Splitting the Baby: An Empirical Test of Rules of Thumb in Regulatory Price Setting

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Abstract: This article provides an empirical evaluation of a recent and important exercise in regulatory price setting. The Telecommunications Act of 1996 requires incumbent monopoly local phone companies to sell components of their network to rival firms at prices determined by state regulators. The prices for these "unbundled network elements" were to be based primarily on independent estimates of forward-looking economic costs. Our econometric analysis reveals that while cost is a primary determinant of element prices, the prices also reflect foregone retail profits for incumbent firms. Statistical tests suggest that "splitting the baby" remains an accurate positivist description of public agency behavior.

Kewords: Regulation; Telecommunications Act of 1996; Public Utilities. JEL Classification: L5, L96,

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I. Introduction

Historically, economists' interest in regulatory price setting has focused on two largely unrelated problems: first, which prices are efficient given the various complex constraints and circumstances applicable to regulated firms? And second, how are regulated prices actually determined in practice? That these two problems are largely unrelated is a commonplace, yet curiously the great bulk of academic research has thus far concentrated on the first. While it is clearly of some utility to understand how efficient prices could, in principle, be determined in some given stylized environment, it is surely more important for policy purposes to understand how prices are arrived at in the "real world." Stigler and Friedland (1962) apparently initiated the analysis of this latter topic, and their answer to the question "What can regulators regulate?" is often somewhat overstated as "not much." Later contributions by Meyer and Leland (1980), Gormley (1983), and many others, have convincingly debunked the notion that regulated prices should be understood as implementations of relatively complex theoretical models of efficient price-setting.

The most important, and most politicized, regulatory pricing program of recent times is that imposed on state public utility commissions by the Telecommunications Act of 1996 ("The Act"). This Act, which has been the subject of extensive analysis and controversy since its implementation, has as its stated goal the establishment of competitive markets for all telecommunications services, including local services which have historically been the exclusive purview of regulated monopoly providers. Due to the acknowledged presence of large scale economies and sunk costs in local services markets, the Act established a three-pronged avenue for entry of competitive firms into these local markets. First, incumbents are required to provide resale of final services at discounts determined by an avoided retail cost calculation. Second, incumbents are required to make available, at prices "based on costs" and *not* based on any sort of rate-of-return calculation, network elements (such as loops, switching, transport, and so on) on an "unbundled" basis, which entrants can use to provide services in combination with other inputs they provide themselves. Finally, entrants may provide services over their own facilities exclusively, though practically even entrants considered primarily facilities-based nearly always combine elements leased from incumbents with their own facilities.[1]

While the Federal Communications Commission ("FCC") provided state commissions fairly explicit guidance on the pricing of the unbundled network elements ("UNEs"),

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[1] RCN Communications, for example, has constructed hybrid fiber-coax networks in eight of the largest U.S. cities. While the company relies primarily on its own network to provision service, it also must purchase unbundled elements from incumbent firms to complete its service. See RCN Form 10-K, Year 2003.

given the complexity of the task and the thousands of inputs and assumptions necessary to implement the FCC's chosen pricing methodology the state utility commissions retained substantial latitude in wholesale price setting.[2] In addition, the pricing of UNEs under the Act takes place in a highly contentious adversarial setting and involves relatively sophisticated outside estimates of the economic costs of the objects being sold, a method not frequently used to set regulated prices. Although, as will be argued below, any credible theoretical model of regulatory price setting is quite unlikely to be both tractable and rich enough to encompass UNE sales, it is clear that costs are a relevant parameter of the pricing problem in every sensible model of it.

This paper considers the pricing of the combination of UNEs referred to as the UNE Platform ("UNE-P") using empirical means. Unlike many such analyses in other areas, we benefit from the availability of detailed, independent assessments of the economic costs of these elements, so that deviations between regulated element prices and element costs are known. Our analysis makes it possible for us to evaluate several important claims about UNE pricing which various parties with financial interests have put forward in this process. In particular, we are able to provide a careful test of the claim, made by incumbent service providers who oppose the development of competitive markets in local services, that element prices implemented by public service commissions incorporate retail price benchmarks, thus inducing competitive entry even when such entry is not economic. In addition, we can evaluate the extent to which the US Congress was successful in inducing the state commissions, which have a unique and indispensable role in this process, to implement a pricing regime based on economic costs. Our general findings support the claim that element prices reflect a politically-sensible "balancing" of the federal mandate to implement cost-based prices, and an apparent desire by regulatory commissions to insulate incumbents from the capital losses such a scheme could generate by including retail margins in the setting of element prices. We find no evidence that embedded costs or retail prices themselves affect UNE prices.

Although our analysis is restricted to the pricing of UNEs under the Act, our results can be added to those few others that have shed light on the actual performance of regulatory price setting. In this sense, we believe our findings can be of general usefulness in the public choice analysis of an important type of government institution.

Our paper is divided into five sections. Section 2 provides background, while Section 4 describes our model and data. Section 4 provides statistical results, and a conclusion completes the manuscript.

II. Background on Regulatory Price Setting

The economic literature on regulatory price setting has followed two distinct paths, the first focusing on the derivation of efficient prices, and the second evaluating the nature of actual price determination by regulatory bodies. The former literature is far more

[2] Under the framework of the Act, the FCC was allowed to establish a general pricing methodology, which is then implemented by the state regulatory commissions. *See AT&T Corp. v. Iowa Utilities Board,* 525 U.S. 366, 119 S.Ct. 721, 142 L.Ed.2d 835 (1999).

extensive, and can be traced to early work by Hotelling (1938), Allais (1948), and others. This literature is not relevant to the current paper, but extensive reviews are available from Spulber (1989), Brown and Sibley (1986), Laffont and Tirole (1993), and many others.

