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Does a municipal electric's supply of communications crowd out private communications investment? An empirical study

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Abstract

There are 2007 municipalities across the United States providing electricity service to their constituents. Of these, over 600 provide some sort of communications services to the community. An important policy question is whether or not public investment in communications crowds out private investment or whether such investment encourages additional entry by creating wholesale markets and economic growth. We test these two hypotheses, the *crowding out* and *stimulation* hypotheses, using a recent dataset for the state of Florida. We find strong evidence favoring the stimulation hypothesis—public investment in communications network increases competitive communications firm entry by a sizeable amount.

Keywords: Municipal broadband; Communications; Public goods; Internet; Public ownership

1. Introduction

There are 2007 municipalities across the United States that provide electricity service to their constituents.[2] In 2004, 616 of these provided some sort of communications services to the community and this number has grown by 37% since 2001.[3] As evidence mounts of the substantial positive effects on economic development from municipal construction of

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[2] See *Electric Power Statistics* page at www.appanet.org. These systems serve about 14% of total households in the United States. Also see APPA Annual Directory and Statistical Report (Multiple years) and Gillett et al. (2004).

[3] Id., years 2003, 2004 and 2005.

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communications networks, more municipalities plan to deploy such networks in the near future.[4] Even large cities that do not provide electricity services are entering the communications business; St. Louis, Atlanta, Philadelphia, Los Angeles, Seattle and many more cities are all in the process of deploying city-wide wireless broadband networks.[5] This phenomenon is not restricted to the United States—municipal wireless broadband networks are operating in Hamburg, Brussels and the British Virgin Islands.[6] Municipal networks are not limited, however, to wireless systems. Municipalities across the country offer some mix of cable, internet and telephone services over wireline and wireless networks, and, as of 2003, had deployed significantly more fiber-optic networks to the home than either the incumbent telephone or cable companies.[7] The 2004 *APPA Annual Directory and Statistical Report* reports that municipal electric operations also operated, as examples, 130 broadband transport networks, 102 cable television networks and 247 municipal data networks.[8]

Recently, municipal entry into the communications markets has come under attack by private communications firms—primarily incumbent local phone and cable companies. These politically powerful firms have successfully lobbied for legislation banning or severely restricting municipal communications networks in Arkansas, Missouri, Minnesota, Nebraska, Nevada, Pennsylvania, South Carolina and Texas.[9] Other states, including Florida and Wisconsin, have passed anti-muni laws that allow municipal provision of communications services under certain conditions.[10] Legislators in Indiana, Nebraska and Ohio are debating anti-muni laws.

One of the principal arguments against municipal provision of communications services is that this public investment will “crowd out” private investment.[11] This argument has some

[4] See, e.g., Ford and Koutsky (in press); Lisa Eckelbecker, High-speed services critical for growth; WPI panelists discuss future of broadband, Telegram and Gazette (July 27, 2004); McGregor McCance, Broadband Service Seen as Economic Stimulus for Rural Virginia Communities, Knight Ridder Tribune Business News (March 4, 2003); Brad Carlson, Citi Cards to boost Boise staff, build new center in Silverstone, The Idaho Business Review (March 15, 2004); John Snow, Broadband scarcity hurts economic development, Business Journal (Jacksonville) (May 16, 2003), Vol. 19, Iss. 31; and various archived news releases at http://www.muniwireless.com/.

[5] Esme Vos, First Anniversary Report, Muniwireless.com (June 2004) and articles on www.muniwireless.com.

[6] Id.

[7] Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers, et al., CC Docket Nos. 01-338, 96-98 and 98-147, Report and Order, FCC 03-36 (rel. August 21, 2003). The services provided by municipalities typically begin as a very narrow service offering. For example, in New Smyrna Beach, Florida, the city began its foray into communications by providing a dial-up internet service that did not require a long-distance telephone call (a service the private sector rejected to provide at the city’s request). Now, the city is deploying fiber-optic networks.

[8] www.appanet.org.

[9] Public Power: Providing the 21st Century Through Community Broadband Services, American Public Power Association (December 2004): www.appanet.org.

