding 95% confidence interval. As the figure shows, the average effect after one year is to increase the followers' rate by roughly $0.60, while after two years, the effect reaches almost $0.80. Table 4 reports that a one standard deviation ($3.37)

[35] Long-run effects that are based on permanent changes in the explanatory variable are reported in Section A3.

[36] The corresponding effects based on the specification that includes one year of lagged neighbor rates are very similar and are contained in Section A3.

[37] It is worth repeating that the cost variable used here (based mostly on the FCC's HCPM cost model) is not universally considered a valid cost proxy. Thus, while a $1 increase in the cost variable is not realized in the UNE rate, one could argue that the cost variable overstates TELRIC costs to such a degree that changes in costs are in fact fully realized in changes in UNE rates.

in the leader's rate leads to a $2.47 increase in the followers' rates. Conversely, the estimates suggest that the effect of followers' rates on other followers is not statistically significant. Thus, the results suggest that the leader states do in fact have a significant impact on the other states in the RBOC region.[38]

Of the variables that capture characteristics of the PUC, the effect of average tenure has the expected sign, but is not statistically significant. In regards to political ideology, neither the effects of the ideology of the commissioners nor the ideology of the commissioners interacted with the ideology of the governor are statistically significant. This may be due to the potentially conflicting effects described above. The effect of the rate-of-return retail rate regulation variable is positive as expected but statistically insignificant and only a third of the effect found by Lehman and Weisman (2000). The lack of statistical significance and smaller estimated effect may be due in part to the evolving nature of incentive regulation plans and the difficulty in classifying them (as noted above). Furthermore, the average retail rate also is statistically insignificant. Finally, while the AT&T arbitration rate has the expected sign, it too is not statistically significant.

However, the election of a Republican governor is associated with a $1.15 increase in UNE rates two years later that is statistically significant. One may attribute this effect to two, perhaps not mutually exclusive effects: a preference for less-aggressive regulation and favorable treatment for large corporations.[39] The effects of both the percent of Republican state legislators

[38] The estimate of the effect of the followers' rate on the leader's rate is somewhat surprising. While it is only roughly two-fifths of the size of the leader's effect on the followers, it is statistically significant at a 90% confidence level. From the coefficient estimates, it appears this effect exists four quarters after the followers change their rates. A possible explanation is that there is a feedback effect. For example, if rates are generally falling, the following pattern may be present: The leader lowers its rate, which is followed six months later by the followers. One year after the followers' rate change, the leader again lowers its rate again, which causes the leader's rate to appear to be influenced by the followers' rate change. Also, given that the coefficient estimates of the effect of the followers' rates on the leaders are not statistically significant, the statistical significance of the overall effect is being driven largely by covariance between the coefficients on the followers' rates and the lagged dependent variable.

[39] One concern with this result could be that Republican governors tend to be elected in less urban, and thus higher UNE-cost, states. However, the average UNE rate in states with Republican governors is virtually identical to the average in states with Democratic governors.

and the interaction of the Republican governor and PUC political affiliation are statistically insignificant.

The variables that capture the Section 271 status of the RBOC indicate that those applications had a strong influence on the UNE rates. On average, UNE rates set during the period prior to applications to enter the long-distance market are roughly $2.00 lower two years later. When the RBOC voluntarily lowered the UNE rate this effect more than doubled.

Finally, the observed level of CLEC use of RBOC UNE lines is both statistically and economically significant. A one standard deviation decrease in UNE lines is associated with UNE rates falling roughly $4.00. This result suggests that PUC commissioners are strongly influenced by the entry (or lack thereof) of CLECs into the UNE market when setting UNE rates.

6. Conclusion.

This paper analyzes the factors that determine the rates that state PUCs set for access to the incumbent's telecommunications network. The results suggest that factors other than cost influence the rates. The rate set by the largest state in each RBOC region appears to influence the rates set by other states in that region. Further, rates tend to be higher in states where the governor is a Republican and lower in the period prior to an RBOC applying for permission to sell long-distance services and when observed competitive entry is lower.

Beyond providing insights into telecommunications regulation, these results may have implications for other areas in which the federal government delegates implementation of policies to state agencies. While state agencies may possess valuable local knowledge, it is possible that the intent of the federal policy will not be realized through the actions of the states. Other policy areas in which this type of analysis may provide some insight include state implementation of the No Child Left Behind Act and environmental policies as dictated by the EPA.

The findings in this paper could be extended in several directions. For example, the rates used in this paper are the monthly rates for the local loop. The PUCs also set one-time

connection fees for these loops that are also important to CLECs pondering entry into a state. Also, while the local loop is arguably the most important network element, the PUCs set rates for many other network elements. Analyses of these additional rates could shed further light on the factors that influence state PUCs. Finally, as noted in footnote 18, initial tests for nation-wide information spillovers suggested that states may have influence outside their RBOC region. Further analysis into this issue could provide additional insight into how state agencies implement federal regulations.

