PRICING BASED ON ECONOMIC COST

The Role and Mechanics of TELRIC

Essays by:

John W. Mayo

William J. Baumol

Robert D. Willig

R. Glenn Hubbard and William H. Lehr

Richard N. Clarke

Terry L. Murray

Mark T. Bryant

Janusz A. Ordover

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INTRODUCTION

No issue emanating from the 1996 Telecommunications Act has engendered more controversy than interconnection pricing. The legal history related to such pricing is well-known. In its August 6, 1996 *Local Competition Order* in CC Docket No. 96-98, the Federal Communications Commission adopted a forward-looking cost standard that it dubbed, "total element long-run incremental cost," or TELRIC. The incumbent LECs and others immediately sought Appellate Court review of the Commission's authority to adopt such a standard, and convinced the Eighth Circuit in 1997 to vacate these TELRIC pricing rules on jurisdictional grounds. This decision was appealed to the United States Supreme Court, which in January 1999 reversed the Eighth Circuit and found that the Commission did have authority under the Act to establish a national pricing standard for interconnection and unbundled network elements.

The incumbent LECs promptly returned to the Eighth Circuit and demanded that the Commission's TELRIC rules again be vacated – this time on their merits. In July 2000, the Eighth Circuit again struck down these rules based largely on its finding that the Act's requirement that prices shall be based on the cost of providing "the" interconnection or element required the use of "actual" costs rather than hypothetical or potential costs. This decision, too, was appealed to the Supreme Court, which in May 2002 again reversed the Eighth Circuit. In its decision in *Verizon v. FCC*, the 7-1 Supreme Court majority affirmed the validity of the Commission's TELRIC rules – but in doing so, not only did this majority opinion find that these rules were legal under the Act and entitled to deference as a reasonable agency action under the *Chevron* doctrine, the majority opinion also examined explicitly the various policy-based attacks against the rules (*e.g.*, they discouraged investment, historical or "parity" cost methods are superior, *etc*.) and found all of these arguments to be unconvincing.

Despite this affirmation of not just the validity, but also the appropriateness of the Commission's TELRIC rules by the Supreme Court and roughly fifty state regulatory commissions, the Commission has again sought comment on these rules, apparently with an eye towards making certain modifications. Perhaps forgotten in all of these heated legal machinations over TELRIC has been the economic foundation for the selection of TELRIC as the basis for setting interconnection and unbundled element prices and the history of its development.

The Commission's TELRIC pricing concept, which applies to network elements, was an outgrowth of a very similar pricing concept known as TSLRIC ("total service long-run incremental cost"), which applied to telecommunications services. TSLRIC, in turn, was a particular instance of the LRIC ("long-run incremental cost") pricing concept which had long been advocated by the incumbent LECs as the appropriate basis for pricing their competitive services. But because LRIC did not allow for the recovery of the carrier's joint and common costs, it was viewed by the Commission and various parties (including CLECs such as AT&T) as being insufficiently compensatory to the incumbents. Thus, the Commission adopted TELRIC as a more generous pricing standard that could provide full compensation for all efficient costs of providing

interconnection and unbundled elements. In settling on TELRIC, the Commission determined that the various embedded cost and parity or opportunity cost pricing standards advocated by the incumbents in CC Docket No. 96-98 for the pricing of their monopoly elements or interconnection were impermissible under the pro-competitive policies of the Act.

Since the Commission's action in adopting TELRIC in 1996, there has been much sniping at individual aspects of the components that make up the Commission's TELRIC rules – raising questions such as: are the required network designs unattainably efficient; is adequate compensation really provided; is facilities investment being discouraged; are the costs of capital, depreciation rates and fill factors set appropriately; do proxy models capture accurately these characteristics; and are there larger roles that alternative embedded or parity cost methods should play in setting interconnection and element prices – but there has been little effort to examine these many issues on a comprehensive economic basis.

To address these and similar questions, AT&T has supported the development of a series of essays on these critical issues concerning the economics of TELRIC. All of these essays' authors are distinguished both by their deep understanding of the theoretical issues surrounding the economics of competitive markets and efficient pricing, but also because of their knowledge of the specific intricacies of telecommunications cost structures and their long experience with setting telecommunications prices – both before and since the Act.

The essays in this series are as follows:

1. *John W. Mayo* discusses why it is appropriate that TELRIC should assume the costs of a network designed to current efficiency standards – and why such an efficiency standard matches closely that which would be expected from a competitive market.

2. *William J. Baumol* explains why the Commission's TELRIC pricing concept provides full compensation to the incumbents for their supply of interconnection and unbundled network elements – and constitutes no "taking" of the incumbents' property.

3. *Robert D. Willig* examines whether the availability of unbundled elements at TELRIC discourages otherwise efficient facilities investments by incumbents and competitors, and finds that the competitive stimulus enabled by TELRIC pricing likely enhances, rather than suppresses, investment.

4. *R. Glenn Hubbard and William H. Lehr* discuss the competitive cost of capital that should appropriately be incorporated into TELRIC and determine that currently employed methods properly account for all risk and other factors that bear on capital costs.

5. *Richard N. Clarke* discusses the several calculation methods that may be used to measure the economic depreciation of a carrier's telecommunications plant and explains why current regulatory depreciation methods capture accurately this economic depreciation.

6. *Terry L. Murray* presents the various reasons why local networks cannot be operated at 100% "fill," explains how "fill factors" should be used in TELRIC calculations, and why these factors should reflect the efficient fills that would be sought by a competitive carrier.

7. *Mark T. Bryant* examines the several available tools for calculating TELRIC and explains why proxy models are the most capable tool for capturing accurately all of the real-world costs involved with the provision of unbundled elements, and further notes why accounting records are particularly unsuitable for this task.

8. *Janusz A. Ordover* evaluates the various alternative methodologies that have been proposed for interconnection and unbundled element pricing and explains why these alternatives do not promote efficient pricing or the development of competitive markets and, thus, are inferior to TELRIC.

Although it would have been possible for each of these authors to analyze at an extremely technical level the subject of their essay, this series is intended to be more accessible to policymakers and other interested parties. Rather than speaking just to professional economists, these essays are intended to provide a clear understanding of the basic economic facts surrounding the construction of TELRIC and the purpose of these aspects of TELRIC in promoting the development of fully competitive local telecommunications markets. It is only with such a foundation that informed decisions may be made concerning possible adjustments to TELRIC.

I would like to thank all of the authors for the thoughtful effort they put into making their essays an insightful roadmap for the proper application of economic pricing in wholesale telecommunications networks. I think it is safe to say that all of us had our appreciation for TELRIC improved through review of each other's work. In addition to the authors, I am indebted to Carol Wilner, Joan Marsh, Larry Lafaro and, most specially, Steve Levinson for support of this project. Greg Neff, Mart Vaarsi and David Lawson have supplied valuable editing assistance.

Richard N. Clarke

Bedminster, New Jersey
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BIOGRAPHICAL SKETCHES OF THE ESSAYS' AUTHORS

William J. Baumol is Professor of Economics at New York University and Professor Emeritus at Princeton University. He received his bachelor's degree in economics from the College of the City of New York in 1942 and his Ph.D. from the University of London in 1949. Professor Baumol taught at the London School of Economics from 1947 through 1949 and then served as a member of the faculty of Princeton University for 42 years. He is the author of roughly 40 professional books and more than 500 articles. Professor Baumol served as president of four leading professional organizations of economists, including the American Economic Association and holds ten honorary degrees from universities in the United States and abroad and is an elected member of the National Academy of Sciences and the American Philosophical Society.

Professor Baumol has taught university courses on the economics of antitrust, regulation and industrial organization, and has been invited to lecture on these subjects in forums throughout the world. He has also written a number of articles and books related to these subjects and has testified extensively on antitrust and regulatory issues before courts and regulatory agencies in the United States and abroad.

Mark T. Bryant has over twenty years experience in telecommunications policy and regulation, with particular emphasis on costing and pricing of network elements and the establishment of conditions necessary for the development of competitive telecommunications markets. From 1984 to 2002, Dr. Bryant was employed by MCI Communications Corporation, and later, WorldCom. While with MCI/WorldCom, he was responsible for assisting in the economic analysis of regulatory and antitrust matters. From 1995, Dr. Bryant had primary responsibility for MCI/WorldCom's participation in the development of the HAI Model, an engineering/economic model for the estimation of telecommunications network costs. Dr. Bryant has testified or appeared before many state regulatory commissions, the FCC, the National Telecommunications and Information Administration, the Ministry of Telecommunications of Japan, and the telecommunications regulatory agency of the government of Mexico.

Prior to his employment with MCI, Dr. Bryant was Assistant Professor of Economics at the University of Kentucky, where he taught courses in telecommunications and broadcast regulation, statistics and television programming. Dr. Bryant holds a B.F.A. from Southern Methodist University and M.A. and Ph.D. degrees in Economics from the University of Texas at Austin.

Richard N. Clarke is Director of Economic Analysis for AT&T. Dr. Clarke brings both theoretical and practical experience to the study of telecommunications markets. While at Bell Laboratories in the 1980s, he modeled the likely competitive effects of early proposals to eliminate the Regional Bell Holding Company line-of-business restrictions from the MFJ. After moving over to AT&T in 1989, he became responsible

for AT&T's regulatory policy on access charges, LEC price cap regulation and interconnection rules. Since the mid 1990s, Dr. Clarke has been responsible for AT&T's economic policy related to the provision of local telephone services. This includes AT&T's positions on the efficient pricing of interconnection, unbundled network elements and the costing of universal service – for U.S. local networks as well as for foreign local and long distance networks. He has testified on efficient unbundling, interconnection and pricing in state and federal proceedings. Dr. Clarke also directs AT&T's participation in the development of the HAI/Hatfield Model of forward looking economic costs of local exchange networks.

Dr. Clarke is the author of numerous papers on economics and telecommunications. He has an A.B. degree in Mathematics and Economics from the University of Michigan, and an A.M and Ph.D. in Economics from Harvard University. Prior to joining AT&T-Bell Laboratories, he was an Assistant Professor of Economics at the University of Wisconsin-Madison, and served as an economist with the Antitrust Division of the U.S. Department of Justice.

R. Glenn Hubbard is the Russell L. Carson Professor of Economics and Finance in the Department of Economics and Graduate School of Business of Columbia University, where he is also Co-Director of the Program on Entrepreneurship at the Graduate School of Business. From February 2001 until March 2003, he was Chairman of the U.S. Council of Economic Advisers under President George W. Bush, where his responsibilities included advising the President on economic policy, tax and budget policy, emerging market financial issues, international finance, health care, and environmental policy. While CEA Chairman, he also chaired the Economic Policy Committee of the OECD. Professor Hubbard, whose research spans tax policy, monetary economics, international finance, and corporate finance has taught at Northwestern, Harvard, and the University of Chicago, as well as Columbia. In addition to writing more than 90 scholarly articles in economics and finance, he is the author of a best-selling textbook on money and financial markets. He was Deputy Assistant Secretary of the U.S. Treasury Department for Tax Policy from 1991-1993. In addition to his responsibilities at Columbia, he is a research associate at the National Bureau of Economic research and the director of the program on tax policy at the American Enterprise Institute in Washington. He has been a consultant to U.S. and non-U.S. government agencies and numerous private corporations.

Professor Hubbard has received B.A. and B.S. degrees from the University of Central Florida, and earned his A.M. and Ph.D. in Economics from Harvard University.

William H. Lehr is an economist and industry consultant. He also serves as a Research Associate in the Center for Technology, Policy and Industrial Development at the Massachusetts Institute of Technology and is the Associate Director of the MIT Research Program on Internet & Telecoms Convergence. Previously, Dr. Lehr was an Associate Research Scholar and Assistant Professor at Columbia University's Graduate School of

Business. Dr. Lehr lectures and publishes academic research on the regulatory and industrial economics of information infrastructure industries. He has published articles on such topics as the impact of the Internet on the structure of the communications infrastructure industries, telecommunications regulation, and the pricing of Internet services. His current research focuses on the convergence of the Internet and wireless services, and the implications for corporate strategy and public policy. In addition to his academic research, Dr. Lehr provides litigation, economic, and business strategy consulting services for firms and public agencies in information technology industries in the United States and abroad.

Dr. Lehr holds a Ph.D. in Economics from Stanford (1992), an MBA from the Wharton Graduate School (1985), and MSE (1984), B.S. (1979) and B.A. (1979) degrees from the University of Pennsylvania.

John W. Mayo is Dean and Professor of Economics, Business and Public Policy at the McDonough School of Business of Georgetown University. Professor Mayo teaches and conducts research in economics, business and public policy. His research interests lie in the areas of industrial organization, regulation and antitrust, and, more generally, the application of microeconomics to public policy. His research has appeared in numerous economics, law and public policy journals. He is also co-author of a comprehensive text on *Government and Business: The Economics of Antitrust and Regulation.*

Prior to his appointment at Georgetown University, Professor Mayo taught graduate and undergraduate economics classes at Washington University, the University of Tennessee and Virginia Tech. He has also served as the Chief Economist, U.S. Senate Small Business Committee. Additionally, Professor Mayo has served as an advisor and consultant to both public and private agencies including the U.S. Department of Justice, the Federal Trade Commission, AT&T, MCI, Sprint, Enron, the Tennessee Valley Authority, the Department of Energy and Oak Ridge National Laboratory. Professor Mayo has participated in many regulatory and antitrust proceedings and has testified before state and federal legislative and regulatory bodies on monopolization, price fixing, mergers, and regulatory pricing policy. Professor Mayo received his B.A. degree in from Hendrix College, and his M.A. and Ph.D. degrees in Economics from Washington University.

Terry L. Murray is President of the California-based consulting firm Murray & Cratty, LLC. The firm specializes in economic, financial and policy analysis of issues concerning regulated industries, particularly the telecommunications and energy industries. Recently, the firm's practice has focused on local competition and industry restructuring issues, including the costing and pricing of unbundled network elements and impairment analysis. Ms. Murray has appeared as an expert witness in regulatory and civil proceedings in 30 states as well as before the Federal Communications Commission.

Before becoming a consultant, Ms. Murray had extensive experience as an economist in government and academia. As a member of the staff of the California Public Utilities

Commission from 1984 to 1990, she helped to develop rules for emerging competition in the electric, gas and telecommunications industries. Her CPUC positions included stints as a Commissioner's Advisor, senior telecommunications analyst in the Policy and Planning Division, and Director of the Division of Ratepayer Advocates. She was a member of the economics faculty at Wesleyan University and has taught courses on telecommunications regulation at Golden Gate University.

Ms. Murray holds a B.A. degree in Economics from Oberlin College and did graduate study in Economics at Yale University, where she completed all requirements for the Ph.D. except the dissertation.

Janusz A. Ordover is Professor of Economics and former Director of the Masters in Economics Program at New York University. He served as Deputy Assistant Attorney General for Economics in the Antitrust Division of the U.S. Department of Justice from 1991 to 1992. While at the Antitrust Division, Professor Ordover served on the White House deregulation task force, guided economic analyses of antitrust enforcement and acted as a liaison between the Justice Department and various regulatory agencies. Professor Ordover served as an advisor to the Organization for Economic Cooperation and Development (OECD) in Paris, the World Bank, and the Inter-American Bank for Development on matters of privatization, regulation, international trade policy and competition policy and as a consultant to the U.S. Department of Justice, Federal Trade Commission, and State Attorneys General. He has advised the governments of Poland, Czech Republic, Russia, Hungary, Argentina, and others on regulation and competition matters, as well as on privatization strategies. Professor Ordover has been involved in the analyses of regulatory and competitive issues in the telecommunications sector in the U.S. and abroad, having acted as an advisor to AT&T, Telstra, Telstra/Clear, Nextel, MCI/Worldcom, and T-Mobile.

Professor Ordover holds a Bachelor's degree in Political Economy from Warsaw University, has done graduate work at McGill University and received his Ph.D. in Economics from Columbia University.