[10] During the period we study in this paper, Florida law did not regulate or limit the provision of communications services or networks by municipalities. In June 2005, Florida enacted S.B. 1322, an act that regulates–but does not prohibit–the provision of communications services by Florida municipalities. The law requires, among other things, municipalities to hold public hearings and prepare a form of business plan prior to embarking upon a communications infrastructure project. The law prohibits cross-subsidization of communications services from other municipal services (like electric power), but does permit municipalities to use revenue bonds to invest in communications networks.

[11] See, for example, the testimony of Kent Lassman, Progress and Freedom Foundation, before the Utilities and Telecommunications Committee, Florida House of Representatives, March 17, 2005 (“The presence of a government-owned or managed entity may discourage investments in new services or facilities by firms already in the market and disincentivise private firms from entering or remaining in the market (p. 5).”) (www.pff.org), and Jim Hu, *Carriers Throw Their Weight Around Towns*, CNET News, December 1, 2004, quoting Qwest spokesman Vince Hancock (“Local governments are competing directly against private businesses, duplicating services and negatively impacting the viability of private industries.”) (news.com.com).

theoretical credibility. However, municipal communications networks are typically "open access" systems that allow private carriers to "lease" portions of the network to provide services. In some cases, the municipality provides only network infrastructure and private firms provide all retail services. Thus, there is good reason to suspect that private firm entry may be encouraged by municipal operation of communications plant.

In sum, we have two opposing hypotheses related to municipal entry into telecommunications: (a) the *crowding out* hypothesis and (b) the *stimulation* hypothesis. As is typical of important policy questions, theory does not provide unambiguous guidance. The relationship between municipal entry and the magnitude of private entry and investment is, in the end, an empirical question, and "an empirical question cannot be settled by non-empirical arguments (Stigler, 1968, p. 115)."

In this paper, we subject the "crowding out" hypothesis to an empirical test using data recently released by the Florida Public Service Commission on the number of competitive local exchange carriers ("CLECs") serving particular markets. Combining this city level data on CLEC entry with demographic and other data, we specify and estimate an empirical model that quantifies the effect of municipal communications on private firm entry. The empirical model performs remarkably well in terms of fit and specification testing does not allow us to reject the null hypothesis of "correct specification." Our empirical model provides no evidence to support the crowding out hypothesis. In fact, we find statistically significant evidence of more private firm entry in markets where municipalities operate communications network (a 63% increase). Thus, the evidence presented here supports the stimulation hypothesis.

2. Background

The crowding out hypothesis proffered by those opposing municipal provision of communications plant and services holds that municipal networks will reduce entry and investment by private firms: if we view that a market is capable of sustaining N^* firms, then the entry of a municipality will displace (at least) one private firm.[12] This argument is straightforward and has theoretical support. However, the argument is perhaps too simple when applied to the communications industry. Entry into the communications industry typically requires large sunk investments in fixed assets that render non-trivial scale economies. In many cases, therefore, the municipality will be the only entrant in particular geographic areas (mainly rural areas) or the sole provider of some services, since the expected return may not be sufficient to warrant the investment by a private firm.[13] So, in many cases, municipal entry may have no

[12] See Sutton (1995) for an excellent analysis of equilibrium industry structure. Another criticism of municipal supply of services is that governments are inefficient providers of services. However, the vast majority of published empirical studies on the public provision of utility services suggests that, if there is any difference, public provision is slightly more efficient (e.g., Hausman and Neufeld, 1991; Foreman-Peck and Waterson, 1985; Byrnes et al., 1986; Bruggink, 1982; Ohlsson, 2003; Renzetti and Dupont, 2003; Estache and Rossim, 2002).

