PHOENIX CENTER POLICY BULLETIN NO. 53

George S. Ford, PhD

June 2021

ELECTRICITY RATES AND THE FUNDING OF MUNICIPAL BROADBAND NETWORKS: AN EMPIRICAL ANALYSIS

Abstract: Most Government-Owned Broadband Networks ("GONs") are typically subsidized by city finances in some way to stay financially viable. In cases where a city has both a GON and a government-run electric utility, a popular method of cross-subsidization is to shift costs of the GON onto the captive ratepayers of the municipally-operated electric utility. This shift of broadband costs to the electric utility can be expected to increase electricity rates. In this BULLETIN, a Differences-in-Differences approach quantifies the effect on electric rates from a utility-funded GON. A GON increases residential and commercial electricity rates by about 5% when the utility-funded model is used, but rates are unaffected for alternative funding arrangements.

I. Background

Worried about their survival in the Information Age and constantly on the lookout for ways to promote local economic development, a few hundred municipalities across the United States have constructed and operate their own high-speed broadband networks. Funding these expensive networks presents financial challenges and most (if not all) Government-Owned Networks ("GONs") are subsidized by city finances in some way.[1] Many of these GONs are found in cities that operate their own electric utilities. Often, these cities seek to place the debt

[1] For a detailed analysis of this subject, *see* T.R. Beard, G.S. Ford, L.J. Spiwak, and M. Stern, *The Law and Economics of Municipal Broadband,* 73 FEDERAL COMMUNICATIONS LAW JOURNAL 1 (2020) (available at http://www.fclj.org/wp-content/uploads/2020/09/MunicipalBroadbandArticleFINAL.9.2.20.pdf). To prevent improper cross-subsidies, several states have sensibly enacted laws to protect captive ratepayers (and taxpayers generally) from such abuse from municipal broadband systems.

of the broadband network (among other expenses) on the electric utility's books, thereby improving the apparent financial condition of the broadband network at the expense of the captive ratepayers of the electricity division.[2] As electricity rates are based on average costs, a shift of broadband costs to the electric utility is expected to increase electricity rates. Alternative funding arrangements, such as General Obligation Bonds, would not directly affect the cost of the electric utility and thus are not expected to affect electricity rates of the municipal utilities.

To demonstrate this subsidization by captive ratepayers, in this BULLETIN a Difference-in-Differences analysis is conducted on the municipal electric utility rates of four Tennessee cities that constructed GONs in or around 2008. Two of these networks are a pair of the largest utility-funded GONs in the United States (Clarksville and Chattanooga). The other two cities, Pulaski and Tullahoma, both operate a municipal electric utility but funded the network with General Obligation Bonds, thereby avoiding loading large portions of the cost of the broadband network on their electric utilities.[3] With data on electricity rates, the effect on electricity rates of the alternative funding arrangement may be estimated. Notably, Tennessee state law and the Tennessee Valley Authority's ("TVA") rules prohibit municipal electric utilities to cross-subsidize broadband networks using electricity rates.[4] If these restrictions are effective, then there should be no observable difference in the path of electricity rates between municipal broadband funding methods. That said, the practical implementation of such restrictions, such as the claim by some municipal electric utilities that the broadband networks are primarily used for Smart Grid support and thus are rightly included in utility costs, may provide sufficient leeway for rates to be impacted.

Using electric utility data from the Energy Information Administration, the analysis indicates electric utility rates for residential and commercial customers in Clarksville and Chattanooga rose by 5.4% (nearly $12 per month) as the result of their utility-funded broadband networks. In contrast, the electric rates of the utilities in Pulaski and Tullahoma did not rise after the deployment of their GONs. Utility-funded broadband networks appear to raise electricity rates and fund a cross-subsidy from captive electric customers to the broadband network. While not raising electricity rates, alternative funding arrangements impose a cost on

---

[2] Municipal electric utilities serve about 16% of Americans. *Investor-Owned Utilities Served 72% of U.S. Electricity Customers in 2017*, Energy Information Administration (August 15, 2019 (available at: https://www.eia.gov/todayinenergy/detail.php?id=40913).

[3] M. Zager, *The Resurgence of Municipal Fiber*, BROADBAND PROPERTIES (May-June 2010) (available at: https://www.bbcmag.com/pub/doc/BBP_MayJune10_ResurgenceOfFiber.pdf).