Robert D. Willig is Professor of Economics and Public Affairs at Princeton University, where he serves as the Faculty Chair of the MPA Program at the Woodrow Wilson School of Public and International Affairs. A former supervisor of economics research at Bell Laboratories, he is the author of *Welfare Analysis of Policies Affecting Prices and Products*; coauthor of *Contestable Markets and the Theory of Industry Structure*; and coeditor of *The Handbook of Industrial Organization*; *Can Privatization Deliver?: Infrastructure for Latin Ame*rica and *Second Generation Reforms in Infrastructure Services*. Professor Willig has written and lectured widely on these subjects, is a Fellow of the Econometric Society and has served on the editorial boards of the American Economic Review and the Journal of Industrial Economics. He served in the Antitrust Division of the U.S. Department of Justice as Deputy Assistant Attorney General for Economics from 1989 to 1991, and has been a member of policy task forces under the

aegis of the Governor of New Jersey, the Defense Science Board, and the National Research Council. He has worked with the Inter-American Development Bank, the World Bank and the governments of many nations on issues of infrastructure (including telecommunications) privatization, regulation and competition policy.

Professor Willig has served as a consultant on telecommunications policy to AT&T, AT&T Wireless, AT&T Broadband, Regional Bell Operating Companies, Teledirect, Telecom of New Zealand, Telstra, Viacom, Comcast, Singapore Cable, EchoStar, DIRECTV, and Singtech. He has testified on telecommunications policy before Congress, the FCC, federal and state courts, and many state public utility commissions. Professor Willig has received an A.B. degree in Mathematics from Harvard University, an M.S. degree in Operations Research from Stanford University and a Ph.D. in Economics, also from Stanford University.

STATEMENT OF THE FCC'S TELRIC RULES

47 CFR Ch. I (10–1–02 Edition)

Subpart F—Pricing of Elements

§ 51.501 Scope.

(a) The rules in this subpart apply to the pricing of network elements, interconnection, and methods of obtaining access to unbundled elements, including physical collocation and virtual collocation.

(b) As used in this subpart, the term ''element'' includes network elements, interconnection, and methods of obtaining interconnection and access to unbundled elements.

§ 51.503 General pricing standard.

(a) An incumbent LEC shall offer elements to requesting telecommunications carriers at rates, terms, and conditions that are just, reasonable, and nondiscriminatory.

(b) An incumbent LEC's rates for each element it offers shall comply with the rate structure rules set forth in §§ 51.507 and 51.509, and shall be established, at the election of the state commission—

(1) Pursuant to the forward-looking economic cost-based pricing methodology set forth in §§ 51.505 and 51.511; or

(2) Consistent with the proxy ceilings and ranges set forth in § 51.513.

(c) The rates that an incumbent LEC assesses for elements shall not vary on the basis of the class of customers served by the requesting carrier, or on the type of services that the requesting carrier purchasing such elements uses them to provide.

§ 51.505 Forward-looking economic cost.

(a) *In general.* The forward-looking economic cost of an element equals the sum of:

(1) The total element long-run incremental cost of the element, as described in paragraph (b); and

(2) A reasonable allocation of forward-looking common costs, as described in paragraph (c).

(b) *Total element long-run incremental cost.* The total element long-run incremental cost of an element is the forward-looking cost over the long run of the total quantity of the facilities and functions that are directly attributable to, or reasonably identifiable as incremental to, such element, calculated taking as a given the incumbent LEC's provision of other elements.

(1) *Efficient network configuration.* The total element long-run incremental cost of an element should be measured based on the use of the most efficient telecommunications technology currently available and the lowest cost network configuration, given the existing location of the incumbent LEC's wire centers.

(2) *Forward-looking cost of capital.* The forward-looking cost of capital shall be used in calculating the total element long-run incremental cost of an element.

(3) *Depreciation rates.* The depreciation rates used in calculating forward-looking economic costs of elements shall be economic depreciation rates.

(c) *Reasonable allocation of forward-looking common costs—*

(1) *Forward-looking common costs.* Forward-looking common costs are economic costs efficiently incurred in providing a group of elements or services (which may include all elements or services provided by the incumbent LEC) that cannot be attributed directly to individual elements or services.

(2) *Reasonable allocation.*

(i) The sum of a reasonable allocation of forward-looking common costs and the total element long-run incremental cost of an element shall not exceed the standalone costs associated with the element. In this context, stand-alone costs are the total forward-looking costs, including corporate costs, that would be incurred to produce a given element if that element were provided by an efficient firm that produced nothing but the given element.

(ii) The sum of the allocation of forward-looking common costs for all elements and services shall equal the total forward-looking common costs, exclusive of retail costs, attributable to operating the incumbent LEC's total network, so as to provide all the elements and services offered.

(d) *Factors that may not be considered.* The following factors shall not be considered in a

calculation of the forward-looking economic cost of an element:

(1) *Embedded costs.* Embedded costs are the costs that the incumbent LEC incurred in the past and that are recorded in the incumbent LEC's books of accounts;

(2) *Retail costs.* Retail costs include the costs of marketing, billing, collection, and other costs associated with offering retail telecommunications services to subscribers who are not telecommunications carriers, described in § 51.609;

(3) *Opportunity costs.* Opportunity costs include the revenues that the incumbent LEC would have received for the sale of telecommunications services, in the absence of competition from telecommunications carriers that purchase elements; and

(4) *Revenues to subsidize other services.* Revenues to subsidize other services include revenues associated with elements or telecommunications service offerings other than the element for which a rate is being established.

(e) *Cost study requirements.* An incumbent LEC must prove to the state commission that the rates for each element it offers do not exceed the forward-looking economic cost per unit of providing the element, using a cost study that complies with the methodology set forth in this section and § 51.511.

(1) A state commission may set a rate outside the proxy ranges or above the proxy ceilings described in § 51.513 only if that commission has given full and fair effect to the economic cost based pricing methodology described in this section and § 51.511 in a state proceeding that meets the requirements of paragraph (e)(2) of this section.

(2) Any state proceeding conducted pursuant to this section shall provide notice and an opportunity for comment to affected parties and shall result in the creation of a written factual record that is sufficient for purposes of review. The record of any state proceeding in which a state commission considers a cost study for purposes of establishing rates under this section shall include any such cost study.

§ 51.507 General rate structure standard.

(a) Element rates shall be structured consistently with the manner in which the costs of providing the elements are incurred.

(b) The costs of dedicated facilities shall be recovered through flat-rated charges.

(c) The costs of shared facilities shall be recovered in a manner that efficiently apportions costs among users. Costs of shared facilities may be apportioned either through usage-sensitive charges or capacity-based flat-rated charges, if the state commission finds that such rates reasonably reflect the costs imposed by the various users.

(d) Recurring costs shall be recovered through recurring charges, unless an incumbent LEC proves to a state commission that such recurring costs are de minimis. Recurring costs shall be considered de minimis when the costs of administering the recurring charge would be excessive in relation to the amount of the recurring costs.

(e) State commissions may, where reasonable, require incumbent LECs to recover nonrecurring costs through recurring charges over a reasonable period of time. Nonrecurring charges shall be allocated efficiently among requesting telecommunications carriers, and shall not permit an incumbent LEC to recover more than the total forward-looking economic cost of providing the applicable element.

(f) State commissions shall establish different rates for elements in at least three defined geographic areas within the state to reflect geographic cost differences.

(1) To establish geographically deaveraged rates, state commissions may use existing density-related zone pricing plans described in § 69.123 of this chapter, or other such cost-related zone plans established pursuant to state law.

(2) In states not using such existing plans, state commissions must create a minimum of three cost-related rate zones.

§ 51.509 Rate structure standards for specific elements.

In addition to the general rules set forth in § 51.507, rates for specific elements shall comply with the following rate structure rules.

(a) *Local loops.* Loop costs shall be recovered through flat-rated charges.

(b) *Local switching.* Local switching costs shall be recovered through a combination of a flat-rated charge for line ports and one or more flat-rated or per minute usage charges for the switching matrix and for trunk ports.

(c) *Dedicated transmission links.* Dedicated transmission link costs shall be recovered through flat-rated charges.

(d) *Shared transmission facilities between tandem switches and end offices.* The costs of shared transmission facilities between tandem switches and end offices may be recovered through usage-sensitive charges, or in another manner consistent with the manner that the incumbent LEC incurs those costs.

(e) *Tandem switching.* Tandem switching costs may be recovered through usage-sensitive charges, or in another manner consistent with the manner that the incumbent LEC incurs those costs.

(f) *Signaling and call-related database services.* Signaling and call-related database service costs shall be usage sensitive, based on either the number of queries or the number of messages, with the exception of the dedicated circuits known as signaling links, the cost of which shall be recovered through flat-rated charges.

(g) *Collocation.* Collocation costs shall be recovered consistent with the rate structure policies established in the *Expanded Interconnection* proceeding, CC Docket No. 91-141.

§ 51.511 Forward-looking economic cost per unit.

(a) The forward-looking economic cost per unit of an element equals the forward-looking economic cost of the element, as defined in § 51.505, divided by a reasonable projection of the sum of the total number of units of the element that the incumbent LEC is likely to provide to requesting telecommunications carriers and the total number of units of the element that the incumbent LEC is likely to use in offering its own services, during a reasonable measuring period.

(b)(1) With respect to elements that an incumbent LEC offers on a flat-rate basis, the number of units is defined as the discrete number of elements (e.g., local loops or local switch ports) that the incumbent LEC uses or provides.

(2) With respect to elements that an incumbent LEC offers on a usage-sensitive basis, the number of units is defined as the unit of measurement of the usage (e.g., minutes of use or call-related database queries) of the element.

EFFICIENT FORWARD-LOOKING TELECOMMUNICATIONS NETWORKS AS A FOUNDATION FOR TELRIC

John W. Mayo[1]

1. Overview

Beginning with the Federal Communication Commission's (FCC's) *First Report and Order* on local exchange competition issued in August of 1996,[2] and continuing through the Supreme Court's *Verizon* decision in 2002,[3] the total element long-run incremental cost (TELRIC) standard for pricing of unbundled network elements (UNEs) has withstood repeated scrutiny and been determined to be sound. These judgments have come not only from the FCC and the United States Supreme Court, but also from a multiplicity of state regulatory authorities that independently have selected TELRIC to guide their pricing of UNEs.[4] Despite these strong endorsements, the TELRIC standard continues to be challenged. Foremost among the challenges is the charge that the TELRIC methodology imposes unrealistic efficiency benchmarks on incumbent local exchange carriers (ILECs), generates UNE prices that are "too low," and consequently allows competitive local exchange carriers (CLECs) to "free ride" on the facilities of the

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[1] Dean, and Professor of Economics, Business and Public Policy, Georgetown University, McDonough School of Business.

[2] *See* Federal Communications Commission, *First Report and Order*, In the matter of: Implementation of the Local Competition Provisions in the Telecommunications Act of 1996, CC Docket No. 96-98, released August 8, 1996 ("*Local Competition Order*").

[3] *Verizon v. FCC*, 535 U.S. 467 (2002) ("*Verizon*").

[4] During the years between 1997 and 2002 in which the Eighth Circuit vacated the effectiveness of the FCC's TELRIC pricing policies, nearly every state regulatory commission adopted similar standards on their own authority. In addition, many foreign regulatory bodies have recommended or adopted TELRIC-like standards to guide their own interconnection pricing.

ILECs. This, it is argued, creates something other than "real" competition at the retail stage.

Interestingly, these complaints about TELRIC begin with a point of agreement among virtually all observers; namely, that economic efficiency requires prices to reflect the underlying marginal cost of supply.[5] Critics of TELRIC, however, argue that such marginal (or incremental) costs must be backward looking and based on "actually" incurred costs, rather than prospective efficient costs. They argue that the TELRIC methodology relies upon the costs of a "hypothetical" rather than "real" network, and by so doing, deprives the ILECs of the opportunity to recover their full historically incurred costs. In its extreme, these critics argue that TELRIC views costs by beginning with a "Blank Slate," and dub this assumption "TELRIC-BS."[6] Clever acronyms aside, the serious question is whether the forward looking, long-run standard for costs is appropriate for determining prices for UNEs. The answer is clearly, "yes."

In the following essay, I explain that TELRIC is intended to provide an economically sound costing and pricing methodology that will enable competition in the local exchange telephone arena – and why this requires TELRIC to reflect "the most efficient telecommunications technology currently available."[7] To make this clearer, I

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[5] *See*, Alfred E. Kahn, "The Road to More Intelligent Telephone Pricing." *Yale Journal on Regulation*, Volume 1, 1984, p. 140, who, citing Paul Samuelson's foundational text, points out that, "Economic efficiency requires that services be priced at their marginal cost." *See also*, David L. Kaserman and John W. Mayo "Cross-Subsidies in Telecommunications," Roadblocks on the Road to More Intelligent Telephone Pricing," *Yale Journal on Regulation*, Volume 11, Winter 1994, p. 123, and the references cited therein.

[6] *See* Alfred E. Kahn, "Whom the Gods Would Destroy, Or How Not to Deregulate," AEI-Brookings Institute Joint Center For Regulatory Studies, Washington, D.C., 2001 ("*Kahn*").

[7] 47 CFR §51.505(b)(1).

first provide some background for the policy debate over TELRIC and the costing and pricing principles that the 1996 Telecommunications Act deemed appropriate. Next, I discuss the economic efficiency principles that provide the proper foundation for the costing/pricing of UNEs, and why these principles compel regulators to set prices for UNEs based on the assumption that local networks are designed efficiently over a long-run horizon. I also explain why any deviations from this efficiency assumption will damage customer welfare and frustrate the emergence of sustainable, competitive markets for local telecommunications services. The essay then closes with some concluding remarks.

2. Background

The Telecommunications Act of 1996 was unequivocal in its endorsement of competition. But mindful of the network nature of local telecommunications, the industry's long history of monopoly, and the substantial fixed cost and scale economy disadvantages facing new entrants, Congress recognized that the task of opening local exchange markets to competition would not be easy.[8] Accordingly, the Act created a variety of means by which new entrants might enter this market and compete. First, the

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[8] As recognized by the Supreme Court, the Act called upon regulators to seek "an entirely new objective of uprooting monopolies" and that the policy charge was "to reorganize markets by rendering regulated utilities' monopolies vulnerable to interlopers." (*Verizon*, p. 16) Thus, in light of the Supreme Court's judgment on this matter, there can be no doubt that the prime directive to the Commission is to cast off anachronistic tendencies to protect the incumbent utilities from competition, and to instead undertake policies that enable the competitive process to be effective. Indeed, the Court goes so far as to note that "the Act appears to be an explicit disavowal of the familiar public-utility model … in favor of novel ratesetting designed to give aspiring competitors every possible incentive to enter local retail telephone markets, short of confiscating the incumbents' property." For a detailed discussion of the larger implications of the Court's opinion, see David L. Kaserman and John W. Mayo "The Supreme Court Weighs in on Local Exchange Competition: The Meta-Message," *Review of Network Economics*, Vol. 1, September 2002, pp. 66-78.

Act permitted new entrants to build their own networks separate from those of the incumbents'. Second, the Act permitted new entrants to buy the unaltered retail services of the incumbents at a wholesale discount, and to resell these services to end user customers. Finally, the Act provided that new entrants may enter local markets by purchasing UNEs from the incumbent, either individually or in combination. By offering these several entry avenues, it was hoped that local telephone markets could transition from monopoly to competition – without needing to quarantine the monopoly ILECs from complementary markets or to restrict their competitive retail activities in local markets.

The Act's wisdom in providing for these three entry avenues has been well demonstrated over the past seven years of competitive experience. To serve enterprise customers in major central business districts, CLECs have generally built their own separate network facilities. But the similar construction of massive parallel networks to serve residence or small business customers (or even large business customers in more remote locations) has proven to be economically infeasible.[9] For this reason entrant carriers have attempted to use resale or UNEs to serve these smaller customers. But

[9] A frequent argument of the ILECs is that it is good public policy to make leased UNE elements more expensive because this will cause new entrants to enter the local exchange industry by making greater initial investments in their own facilities. This argument, however, is completely contrary to sound business practices and to economic efficiency. Rather, the most efficient entry methods are to seek out ways to develop a market presence without investing large amounts of capital that may be sunk or stranded if the market entry is unsuccessful. Over time, as an entrant gains market presence, the prospect of large sunk cost losses is mitigated and more investment will become warranted. The imposition of high UNE rates will, however, simply foreclose the lower sunk cost entry option and, given the unattractive alternative of entry via huge sunk cost investments, prospective entrants will simply choose not to enter. For a more detailed discussion of the relationship between UNE pricing and investment, see the companion essay by Robert Willig.

experience has shown that entrants need to be able to differentiate their services from those of the incumbent and to offer innovative pricing options to customers. For this reason, resale (with its frozen service definitions and limited discounts), has proven to be unattractive.[10] In contrast, UNE-based entry has been the most successful method for CLECs to provide services to residence and small business customers. This has been due to the flexibility that TELRIC-priced UNE entry offers in allowing CLECs to create local telephone services that are attractive and economic to wide ranges of customers.

