EXHIBIT 2

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Joint Petition for Forbearance From the Current Pricing Rules for the Unbundled Network Element Platform	)	WC Docket No. 03-189
Petition for Forbearance From The Current Pricing Rules for the Unbundled Network Element Platform	)	WC Docket No. 03-157

REPLY DECLARATION OF R. CARTER HILL, PH.D.

1. My name is Carter Hill. I am a Professor of Economics at Louisiana State University. Over the course of my career, I have (co)authored six books on econometrics, some translated into Chinese, Portuguese and Japanese, and other textbook supplements, and have published over 70 papers in economics and econometrics. My curriculum vita is attached.

2. I was asked by Z-Tel Communications, Inc., to evaluate the Declaration of Thomas W. Hazlett, Ph.D., Arthur M. Havenner, Ph.D., and Coleman Bazelon, Ph.D. ("HHB") with respect to their analysis of the econometric models contained in the Phoenix Center's Policy Bulletin No. 5, entitled *Competition and Bell Company Investment in Telecommunications Plant: The Effects of UNE-P*.[1] Z-Tel also requested that I provide comments and suggestions on the Phoenix Center analysis.

3. Overall, I find HHB's criticisms of the econometric model presented in the Phoenix Center's Policy Bulletin unpersuasive. In fact, I find the HHB analysis actually affirms the modeling choices made by the Phoenix Center. In several cases, HHB's use of the

[1] *See Petition for Forbearance from the Current Pricing Rules for the Unbundled Network Element Platform*, Reply Comments of Verizon Telephone Companies in Support of Petition for Expedited Forbearance, WC Docket No. 03-157 at Exhibit 1 (filed Sept. 2, 2003).

terminology, tools, and techniques of econometrics is incorrect and/or questionable, as I explain in more detail below. While I do recommend a few changes to the Phoenix Center econometric analysis and (primarily) the discussion of it, these changes are unlikely to alter the primary findings of the study.

I. COMMENTS ON THE HHB DECLARATION.

4. My comments on the HHB Declaration focus on five fundamental econometric errors the authors make. First, HHB's contention that the Phoenix Center's results are based on spurious correlation is misplaced; indeed, utilizing the accepted definition of spurious correlation, it is the HHB model, not the Phoenix Center model, that suffers from this flaw. Second, HHB criticizes the Phoenix Center treatment of state size in their analysis; I observe below that the Phoenix Center treatment is consistent with standard econometric practice. Third, the HHB comparison of explanatory power between its model and the Phoenix Center model is misplaced. Rudimentary econometrics indicate that such comparisons are invalid across models with different dependent variables and/or sample sizes and, in most cases, the measure of explanatory power reported by HHB are not useful given their modeling choices. Fourth, HHB's claim that the Phoenix Center model excludes relevant factors is unpersuasive. The Phoenix Center's treatment of variables HHB believe are missing is certainly plausible, and support for their modeling choices is provided by model specification tests. Finally, HHB incorrectly conclude that a finding of statistical insignificance (as HHB find in their model comparing Bell investment and UNE-P) indicates the absence of a relationship. That is not the case. A finding of statistical insignificance implies only that there is insufficient information in the data to allow a precise estimation of the parameter in question, or that the model estimated is poorly specified. It does not mean that the parameter is actually zero, or that no relationship exists. The fact that the Phoenix Center is able to use the same data and consistently produce a highly significant relationship suggests that HHB have a poorly specified model.

A. Spurious Correlation.

5. HHB state that the results in the Phoenix Center Policy Bulletin No. 5 are "wholly the product of spurious correlation." (HHB at 2, ¶ 8). They are wrong. "Spurious regression" has had a specific meaning in econometrics since the path-breaking research by Granger and Newbold.[2] Granger and Newbold pointed out that estimating regressions using stochastically trending (non-stationary) variables might produce spurious results – that is, results that appear significant (*e.g.*, high R^2 values and large *t*-statistics) – despite the absence of any real relationship among the variables. In fact, HHB estimate a model using *gross investment* as the dependent variable which, as shown in their Figure 1, is a "slow turning series." (*See* HHB at 5). Because such slow turns are characteristic of variables that are non-stationary, it is probably the case that the HHB regressions are spurious in the econometrically accepted terminology.

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[2] C. W. J. Granger and P. Newbold, "Spurious Regressions in Econometrics," *Journal of Econometrics*, 111-120 (1974).

6. Importantly, the classic method of correcting the spurious correlation problem is to "first difference the data," which makes a non-stationary random walk series stationary, and thus suitable for analysis by regression methods. The Phoenix Center model used first-differenced data, whereas the HHB alternatives do not. Thus, when HHB argue that the Phoenix Center results are "not robust … when [the model] is applied to a similar set of facts," I would argue that the models estimated by HHB are not similar, or superior, to the Phoenix Center model, primarily because of their estimation of the model on undifferenced, or levels, data. (HHB, Appendix at 1, ¶ 2). In fact, based on traditional econometric methods, the Phoenix Center approach (using first differenced data) represents the proper methodology. By estimating their regression with data in "levels," HHB *invite* spurious results. (*See* HHB, Appendix at 4-8).

B. State Size and Weighted Least Squares.

7. HHB also argue that the Phoenix Center study fails to account properly for state size, because only some variables are divided by total access lines. (*See* HHB, Appendix at 3, ¶ 3). The criticism is incorrect. To clarify, consider the simple regression model:

$$y = \beta_1 + \beta_2 x + e\,. \tag{1}$$

If the random error e is heteroscedastic, so that its variance is not constant for all observations, then weighted least squares can improve upon the efficiency, or precision of estimation, of the usual ordinary least squares estimator. It does so by re-weighting the variables in such a way that the error variance becomes constant for all observations. If, for example, the variance of the error term is proportional to state size n squared (that is, $\mathrm{var}(e) = \sigma^2 n^2$), then the transformed model

$$\frac{y}{n} = \beta_1 \frac{1}{n} + \beta_2 \frac{x}{n} + \frac{e}{n} \tag{2}$$

is suitable for estimation by ordinary least squares because the weighted error term e/n is now homoscedastic, with variance σ^2. HHB argue that their weighting, which weights all variables including the intercept, is the correct weighting. (*See* HHB, Appendix at 5, ¶ 12). The weighting in Equation (2) is only correct if the resulting model error is homoscedastic and all other assumptions of the linear regression model hold. The weighting does nothing about the fact that the data might be non-stationary, which is solved by differencing the data, as performed by the Phoenix Center model.