[13] In most cases (particularly in Florida), the municipal provision of communications services arose from a refusal of incumbent phone companies to provide high-capacity telephone and Internet services desired by the community even after a direct request for such services was made. See, e.g., *Scottsburg, Indiana Wireless Network Saves the Community*, Muniwireless (April 29, 2004): ("Scottsburg, Indiana is a community of 6000 people, 29 miles (47 km) north of Louisville Kentucky. Scottsburg does not have wired broadband and the costs of deploying one are prohibitive. Just to give you an example, it costs $1300 per month to lease a T1 line in Scottsburg; in Louisville, it costs only $300 per month. The town approached Verizon about bringing broadband to their community, but the latter told them that there were not enough residents to make it worth Verizon's trouble."). Also see Phil Davies, Broadband.gov: A growing number of small cities in the district offer their residents high-speed Internet access. Does local government belong in the telecom business? Fedgazette (November 2004).

effect on private entry (at least, at the local distribution plant level), but it may be an important element of the ubiquitous supply of advanced communications services.

Further, in most cases, the municipal networks offer wholesale access to key components of telecommunications infrastructure such as local loop plant.[14] Since many telecommunications firm provide service by combining their own retail operations and telecommunications plant with facilities leased from other telecommunications carriers, the ability to purchase network elements at reasonable prices may increase private firm entry and investment.[15] Efforts by retailers to gain access to local customers through wholesale arrangements with private firms (typically monopolists) on reasonable terms and conditions have been difficult, but the incentives of publicly owned networks are different. The unbundling obligations of the *1996 Telecommunications Act* attempted to force such access to private networks, but actions by the Federal Communications Commission ("FCC") have ended most unbundling obligations.[16]

Unlike private firms, municipal communications operations are almost always "open systems," providing "unbundled" access by retailers to end-users connected to the network (with reasonable terms and conditions).[17] UTOPIA, a government-funded communications network in Utah, provides no retail services, but relies its "open access" to retail operators to acquire and maintain customers.[18] In Leesburg, Florida, the municipality leases strands of its dark fiber network to alternative providers, so that those private firms can utilize Leesburg's network to deploy their own services cost-effectively. Similarly, the municipal communications system serving Gainesville, Florida, provides high-capacity circuits to independent wireless providers, making those networks more cost-effective, and leases itself long-haul capacity from competitive carriers. The ability to access local distribution plant, the most difficult telecommunications asset to replicate since nearly all costs are sunk, reduces entry barriers and, consequently, increases the ability of private firms to enter. So, there is a plausible argument that municipal entry may actually encourage private firm entry and investment.

Municipal involvement may have an even more direct effect on private investment. In New Smyrna Beach, Florida, for example, the city purposely avoided capital expenses by contracting with competitive local exchange carriers to provide the necessary facilities for service provision. In each case, the municipality's operation of local communications plant directly stimulated private firm entry and investment.

These anecdotes are interesting, but more compelling evidence results from a systematic, ceteris paribus analysis of the relationship between public and private communications. To that end, in the next section, we specify and estimate an empirical model designed to quantify the relationship between private firm entry and the municipal provision of communications network.

[14] In Wisconsin, for example, state law requires that municipalities can provide communications services only on a wholesale basis.

[15] For example, there are more than 1000 long distance retailers in the United States, yet there are only about seven nationwide long distance networks providing the underlying transport required for the retail sector. Trends in Telephone Service, Federal Communications Commission (June 2005), at Table 9.4: www.fcc.gov.

[16] Order on Remand, Federal Communications Commission, FCC 04-290 (December 15, 2004) and Report and Order and Notice of Proposed Rulemaking, Federal Communications Commission, FCC 05-150 (August 5, 2005).

[17] The 2004 *APPA Annual Directory and Statistical Report* indicates that 71% of municipal networks in Florida offer wholesale capacity. This figure likely understates the actual number, since in the APPA data "wholesale" has a particular meaning. Discussions with members of the Florida Municipal Electric Association did not reveal any municipal communications networks that did not offer wholesale services of some type.

[18] http://www.utopianet.org/.

3. The empirical framework

In the *Annual Report to the Florida Legislature on the Status of Competition in the Telecommunications Industry in Florida* (2004), the Florida Public Service Commission lists the number of CLECs operating in each local rate exchange in the state of Florida.[19] This format is convenient, since it can be merged city-specific demographic and other data to evaluate how municipal provisioning of services affects private firm entry, holding other factors systematically influencing CLEC entry constant.