Research into the actual nature of regulatory price setting, which can be associated with both the Public choice tradition and the Chicago School, began with Stigler and Friedland (1962), who evaluated whether or not the presence of price regulation among US states in electric markets led to significant differences in observed prices for electricity. Their finding- that regulation had a modest or negligible effect on prices- has been extensively cited ever since in defense of the proposition that regulation is largely ineffective in achieving its stated goals of controlling monopoly power and mitigating price discrimination. Later work by Jordan (1972) goes farther, and suggests that regulation may have perverse effects, rather than no effect, at least in oligopolistic industries. Joskow (1974) found that regulated electricity prices did not fall during periods of falling production costs, but did exhibit substantial resistance to increases during inflationary episodes. Studies by Moore (1970) and Callen, Mathewson and Mohring (1976) provided additional evidence.

An important study by Meyer and Leland (1980) found that the degree to which regulation reduced electricity prices below purported monopoly levels (which they sought to directly estimate) varied widely among states and across time, although in general it was concluded that regulation did restrain prices, often substantially. Strong support for this conclusion was provided by subsequent study by Greene and Smiley (1983), who argued that regulated electricity prices were often well below their unconstrained monopoly levels.

Evidence from industries other than electric power includes studies of cable television markets, such as those of Zupan (1989), Prager (1990), Jaffee and Kanter (1990), Mayo and Otsuka (1991) and Otsuka (1993). Although these studies use varying methodologies and do not reach identical conclusions, it is certainly fair to say that, in general, regulation does have an effect on market outcomes, although these effects are neither obvious enough, nor large enough, to be detected in every instance.

Although regulation may generally be taken to have reduced prices below monopoly levels in most "monopoly" markets in recent times, such a finding does not imply that regulation may be best understood from a "public interest" perspective. Kaserman and Mayo (1995: 548) probably speak for most students of regulation when they note, "the fundamental problem with the public interest theory of regulation is that it simply does not perform well empirically … even in those industries that are natural monopolies, the regulatory policies observed in practice often depart from the policies that our normative analysis would recommend (and the public interest theory, therefore, would predict)."

We are left, then, with a rather unfocused positive description of regulatory price setting. The roles of efficiency, interest group politics, legal constraints, poor information, and myriad other factors make solid a priori predictions difficult. The work of Stigler (1971), Posner (1974), Mitnick (1980), Romer and Rosenthal (1985), and many others led Brown and Sibley (1986: 4) to conclude, "Recent work on the positive theory of regulation paints a complex picture of economic regulation. Regulators are assumed to be interested in maximizing political support for their incumbency and do so through their regulatory decisions." Spulber (1989: 273) notes that, "[a]nother view … is that utility rates reflect the preferences of regulatory commissioners or their staffs." Former utility commissioners Marilyn O'Leary and David Smith (1989: 223) concur, noting, "[i]t is difficult for economists to understand regulatory decision making because they usually do not understand how regulators see their role …. Regulators understand their duty to balance the interests of rate-payers and shareholders when making a decision. They understand they have an economic function to set price, but they act in an environment of inputs, constraints, and concerns that are not economic in nature. [The objective of fairness] may not make it possible for the economic criterion of efficiency to be achieved."

The difficulties enumerated above, in our view, make the establishment and dissemination of empirical regularities in regulated pricing particularly valuable. If, as seems likely, it is quite unrealistic to expect any one tractable positive theory of price setting to be satisfactory in every case, then it is surely a useful thing to examine the most important cases in order to determine what if anything can be reliably said about actual regulatory experience. This is the approach we adopt here, and our example, which is of contemporary importance, concerns the pricing of unbundled network elements by state commissions under the mandates of the Telecommunications Act of 1996 and the FCC.

III. Regulatory Price Setting and the Telecom Act

Prior to the Act, local exchange telecommunications markets were dominated by incumbent local exchange companies ("ILECs"), which are regulated monopolies. Facing little or no competition at any stage of production, prominent ILECs, such as the "Baby Bells", enjoyed virtual monopoly positions in sales of local switched services and exercised close control over the ubiquitous local switched network infrastructure. Such competition as existed was limited to special "niches" used solely by large business customers.

In an effort to open local markets to competition, the Act specified that network elements – that is, those network functions and devices that allow telecommunications services to be provided to customers -- be sold to competitors at regulated prices, and that these prices be determined in contested hearings on a state-by-state basis, without reference to rate of return considerations. Thus, Congress believed that the experience of long distance competition could, in a sense, be duplicated in local services by a mandatory wholesale market.[3] Because entrants could be expected to build at least some network components more easily than others, and the cost-benefit calculus of entrants would vary substantially among firms, it was seen as vital that the ILECs' networks be made available on both a "piece-part" and combined basis.

[3] In long distance, there are over 900 long distance carriers, all providing service over about seven nationwide long distance networks. See *Trends in Telephone Service*, Federal Communications Commission (May 2004) at Table 9.4.