[4] *Broadband Internet Development, Availability, and Adoption in Tennessee Four Years After the Broadband Accessibility Act (Public Chapter 228, Acts of 2017)*, Tennessee Advisory Commission on Intergovernmental Relations (January 2021) (available at: https://www.tn.gov/content/dam/tn/tacir/2021publications/2021_BroadbandUpdate.pdf).

the city—costs that may require subsidies from other sources (e.g., higher taxes). Such subsidies are not addressed in this analysis. Thus, despite the mandates of the Tennessee law and TVA regulations, GONs appear to be using electric rates to subsidize broadband operations.

II. Background

If an entrant believes it can profitably serve a market, then it will enter that market. Alternately, if an existing firm is losing money in a market, then it will exit that market. Over time, this process of entry-and-exit plays out and the number of sellers reaches an equilibrium. Like prices and quantities, the number of providers represents an equilibrium of the number of firms that can profitably serve a market given the economic conditions of the marketplace. Depending on market conditions, that equilibrium may be zero, one, few, or many firms.

Providing broadband services is subject to the same forces. If a private broadband provider believes it can profitably serve a market (or serve it with a particular technology), then it will do so. If not, then it will not enter. Given the high fixed costs of providing broadband service, the expectation is that only a few firms can serve any given market. The lack of private entry, therefore, is a signal of a lack of profitability, not necessarily some sort of public policy failure. If market conditions only permit two firms to operate profitably, then three firms is a crowd.[5]

Adding an additional firm to a market in a structural equilibrium implies losses for one or more providers. Those losses eventually lead to the exit of a provider, or else the losses must be covered from some outside financial source. Cross-subsidies from monopoly services (i.e., electricity) to competitive services (i.e., broadband) are generally frowned upon. When the broadband entrant is the local government, financial losses are often funded by direct or indirect taxes, where constituents absorb the costs of building and operating a GON not recovered by the network's gross margins.[6] Presumably, the manifestation of such loss-recovery efforts differs among GON funding methods.

In some cities, GONs are financed using General Obligation Bonds paid from tax revenues and other sources of the municipality's income. Several cities funding their GONs in this manner have increased taxes (sometimes explicitly, sometimes not) to cover the losses from the broadband network.[7] Alternately, in cities that operate an electric utility, profits from electricity services may be used to cover losses. In the utility-funded financial model, it is a common

---

5 *The Law and Economics of Municipal Broadband*, *supra* n. 1.

6 *Broadband Internet Development, Availability, and Adoption in Tennessee Four Years After the Broadband Accessibility Act (Public Chapter 228, Acts of 2017)*, *supra* n. 4.

7 *The Law and Economics of Municipal Broadband*, *supra* n. 1.

practice for cities to shift the costs of the broadband network (especially debt) to the electric utility's books. Since electricity rates are set to meet a revenue requirement (basically, average cost pricing) across a captive rate base, the utility-funded model raises the cost of electric service and, in turn, is expected to increase electricity rates.[8] While investor-owned utilities would be prohibited by regulators from engaging in this cross-subsidy, municipalities (and electric cooperatives) generally self-regulate their utility rates and practices, permitting such cross-subsidies, albeit such subsidies must evade the requirements of state law and TVA rules.

In a detailed financial analysis of the utility-funded GON in Opelika, Alabama (which was recently sold after years of heavy losses), Ford (2017) and Beard et al. (2020) provide direct evidence of rate increases for the city's electric customers to cover the broadband network debt payments.[9] In that city, electricity rates were increased by an average rate of $5.39 to cover a $0.8 million revenue shortfall, an amount well short of the $1.4 million in annual debt service for the broadband network placed on the electric utility's books.[10] A plausible alternative to a detailed analysis of financial records (which may not be available or feasible) is a statistical analysis of electric rates before-and-after a GON deployment. Even for cities that operate an electric utility, funding a GON using General Obligation Bonds should not directly affect electricity rates—a testable hypothesis.[11] A utility-funded GON, in contrast, should increase electricity rates by increasing the electric utility's costs—a testable hypothesis. An analysis of changes in electricity rates before-and-after a GON deployment permits an assessment of these two hypotheses based on alternative funding models.

III. Data

Two of the nation's largest GONs are operated in the Tennessee cities of Chattanooga and Clarksville. These two cities are ideally suited to an analysis of the electricity rate effects of a GON since both cities loaded most of the debt of the broadband network on the city's electric utility. These cities began taking on debt for the construction and operation of their GONs in 2007 for Clarksville and 2008 for Chattanooga; these years guide the selection of the treatment

---

8 *See*, *e.g.*, J. Bonbright, A. Danielson & D. Kamerschen, PRINCIPLES OF PUBLIC UTILITY RATES (1988).