8. Additionally, if the units of observation are of different sizes, such as states, it is common empirical practice to specify regression models in terms of "per capita" data (or in agricultural production studies "per acre" data) without scaling the intercept and/or dummy variables. That is, if n is a measure of population size, then a model in per capita terms is

$$\frac{y}{n} = \alpha_1 + \alpha_2 \frac{x}{n} + u\,. \tag{3}$$

The parameters in Equations (2) and (3), which embody the economic content of the model, are different, but one specification is not necessarily better than the other. The parameters in Equation (2) are the same as those in Equation (1), and by using the weighted variables in Equation (2) we estimate the economic parameters defined in Equation (1) using the best linear unbiased estimator if the weighted error e/n is homoscedastic and the equation (2) is otherwise well behaved. That said, the parameters in Equation (3) do not measure exactly the same relationship as those in Equations (1) and (2). In Equation (3), we are asking about how changes in the per capita variable x/n affect the per capita variable y/n. The intercept of Equation (3) does not measure the same "level" as the intercept in Equations (1) and (2). Whether we operate with Equations (1 & 2) or (3) depends on two factors: (i) whether the economic relationship of interest is between the variables in unweighted form (Equation 1) or whether it is the relationship of interest between the "per capita" variables in Equation (3); and (ii) whether the error assumptions for the models summarized by Equations (2) or (3) are met. Choosing not to weight the intercept and dummy variables does not destroy the validity of the statistical results, as claimed by HHB. (*See* HHB, Appendix at 5, ¶ 12). In fact, many practitioners recommend including an unweighted constant term in a weighted least squares regression in order to avoid the statistical problems accompanying an omitted constant term.[3] So, while the economic interpretation for Equations (2) and (3) is somewhat different, either is plausible depending upon whether the error assumptions in each are satisfied.

C. Comparison of Explanatory Power.

9. HHB argue that their alternative specification explains "BOC gross investment better" than the Phoenix Center model. (*See* HHB, Appendix at 5, ¶ 11). This claim is without merit due to the differences in the sample and the fundamental difference in the data and models being compared. The first alternate HHB model uses neither the same dependent variable nor the same sample size as the Phoenix Center models. (*See* HHB, Appendix at 4, ¶ 10). Comparing R^2 across models without the same dependent variable and/or sample size, as proposed by HHB, is simply invalid.[4]

10. The model R^2 is designed to measure the percentage variation in the model's dependent variable (about its sample mean) explained by the variation in the explanatory variable (about its sample mean). This measure is only valid if the model includes a constant term, which is a variable that has an unchanging value for all sample observations. The HHB models, comparable to Equation (2), have no constant term and

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[3] A. H. Studenmund, *Using Econometrics, 2nd Ed.*, 386-387 (1992) and P. Rao and R. L. Miller, *Applied Econometrics*, 121 (1971).

[4] "It is crucial to note that in comparing two models on the basis of R^2, whether adjusted or not, *the sample size n and the dependent variable must be the same.*" Damodar Gujarti, *Basic Economics*, 209 (1995) (emphasis in original).

thus R^2 is not meaningful.[5] For models like Equation (2), there are various measures that can be computed, but their interpretation is no longer the same and/or their range may no longer the [0,1] interval.[6] Thus, the measure of fit discussed by HHB is fundamentally different from the corresponding measure in the Phoenix Center model and cannot be used as a measure of either internal or external validity.

D. Issue of Omitted Variables.

11. HHB argue that the Phoenix Center model fails to account for differences in economic climates and differences in regulatory policies among states. (*See* HHB, Appendix at 3, ¶¶ 4-5). Actually, the presence of such differences is a strong advantage of the differenced data model given in Phoenix Center Policy Bulletin No. 5. By taking differences of state level data, all time-invariant state-level factors are subtracted. Thus, differencing is equivalent to the standard "fixed-effects" model in the panel data (time series and cross section data) literature.[7] It is quite plausible, I think, to assume constancy in economic and regulatory climates over the relatively short time period evaluated by the Phoenix Center models.

E. Statistical Insignificance as Evidence.

12. HHB make much of the fact that the UNE-P variables are not statistically significant in their regressions. As noted above, their regressions are suspect because they are in "levels" rather than "differences." Additionally, their models suffer from other evidence of mis-specification, namely that in Table A4, they find a very large, positive and statistically significant effect of the cost of capital upon changes in capital stock. (*See* HHB, Appendix at 8). This result is not credible, and suggests fundamental flaws in the HHB model. It is unsound to contend that statistical insignificance alone, particularly when based on an invalid model specification, disproves the validity of a model that finds statistical significance using the exact same data.

13. Those factors aside, the finding of an insignificant coefficient in any regression does not imply that there is no relationship between the variables in question; such a conclusion is a classic misinterpretation of hypothesis tests. An insignificant coefficient implies that we "cannot reject" the hypothesis that the underlying parameter is zero. This statement means that there is insufficient information in the data to allow a precise estimation of the parameter in question. It does not mean that the parameter is actually zero, or that no relationship exists.

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[5] Pindyck and Rubinfeld note that with weighted least squares "the reported R2 [] fails to provide a useful measure of goodness of fit." Robert S. Pindyck and Daniel L. Rubinfeld, *Econometric Models & Economic Forecasts, 3rd Ed.*, 132 (1991).

[6] For a complete exposition of the issues, *see* Judge, Griffiths, Hill, Lütkepohl and Lee, *The Theory and Practice of Econometrics, 2nd Edition*, 29-32 (1985).

[7] *See, e.g,* Jeffrey Wooldridge, *Econometric Analysis of Cross Section and Panel Data*, 279-285 (2002) ("Wooldridge").

14. Related to the issue of statistical significance, HHB claim that "[a]n explanatory model with estimated coefficients not significantly different from zero is suspect." (HHB, Appendix at 5, ¶ 11, n.5). HHB are referring to the constant term and the coefficient of revenues with this comment. First, practitioners generally include all variables that have a theoretical justification for inclusion, regardless of statistical significance. I have done extensive work on "pre-testing" as a method of model selection in econometrics. By "pre-testing" I mean examining statistical significance of variables, using standard *t*-tests or *F*-tests, and re-specifying the model as a result. Often this amounts to deleting insignificant variables. My research, and the work of others, shows that following such a strategy can have very negative effects when the objective is to precisely and accurately estimate all the coefficients in the model. My counsel to colleagues and students alike is to retain important explanatory variables, such as those indicated by economic theory, regardless of their statistical significance. In the Phoenix Center model, both the intercept and revenue belong and should remain in the model.