Despite the apparent efficiency of entry based upon TELRIC pricing of UNEs, the TELRIC pricing standard has continued to evoke heated disputes among telecommunications firms. On one hand, incumbents charge that such pricing effectively confiscates their property, undermining their ability to invest and profit. They argue that policymakers must remedy this by either eliminating TELRIC-based pricing of UNEs or, alternatively, drastically modifying the TELRIC concept in a manner far more generous to the ILECs. On the other hand, new entrants strongly defend TELRIC. First, they observe that TELRIC is appropriate because it matches the efficient cost levels and price signals that would be generated if local telecommunications markets already were competitive. Second, new entrants state that without TELRIC pricing of UNEs, competitive entry into local telecommunications will be hindered (if not blocked altogether), and the development of competition in local exchange telephony will be

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[10] For a discussion of the proper economic approach to determining the level of such a resale discount, see David L. Kaserman and John W. Mayo, "An Efficient Avoided Cost Pricing Rule for Resale of Local Exchange Telephone Service," *Journal of Regulatory Economics*, Volume 11, January 1997, pp. 91-107.

retarded – all in direct contradiction to the mandates of the Telecommunications Act and proper economic policy.

In an industry already steeped in acronyms, it is easy to mistake the in-fighting of the ILECs and the CLECs over TELRIC as simply an arcane regulatory tug-of-war over available dollars. The higher are input prices, the better off are the ILECs, while lower input prices financially favor the new entrants. If, indeed, this were simply a zero-sum game between private contestants, then the role of economic efficiency principles in the policy debate is minimal. In fact, however, the TELRIC controversy is at the very heart of the larger economic issue of whether consumers in the United States will enjoy the benefits of competition – greater choice, downward cost pressure, lower prices and more innovation – or whether this efficient and pro-competitive pricing policy will be abandoned in favor of regulatory policies that find comfort in the continuance of slowly evolving monopoly stability in pricing, product capabilities, service quality, *etc*.

Because of the significance of any decision to retreat from TELRIC's precept that pricing should be based on the cost of efficient networks, it is critical that today's policymakers have a set of guiding principles against which to judge the merits of these conflicting predictions as to the appropriateness of TELRIC, and its resultant effect on the development of competition and economic welfare.

3. Principles of Efficient Economic Pricing

The beneficial properties of the efficient cost levels and prices that arise naturally in competitively organized industries are well-known in economics. The challenge here is how to insert such properties into a local telecommunications industry whose supply

process for UNEs is not yet subject to such effective competition. Accordingly, the goal of a competition-enabling policy must be to fashion a pricing methodology that emulates the pricing that would prevail in this market if it were competitive. In this respect, the pricing methodology should – in so far as is possible – mirror the underlying drivers of competitively-determined prices. Thus, one is immediately led to examine the characteristics of competitively-based prices. These characteristics form the basis of a sound regulatory pricing methodology to be applied when effective competition is not present.[11]

There is general consensus regarding the principles that define the efficient costs upon which wholesale prices should be based. Specifically, such costs should be: (1) forward-looking (as opposed to historical or embedded); (2) long run (as opposed to short run in nature); (3) based on least-cost production methods (as opposed to observed, potentially inefficient, production methods); (4) closely related to identifiable causal factors (as opposed to arbitrary allocations); and (5) incremental.

First, it is important that cost calculations be forward-looking because this is precisely the perspective that governs the actions of competitive sellers and buyers. Competitive sellers make pricing and output decisions based on how these actions are likely to affect present and future costs and revenues. Neither the existence nor absence of sunk costs, nor the magnitude of historical (or embedded) costs affects the firm's optimal behavior. Likewise, consumers make choices based on forward-looking

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[11] It is widely agreed that where effective competition (*i.e.*, the absence of significant monopoly power) is present, there is no need for any regulatory pricing. Rather, competition makes government interference in the market both unnecessary and undesirable.

assessments. History is unchangeable. When making purchase decisions, buyers consider their current and anticipated future incomes. They assess current and future relative prices. Past costs and foregone opportunities are irrelevant.[12]

Second, the economically appropriate time frame upon which to evaluate costs for pricing purposes is the long run. This is defined as the period of time over which all relevant input quantities are variable. The long-run perspective is warranted by several considerations. First, competitive markets move prices toward long-run costs. Therefore, long-run costs provide the competitive equilibrium standard. Second, long-run costs are dependent solely upon forward-looking production technologies and input prices, whereas short-run costs may be distorted by past plant choices and input costs. And third, any firm contemplating entry will, by definition, be looking at its own long-run costs, because it will not yet have constructed (*i.e.*, make embedded) its plant. Thus, this firm will compare its own expected long-run costs to the prices charged by the incumbent firms to make its entry decision.[13]

Third, costs must be based on the least-cost method of production if wholesale costs (and prices) are to mirror the costs and prices that would result from competitive supply of these services. In a competitive market, firms that fail to minimize their costs by choosing the wrong technology or by incurring avoidable costs face dire

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[12] Forward-looking does not mean that efficient economic costs fail to account for the fixed costs firms must incur in order to undertake production. To the contrary, so long as the cost standard in use is based on *long-run* costs, firms will earn the return necessary to place and replace efficient, productive capacity by pricing to recover these costs. A companion essay by William Baumol addresses this issue at greater length.

[13] Indeed, the insightful prospective entrant will not simply look at prevailing prices when making its entry decision, but rather will consider the prices that likely will exist post-entry.

consequences. Either they reduce their prices to match their lower-cost rivals and require their shareholders to bear the loss, or they try to maintain higher prices consistent with their "actual" costs, and are culled quickly from the market. Thus, if wholesale prices are to foster the growth of retail competition, they must reflect costs consistent with use of the best available current technology.

Prices that reflect higher historical (embedded) costs will simply foist the inefficiencies of the incumbent onto its rivals who must purchase inputs at prices that reflect inefficient technologies. Such pricing would spawn a variety of undesirable consequences, including the creation of regulation-generated barriers to entry, higher retail-stage costs and prices, and perverse performance incentives for the incumbent firm. Specifically, input prices that are higher than the most efficient technology currently available impose a cost asymmetry on new entrants that constitutes a classic barrier to entry.[14] This is because these higher input costs are "real" and incremental to the entrant, but are illusory to the decision-making of the incumbent (which is based on its economically efficient costs). Thus, these cost asymmetries will suppress entry and retail pricing pressure from prospective carriers, with the predictable consequence of higher retail-stage prices. In addition, if regulatory pricing were to build upon a standard of observed, as opposed to least-cost, methods of production, incumbents would have a perverse incentive to adopt non-cost-minimizing production techniques in order to secure higher wholesale prices, and thereby deter competitive entry. In effect, the incumbent firm would be told, "the higher are your costs, the less competition you will face." This is hardly a recipe for efficient behavior or maximum market performance. Indeed, this

[14] *See* George J. Stigler, *The Organization of Industry*, Homewood, Illinois: Irwin, 1968.

would represent a return to all of the ills associated with old utility-style rate-of-return regulation.[15] Over the past several decades, such regulation has properly been replaced by more incentive-compatible methods.

Fourth, economic efficiency dictates that all prices should reflect as closely as possible the causal factors that drive the cost of supply. It is both efficient from an economic perspective, and fair from a competitive perspective, that consumers of a good, service or element should pay for the economic costs associated with its provision. It is also demonstrably economically inefficient and competitively unfair to have established prices in excess of these levels and uncoupled from the way in which economic costs are incurred.[16]

Finally, while accountants, economists and policymakers use a variety of related cost concepts to investigate firm behavior and evaluate market performance, it is the concept of incremental cost that is most fundamental to competitive firm behavior. This focus on incremental cost is common among all profit-maximizing firms and across all types of market structures. If an incremental action adds more to the firm's revenues than to its costs, it should be undertaken. If not, the activity should be avoided or abandoned.

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[15] See, e.g., Harvey Averch and Leland Johnson, "Behavior of the Firm Under Regulatory Constraint," *American Economic Review*, Vol. 52, December 1962, pp. 1053-1069, and subsequent literature.

[16] Unfortunately, in the telecommunications industry there is a long history of "allocating" costs and setting prices independent of cost-causal principles. Such historical practices are both unwarranted and ineffective. *See*, William J. Baumol, Michael F. Koehn and Robert D. Willig, "How Arbitrary is 'Arbitrary,' or, Toward the Deserved Demise of Full Cost Allocation," *Public Utilities Fortnightly*, September 3, 1987; or Ross C. Eriksson, David L. Kaserman and John W. Mayo, "Targeted and Untargeted Subsidy Schemes: Evidence from Post-Divestiture Efforts to Promote Universal Telephone Service," *Journal of Law and Economics*, Volume 41, October 1998, pp. 477-502.

In addition to being the central guide to the behavior of profit maximizing firms, the concept of marginal or incremental cost is also central to determining the best allocation of society's resources. Allocative efficiency requires that the incremental benefit to a consumer who is just barely induced to purchase an item at its prevailing price, must be just equal to the incremental cost of supplying that last item. Competitive market forces provide this optimal outcome automatically by forcing prevailing prices down to just match the incremental cost of an item. It is because they do so that competitive markets are heralded for their efficiency. Thus, to promote competitive behavior and to realize economic efficiency, prices must be based upon incremental costs.

When wholesale prices are based on costs that reflect the above properties, correct economic signals will be provided both to new entrants and incumbents. Specifically, efficient firms will be encouraged to enter and inefficient firms will be discouraged from entry. As a result, the competition that emerges between and among incumbents and new entrants will be both efficient and sustainable. Furthermore, adoption of such costing and pricing principles will lead to lower and more efficient retail prices – and this improved market performance will provide a general stimulus to the overall economy.

4. Why UNE Pricing Must Assume Efficient Networks

As described in the preceding section, economic efficiency requires input prices to be developed using a benchmark of the most efficient technology available. Adoption of such a standard for the development of UNE pricing is especially critical as it is the foundation both for the affirmative development of competition in local exchange

markets and for avoiding the erection of regulatory barriers to competition. In this regard, and pursuant to the Act's directives, the TELRIC standard for the pricing of UNEs requires that ILECs be reimbursed only for the costs that would be incurred by an efficient, forward-looking network to supply the UNE. To the extent that an ILEC may not actually operate at full efficiency, the FCC's TELRIC standard provides that such deficiencies not be recompensed through mark-ups on their rivals' input prices.

The requirement that TELRIC be computed based upon "the most efficient telecommunications technology currently available" is squarely consistent with both the legislative mandate of the Telecommunications Act and the economic efficiency mandate of competitive markets. It is no more nor less demanding than what market forces would impose on any competitive firm. Clearly, establishing a cost standard tied to inefficient technology – even though it may be embedded – is contrary to the intent of the Telecommunications Act's goal of enabling competition. If the costs of inefficient technologies are used as the basis for establishing UNE prices, the consequence will be excessive retail rates that will result in a wealth transfer from retail customers to the ILEC's shareholders. UNE pricing based on inefficient technologies will also result in the erection of regulatory barriers to new entry, and thereby reinforce and perpetuate the monopoly position of the ILEC.

But, is "the most efficient telecommunications technology currently available" standard too demanding? Is it more demanding than the competitive market benchmark?

The answer to both questions is clearly, "no."[17] In this regard, as a long run model, TELRIC-based cost calculations appropriately consider all plant and equipment to be malleable, and are therefore constructed from the ground up. While holding ILEC performance to an efficient standard, however, the TELRIC methodology is not designed unrealistically to expect technologies or component prices that are not currently available. That is, even while allowing for the appropriate degree of long run flexibility, TELRIC methods do not rely upon hyper-efficient or unrealizable efficiencies. Rather, established TELRIC methods use actual customer locations, actual switch locations, actual switch prices, actual labor rates, actual topographical conditions, actual efficient engineering algorithms for the design of feeder and loop plant, and so on.[18] Indeed, because the simplified engineering algorithms available in TELRIC models typically do not incorporate all of the efficiencies that real world engineers (with access to more detailed data and more powerful cost-minimizing algorithms) may exploit, computed TELRICs likely exceed truly minimized costs.[19] Thus, TELRIC adheres appropriately to the competitive market requirements that relevant costs are those that are efficient and that these cost levels match those "currently available" when all plant and equipment is considered malleable (*i.e.*, the long run).

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[17] See the essay in this series by Richard Clarke, who explains that even competitive firms whose assets do not possess the latest technology are forced to depreciate those assets in order to have them reflect their current market value, which is based on the most efficient telecommunications technology currently available as used by their competitors.

[18] See the essay in this series by Mark Bryant for a description of how proxy models use such actual information to estimate costs.

[19] Because TELRIC models generally employ only currently available input prices for network equipment such as switches and fiber cables, and do not incorporate expectations for lower levels of these input prices in the future, this provides another reason why calculated UNE prices may be a conservatively high estimate of achievable minimum cost.

Although TELRIC-level costs are attainable by real world firms, ILECs argue that because their embedded networks do not actually match these efficiency levels, these levels should not form the cost basis for their UNE pricing.[20] There are numerous deficiencies with this argument. First, as noted above, TELRIC does not represent an unattainable cost level. While it may be intended to represent an efficient cost of supply, calculation restrictions such as use of pre-existing wire center locations and exchange boundaries, current (or slightly historic) prices for equipment inputs and operating expenses, less than fully optimal engineering algorithms, *etc*., all combine to keep computed TELRICs above absolute minimum levels.[21] Second, even though firms in a competitive industry with decreasing costs over time may be forced by the market to price at levels that are sometimes below their current costs, the FCC's TELRIC rules do not impose this requirement.[22] Finally, forward-looking UNE costs are not always less than historical costs.[23] When forward-looking costs exceed historical cost, TELRIC pricing rules do not require the ILEC to flow its windfall savings through to UNE prices. Rather, the CLEC is expected to pay the full forward-looking cost of the UNE –

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[20] *Kahn* (at pp. 3-16) argues that the ILECs should not have their costs built on a "blank slate."

[21] As noted previously, "This benchmark of forward-looking cost and existing network design most closely represents the incremental costs that incumbents actually expect to incur in making network elements available to new entrants." *Local Competition Order*, para. 685.

[22] The classic example of this phenomenon is the "learning curve" for high technology products. In high technology industries such as telecommunications, a new product may initially face scant demand, or be produced via a process that is expected to become far more efficient as production volumes scale up and technicians become more familiar with its intricacies. Faced with such a learning curve, it is optimal for the firm to price this product at a level less than its initial cost of manufacture. By doing so, the firm stimulates demand for the product, and by scaling up its production of the product, it "learns" how to produce the product more efficiently.

[23] For instance, this would be the case if certain UNEs are more expensive to provide on a forward-looking basis than they have been to provide in the past. Copper loops are one oft-cited example. For obvious reasons, this is not a circumstance that the ILECs have chosen to highlight.

regardless of whether these forward-looking costs exceed or fall short of historical, embedded costs. It would never be appropriate for UNE prices to contingently reflect historical cost when such costs exceed forward-looking costs, and forward-looking costs when they exceed historical. Such a policy would perversely lead either to slavish historical cost pricing, or even worse, to "heads the ILEC wins, tails the CLEC loses" hybrid pricing.[24]

Finally, while the affirmative merits of TELRIC pricing of inputs are compelling, the economic infirmities of the alternatives to TELRIC are equally compelling. A companion essay of Janusz Ordover provides a detailed critique of the various alternatives to TELRIC pricing of UNEs. He demonstrates that none of these alternatives could provide the same efficiency in entry and pricing decisions as TELRIC. And as to the charge that TELRIC-based pricing encourages competition only at the expense of fair compensation to the ILECs, this is refuted in the essay provided by William Baumol. Other more specific ILEC complaints about TELRIC (*e.g.*, that it incorporates inadequate measures of depreciation, cost of capital or fill factors, *etc*.) are not conceptual faults, but ones that are practical in nature and can readily be addressed by state public utility commissions in UNE rate-making proceedings.[25]

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[24] Indeed, it is next to impossible to compute prices that are based only on the network efficiencies that the ILEC chooses to achieve. Moral hazard and information asymmetry problems overwhelm such an option. Such calculations would be inextricably linked to the embedded costs of the sunk networks of the ILECs – and all of the perverse anticompetitive incentives that such a pricing structure would entail. See the companion essay by Janusz Ordover for further analysis explaining why such hybrid pricing concepts are undesirable and unworkable.