9 G.S. Ford, *Financial Implications of Opelika's Municipal Broadband Network*, PHOENIX CENTER POLICY PERSPECTIVE NO. 17-11 (August 24, 2017) (available at https://www.phoenix-center.org/perspectives/Perspective17-11Final.pdf); *The Law and Economics of Municipal Broadband, supra* n. 1; G.S. Ford, *Opelika Gets a Day of Reckoning with OPS One Deal*, OPELIKA-AUBURN NEWS (October 22, 2018) (available at: https://oanow.com/business/george-ford-opelika-gets-a-day-of-reckoning-with-ops-one-deal/article_653d23b6-d5af-11e8-9b79-43f9ec4a254c.html).

10 *Financial Implications of Opelika's Municipal Broadband Network, id*. at pp. 2-3.

11 A city operating a municipal electric utility may still increase electricity rates to service General Obligation Bonds, since some portion of the utility's profits are often transferred to the city's general budget.

period.[12] The (smaller) cities of Pulaski and Tullahoma, both also operating an electric utility, built broadband networks at about the same time but did not shift the debt of the networks to the electric utility but funded the networks with General Obligation Bonds ("GOB"). I define the treatment date as year 2008 but exclude 2008 and 2009 as transition years, since the exact initiation dates of these GONs are not identical. The effect of the alternate financial arrangements on electricity rates may be estimated by comparing average rates before-and-after the treatment date between the two funding types using a Difference-in-Differences statistical approach.

Data on electricity revenues, sales, and customers is obtained from the Energy Information Administration ("EIA"), a federal government agency that collects and reports detailed statistics on the electric utility industry (among others).[13] Data on municipal utilities serving the state of Tennessee is obtained for years 2003 through 2018 (the pre-treatment period includes five years). Rates are measured (in real dollars) as the average of residential and commercial user rates per kilowatt hour ("kWh").[14] Only utilities with a full complement of data are retained for analysis (62 municipal utilities). There are other GONs in the state, but they began operations long before or after the four analyzed here and several have sold to provide providers.[15] These utilities are excluded from the sample (leaving 53 utilities) and set aside for future research.[16]

IV. Empirical Methods

The data obtained from the EIA spanning years 2003 through 2018 is well suited to estimating a causal effect of a GON on electricity rates using the Difference-in-Differences ("DiD") approach with data both before-and-after the GONs were created.[17] To illustrate the DiD estimator, say there are two groups of electric utilities (A and B) and two periods for which

---

[12] EPB Annual Report (2008) at p. 41 (available at: https://epb.com/storage/app/media/uploaded-files/2008.pdf); *Comprehensive Annual Financial Report,* City of Clarksville, Tennessee (June 30, 2007) at p. 20 (available at: https://www.cityofclarksville.com/ArchiveCenter/ViewFile/Item/55).

[13] Data available at: https://www.eia.gov/electricity/data/eia861.

[14] Rates are adjusted by the Consumer Price Index: https://fred.stlouisfed.org/series/CPIAUCSL.

[15] For a list, *see* https://muninetworks.org/content/municipal-ftth-networks.

[16] The excluded utilities, including two that have sold to provide providers, include Bristol, Columbia, Covington, Erwin, Fayetteville, Jackson, Memphis, and Morristown. *See, e.g., Broadband Internet Deployment, Availability, and Adoption in Tennessee*, Report of the Tennessee Advisory Commission on Intergovernmental Relations (January 2017) (available at: https://www.tn.gov/content/dam/tn/tacir/documents/2017_Broadband.pdf). Morristown began service in 2006 and funded the network with General Obligation Bonds. This date is close to the treatment year, but the network initially served only businesses. Adding Morristown to GOB-funded treatment group makes the rates more comparable between the treated and control groups.

[17] *See*, *e.g.*, J.D. Angrist and J.S. Pischke, MOSTLY HARMLESS ECONOMETRICS: AN EMPIRICIST'S COMPANION (2008).