15. Second, insignificant (or redundant) variables neither create bias nor disturb the consistency of the estimators. The efficiency of the estimator is reduced, which may mean smaller *t*-statistics than would otherwise be obtained.

16. Third, published empirical studies almost always include insignificant coefficients.[8] Clearly, reporting statistical insignificance is not generally viewed as evidence of specification problems.

II. COMMENTS ON PHOENIX CENTER POLICY BULLETIN NO. 5.

17. As I have already discussed in some detail, given the limitations and type of data employed, the first difference approach of the Phoenix Center Policy Bulletin No. 5 is sensible, if not advisable. I do have a few suggestions, however, that I believe would improve the Phoenix Center's analysis.

18. First, there are some notational problems with Equations (1) and (2). For example, the variable Z_t and the constant term of the regression would be collinear. A correction would be to specify the constant term of the regression in terms of Z_t. This change does not implicate the estimated coefficients reported in the Bulletin, but will clarify the interpretations of those coefficients. Consistency with regard to the subscripts also needs to be addressed.

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[8] For example, in Jorgenson and Stephenson's 1971 paper on investment by U.S. manufacturing industries, nearly 40% of the reported coefficients were statistically insignificant. *See* Dale W. Jorgenson and James A. Stephenson, "Investment Behavior in U.S. Manufacturing, 1947-1960," *Econometrica*, Vol. 35, No. 2, at 169-220 (April 1967). In the May 2003 *American Economic Review*, Chevalier *et. al.* report regression results where only 39 of 85 (46%) estimated coefficients are statistically significant. *See* Judith A. Chevalier, Anil K. Kashyap, and Peter E. Rossi, "Why Don't Prices Rise During Periods of Peak Demand? Evidence from Scanner Data," *American Economic Review*, Vol. 93, No. 1, at 15-37 (March 2003).

19. Second, if the error term of Bulletin Equation (1) is well-behaved, as claimed, then the error term of Bulletin Equation (2) will be correlated. However, as noted, there are good reasons to suspect that Equation (1) is not properly specified. If the error in Equation (1) follows a stochastic trend then the differenced error in Equation (2) will be uncorrelated. This question can be tested.[9] If serial correlation is detected then the so-called "robust covariance matrix" should be used to compute standard errors. However, it is likely that by differencing the data any stochastic trends have been removed.

20. Confidence in results, especially controversial and policy-relevant results, would be higher if the estimated coefficient and significance levels were found to be robust across a variety of alternate specifications. While the re-specification of the explanatory variables from first-differences to levels is undesirable, I believe the results of the Bulletin would be more convincing if they were robust to the inclusion of additional explanatory variables, alternative measures of included explanatory variables, lagged values of explanatory variables, lagged values of the dependent variable as an explanatory variable, and alternative estimation methods. Estimating this dynamic relationship is a challenge given such a short time-series of data; thus, establishing a body of evidence from alternative specifications, and carrying out diagnostic checks, is desirable.

III. CONCLUDING COMMENTS.

21. The HHB Declaration makes a number of criticisms of the Phoenix Center's model of investment. I believe their criticisms are unfounded and/or incorrect. Of the two specifications and analyses, I find the Phoenix Center's much more defensible on econometric grounds.

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[9] *See* Wooldridge at 282-283.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on September 22, 2003 by:

R. Carter Hill, Ph.D.
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R. Carter Hill, Ph.D.

EXHIBIT 3

PHOENIX CENTER FOR ADVANCED LEGAL & ECONOMIC PUBLIC POLICY STUDIES
www.phoenix-center.org

PHOENIX CENTER POLICY BULLETIN NO. 6

17 September 2003

UNE-P DRIVES BELL INVESTMENT: A SYNTHESIS MODEL

Abstract: The purpose of this POLICY BULLETIN is to evaluate the robustness of the empirical results presented in PHOENIX CENTER POLICY BULLETIN NO. 5, *Competition and Bell Company Investment in Telecommunications Plant: The Effects of UNE-P.* To accomplish this goal, this POLICY BULLETIN incorporates the constructive comments made by Drs. Thomas Hazlett, Arthur Havenner and Coleman Bazelon ("HHB") and by Dr. Carter Hill about POLICY BULLETIN NO. 5 and, accordingly, estimates twenty new specifications models of the Bell Company investment equation. While these new specifications represent a synthesis of the modeling preferences of the Phoenix Center and the aforementioned economists, they nonetheless remain true to the neoclassical model of investment and valid econometric practice. These new specifications vary by estimation technique, explanatory variables included, and the measure of investment. Despite wide variations in model specification, all our new empirical specifications, especially those based on the suggestions of Drs. Hazlett *et al.*, confirm that UNE-P competition increases Bell Company investment in local telecommunications plant. *In all twenty models, the effect of UNE-P competition is positive and statistically significant.* Despite the changes to specification, the new models continue to perform well in specification tests, which is, of course, encouraging. As such, the models set forth in this *Policy Bulletin* affirm both the results and specification of the empirical models in POLICY BULLETIN NO. 5.

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I. Preface and Introduction

Since its inception, the Phoenix Center has sought to create a forum where rigorous debate about the complex policy issues facing our society can find fertile ground. For this reason, consistent with our mandate under Section 501(c)(3) of the U.S. Internal Revenue Code, the Phoenix Center does not seek to influence the political process by participating as a party in any regulatory proceeding or engaging in lobbying of legislatures. To the contrary, the Phoenix Center attempts to provide and disseminate freely through its web page thorough analytical research and analysis for the public dialectic.

We are very pleased to report that our recently-released POLICY BULLETIN NO. 5, *Competition and Bell Company Investment in Telecommunications Plant: The Effects of UNE-P* (July 2003)[1] has fostered our desired Socratic debate. As a bit of recap, POLICY BULLETIN NO. 5 evaluated, using a simple economic and econometric model, the relationship between UNE-P and Bell Company investment in telecommunications plant at the state level. For the analysis, data from the Automated Reporting and Management Information System ("ARMIS") and other publicly-available data were used. This state-level data provides sufficient variation and sample size to estimate econometrically the parameters of an investment model. From the results of an econometric analysis, we concluded that UNE-P had a positive and sizeable effect on BOC investment in telecommunications plant, with each UNE-P line increasing on average BOC net investment by about $759.00.

