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*The Positive Effects of Unbundling on Broadband Deployment*

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### *The Positive Effects of Unbundling on Broadband Deployment*

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*Abstract:* This POLICY PAPER examines whether there is a relationship between regulated rates for “unbundled local loops” and deployment of broadband technology by incumbents and entrants. Using an econometric model that analyzes 2002 and 2003 local loop rates and takes into account price variability and other factors that may impact broadband deployment, this POLICY PAPER finds that unbundled loop prices based on Total Element Long Run Incremental Cost (“TELRIC”) are associated with *increased availability* of broadband services and increased availability of *competitive* broadband services (four or more providers). As a result, this POLICY PAPER concludes that current policies which are hostile to the market-opening provisions of the 1996 Act will actually make it harder to achieve President Bush’s stated goal of “universal, affordable access for broadband technology by 2007” and will, instead, lead to greater economic concentration and incumbent market power in the industry as firms are forced to exit the market.

#### I. Introduction

Ever since the passage of the Telecommunications Act of 1996, the incumbent Bell monopolies have argued that the 1996 Act’s wholesale network access policies (like unbundling) dampen or decrease their incentive to deploy

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broadband technology. Despite significant empirical evidence to the contrary,<sup>1</sup> none in support,<sup>2</sup> and a specific Supreme Court finding that this argument “founders on fact”,<sup>3</sup> this canard has nonetheless found welcome ears with many of the Bush Administration’s telecom lieutenants.<sup>4</sup> Indeed, the Bush

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<sup>1</sup> Research has already conclusively proved that the competition produced by the market-opening provisions of the 1996 Act increased the incumbent Bell companies’ average net CapEx investment by \$759 per year, or about 6.4% per year in the aggregate, for each UNE-P access line. PHOENIX CENTER POLICY BULLETIN NO. 5, *Competition and Bell Company Investment in Telecommunications Plant: The Effects of UNE-P* (17 September 2003) (<http://www.phoenix-center.org/PolicyBulletin/PolicyBulletin5.pdf>). See also, PHOENIX CENTER POLICY BULLETIN NO. 6: *UNE-P Drives Bell Investment - A Synthesis Model* (17 September 2003) (available at: <http://www.phoenix-center.org/PolicyBulletin/PolicyBulletin6Final.pdf>); G. S. Ford and M. D. Pelcovits, *Unbundling and Facilities-Based Entry by CLECs: Two Empirical Tests* (July 2002): [www.telepolicy.com](http://www.telepolicy.com); T. R. Beard, R. B. Ekelund Jr., and G.S. Ford, *Pursuing Competition in Local Telephony: The Law and Economics of Unbundling and Impairment* (November 2002)([www.telepolicy.com](http://www.telepolicy.com)); T. R. Beard, G. S. Ford, and T.M. Koutsky, *Mandated Access and the Make-or-Buy Decision: The Case of Local Telecommunications Competition* (December 2002) ([www.telepolicy.com](http://www.telepolicy.com)); R. D. Willig, W. H. Lehr, J. P. Bigelow, and S. B. Levinson, *Stimulating Investment and the Telecommunications Act of 1996*, Unpublished Manuscript (October 2002); K. A. Hassett and L. J. Kotlikoff, *The Role of Competition in Stimulating Telecom Investment*, AEI PUBLICATION (October 2, 2002) ([www.aei.org/publications/pubID.14873/pub\\_detail.asp](http://www.aei.org/publications/pubID.14873/pub_detail.asp)). Hassett et al. (2002) perform a simulation rather than using actual data. See also, *Does Unbundling Really Discourage Facilities-Based Entry? An Econometric Examination of the Unbundled Local Switching Restriction*, Z-TEL POLICY PAPER NO. 4 (February 2002)([www.telepolicy.com](http://www.telepolicy.com)); *Competition at the Crossroads: Can Public Utility Commissions Save Local Telephone Competition?*, Consumer Federation of America (October 2003) (<http://www.consumerfed.org/pr10.07.03.html>).