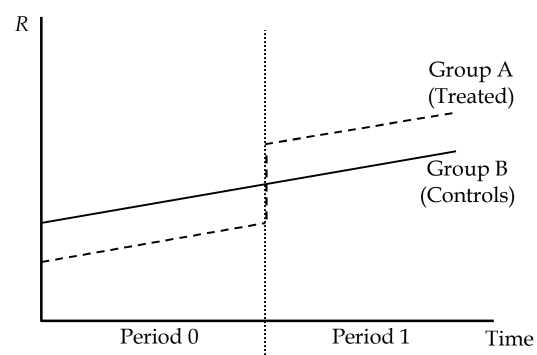
electricity rates may be observed (0 and 1). Neither group operates a GON in the first period, but the utilities in Group A begin the operation of a GON in the second period. The rate effect of the GON may be calculated as:

$$\delta = (R_1^A - R_0^A) - (R_1^B - R_0^B), \tag{1}$$

where R indicates the average rate for the groups. Equation (1) is the DiD estimator; δ is simply the difference in rates between the two groups between Period 1 and Period 0. If the two groups are otherwise comparable and their rates follow the same path over time (the common trends assumption), then δ is an estimate of the causal effect of a GON on electricity rates.

As an example, say that the average rate (revenue per kilowatt hour kWh) in Period 0 (the first period) for Group A is \$0.10 and for Group B is \$0.11. In Period 1, the rates are \$0.13 for Group A (now operating GONs) and \$0.12 for Utility B. By Equation (1), the DiD estimator is δ = \$0.02, which is the average treatment effect of a GON on electricity rates.

Figure 1. Difference-in-Differences



This DiD estimator is illustrated in Figure 1. In Period 0, the two groups have different mean rates, but the trend in rates is the same. Both series have mild positive trends. After the switch to Period 1 (indicated by the vertical line), the rate for Group A rises sharply and is now larger than the rate for Group B. Comparing the average rates across the two periods quantifies the effect of the treatment.

The DiD estimator may be obtained from the least-squares regression,

$$\ln R_{i,t} = \delta D_i \cdot P + \beta X_{i,t} + \lambda_t + \mu_i + e_{i,t}, \tag{2}$$

where D is a dummy variable for the treated units, P is a dummy variable indicating the treatment period, $X_{i,t}$ is a set of regressors, λ_t is a period fixed effect, μ_i is a utility fixed effect, and $e_{i,t}$ is the econometric disturbance term.[18] The coefficient δ is the DiD estimator and hypothesis testing may be conducted using the estimate parameter's t-statistic. Here, we have two treatment types: utility-funded and GOB-funded GONs. Equation (2) requires only a slight modification to estimate the different effects,

$$\begin{aligned}\ln R_{i,t} &= \delta^{UTIL} D_i^{UTIL} \cdot P + \delta^{GOB} D_i^{GOB} \cdot P \\ &+ \beta X_{i,t} + \lambda_t + \mu_i + e_{i,t}\end{aligned}, \qquad (3)$$

where the δ coefficient is unique for utility-funded GONs (δ^{UTIL}) and GOB-funded GONs (δ^{GOB}).

Given that there are only two treated units of each type, the standard approach of using clustered standard errors for inference is problematic; clustered errors with few treated units are biased downward.[19] A suitable alternative is to collapse the data to pre- and post-period means. Still, the δ estimates are based on two treated units of each type, so a check on inferences from the t-tests is conducted by Randomized Inference.[20] Randomized Inference is a non-parametric approach that involves obtaining the empirical distribution of δ by simulation (δ^E).[21] This technique is a robustness check and does not resolve the low power of the parametric test (and it is also a low-power test), but supports inference when the number of treated units is few. Low power implies a relatively low probability of rejection of the null hypothesis ("no treatment effect").

---

18 This modeling choice was based on an extensive Monte Carlo analysis of modeling options.

19 T.G. Conley & C.R. Taber, *Inference with "Difference in Differences" with a Small Number of Policy Changes*, 93 REVIEW OF ECONOMICS AND STATISTICS 113-125 (2011).