Subsequently, two formal responses to the analysis set forth in POLICY BULLETIN NO. 5 were released. On one hand, in a document filed in Verizon's Forbearance Petition (WC Docket No. 03-157), Verizon employed Drs. Thomas Hazlett (the Manhattan Institute), Arthur Havenner (Univ. California – Davis), and Coleman Bazelon (Analysis Group) to comment on the empirical analysis contained in the BULLETIN.[2] Verizon's advocates propose several modifications to our model, and present a few alternate specifications.[3] On the other hand, Z-Tel Communications,

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1 http://www.phoenix-center.org/PolicyBulletin/PolicyBulletin5.pdf.

2 Declaration of Thomas W. Hazlett, Ph.D., Arthur M. Havenner, Ph.D., and Coleman Bazelon, Ph.D., on Behalf of Verizon Communications, Inc., Reply Comments of Verizon Telephone Companies in Support of Petition for Expedited Forbearance from the Current Pricing Rules for the Unbundled Network Element Platform, WC Docket No. 03-157 (filed Sept. 2, 2003) (available at: http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6514783810 and is also posted on the Phoenix Center's web page).

3 The declaration of HHB also includes an anecdotal discussion of investment and UNE-P, but we do not dwell on that discussion here. Because HHB's anecdotes include little more than quotes from investment analysts and the observation that investment is falling while UNE-P is rising. This *post hoc* fallacy line of reasoning is standard Bell Company argument, and brings nothing new to the debate. Further, investment analysts, for the most part, report to investors what they hear from corporate executives. Consequently, the analysts' claim that there is a link between UNE-P and investment often is based on little more than the fact a Bell executive told them that such a (Footnote Continued….)

Inc. asked Dr. Carter Hill (Louisiana State University) to review the declaration of Hazlett, Havenner, and Bazelon as well as provide comments on the econometric model in POLICY BULLETIN NO. 5.[4]

In response both to the comments of Hazlett, Havenner and Bazelon ("HHB") and to Carter Hill ("Hill"), this POLICY BULLETIN summarizes an extensive effort to evaluate the robustness of the empirical results reported in POLICY BULLETIN NO. 5. While these new specifications represent a synthesis of the modeling preferences of the Phoenix Center and the aforementioned economists, they nonetheless remain true to the neoclassical model of investment and valid econometric practice. These new specifications vary by estimation technique, explanatory variables included, and the measure of investment. Despite wide variations in model specification, all our new empirical models, especially those based on the suggestions of HHB, confirm that UNE-P competition increases Bell Company investment in local telecommunications plant. *In all twenty specifications, the effect of UNE-P competition is positive and statistically significant*. Despite the changes to specification, the new models continue to perform well in specification tests, which is, of course, encouraging. As such, our new models affirm both the results and specification of the empirical models in POLICY BULLETIN NO. 5.

This POLICY BULLETIN proceeds as follows. In Section II, we describe our investment models and define the variables included in the analysis. Section III includes a discussion of the results and related topics. Conclusions are then provided in Section IV.

II. The Phoenix-Investment Empirical Model

In specifying our empirical models, the primary objective is consistency with economic and econometric theory, and the neo-classical model of investment, developed by Dale Jorgenson (1963), serves as our theoretical foundation.[5] While this body of work is rather technical, the empirical relationship of interest can be summarized generally as follows:

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link existed. Analysts rarely, if ever, conduct their own, independent econometric analysis of causality. The other problem with a heavy reliance on investment analysts is that they are not known generally for their accuracy. As Martin Weiss pointed out in a recent editorial, at one time "nine out of 10 or more … brokerages [had] 'buy' or 'hold' ratings on bankrupt companies." *Analyzing the analysts: A conversation with Martin Weiss, of Weiss Ratings*. WALL STREET WEEK (Jan. 31, 2003).

4 Declaration of R. Carter Hill, Ph.D., on Behalf of Z-Tel Communications, Inc., *In the Matter of Petition for Forbearance From the Current Pricing Rules for the Unbundled Network Element Platform*, WC Docket No. 03-157 (September 18, 2003). Dr. Hill generously provided us a draft copy of his comments prior to the filing date and the final version will be posted on the Phoenix Center's web page.

5 D. W. Jorgenson, *Capital Theory and Investment Behavior*, AMERICAN ECONOMIC REVIEW, Vol. 53, Issue 2, (May 1963) at 247-259.

$$I = \Delta K = f(\Delta R, \Delta C, \Delta X) + \delta K, \quad (1)$$

where investment (I) equals the change in capital stock (ΔK) and is a function of changes in the monetary value of output (ΔR), changes in the cost of capital (ΔC), changes in other relevant factors (ΔX), and the existing capital stock *K* (δ is the replacement portion of capital).[6] Particular assumptions about functional forms and lag structures offer a wide variety of empirical specifications for the neo-classical model of investment.[7]

In POLICY BULLETIN NO. 5, we presented two models generally consistent with Equation (1). The monetary value of output (ΔR) was measured by changes in total operating revenues, and changes in the cost of capital (ΔC) were subsumed into a period dummy variable under the assumption that the cost of capital was constant across the Bell Companies. Existing capital stock (K) was not included in the regression, but as we discuss later, this exclusion did not bias our earlier results. Model 2 from the BULLETIN estimated that Bell Company investment rose an average of $759.[00] per UNE-P line in the state. Despite Model 2's parsimonious specification, statistical tests of model specification indicated that the results of that model were biased estimates of the true parameters of interest (the goal of regression analysis), confirmation of which is provided by our new model specifications.

In their review of BULLETIN NO. 5, HHB recommend three major changes to our empirical model. First, HHB suggest making the empirical model dynamic by including the existing capital stock in the regression and lagged values of some explanatory variables.[8] Second, they recommend letting the cost of capital vary by Bell Company.[9] Third, they propose estimating the models using weighted least squares where all variables are weighted by (the inverse of) access lines.[10] Many of our new empirical models incorporate these suggestions, and in some cases adopt more dynamic specifications than proposed by HHB.[11] In every instance, these changes *affirm and, in many cases, strengthen* the conclusion that Bell Company investment is positively related to UNE-P competition.

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6 *See, e.g.*, D. W. Jorgenson and J. A. Stephenson, *Investment Behavior in U.S. Manufacturing*, 1947-1960, ECONOMETRICA, Vol. 35, No. 2 (April 1967) at 169-220.

7 Typically, academic research uses time series data when analyzing investment. We do not, however, have long data series on either investment or UNE-P lines. Nevertheless, it is important to use theory as our guide to specification.