[25] Essays by Glenn Hubbard and William Lehr, Richard Clarke and Terry Murray address these specific issues.

5. Concluding Remarks

In sum, the FCC's TELRIC methodology which is built upon a standard of "the most efficient telecommunications technology currently available" for pricing UNEs is squarely consistent with sound principles of economic costing and pricing. Because TELRIC-determined UNE prices are intended to emulate competitive market costs and prices, and because such costs are forward-looking and long-run in nature, they must be based on the cost of an *efficient* local network. While such efficiency may be challenging for any firm to achieve, and be especially challenging for firms that have lived for the last century in a protected monopoly environment, it defines the cost level that a competitive market is expected to strive for and produce. To excuse inefficiency and allow UNE prices to exceed TELRIC is a recipe for reduced competition in local and bundled service telecommunications, higher customer prices, less innovation and less technical progress.

TELRIC-BASED PRICES ARE COMPENSATORY PAYMENTS

William J. Baumol[1]

1. Overview

A central purpose of the Telecommunications Act of 1996 is to extend effective competition to the local telecommunications arena. Under the guidance of the Federal Communications Commission (FCC), a number of steps have been undertaken to achieve this goal. One of the major obstacles previously preventing viable entry by prospective competitors was the need to enter via inefficient replication of monopoly-owned facilities that were already in place. The solution adopted was to permit prospective competitors to lease use of the incumbent local exchange carriers' (ILEC) local networks. This, of course, unavoidably gave rise to differences over the prices charged for lease of these facilities. It was essential, simultaneously, for these prices to be set at sufficiently modest levels to permit efficient entrants a viable opportunity to provide finished telecommunications services at a cost comparable to that of the rival ILEC -- but that also compensated the ILEC fully for its cost of providing these leased facilities.

Guided by these twin goals (and the conditions appropriately imposed by the Telecommunications Act), the FCC required the ILECs to lease their facilities at what it called, the "forward-looking cost" of these facilities. Furthermore, the FCC determined that this forward-looking cost should include not only the direct incremental costs, *i.e.*,

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[1] Professor of Economics, New York University and Professor of Economics, Emeritus, Princeton University.

the *added* costs, incurred by the ILEC in providing the competitor access to components of its local network facilities, but also an appropriate pro-rata share of the forward-looking joint and common costs incurred by the ILEC. This cost concept was dubbed "forward-looking economic cost" (FLEC) or, with some abuse of terminology, "total element long run incremental cost" (TELRIC).[2]

The near-monopolist ILECs continue to oppose the use of TELRIC-based pricing on the basis of a number of allegations, one of the most important being that it does not provide them with adequate compensation for the creation and utilization of their networks and may leave pertinent costs completely uncovered because it assumes hypothetically that they operate in an efficient fashion. Furthermore, the ILECs argue that TELRIC pricing constitutes a threat to their current investment returns and thus amounts to an unjustifiable "taking."

None of these contentions is valid. On the contrary, TELRIC-based pricing provides appropriate compensation that encourages economic efficiency and that values ILEC investments as would a competitive market. Thus, TELRIC yields prices similar to the efficient prices that would emerge in a fully competitive market. Such prices have repeatedly been shown to promote the public interest. And because these prices are compensatory on the standards of a competitive market, they clearly entail no "taking."

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[2] Literally, the term "TELRIC" would appear to include only the costs directly incremental to the provision of the network element and not its associated forward-looking joint and common costs. However, the term "TELRIC" has come to represent forward looking economic costs that include *both* the incremental costs *and* the joint and common costs associated with a network element and is so interpreted by the FCC. See the quotation from the FCC rules provided below.

2. For What Costs Does TELRIC Compensate?

The FCC's "TELRIC" pricing rules are explicitly designed so as to permit full recovery of *both* the long run incremental costs of providing the leased elements *plus* an appropriate share of the associated joint and common costs. Let me quote the official FCC rules regarding the pricing of network elements.

> As used in this subpart, the term "element" includes network elements, interconnection, and methods of obtaining interconnection and access to unbundled elements (47 CFR 51.501(b)).
>
> An incumbent LEC's rates for each element it offers shall be established….at the election of the state commission—(1) pursuant to the forward-looking cost based pricing methodology set forth [below] or (2) consistent with the proxy ceilings and ranges set forth [below] (47 CFR 51.503(b)).
>
> The forward-looking economic cost of an element equals the sum of: (1) The total element long-run incremental cost of the element … and (2) A reasonable allocation of the forward-looking common costs (47 CFR 51.505(a)).
>
> The total element long-run incremental cost of an element is the forward-looking cost over the long run of the total quantity of the [pertinent] facilities and functions (47 CFR 51.505(b)).
>
> Forward-looking common costs are economic costs efficiently incurred in providing a group of elements or services…that cannot be attributed directly to individual elements or services (47 CFR 51.505(c)).
>
> The sum of a reasonable allocation of forward-looking common costs and the total element long-run incremental cost of an element shall not exceed the stand-alone costs associated with the element.[3] (47 CFR 51.505(c))
>
> The sum of the allocation of forward-looking common costs for all elements and services shall equal the total forward-looking common costs, exclusive of retail costs, attributable to operating the incumbent LEC's total network, so as to provide all the elements and services offered (47 CFR 51.505(c)).

Four important points emerge from these quoted passages. The first is that charges for provision of an element to a competitor are not equal to just its incremental

[3] The stand-alone cost of an element can be shown to be the highest price for use of the element that can persist in an effectively competitive market. (Insert by the present author, language not in the FCC document).

cost. Rather, that fee will also include an amount equal to "a reasonable allocation of forward-looking common costs."

The second point is that both the incremental costs and joint and common costs are to be measured over the long run. This ensures that the costs of *all* of the ILEC's productive assets are included in the cost calculation. Under this rule no asset or expense is exempted from compensation simply because it is inherited from the past, so that its current use is considered to be "free."

The third point made by the FCC is that although lease fees will provide adequate competitive compensation, they will not be allowed to be so high as to provide a monopoly profit to the incumbent LEC.

Fourth, the FCC rules deal with the earnings that will be available for compensation of the ILEC's investors. The final paragraph cited above explicitly ensures that the fees will be compensatory and will enable the ILEC to cover all of its efficient economic costs. But do these rules merely provide for recovery of "costs" defined in a way that deprives investors of an appropriate return on their capital? The answer is clearly, "no." The FCC's rules require that "the forward-looking cost of capital shall be used in calculating the total element long-run incremental cost of an element." In other words, the pricing rules explicitly provide for a competitive-market rate of return -- which is precisely the return the ILEC would expect if it were operating efficiently in an effectively competitive market.

3. The Use of Efficient, Forward-Looking Costs

The ILECs argue that TELRIC pricing is not compensatory because the costs that they are permitted to recover are forward-looking, and do not take into account the costs that they actually incur, but rather substitute those that would be incurred if today's operations were carried out with ideal efficiency. They complain that no firm can be expected to be perfectly efficient, and that adherence to this standard prevents the ILEC from recouping any costs incurred in the past that happen to have been higher than the corresponding efficient costs in markets today. On the contrary, forward-looking pricing provides precisely the compensation that an ILEC could expect if it were operating in an effectively competitive market.

The FCC rules state:

> The total element long-run incremental cost of an element should be measured based on use of the most efficient telecommunications technology currently available and the lowest cost network configuration, given the existing location of the incumbent LEC's wire centers (47 CFR 51.505(b)(1)).
>
> The following factors shall not be considered in a calculation of the forward-looking economic cost of an element: (1) *Embedded costs*. Embedded costs are the costs that the incumbent LEC incurred in the past and that are recorded in the incumbent LEC's books of accounts (47 CFR 51.505(d)(1)).

Thus, it is indeed true that the FCC requires cost calculations to be based on the outlays that would be entailed if the technology employed were the most efficient currently available, and that it does preclude use of embedded cost figures. But this is precisely what a competitive market *always* does, and thereby meets the requirements of economic efficiency and rational promotion of the public interest.[4] This passage from the

[4] A companion essay by John Mayo addresses more completely the entirely valid logic of TELRIC's efficient network assumption.

FCC's rules also demonstrates that TELRIC entails no requirement that the ILEC location choices be perfectly efficient, and is thereby more generous to the ILEC than an ideally competitive market would be. These rules direct that costs be calculated on the basis of the ILECs' current switching locations, or nodes, whether efficient or inefficient, instead of the number and location of a perfectly optimal set of switches. In contrast, in effectively competitive markets incumbent suppliers cannot recoup any excess in costs imposed by imperfect efficiency of their facility locations, because entrants can select the locations that are now most efficient. Furthermore, TELRIC prices are only required to take into account current efficient costs – without adaptation to the prospects of even lower levels of cost that can reasonably be expected to be achieved by the ILECs via future productivity improvements.

A few examples will help illustrate the correspondence of TELRIC to competitive pricing. Suppose a firm has recently acquired a machine for $100, but before the machine has been installed, technical progress enhances machine design and so makes available a substitute machine with equal expected life and production capacity, but at a price of $75.[5] If the firm decides to resell its newly acquired and unused machine, will any buyer in a free competitive market be willing to pay the original price of $100 and enable the firm to recoup its previous outlay?[6] It is obvious that with a perfect substitute

[5] Many of us have had just such an experience in purchasing personal computers. Between the time that the order is placed and we receive delivery, the price of similar machines has dropped.

[6] For expository convenience, it is assumed here that there are no additional removal and re-installation costs incurred if the machine is redeployed.

available for $75, no buyer will be prepared to pay the original price.[7] But not only will a competitive market preclude recovery of the currently excessive original cost of the machine via resale; it also will not permit the firm to recover the original cost of the machine through the prices of the final products it is used to provide. This is because the availability of the newer and more efficient machine will enable competitors to provide the final product at prices that cover *only* the costs of this currently available, most efficient equipment. Thus, the only relevant *economic* capital costs are the forward-looking costs of such equipment -- and competitive markets permit full recovery of these costs, just as TELRIC does. Competitive forces cannot make any allowance for historical costs because no current rival will abstain from competing via a final-product price that covers only the forward-looking costs of its investment, whether or not they exceed the historical costs. In competitive markets, embedded cost is patently a piece of irrelevant ancient history. And since competitive market prices are those that are required for economic efficiency, it is clear that the public interest makes it incumbent upon the FCC to require prices to be completely independent of embedded cost and to be based instead on the costs of efficient operation.

Opponents of forward-looking pricing may allege that such competitive-market pricing must generally not be compensatory because if production technology or input prices improve in the future, this must result in unrecovered costs. This is false for several reasons. The first is that forward-looking investment decisions are based on the firm's best expectations of what prices and equipment values will prevail in the future.

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[7] Indeed, if the substitute machine is also more efficient than the old machine, the market price of the old machine may well be below $75.

Thus, if a competitive market expects these prices and values to decline, it will reflect this in its offer prices for current equipment and its depreciation charges against such equipment.[8] FCC rules require TELRIC to incorporate these considerations in their calculations in a similar fashion. Hence both competitive markets and TELRIC pricing provide for full *ex ante* compensation of investments. Of course it is always possible that previous expectations will turn out to be incorrect and for a firm to find, *ex post*, that it has incurred uncompensated costs. But this is a risk that any firm in a competitive market must face, and a risk that the Telecommunications Act requires ILECs to face.[9] Investment decisions must be made before all uncertainties can be resolved, and indeed in the real world they can never disappear. Neither competitive markets nor TELRIC can immunize an ILEC against unforeseen losses.

It is also worth noting that forward-looking prices do not always fall short of embedded costs. Indeed, forward-looking costs may often exceed embedded costs. This is readily demonstrated in competitive markets for residential housing. How many homes constructed for $20,000 a half century ago today have a market value of several hundred thousand dollars? This can occur only if current prices are guided by the forward-looking costs of new home construction. Original costs of pre-existing homes are irrelevant.[10]

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[8] A companion essay by Richard Clarke deals with TELRIC depreciation issues in more detail.

[9] *See*, 47 USC 252(d)(1)(A) and (B) on interconnection and network element charges stating that they "shall be –(i) based on the cost (determined without reference to a rate-of-return or other rate-based proceeding) of providing the interconnection or network element (whichever is applicable), and (ii) nondiscriminatory, and may include a reasonable profit."

[10] It is also worth noting that in a competitive market the current high market price of such a building will prevail even if the owner has rented it out in the past and recouped his $20,000 investment many times over.

Valuation of assets at their forward-looking costs also ensures that they are used efficiently, and are not wastefully discarded even if they remain productive. An old piece of equipment that still has some useful life would be considered too expensive by prospective buyers or users and wastefully abandoned if it were placed on the market at a price corresponding to its high embedded cost or expected to return revenues based on that embedded amount. Adjustment of the valuation of this equipment to its forward-looking cost ensures its continued, productive use.

This feature of forward-looking costs makes clear that such costs represent the "opportunity costs" of the equipment, that is, the amount they are worth in another use or in making it unnecessary to purchase new equipment as a substitute for them. And these costs are the same regardless of whether the firm disposes of the equipment by sale, or retains the equipment in production. If it does the latter, the pertinent question is how much cash does retention of the equipment force it to tie up? The answer is the same amount as its resale value.

To see this, let's look at an example that shows the opportunity costs associated with continued utilization of the equipment in production as compared to what the cash value of the equipment could earn if it were invested in, say, securities. At a current interest rate of 10%, the annual capital cost of the equipment to the firm in the previous example would be 10% of $75 or $7.50 per year. It would not entail a cost of 10% of the $100 embedded cost (or $10) because the equipment resale market will not enable that firm to recoup the $100 amount for the equipment and thereby provide it with securities that can yield $10 per year. Thus, efficiency in decision making by the firm that owns

the equipment and is considering whether or not to replace it requires the firm to consider that retention of the equipment costs it no more than a foregone interest earning of $7.50 per year, not $10.

4. Stranded Investments and Takings

Critics of TELRIC-based prices have also alleged that because TELRIC takes no account of the ILECs' historical embedded costs (and therefore fails to ensure full recovery of these costs), the imposition of this pricing constitutes an unlawful "taking" of their property. While the antecedent is certainly true, the consequent is false. All that is necessary to ensure full compensation is that rates provide the opportunity to recover costs as they would be evaluated in a competitive market.[11] This is exactly the opportunity offered by unquestionably legal competitive markets, and TELRIC need do no more and no less. Because TELRIC prices are consistent with the pricing that would automatically emerge if the pertinent markets were fully and effectively competitive, the FCC's design of these prices must be fully compensatory on a forward-looking basis.

Indeed, to equate the absence of a "taking" with the full *ex post* recovery of embedded cost (a magnitude totally irrelevant to free-market behavior) is to impugn the validity not only of competition, but also of incentive regulation structures such as "price

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[11] As the Supreme Court noted in *Verizon v. FCC*, 535 U.S. 467 (2002) at pp. 11-12, *FPC v. Hope Natural Gas Co.*, 320 U.S. 591, at 605 (1944) holds that, "Rates which enable the company to operate successfully, to maintain its financial integrity, to attract capital, and to compensate its investors for the risks assumed certainly cannot be condemned as invalid though they might produce only a meager return on the so-called 'fair value' rate base." Further, the Supreme Court in *Verizon* at note 6 also observed that *Duquesne Light Co. v. Barasch*, 488 U.S. 299 (1989) at pp. 311-12 and note 7, "provided that capital invested with prudence at the time but rendered useless by unforeseen events would not be recoverable through regulated rates, just as it would be worthless in terms of market value." ("The loss to utilities from prudent but ultimately unsuccessful investments under such a system is greater than under a pure prudent investment rule, but less than under a fair value approach.")

caps," that the ILECs have vigorously embraced over the past dozen years. Rather, as noted above, in any competitive market, the value of any plant or equipment that is the property of investors is given by the current replacement cost of that item. So long as pricing rules permit full compensation of all forward-looking costs, as the competitive market model, the price cap regulation model and the TELRIC model require, none can constitute a "taking" in any reasonable use of the term. Thus, "takings" allegations patently provide no reason to undermine the system of TELRIC-based prices that offer the best hope of making local competition viable. Moreover, the TELRIC approach offers this promise without imposing an iota of subsidy from the ILECs to their competitors.[12]

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[12]A word must also be said about the fact that the current author and others, have in principle advocated an alternative pricing approach that has been labeled "parity pricing" or pricing according to "the efficient component-pricing rule." Opponents of TELRIC-based pricing have argued that parity pricing is a better way to determine fees for access to an ILEC's network elements.