<sup>2</sup> R. B. Ekelund Jr. and G. S. Ford, *Innovation, Investment, and Unbundling: An Empirical Update*, 20 YALE JOURNAL ON REGULATION 383-388 (2003); G. S. Ford, *Do Unbundling Policies Discourage CLEC Facilities-Based Investment?* (Commenting on R. W. Crandall, A. T. Ingraham, and H. J. Singer, *Do Unbundling Policies Discourage CLEC Facilities-Based Investment?*) (available at [www.telepolicy.com](http://www.telepolicy.com)). See also Phoenix Center POLICY BULLETIN NO. 6, *supra id.*; Comments of Drs. Thomas Hazlett (the Manhattan Institute), Arthur Havenner (Univ. California - Davis), and Coleman Bazelon (HHB I) to Phoenix Center POLICY BULLETIN No. 5 (<http://www.phoenix-center.org/PolicyBulletin/HazlettetalComments.pdf>); R. Carter Hill Comments PHOENIX CENTER POLICY BULLETIN No. 5 (<http://www.phoenix-center.org/PolicyBulletin/HillComments.pdf>); Further Comments of Drs. Thomas Hazlett (the Manhattan Institute), Arthur Havenner (Univ. California - Davis), and Coleman Bazelon (Analysis Group) PHOENIX CENTER POLICY BULLETIN No. 6 (HHB II) (<http://www.phoenix-center.org/critiques/HHBII.pdf>); A Response to Drs. Hazlett, Havenner and Bazelon (<http://www.phoenix-center.org/critiques/ReplytoHHBII.pdf>).

<sup>3</sup> *Verizon v. FCC*, 122 S.Ct. 1646, 1675 (2002).

<sup>4</sup> See, e.g., Separate Statement of FCC Chairman Michael Powell, *In the Matter of Unbundled Access to Network Elements, Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers*, Order And Notice Of Proposed Rulemaking, \_\_\_ FCC Rcd \_\_\_, FCC 04-179 (rel.

(Footnote Continued. . . .)

Administration recently decided not to defend and support the Federal Communications Commission's local telephone network unbundling policies before the Supreme Court,<sup>5</sup> and the FCC has just released "interim" unbundling rules that increase significantly the price for local loop connections that facilities-based entrants depend upon to provide U.S. small and mid-sized businesses with new, innovative and inexpensive services.<sup>6</sup> As a result, as the incumbents raise their wholesale rates above, and lower their commercial rates below, cost,<sup>7</sup>

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August 20, 2004) (hereinafter "*Interim Rules*") (UNE-P is a "synthetic form of competition that would never have proved sustainable, or have provided long-lasting consumer benefits."); Kathleen Q. Abernathy, *My View from the Doorstep of FCC Change*, 54 FED. COM. L.J. 199, 206-7 (2002) ("Excessive sharing of facilities destroys the investment incentives of both incumbents and new entrants alike: rational incumbents avoid risking capital on new facilities if rivals can get a free ride, and rational entrants will refrain from deploying their own facilities if they have unrestricted access to incumbents' networks at cost-based rates. This stifling of investment incentives is all the more problematic where supposedly "cost-based" rates are, as in some cases, based on a model that makes unrealistic economic assumptions and accordingly turn out to be *below* actual cost. In striving to stimulate *some* form of local telephone competition, by creating expansive resale and unbundling opportunities, we have adopted rules that have failed to engender, and may have actually hampered, *facilities-based* competition—which is the most viable strategy in the long term and the one most likely to benefit consumers."). Curiously, it is unclear why public policy should focus so exclusively on the investment incentives of four firms rather than on generic sector investment. In so doing, these policies reek of centralized industrial planning and a deliberate choice in picking winners and losers.

<sup>5</sup> Press Release: Statement by acting NTIA Administrator Michael D. Gallagher on Solicitor General's decision not to appeal DC Circuit Court decision (9 June 2004).

<sup>6</sup> *Interim Rules*, *supra* n. 4; and *c.f.*, Lawrence J. Spiwak, *Interim Rules Buck Telecom Act*, LEGAL TIMES (30 August 2004) (available at <http://www.phoenix-center.org/LegalTimes30Aug2004.pdf>).