The Act, in Section 252(d)(A)(i), requires that wholesale prices for unbundled network elements be "based on the cost (determined without reference to a rate-of-return or other rate-based proceeding) of providing the …network element." The FCC sought to implement this requirement, after extensive and contentious debate, by promulgating the so-called "Total Element Long Run Incremental Cost" or "TELRIC" methodology. The FCC established a forward-looking cost calculation procedure that essentially calculates the costs of elements on an economic basis, through the use of complex engineering studies of the costs of duplicating current network functionality on a forward-looking basis, using current technology and imposing relatively few technical properties of the existing, "embedded" network on the cost calculations. Thus, although not usually stated in these terms, the TELRIC methodology essentially values the existing network, and its elements, by asking how much it would cost today to duplicate the functions and services of the existing network using the technologies and prices relevant today. Historical network costs are not to be considered, nor will regulated element pricing be used to facilitate cost recovery, as such a procedure would lead, in the FCC's view, to incorrect signals to potential entrants. The FCC concluded that a "cost-based pricing methodology based on forward-looking economic costs… best furthers the goals of the 1996 Act. In dynamic competitive markets, firms take action based not on embedded costs, but on the relationship between market-determined prices and forward-looking economic costs."[4]

While the FCC's TELRIC standard was a fairly comprehensive cost methodology, the actual implementation of the policy was left largely to the state commissions, and these commissions may well be amenable to persuasion by incumbent firms with which they have had long-term dealings.[5] Exploiting both the inexactitude of TELRIC principles as well as the political nature of regulatory commissions, parties put forth a variety of arguments for either a distorted or loose application of TELRIC principles. Although the potential list of such arguments is open-ended, several recur frequently enough so that they may be identified and evaluated in the analysis presented below. These arguments have different origins, and are unified only in their incompatibility with strict economic cost criteria. We focus here on three of these that, in various guises, appear (to us) to constitute the bulk of the arguments in this matter.

First, element prices may contain components related to, or derived from, embedded (historical) costs. State utility commissions used these costs to regulate utility prices for

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4 *Implementation of the Local Competition Provisions in the Telecommunications Act of 1996*, First Report and Order, CC Docket No. 96-98, 11 FCC Rcd 15499, 15782-807, (1996) at ¶ 619).

5 Legal opinions, especially *AT&T v. Iowa Utilities Board* (1999), make it clear that the FCC cannot establish rules so exacting that they effectively dictate to state authorities the prices of elements. Thus, the states retain a good deal of autonomy in price setting. See *AT&T Corp. v. Iowa Utilities Board,* 525 U.S. 366, 119 S.Ct. 721, 142 L.Ed.2d 835 (1999). The TELRIC standard itself has been the focus of extended litigation, culminating in the *Verizon v. FCC* decision of the US Supreme Court (2002), where the court upheld the TELRIC methodology as lawful and reasonable, dismissing arguments made by incumbent firms that TELRIC was both confiscatory and produced "parasitic" competition. See and *Verizon Communications Inc. v. FCC*, 122 S. Ct. 1646 (2002). Yet TELRIC is a methodology only, and this methodology can be applied in many ways, leading to very different sorts of outcomes. It is fair to say, then, that these debates were not really settled by the Verizon ruling, and the political and legal battles between the incumbent firms and potential entrants continue without pause.

almost a century prior to passage of the Act, and many commissioners may be receptive to arguments that such costs should be recovered through element pricing. In addition, if element sales actually lead to expanded competition, retail prices may be incapable of generating full historical cost recovery in some cases, and competition in any event makes retail rate regulation more difficult. To the extent commissions are receptive to arguments of this sort, one would expect element prices to reflect embedded costs.

Second, many incumbents have historically argued for application of some form of the "efficient component pricing rule" (ECPR) to price elements.[6] This rule produces economically efficient input prices under certain conditions on the nature of competition in retail markets. In particular, the rule holds that prices for inputs sold to competitors should equal economic costs plus a component representing inframarginal rents earned in the output market due to the presence of increasing marginal costs. Although the originators of this doctrine have objected to its application to element pricing given the nature of telecommunications competition, incumbent firms have long argued for its use, and did so originally in those debates that led the FCC to adopt the TELRIC standard. In practice, the idea is that element prices should include a component that represents lost rents the incumbent would otherwise have earned, had it retained the retail customer lost to an entrant. It is argued that any voluntary sale of the element would necessarily include such a component in the price.

Third, a number of incumbents have vigorously argued that state commissions have improperly used regulated retail rates to set element prices, claiming "states have set discounts against below cost residential retail rates rather than on any realistic measure of cost."[7] The implication here is that element prices are selected, taking retail service rates in to account, so that entrants are virtually guaranteed a positive, attractive margin. In this view, commissions have "stacked the deck" by pricing elements to (artificially) induce entry by assuring entrants of large returns.

Thus, in addition to TELRIC, the debate surrounding element prices suggest three additional factors that may influence price setting by state commissions. Each of these further factors represents a potential source of deviation in prices from their economic cost bases. As explained above, court rulings and the practical difficulties of regulation combine to give state commissions some latitude in setting prices so that, if they wished, they could presumably incorporate these factors into their price-setting.

One may object to all of these arguments on theoretical grounds, of course, by noting that the factors identified above, such as retail rates or embedded costs, are not economically meaningful on their own, but rather simply serve as shorthand for various private interests, which are best and correctly measured only by profits or returns

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[6] *Verizon v. FCC, Id.*

[7] Ex Parte Presenation, Messrs. I. Seidenberg, W. Barr, and T. Tauke and Ms. D. Toben, representing Verizon, met separately with Chairman Powell and Mr. C. Libertelli, Commissioner Abernathy and Mr. M. Brill, Commissioner Copps and Mr. J. Goldstein, and Commissioner Martin and Mr. D. Gonzales (Ms. Toben did not attend this meeting), CC Docket No. 01-338, Federal Communications Commission (August 16, 2002) at 16. Also see *Telecommunications Reports Daily* (September 12, 2002) and Glenn Bischoff, USTA Calls For the End of UNE-P, TELRIC, *TelephonyOnline.com* (Sept. 13 2002).