Using this data, we specify an empirical model of the number of private, competitive communications firms serving a market as:

$$\begin{aligned} N_i = {} & \gamma_1 \mathrm{DMUNI}_i + \gamma_2 \mathrm{DCOMM}_i + \beta_1 \mathrm{HH}_i + \beta_2 \mathrm{INC}_i + \beta_3 \mathrm{URBAN}_i + \beta_4 \mathrm{URBANC}_i \\ & + \beta_5 \mathrm{DENSE}_i + \beta_6 \mathrm{LOOP}_i + \beta_7 + \beta_8 \mathrm{DVERIZON}_i + \beta_9 \mathrm{DSPRINT}_i + \varepsilon_i \end{aligned} \tag{1}$$

where N is the number of CLECs serving market i. The first explanatory variable (DMUNI) is a dummy variable that indicates whether market i is served by a municipally operated utility providing electricity services. DCOMM, the second regressor, indicates using a dummy variable whether or not those particular municipalities also operate a communications network, so that DCOMM is a subset of DMUNI. These two variables are of most interest for assessing the competing hypotheses.

A legitimate question regarding the specification is why include the variable DMUNI in the regression, since it is not obvious why a city with a municipal electric operator would experience any more or less telecommunications entry than other cities. We must consider the possibility, however, that these cities chose to construct municipal electric systems because the private sector would not. Thus, there may be particular features of these cities not captured completely by income, population density and other variables in the regression. Recognizing that electric and telecommunications distribution networks have similar supply-side characteristics, we include DMUNI in the regression to evaluate whether those market features that led to requirement of municipal electric supply also influence telecommunications entry. (The results reported later indicate our specification choice is valid.) In any case, it is easy to extract the effect of the inclusion of this variable and we do so by calculating the effect of municipal communications networks on private entry both accounting for and ignoring the influence of the DMUNI variable.

In addition to variables indicating whether the market has municipally supplied electricity service and whether these particular markets also have a municipally supplied communications network (DCOMM = 1, DMUNI = 1), there are a number of other regressors that measure the demographic and ILEC profile of the market. Based on earlier research by Zolnierek et al. (2001) and Beard et al. (2004), the demographic determinants of CLEC entry include five variables: (1) HH is city households (in thousands); (2) INC is per-capita income (in thousands); (3) URBAN is the percent of population in urban areas; (4) URBANC is a dummy variable that equals one if the entire urban population is located inside the urbanized areas (a measure of urban density); and (5) DENSE is households per thousand square land miles. CLEC entry is likely to be affected by the characteristics of the incumbent local exchange carrier serving the city, since interconnection among entrants and incumbents is nearly always required. ILEC-specific factors

[19] http://www.psc.state.fl.us/.

are captured by three variables: (1) LOOP is the price of an unbundled loop in the market; (2) DVERIZON is the dummy variable for Verizon exchanges; and (3) DSPRINT is a dummy variable for Sprint exchanges. The constant term of the regression (β_7) includes the mean effect for BellSouth Communications.

We expect all the demographic variables (HH, INC, URBAN, URBANC and DENSE) to be positively related to CLEC entry; more firms are expected in larger, richer and more densely populated markets. Following the law of demand, a negative sign on the loop price (LOOP) is expected, since an unbundled loop in an input of production (Beard and Ford, 2005). About half of competitive lines in Florida are serviced using unbundled elements, so we expect loop prices to be a significant determinant of CLEC entry.[20] We expect the dummy variables DVERIZON and DSPRINT to be negative, indicating less entry in these regions than in the BellSouth region. Of these three ILECs, BellSouth was the only one in Florida required to satisfy the competitive checklist of Section 271 of the 1996 Act prior to offering interLATA long distance services. Under Section 271, interLATA entry was a quid pro quo for opening its markets to competition from CLECs. As a result, Bellsouth was required to do far more to allow competition than its sister ILECs and, consequently, there is considerably more competition in the BellSouth region than any of the other ILEC regions in Florida. Random influences on CLEC entry are captured by the econometric disturbance term (ε).