<sup>7</sup> Anne Marie Squeo, *Bells Mount Two-Way Assault on Local Market - New-Client Perks Pressure Rivals, Who Also Face Rise In Rates for Using Network*, WALL STREET JOURNAL (3 August 2004) (Reporting that while on the one hand SBC is currently asking Michigan regulators to raise wholesale rates from \$14/month to \$28/month on the ground that current rates below \$28 are purportedly confiscatory and below costs; yet on the other hand, quotes SBC Chief Operating Officer Randall Stephenson as stating that even though selling UNE-P at \$14 is below cost, it is profitable for SBC to offer retail service in Michigan at a "promotional" rate of \$7.95 because when the promotion expires in six months, the price would jump to \$17.95. ("If I keep this customer [with promotions], I'm going to get \$28 in the future and that's a lot better than \$14."). *Significantly, however, \$17.96 is still 36% below the \$28 to which SBC is asking Michigan regulators to boost its wholesale rate.*

firms as large as AT&T and as small as Hoosier Telecom are being squeezed from the “mass market” for local telephone services.<sup>8</sup>

According to FCC Chairman Michael Powell, however, we need not worry about the demise of the 1996 Act’s wholesale access provisions, because in one year “no one significant will be competing using unbundled network elements”<sup>9</sup>; instead, “there is going to be more competition, it’s going to be better than what we had before, and I’ll even go so far as to say: this isn’t a prediction, it’s a promise.”<sup>10</sup> The purpose of this POLICY PAPER, therefore, is to test Mr. Powell’s fundamental assumption that regulated rates for wholesale network access policies (like unbundling) dampen or decrease the incentive to deploy broadband technology.

The variability in rates for unbundled loops should help test which policy will result in the broadest availability of broadband services – *i.e.*, a policy that promotes competition and choice (*e.g.*, low loop rates) or a policy that promotes the protection of incumbent investment (*e.g.*, high loop rates). Generally, if the argument that unbundling deters investment is correct, then we would expect to see more broadband deployment in states with higher unbundled loop prices, *ceteris paribus*.

The econometric analysis in this POLICY PAPER shows the opposite, however: unbundled loop prices based on Total Element Long Run Incremental Cost (“TELRIC”) actually lead to *increased availability* of broadband services and increased availability of *competitive* broadband services defined as area with at least four broadband providers. As a result, current policies which are openly

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<sup>8</sup> *Id.* To wit, on 22 July 2004 five private investment firms – Kohlberg Kravis Roberts & Co., Centennial Ventures, Columbia Capital, Madison Dearborn Partners LLC and M/C Venture Partners – that have major stakes in large facilities-based CLECs such as Time Warner Telecom, NuVox Communications, Allegiance Telecom, and XO Communications Inc., wrote to Mr. Powell urging him to recognize and halt the adverse consequences of his policies. They noted that because most CLECs “operate on thin margins in highly price sensitive markets ... they simply [can] not absorb such dramatic cost increases or pass them along to customers in the form of increased rates”. As such, the expected radical “increase in the price of the embedded base of high capacity loops and transport likely would cause some (competitors) to violate loan covenants.”

<sup>9</sup> 15 June 2004 Gartner Fellows Interview with Michael Powell [http://www4.gartner.com/research/fellows/asset\\_91308\\_1176.jsp](http://www4.gartner.com/research/fellows/asset_91308_1176.jsp).

<sup>10</sup> Mark Wigfield, *FCC to Begin Work on Interim Phone Rules*, DOW JONES NEWSWIRE (10 June 2004).

hostile to the market-opening provisions of the 1996 Act will actually hinder President Bush's self-professed goal of "universal, affordable access for broadband technology by 2007."<sup>11</sup> Instead, these new policies will, in fact, lead to greater economic concentration and incumbent market power in the industry as firms are forced to exit the market.<sup>12</sup>

## II. Empirical Model

The empirical analysis contained in this POLICY PAPER addresses the relationship between the price of unbundled loops and broadband availability. Local loops are the wires that connect each and every home, office, business, or building to the incumbent local telephone company's central switching offices. Unbundling these loops requires the incumbent to lease those wires at a price approximating forward-looking economic costs to new entrants, so that new entrants need not deploy their own loops in order to offer service in a region. These loops are generally made up of twisted copper wires and, increasingly, fiber optic cable. While there has been extensive debate before the FCC and state commissions as to whether a policy that forces incumbents to lease these loops (particularly fiber loops) would provide a disincentive for incumbents to deploy more fiber and broadband technology, until the end of 2003, federal rules clearly required that incumbents lease *all* of their loops – fiber optic loops included – to new entrants at rates set by the state regulatory commission.<sup>13</sup> As such, this