(Peltzman 1976; Beard et al 2003). Taking the "economic theory of regulation" view, one would use economic costs to determine prices, but the levels of embedded costs, for example, would be irrelevant. Rather, the public commissions involved would select prices to maximize their utility (represented, perhaps, by political support), and the resulting prices would have nothing to do per se with embedded costs and so on. Indeed, one could logically go farther and note that the selection of element prices is actually only a small part of the ongoing and complex regulatory game between public bodies, firms, and other interested parties. Given this, why should one expect the single set of decisions represented by UNE prices to have any discernable pattern on their own?

We feel there are two responses to these complaints. First, "rules of thumb" are useful mechanisms precisely in environments where "full optimality" is incalculably complex (Quandt and Baumol, 1964). The complexity of the regulatory environment, with incomplete information, changing players, political intrigue, and so on, would seem a potentially fruitful place to look for operative rules of thumb. Second, and more importantly, the complexity of explaining regulatory outcomes in a positive fashion suggests that the search for rules of thumb is a very valuable enterprise, as such rules serve to both delineate the boundaries of theoretical models, and provide policy-relevant information useful to regulators, politicians, and others. If one is able to identify robust characteristics of regulatory price setting, then it becomes possible to assess the success of the Act itself, and suggest feasible improvements in its implementation or, alternately, explain why it should be scrapped. The identification of such characteristics of UNE price setting is the goal of this paper.

IV. Empirical Model of Wholesale Price Determination for UNEs

The discussion above suggests that the wholesale price for UNEs (P) can be viewed as a function of forward-looking economic costs (C) (the legal pricing standard) plus an additive term (Ω):

$$P = g(C) + \Omega(Z, \varepsilon) \qquad (1)$$

where this additive term (either positive or negative) reflects the systematic (Z) and idiosyncratic (ε) influences on wholesale price determination. As previously mentioned, systematic influences may include the embedded/current costs, retail prices, and alternative pricing methods (*i.e.*, the ECPR).

Giving a more specific function form to the relationship allows for a statistical test of the relative influences of cost and other factors on UNE prices. We use the following functional form for our analysis:

$$P = \alpha_0 + \alpha_1 C + \alpha_2 M + \alpha_3 T + \alpha_4 E + \alpha_5 X + \varepsilon, \qquad (2)$$

where P is wholesale price, C is forward-looking cost, M is the retail opportunity cost (average revenue minus forward-looking cost), T is retail price for residential local telephone service, E is embedded cost, X is a vector of other variables that may affect P, ε is a well-behaved econometric disturbance term, and the α's are the coefficients to be estimated.

The explanatory variables of primary interest include C, M, T, and E. Since all four variables are measured in dollars per-line/month, the coefficients themselves provide a reasonable ranking of each variable's importance in price determination. The coefficients also allow for some interesting tests of particular rules-of-thumb for price determination. For example, one testable hypothesis concerns whether or not state regulatory commissions adopt a "splitting-the-baby" approach to price determination -- that is, rendering decisions that lie between the proposals of the two adversaries. Computing a simple average of the two positions is not uncommon in regulatory proceedings, though this "technique" is rarely cited explicitly.[8] In the context of Equation (2), a "splitting-the-baby" approach to wholesale price determination suggests that the hypothesis that the coefficient α_1 equals 1.00 and α_2 equals 0.50 cannot be rejected. In other words, the primary position of the CLECs (and the FCC) is that wholesale prices should equal forward-looking costs whereas the ECPR is the favored price methodology of the ILECs.[9] What the coefficient values just mentioned imply is that wholesale price is set equal to cost ($\alpha_1 = 1.00$) plus one-half ($\alpha_3 = 0.50$) of the retail opportunity cost (measured by M). A joint test of these coefficient restrictions will indicate whether existing wholesale prices for UNE-Platform are consistent with the "splitting-the-baby" approach.

Another method of evaluating the relative influence of each regressor on wholesale prices (P) is to compute the standardized coefficient for each variable (Wooldridge, 2003: 186). The standardized coefficient measures changes in the dependent and explanatory variable in terms of standard deviations, so the coefficients are metric-free. If the standardized coefficient on C is found to be 0.5, then the UNE-P price (P) changes by 0.5 standard deviations for every one standard deviation change in C. If the coefficients of all the explanatory variables are standardized, then the relative importance of each explanatory factor can be determined. For the splitting-the-baby hypothesis, the standardized coefficient on variable C would be twice as large as the standardized coefficient on variable M.

1. DATA

All data is measured at the State level for Bell Company territories in the contiguous 48 States except for Connecticut, Rhode Island, and Nevada (leaving 45 observations). These States were excluded from the sample due to missing data on wholesale prices.[10]

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[8] For example, in a recent UNE cost proceeding before the California Public Utilities Commission, the ILEC proposed a cost of capital of 12.19% and the CLECs presented evidence supporting a cost of capital of 7.1%. The simple average of the two proposals is 9.65%; the commission selected a cost of capital of 9.44%. *Opinion Establishing Revised Unbundled Network Element Rates for Pacific Bell Telephone Company Dba SBC California*, Application 01-02-024, California Public Utilities Commission (September 23, 2004).