The effects of the municipal provision of communications networks on CLEC entry can be summarized as follows. For expositional purposes, let the term βX be the sum of the estimated β coefficients multiplied by the sample means of the variables.[21] We have three scenarios of interest, with the mean number of CLECs per market being:

(i) No municipal electricity	$N_1 = \beta X$
(ii) Municipal electricity, no communications	$N_2 = \gamma_1 + \beta X$
(iii) Municipal electricity, with communications	$N_3 = \gamma_1 + \gamma_2 + \beta X$

The difference $N_3 - N_2$ measures the mean effect of the provision of communications network by a city with municipally supplied electricity. Thus, the competing hypotheses on the effect of communications supply are tested directly by the coefficient γ_2. If γ_2 is negative, then there is crowding out. If γ_2 is positive, then the municipal supply of communications network leads to an increase in private firm entry (the stimulation hypothesis). Of course, municipal entry may have no effect and, in that case, γ_2 will be statistically indistinguishable from zero. The null hypothesis of zero-effect can be tested using the t-statistic on γ_2. If the hypothesis is rejected, then the sign on γ_2 serves to distinguish which of the two competing hypotheses is more consistent with the data. In sum, the crowding out hypothesis is supported if $\gamma_2 < 0$ and the stimulation hypothesis is supported if $\gamma_2 > 0$. The sign on γ_2, if the coefficient is statistically different from zero, indicates which hypothesis is more consistent with the data. Ignoring the provision of municipal electricity, the effect of municipal communications networks on CLEC entry can be measured by the sign and significance of $\gamma_1 + \gamma_2$, since those cities where DCOMM = 1 is a subset of those where DMUNI = 1. We provide the result of a statistical test on this constraint.

[20] Local Telephone Competition - Status as of June 30, 2004, Federal Communications Commission (December 22, 2004), at Table 10: www.fcc.gov.

[21] We cannot reject the null hypothesis that the means of each of the demographic regressors and the loop price are equal across cities with and without municipal electric operations.

3.1. Estimation technique

Evaluating the two competing hypotheses on municipally supplied communications network hinges on hypothesis testing (particularly on γ_2), so the efficiency of our estimated coefficients is critical. The dependent variable N is a non-negative count of CLECs, and linear regression for such data can result in inefficient, inconsistent and biased estimates (Long, 1997, p. 217). So, we employ more appropriate estimation techniques including negative binomial and Poisson regressions. Due to evidence of (mild) overdispersion in the data, the negative binomial estimation technique is more appropriate, since the negative binomial regression does not require equality of the conditional mean and variance (but does require the conditional variance to exceed the mean).[22] In the presence of overdispersion, the negative binomial regression is more efficient than Poisson (Wooldridge, 2002, Chapter 19), so Model 1 in Table 1 is a negative binomial regression.[23]

The Poisson regression, which requires that the conditional mean of the data equal the conditional variance, can produce estimated standard errors that are too small in the presence of overdispersion, thereby leading to a spurious overstatement of statistical significance (Gourieroux et al., 1984). However, it is possible to calculate fully robust standard errors for Poisson regression in the presence of overdispersion and we do so (Wooldridge, 2002, pp. 649–650).[24] The Poisson regression is Model 2 in Table 1.

In addition to reporting the results from the estimation techniques for count data, the ordinary least squares estimates are provided as Model 3 in Table 1. For this model, the dependent variable is expressed in natural log form [i.e., ln(N)].[25] Since least squares regression is biased and inefficient for count data, we do not discuss the results in any detail (King, 1988). We do note, however, that the results from the least square regression are generally comparable to the count model techniques.

3.2. Data

Our dependent variable, N, is taken from the *Annual Report to the Florida Legislature on the Status of Competition in the Telecommunications Industry in Florida* (2004), Appendix B. We

[22] Overdisperson tests include those proposed by was mentioned here but not in the reference list. Cameron and Trivedi (1998, $t=2.45$) and Wooldridge (1997, $t=4.41$), which both tests indicate the presence of overdispersion in the dependent variable. Both tests require first estimating the equation using Poisson, then running secondary regressions $(y-y)^2-y$ on y^2 for the first test and e^2-1 on y, where e is the standardized residual, for the second. The t-statistic on the sole regressor is a test of the null of "equality of the conditional mean and variance." The statistically significant and positive coefficient α in the negative binomial regression (Table 1) indicates mild overdispersion (Cameron and Trivedi, 1998 at 79).