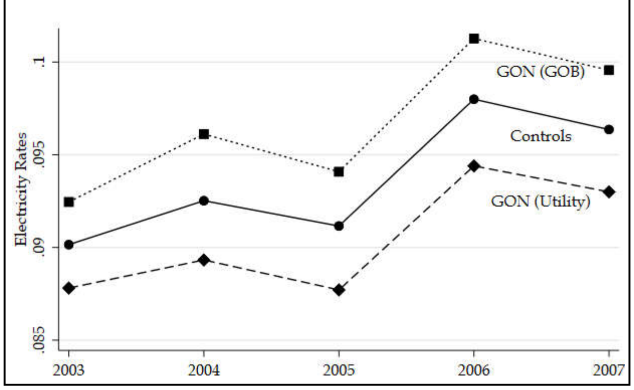
20 R. A. Fisher, THE DESIGN OF EXPERIMENTS (1935); F. Harrell, REGRESSION MODELING STRATEGIES (2001). A thorough treatment is provided in S.Athey and G.W. Imbens, *The Econometrics of Randomized Experiments*, HANDBOOK OF ECONOMIC FIELD EXPERIMENTS, Volume 1, Ch. 3, 73-140 (2017) (draft available at: https://www.theigc.org/wp-content/uploads/2016/06/athey_imbens_june19.pdf).

21 This simulation assigns a false treatment to two randomly selected control units and then estimates the treatment effect. With 54 control units, there are 1,326 possible combinations. The estimated treatment effect, δ is then compared to the empirical distribution of treatment effects from the simulations to determine how much of the tail of the distribution is cut off by δ. Like the parametric test, the percent of the δ^E tail cutoff by the estimated δ is an indicator of how rare the outcome is.

V. Choosing a Control Group

The DiD estimator is not simply a comparison of outcomes between groups over time. Rather, the control group serves as a stand-in for the treated group as if the treated group had not received the treatment. The outcomes of the control group serve as the counterfactual for the treatment groups. As such, it is important to consider whether the control and treated groups satisfy the common trends assumption. To support the common trends assumption, the control group is limited to municipal electric utilities serving the State of Tennessee. The climate, economic, regulatory environments and the ownership-types are all comparable across all utilities in the sample.

Figure 2. Pre-Treatment Trends



A check on common trends, which is not formally testable, is conducted by visual inspection of pre-treatment trends, by comparing the growth rates of the outcomes, and estimating pseudo-treatments by assigning a false treatment for years 2006 and 2007. Pre-treatment trends are illustrated in Figure 2. While the GON cities have slightly different average electricity rates in the pre-treatment period, the pattern in rates for both treated groups and the control group are nearly identical in the pre-treatment period, providing strong support for the common trends assumption. The null hypothesis of equal growth rates cannot be rejected at anywhere near traditional levels.[22] Estimating Equation (3) with a pseudo-treatment for years 2006-2007 (the following year excluded) also indicates no difference in rates. The control group, consisting of 49 municipal electric utilities, is acceptable by these standards.

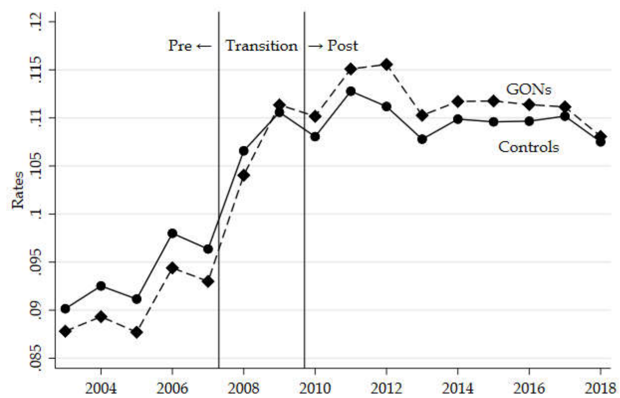
---

[22] The growth rates are computed by regressing the natural log of sales-per-kWh on a time trend, treated group dummies, the interaction of the time trend with the treated group dummies, and utility fixed effects.

VI. Electricity Rate Patterns

In Figure 3, the full complement of rates for the utility-funded and control groups over time is illustrated. The transition period of 2008 and 2009 is indicated. While the treated utilities have below average rate prior to the deployment of the GONs, their rates are noticeably higher in the treatment period, with the switch occurring during the transition.

Figure 3. Rates Across Time
(Utility Funded GONs)



The clear pattern in electricity rates before-and-after the treatment reveals a rate increase and is a textbook depiction of a DiD estimator. Prior to the treatment, the trends are the same, with the GON cities charging slightly lower rates. After the treatment, the electricity rates in the GON cities are higher than the control group. The change in relative electricity rates occurred during the transition period, providing strong evidence of a rate effect from the treatment.