[9] See *Verizon v. FCC*, supra nt. 5 and Beard et al (2002).

[10] Wholesale price data is restricted to Bell Company territories, so that Hawaii and Alaska are excluded. CCM rate data was not available for Connecticut, and switching price data was unavailable for Nevada and Rhode Island.

These excluded States account for fewer than one-percent of all access lines (0.8%). Descriptive statistics and sources are provided in Table 1.

For the price variable (P), we use the wholesale price for the combination of unbundled elements referred to as UNE-Platform or UNE-P. We use the UNE-P price for a number of reasons. First, the UNE-P is a combination of an unbundled loop, switching functionality, and transport, and thereby allows competitive local exchange carriers ("CLECs") to provide local phone service primarily using the ILECs' network. Because the combination of elements included in UNE-P allows the CLEC to provide retail service to residential and small business customers, it is possible to match the UNEs with retail offerings for which prices and margins can be computed. Second, UNE-P is the most successful and highest growth mode of competitive entry for residential consumers and, as such, is the mode of entry most under attack by the BOCs and most defended by CLECs (Pace Coalition, 2003). The heated political debate over UNE-P suggests non-cost factors could play a substantial role in regulatory price determination.

Wholesale prices are measured using summary information provided by Kovacs et al (2002). This source of data provides estimates of switching costs, but the estimates are often in error for many States. Thus, wholesale prices for unbundled switching are computed by adjusting the Kovacs estimates to better match up with the actual wholesale prices for unbundled switching.[11] For comparison purposes, the regression also is estimated using the unadjusted Kovacs data and the results presented, but we do not discuss this alternate regression. The more interesting results for the two different dependent variables are virtually identical.

Forward-looking cost C is measured by the output of the publicly available Hybrid Proxy Cost model ("HCPM"), a forward-looking cost model developed by the FCC.[12] This variable is a summary index for all State specific exogenous (*i.e.*, geographic) effects that influence the forward-looking cost of network elements. For consistency with the ILEC position that "[S]tates have set discounts against below cost residential retail rates rather than on any realistic measure of cost," retail price T is measured by the residential retail rate. Gregg (2001) provides State-by-State measures of retail residential rates. Retail opportunity costs M are computed as the difference between average revenue per line (A), computing using ARMIS data, and forward-looking cost C. Embedded costs E are measured as total expenditures per access line (switched and special), and these costs are provided by ARMIS.

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[11] Computing the cost of the UNE-P is a difficult undertaking. The authors are grateful to Kevin King and Michael Strobl at Z-Tel Communications (a CLEC providing service in 48 states using UNE-P) for assisting with these calculations.

[12] The model and its output can be downloaded at: http://www.fcc.gov/wcb/tapd/hcpm/. The method used to compute the cost per line (loop and switching) follows the FCC's methodology used in its latest 271 Orders. *See, e.g., In the Matter of Application of Verizon Pennsylvania Inc., et al. for Authorization to Provide In-Region, InterLATA Services in Pennsylvania*, Memorandum Opinion and Order, FCC 01-269, ___ FCC Rcd ___ (rel. Sept. 19, 2001)

Also included as regressors are ILEC specific dummy variables for BellSouth (DBLS), Verizon (DVZ), and Qwest (DQWST).[13] For the ILEC dummy variables, the variable equals 1.00 if the relevant carrier serves the State, zero otherwise. Given that the ILECs present very similar cases during the cost proceedings within their regions, the costs within each ILEC region may be more alike than costs between ILEC regions. These dummy variables should capture that effect, as well as any difference in the political influence exerted on State commissions by the ILECs (or any other ILEC specific influence on wholesale prices). The estimated coefficients on the dummy variables measure the difference between these three ILECs and SBC (the ILEC dummy excluded).

Finally, we include a dummy variable that indicates whether the public service commissioners are elected or appointed (DELECT) and their respective terms of service (TERM). Earlier research suggests that the political form of the commissions has an impact on some decisions by state regulatory commissions (Kwoka, 2002; Ando and Palmer, 1998; Gormley, 1981).

2. MODEL SPECIFICATION AND EVALUATION

The final specification of Equation (2) is:

$$P = \alpha_0 + \alpha_1 C + \alpha_2 M + \alpha_3 T + \alpha_4 E + \alpha_5 DBLS + \alpha_6 DVZ + \alpha_7 DQW + \alpha_8 DELECT + \alpha_9 TERM + \varepsilon_a, \quad (3)$$

Two versions of Equation (3) are estimated. Model 1 uses the adjusted CCM data whereas Model 2 uses the unadjusted CCM data. Model 2 is provided for illustrative purposes only and the results are not discussed in any detail. Regression results are summarized in Table 2.

Econometric specification errors such as omitted variables, endogenous explanatory variables, errors in measurement, or an incorrect functional form, can each cause least-squares estimates to be biased, inconsistent, and inefficient. The RESET test is a general test of specification error, and is capable of detecting all of the specification problems listed above (Ramsey 1969), and the test is particularly sensitive to omitted variables and incorrect functional form.[14] The null hypothesis for RESET is "no specification error," so specification error is indicated if the null-hypothesis is rejected. The RESET F-statistics are provided in Table 2, and the RESET F-statistic is not statistically significance for Model 1, so there is no evidence of specification error for these models (*i.e.*, null-hypothesis of "no specification error" cannot be rejected at standard significance levels). Accordingly, the RESET test indicates that the regression equations do not suffer from these important specification errors. The null hypothesis of no specification error is

[13] States are assigned to each ILEC as follows: BellSouth (AL, GA, FL, KY, LA, MS, NC, SC); Verizon (NY, MA, ME, WV, VT, PA, VA, MD, NJ, DE, RI, NH); and Qwest (AZ, CO, ID, IA, MN, MT, NE, NM, ND, OR, SD, UT, WA, WY).