8 HHB Appendix at ¶15 and n. 7.

9 HHB Appendix at ¶17.

10 HHB Appendix at ¶3. The inverse of access lines is used as the weight.

11 HHB specify a dynamic structure by including initial (or lagged) capital stock. We include this variable, as well as lagged investment and lagged market size in some of our models.

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Z-Tel's expert Dr. Carter Hill recommends altering the symbolic discussion of the empirical models, and his recommendations are now incorporated into the latest version of Policy Bulletin No. 5 (released September 19, 2003). Dr. Hill also points to a potential problem with the econometric error terms in our regression, and suggests basing our t-statistics on Newey-West robust standard errors. We incorporate this suggestion into our analysis, and update Policy Bulletin No. 5 accordingly. Hill also recommends assessing the robustness of our earlier estimates through alternate specifications. To comply, this document summarizes twenty different specifications of the investment equation.

A. *General Empirical Framework*

For the twenty empirical models estimated here, the general framework is as follows. The change in capital stock, or net investment, is taken to be a function of the annual change in revenue (ΔR), the annual change in UNE-P lines (ΔU), the annual change in the cost of capital (ΔC), the existing (or "lagged" or "beginning" capital stock) capital stock (K), a dummy variable that equals (1) for the period 2001 to 2002, (0) otherwise, and a constant term. We do deviate from this general framework in some cases in order to employ different measures of relevant variables and to illustrate that the estimated coefficients are not very sensitive to specification. Most of the models are estimated using weighted least squares ("WLS") as recommended by HHB. The data is measured at the state level, unless otherwise indicated. All models are estimated using 52 observations as before.[12] States included are from the BellSouth, SBC, and Verizon (excluding GTE) regions only. Qwest data for year 2002 is not available.

The variables used in the analysis include:

I =	Annual change in Average Net Investment, Subject to Separations, from ARMIS Form 43-01;
I′ =	Annual change in Total Plant in Service less Accumulated Depreciation and Accumulated Amortization, Subject to Separations, from ARMIS Form 43-01;
ΔR =	Annual change in Total Operating Revenue, Subject to Separations, from ARMIS Form 43-01;

12 We do not, as suggested by HHB, unnecessarily reduce variation and sample size by aggregating data up to the Bell Company level (HHB Appendix at ¶10).

ΔU = Annual change in UNE-P lines measured from June of each year as reported in the FCC's Form 477 data;[13]

ΔC = Annual change in the weighted average cost of capital for the relevant Bell Company;

K_{t-1} = The prior year's Average Net Investment, Subject to Separations, from ARMIS Form 43-01 (i.e., lagged net investment);

K'_{t-1} = The prior year's Total Plant in Service less Accumulated Depreciation and Accumulated Amortization, Subject to Separations, from ARMIS Form 43-01 (i.e., lagged net investment);

Period = A dummy variable that equals 1 for investment in year 2002, 0 otherwise;

$\Delta(R/c)$ = Annual change in Total Operating Revenue, Subject to Separations, divided by the user cost of capital;[14]

$\Delta(R/c)_{t-1}$ = The prior year's value of $\Delta(R/c)$;

I_{t-1} = The prior year's value of I;

I'_{t-1} = The prior year's value of I'.

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[13] The weighted-average cost of capital is computed using the following: (i) debt costs are assumed to equal the Aa corporate bond yields for June 2000, 2001, and 2002, (ii) the cost of equity is computed using the Capital Asset Pricing Model, where the 10-year Treasury Bond yield (June) is the risk-free rate, the risk-premium is 5%, and the Betas are computed as 5-year Betas (using weekly data) ending in December for the relevant year for Bellsouth, SBC, and Verizon. The risk premium is from Tom Copeland, Tim Koller, and Jack Murrin, VALUATION: MEASURING AND MANAGING THE VALUE OF COMPANIES, 3rd Ed., McKinsey & Company, Inc. (2000), at 216 ("In early 2000, we were recommending using a 4½ percent to 5 percent historically estimated market risk premium for U.S. companies."). Stock prices provided by Yahoo finance. Bond yields provided by the St. Louis Federal Reserve Bank (http://research.stlouisfed.org/fred2/) and the U.S. Treasury (http://www.ustreas.gov/offices/domestic-finance/debt-management/interest-rate/index.html). Capital structure is assumed to be 40% debt, 60% equity. The variable is expressed in percentage points.

[14] The user cost of capital is estimated as the producer price index for telephone communications multiplied by the sum of the weighted average cost of capital and the depreciation rate. The depreciation rate is measured as the average annual difference in Accumulated Depreciation divided by Average Net Investment for years 2000 and 2002. *See* Larry Neal, *Investment Behavior by American Railroads: 1987-1914*, REVIEW OF ECONOMICS AND STATISTICS, Vol. 51, No. 2 (May 1969) at 126-135. The price index is provided by the Bureau of Labor Statistics (http://www.bls.gov).

We employ Δ(R/c) as a substitute for both variables ΔR and ΔC, since Δ(R/c) is computed using revenue (R) and the user cost of capital (c).[15] Lagged values of Δ(R/c) appear in a few of the alternate specifications, as recommended by HHB.[16] Two different versions of the capital stock and investment are available in ARMIS (K, K' and I, I'). Models 1 through 10 use the variables K and I, whereas Models 11 through 20 use the variables K' and I'. Models 11 through 20 are comparable to Models 1 through 10, with the only difference being the substitution of these two variables.

B. *Model Specification Issues*

If a regression equation is not specified correctly, the estimated coefficients may be biased estimates of the true population parameters.[17] In a policy context, it is important, therefore, to subject empirical models to specification tests in an effort to determine whether (and what type of) specification errors are present. Specification tests are important when somewhat parsimonious specifications are employed.[18]

Ramsey's RESET is a very general test of specification error, capable of detecting omitted variables bias, incorrect functional form, and the consequences of simultaneity bias.[19] While the test is desirable in that it is relatively powerful and is easy to implement, it only indicates that some type of specification error is present, providing no guidance as to how to remedy the problem.[20] The null hypothesis of RESET is "no specification error." If the RESET F statistic does not exceed the critical value, the null is not rejected. The null of RESET is not rejected for

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15 This specification of the revenue/cost of capital variable is frequently used in the empirical analysis of investment. *See, e.g.,* Jorgenson and Stephenson, *supra* n. 6.