[23] Overdispersion occurs when one event makes other within-observation events more likely; underdispersion occurs when one event makes other events less likely. Overdispersion is a somewhat peculiar finding for the number of firms serving a market, since an additional firm should reduce the profitability of further entry. The overdispersion is mild, however.

[24] By robust, we mean robust to overdispersion. The robust standard errors reported in Table 1 are not robust to heteroskedasticity. We estimated Eq. (1) using least squares and the natural logarithmic transformation of N as the dependent variable, a specification that is close approximation to the negative binomial model. From this regression, we were unable to reject the White test's null hypothesis of homoskedastic disturbances ($\chi^2=14.05$, probability 0.52). So, we do not believe heteroskedasticity is a problem.

[25] Linear least squares with a logarithmic transformation of the dependent variable is a close approximation to Poisson and negative binomial regression: for Poisson, we have $y=\exp(x\beta)$ and, for the transformed least squares regression, we have $\ln(y)=x\beta$ (Long, 1997, pp. 224–228). However, the least squares estimates remain biased, despite the transformation (King, 1988).

Table 1
Regression results

Variable	Coef.	Model (1): Neg. binomial	Model (2): Poisson	Model (3): OLS	Mean (S.D.) [min, max]
DMUNI	γ_1	−0.363	−0.405	−0.381	0.190
		(−2.70)*	(−3.75)*	(−2.52)*	(...)
		[−1.92]**	[−1.98]*	[−1.71]**	[0, 1]
DCOMM	γ_2	0.487	0.530	0.525	0.119
		(3.17)*	(4.42)*	(2.78)*	()
		[2.49]*	[2.49]*	[2.33]*	[0, 1]
HH	β_1	0.003	0.003	0.004	18.332
		(4.49)*	(7.39)*	(3.31)*	(36.258)
		[3.65]*	[5.22]*	[3.10]*	[0.32, 308.7]
INC	β_2	−0.005	−0.005	−0.005	20.706
		(−1.38)	(−1.74)	(−1.10)	(9.176)
		[−1.40]	[−1.29]	[−1.19]	[10.0, 66.9]
URBAN	β_3	0.882	0.853	0.908	0.965
		(2.57)*	(3.12)*	(2.12)*	(0.092)
		[5.35]*	[5.07]*	[4.39]*	[0.11, 1.0]
URBANC	β_4	0.280	0.269	0.310	0.698
		(3.42)*	(4.32)*	(2.90)*	(...)
		[3.79]*	[3.63]*	[3.22]*	[0, 1]
DENSE	β_5	0.181	0.217	0.024	0.347
		(1.46)	(2.91)*	(0.12)*	(0.251)
		[1.29]	[2.03]*	[0.11]*	[0.04, 1.61]
LOOP	β_6	−0.014	−0.015	−0.015	26.320
		(−3.48)*	(−4.98)*	(−2.83)*	(10.096)
		[−3.81]*	[−3.95]*	[−3.30]*	[9.9, 41.7]
Constant	β_7	2.710	2.757	2.698	...
		(7.27)*	(9.38)*	(5.68)*	
		[11.96]*	[11.63]*	[9.74]*	
DVERIZON	β_8	−0.672	−0.657	−0.658	0.159
		(−7.21)*	(−9.59)*	(−5.05)*	(...)
		[−10.34]*	[−10.54]*	[−7.08]*	[0, 1]
DSPRINT	β_9	−0.771	−0.461	−0.813	0.421
		(−11.09)*	(−14.90)*	(−8.42)*	(...)
		[−11.19]*	[−11.13]*	[−9.61]*	[0, 1]
α		0.037*	...	...	...
		(−11.21)			
		[−8.02]*			
N					23.333
					(16.39)
					[1, 81]
(Pseudo) R^2		0.81	0.82	0.73	
RESET *F*		2.04	1.39	0.98	
RESET robust *F*		2.57	1.34	...	
χ^2: $\gamma_1+\gamma_2=0$		4.09*	3.77*	4.15*	
Obs.		126	126	126	