[14] The RESET Test is valid only for least-squares regressions. Ramsey's RESET Test is performed by including as regressors the powers of the predicted values of the regression. The joint significance of these additional regressors is evaluated, and the null hypothesis of "no specification error" is rejected if the RESET F-Statistic exceeds the critical value (*i.e.*, the test of the joint restriction that all of the additional coefficients equal zero is statistically significant).

rejected for Model 2, and this is probably the result of systematic errors in the price estimates.

Another test for specification error is the White test, which is used as a test for heteroscedasticity. Heteroscedasticity results in unbiased but inefficient coefficient estimates, implying the standard errors of the estimated coefficients are too large (and, consequently, the t-statistics are too small). We are unable to reject the null hypothesis of the White test (homoscedastic errors) at even the 10% level for Models 1 and 2.

Because the regression includes a number of measures of prices and costs, there exists the potential for multicollinearity to influence the efficiency of the standard errors (and thus the t-statistics). The correlation coefficients of the variables are provided in Table 1, and none of these coefficients exceeds 0.60. So, while there is some correlation between the regressors (as always), the correlations are not particularly high. Furthermore, multicollinearity typically leads to low t-statistics and a high R-squared. While the R-squares of the regressions are high, so are the t-statistics. Thus, the efficiency of the estimates does not appear to be affected adversely by correlation among the regressors.

V. Summary of Findings

Results from the least squares estimation of Equation (3) are summarized in Table 2. Most of the explanatory variables are statistically significant at the 10% level or better, and the model explains about 80% of the variation in the wholesale price for UNE-P. R-squared is often low for cross sectional data, so the relatively high R-squared is encouraging.

The regression results indicate that forward-looking cost is an important factor in setting wholesale prices for unbundled elements. Model 1 indicates that wholesale prices adjust to forward-looking cost on slightly more than dollar-for-dollar (α_1 = 1.27), though we cannot reject the hypothesis that the coefficient is equal to 1.00 (F-stat = 1.70). The standardized coefficient is 0.699, which is considerably larger than the other regressors of interest.

The retail opportunity cost M is also positively signed and statistically different from zero. Thus, the ILECs' attempts to incorporate retail margins into wholesale prices appear to have met with some success. The estimated coefficient on the margin indicates that wholesale prices increase by about $0.37 for every $1.00 increase in the retail opportunity cost of the ILEC. The standardized coefficient is 0.247, the second largest determinant of UNE price.

Of the four variables of primary interest (C, M, T, and E), only forward-looking cost and the margin are statistically significant determinants of price. The signs on both the retail price (T) and embedded cost (E) are negative, but we are unable to reject the null hypothesis that either of the coefficients is zero. The null hypothesis that both T and E are jointly zero cannot be rejected at standard significance levels (F = 0.70). Both the un-standardized and standardized coefficients indicate that these two variables explain very little variation in wholesale price relative to forward-looking cost (C) or the margin (M).

There exist systematic and sizeable non-cost based differences in wholesale prices for UNEs across the BOCs; all the ILEC dummy variables are positive and statistically significant. Relative to SBC, all three Bell Companies appear to have attained successfully higher wholesale prices on average, for reasons other than those factors included in the regression. On average and holding forward-looking costs (and other regressors) constant, BellSouth and Verizon's wholesale price for UNE-P are about $10 higher than SBC and $6 higher than Qwest.[15] Qwest's UNE-P price is $4 more than SBC's UNE-P price, on average and *ceteris paribus*. Neither the coefficient on the election dummy variable, nor the service term, is statistically different from zero, suggesting that the method of commissioner selection or commissioner tenure are not important factors in UNE rate determination.

As discussed earlier, if state regulatory commissions take the preferred pricing positions of the CLECs and ILECs and "split-the-baby," then we should find that $\alpha_1 = 1.00$ and $\alpha_2 = 0.50$. Considering the highly contentious nature of the cost proceedings and the absence of detailed information on the consequences of particular pricing choices, adopting a split-the-baby rule of thumb seems reasonable. For Model 1, the F-statistic on the joint restrictions ($\alpha_1 = 1.00$; $\alpha_2 = 0.50$) is 2.32, which is not statistically significant even at the 10% level. An alternate test of the rule of thumb involves the standardized coefficients and the constraint ($\alpha_1/\alpha_2 = 2$); that is, the hypothesis is that cost (C) contributes twice as much to price determination as does the retail margin (M). The F-statistic on this constraint is 0.34, which is not statistically significant. Based on both of these statistical tests, we cannot reject the null hypothesis that state regulatory commissions adopted the "split the baby" rule-of-thumb in setting prices for UNEs (UNE-P in particular).

VI. Conclusion

The actual details of regulatory price setting have long been of interest to economists. Although Sigler's finding that regulators do not really "regulate" has intuitive appeal, empirical results from Meyer and Leland (1980) onwards invariably find *some* effects of regulation on price. These effects, however, are often hard to rationalize on welfare or simple positivist grounds. This article looks at the most important recent regulatory initiative, the pricing of network elements under the Telecommunications Act of 1996, in hopes of contributing to this debate.