16 HHB Appendix at n. 7.

17 D. N. Gujarati, BASIC ECONOMETRICS (1995) at 454-459.

18 Parsimony is not a flaw, as explained by Gujarati:

> A model can never be a completely accurate description of reality; to describe reality one may have to develop such a complex model that it will be of little practical use. Some amount of abstraction or simplification is inevitable in any model building. The Occam's razor [], or the principle of parsimony, states that a model be kept as simple as possible or, as Milton Friedman would say, "A hypothesis [model] is important if it 'explains' much by little …" What this means is that one should introduce in the model a few key variables that capture the essence of the phenomenon under study and relegate all minor and random influences to the error term u_t.

Although parsimony is desirable, it is important to subject a parsimonious specification to careful scrutiny, to ensure that specification errors, which often have severe statistical consequences, are not present. Gujarati, *supra* n. 17 at 453-4 (emphasis in original).

19 *Id.* at 464-466; *see also* J.B. Ramsey, *Tests for Specification Errors in Classical Linear Least Squares Regression Analysis*, JOURNAL OF THE ROYAL STATISTICAL SOCIETY, SERIES B, VOL. 31 (1969) at pp. 350-371.

20 Gujarati, *supra* n. 17 at 466.

18 of the 20 models, and the 2 rejections were expected (given the results from POLICY BULLETIN NO. 5).

Another common problem with regression is heteroscedasticity, which is an undesirable property of the random disturbance term of the regression.[21] The presence of heteroscedasticity implies the estimated standard errors of the estimated coefficients are inefficient, meaning they are either too large or too small.[22] The estimated coefficients themselves, however, are unbiased.[23] If heteroscedasticity is of a known form, then the equation can be weighted accordingly to render efficient standard errors (*i.e.,* weighted least squares or WLS).[24] If unknown, then other methods are available to compute asymptotically valid standard errors such as the White and Newey-West procedures.[25] Based on the comments of Hill, whose recommendations are based on the properties of error terms in first-difference models, all reported t-statistics in the table are computed using Newey-West robust standard errors.[26] The White test statistic is reported for all models.

C. *Summary of Results*

The estimates from our twenty models are summarized in Tables 1 and 2. Because the standard R^2 (a measure of goodness of fit) is not valid for WLS, for those regressions estimated by WLS we provide a Pseudo-R^2 computed as the squared correlation coefficient between the actual and fitted value of the weighted regression.[27] We are encouraged that the signs, magnitudes, and significance levels of the estimated coefficients are reasonably stable across comparable models. Absence of such stability could indicate problems with model specification.

Models 1 and 2 would be identical to Models 1 and 2 from POLICY BULLETIN NO. 5 except for the inclusion of two additional explanatory variables – the cost of capital (ΔC) and existing (or lagged) capital stock (K_{t-1}). These additional variables were proposed by HHB. As in BULLETIN

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21 *Id.* at 355-358.

22 *Id.* at 366-367.

23 *Id.* at 362.

24 *Id.* at 381-382.

25 *Id.* at 382-383.

26 J. M. Wooldridge, ECONOMETRIC ANALYSIS OF CROSS SECTION AND PANEL DATA (2002) at 282-3; W. Newey and K. West, *A Simple Positive Semi-Definite, Heteroscedasticity and Autocorrelation Consistent Covariance Matrix*, ECONOMETRICA, 55, 1987a, pp. 703-708. Some researchers recommend always reporting robust standard errors. Gujarati, *supra* n. 17 at 383.

27 R^2 is a rather standard measure of goodness of fit that takes on values between 0 and 1. It is interpreted as the percent of variation in the dependent variable explained by the regression. Gujarati, *supra* n. 17 at 74. R^2 and Pseudo-R^2 across the regressions are not comparable.

NO. 5, the null of RESET is easily rejected for Model 1, indicating the model is mis-specified in some way. Consequently, we do not discuss the results from that model. Model 2, alternately, easily survives RESET. Our prior Model 2 from BULLETIN NO. 5 also passed RESET, indicating that model likely did not suffer from specification errors. The results for Model 2 reported here support that finding. Neither of the two additional explanatory variables is statistically significant, and the coefficient on ΔU is barely affected ($757.50 versus $759.00).[28]

Model 3 is simply Model 2 estimated by WLS. This alternate estimation technique results in larger t-statistics, indicating the weighting procedure improved efficiency. Five of the six explanatory variables are now statistically significant. The estimated coefficient on UNE-P lines is $931.80, which is about 23% higher than the estimate reported in POLICY BULLETIN NO. 2. Other statistically significant variables include revenues (ΔR), lagged capital stock (K_{t-1}), the period dummy variable, and the constant term. The cost of capital is not statistically different from zero, but has the correct sign (negative).[29]

In Model 4, the revenue (ΔR) and cost of capital (ΔC) variables are replaced with a substitute variable measured as total revenues divided by the user cost of capital Δ(R/c). This variable is commonly employed in investment regressions such as those estimated here, and serves as a proxy for the optimal capital stock.[30] All of the explanatory variables in Model 4 are statistically significant at the 5% level or better. The coefficient on UNE-P lines is $688.10. Models 5 and 6 are more dynamic in their specification than proposed by HHB, including lagged values of Δ(R/c) and the dependent variable (I_{t-1}). These more dynamic specifications do not perform any better than the more simple models, and the sign, size, and significance of the UNE-P variable (ΔU) is unaffected.

Models 7 through 10 are varied specifications of the investment equation, and the results from these models are generally comparable with the others. In every case, the coefficient on UNE-P lines is positive, large, and statistically significant. The models perform well, with a high degree of statistical significance and no evidence they are mis-specified (by RESET). Across the full range of usable models (Models 2 through 10), the coefficient on UNE-P ranges from $1011.40 to $665.80, with an average coefficient of $808.30.

For Models 11 through 20 (Table 2), the dependent variable is measured using our alternate measure of capital stock and investment (K′, I′). Otherwise, these models are identical to Models 1 through 10. Models 12 through 20 pass RESET easily, suggesting the estimated

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28 Passing the RESET does not imply that all potentially statistically significant variables are in the regression, only that the variables omitted from the regression do not bias the coefficients. The stability of the coefficient, therefore, is encouraging.

29 Contrariwise, HHB report a positive and statistically significant coefficient on the cost of capital.

30 Jorgenson and Stephenson, *supra* n. 6.

coefficients are not influenced by specification error. In all ten models, the coefficient on UNE-P lines is positive and statistically significant. Across Models 12 through 20 (those passing RESET), the coefficient on UNE-P ranges from \$868.[40] to \$523.[80], with an average coefficient of \$655.[20]. Relative to Models 1 through 10, we observe less statistical significance of the existing capital stock (K) and period dummy variable in Models 11 through 20. The cost of capital (ΔC) is correctly signed and statistical significant in half the models in which it is included. As before, the more dynamic specifications are of little statistical consequence. Thus, we find no support for HHB's supposition that more dynamic specifications would alter our earlier conclusions.

