# Unbundling and Facilities-Based Entry by CLECs: Two Empirical Tests

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In this paper, the determinants of the provision of facilities-based lines by competitive local exchange carriers ("CLECs") are examined using data collected by the Federal Communications Commission and the entry decisions of a large, facilities-based CLEC. The multiple regression models are based on the economics of entry, considering both the effects of market size and sunk costs on provision of facilities-based service to end-users by CLECs.

Following Martin (1988), Sutton (1990) and Beard and Ford (2002), the extent of facilities-based entry by CLECs is assumed to be a positive related to market size and inversely related to the fixed/sunk costs of entry.[1] Size is measured as the total revenues of the Bell Operating Company ("BOC") in the state (*SIZE*) in millions of dollars. Sunk cost requirements are assumed to be inversely related to the density of market size, measured as BOC total revenues per square mile (*DENSE*). The percent of the state's population living in metropolitan areas, another measure of density, should also reduce the sunk costs of facilities investment (*METPOP*).[2]

The unbundling obligations and the companion pricing standard for unbundled elements may influence facilities-based entry in a variety of ways. So, the unbundled loop (highest density zone) and switching price in the state (*PLOOP*, *PSWITCH*) are included as regressors in the model.

Positive signs are expected on the market size and density variables (*SIZE*, *DENSE*, and *METPOP*). No a priori expectations are made with respect to the unbundled loop prices, since either a positive or negative sign is consistent with theory – element prices are ambiguously related to market size and the (exogenous and/or endogenous) sunk costs of entry.[3] Lower element prices, for example, may lead to more intense price competition and/or indicate a more favorable regulatory environment. Complementarity between elements and facilities may assist facilities-based entry by expanding market size or reducing entry costs. Additionally, unbundled element rates are estimates of average incremental cost at minimum viable scale. Thus, the element rates may serve as reasonable proxies for the average cost of duplicative network.[4]

Finally, Beard and Ford (2002) and Ekelund and Ford (2002) show that that entry using unbundled elements is higher in markets where element prices are lower (i.e., element de-

[1] The equilibrium number of firms in an industry, $N^*$, can be written as $N^* = (S/E)^{0.50}$, where $S$ is market size and $E$ is sunk entry costs. See, e.g., JOHN SUTTON, SUNK COST AND MARKET STRUCTURE (1990), Ch. 3; T. Randolph Beard and George S. Ford, *Competition in Local and Long-Distance Telecommunications Markets*, *in* INTERNATIONAL HANDBOOK OF TELECOMMUNICATIONS ECONOMICS, Volume I (Gary Madden ed. 2002); *and* STEPHEN MARTIN, INDUSTRIAL ECONOMICS: ECONOMIC ANALYSIS AND PUBLIC POLICY (1988), at 197-98.

[2] RCN, a facilities-based entrant, has limited its entry to the most densely populated markets (RCN 2001 10-K).

[3] Facilities-based entry is more common in dense markets, and loop prices are lower in dense markets (which is expected). The average loop price in the five largest CLEC facilities-based markets is about 30% less than the smaller markets (means difference t-stat = 2.72). If the density measures in the regression do not properly account for the total influence of density on entry, then the sign on the loop price may simply arise from this correlation, and not causation *per se*.

[4] Cost equivalence is not required, just correlation.

mands slope downward).[5] Thus, the relationship between entry via elements and facilities also is measured by the coefficients on the element prices.[6]

The estimated (semilog) regression equation is

$$\ln FBE_i = a_1 + \sum_{j=2}^{6} a_j X_i + \varepsilon_i ,$$

where all the $X_i$ are measured at the state level $i$ (BOC data only) and $\varepsilon$ is a well-behaved, econometric disturbance term. Two vintages of the dependent variable data (Dec-2000 and June-2001) are used to estimate the equation.[7] Data limitations produce 62 usable observations.

The quantity of CLEC facilities based lines (*FBE*) is compiled by the FCC (Form 477 data). Market size (*SIZE*) is provided by ARMIS 43-04 (Year 2000). Square miles and metropolitan population are census data. The loop price (*PLOOP*) is the loop price for the highest density zone (Gregg 2001).[8] Switching element price (switching and transport) is based on individual element prices from interconnection agreements and state tariffs.

The results of the least squares regression are summarized in Table 1. The R-square of the regression is 0.83, so the model explains 83% of the variation in the dependent variable. All variables but *DENSE* are statistically significant at the 2% level or better in a two-tail test. *DENSE* is statistically significant at the 8% level in a one-tail test. Ramsey's RESET test does not indicate that specification error is a problem (22% significance level), but White's test rejects homoskedastic disturbances (4% significance level). Thus, White's standard errors are used to compute the t-statistics reported in the table.