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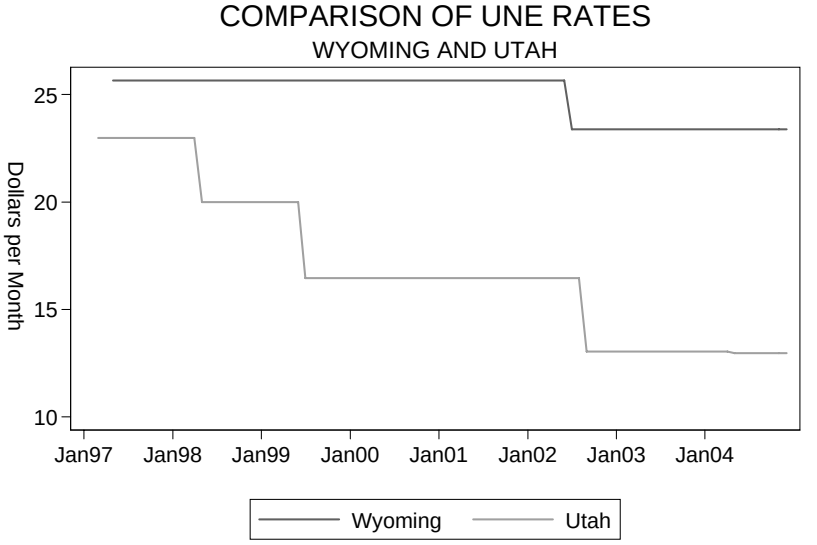
FIGURE 1


COMPARISON OF UNE RATES
WYOMING AND UTAH
Dollars per Month
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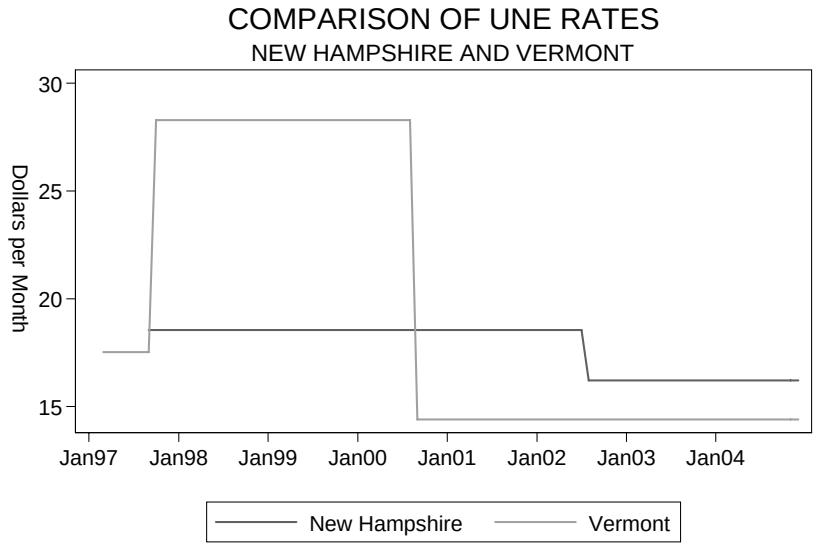
20
15
10
Jan97
Jan98
Jan99
Jan00
Jan01
Jan02
Jan03
Jan04
Wyoming
Utah


COMPARISON OF UNE RATES
NEW HAMPSHIRE AND VERMONT
Dollars per Month
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25
20
15
Jan97
Jan98
Jan99
Jan00
Jan01
Jan02
Jan03
Jan04
New Hampshire
Vermont

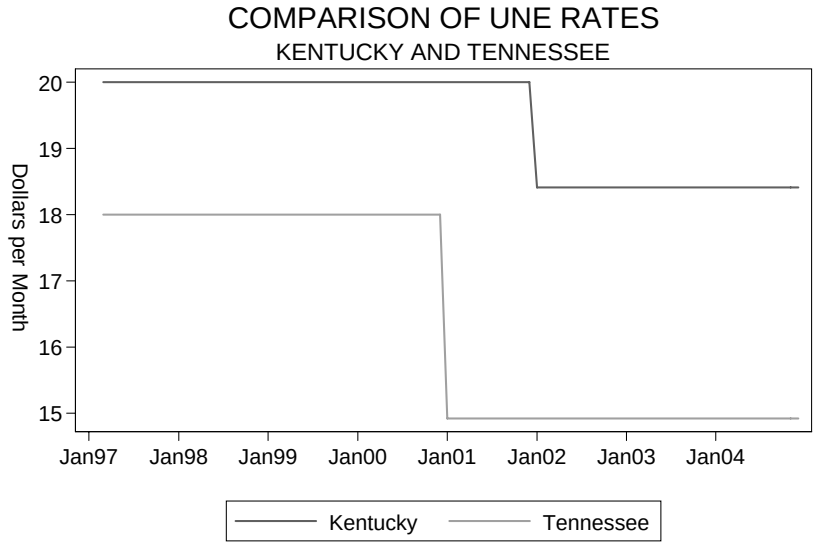
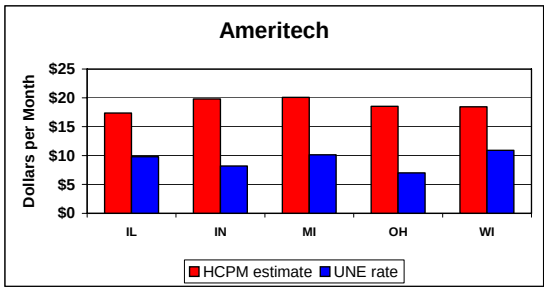

COMPARISON OF UNE RATES
KENTUCKY AND TENNESSEE
Dollars per Month
20
19
18
17
16
15
Jan97
Jan98
Jan99
Jan00
Jan01
Jan02
Jan03
Jan04
Kentucky
Tennessee

FIGURE 2


Ameritech
Dollars per Month
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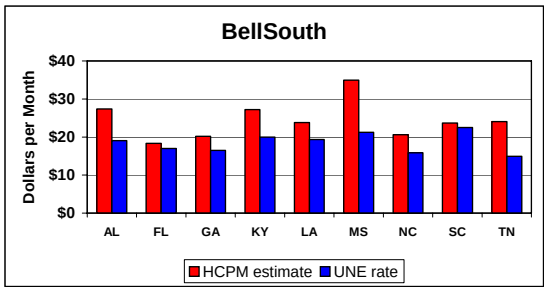
$20
$15
$10
$5
$0
IL
IN
MI
OH
WI
HCPM estimate
UNE rate