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<sup>11</sup> 26 March 2004 Remarks by the President on Homeownership Expo New Mexico, Albuquerque, New Mexico (<http://www.whitehouse.gov/news/releases/2004/03/20040326-9.html>). Curiously, however, President Bush appear to prefer to take a sequential approach to the problem – that is: "We ought to have a universal, affordable access for broadband technology by the year 2007, and then we ought to make sure as soon as possible thereafter, consumers have got plenty of choices when it comes to purchasing the broadband carrier." Taking this thought to its logical conclusion, it would appear that one fundamental assumption underlies the President's broadband policy: a view that promoting broadband competition or "choice" is incompatible with promoting broadband deployment, at least in the near term.

<sup>12</sup> See *supra* nn. 7-8.

<sup>13</sup> C.f., State Of Maine Public Utilities Commission, Docket No. 2002-682, *Verizon-Maine Proposed Schedules, Terms, Conditions and Rates for Unbundled Network Elements and Interconnection* (PUC 20) and *Resold Services* (PUC 21) (September 3, 2004) ([http://www.state.me.us/mpuc/orders/2002/2002-682o\\_Part%20II.pdf](http://www.state.me.us/mpuc/orders/2002/2002-682o_Part%20II.pdf)) (holding that the incumbent Bell monopoly must: (1) include all of its wholesale offerings in its state wholesale tariff, including unbundled network elements (UNEs) provided pursuant to section 271 of the Telecommunications Act of 1996; and (2) file prices for all offerings contained in the wholesale tariff for our review for compliance with federal pricing standards, *i.e.* "Total Element Long Run (Footnote Continued. . . .)

POLICY PAPER develops an econometric model that analyzes the rates that states have set for these rates in 2002 and 2003, takes into account this variability in prices and other factors that may impact broadband deployment, and determines whether local loop lease rates affect deployment of broadband service.<sup>14</sup>

Using publicly-available data collected and distributed by the FCC, this POLICY PAPER creates two measures of broadband availability. The first variable reflects only availability of a single broadband provider and is defined as the percentage of zip codes in a state that have at least one provider of broadband services. The FCC publishes this zip code data annually. This variable ( $A_U$ ) reflects only the universality of access. The second variable is defined as the percentage of zip codes in a state that have at least four providers of broadband services. This variable ( $A_C$ ) measures competitive access to broadband services.<sup>15</sup> With these two measures of availability we can evaluate the influence of unbundling on both the general availability of broadband service as well as whether or not the service is provided competitively.

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Incremental Cost (TELRIC)" for section 251 UNEs and "just and reasonable" rates pursuant to sections 201 and 202 of the Communications Act of 1934 for section 271 UNEs.

<sup>14</sup> One of the major arguments supporting the movement to remove these access and pricing decisions from state commissions is that there are allegedly high differences in the prices for that access. This argument does not withstand scrutiny, however, because it has been statistically proven that that differences in UNE-P prices both across States and within States are due to genuine cost differences and differences in TELRIC and are not because of regulatory failure by the States. PHOENIX CENTER POLICY BULLETIN No. 9: *Federalism in Telecommunications Regulation: Effectiveness and Accuracy of State Commission Implementation of TELRIC in Local Telecoms Markets* (9 March 2004) (<http://www.phoenix-center.org/PCPB9Final.pdf>).

<sup>15</sup> The choice of four or more competitors is based on R. Selten, *A Simple Model of Imperfect Competition where Four are Few and Six are Many*, 2 INTERNATIONAL JOURNAL OF GAME THEORY 141-201 (1973); see also Report & Order and Notice of Proposed Rulemaking, 2002 Biennial Regulatory Review – Review of the Commission’s Broadcast Ownership Rules and Other Rules Adopted Pursuant to Section 202 of the Telecommunications Act of 1996, MB Docket 02-277 (July 2, 2003) at ft. 609 (“A game-theoretic analysis of the number of independent firms that are required to produce competitive market performance is provided by R. Selten [sic], *A Simple Model of Imperfect Competition Where Four are Few and Six are Many*, INT’L J. GAME THEORY 2 (1973). This model is presented more intuitively in Louis Phillips [sic], *COMPETITION POLICY: A GAME THEORY PERSPECTIVE* Ch. 2 (Cambridge, UK: Cambridge Univ. Press 1995). An empirical study which finds that additional market entry has little effect on market conduct once a market has between three and five firms is provided by Timothy F. Bresnahan and Peter C. Reiss, *Entry and Competition in Concentrated Markets*, 99 J. OF POL. ECON. 997-1009 (1991). These limits roughly comport with the limit in the DOJ/FTC Merger Guidelines between moderately- and highly-concentrated markets. DOJ/FTC Guidelines § 1.51.”)