Traditional *t*-statistics in parenthesis; robust *t*-statistics in brackets.
* Significance at 5% level.
** Significance at 10% level.

limit our analysis to the state of Florida since it is the only source of which we are aware that provides exchange specific data on CLEC activity. We also focus on business CLECs, since entrants serving businesses are more likely to be facilities-based, thereby the analysis can be extrapolated to financial investments in the community rather than just a count of sellers. We combine the exchange-level CLEC data presented in the *Annual Report* with city demographic data from the 2000 Census.[26] We use the 2004 *APPA Annual Directory and Statistical Report* to indicate whether cities with municipal electric services also operate some type of communications network. We also match the cities to unbundled loop prices, which apply only to the largest incumbent phone companies in Florida (BellSouth, Verizon and Sprint).[27] The *Annual Report* (2003) lists data for 277 cities, but only 225 of these are in the large ILEC regions for which loop price data is available. Of these markets, we are able to match up demographic and loop price data to 163 cities. Since our focus is on business CLECs, it is reasonable to limit our sample to cities with at least some urban population, leaving us with 126 exchanges in our final dataset.[28] In the final sample, there are 24 (19%) municipally operated electric companies, with 15 of these municipalities operating communications plant (12%).

4. Results

Estimates of Eq. (1) are summarized in Table 1, along with the descriptive statistics of the variables in the model. Both the traditional (in parenthesis) and robust standard errors (in brackets) are used to compute the *t*-statistics. Eq. (1) is estimated by the negative binomial (Model 1) and Poisson method (Model 2), and ordinary least squares (Model 3). Both of the models fit the data well, with a psuedo-R^2 of 0.81 for Model 1, 0.82 for Model 2 and 0.73 for Model 3. Such a good fit to the data is encouraging, particularly for cross-sectional data.[29]

Model specification is evaluated using RESET, where Wooldridge's (1991, 1997) robust RESET specification test for conditional mean regressions is employed. The null hypothesis of "no specification error" cannot be rejected for either model at even the 10% level.[30] This result is encouraging, since RESET is a rather general specification error test capable of detecting incorrect functional form, omitted variables and simultaneity (though it has the most power against incorrect functional form) (Ramsey, 1969; Gujarati, 1995, pp. 464–466; Godfrey et al., 1988). Both the standard and robust RESET *F*-statistics are reported for each regression.

The estimated coefficients across the two models are very similar and all but two (INC and DENSE) of the estimated coefficients are statistically different from zero at traditional levels, regardless of whether the traditional or robust standard errors are used for hypothesis testing. DENSE is statistically significant in Model 2, though not in Model 1. The signs on all statistically significant demographic variables (HH, URBAN, URBANC and DENSE) are as expected—CLECs tend to enter large, densely populated markets. Also as expected, the signs on DVERIZON and DSPRINT are negative and statistically different from zero, indicating that

[26] The data for "Places" in Florida was extracted from the SF3 data using the *dataferret* interface made available by the Census Bureau (www.census.gov).

[27] Trinsic Communications (www.trinsic.com), a Florida-based competitive telecommunications carrier that purchases loops in nearly every state (including Florida), provided the loop price data at the authors' request.

[28] The impact of municipal communications networks on private entry is slightly larger (about 15%) if this sample restriction is ignored.

[29] The Psuedo-R^2 is computed as the squared correlation coefficient between the predicted and actual values of the dependent variable. While an imperfect measure of fit (as are all such measures for non-linear regression), the statistic does illustrate that our chosen model explains a large percentage of the variation in CLEC counts (Cameron and Trivedi, 1998: 151–8).

[30] In an alternate specification, continuous regressors were log transformed. We were able to reject the null hypothesis of RESET at the 10% level for this specification, suggesting our chosen specification is preferred.