This is false. First, TELRIC-based pricing as specified by the FCC is, in fact, not inconsistent with results of a parity-pricing approach. A particular allocation of the common costs can make the two price determination methods consistent with one another. Second, and more important, as my coauthors and I have always emphasized, (*see* William J. Baumol and J. Gregory Sidak, *Toward Competition in Local Telephony*, Cambridge Mass.: MIT Press 1994 at 108) parity pricing yields efficient access prices only so long as the final-product prices, in this case the prices that the ILECs charge business firms, households and individuals for the purchase of retail telecommunications services, are set at the levels that would emerge in an effectively competitive market. If instead these prices are distorted by long regulatory practice and permit the earning of supra-competitive profits by the ILEC, then parity pricing is not appropriate in terms of the public interest. But it is clear that the prices charged by the ILECs to their final-product customers are marked by exactly the sorts of distortions just mentioned. These prices are riddled with cross-subsidies, they have little correspondence with pertinent costs or competitive-market price levels, and they may well provide returns above competitive levels. Because of these shortcomings, parity pricing provides no appropriate substitute for TELRIC in the lease pricing of local network components. See the companion essay by Janusz Ordover for further elaboration.

5. Final Comment

This essay has reviewed the substance of the FCC's TELRIC-based pricing rules. It has shown that those rules do not amount to barebones pricing that would deprive the ILECs of compensatory prices and competitive earnings. It was shown that, on the contrary, those rules very explicitly ensure that the ILECs will have the opportunity to obtain such earnings, so that the mandated TELRIC access fees must be deemed compensatory. Moreover, the use of forward-looking costs and rates of return as well as an efficiency standard is exactly what the competitive market guide for regulation and the public interest require. There is no economically viable reason for modification of this approach.

INVESTMENT IS APPROPRIATELY STIMULATED BY TELRIC

Robert D. Willig[1]

1. Introduction

In the debate over the implementation of the Telecommunications Act of 1996, incumbent local exchange carriers (ILECs) have claimed that its requirements suppress incentives for investment in network infrastructure. They argue that they are denied a compensatory ("fair") return on their investments by the requirement that they unbundle their local networks and lease use of the unbundled network elements (UNEs) at prices based on total element long-run incremental cost (TELRIC). The ILECs further argue that the mandated availability of UNEs at these regulated prices permits competitive local exchange carriers (CLECs) to "free ride" on ILEC networks and discourages CLEC investments, as well their own. Based on their claims that both CLECs' and their own investments are suppressed, the ILECs argue that policy changes should be made to remove requirements that they provide CLECs with access to TELRIC-priced UNEs.

In sharp contrast, the CLECs assert that the availability of UNEs at TELRIC based prices is necessary for competition. It is this competition that enables them to invest, and that motivates the ILECs to increase their investment in network facilities. The CLECs argue that the competition created by access to UNEs brings about lower prices, better quality and more service, and does not discourage any efficient ILEC investment. Under this view, the previous lack of competition in monopoly local

[1] Professor of Economics and Public Affairs, Princeton University.

telephone markets may have dissuaded the ILECs from making certain investments, and the competitive stimulus from CLEC entry under the 1996 Act may have encouraged greater investment by both the ILECs and the CLECs.

These two competing views may be termed the *Investment Deterrence Hypothesis* and the *Competitive Stimulus Hypothesis*, respectively. These hypotheses can be examined from both theoretical and empirical standpoints. I believe that the *Competitive Stimulus Hypothesis* stands on much firmer theoretical ground than the *Investment Deterrence Hypothesis* in this setting. Nonetheless, I recognize that amidst the contention and complex regulatory dynamics that surround local telecommunications today, the question of which hypothesis is correct should be put to a sound empirical test.

This essay concludes both that the *Investment Deterrence Hypothesis* is refuted by the empirical evidence and that the data provide reasonable support for the *Competitive Stimulus Hypothesis*. The analysis shows that there is no valid foundation for the view that investment would be enhanced by any effort to reinterpret current TELRIC rules in a manner that raises UNE prices. To the contrary, the data indicate that higher UNE prices would weaken competition and discourage investment by both ILECs and CLECs.

2. Investment Theory

The *Competitive Stimulus Hypothesis* is far more consistent with economic theory than the *Investment Deterrence Hypothesis* in the setting of local telecommunications today. The availability of UNEs facilitates entry and activity by local telephone competitors, and total industry investment expands as this competition results in lower prices, increased demand, and improved customer choice and service quality.

Indeed, without access to TELRIC-priced UNEs, CLEC investment may well be suppressed because the ILECs enjoy enormous advantages over new entrants as a result of their legacy as protected franchise monopolists that currently serve over 90% of existing demand. ILECs benefit from large economies of scale and scope and enjoy important first mover advantages relative to CLECs with respect to rights-of-way and placement of outside plant and its supporting structures. The ILECs are also protected by sunk cost entry barriers – *i.e.*, competitive facilities-based entry by CLECs would be very risky because much of the costs of local network facilities are sunk, and therefore cannot be recovered if the CLEC ultimately is unable to remain viable in its competition with the incumbents. The economies of scale and scope endemic to local telephony imply that CLEC entry with cost-efficient facilities would be likely to create excess supply and strong pressure to move prices downwards towards marginal costs and below average costs. Thus, without access to UNEs at competitive prices, it is unlikely that CLECs could overcome profitably the daunting barriers to entry, and local telephony would remain the domain of monopoly.

According to the *Investment Deterrence Hypothesis*, the availability of UNEs for lease at TELRIC-based prices discourages ILEC investment by rendering it less profitable than it would be without the unbundling mandate. In this view, unbundling rules compel the ILEC to lease portions of its local exchange network to CLECs at returns that are lower than it could earn if it used this network to provide retail services

directly to customers.[2] The combined return accruing to the ILEC from its local network investment is thereby diminished, and along with this return (it is argued) goes the ILECs' incentive to invest.

The ILECs contend that the TELRIC methodology adopted by the Federal Communications Commission (FCC) to determine the rates that CLECs pay for UNEs does not adequately compensate ILECs for their investments in assets that are long-lived and may be partially or wholly sunk.[3] Although it goes without saying that the ILECs are motivated to seek from regulation more rather than less compensation, the key issue is whether TELRIC compensation provides for efficient investment by the ILECs. By its very definition, TELRIC allows the ILECs to recover their full economic costs, including the risk-adjusted competitive rates of return on capital and forward-looking depreciation with lives that reflect both technological and economic obsolescence.[4] Thus, because TELRIC provides ILECs with the same investment incentives as are faced by participants in competitive markets, the ILECs' *Investment Deterrence Hypothesis* would appear to be either an illogical indictment of investment incentives in competitive markets generally, or just a complaint about the regulatory process constraining their pricing and profits.

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[2] The proponents of this theory are rarely clear as to whether their retail pricing benchmark is an efficient structure of regulated retail prices, or substantially higher prices that regulation has somehow allowed the ILECs to impose on their captive retail customers.

[3] Reply Affidavit of Jerry A. Hausman, In the Matter of Implementation of Local Competition Provisions in the Telecommunications Act of 1996, CC Docket No. 96-98 (filed May 30, 1996). For a critique of the foregoing, see R. Glenn Hubbard and William H. Lehr, "Capital Recovery Issues In TSLRIC Pricing: Response To Professor Jerry A. Hausman", submitted *ex parte* by AT&T to the FCC, In the Matter of Implementation of Local Competition Provisions in the Telecommunications Act of 1996, CC Docket No. 96-98 (July 18, 1996).

[4] See companion essays by William Baumol, Glenn Hubbard and William Lehr, and Richard Clarke for further elaboration of the compensatory nature of TELRIC.

There is powerful economic logic that goes the other way in showing that competition is an impetus to investment, as compared to monopoly. Consider a monopoly ILEC that does not face mandatory unbundling. Like any rational firm, the firm's investment will be governed by the perspective that the firm will install further units of capital so long as the incremental expected revenues from these units exceed the costs (inclusive of risks) of acquiring them. Because the services produced by this further capital may compete with (and bid down the price for) other services produced by the ILEC's current capital, the profitability of additional investment by the monopoly ILEC is attenuated.

Competition changes the ILEC's perspective on what is profitable. In a competitive environment, new investment by the ILEC doesn't simply have the effect of reducing the profitability of its former production. Rather, this investment may be used as a competitive weapon (*e.g.*, by producing more and higher quality service) to increase the ILEC's overall business by defending and taking market share from its competitors. Due to these potential positive effects of investment on the profitability of an ILEC exposed to competition and the heightened threat of loss of business to rivals, the ILEC (and its rival CLECs) are impelled to lower prices, produce more, innovate and invest more to accomplish these goals. The result is that incentives for investment and innovation are greater under the pressures of a competitive environment.[5]

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[5] The only set of circumstances under which this comparison might be distorted by CLECs' use of UNEs would be if CLECs' use of UNEs degraded the potential productivity of these facilities in serving the ILECs' customers. I am aware of no evidence that this is the case.

A classic illustration of these investment incentives is provided by the digital subscriber line (DSL) experience of the late 1990s. Prior to the ’90s, T1 was the only available technology for data services, and it was controlled by the ILECs. Although the ILECs developed more efficient DSL technologies in the early ‘90s, they chose not to invest and deploy these innovative technologies because this would bid down the price of their pre-existing monopoly T1 data services. With the advent of competitive cable modem technology in the late ‘90s and the ability of CLECs to use UNEs to provision their own competitive DSL services, ILEC investment in DSL technology exploded in response.

Thus far, this discussion has focused on the incentives for ILEC investment. I now turn to CLEC investment. When it is economically viable to do so, a CLEC would likely prefer to deploy its own facilities and avoid being dependent on its largest competitor for essential inputs. But because of scale economies, it is not economically practical for CLECs to replicate ILEC networks or, in many instances, even particular portions of the extant networks. UNEs, however, permit CLECs to share incumbent scale economies and provide efficient competition using shared facilities in those many instances where deploying alternative facilities is not economically feasible.

UNEs can facilitate deployment of alternative facilities by CLECs when it is potentially economic to do so. For example, UNEs allow CLECs to acquire a customer base and adequate scale to justify investment in their own facilities and, thus, may allow a CLEC dynamically to overcome sunk cost entry barriers.

Overall, the *Competitive Stimulus Hypothesis* follows naturally from basic economic theory and its understanding of competitive markets. Increased competition enabled by UNEs can be expected to result in lower retail prices both because of efficiency improvements induced by competition and because of the pressure competition places on above-cost pricing. Lower prices result in increased demand. Growing demand will induce additional facilities investment by both ILECs and CLECs. Additionally, in a competitive environment, both the incumbent and the entrant will face enhanced incentives to improve quality and innovate with respect to services, leading to further investment.

3. The Historical Record

The theory behind the *Competitive Stimulus Hypothesis* is borne out by a rigorous econometric empirical analysis of CLEC and ILEC investment behavior since the passage of the Telecommunications Act in 1996. But before describing the econometrics, it is useful to review summary data on the recent history of telecommunications investment. The attached chart shows the course of investment by ILECs in local telecommunications for the 1992-2001 period,[6] and by the CLECs over the 1996-2002 period.

[Insert Chart here]

The first point to note is that over the half decade prior to the '96 Act, investment by the monopoly ILECs was stagnant. With the advent of the Act, it accelerated markedly for

[6] Although 2002 data are also available from BellSouth, SBC and Verizon, due to accounting irregularities, Qwest has not yet filed audited financial reports with the FCC for 2002.

four years, then in 2000 began to tail off. CLEC investment followed the same pattern – dramatic growth for the first four years after the Act, then a decline.

Some analysts have looked at this history and focused on only the most recent several years. From evidence of the decline that occurred since 2000, they have concluded that CLECs' use of UNEs priced at TELRIC was the cause of this fall-off.[7] Other analysts have focused on evidence of the stagnancy of ILEC investment in the pre-competitive era and the flowering of investment immediately following the Act. They have concluded that CLEC competitive pressure affirmatively stimulated investment.[8] The later tail-off in investment is ascribed to transition towards a more sustainable long-run path, and it is observed that despite this tail-off, net telecommunications plant remains well above its levels prior to the '96 Act.[9]

4. Empirical Tests and Results

I now discuss empirical research that I have performed, along with studies performed by others, that address the issue of whether the availability of UNEs at TELRIC-based prices enhances or detracts from telecommunications investment.

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[7] See, for example, J. A. Eisenach and T. M. Leonard, *Telecom Deregulation and the Economy: The Impact of UNE-P on Jobs, Investment and Growth*, Progress & Freedom Foundation, Progress On Point, Release 10.3 (January 2003).

[8] See, for example, Phoenix Center for Advanced Legal and Economic Studies, "The Truth about Telecommunications Investment," Phoenix Center Policy Bulletin, No. 4, June 24, 2003.

[9] Nortel chief executive Frank Dunn also agrees that telecommunications capital spending rose to unsustainable levels in the late '90s. "Everybody is looking for this big capital spending to start again. Well it's not going to happen. What was spent in 1999-2000 was unaffordable. Carriers were running to some 20 to 22 percent of their revenue in capex spending. ... There is no business model that could afford that kind of spending. So we're back down to the low teens. And, historically, that's where this industry has always been. And that's where it should be." *Reuters*, "Nortel CEO Sees No Surge in Telecoms Spending," November 17, 2003.

A. My Own Analysis

As discussed above, the *Investment Deterrence* and *Competitive Stimulus Hypotheses* make different predictions regarding the effect of UNE prices on ILEC investment. In an analysis that I developed with several co-authors, we employed a state-by-state cross section of data to carry out regression analyses to test which of these two hypotheses has greater empirical support.[10] The cross-sectional variation in the terms and conditions at which UNEs are available in the different states allows us to determine the linkages among the availability of UNEs, CLEC competitive activity and ILEC investment in network infrastructure.

This analysis employed standard econometric tools that are widely accepted in the field. We used a variety of these techniques to estimate directly how ILEC network investment is positively influenced by competition from CLECs – and to measure how CLEC entry is positively influenced by the availability of UNEs. The directions and magnitudes of these impacts are estimated controlling for state-by-state variations in other supply and demand influences on CLEC activity and ILEC investment. This research design avoids the ambiguity of time series analysis of investment that is unable to control for all of the other forces likely to bear on the recent progress of local telecommunications investment.

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[10] See, "Stimulating Investment and the Telecommunications Act of 1996," by Robert D. Willig, William H. Lehr, John P. Bigelow and Stephen B. Levinson, October 2002, attached to *ex parte* letter of Joan Marsh, AT&T, to Marlene Dortch, FCC, In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers, CC Docket No. 01-338, (October 11, 2002).

As explained in greater detail in the Technical Appendix to this essay, our results unambiguously refute the *Investment Deterrence Hypothesis* and provide strong support for the *Competitive Stimulus Hypothesis.* Overall, we estimated that each 1% *reduction* in UNE rates corresponds with rigorous statistical significance to approximately a 2.1% to 2.9% *increase* in ILEC investment. Thus, raising TELRIC or restricting access to UNEs, as the ILECs advocate, would *both* reduce the competitive alternatives available to consumers *and* reduce the ILECs' capital spending on their own networks.

B. Complementary Analyses

Numerous other empirical studies have similarly concluded that the availability of UNEs at TELRIC has not impeded telecommunications investment.

One study by the Phoenix Center examined data from the Commerce Department's Bureau of Economic Analysis (BEA), and found that an additional $267 billion in telecommunications industry capital spending was generated between 1996 and 2001.[11] That is, the BEA reported total telecommunications investment of $572 billion during the period 1996-2001, compared to investment of only $305 billion that would have been expected based on historic investment levels from the fifteen years preceding the '96 Act. According to this Phoenix study:

> Plainly, investment by telecommunications firms skyrocketed after the passage of the 1996 Act. From 1980 through 1995, investment by telecommunications firms grew at an annual rate of 2.8%, with average investment level of about $38.8 billion. After the 1996 Act, investment by telecommunications firm[s] has grown at an average annual rate of 22.3%, with $95.3 billion invested annually (on average) for a total of about $572 billion during this time.