Of course, broadband availability will be affected by more than just unbundling policy. A number of factors are expected to affect the ubiquity and competitiveness of broadband access including per-capita income, population density, time, and region specific factors. Measures for these factors include per-capita state income (*INC*), the percent of rural population (*RURAL*), the number of large cities (>250,000 in population) in a state (*BIGCITY*), and dummy variables for time (the data is semester data) and Bell Company region (*DVZ*, *DBLS*, *DSBC*, *DAMER*; *DQWEST* is excluded to avoid the dummy trap).<sup>16</sup>

Primarily, the policy inquiry should be on whether or not the prices of unbundled loops bear some relation to broadband availability.<sup>17</sup> This POLICY PAPER tests this proposition because many policymakers argue that the requirements that incumbents lease these loops to competitors at rates established by the state commission retard or stunt the deployment of new broadband services.<sup>18</sup> At the same time, having unbundled loops can promote deployment of broadband technology by new entrants, particularly those that utilize these loops to provide digital subscriber line (“DSL”) broadband services, so are a fundamental component of broadband availability and competition. Thus, the question is an empirical one, and empirical questions cannot be resolved by non-empirical arguments. By examining the variability in rates for unbundled loops, it is possible to test which policy will result in the broadest availability of broadband services – *i.e.*, a policy that promotes competition and choice (*e.g.*, low loop rates) or a policy that promotes the protection of incumbent investment (*e.g.*, high loop rates).

For purposes of analysis, price is measured as the statewide average unbundled loop price. In addition to the price of the unbundled loop ( $P_L$ ), the

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<sup>16</sup> The variable *INC* is measured using per-capita state income published by the Bureau of Economic Analysis ([www.bea.gov](http://www.bea.gov)). The variables *RURAL* and *BIGCITY* are from U.S. Census data ([www.census.gov](http://www.census.gov)). Loop prices are from Regulatory Source Associates, Telecom Regulatory Note (April 5, 2004) and loop cost is measured by the FCC’s HCPM ([www.fcc.gov/wcb](http://www.fcc.gov/wcb)).

<sup>17</sup> Former FCC Chief Economist Simon Wilke reported that an internal FCC study found that the Bell Companies deployed more broadband in markets where competitor Covad had deployed its broadband service using unbundled loops. COMMUNICATIONS DAILY, November 24 (2004). The Powell Administration denies that such a study exists. See ALTS Request for Data Regarding ILEC Deployment of DSL Lines (Nov. 21, 2003): <http://206.161.82.210/Filings/112103ALTSFOIArequest.pdf>.

<sup>18</sup> See *supra* nn. 9-10.

model includes a measure of the cost of unbundled loops ( $C_L$ ). By including both of these variables in the empirical model, it is possible to estimate the unique contributions of loop price and loop cost on availability. In other words, the estimated effect of loop price on availability is determined holding cost constant, so any effect of price on availability and competitive choice is independent of the correlation between availability and costs.

Since the availability variables ( $A_i$ ) are both defined as a percentage, estimation is conducted using the Minimum Logit Chi-Square ("MLC") method (Berkson 1953; Maddala 1983).<sup>19</sup> The estimated regression is

$$\ln\left(\frac{A_i}{1-A_i}\right) = \beta_1 \ln P_L + \beta_2 \ln C_L + \beta_3 \ln INC + \beta_4 \ln BIGCITY + \beta_5 RURAL + \sum_{m=6}^{14} \beta_m D_m + \varepsilon \quad (1)$$

where  $D$  are time and Bell Company specific dummy variables (three time and five Bell dummies) and  $i$  is either  $U$  or  $C$  (our *universality* and *competitive* availability indexes). The logarithmic functional form for the explanatory variables is selected based on Godfrey *et al.* (1988).<sup>20</sup> The MLC method is estimated by weighted least squares.<sup>21</sup> Two versions of Equation (1) are estimated. The first employs  $A_U$  as the dependent variable (the percent of zip codes with at least one broadband provider) while in the second regression the dependent variable is  $A_C$  (the percent of zip codes with at least four broadband providers). In other respects, the models are identical.