Figure 4. Rates Across Time
(GOB-Funded GONs)

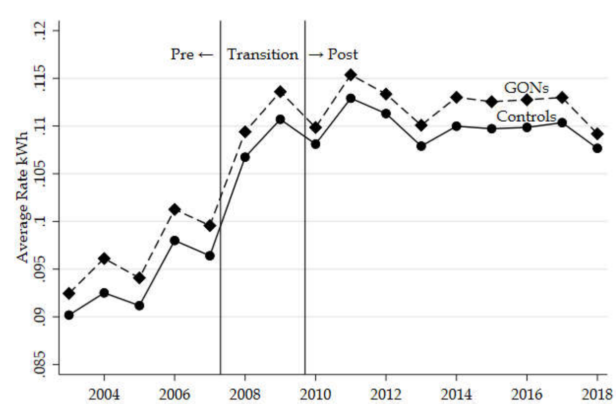
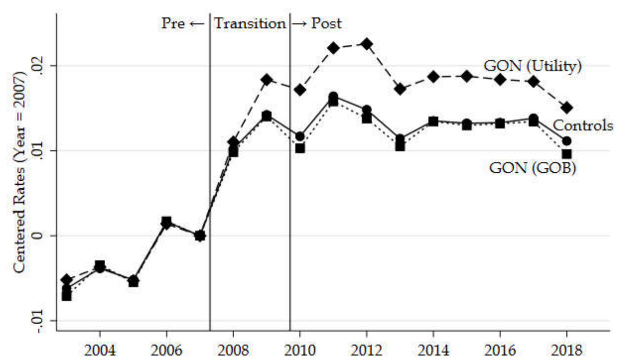


Figure 4 illustrates the pattern in electricity rates for GOB-funded GONs and the control group. For these utilities, the average electric rates are approximately the same size across the treated and control groups and across periods; the pattern in rates is nearly identical in the pre- and post-treatment period. Unlike the utility-funded GONs, there is no apparent impact on electricity rates for these GOB-funded GONs.

Figure 5. Centered Rates Across Time



A clearer picture of the rate changes across groups and time is provided in Figure 5. In this figure, the data is "centered" by subtracting from the annual rate data for each utility the rate in year 2007, the last year of the pre-treatment sample. The overlap of the trends in the pre-treatment period illustrates common trends across the groups. This tight fit between the rates continues throughout the entire sample period for the GOB-funded GONs. For the utility-funded GONs, alternately, the rates materially depart from the control group beginning in year 2009 and persist through 2018. Clearly, the utility-funded GONs lead to higher electricity rates. This graphical analysis confirms expectations. By shifting costs to the electricity utility, electricity rates rise for the utility-funded GONs, despite legal restrictions on cross-subsidies. No such effect is observed for the GOB-funded GONs. Next, I turn to statistical testing to confirm these findings.

VII. Statistical Analysis

Table 1 summarizes the mean electricity rates between the treated and the control groups. For the control groups, the average rate of $0.0936 in pre-treatment period rises to $0.1098 post treatment, a 17.2% increase in (real) rates. For the utility-funded GONs, the rates rise from $0.0904 to $0.1117, which is a more sizable 23.5% increase. From the descriptive statistics, the utility-funded GONs switched from relatively low-price providers of electricity to relatively high-price providers following the deployment of the broadband networks. For the GOB-funded GONs, rates rose from $0.0967 to $0.1121, a difference of $0.0154 that is slightly less than that of the control group.

Table 1. Pre-Post Rate Comparisons

	Control Group	Utility-Funded GONs	GOB-Funded GONs
Pre-Treatment	0.0936	0.0904	0.0967
Post-Treatment	0.1098	0.1117	0.1121
δ (Equation 1)	0.0161	0.0212	0.0154
% Change	17.2%	23.5%	16.0%
Utilities	49	2	2

Hypothesis tests based on Equation (3) confirm the apparent differences in the rate changes are sizable for the utility-funded GONs. The dependent variable in the regression in the natural log of the electricity rate. Results are summarized in Table 2. In the first column of the table, Equation (3) is estimated without any regressors. Given the common practice of multi-part tariffs in the electric utility industry, the *X* includes the (natural log of) average customer consumption in kWh for the second set of results.