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[11] Phoenix Center for Advanced Legal and Economic Studies, "The Truth about Telecommunications Investment," Phoenix Center Policy Bulletin, No. 4, June 24, 2003.

A second Phoenix study used a model that regressed indicators of UNE competition and RBOC size on net investment by state, and demonstrated that the RBOCs invested more heavily in their networks in states where the competition they faced was most intense.[12] This study found that net investment by BellSouth, SBC and Verizon increased on average by $759 for every UNE-P access line leased by a CLEC. The study further concluded:

> . . . UNE-P competition is shown to positively affect BOC net investment. So, while BOC net investment may be down relative to previous years due to economic conditions and other factors, *UNE-P itself exerts a positive influence on investment.* Thus, it appears that factors other than UNE-P are fully responsible for the lower investment levels by the BOCs in 2002. In fact, UNE-P competition is shown to offset investment reductions in 2002 by about 50%.[13]

The empirical model estimated in this Phoenix study provoked a debate among several economic analysts.[14] The Phoenix Center responded to these criticisms by observing:

> 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. Second, they recommend letting the cost of capital vary by Bell Company. Third, they propose estimating the models using weighted least squares where all variables are weighted by (the inverse of) access lines. Many of our new empirical models incorporate these suggestions, and in some cases adopt more dynamic specifications than proposed by HHB. In every

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[12] Phoenix Center for Advanced Legal and Economic Studies, "Competition and Bell Company Investment in Telecommunications Plant: The Effects of UNE-P," Phoenix Center Policy Bulletin, No. 5, July 9, 2003, updated September 17, 2003. The study is based on 2002 data filed by BellSouth, SBC and Verizon with the FCC. Qwest had not yet filed its 2002 financial data at the time of the study.

[13] *Ibid.* at p. 14.

[14] See, 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 September 2, 2003); and 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).

> instance, these changes *affirm and, in many cases, strengthen* the conclusion that Bell Company investment is positively related to UNE-P competition.[15]

Another study has examined the state-by-state leased element purchases by a major CLEC, AT&T, and compares the level of these purchases with the extent to which AT&T has deployed its own local network facilities in that state.[16] This analysis finds that no matter what measure of AT&T investment deployment is used (*i.e.*, number of local switches, number of switch terminations or route miles of local fiber), there is a significant positive relationship between AT&T's use of leased network elements and its investment in its own local network facilities.

Finally, empirical findings that competitive access to network elements stimulates rather than deters investment are not unique to just the U.S. experience with unbundling. The Organization for Economic Cooperation and Development (OECD) has found that in the thirty developed countries that constitute its membership, "the evidence indicates that opening access networks, and network elements, to competitive forces increases investment and the pace of development."[17] The OECD also notes that, "to date the major criticisms of unbundling or line sharing are that such policies allegedly discourage investment in new infrastructure. No evidence has been forwarded to substantiate this claim."[18]

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[15] Phoenix Center for Advanced Legal and Economic Studies, "UNE-P Drives Bell Investment: A Synthesis Model," Phoenix Center Policy Bulletin, No. 6, September 17, 2003, p. 4.

[16] Declaration of Richard N. Clarke, attached to Reply Comments of AT&T Corp., In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers, CC Docket No. 01-338, (filed July 17, 2002).

[17] Organization for Economic Cooperation and Development, *The Development of Broadband Access in OECD Countries*, October 29, 2001, p. 4. ("*OECD Report*").

[18] *OECD Report*, p. 15.

C. Dissenting Analyses

John Haring *et al.* purport to explain the relationship between ILEC investment and UNE pricing by regressing RBOC net plant in a state on the number of RBOC loops, the number of unemployed persons in the state, real gross state product, and the product of the number of RBOC loops and the UNE loop price for zone 1.[19] This relationship has neither any basis nor any meaningful interpretation in economic theory. In fact, Haring, *et al*. have effectively performed the equivalent of a regression tautology. These authors use RBOC net plant in a state as the dependent variable, but then employ an equation where that dependent variable is a function of loops. They then examine whether total net plant is larger when the aggregate value of loops is larger (assuming loops are valued at the zone 1 UNE loop price). Not surprisingly, they find that this is the case. This analysis is flawed because loops constitute a significant portion of net plant, so the result will likely be a positive relationship as a matter of arithmetic rather than as a policy-relevant causal relationship. Further, use of net plant as the dependent variable is flawed because the relevant issue is how the availability of UNEs affects *investment*. Investment is the *change* in net plant rather than the simple level of net plant.

Another flawed study was prepared directly by BellSouth, SBC and Verizon to examine the relationship between total ILEC investment per line and CLEC UNE-P lines

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[19] John Haring, Margaret L. Rettle, Jeffrey H. Rohlfs, and Harry M. Shooshan III of Strategic Policy Research, "UNE Prices and Telecommunications Investment," attached to the Reply Comments of Qwest, In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers, CC Docket No. 01-338, (July 17, 2002).

per 1000 RBOC access lines.[20] The authors' chief result is their finding that RBOC investment per line does not increase when the number of CLEC UNE-P lines increases. They conclude from this that there is no relationship between UNE unbundling and ILEC investment. This conclusion, however, is not supported by the regressions estimated in the report. First, it appears that the authors make the same mistake as Haring, *et al.*, in that they conflate the *stock* of capital per line with investment (which is the *change* in the stock of capital per line). Second, the RBOC authors fail to control for other significant factors that could reasonably influence the relationship between ILEC capital per line and the proportion of lines served by CLECs using UNE-P. Such factors include demand conditions, the cost of telecommunications infrastructure or the effects of regulation. As a matter of basic econometrics, the omission of such highly relevant variables means that the estimates obtained are likely biased and unreliable. Third, the data relied upon for this analysis are incomplete and severely flawed.[21]

5. Conclusions

The results of the empirical analyses reported here should come as welcome news for regulators and policymakers. Had the *Investment Deterrence Hypothesis* found valid empirical support, policymakers and regulators would face an uncomfortable trade-off between the pro-competitive dictates of the Telecommunications Act and the growth-promoting effects of investment. Fortunately, the empirical evidence we have studied

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[20] "UNE-P and Investment," Prepared for and Submitted by BellSouth, SBC, and Verizon, In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers, CC Docket No. 01-338, (July 17, 2002).

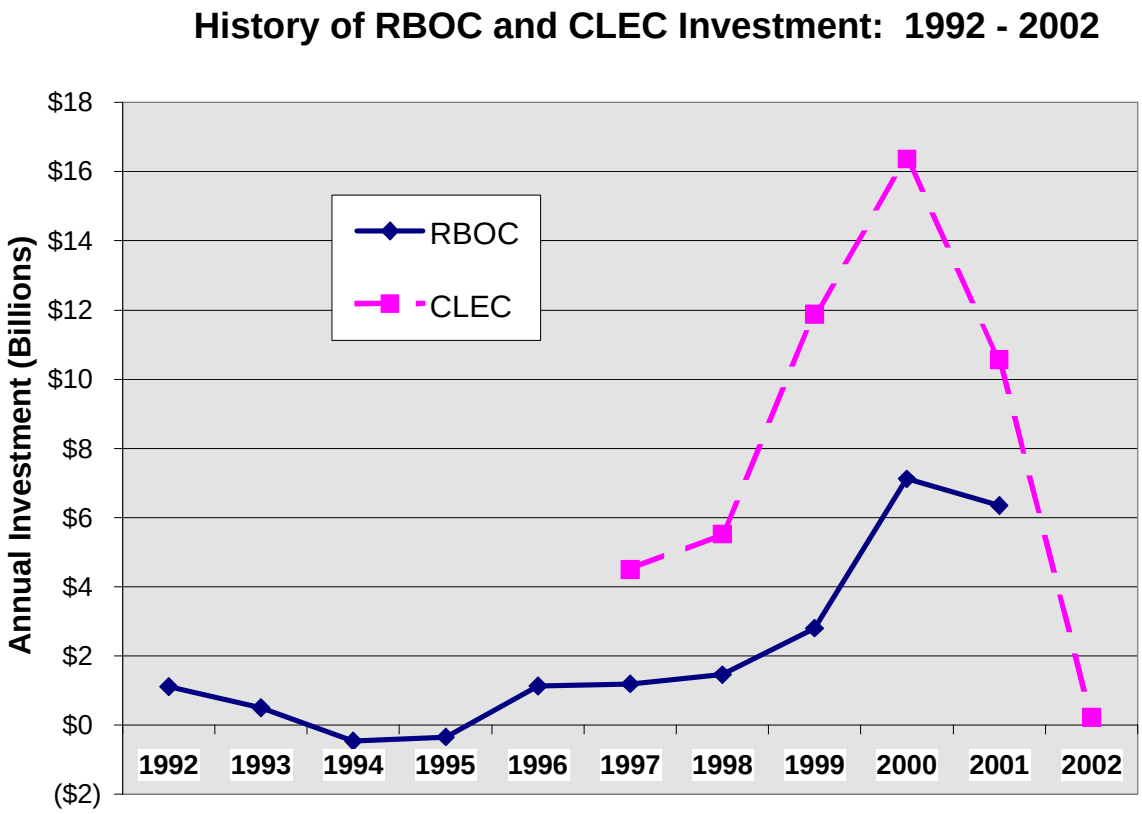
[21] *See*, C. Michael Pfau, "Correcting the RBOCs' Empirical Analyses of the Linkage Between UNE-P and Investment," *ex parte* letter from Joan Marsh, AT&T to Ms. Marlene Dortch, Secretary, FCC in CC Docket No. 01-338, filed October 16, 2002.

supports the *Competitive Stimulus Hypothesis* that the efficiency-enhancing effects of competition also promote investment. Therefore, no such trade-off is necessary. Regulatory policies that support access to unbundled network elements encourage both competition and investment.

Regulators may take further comfort that this empirical conclusion is also consistent with sound economic theory. As a general matter in economics, competitive markets produce greater output, which leads to greater investment, at lower prices than their monopolistic counterparts. So, policy mechanisms like the provision of UNEs at TELRIC-based prices, which encourage competition, should also encourage investment. This mechanism forms the basis for recent work by Kotlikoff and Hassett in which they analyze a dynamic and strategic model of entry and competition in telecommunications-related markets.[22] They find, among other things, that telecommunications competition stimulates investment, a conclusion that is consistent with our finding of empirical support for the *Competitive Stimulus Hypothesis*. The significance they attach to that finding for future economic growth is consistent with our finding that the elasticity of ILEC investment with respect to UNE prices is such that a 1% reduction in UNE prices may be expected to lead to an increase in ILEC investment of between 2.1 and 2.9%.

[22] Kevin A. Hassett and Laurence J. Kotlikoff, "The Economics of Telecom Investment," mimeo (September 2002).

Chart



Data sources:

- RBOC investment data is year over year change in net plant from RBOC ARMIS reports to the FCC.
- CLEC data are cumulative capital expenditures from 2003 Association for Local Telecommunications (ALTS) Report, reduced by 10% annual depreciation.

Technical Appendix

Overview of Our Empirical Analysis

The empirical analysis in my work with Lehr, Bigelow and Levinson proceeded in two stages. First, to distinguish between the competing predictions made by the two hypotheses, we conducted an analysis of the "reduced-form" relationship between ILEC investment and UNE prices. To the extent that this relationship is positive, *i.e.* if higher UNE prices are associated with greater ILEC investment, the *Investment Deterrence Hypothesis* is supported. To the extent that this relationship is negative, *i.e.*, if lower UNE prices are associated with greater ILEC investment, the *Competitive Stimulus Hypothesis* is supported. Second, to examine more rigorously the linkages suggested by the *Competitive Stimulus Hypothesis* among UNE prices, CLEC participation in local telephone markets and ILEC investment, we conducted a further set of "structural form" regressions.

Specification of the Reduced-Form Regression

The first analysis we performed of the relationship between UNE prices and ILEC investment is based on a reduced-form specification of the determinants of ILEC investment. A reduced-form specification is one that is derived from a more complex set of simultaneously interacting relationships. In a reduced-form specification, interactions between variables that exert mutual effects on one another are pushed into the background and the relationship to be estimated is a straightforward one between predetermined independent (or "exogenous") variables and a single dependent (or

"endogenous") variable. By contrast, structural-form relationships embody the interactions between endogenous and exogenous variables explicitly, have meaningful behavioral interpretations, and generally must be viewed as a system of relationships. Their interaction, however, is more complex. Reduced-form relationships are simpler because a variety of behavioral relationships have been subsumed into them.[23]

In the analysis developed in the paper, the reduced-form relationship is between ILEC investment as the dependent variable, and a group of exogenous variables that influence ILEC investment either directly or indirectly through their effects on CLEC activity. The reduced-form relationship takes the form:

$$\begin{pmatrix} ILEC \\ Investment \end{pmatrix} = R\begin{pmatrix} Demand \\ Factors \end{pmatrix}, \begin{pmatrix} Current \\ Revenue \end{pmatrix}, \begin{pmatrix} ILEC\ Cost\ of \\ Investment \end{pmatrix}, \begin{pmatrix} CLEC\ Cost\ of \\ Participation \end{pmatrix}, \begin{pmatrix} Regulatory \\ Regime \end{pmatrix}.$$

The Demand Factors, ILEC Cost of Investment, and Regulatory Regime variables are included to control for the effects of other factors on ILEC investment decisions –

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[23] For example, in the standard economic model of a competitive market, the quantity demanded of a good is determined by its price, the levels and distribution of income of its consumers, the prices of substitute and complementary goods, and parameters that reflect tastes. Likewise, the quantity supplied of a good is determined by its price, the prices of goods and services used to produce the good, and parameters describing the technology for producing the good. In the marketplace, the price of the good is determined by simultaneous operation of the demand relationship, the supply relationship, and the equilibrium condition that the quantity demanded should be equal to the quantity supplied. In this model the demand relationship and the supply relationship interact simultaneously to determine two variables, *i.e.*, the quantity of the good changing hands in the market and the market price. The values of these two "endogenous" variables are simultaneously determined by the demand and supply relationships and the values of the predetermined or exogenous variables such as income, prices of substitutes and complements, taste parameters, prices of factors of production, and technology parameters. If one knew the demand and supply relationships, one could use them to calculate the market equilibrium price as a function of the exogenous variables. The resulting relationship is called a "reduced form," because the simultaneous interaction of multiple relationships and variables has been reduced to a single relationship between the endogenous dependent variable and the exogenous independent variables.

that is, factors not associated with UNE-based unbundling requirements. Demand factors and the level of current revenue (an indication of current market prices) are included because they may be expected to influence ILEC investment directly, inasmuch as increased demand or higher prices should be expected to encourage investment, and indirectly, because they may have the same effect on CLEC activity. The cost to an ILEC of its own investment should certainly influence the level of ILEC investment. Variables relevant to describing the nature of the regulatory regime are also included because the character of regulation may be expected to have an effect on ILEC investment.

The CLEC Cost-of-Participation variable is the variable whose coefficient provides the basis for distinguishing between the two competing hypotheses. According to the *Investment Deterrence Hypothesis*, increases in UNE prices, which increase the cost of CLEC participation via UNEs, should increase ILEC investment. That is, higher UNE prices render UNE-based entry less economically viable for CLECs, thereby alleviating the risk of alleged "free-riding" by CLECs. According to the *Investment Deterrence Hypothesis*, this should increase the ILEC's incentive to invest. In contrast, the *Competitive Stimulus Hypothesis* predicts that higher UNE prices will reduce ILEC investment because less economically-viable network element unbundling reduces CLEC competitive activity and the spur that such activity would otherwise provide for ILEC investment.

Thus, empirically one may distinguish between these two hypotheses by examining the sign and the level of statistical significance of the estimated coefficient on the CLEC Cost-of-Participation variable.

Specification of the Structural-Form Regressions

In order to test directly the *Competitive Stimulus Hypothesis*, we used a structural approach. The *Competitive Stimulus Hypothesis* does not merely predict the negative relationship between UNE pricing and ILEC investment confirmed in the previous section. That prediction is based on further empirically testable predictions that the level of CLEC competition will be negatively related to UNE pricing and that the level of ILEC investment will be positively related to the level of CLEC competitive activity. Thus, according to the full economic structure of the *Competitive Stimulus Hypothesis*, it is the combination of these two effects that gives rise to the overall negative relationship observed between ILEC investment and UNE pricing.