There are three possible results from this regression: (a) that higher loop rates promote broadband availability ( $\beta_1 > 0$ ); (b) that higher loop rates retard broadband availability ( $\beta_1 < 0$ ); or (c) that loop rates have no (measurable) relationship to broadband availability ( $\beta_1 = 0$ ). The magnitude of the estimated

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<sup>19</sup> J. Berkson, *A Statistically Precise and Relatively Simple Method of Estimating the Bio-Assay with Quantal Response, Based on the Logistic Function*, 48 JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION at 565-99; G. S. Maddala, *LIMITED-DEPENDENT AND QUALITATIVE VARIABLES IN ECONOMETRICS* (1983).

<sup>20</sup> Godfrey, L. G., M. McAleer and C. R. McKenzie, *Variable Addition and Lagrange Multiplier Tests for Linear and Logarithmic Regression Models*, REVIEW OF ECONOMICS AND STATISTICS, 70 (3), pp. 492-503 (1988).

<sup>21</sup> Maddala, *supra* n. 19, at 30.

coefficient  $\beta_1$  can be used to quantify the relationship between loop prices and availability.

Notably, regulations to date have required loop prices to equal forward-looking costs. By including as a regressor an estimate of forward-looking cost that is void of state-specific regulatory and political idiosyncrasies, the empirical model estimates the effect of price on broadband availability independent of the cost of component of the price. Given that both price and cost are included as regressors, it is also possible to interpret the effect of price as the aggressiveness with which state commissions have established cost-based rates. As the FCC and long-established case law recognize, forward-looking cost must be estimated so that the end rate falls within a “zone of reasonableness” (*i.e.*, the rate can neither be confiscatory nor excessive).<sup>22</sup> Some state commissions may draw from the lower end of the zone of reasonableness while others the higher end. The particular specification used by the model herein allows us to measure the impact of these pricing decisions by the state commission.

#### A. Specification Issues

To provide confidence in this chosen specification, the analysis subjects the empirical model to the specification test RESET. RESET is capable of detecting a variety of specification errors including omitted variables and incorrect function form.<sup>23</sup> The null hypothesis of RESET is “no specification error,” so specification error is indicated only if the null is rejected. The RESET F-Statistic is well below the critical value for both regression models providing evidence that specification error is not a problem. RESET is also recommended by Gilchrest *et al.* (1988) in selecting a particular functional form, and the analysis also employs RESET in this way to finalize the specification. White’s test for heteroscedasticity

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<sup>22</sup> *In the Matter of Joint Application by SBC Communications Inc., Southwestern Bell Telephone Company, and Southwestern Bell Communications Services, Inc. d/b/a Southwestern Bell Long Distance for Provision of In-Region, InterLATA Services in Kansas and Oklahoma*, Memorandum and Order, FCC 01-29, \_\_\_ FCC Rcd \_\_\_ (rel. January 22, 2001) at ¶ 81-82; *In the Matter of Application of Verizon New England Inc., Bell Atlantic Communications, Inc. (d/b/a Verizon Long Distance), NYNEX Long Distance Company (d/b/a Verizon Enterprise Solutions) And Verizon Global Networks Inc., For Authorization to Provide In-Region, InterLATA Services in Massachusetts*, Memorandum and Order, FCC 01-130 \_\_\_ FCC Rcd \_\_\_ (rel. April 16, 200) at ¶¶ 22-27; *Farmers Union Cent. Exch., Inc. v. FERC*, 734 F.2d 1486, 1504 (D.C. Cir. 1984) (holding that the concept of “just and reasonable” must clearly be more than a “mere vessel into which meaning must be poured”).