All market size and sunk cost proxy variables (*SIZE*, *DENSE*, and *METPOP*) have the correct sign (positive), and only *DENSE* is not statistically significant at standard levels (for a two-tail test). While unbundled element prices may influence facilities-based entry in a variety of ways, the regression results indicate that unbundled element prices have negative and statistically significant relationships to facilities-based entry by CLECs. The estimated elasticities of primary interest include 0.48 for *SIZE*, -0.43 for *PLOOP*, and –0.55 for *PSWITCH*. A 10% increase in the loop rate, for example, reduces CLEC facilities-based entry by about 4%. The elasticities of demand for the elements themselves are elastic, averaging about –1.5.[9]

**Table 1. Least Squares Results**

| Variable | Coef. (White t-stat) | Mean (St. Dev.) |
|---|---|---|
| *Constant* | 9.84 | |
| | (16.38) | |
| *SIZE* | 0.27 | 2.39 |
| | (11.45) | (2.10) |
| *DENSE* | 0.003 | 21.27 |
| | (1.45) | (25.87) |
| *METPOP* | 2.35 | 0.75 |
| | (3.85) | (0.15) |
| *PLOOP* | -0.032 | 12.55 |
| | (-2.31) | (4.22) |
| *PSWITCH* | -0.035 | 13.73 |
| | (-3.13) | (6.14) |
| *FBE* | | 154,018 |
| | | (173,971) |
| $R^2$ | 0.82 | |
| RESET F | 1.64 | |

In an alternative regression, the entry of RCN Communications in particular markets (states) is evaluated. RCN is the largest facilities-based provider of telephone, cable, and internet services to residential subscribers. The company provides service to more than one-million subscribers in six markets: New York, Massachusetts, Pennsylvania, Illinois,

[5] T. R. Beard and G. S. Ford, *Make or Buy? Unbundled Elements as Substitutes for Competitive Facilities in the Local Exchange Network* (June 2002) and R. B. Ekelund Jr. and G. S. Ford, *Preliminary Evidence on the Demand for Unbundled Elements* (June 2002).

[6] Simultaneity bias precludes the estimation of one type of CLEC output (facilities-based, elements, resale) on another, without an estimation technique that properly accounts for the joint determination of the two series.

[7] Preliminary regressions indicated no statistically significant difference between the output levels of the two vintages.

[8] Billy Jack Gregg, *A Survey of Unbundled Network Element Prices in the United States* (2001).

[9] See Beard and Ford (2002) and Ekelund and Ford (2002).

California, and the District of Columbia.[10] It is worth noting that about 12% of RCN's end-user service is provided over incumbent local exchange facilities.[11]

RCN's entry into a market is indicated by a dummy variable equal to 1.00 in the above listed markets, 0 otherwise (*DRCN*). The same explanatory variables are used with the exception of *PSWITCH*, which is excluded because the missing values for the variable reduce the already small number of RCN markets.

A total of 48 observations are used to estimate the probit equation, and results are summarized in Table 2. Reported t-statistics are based on robust standard errors. The McFadden R-square (likelihood ratio index) for the probit is 0.75

As before, size is found to positively influence entry, whereas sunk costs reduce entry. Both *SIZE* and *DENSE* are statistically significant at standard levels (*METPOP* is significant at the 10% level in a one-tail t-test). The probability RCN enters a particular market is negatively related to the unbundled loop price (*PLOOP*).[12] The *PLOOP* variable is statistically significant at better than the 5% level.

**Table 2. Probit Results for RCN Entry**

| Variable | Coef. (t-stat) | Coef. (t-stat) | Mean (St. Dev.) |
|---|---|---|---|
| *Constant* | -6.03 | -10.52 | |
| | (1.15) | (1.80) | |
| *SIZE* | 0.54 | 0.32 | 1.79 |
| | (2.83) | (2.44) | (1.95) |
| *DENSE* | 0.001 | | 96.06 |
| | (5.05) | | (521.0) |
| *METPOP* | 8.49 | 14.48 | 0.68 |
| | (1.29) | (2.02) | (0.21) |
| *PLOOP* | -0.42 | -0.39 | 13.47 |
| | (-2.28) | (-3.06) | (4.87) |
| *DRCN* | | | 0.125 |
| | | | (0.33) |
| McFadden $R^2$ | 0.75 | 0.68 | |

The District of Columbia is a clear outlier for the *DENSE* variable, and a RCN market.[13] In an alternate specification, *DENSE* is excluded as a regressor. In this regression, METPOP is statistically significant at better than the 5% level. The coefficient on *SIZE* declines slightly, but the *PLOOP* coefficient is not materially altered.

These estimated regressions indicate that CLEC facilities-based entry is positively related to market size and inversely related to the sunk costs of entry. Both regressions indicate that unbundled element prices are inversely related to facilities-based entry. While the exact determinants of these inverse relationships cannot be determined (by these models), the results indicate that, on average and other things constant, higher element rates are associated with a reduced amount of facilities-based entry by CLECs.

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[10] RCN 2001 10-K. Because RCN is the incumbent operator in its New Jersey markets, we exclude New Jersey as a market in which RCN is an entrant.

[11] RCN 2001, 3 Qtr 10-Q.

[12] The average loop price in RCN markets is about 63% of the average loop rate in other markets (means-difference t = 2.57).

[13] The sizeable increase in the standard deviation of *DENSE* (relative to Table 1) is attributable to the inclusion of the District of Columbia.