BellSouth
Dollars per Month
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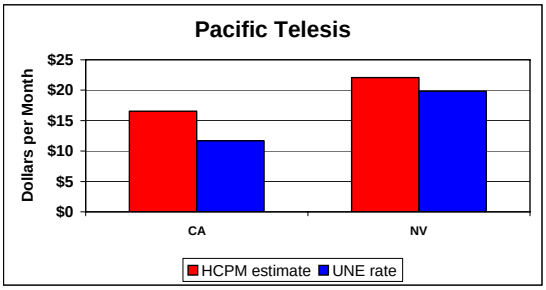
$10
$0
AL
FL
GA
KY
LA
MS
NC
SC
TN
HCPM estimate
UNE rate


Pacific Telesis
Dollars per Month
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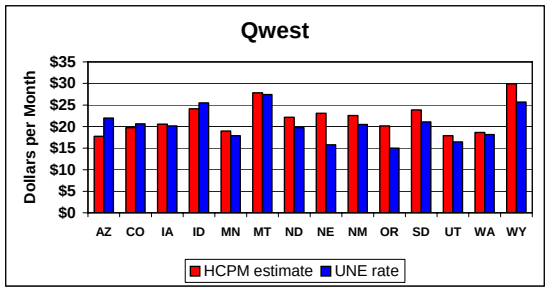
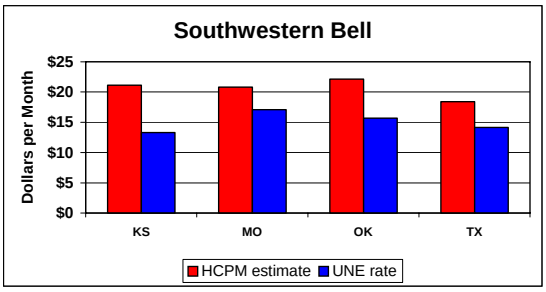
$20
$15
$10
$5
$0
CA
NV
HCPM estimate
UNE rate


Qwest
Dollars per Month
$35
$30
$25
$20
$15
$10
$5
$0
AZ
CO
IA
ID
MN
MT
ND
NE
NM
OR
SD
UT
WA
WY
HCPM estimate
UNE rate


Southwestern Bell
Dollars per Month
$25
$20
$15
$10
$5
$0
KS
MO
OK
TX
HCPM estimate
UNE rate

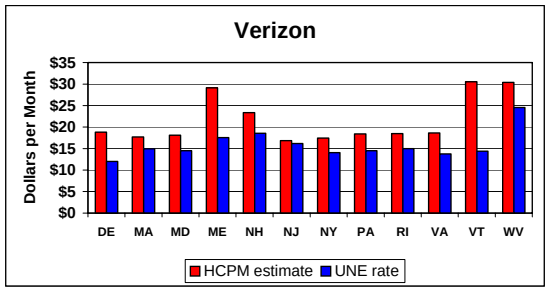

Verizon
Dollars per Month
$35
$30
$25
$20
$15
$10
$5
$0
DE
MA
MD
ME
NH
NJ
NY
PA
RI
VA
VT
WV
HCPM estimate
UNE rate