In order to investigate empirically these two effects, we employ a specification that looks beyond the summary relationships embodied in the reduced-form. This specification involves a system of two equations. The first,

$$\begin{pmatrix} ILEC \\ Investment \end{pmatrix} = f\begin{pmatrix} Demand \\ Factors \end{pmatrix}, \begin{pmatrix} Current \\ Revenue \end{pmatrix}, \begin{pmatrix} ILEC\ Cost\ of \\ Investment \end{pmatrix}, \begin{pmatrix} Regulatory \\ Regime \end{pmatrix}, \begin{pmatrix} CLEC \\ Activity \end{pmatrix},$$

posits that ILEC investment is a function of demand factors, current revenue, the cost of investment to ILEC firms, the form of the regulatory regime, and the level of competitive activity by CLEC firms. This equation reflects the direct determinants of the ILECs' behavior.

The second equation reflects the determinants of the behavior of CLECs. It takes the form:

$$\begin{pmatrix} CLEC \\ Activity \end{pmatrix} = g\begin{pmatrix} Demand \\ Factors \end{pmatrix}, \begin{pmatrix} Current \\ Revenue \end{pmatrix}, \begin{pmatrix} CLEC\ Cost\ of \\ Participat\ ion \end{pmatrix}.$$

In this equation the cost of participation to a CLEC is measured by the UNE prices.

Taken together, these two equations form a system that determines two endogenous variables, ILEC investment and CLEC activity, as functions of the exogenous variables. In this system, support for the *Competitive Stimulus Hypothesis* would take the form of a finding that CLEC Cost-of-Participation is negatively related to CLEC activity in the second equation and that the level of ILEC investment is positively related to the level of CLEC activity in the first equation.

Results

We found statistical evidence that the relationship between UNE pricing and ILEC investment is negative and, therefore, that the empirical evidence refutes the *Investment Deterrence Hypothesis* and is consistent with the *Competitive Stimulus Hypothesis*. Our reduced-form regressions are statistically significant and explain a large share of the variation in the dependent variable, ILEC investment. Moreover, the estimated effects of various other independent control variables include statistically significant estimates that are consistent with the underlying economic theory.

Having found confirmation of the *Competitive Stimulus Hypothesis'* prediction in the first stage, we also tested directly the mechanism of *the Competitive Stimulus Hypothesis* using "structural-form" relationships. According to the *Competitive Stimulus*

Hypothesis, lower UNE prices lead to greater CLEC activity, and greater CLEC activity leads to greater ILEC investment. We therefore estimate the effect of UNE prices on CLEC activity and the effect of CLEC activity on ILEC investment. Again, we found a negative relationship between UNE prices and CLEC activity, *i.e.*, that higher UNE prices lead to less CLEC activity, and a positive relationship between CLEC activity and ILEC investment, *i.e.*, that greater CLEC activity leads to greater ILEC investment. Notably, these results are obtained from regressions that are themselves statistically significant, explain a high share of the variation in the dependent variable and produce estimates consistent with economic theory.[24]

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[24] An earlier version of the analysis described above (which was based on a less complete data set) was included in a filing to the FCC in the *Declaration of Robert D. Willig on Behalf of AT&T*, In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers, CC Docket No. 01-338, (April 5, 2002).

The principal challenge made to that earlier analysis was that it relied on UNE-P rates from June 2002 to explain CLEC activity and ILEC investment from earlier periods. The results we report in this analysis were obtained using UNE price data from a variety of sources compiled at various times between 1996 and 2002. Our data include UNE-P rates compiled by AT&T in 2002 as well as Regulatory Research Associates *TeleFOCUS* estimates from August 2000; the National Regulatory Research Institute's estimates from Spring 2001 and July 2002; and the loop proxy rates established by the FCC in its August 1996 *First Report and Order* in CC Docket No. 96-98. We have continued to find empirical support for the *Competitive Stimulus Hypothesis* and support adequate to reject the *Investment Deterrence Hypothesis* using UNE price data from as early as 1996 as well as with data from 2002. Thus, our conclusions are not dependent on the time at which the UNE-P rates were compiled.

TELRIC AND THE COST OF CAPITAL

R. Glenn Hubbard[1]
and
William H. Lehr[2]

1. Introduction

This essay explains the correct method for estimating the cost of capital component of the total element long-run incremental cost (TELRIC) for unbundled network elements (UNEs). Under the Telecommunications Act of 1996, incumbent local exchange carriers (ILECs) are required to lease UNEs to Competitive Local Exchange Carriers (CLECs) at non-discriminatory, cost-based rates. To assure that ILECs are fairly compensated and that both ILECs and CLECs face efficient incentives to invest in new infrastructure, UNEs should be priced at their economic cost, as measured by per unit TELRIC. When set at this level, UNE rates mimic the prices that would prevail if competitive alternative sources for UNEs were already available.

In this essay, we explain why the standard approaches used by financial analysts to estimate the cost of capital are consistent with TELRIC principles. Properly applied, the standard techniques of the Capital Asset Pricing Model (CAPM) and Discounted Cash Flow (DCF) modeling produce reliable estimates of the cost of capital. These same techniques are used by financial analysts to value firms and investments in all sectors of

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[1] Russell L. Carson Professor of Finance and Economics, Columbia University and National Bureau of Economic Research.

[2] Research Associate, Massachusetts Institute of Technology.

the economy.[3] Because of the fungibility of financial resources and robust competition among investors, the prices for publicly traded debt and equity already reflect all available information and provide the best indicator of investor expectations and valuation of risk. This is what it means to say that financial markets are "efficient."

Estimates of the cost of capital developed through proper application of the CAPM and DCF models determine appropriate compensation to investors for committing their funds to the business of providing UNEs. There is no need to augment these estimates with additional *ad hoc* premiums in order to compensate incumbent carriers for risks from future competition or because investments in telecommunications infrastructure may be long-lived, subject to certain uncertainties or may be substantially sunk. Market prices for the financial securities of telecommunication firms already reflect a synthesis of informed analysts' assessments of the valuation implications of these effects. These market price data provide the most reliable source of objective estimates of ILEC costs of capital. Additional premiums would be duplicative and would result in TELRIC estimates that exceed economic costs, which would result in UNE rates that are inefficiently high.

In this essay, we explain the purposes of developing cost of capital estimates; how traditional CAPM and DCF approaches ought to be applied to be consistent with

[3] In addition to the DCF and CAPM methodologies, there are several other methodologies that also may be used to estimate costs of capital. These include "comparable earnings," "risk premium" and "market-to-book" methodologies, among others. In general, these methodologies are less sophisticated than the DCF and CAPM methodologies that are the principal choices of financial analysts.

TELRIC principles; and refute several misguided arguments suggesting that traditional approaches may understate the cost of capital applicable to UNEs.

2. Purposes of Developing Cost of Capital Estimates

Along with operating and depreciation expense, the cost of capital is one of the three components that comprise TELRIC. The cost of capital "reflects the rate of return that investors expect to receive from alternative investments that have the same risk."[4] Thus, the cost of capital represents the "price" for financial resources that are used by the firm to provide UNEs. It is what the firm must pay investors to attract the financial resources needed to fund business investment and operations. It is usually expressed as an annual percentage return per dollar of investment that investors expect to earn in order to compensate them for the use of their funds.

Alternatively, the cost of capital may be considered to be the "required rate of return" or "discount rate" at which the present value of the expected future cash flows from an investment exactly equals the cost of undertaking the investment.

As noted earlier, financial markets are extremely competitive and investors face many alternatives for committing their money. Instead of investing their funds in a local telephone business, an investor could invest those funds in a portfolio of publicly traded debt and equity that has an equivalent risk profile. The market price of such a portfolio establishes the opportunity cost for funds, or the relevant cost of capital. Indeed, the

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[4] *See* Federal Communications Commission, *Report and Order and Order on Remand in CC Docket No. 01-338*, 2003 WL 22175730 (F.C.C.), ¶ 671, released August 21, 2003, (*"Triennial Review Order"*).

value of a business may be computed as the sum of the market value of the firm's debt and equity.

Conceptually, the cost of capital may be divided into two components: first, investors must be compensated for the time-value of money; second, investors must be compensated for bearing risk. The time-value of money reflects the rate of return that an investor would earn if the funds were committed to a riskless asset (*i.e.*, an asset with zero default risk). It reflects the compensation investors demand in order to induce them to defer present consumption and to protect them from expected inflation. The expected riskless rate of return fluctuates with the supply and demand for funds, rising when funds are relatively scarce and falling when funds are relatively plentiful, and therefore, fluctuates over time in response to changes in the overall economy.[5] The time-value demanded also varies with the duration for which the funds are committed.

The second component of the cost of capital compensates investors for bearing risk, or the chance that the return they actually earn may differ from the return they expected. The riskier the investment, the higher the risk premium demanded by investors. Because different projects or investments may have different risk profiles, the cost of capital will vary depending on the project being evaluated. This means that the cost of capital relevant for evaluating a particular investment ought to be based on investments of equivalent risk.[6]

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[5] Because the returns for assets that are free from default risk still may fluctuate over time, these assets are not completely "riskless," but include "maturity" or "interest rate" risk.

[6] Conceptually, the risk premium may be further subdivided into systematic and unsystematic risk. The systematic risk is associated with fluctuations in financial markets, whereas the

Appropriate estimates of the cost of capital must be forward-looking. Investors do not care about what happened yesterday, only about what they expect to earn over the future useful life of an investment. The historical costs incurred by a firm in developing its infrastructure and business are irrelevant. Of course, this forward-looking perspective is also required by TELRIC and is consistent with using financial market data to estimate the cost of capital.

Because a firm typically owns a collection of investments with different risk profiles, the firm's overall cost of capital may differ from the cost of capital that is appropriate for a particular investment. Thus, the cost of capital used to provide particular UNEs may differ from an efficient ILEC's overall cost of capital, or from the cost of capital for other UNEs. For example, ILEC holding companies engage in a wide range of businesses, a number of which may be riskier than providing UNEs over local telephone networks. But the data necessary to discern individual costs of capital for specific UNEs may not be available because companies generally do not issue separate securities for each of their particular lines of business. For this reason, cost of capital estimates based upon the debt and equity of ILEC holding companies may overstate the cost of capital associated with their UNE business.

3. Estimating the Cost of Capital

Estimating the cost of capital can be broken down into four steps: (1) estimate the cost of equity (k_e); (2) estimate the cost of debt (k_d); (3) estimate the relative shares of debt (x) and equity (1−x) in the firm's capital structure; and then, (4) calculate the cost of

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unsystematic risk is associated with factors that are unique to the firm or investment. By diversifying her portfolio, an investor can eliminate much if not all of the unsystematic risk.

capital as the weighted average of the debt and equity costs.[7] This is formally referred to as the weighted average cost of capital (WACC).

$$WACC = (1-x)k_e + xk_d$$

To estimate values for each of these parameters, we should use market data from financial securities reflecting a similar risk profile as that faced by providers of UNEs. The basic methods for this estimation are the same whether the industry is automobiles, cereal, or telecommunications. Because even good analysts may differ in their choices of what comparables to use, the time period over which data ought to be analyzed, and which securities ought to be evaluated, estimates of the cost of capital may vary. Hence, analysts and regulators commonly may develop a range of estimates for the cost of capital.[8] If a point estimate is required, the median of this range is usually selected.

Teaching these standard estimation methodologies is a staple of financial economics, and there are numerous finance and investment textbooks that explain these methods in detail.[9] In the following sections, we provide only a brief summary of the tasks involved – with a focus on the issues that are most relevant for TELRIC.

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[7] If the firm's capital structure also includes other sources of capital such as preferred stock or short-term debt, then these components would also be included in the weighted average. For clarity of presentation, we do not incorporate them in the above equation.

[8] Because inflation risk is one of the risks that investors must be compensated for, the cost of capital is usually provided in nominal terms.

[9] *See, e.g.*, Aswath Damodaran, *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset*, 2nd ed., John Wiley & Sons, 2002; Richard Brealey and Stewart Myers, *Principles of Corporate Finance*, 5th ed., McGraw-Hill: New York, 1996; William Sharpe, Gordon Alexander, and Jeffrey Bailey, *Investments*, 5th ed, Prentice Hall: Englewood Cliffs, NJ, 1995; A. Lawrence Kolbe, James A. Read, and George R. Hall, *The Cost of Capital: Estimating the Rate of Return for Public Utilities*, MIT Press: Cambridge, MA, 1986.

A. Estimating the Cost of Debt

One can compute a firm's forward-looking cost of debt by measuring the yields to maturity on its outstanding bonds. A bond's yield to maturity is the interest rate that the borrower (the firm) would be required to pay if the bonds were issued today. As such, the yield to maturity incorporates bond investors' expectations about future returns on the bonds and represents the forward-looking cost of debt.[10] ILEC debt is publicly traded and price data indicating the yield to maturity for these bonds are available in the financial press.[11]

A firm may rely on a mixture of debt instruments with different maturities. It is possible to collect forward-looking rates for each of these, with appropriate weights in the WACC computation, or alternatively, to compute a weighted-average cost of debt that blends the rates for short-term and longer-term debt instruments.

Current prices for ILEC securities already reflect analysts' expectations of the impact of future competition. And, because the industry is in transition, it is likely that the current spread in telephone company debt relative to riskless debt for shorter maturities likely overstates the premiums that will be required in the long-run, once the competitive equilibrium is obtained. Thus, market price data for the debt securities

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[10] This interpretation of yield to maturity abstracts slightly from potential tax effects.

[11] Current market valuations may not be available for some ILEC debt that is not frequently traded.

issued by the ILECs provide the closest match to prices for corporate debt with the risk profile associated with the business of providing UNEs.[12]

B. Estimating the Cost of Equity

There are two methods commonly used to estimate the cost of equity. These are Discounted Cash Flow and the Capital Asset Pricing Model. Typically, an analyst will use both methods to estimate a range for the cost of equity, if the appropriate data are available.

Discounted Cash Flow Method The DCF approach uses market price and earnings data for the equities from a group of companies with similar risk characteristics and net cash flow forecasts to compute the cost of capital for the company in question. The basic approach resembles a present value calculation in which one knows both the cash flows (*i.e.*, projected earnings or dividends) and the present value (share price) of an equity, and uses this information to compute the discount rate or cost of capital associated with that equity. While the equity's current price and cash flow are well-known, the challenge lies in forecasting accurately the stream of future cash flows that the equity will return over time.

In the simplest version of the DCF model, current cash flows or earnings are projected to grow at a constant rate. This forecast of earnings growth may be derived from historical earnings growth or from publicly-available analyst forecasts for earnings

[12] This is preferable to using one of the indices that are publicly reported for portfolios of corporate bonds with similar risk ratings as for the debt issued by an ILEC. Bond ratings only provide a relatively coarse metric of investors' risk valuation, and these indices include companies that operate in industries with very different economics than the local telephone business. The typical corporation included in a market bond index will face a different profile for capital intensity, technical and market uncertainty, and regulatory oversight.

growth over the next five years.[13] Generally, it is preferable to use the analyst forecasts because they are forward-looking.

However, this approach must be applied with care. What analysts forecast for the next five years may not represent accurately expectations for growth in later periods. In addition, any constant growth rate is likely to lead to nonsensical projections. Unless by pure chance this forecasted constant growth rate coincides exactly with the expected long-run growth rate for the overall economy, either the firm's earnings will vanish completely as a component of the economy, or they will eventually grow to outstrip the entire output of the economy. Therefore, rather than assuming an indefinite constant growth rate, analysts typically assume a multistage growth model which uses analyst forecasts for the particular firm's earnings growth over an initial period (*e.g.*, five years), a consensus forecast of long-term economy-wide growth for years far out (*e.g.*, years 15 and beyond),[14] and a gradual transition between these two growth rates during the intervening years (*e.g.*, years 6 through 14).

One challenge in applying the DCF model is identifying a set of "comparable" equity securities that have similar risk/return characteristics to those anticipated for the target investment or firm. In some cases, this may not be possible. But such comparables are readily available for UNE investments because the ILECs have been in the UNE business for several years. Note that even though the ILECs currently are

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[13] For example, Thomson Financial publishes a database of median analyst earnings growth forecasts as part of its First Call subscription database service (these forecasts were formerly available from the Institutional Brokers' Estimate System, or I/B/E/S).