Table 2. Summary of Results

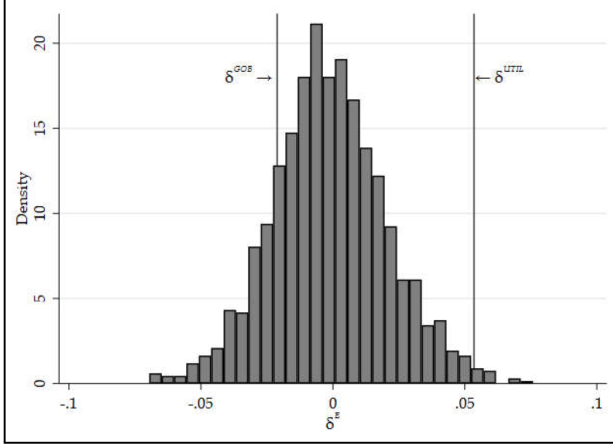
	Coef (t-stat)	Coef (t-stat)
δ^{UTIL}	0.0518** (2.28)	0.0529** (2.37)
δ^{GOB}	-0.0108 (-0.47)	-0.0207 (-0.89)
β	…	-0.1246 (-1.64)
F-Stat	2.76*	2.79**
Observations	106	106
Sig. Levels: *** 1%, ** 5%, * 10%.		

Between the two models, the δ^{GON} coefficients are very similar at about 0.052, both of which indicate about a 5.4% treatment effect on rates [= exp(δ) – 1]. The coefficients are statistically significant at better than the 5% level. Alternately, the δ^{GOB} coefficient, which indicates a 1-2% relative decline in rates, neither coefficient is statistically different from zero at traditional levels.

Randomized Inference confirms these results. For the results conditioned on *X*, the boundaries of the 90% confidence interval of δ^{E} are -0.0373 and 0.0370 (nearly symmetric); δ^{UTIL}

cuts off 1.4% of the tail of δ^E. Alternately, δ^{GOB} is within the confidence interval (cutting off 35.2% of the lower tail).[23] Figure 6 illustrates δ^E and the estimated δ coefficients.

Figure 6. Randomized Inference

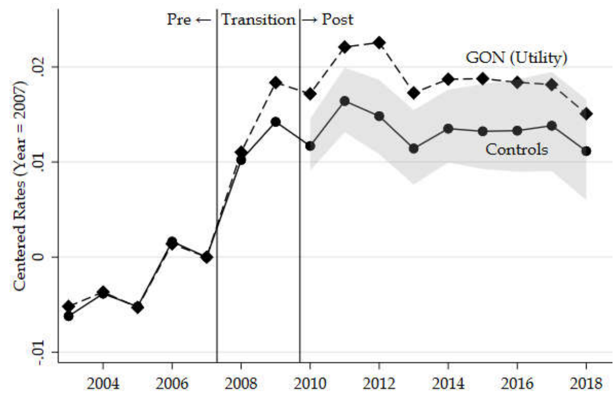


Another way to apply Randomized Inference is to construct an empirical confidence interval for the control group's rates during the treatment period and then append this confidence interval to Figure 5. This confidence interval is constructed by computing the means for all possible pairs of utilities in the control group and using the values of the lower-and-upper 5% tails to define the confidence interval. To reduce clutter, only the utility-funded GONs are illustrated in this figure (the GOB-funded GONs have rates well within the confidence interval). As shown in the figure, the utility-funded GON rates are outside or else at-the-boundary of the 90% confidence interval constructed in this manner by Randomized Inference.

[23] Randomized Inference on the t-statistics rather than the δ produced nearly identical results.

PHOENIX CENTER FOR ADVANCED LEGAL & ECONOMIC PUBLIC POLICY STUDIES
5335 Wisconsin Avenue, NW, Suite 440
Washington, D.C. 20015
Tel: (+1) (202) 274-0235 • Fax: (+1) (202) 318-4909
www.phoenix-center.org

Figure 7. Centered Rates Across Time
(90% Confidence Interval by Rand. Inf.)



How much are electricity customers paying for the broadband network? During the treatment period, the average (residential and commercial) customer in the utility-funded GON sample pays $215 monthly for electricity. Given the 5.4% increase in electricity rates, the subsidy from each electric ratepayer to the broadband network is $11.44 monthly or $137.27 annually on average. The monthly increase is $7.36 for residential and $38.21 for commercial customers, or $88.35 and $458.55 annually.[24] Plainly, these are sizable cross-subsidies to broadband customers paid by all electric utility customers, not just the GON's broadband subscribers.