FIGURE 3

CUMULATIVE EFFECT OF A $1 INCREASE IN LEADER'S RATE ON FOLLOWER'S RATE

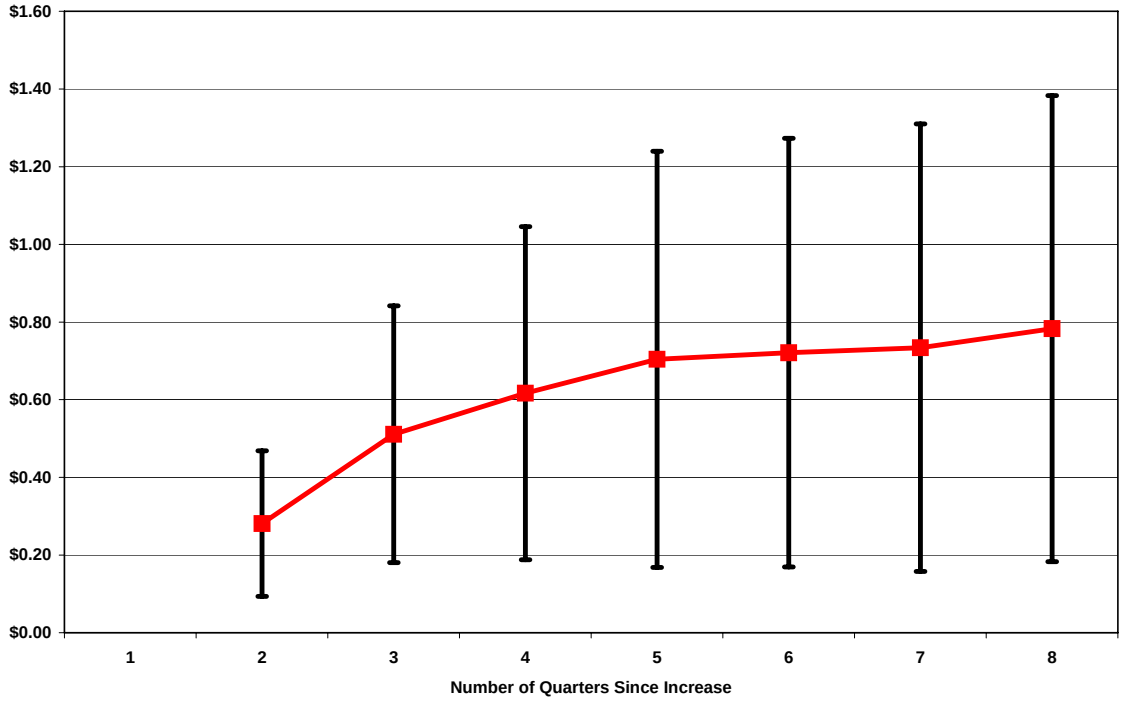


TABLE 1

SUMMARY STATISTICS

Variable	Mean	Minimum	Maximum	Standard Deviaion
Lagging Neighbor States' Rates One Year (n = 1103)				
UNE Rate (All States)	$16.62	$7.01	$28.82	4.59
UNE Rate (Leader States)	$15.30	$9.81	$20.65	3.41
UNE Rate (Weighted Average of Follower States)	$15.80	$8.13	$27.22	3.14
Cost Variable	$21.27	$13.97	$41.78	4.38
Percent of Commissioners Republican	46.3%	0.0%	100.0%	30.7
Average Tenure of Commissioners (years)	5.2	0	22.5	3.1
Rate of Return Retail Rate Regulation	0.18	0	1	0.39
Governor Republican	0.6	0	1	0.49
AT&T Arbitration	0.16	0	1	0.37
Period Prior to Section 271 Decision	0.25	0	1	0.43
Voluntary Reduction	0.07	0	1	0.26
UNE Entry (Lagged One Year, Divided by Standard Deviation)	0.54	0	2.77	0.69
Average Retail Rate	$29.16	$14.45	$44.44	5.16
Lagging Neighbor States' Rates Two Years (n = 919)				
UNE Rate (All States)	$16.44	$7.01	$28.29	4.49
UNE Rate (Leader States)	$15.11	$9.81	$20.65	3.37
UNE Rate (Weighted Average of Follower States)	$15.65	$8.13	$20.51	3.13
Cost Variable	$21.24	$13.97	$35.86	4.22
Percent of Commissioners Republican	45.8%	0.0%	100.0%	30.8
Average Tenure of Commissioners (years)	5.2	0.1	22.5	3.0
Rate of Return Retail Rate Regulation	0.17	0	1	0.37
Governor Republican	0.6	0	1	0.49
AT&T Arbitration	0.11	0	1	0.31
Period Prior to Section 271 Decision	0.29	0	1	0.45
Voluntary Reduction	0.09	0	1	0.28
UNE Entry (Lagged One Year)	0.64	0	2.77	0.71
Average Retail Rate	$29.53	$14.45	$44.44	5.22

TABLE 2

CORRELATION MATRIX OF NON-UNE RATE EXPLANATORY VARIABLES

ONE-YEAR LAG SPECIFICATION	Cost	% PUC Repub	PUC Tenure	AT&T Arb.	ROR Reg	Gov. Repub.	% Legis. Repub.	Section 271	Voluntary	Gov. & % PUC Repub.	UNE Lines	Retail Rate
Cost	1.00											
% PUC Repub	-0.23	1.00										
PUC Tenure	0.24	0.00	1.00									
AT&T Arb.	0.17	-0.14	0.00	1.00								
ROR Reg	0.23	-0.08	-0.02	0.10	1.00							
Gov. Repub.	-0.07	0.44	0.01	0.14	-0.04	1.00						
% Legis. Repub.	0.04	0.20	0.11	0.10	0.27	0.12	1.00					
Section 271	0.00	0.03	-0.01	-0.26	-0.06	0.04	-0.06	1.00				
Voluntary	0.01	0.10	0.06	-0.12	0.08	-0.01	0.13	0.49	1.00			
Gov. & % PUC Repub.	-0.18	0.80	-0.01	0.00	-0.08	0.78	0.19	0.00	0.05	1.00		
UNE Lines	-0.11	0.07	-0.07	-0.29	-0.12	-0.05	0.04	0.50	0.37	-0.01	1.00	
Retail Rate	0.43	0.01	0.15	-0.09	-0.12	-0.06	-0.19	0.21	0.08	-0.04	0.12	1.00

TWO-YEAR LAG SPECIFICATION	Cost	% PUC Repub	PUC Tenure	AT&T Arb.	ROR Reg	Gov. Repub.	% Legis. Repub.	Section 271	Voluntary	Gov. & % PUC Repub.	UNE Lines	Retail Rate
Cost	1.00											
% PUC Repub	-0.24	1.00										
PUC Tenure	0.28	0.01	1.00									
AT&T Arb.	0.22	-0.17	0.04	1.00								
ROR Reg	0.18	-0.08	-0.02	0.12	1.00							
Gov. Repub.	-0.09	0.42	0.00	0.16	-0.02	1.00						
% Legis. Repub.	0.00	0.23	0.10	0.13	0.29	0.14	1.00					
Section 271	0.01	0.04	0.00	-0.22	-0.03	0.04	-0.06	1.00				
Voluntary	0.01	0.11	0.07	-0.11	0.11	0.00	0.14	0.49	1.00			
Gov. & % PUC Repub.	-0.20	0.80	-0.01	-0.02	-0.07	0.77	0.23	0.01	0.06	1.00		
UNE Lines	-0.13	0.09	-0.08	-0.26	-0.09	-0.05	0.05	0.48	0.35	0.01	1.00	
Retail Rate	0.45	0.03	0.18	-0.02	-0.10	-0.07	-0.16	0.19	0.06	-0.02	0.09	1.00