We find that forward-looking economics costs (the relevant cost standard) contribute most to the determination of wholesale UNE prices for UNE-P when compared to embedded costs, retail prices, or the retail opportunity cost of the ILEC. Econometric evidence suggests that retail opportunity cost (ECPR) also plays an important role in wholesale price setting. Overall, the evidence presented here suggests that State regulators have, to a large extent, set wholesale prices between forward-looking cost and the ECPR rate. It appears, as is common in regulatory proceedings, the interests of both parties have been balanced.

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[15] The null hypothesis of equality of the coefficients on DBLS and DVZ could not be rejected (F =0.42). These two coefficients were statistically different than the coefficient on DQWST.

While it seems unlikely that our findings can be explained by a public interest theory of regulation, or by any purely positive theory for that matter, we may add our results to those, described earlier, that hold that regulators do, in fact, regulate things. Prices primarily, but not completely, based on costs are consistent with guidance and exhortations provided by the FCC to state officials. Yet, prices do incorporate forgone margins, and are therefore responsive to incumbent opportunity costs, the basis of unregulated monopoly pricing. The challenge is to explain such a "splitting the baby" outcome in a positive theoretic framework.

Table 1. Descriptive Statistics

Variable	Definition	Mean	St. Dev.	Source
P	Price for the UNE-P. [Unadj. Capital Commerce Mkt data]	26.17 [23.42]	8.17 [5.68]	(1) (2)
C	Estimate of Statewide average cost for loop and switching.	21.72	4.48	(3)
M	Average revenue per switched access line minus C.	21.08	5.46	(5)
T	Residential retail rate for local phone service.	21.07	3.75	(4)
E	Estimate of Statewide average embedded costs per voice-grade line.	36.12	5.15	(5)
A	Average revenue per switched access line.	42.80	6.66	(5)
DBLS	Dummy variable for BellSouth States.	0.20	…	
DVZ	Dummy variable for Verizon States.	0.24	…	
DQWST	Dummy variable for Qwest States.	0.31	…	
DELECT	Dummy variable for States with Elected Commissioners.	0.26	…	(6)
TERM	Service Term (in years) of Commissioners.	5.38	1.00	(6)

Correlation Matrix

(Log-form upper right, Level form lower left)

	P	C	M	T	E
P	1.00				
C	0.77	1.00			
M	0.06	-0.11	1.00		
T	0.45	0.46	0.22	1.00	
E	0.36	0.39	0.10	0.58	1.00

(1) Kovacs et al (2002) adjusted to correct switching/transport rates.
(2) Kovacs et al (2002), unadjusted.
(3) FCC's Hybrid Proxy Cost Model.
(4) Gregg (2001).
(5) Embedded Cost: ARMIS 43-03 (2001). Computed as Row 750 divided by switched access lines (from ARMIS 43-08, 2001). Revenues: ARMIS 43-03 (2001). Computed as sum of Row 5001, 5002, 5050, 5060, 5069, 5081, 5082, 5084, 5110, and 5160, divided by switched access lines (from ARMIS 43-08, 2001).
(6) National Association of Regulatory Utilities Commissioners (NARUC).

Table 2. Regression Results

Variable	Model 1 Coefficients	Stan. Coefficients	Model 2	Stan. Coefficients
Constant	-7.060 (-1.12)		-3.450 (-0.63)	
C	1.270 (6.13)*	0.699	1.047 (5.79)*	0.827
M	0.367 (1.73)**	0.247	0.639 (3.44)*	0.615
T	-0.289 (-1.12)	-0.133	-0.349 (-1.55)	-0.230
E	-0.010 (-0.05)	-0.005	-0.165 (-0.92)	-0.123
DBLS	8.594 (3.94)*		-0.249 (-0.13)	
DVZ	9.932 (3.82)*		8.785 (3.88)*	
DQWST	4.024 (2.16)*		6.442 (3.97)*	
DELECT	1.715 (1.04)		0.866 (0.60)	
DTERM	-0.324 (-0.49)		-0.345 (-0.60)	
R^2	0.80		0.68	
Adj. R^2	0.74		0.60	
F-Statistic	15.11*		8.25*	
RESET F	0.43		6.84*	
White χ^2	15.77		17.90	
$\alpha_1 = 1.00, \alpha_2 = 0.50$	2.28		0.30	

* Statistically Significant at 5% level or better (two-tailed test).
** Statistically Significant at 10% level or better (two-tailed test).

REFERENCES

Allais, M. (1948). Le Problème de la Coordination des Transports et la Théorie Économique, *Revue d' Économie Politique.* 58: 212-271.

Ando, A. W. and Palmer, K. L. (1998). *Getting on the Map: The Political Economy Of State-Level Electricity Restructuring, Discussion Paper 98-19-REV*. Washington, DC: Resources for the Future (http://www.rff.org/Documents/RFF-DP-98-19-REV.pdf).

Beard, T.R. Ford, G. S. and Spiwak, L. J. (2002). Why ADCo? Why Now? An Economic Exploration into the Future of Industry Structure for the "Last Mile" in Local Telecommunications Markets, *Federal Communications Law Journal*. 54: 421-459 (http://www.law.indiana.edu/fclj/pubs/v54/no3/spiwak.pdf).

Beard, T. R., Kaserman, D. L., and Mayo, J. (2003). A Graphical Exposition of the Economic Theory of Regulation, *Economic Inquiry*. 41: 592-605.