<sup>23</sup> D. Gujarati, *BASIC ECONOMETRICS* (1995) at 464-6.

does indicate that the regression disturbances are not homoscedastic (despite the MLC estimation technique), so White's robust standard errors are used to compute the t-statistics.<sup>24</sup>

The fact the prices should be "based on cost" may result in a relatively high correlation between loop price and loop cost variables. Analysis finds that that is the case – loop prices and costs have a simple linear correlation coefficient of 0.79 ( $\rho = 0.79$ ). This collinearity does not bias the estimated coefficients in our model, although it does reduce the efficiency of our estimates (that is, it decreases the t-statistics). However, the effect of this collinearity will actually serve to dampen the importance of loop price as a determinant of availability, which would make it more likely that the variable of particular concern (*i.e.*, loop price) would be closer to zero (making a finding of "no effect" more likely). Generally, if the coefficient of interest ( $\beta_1$ ) is found to be statistically different from zero (the null is rejected), then the analysis concludes that there is insufficient collinearity to require model adjustment.<sup>25</sup> Interestingly, the fact that the analysis finds a relationship between broadband availability and loop rates even with this collinearity bolsters confidence in the results.

### B. *Summary of Results*

The results of the estimation and descriptive statistics are summarized in Table 1. Table 1 shows a number of interesting relationships between broadband availability and various factors, including rural population, time, and, of particular interest to this study, unbundled loop prices. The regressions explain large percentages of the variation in the availability (of both types) across states (the unweighted R-squares are 0.63 and 0.78, respectively).<sup>26</sup>

Both broadband availability and competitiveness appear to be driven primarily by rural population, time, and unbundled loop prices. All of these variables are statistically significant determinants of the availability (at the 5% level or better) in both models. The results indicate that states with a higher proportion of rural population have less broadband availability, another

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<sup>24</sup> *Id.* at 382-3.

<sup>25</sup> *Id.* at 344-5. We also note that the Variance Inflation Factors for both  $P_L$  and  $C_L$  are less than 10, a number which is generally taken to imply high multicollinearity. *Id.* at 338-9.

<sup>26</sup> Weighted least squares eliminates the constant term, so the analysis reports the unweighted values for R-squared.

unsurprising result. The effect of rural population is large and highly statistically significant. As expected, the time-specific dummy variables indicate that broadband penetration has risen over time (all time dummies measure the difference from June 2002 data).

There are a few differences in the models. For example, there is a negative and marginally statistically significant relationship between the number of large cities in a state and universality, but the variable appears to have no effect on competitiveness. Income is relevant for competitiveness, but not for universality. The sign on the income variable is positive as would be expected and the regressor is statistically different from zero at better than the 10% level.

Turning to important relationship between loop price and our measures of broadband universality and competitiveness, the null hypothesis that the loop price has no effect on is rejected in both models. The coefficient on loop price ( $\beta_1$ ) is consistently negative meaning that higher loop prices, holding costs and other factors constant, reduce both the universal and competitive availability of broadband services. For universality (Model 1), the implied elasticity is -0.10 indicating that a 10% decrease in the loop price (other things constant) will lead to a 1% increase in the number of zip codes with at least one broadband provider. At the sample mean, this increase would reduce the percentage of zip codes without broadband service by approximately 9%. At the sample mean, the elasticity of competitiveness with respect to loop price is -0.08.

Table 2 summarizes the effects on broadband availability for each state resulting from a \$1 increase in the loop rate. This simulation uses the estimated coefficients from the regression model to predict the reduction in availability of broadband services, based on average population in each state. If loop rates had been higher by \$1 across all states, then the model predicts that about 3.6 million households would be unable to purchase broadband services today. It is interesting to note that if all states were to adopt the FCC's 12.95% cost of capital for unbundled elements set in the *Virginia Arbitration Order* (2003), loop prices would, on average, be about \$2 higher.<sup>27</sup> Thus, if states had followed the same

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<sup>27</sup> *In the Matter of Petition of WorldCom, Inc. Pursuant to Section 252(e)(5) of the Communications Act for Preemption of the Jurisdiction of the Virginia State Corporation Commission Regarding Interconnection Disputes with Verizon Virginia Inc., and for Expedited Arbitration*, Memorandum Opinion and Order, CC Docket No. 00-218 (August 29, 2003) at ¶64. The average cost of capital adopted in states for TELRIC models is about 10%. For every one-percentage point increase in the cost of capital, the loop rate increases by about 5%.

peculiar logic contained in the FCC's *Order* related to the cost of capital, then about seven million households would be without access to broadband services today.