TABLE 3

COEFFICIENT ESTIMATES FROM 1-YEAR & 2-YEAR LAG SPECIFICATIONS

Explanatory Variable	One-Year Specification	Two-Year Specification
UNE Rate, Lagged One Quarter	0.876 *** (17.18)	0.815 *** (12.37)
Effect of Leader's Rate on Followers		
Lagged One Quarter	-0.012 (-0.15)	
Lagged Two Quarters	0.164 * (1.73)	0.281 *** (3.02)
Lagged Three Quarters	-0.016 (-0.22)	
Lagged Four Quarters	-0.058 (-1.64)	-0.081 (-0.89)
Lagged Five Quarters		
Lagged Six Quarters		-0.054 (-0.90)
Lagged Seven Quarters		
Lagged Eight Quarters		0.038 (1.16)
Effect of Followers' Rates on Other Followers		
Lagged One Quarter	0.001 (0.20)	
Lagged Two Quarters	0.076 (0.54)	-0.112 (-1.27)
Lagged Three Quarters	-0.080 (-0.73)	
Lagged Four Quarters	-0.016 (-0.33)	0.009 (0.89)
Lagged Five Quarters		
Lagged Six Quarters		0.026 (0.34)
Lagged Seven Quarters		
Lagged Eight Quarters		0.012 (0.15)
Effect of Followers' Rates on Leaders		
Lagged One Quarter	0.048 (0.62)	
Lagged Two Quarters	-0.060 (-0.70)	0.028 (0.37)
Lagged Three Quarters	0.003 (0.04)	
Lagged Four Quarters	0.065 (1.69)	0.045 (1.06)
Lagged Five Quarters		
Lagged Six Quarters		0.008 (0.21)
Lagged Seven Quarters		
Lagged Eight Quarters		0.018 (0.46)

Cost	0.061 (1.91)	*	0.096 (2.38)	**
Percent of PUC Republican	0.000 (-0.12)		-0.002 (-0.97)	
Average Tenure of PUC	0.017 (1.10)		0.016 (0.93)	
ROR Retail Rate Regulation	0.187 (0.28)		0.154 (0.20)	
Governor Republican	0.211 (1.53)		0.263 (1.85)	*
Percent of State Legislature Republican	-0.244 (-0.53)		-0.375 (-0.69)	
Percent of PUC Republican Interacted with Governor	-0.002 (-0.98)		-0.002 (-0.85)	
AT&T Arbitration	0.083 (0.30)		0.074 (0.30)	
Period Prior to Section 271 Decision	-0.481 (-2.65)	**	-0.479 (-2.48)	***
Voluntary Reduction by RBOC	-0.532 (-2.45)	**	-0.636 (-2.16)	**
UNE Entry (lagged 1 year, divided by standard deviation for that state)	0.770 (1.72)	*	0.999 (1.92)	*
Average Retail Rate (lagged 1 year)	0.008 (0.77)		0.011 (0.79)	
Overall F-Statistic	1894		1412	
Number of Observations	1103		919	
Arellano-Bond Test				
For AR(1) in First Differences (p-value)	-2.85 (0.00)	***	-2.57 (0.01)	***
For AR(2) in First Differences (p-value)	-0.22 (0.82)		-0.8 (0.42)	
Hansen Test of Overidentified Restrictions (p-value)	1.76 (0.94)		2.59 (0.86)	

Notes:
Year dummy variables are included and are generally statistically significant.
Unless otherwise noted, t-statistics are reported in parentheses.
*** - statistically significant at 99% confidence level
** - statistically significant at 95% confidence level
* - statistically significant at 90% confidence level

TABLE 4

EFFECTS OF CHANGES IN EXPLANATORY VARIABLES ON UNE RATES TWO YEARS LATER USING TWO-YEAR LAG SPECIFICATION

Explanatory Variable	Effect of a 1-Unit Increase		Economic Effect[1]	
Effect of Neighbors' Rates				
Leader's Rate on Followers (C)	0.73 (2.57)	**	2.47 (2.57)	**
Followers' Rates on Followers (C)	-0.35 (-1.03)		-1.10 (-1.03)	
Followers' Rates on Leaders (C)	0.31 (1.91)	*	0.97 (1.91)	*
Effect of Other Explanatory Variables				
Cost (C)	0.40 (3.65)	***	1.68 (3.65)	***
Percent of PUC Republican (C)	-0.01 (-1.10)		-0.31 (-1.10)	
Average Tenure of PUC (C)	0.07 (0.96)		0.21 (0.96)	
ROR Retail Rate Regulation (B)	0.67 (0.20)		0.67 (0.20)	
Governor Republican (C)	1.15 (1.89)	*	1.15 (1.89)	*
Percent of State Legislature Republican (C)	-1.63 (-0.74)		-0.23 (-0.74)	
Percent of PUC Republican Interacted with Governor Republican	-0.01 (-0.81)		-0.37 (-0.81)	
AT&T Arbitration (B)	0.32 (0.30)		0.32 (0.30)	
Period Prior to Section 271 Decision (B)	-2.08 (-2.27)	**	-2.08 (-2.27)	**
Voluntary Reduction by RBOC (B)	-2.77 (-2.19)	**	-2.77 (-2.19)	**
UNE Entry (lagged 1 year, divided by standard deviation for that state) (C) [2]	4.35 (2.42)	**	4.35 (2.42)	**
Average Retail Rate (lagged 1 year) (C)	0.05 (0.81)		0.24 (0.81)	

(B) - binary explanatory variable
(C) - continuous explanatory variable

[1] Economic effects for continuous explanatory variables are based on a one standard deviation increase in that variable, while economic effects for binary explanatory variables are based on a change in the variable from zero to one.
[2] This variable is already scaled by dividing by the standard deviation, so the economic effect is based on a one-unit increase.