CLECs are more likely to enter cities inside the BellSouth region, even after accounting for variations in unbundled loop prices. Higher unbundled loop prices also reduce CLEC entry, as indicated by the negative and statistically significant coefficient on LOOP. We compute the elasticity for loop prices to be about -0.30, implying a 10% increase in the price of an unbundled loop reduces the number of CLECs serving a market by 3% (about one CLEC).[31]

Turning to the key policy variables, we observe that both DMUNI and DCOMM are statistically different from zero. The estimated parameters indicate that CLEC activity generally is lower in cities with municipal electric operations ($\gamma_1 \approx -0.40$). However, the regression also indicates that the provision of communications services by municipal electrics significantly increases CLEC entry ($\gamma_2 \approx 0.50$). Both coefficients are statistically different from zero at better than the 5% level. Based on the average response over all cities in the sample, the mean predictions from the regression are summarized as follows:

(i) No municipal electricity	$N_1 = 23.18$
(ii) Municipal electricity, no communications	$N_2 = 16.12$
(iii) Municipal electricity, with communications	$N_3 = 26.24$

The model predicts that cities that self-supply electricity have approximately seven fewer CLECs ($N_3 - N_1$), on average, than do similarly situated cities without municipal electricity operations (a 30% reduction).[32] Within the group of cities self-supplying electricity (DMUNI = 1), those cities with communications networks (DCOMM = 1) average about 10 more CLECs ($N_3 - N_2$), other things constant (a 63% increase).[33] Relative to cities that do not have municipal electric operations, municipalities operating both electric and communications networks ($N_3 - N_1$) have on average about three more CLECs (a 13% increase) than similarly situated cities without municipally supplied electricity. This latter increase is statistically different from zero; that is, the hypothesis $\gamma_1 + \gamma_2 = 0$ is rejected for all three models. Thus, there are more CLECs in those municipalities operating communications networks than in cities that do not have municipally run communications networks, regardless of whether those cities also supply electricity services.

Our empirical model provides no support for the crowding out hypothesis, but strong support for the stimulation hypothesis ($\gamma_2 > 0$, $\gamma_1 + \gamma_2 > 0$). Other things constant, the empirical model indicates that municipally operated communications networks lead to a 63% increase in CLEC count relative to other cities supplying their own electricity and a 13% increase in CLEC count relative to cities with privately supplied electricity.

5. Conclusions

The municipal supply of communications services is on the rise. One concern with this trend is that public investment in communications networks may crowd out private investment. In this paper, we subjected this hypothesis to an empirical test and found no evidence to support the "crowding out" hypothesis. Indeed, the empirical model indicates that municipal communica-

[31] As recommended by Cameron and Trivedi (1998: 80–81), we report the average response over all cities in the sample, rather than compute the responses at the sample means.

[32] As mentioned in the text, we suspect that the relative lack of interest in these communities may be motivated by the same factors that required the community to construct and operate its own electric utility. In many cases, municipal electric operations serve relatively poor areas with low population and, as indicated by the regression, other random factors that reduce the presence of privately run telecommunications firms.

[33] Depending on what services the municipal is providing, it may be required to be a registered CLEC.

tions actually increases private firm entry and, presumably as a consequence, private investment. The empirical model predicts that 13% fewer retail competitors accompany the absence of municipal provider. Legislation limiting municipal supply of communications services may reduce retail competition and this possibility should be part of any legislative debate.

There are a number of interesting and complex issues not addressed in this paper. For example, if the government does provide retail services, how does its objective function differ from that of a private firm? Does the capital cost of the network differ between public and private firms? Does municipal network sharing improve social welfare? Is the network a natural monopoly? Are there important cost savings from vertically integrated supply of retail services and the network itself? What are the terms and conditions of network access to the open network? All of these questions (and many more) are relevant to the issue of municipal construction of communications networks. Answering a lengthy list of complex questions is beyond the scope of this paper. Instead, we focus simply on the empirical question of whether or not there is more or less private entry in markets where there is a municipal network. Our analysis supports the stimulation hypothesis. Of course, this study should be considered but one element of a portfolio of evidence on this important topic.

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