### III. Conclusion

This study adds to the mounting work showing that wholesale network access requirements (like unbundling) do not dampen broadband availability or investment incentives more generally. To the contrary, the analysis contained herein strongly shows that states that have established relatively lower rates for unbundled loop access have enjoyed *more* consumer choice and have seen *more* deployment of broadband technology within their borders.

Notwithstanding, the Administration and the FCC in particular recently have made significant efforts to reverse these policies and severely curtail competitive choice for residential and small business telephone consumers based upon flawed analytical foundations and little empirical support. Given the huge stakes involved, however, perhaps it is not too much to ask for policymakers to study and consider the evidence before they decide that a policy is or is not working.

**Table 1. Summary of Econometric Estimates**

	Dep. Var. = $A_U$	Dep. = Var. $A_C$	Mean <sup>a</sup>
	Coef. (t-stat)	Coef. (t-stat)	(St. Dev)
$\ln P_L$	-0.837 (-2.54)*	-0.333 (-2.99)*	14.70 [4.29]
$\ln C_L$	13.735 (0.31)	-0.047 (-0.35)	14.15 [5.84]
$\ln INC$	0.712 (1.19)	0.284 (1.85)**	30.36 <sup>a</sup> [22.55]
$\ln BIGCITY$	-0.052 (-1.76)**	-0.001 (-0.19)	1.33 [1.98]
<i>RURAL</i>	-3.797 (-5.15)*	-1.704 (-8.34)*	0.28 [0.15]
<i>DQWEST</i>	1.718 (0.62)	0.083 (0.13)	0.28 [0.45]
<i>DVZ</i>	2.375 (0.86)	0.257 (0.39)	0.28 [0.45]
<i>DBLS</i>	2.916 (1.07)	0.533 (0.83)	0.18 [0.39]
<i>DSBC</i>	2.110 (0.79)	0.190 (0.29)	0.16 [0.37]
<i>DAMER</i>	2.053 (0.79)	0.066 (0.11)	0.10 [0.30]
<i>DEC2003</i>	0.873 (7.07)*	0.178 (4.70)*	0.25 [0.43]
<i>JUNE2003</i>	0.564 (4.41)*	0.123 (3.26)*	0.25 [0.43]
<i>DEC2002</i>	0.266 (2.18)*	0.040 (1.06)	0.25 [0.43]
<i>AU</i>	...	...	0.89 [0.10]
<i>AC</i>	...	...	0.41 [0.22]
R <sup>2</sup> (Unwgt)	0.63	0.78	
White $\chi^2$	42.82*	31.13*	
RESET F (Prob.)	0.46 (0.63)	0.17 (0.85)	

\* Statistically Significant at the 5% level or better.  
\*\* Statistically Significant at the 10% level or better.  
<sup>a</sup> Descriptive statistics are not expressed in log form.

**Table 2. Reduction in Household Availability of Broadband for Every \$1 Increase in the Unbundled Loop Rate**

State	Households Affected	State	Households Affected
Alabama	59,923	Montana	12,384
Alaska	7,533	Nebraska	21,912
Arizona	63,019	Nevada	23,735
Arkansas	35,809	New Hampshire	16,305
California	417,226	New Jersey	106,328
Colorado	56,277	New Mexico	22,944
Connecticut	42,483	New York	239,796
Delaware	9,976	North Carolina	104,814
Dist.of Columbia	8,737	North Dakota	8,462
Florida	214,478	Ohio	149,670
Georgia	105,468	Oklahoma	46,026
Hawaii	13,278	Oregon	44,031
Idaho	16,890	Pennsylvania	162,364
Illinois	157,066	Rhode Island	13,828
Indiana	80,735	South Carolina	53,559
Iowa	39,077	South Dakota	9,941
Kansas	34,743	Tennessee	76,366
Kentucky	55,520	Texas	252,936
Louisiana	56,758	Utah	24,320
Maine	17,475	Vermont	8,325
Maryland	71,412	Virginia	93,634
Massachusetts	82,799	Washington	79,909
Michigan	127,586	West Virginia	25,593
Minnesota	61,884	Wisconsin	69,865
Mississippi	36,429	Wyoming	6,639
Missouri	74,130		