Notes:
t-statistics are reported in parentheses.
*** - statistically significant at 99% confidence level
** - statistically significant at 95% confidence level
* - statistically significant at 90% confidence level

APPENDICES

A1. Data notes.

This appendix describes some of the details of the data used in the analysis.

A1.1. UNE rates.

For 18 of the 919 observations de-averaged rates were reported and a statewide average was neither reported nor could be calculated based on the available data. In those instances a simple average of the de-averaged rates was used as the statewide average rate.

In December 1997 the Texas PUC set both a statewide rate that was effective immediately and de-averaged rates that were to take effect a month later. In this analysis the initial statewide rate is ignored.

The former Pacific Telesis region includes only two states, California (the leader) and Nevada. Thus, Nevada is the only follower state and the rates of other follower states in the region do not exist. To keep Nevada in the sample and given that SBC now controls the former Pacific Telesis and Ameritech regions, the rates of the follower states in the former Ameritech region are used as a proxy for the other follower rates for Nevada.

A1.2. Cost estimate.

The HCPM data were received via email from the FCC.

Both the embedded and HCPM cost estimates are reported annually. Quarterly values are obtained via linear interpolation of the data.

For each year except 2000, the HCPM cost estimate is provided only for the cost of the entire line, which includes, in addition to the loop cost, the cost for line port, EO usage, signaling, transport, billing/bill inquiries, and directory listing. To obtain an estimate of the loop

cost for those years, the fraction of the line cost that is attributable to the loop in 2000 is applied to the total line costs in the other years.

A1.3. PUC characteristics.

Data regarding PUC commissioners were derived from *Profiles of Regulatory Agencies of the United States & Canada: Yearbook 1995-1996* (NARUC) and NARUC membership directories (specifically, directories dated January 1998, February 1999, February 2002, February 2003, July 2003, and March 2004).

Besides being reported as either a Democrat or Republican, a commissioner could also be listed as independent or have no reported political affiliation. For the purposes of this analysis, those commissioners who were reported as independent of for whom a political affiliation was not reported are equally Democrat and Republican. (For example, if a state's PUC is composed entirely of independents and/or commissioners for whom their political affiliation is not reported, the value of the variable percent of commissioners that are Republican for that PUC would be 0.5.)

The type of retail rate regulation employed in each state is derived from reports in the *State Telephone Regulation Report* (1/25/96, 2/8/96, 3/20/97, 4/3/97, 4/3/98, 4/17/98, 8/20/99, 9/3/99, 9/29/00, 10/13/00, 10/27/00, 2/15/02, 3/1/02, 3/15/02, 5/9/03, 5/23/03, 6/6/03, 7/30/04, 8/13/04, and 8/27/04). For some of the descriptions of the regulatory plans, only a year was given for the beginning or the end of the plan's duration. In those instances, the exact dates were inferred from the prior or succeeding plan.

The three residential customer satisfaction variables used as instruments for the form of retail rate regulation come from the annual FCC ARMIS Report 43-06. Specifically, they are the percent of customers surveyed that are dissatisfied with the RBOC's installation, repair, and billing services. Quarterly values are obtained via linear interpolation of the data.

Estimates of retail rates are somewhat problematic as retail rates can vary across customers and regions within a state. The proxy used in this analysis is the RBOC's local

network services revenue (Row 520 from ARMIS report 43-03) divided by the number of switched access lines.

A1.3. State political variables.

The gubernatorial data are obtained from the Book of the States (The Council of State Governments, 1996-1997, 1998-1999, 2001-2002, 2002, 2003) and the CNN.com web page "2004 Election Results" (http://www.cnn.com/ELECTION/2004/pages/results/governor/full.list/). The state legislature data are obtained from Statistical Abstracts of the United States (U.S. Census Bureau, 2002, 2003, 2004-2005) and the National Conference of State Legislatures website (2005 Partisan Composition of State Legislatures, http://www.ncsl.org/ncsldb/elect98/partcomp.cfm?yearsel=2005).

As Nebraska's legislature is non-partisan, for this analysis the percent of state legislatures that are Republican is assumed to be 50%.

A1.4. Section 271 status.

Data regarding RBOC applications to provide long-distance service are obtained from the FCC web page "RBOC Applications to Provide In-region, InterLATA Services Under § 271" (http://www.fcc.gov/Bureaus/Common_Carrier/in-region_applications/).

A1.5. Level of competitive UNE entry.

The data reported are from two series of (non-overlapping) reports of RBOC survey responses. The 1997 and 1998 data are from voluntary surveys completed by the RBOCs and are reported in the December 1998 and August 1999 FCC *Local Competition* reports produced by the Industry Analysis Division in the Common Carrier Bureau. The data for 1999 forward are based on RBOC responses to the mandatory Form 477 survey and are obtained from reports entitled *Selected RBOC Local Telephone Data*. Both data series can be found at http://www.fcc.gov/wcb/iatd/comp.html.

The UNE line count used in this analysis includes both UNE-L and UNE-P lines. UNE-L lines are where the CLEC leases only the local loop, whereas UNE-P lines involve the CLEC leasing switching unbundled elements in addition to the local loop.

For some states the first report of the number of UNE lines is made some time (at most one year) after the CLECs are able to begin leasing the lines. The data for the period prior to this first report is linearly interpolated by assuming that zero UNE lines were being leased prior to a rate being set.