D. *Levels versus Changes*

In the alternate models presented by HHB the explanatory variables are expressed in their annual levels rather than annual changes in levels as prescribed by the neo-classical model of investment. Besides being an atheoretic and arbitrary model choice, there are potentially severe econometric consequences of HHB's re-specification as described by Hill. Nevertheless, if we ignore the serious defects in using the levels rather than changes in the variables, we can evaluate whether or not the investment equation is better estimated using either the annual changes in the explanatory variables (as in POLICY BULLETIN NO. 5 and here) or the levels of the variables (as in HHB). We test the alternative specifications using the Davidson-MacKinnon *J* Test.[31]

The Davidson-MacKinnon *J*-test is performed by adding the predicated values from two rival regressions, say Phoenix and HHB, as an additional explanatory variable in the rival model. If this additional regressor is statistically significant in rival model HHB, but not in rival model Phoenix, then model Phoenix is the preferred specification (and vice versa).[32] More specifically, say Model Phoenix can be summarized as $I = a\Delta X$ and the HHB model as $I = bX$. The fitted values from each regression, respectively, are $\hat{I}_P$ and $\hat{I}_H$. The supplementary test regressions are:

$$\text{Phoenix:} \qquad I = a\Delta X + d\cdot\hat{I}_H$$

$$\text{HHB:} \qquad I = bX + e\cdot\hat{I}_P.$$

If the hypothesis $d = 0$ is not rejected, but the hypothesis $e = 0$ is rejected, then the Phoenix model is the better specification. Alternately, if the hypothesis $d = 0$ is rejected, but the hypothesis $e = 0$ is not rejected, then the HHB model is the better specification. This conclusion

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31 Gujarati, *supra* n. 17 at 490-491.

32 *Id.* at 491. A shortcoming of this approach is that we may observe statistical significance or insignificance in both models, which renders an ambiguous result. The *J*-test is only asymptotically valid, implying it may not perform well in very small samples.

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is based on the fact that the influence of the variables in Model HHB, captured by the fitted value from that model, adds no additional explanatory power beyond that contributed by Model Phoenix.

We use Model 3 (from Table 1) to compare the rival specifications, one using changes in the explanatory variables (the Phoenix approach) versus the levels of the explanatory variables (the HHB approach). Inserting the predicted value from the HHB regression of investment in the Phoenix model, the estimated coefficient is 0.53 and the t-statistic is 0.54, which is *not* statistically significant. For the HHB regression, the predicted value from the Phoenix model is included as a regressor and the estimated coefficient is 1.0 and the t-statistic is 3.48, which *is highly* statistically significant. Thus, by the *J*-test, the Phoenix specification is preferred and the explanatory variables should be expressed as annual differences and not levels. Further, when the explanatory variables are expressed in levels, the estimated regression easily fails RESET, indicating that specification error is present.[33]

E. *Summary*

In sum, we find no evidence of 'weakness' in the results; the results are, in fact, extremely robust. We tried alternative measures of some variables, alternate estimation techniques, and dynamic model specifications, and none of these changes produced evidence conflicting with our earlier finding. Based on the analysis summarized here and the comments of HHB, we find no reason to question the empirical results from POLICY BULLETIN NO. 5. While our models cannot explain why investment responds to UNE-P competition, the results provide strong evidence that investment is impacted by such competition.

III. Conclusion

In POLICY BULLETIN NO. 5, we showed using econometric analysis and publicly availably data that Bell Company investment is positively related to UNE-P competition. Here, we show that this result is robust across a wide range of model specifications. These alternate specifications were recommended by Tom Hazlett, Art Havenner, and Coleman Bazelon (on behalf of Verizon) and Carter Hill (on behalf of Z-Tel). Despite re-specification and different estimation techniques, the measured effect of UNE-P competition on Bell investment remains large and statistically significant (in all models). These new empirical results are generally comparable to our earlier estimates, supporting the reasonableness of our chosen specification.

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[33] The RESET F is 4.59, which is significant at better than the 1% level.

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We also show that, using statistical tests, our specification of the investment relationship is preferred to the arbitrary specification adopted by Verizon's advocates.[34]

Accordingly, the conclusion reached in POLICY BULLETIN NO. 5 below (citations omitted) continues to ring true:

> … the current cynicism, ideological bias and outright ignorance towards UNE-P and TELRIC pricing must come to an end. Like it or not, "Congress passed a ratesetting statute with the aim not just to balance interests between sellers and buyers, *but to reorganize markets by rendering regulated utilities' monopolies vulnerable to interlopers, even if that meant swallowing the traditional federal reluctance to intrude into local telephone markets*." As TELRIC does not result in confiscatory rates (if anything, they still remain on the "creamy" side in many jurisdictions), the growing push for BOC sector-specific relief (and, *a fortiori*, a decline in competitive pressures) is specious at best and raises troubling indications of regulatory capture at worst.
>
> If policymakers really want to maximize consumer welfare by protecting competition and not individual competitors (*i.e.,* the BOCs), then U.S. policymakers should stop dreaming that a monopolist will change its spots and invest in new facilities if only it received relief from "pesky" competitive

[34] Despite the fact the data provide strong evidence of a positive relationship between Bell Company investment and UNE-P competition, we do not encourage policymakers to make investment a policy target. As noted in POLICY PAPER NO. 18, *Set It and Forget It? Market Power and the Consequences of Premature Deregulation in Telecommunications Markets* (July 2003) (http://www.phoenix-center.org/pcpp/PCPP18.pdf) a single-minded focus on capital expenditures by telecommunications firms is misplaced, since the impact to consumer and social welfare of increased capital expenditures is not always positive. Policymakers should focus on the efficient provision of telecommunications services, not whether or not the provision of such services is sufficiently capital intensive to satisfy equipment vendors.

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pressures. Instead, if policymakers focus on their core and interrelated statutory mandates – *i.e.*, (a) prevent dominant firms under their jurisdictions from exercising their market power by raising prices and restricting output; and (b) reduce entry barriers for new firms – then we might just get out of the current telecoms slump before it is too late.