Brown, S. and Sibley, D. (1986). *The Theory of Public Utility Pricing*. Cambridge: Cambridge University Press.

Callen, J., Mathewson, G. F. and Mohring, H. (1976). The Benefits and Costs of Rate of Return Regulation, *American Economic Review.* 66: 290-97.

Smiley, R. and Greene, W. (1983). Determinants of the Effectiveness of Electric Utility Regulation, *Resources and Energy.* 5: 65-81.

Gormley, W. T. (1981). Public Advocacy in Public Utility Commission Proceedings, *Journal of Applied Behavioral Science.* 17: 446-462.

Gormley, W. T. (1983). *The Politics of Public Utility Regulation*. Pittsburgh: University of Pittsburgh Press.

Gregg, B. J. (2001). *A Survey of Unbundled Network Element Prices in the United States* (unpublished manuscript, updated July 1, 2001). Columbus, Ohio: National Regulatory Research Institute (http://www.nrri.ohio-state.edu/programs/telecommunications.html).

Hazlett, T. (1997). Prices and Outputs Under Cable TV Re-Regulation, *Journal of Regulatory Economics.* 12: 173-195.

Hotelling, H. (1938). The General Welfare in Relation to Problems of Taxation of Railway and Utility Rates, *Econometrica.* 6: 242-269.

Jaffe, A. B. and Kanter, D. M. (1990). Market Power of Local Cable Television Franchises: Evidence from the Effects of Deregulation, *RAND Journal of Economic*s. 21: 226-234.

Jordan, W. A. (1972). Producer Protection, Prior Market Structure and the Effects of Government Regulation, *Journal of Law and Economics.* 15: 151-76.

Joskow, P. L. (1974). Inflation and Environmental Concern: Structural Change in the Process of Public Utility Price Regulation, *Journal of Law and Economics.* 17: 291-327.

Kaserman, D. L. and Mayo, J. W. (1995). *Government and Business: The Economics of Antitrust and Regulation*. Ft. Worth, TX: Dryden Press, Harcourt Brace College Publishers.

Kovaks, A.M., Burns, K. L. and Vitale, G. S. (2002). *The Status of 271 and UNE-Platform in the Regional Bells' Territories.* Commerce Capital Markets Equity Research (August 22).

Kwoka, J. (2002). Governance Alternatives and Pricing in the U.S. Electric Power Industry, *Journal of Law and Economic Organization*. 18: 278-294.

Laffont, J and Tirole, J. (1993). *A Theory of Incentives in Procurement and Regulation*. Cambridge, MA: MIT Press.

Mayo, J.W., and Otsuka, Y. (1991). Demand, Pricing, and Regulation: Evidence from the Cable TV Industry. *Rand Journal of Economics.* 22: 396-410.

Meyer, R. A. and Leland, H. E. (1980). The Effectiveness of Price Regulation, *The Review of Economics and Statistics*. 62: 555-66.

Mitnick, B. (1980). *The Political Economy of Regulation*. New York: Columbia University Press.

Moore, T. G. (1970). The Effectiveness of Regulation of Electric Utility Prices, *Southern Economic Journal*. 36: 365-75.

O'Leary, M. and Smith, D. B. (1989). The Contribution of Economic Theory to the Regulatory Process: Strengths, Weaknesses, and Future Directions. In K. Nowotny, D. Smith, and H. M. Trebing (Eds.) *Public Utility Regulation* 223-238. Boston: Kluwer Academic Publishers.

Otsuka, Y. (1993). A Welfare Analysis of Local Franchise and Other Types of Regulation: Evidence from the Cable Industry, *Journal of Regulatory Economics*. 11: 157-180.

Pace Coalition (2003). *The UNE-P Fact Report: January 2003*. Washington, DC: The Pace Coalition.

Peltzman, S. (1976). Toward a More General Theory of Regulation, *Journal of Law and Economics*. 19: 211-240.

Posner, R. A. (1974). Theories of Economic Regulation, *Bell Journal of Economics.* 5: 335-358.

Prager, R.A. (1990). Firm Behavior in Franchise Monopoly Markets, *Rand Journal of Economics.* 21: 211-25.

Quandt, R. and Baumol, W. J. (1964). Rules of Thumb and Optimally Imperfect Decisions, *American Economic Review.* 54: 23-46.

Ramsey, J.B. (1969). Tests for Specification Error in Classical Linear Least Squares Regression Analysis, *Journal of the Royal Statistical Society*, *Series B.* 31: 350–371.

Romer, T. and Rosenthal, H. (1987). Modern Political Economy and the Study of Regulation. In E. Bailey (ed.), *Public Regulation: Perspectives on Institutions and Policies*, 73-116. Cambridge, MA: MIT Press.

Rubinovitz, R. (1993). Market Power and Price Increases for Basic Cable Service since Deregulation, *RAND Journal of Economics.* 24: 1-18.

Spulber, J. (1989). *Regulation and Markets*. Cambridge, MA: M.I.T. Press.

Stigler, G. J. (1971). The Theory of Economic Regulation, *Bell Journal of Economics and Management Science*. 2: 3-21.

Stigler, G. J. and Friedland, C. (1962). What Can Regulators Regulate? The Case of Electricity, *Journal of Law and Economics.* 5: 1-19.

Wooldridge, J. W. (2003). *Introductory Econometrics*. Mason, OH: South-Western.

Zupan, M.A. (1989). The Efficacy of Franchise Bidding in the Case of CATV: Some Systematic Evidence, *Journal of Law and Economics*. 32: 401-56.