Finally, the data are reported on a quarterly, annual, or semi-annual basis depending on the time period. Quarterly values are obtained when necessary via linear interpolation of the data.

A2. Tests of instrument validity and the exogeneity of the average retail rate variable.

This appendix outlines how the validity of the instruments used in the UNE rates regressions is tested. Section A2.1 describes the tests performed to determine if the instruments are not correlated with the error term, while Section A2.2 details the test used to determine if the instruments are sufficiently correlated with the endogenous explanatory variables.

Section A.3 explains the econometric test used to confirm that the lagged average retail rate is exogenous to the determination of UNE rates.

(This appendix borrows heavily from Baum, Schaffer, and Stillman (2004).)

A2.1. Tests of instruments' orthogonality to the error process.

When there are more instruments than endogenous variables (i.e., the model is overidentified), one can test whether all of the instruments are orthogonal to the error term. In GMM estimation the overidentifying restrictions can be tested with Hansen's J statistic, which if found to be greater than a threshold value indicates that the instruments are not exogenous or that they should be included as explanatory (rather than instrumental) variables in the regression. The J statistics are reported in Table A1. The J statistics for the base model suggest that the instrument set as a whole is orthogonal to the error term.

One can also test whether subsets of instruments are orthogonal to the error process. The test statistic (referred to as the C statistic) is the difference in J statistics between the specification that includes all the instruments and the specification that excludes the instruments to be tested. If the C statistics exceeds a threshold value, there is cause for concern that the tested instruments are not valid. Table A1 also details the C statistics for the instrument sets used for each of the three endogenous explanatory variables. The C-statistics indicate that the instrument sets used for the three endogenous variables are neither correlated to UNE rates nor endogenous.

A2.2. Tests of instrument relevance.

In addition to being orthogonal to the error term, instruments also must be sufficiently correlated with the endogenous explanatory variables. To test for this, each endogenous explanatory variable is regressed on all of the exogenous and instrumental variables in the model. The coefficients on the instruments are then tested for whether they are jointly equal to zero. To be valid, the coefficients should not jointly equal zero.

This test is complicated by the use of the system GMM estimator. By definition, the system GMM estimator estimates two equations simultaneously, one in levels and the other in first differences. The equation in levels is estimated along with the equation in first differences

because estimations in first differences with highly persistent dependent variables result in weak instruments (Bond, 2002, p 154).

Table A2 reports the results of the tests of instrument relevance for each of the three endogenous explanatory variables for the equations in both levels and first differences. The chi-square values suggest that the instruments easily pass the threshold test for relevance except for the form of retail rate regulation variable in the first differences equation. As noted above, this result is not worrisome as it is addressed by the system GMM estimation.

A2.3. Test of the exogeneity of the lagged average retail rate.

One may be concerned that the average retail rate variable is endogenous, even though it is lagged one year. To test for this the C statistic can be used where the J statistic from the model assuming the variable is endogenous is subtracted from the J statistic assuming the variable is exogenous. The results of this test are shown at the bottom of Table A1 and confirm that the variable is exogenous.

A3. Additional results.

This appendix describes the further results from the model.

Table A3 contains the economic effects two years after a change in an explanatory variable based on the coefficient estimates the one-year lag specification. Table A4 details the long-run economic effects based on the coefficient estimates from both the two-year and one-year lag specifications.

TABLE A1

TESTS OF OVERIDENTIFYING RESTRICTIONS

	One-Year Lag Specification	Two-Year Lag Specification	Degrees of Freedom
Base Model			
Hansen's J Statistic	1.76 (0.940)	2.59 (0.858)	6
Excluding Instruments for Lagged Dependent Variable			
Hansen's J Statistic	0.25 (0.617)	0.34 (0.561)	1
C-Statistic	1.51 (0.912)	2.25 (0.814)	5
Excluding All ROR & Entry Instruments			
Hansen's J Statistic	0.67 (0.714)	0.51 (0.777)	2
C-Statistic	1.09 (0.896)	2.08 (0.721)	4
Excluding ROR Instruments			
Hansen's J Statistic	0.91 (0.824)	1.27 (0.737)	3
C-Statistic	0.85 (0.837)	1.32 (0.724)	3
Excluding Entry Instruments			
Hansen's J Statistic	1.21 (0.944)	1.04 (0.960)	5
C-Statistic	0.55 (0.458)	1.55 (0.213)	1
Assuming Average Retail Rate Endogenous			
Hansen's J Statistic	1.42 (0.992)	1.33 (0.932)	5
C-Statistic	0.34 (0.560)	1.26 (0.262)	1

Notes:
C-Statistics are based on comparisons to base model.
P-values are reported in parentheses.

TABLE A2

TESTS OF INSTRUMENT RELEVANCE

Endogenous Regressor / Equation	One-Year Lag Specification	Two-Year Lag Specification
Lagged Dependent Variable		
Levels Equation	160.23 (0.000)	133.20 (0.000)
First Differences Equation	2449.49 (0.000)	1814.71 (0.000)
Form of Retail Rate Regulation		
Levels Equation	25.16 (0.000)	23.39 (0.000)
First Differences Equation	6.71 (0.568)	6.37 (0.606)
Level of CLEC UNE Entry		
Levels Equation	57.24 (0.000)	56.65 (0.000)
First Differences Equation	67.13 (0.000)	62.85 (0.000)

Notes:
Chi-square test statistics are reported with p-values in parentheses.
Chi-square test statistics are from joint-significance tests of the instruments in the first-stage regression.