Table 1. Summary of Results

(Dep. Variable: $\Delta K = I$)

	Model 1, OLS	Model 2, OLS	Model 3, WLS	Model 4, WLS	Model 5, WLS	Model 6, WLS	Model 7, WLS	Model 8, WLS	Model 9, WLS	Model 10, WLS
Constant	1.5+08	40.94	4.7+07	5.3+07	5.6+07	5.4+07	3.3+07	5.0+07	5.2+07	-1.6+06
	(2.23)*	(1.07)	(2.25)*	(4.27)*	(3.94)*	(3.69)*	(1.38)	(3.91)*	(3.97)*	(-0.12)
ΔR	0.84	0.45	0.75	…	…	…	0.89	0.74	…	1.21
	(1.49)	(1.72)**	(3.19)*				(3.53)*	(4.05)*		(6.35)*
ΔU	**1388.0**	**757.5**	**931.8**	**688.1**	**666.6**	**665.8**	**1011.4**	**927.0**	**688.9**	**937.6**
	(3.27)*	**(3.46)***	**(4.21)***	**(2.76)***	**(2.81)***	**(2.73)***	**(3.99)***	**(4.46)***	**(2.63)***	**(4.16)***
ΔC	-1.2+08	6.87	-6.3+07	…	…	…	-4.1+07	…	…	…
	(-0.68)	(0.33)	(-0.10)				(-0.54)			
K_{t-1}	-0.076	-0.036	-0.035	-0.065	-0.045	-0.036	-0.02	-0.035	-0.058	…
	(-2.71)*	(-0.71)	(-2.58)*	(-4.51)*	(-2.10)*	(-1.76)**	(-1.19)	(-2.71)*	(-3.24)*	
Period	-1.9+07	-67.57	-8.0+07	-8.3+07	-8.5+07	-8.2+07	-6.6+07	-8.1+07	-8.0+07	…
	(-2.02)*	(-3.78)*	(-3.84)*	(-5.55)*	(-5.34)*	(-4.77)*	(-3.06)*	(-4.58)*	(-4.93)*	
$\Delta(R/c)$	…	…	…	8.95	5.34	4.63	…	…	8.55	…
				(2.82)*	(1.23)	(1.14)			(2.69)*	
$\Delta(R/c)_{t-1}$		…	…		-4.11	-4.44	…	…		…
					(-0.96)	(-1.08)				
Net I_{t-1}	…	…	…		…	-0.17	-0.31	…	-0.15	-0.48
						(-0.78)	(-1.58)		(-0.72)	(-3.11)*
Adj. R^2	0.57	0.43	…		…	…	…	…	…	…
Pseudo.-R^2	…	…	0.28	0.29	0.29	0.29	0.31	0.28	0.30	0.21
RESET F	9.10*	1.51	1.52	1.53	1.36	1.81	1.91	1.49	1.77	1.07
White χ^2	33.91*	13.05	12.22	10.17	12.73	21.41**	26.42*	8.60	22.17*	13.26**

* Statistically Significant at the 5% level or better.
** Statistically Significant at the 10% level or better.
Notes: All t-statistics computed using Newey-West robust standard errors. Pseudo-R^2 is computed as the squared correlation coefficient between the actual and fitted dependent variable. In Model 2, I, ΔR, ΔU, and K_{t-1} are all divided by total switched access lines.

Table 2. Summary of Results

(Dep. Variable: $\Delta K' = I'$)

	Model 1, OLS	Model 2, OLS	Model 3, WLS	Model 4, WLS	Model 5, WLS	Model 6, WLS	Model 7, WLS	Model 8, WLS	Model 9, WLS	Model 10, WLS
Constant	4.5+08	7.08	-1.5+07	3.0+07	2.9+07	2.8+07	-2.0+07	2.9+07	2.8+07	-2.1+07
	(1.42)	(0.20)	(-0.85)	(4.14)*	(4.00)*	(3.72)*	(-1.16)	(3.23)*	(3.96)*	(-2.22)*
ΔR	0.58	0.32	0.77	…	…	…	0.75	0.51	…	0.60
	(2.88)*	(2.19)*	(4.84)*				(4.80)*	(3.41)*		(3.32)*
ΔU	**807.1**	**589.6**	**763.0**	**542.6**	**552.1**	**533.6**	**728.0**	**644.0**	**523.8**	**868.4**
	(6.66)*	**(4.70)***	**(5.15)***	**(3.19)***	**(3.09)***	**(2.89)***	**(4.90)***	**(3.30)***	**(2.93)***	**(3.85)***
ΔC	-5.6+06	-28.05	-1.7+07	…	…	…	-1.7+08	…	…	…
	(-0.06)	(-1.50)	(-3.08)*				(-3.12)*			
K'_{t-1}	-0.024	0.028	-0.019	-0.008	-0.012	-0.006	0.029	-0.013	-0.002	…
	(-4.10)*	(0.71)	(-2.04)*	(-0.83)	(-0.84)	(-0.40)	(2.52)*	(-1.35)	(-0.13)	
Period	-1.4+08	-46.61	-1.9+07	-3.6+07	-3.6+07	-3.4+07	-1.2+07	-3.9+07	-3.4+07	…
	(-3.25)*	(-3.15)*	(-1.00)	(-2.14)*	(-2.07)*	(-1.75)**	(-0.60)	(-1.98)**	(-1.82)**	
$\Delta(R/c)$	…	…	…	8.22	9.14	8.75	…	…	7.77	…
				(4.85)*	(3.09)*	(3.35)*			(3.86)*	
$\Delta(R/c)_{t-1}$		…	…		-1.04	-1.10	…	…		…
					(-0.40)	(-0.43)				
Net I'_{t-1}	…	…	…		…	-0.12	-0.25	…	-0.12	-0.06
						(-0.48)	(-1.15)		(-0.48)	(-0.32)
Adj. R^2	0.71	0.38	…		…	…	…	…	…	…
Pseudo.-R^2	…	…	0.40	0.23	0.22	0.23	0.20	0.20	0.23	0.19
RESET F	4.94*	1.01	0.53	0.54	0.59	0.55	0.38	1.16	0.48	0.75
White χ^2	18.63*	5.51	7.03	6.16	7.64	10.25	8.38	8.30	9.17	1.05

* Statistically Significant at the 5% level or better.
** Statistically Significant at the 10% level or better.
Notes: All t-statistics computed using Newey-West robust standard errors. Pseudo-R^2 is computed as the squared correlation coefficient between the actual and fitted dependent variable. In Model 2, I', ΔR, ΔU, and K'_{t-1} are all divided by total switched access lines.