For Chattanooga, the total annual cross-subsidy is about $24.3 million, while for Clarksville the annual subsidy is $8.0 million. In 2015 (about the mid-point of the treatment period), Chattanooga's GON reported 67,000 broadband customers.[25] The cross-subsidy in Chattanooga amounts to a sizable $30.22 per broadband subscriber month. Average monthly revenue per broadband subscriber was $147 in 2015, so the total consumer expenditures by Chattanoogans for the city's broadband accounts was about $177 including the subsidy. Note, however, that the subsidy calculated here does not include the $111 million in subsidies received from the Federal government to construct the network.[26] Clarksville's 18,000 broadband subscribers in

---

[24] The average monthly bills are $138.51 and $718.92 for the customer types. A statistical test of the equality of the δ coefficients across the customer types is not rejected at standard significance levels.

[25] EPB Financial Highlights (2005) at p. 13 (available at: https://static.epb.com/annual-reports/2015/wp-content/uploads/2015/10/2015-financial-report.pdf).

[26] K.E. McCarthy, *Chattanooga High Speed Broadband Initiative*, OLR Research Report 2012-R-0515 (December 14, 2012) (available at: https://www.cga.ct.gov/2012/rpt/2012-R-0515.htm).

2015 received a $37 monthly subsidy from its electricity utility customers.[27] Observed prices for utility-funded and federally-subsidized GONs do not reflect the full cost of these broadband accounts.[28]

The evidence is clear and not unexpected: despite legal efforts to curb cross-subsidies, when GONs are funded by shifting costs to the electric utility, electricity rates rise to account for the increased costs. When alternative funding mechanisms are used, there is no effect on electricity rates. These findings suggests that the state law and TVA rules aimed at reducing the burden on electric rate payers of the broadband networks are ineffective. Note, however, that the lack of a rate effect for GOB-funded GONs does not imply that the broadband networks are unsubsidized in these cities. A thorough review of the city's financial records is required to determine whether the city is subsidizing the broadband network; years of front-end losses typical of a broadband network must be covered by some means. Certainly, the General Obligation Bonds impose a cost on the city, and those costs must be paid from the gross profits of the broadband network or else from other government revenues.

VIII. Conclusion

Municipal broadband networks typically require a source of subsidy dollars to cover losses. Monopoly municipal electric utilities are one such source of subsidy dollars with municipalities allowing the electric utility to shoulder the much of the broadband network's debt, sometimes claiming that the broadband networks are electric-utility assets used for Smart Grid technology. Despite laws and rules designed to shield electric ratepayers from higher rates to subsidize the GONs, this cost-shifting to captive electric ratepayers increases the cost of the electric utility and presumably electricity rates.

In this BULLETIN, the pattern of electricity rates over time for four GONs in Tennessee are analyzed, two of which are utility-funded and two of which are funded by General Obligation Bonds. Simple means comparisons, graphical analysis, and a Difference-in-Differences model all provide strong evidence of significant electricity rate increases in cities using the utility-funded model. The average monthly increase of nearly $12 for residential and commercial users translates into millions of dollars of cross-subsidy from captive electric rate payers to the broadband networks. No electricity rate increases are found, alternately, for GONs funded through General Obligation Bonds.

---

27 *Comprehensive Annual Financial Report for the Fiscal Year Ended June 30, 2015*, City of Clarksville, Tennessee (June 2015), at p. 129 (available at: https://www.cityofclarksville.com/ArchiveCenter/ViewFile/Item/51).

28 G.S. Ford, *A Review of the Berkman Center's Price Survey of Municipal Broadband Markets*, PHOENIX CENTER POLICY PERSPECTIVE No. 18-01 (January 24, 2018) (available at: https://www.phoenix-center.org/perspectives/Perspective18-01Final.pdf).

Subsidizing broadband via higher electricity rates is a questionable policy choice, at least more dubious than higher taxes, and is discouraged by state law and TVA rules. Since low-income households require electricity, electricity rate increases as a subsidy source are a type of regressive tax. Additionally, many low-income households cannot afford broadband, so the higher electricity rates constitute a subsidy from lower- to higher-income households. General taxes may do the same, though some forms of taxation may not be so regressive. In any case, the choice of funding municipal broadband networks has cost implications for constituents, and the higher electricity rates from utility-funded models should be addressed by municipal governments, or electric cooperatives, contemplating such investments in broadband infrastructure.

PHOENIX CENTER FOR ADVANCED LEGAL & ECONOMIC PUBLIC POLICY STUDIES
5335 Wisconsin Avenue, NW, Suite 440
Washington, D.C. 20015
Tel: (+1) (202) 274-0235 ● Fax: (+1) (202) 318-4909
www.phoenix-center.org