TABLE A3

EFFECTS OF CHANGES IN EXPLANATORY VARIABLES ON UNE RATES TWO YEARS LATER USING ONE-YEAR LAG SPECIFICATION

Explanatory Variable	Effect of a 1-Unit Increase		Economic Effect[1]	
Effect of Neighbors' Rates				
Leader's Rate on Followers (C)	0.441 (2.16)	**	1.50 (2.16)	**
Followers' Rates on Followers (C)	0.015 (0.08)		0.07 (0.08)	
Followers' Rates on Leaders (C)	0.237 (1.68)	*	0.61 (1.68)	*
Effect of Other Explanatory Variables				
Cost (C)	0.319 (2.58)	**	1.40 (2.58)	**
Percent of PUC Republican (C)	-0.001 (-0.13)		-0.03 (-0.13)	
Average Tenure of PUC (C)	0.089 (1.13)		0.28 (1.13)	
ROR Retail Rate Regulation (B)	0.985 (0.28)		0.99 (0.28)	
Governor Republican (C)	1.11 (1.61)		0.54 (1.61)	
Percent of State Legislature Republican (C)	-1.29 (-0.55)		-0.18 (-0.55)	
Percent of PUC Republican Interacted with Governor Republican (C)	-0.012 (-0.89)		-0.48 (-0.89)	
AT&T Arbitration (B)	0.439 (0.30)		0.44 (0.30)	
Period Prior to Section 271 Decision (B)	-2.35 (-2.84)	***	-2.35 (-2.84)	***
Voluntary Reduction by RBOC (B)	-2.80 (-2.32)	**	-2.80 (-2.32)	**
UNE Entry (lagged 1 year, divided by standard deviation for that state) (C) [2]	4.06 (2.01)	**	4.06 (2.01)	**
Average Retail Rate (lagged 1 year) (C)	0.041 (0.78)		0.21 (0.78)	

(B) - binary explanatory variable
(C) - continuous explanatory variable

[1] Economic effects for continuous explanatory variables are based on a one standard deviation increase in that variable, while economic effects for binary explanatory variables are based on a change in the variable from zero to one.
[2] This variable is already scaled by dividing by the standard deviation, so the economic effect is based on a one-unit increase.

Notes:
t-statistics are reported in parentheses.
*** - statistically significant at 99% confidence level
** - statistically significant at 95% confidence level
* - statistically significant at 90% confidence level

TABLE A4

EFFECTS OF CHANGES IN EXPLANATORY VARIABLES ON UNE RATES
LONG-RUN

Variable	Based on One-Year Lag Specifiation: Effect of a 1-Unit Increase	Based on One-Year Lag Specifiation: Economic Effect[1]	Based on Two-Year Lag Specifiation: Effect of a 1-Unit Increase	Based on Two-Year Lag Specifiation: Economic Effect[1]
Effect of Neighbors' Rates				
Leader's Rate on Followers (C)	0.63 (1.67)	2.16 (1.67)	1.00 ** (2.47)	3.36 ** (2.47)
Followers' Rates on Followers (C)	-0.067 (-0.21)	-0.31 (-0.21)	-0.345 (-0.98)	-1.08 (-0.98)
Followers' Rates on Leaders (C)	0.467 *** (3.38)	1.21 *** (3.38)	0.534 *** (4.79)	1.67 *** (4.79)
Effect of Other Explanatory Variables				
Cost (C)	0.489 *** (3.93)	2.14 *** (3.93)	0.521 *** (5.17)	2.20 *** (5.17)
Percent of PUC Republican (C)	-0.002 (-0.13)	-0.07 (-0.13)	-0.011 (-1.20)	-0.38 (-1.20)
Average Tenure of PUC (C)	0.136 (1.11)	0.42 (1.11)	0.087 (0.96)	0.26 (0.96)
ROR Retail Rate Regulation (B)	1.510 (0.29)	1.51 (0.29)	0.834 (0.20)	0.83 (0.20)
Governor Republican (C)	1.71 (1.53)	0.84 (1.53)	1.42 * (1.75)	1.42 * (1.75)
Percent of State Legislature Republican (C)	-1.97 (-0.57)	-0.28 (-0.57)	-2.03 (-0.77)	-0.28 (-0.77)
Percent of PUC Republican Interacted with Governor Republican (C)	-0.019 (-0.78)	-0.77 (-0.78)	-0.011 (-0.77)	-0.45 (-0.77)
AT&T Arbitration (B)	0.672 (0.30)	0.67 (0.30)	0.401 (0.30)	0.40 (0.30)
Period Prior to Section 271 Decision (B)	-3.890 ** (-2.24)	-3.89 ** (-2.24)	-2.590 * (-1.90)	-2.59 * (-1.90)
Voluntary Reduction by RBOC (B)	-4.29 * (-1.78)	-4.29 * (-1.78)	-3.44 * (-1.96)	-3.44 * (-1.96)
UNE Entry (lagged 1 year, divided by standard deviation for that state) (C) [2]	6.22 ** (2.18)	6.22 ** (2.18)	5.40 ** (2.60)	5.40 ** (2.60)
Average Retail Rate (lagged 1 year) (C)	0.063 (0.77)	0.33 (0.77)	0.058 (0.80)	0.30 (0.80)

(B) - binary explanatory variable
(C) - continuous explanatory variable

[1] Economic effects for continuous explanatory variables are based on a one standard deviation increase in that variable, while economic effects for binary explanatory variables are based on a change in the variable from zero to one.
[2] This variable is already scaled by dividing by the standard deviation, so the economic effect is based on a one-unit increase.

Notes:
t-statistics are reported in parentheses.
*** - statistically significant at 99% confidence level
** - statistically significant at 95% confidence level
* - statistically significant at 90% confidence level