[14] For example, the Federal Reserve Bank of Philadelphia publishes a *Survey of Professional Forecasters* that includes a consensus forecast for long-run economic growth.

providing these services in a monopoly environment, their equity prices already incorporate investors' expectations regarding the impact on ILEC earnings from future facilities-based competition.[15] The simple average of the discount rates calculated over the set of comparable companies provides the DCF-estimate of the forward-looking cost of equity.

Capital Asset Pricing Model The second method commonly used to estimate the cost of equity is the CAPM. This model is derived from modern portfolio theory, which establishes appropriate relationships between expected returns and risk. In essence, the CAPM attempts to estimate the risk premium demanded by investors in a particular company's equity over the return offered by risk-free securities (e.g., U.S. government securities).[16] In algebraic form, the CAPM asserts that:

$$\begin{array}{c}\text{Cost of equity for the}\\ \text{particular company}\end{array} = \begin{array}{c}\text{Risk-free}\\ \text{return}\end{array} + \begin{array}{c}\text{Risk premium for the}\\ \text{particular company,}\end{array}$$

where the:

$$\text{Risk premium for the company} = \text{Company beta} \times \text{Market risk premium.}$$

To apply the CAPM methodology to estimate the cost of equity, one must first calculate both the "beta" for the company and the overall market risk premium. A company's beta is estimated from market data relating the company's return to the return

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[15] Note, however, that because facilities-based competition in the provision of local UNEs is never likely to be as competitive as long distance or cellular (five or six similarly sized facilities networks each with substantial excess capacity), use of the ILEC holding companies as comparables is likely to generate estimates of equity costs that overstate the equity costs of providing just UNEs. This is because the ILEC holding companies offer long distance and cellular service in addition to local UNEs and the risk associated with UNE provision should continue to be less than the holding company's average risk.

[16] As noted earlier, the term "risk-free" as used here means free only from default risk. It will still include market risks of interest rate fluctuations, *etc.*

on a market-basket index (*e.g.,* the S&P 500 index or the Value Line NYSE composite index). Publicly available estimates of company betas are provided by several investment companies.[17] To smooth out possible inaccuracies in the calculation of any single company's beta, it is common to use an average of the betas for a group of comparable companies.[18] Once again, the most appropriate group of comparable companies for the UNE business is publicly-traded ILECs that provide UNEs.[19]

In addition to the beta term in the CAPM, it is necessary to include an estimate of the market risk premium relative to the risk-free return. Returns on U.S. Treasury debt securities are generally used to provide this benchmark for risk-free returns.

Because estimation of both the company betas and the market risk premium depend on historical data, the CAPM model implicitly assumes that fundamental risk/return relationships have not changed over time. This assumption likely produces overstated cost of capital estimates. Recent scholarship suggests that the market risk premium has been declining over the past fifty years.[20] Hence, market risk premium

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[17] Value Line and BARRA both publish estimates of company betas.

[18] Because capital structure (*i.e.,* mix of debt and equity) affects the tax liability of a company and the total risk borne by its equity holders, it is necessary to first adjust the betas to control for differences in capital structure. This is accomplished by "unleveraging" the company betas to compute pure equity betas that can then be averaged and re-levered using the subject company's actual capital structure.

[19] As with the market prices of publicly-traded debt and equity securities incorporated in DCF analyses, CAPM parameters such as betas reflect investor expectations of the full impact of expected future competition on the cost of equity associated with ILEC comparables. But because these betas are developed at a holding company level, their use should provide conservatively high estimates of the CAPM cost of equity associated with the provision of UNEs.

[20] *See, e.g.*, Eugene Fama and Kenneth French, 2002, "The Equity Premium," *Journal of Finance* 57(2), 637-59; or, James Claus and Jacob Thomas, 2001, "Equity Premia as Low as Three Percent? Evidence from Analysts' Earnings Forecasts for Domestic and International Stock Markets," *Journal of Finance* 56(5), 1629-1666.

estimates derived from a long time series (*e.g.*, data from 1926-2003, or longer) may overstate forward-looking market risk premiums, which would tend to overstate costs of capital calculated using the CAPM.

C. Estimating the Optimal Capital Structure

To complete the estimation of the cost of capital, one must determine the forward-looking capital structure for the company. This is expressed as a forecast of weights representing the share of total financing for the company that will be provided as debt and as equity. Because debt has a prior claim on a company's cash flow, returns to debt generally are lower than returns to equity. Therefore, assuming a higher share of debt financing (or leverage) will result in a lower estimate of the WACC or cost of capital.

A firm's forward-looking (or target) capital structure should be the structure that minimizes its overall cost of finance. Typically, this is a mixture of debt and equity that depends on the relative costs of each of these components, and on the risk profile of the firm. For these reasons, the forward-looking capital structure may differ both from the firm's "book" capital structure (*i.e.*, the structure that existed when the debt and equity were floated) and from its current "market" capital structure (*i.e.*, the structure measured based on current market values for the company's debt and equity).[21] In particular, the forward-looking weighting generally will not be the market weighting that a company

[21] While the "market" capital structure should reflect current market values for both the debt and equity of the firm, in practice this structure is usually measured as a hybrid of the market value of the equity coupled with the "book" value of the debt. This is, of course, improper. The true "market" capital structure should reflect market values for both the firm's equity *and* its debt. Because interest rates generally have dropped significantly since most of the ILECs' debt was issued, failing to value this debt at current market levels leads to gross underestimates of the share of debt in an ILEC's current "market" capital structure.

happens to have in any particular short-run period, for this value can vary widely with short-run fluctuations in the market price of equity. For example, if market interest rates have declined substantially since the company last issued securities, its book capital structure may reflect a lower than optimal fraction of debt – and because this interest rate decline may also have caused equity values to rise, the company's market capital structure may now also reflect an excessive fraction of equity. Rather, the relevant market weighting is the *target* weighting of debt and equity that an informed management team would employ over the long run.[22] This target weighting almost certainly has much less equity, and much more debt, than the current market weightings.

4. False Arguments for Additional Premiums

In the preceding discussion, we have explained why traditional DCF and CAPM approaches to estimating the cost of capital are appropriate for computing the TELRIC to be used in setting prices for UNEs. When properly applied, these estimates are sufficient and no additional premiums should be added or subtracted. Nevertheless, a number of arguments have been made in support of adding additional premiums. We explain why these arguments are incorrect.

A. Argument 1: Future Facilities-Based Competition Increases the Risk of Providing UNEs

Today, the ILECs retain a virtual monopoly over local telephone services. However, over the longer term, additional facilities-based competition may develop.

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[22] *See, e.g.*, Stephen A. Ross, Randolph W. Westerfield and Jeffrey Jaffe, *Corporate Finance*, 4th ed., Chicago: Irwin, 1996, p. 441.

Therefore, it is argued, that to be consistent with TELRIC's long-run perspective, the cost of capital estimate ought to reflect the impact of this future facilities-based competition.

We have already explained how market prices for ILEC debt and equities incorporate a consensus expectation of future risk from facilities-based competition. Therefore, a properly applied DCF or CAPM analysis already takes the impact of such expected competition into account. Adding an additional premium or adjusting the calculations to account for the impact of such competition would be duplicative and would overstate the appropriate cost of capital.[23] And it would be clearly incorrect to base estimates of UNE cost of capital on assumptions of greater levels of future competition than investors actually expect over the long term – as reflected in market debt and equity prices. This is particularly true given that the FCC's Triennial Review Order requires UNEs to be provided by ILECs only when multiple facilities-based alternatives do not exist.[24]

B. Argument 2: Premiums Must Be Added to Account for "Real Options" Effects

In recent years, finance theory has been formalized to consider the effects of so-called "real options" on asset values. Options are securities that provide a contingent opportunity or responsibility to take an action that might not actually be exercised. For

[23] Even if investor or analyst expectations have failed to account for changes in future competitive risks, it does not follow that the ILECs' UNE investments will be more likely to become stranded if wholesale demand shifts to CLEC-owned facilities. This logic is incorrect because it assumes that there will be excessive CLEC facilities investment. Ironically, excessive CLEC investment is most likely to occur in markets where UNE rates are set above economic costs. When above-cost UNE rates do not simply foreclose competition altogether, a CLEC that enters will have to invest in its own facilities and the likelihood of uneconomic stranding of ILEC assets is increased. Thus, the best way to assure efficient utilization of ILEC facilities is to price UNEs correctly at their economic cost.

[24] *See, e.g., Triennial Review Order* at ¶ 498.

example, an option to buy a stock allows an investor to purchase the stock for some fixed price (exercise price) at any point prior to the expiration of the option. If the stock price exceeds the exercise price, the option likely will be exercised. As long as there is a chance that the stock price will exceed the exercise price during the lifetime of the option (*i.e.*, that the option will be "in the money"), the option will be valuable. Options are widely traded on financial markets.

A similar theory may be applied to investments in real assets. Options on such assets are referred to as real options. One way in which real options may arise is if the timing of an investment is discretionary, the investment is not reversible (*i.e.*, once made is sunk), and future returns are uncertain. In such circumstances, there may be benefits to waiting to invest because some of the uncertainty regarding future earnings may be resolved over the waiting period.[25] Therefore, investing early extinguishes the opportunity to benefit from such learning. This may be thought of as exercising an option before it expires. When this circumstance applies, the remaining value of such an option at the time of investment should be added to the cost of the investment.

Superficially, the prior situation might seem to fit local telephone investments: that is, large sunk costs in the face of substantial business uncertainty regarding future returns. The actual situation, however, is far more complex. Investment in telecommunications infrastructure is also associated with substantial first-mover advantages as evidenced by CLECs' difficulty in penetrating the ILEC monopolies. In

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[25] *See* Avinash Dixit and Robert S. Pindyck, *Investment Under Uncertainty*, Princeton: Princeton University Press, 1994; or, for a review of that book, see R. Glenn Hubbard, "Investment Under Uncertainty: Keeping One's Options Open," *Journal of Economic Literature* 32 (December 1994), pp. 1816-1832.

such cases, waiting to invest is costly and real options effects work in the opposite direction, implicitly lowering the economic cost of investment.[26]

Ultimately which types of real options are more valuable, and hence which way the net real options effect operates, is an empirical question. Fortunately, the financial markets already do this calculation for us. Stock prices, expected dividend growth rates and betas already capture this information. Thus, although the real options framework offers a pedagogically useful framework for understanding certain of the factors that influence asset valuations, these options do not create new sources of value that are not captured by market prices. The impact of factors such as sunk costs and uncertainty that may create real options is already incorporated into DCF or CAPM market-based estimates.

C. Argument 3: Regulatory Rates of Return Set a Floor on the Cost of Capital

When the 1996 Telecommunications Act was passed, the FCC's most recent investigation into the ILECs' cost of capital dated from six years earlier in 1990, when the FCC determined this cost to be 11.25 percent.[27] Over the intervening thirteen years, reductions in interest rates, changes in stock prices and risk profiles and premiums, along with many other events have impacted our economy and the resultant cost of capital. But

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[26] *See* William J. Baumol, "Option Value Analysis and Telephone Access Charges," Richard N. Clarke, "Rethinking the Implications of Real Options Theory for the U.S. Local Telephone Industry" and Michael D. Pelcovits, "Application of Real Options Theory to TELRIC Models: Real Trouble or Red Herring" in James Alleman and Eli Noam, eds., *The New Investment Theory of Real Options and Its Implications for Telecommunications Economics*, Boston: Kluwer Academic Publishers, 1999, pp. 215-244.

[27] *See*, Federal Communications Commission, *Order in CC Docket No. 89-624*, 5 FCC Rcd 7507, (released December 7, 1990).

simply knowing that changes have occurred tells us little as to whether any previously set rate is now too high or too low. The only way to determine whether any particular cost of capital figure is too high or too low is to repeat the complete calculation analysis using the techniques described above.

Despite the clear need to consider all of the relevant changes that may have occurred over the years, the incumbents have argued that current regulatory rates of return are set too low because these rates were not developed through use of best industry practices or do not reflect most recent theoretical or empirical learning. This is simply untrue. For many years and in nearly all regulatory proceedings at the state or federal level addressing cost of capital, policymakers have relied on precisely the same advanced methods and empirical knowledge that we have described above. While some regulatory decisions may have been premised on inferior analysis, this has not been the rule, and even when it may have occurred, there is no evidence that the calculated estimates have been understatements rather than overstatements of the appropriate rate of return.

D. Argument 4: CLEC Cost of Capital Provides a Better Proxy for UNE Capital Costs

Because the ILECs still have one foot in the old, pre-competitive regulatory world and remain subject to a number of regulatory restrictions not faced by CLECs, some will argue that we should apply DCF or CAPM analyses using a sample of CLECs (rather than the ILECs), as the comparable companies. This ignores the fact that the CLECs' cost of capital reflects myriad risks associated with entry barriers that ILECs, as "first movers," do not face. And even if particular CLECs could appropriately be included in

the set of comparables notwithstanding their higher risk profile, it would certainly be inappropriate to exclude the ILECs from the set of comparables.

E. Argument 5: Internal Hurdle Rates Provide Better Cost of Capital Estimates

Some analysts have argued in favor of using internal hurdle rates used by companies to screen investments, as the best estimate of the cost of capital. Such an approach is unsound. Although theoretically such rates ought to be set using the same techniques as are described above, companies may follow different and inappropriate practices. Further, these rates may not be readily available or verifiable, and may be developed with different criteria or organizational goals in mind. In particular, because most project managers tend to be over-exuberant in their predictions of the profitability of projects for which they are responsible, and because they are using outside investors' funds (and not their own wealth) to finance these projects, companies typically set internal hurdle rates comfortably above their true costs of capital in order to correct for these biases in their managers' expectations. Finally, companies may face firm-specific capital constraints that can increase their hurdle rates above the cost of capital that is relevant for any particular investment.

5. Conclusion

The Telecommunications Act of 1996 contains broad instructions to promote competition in local telephone service so that it eventually may be deregulated. If this goal is to be realized, the prices for UNEs provided by ILECs must correctly reflect incremental costs that are: long-run, forward-looking, based on the most efficient

available technology, and consistent with cost causation. The FCC embraced this in its definition of TELRIC.

As a long-run cost, TELRIC includes all of the incremental costs associated with the efficient provision of network elements. This includes an allowance to recover efficient capital investments, an appropriate share of joint and common costs and an allowance to earn a reasonable profit. These costs are embodied in a cost of capital which reflects the normal return on funds invested in businesses of a similar character as the provision of UNEs.

In this essay we have explained how the tried-and-true approaches to estimating WACC remain appropriate and consistent with TELRIC principles. Application of the DCF and/or CAPM approaches offers the best means for using actual market data to ensure that estimates will be forward-looking, unbiased, transparent and verifiable. Furthermore, because of the competitiveness of markets for financial resources, these market price data reflect rapidly all available information concerning risk and provide the best source of information for estimating capital costs. The WACC estimates that are derived using these methods account well for increases in competition that may have occurred or are expected to occur, as well as any of the other uncertainties or risks facing firms that would provide UNEs.

DEPRECIATION COSTS HAVE BEEN PROPERLY INCORPORATED INTO TELRIC

Richard N. Clarke[1]

1. Overview

This essay addresses the depreciation methods that may be used to calculate the total element long-run incremental cost (TELRIC) for unbundled network elements (UNEs). The central debate over depreciation concerns whether the regulatory depreciation methods that have commonly been incorporated into accepted TELRIC models or employed in UNE pricing proceedings match reasonably the economic depreciation of capital used to supply UNEs. I describe the various depreciation paradigms that have been proposed as proxies for economic depreciation and explain why I believe current regulatory depreciation practices come closest to this ideal.

The inputs used by a firm to produce its output generally divide into two categories: long term inputs that provide productive services over periods greater than a year or so, and short term inputs that provide productive services with durations of less than a year. The costs of the former inputs are generally called "capital" costs, and the costs of the latter inputs are called "expenses." In the telecommunications business, an example of a capital cost could be a switch or a fiber optic line that once installed, may

[1] Director of Economic Analysis, AT&T.

provide telecommunications services for fifteen or twenty years. An example of an expense could be an advertising campaign or a repairperson's salary.[2]

For a firm to make correct decisions as to whether to produce or not produce, to buy an input or not to buy an input, or to invest or not invest, it must match appropriately the costs of its production to the benefits (*i.e.*, revenues) that it receives from its production. Because the benefits from capital inputs accrue over an extended period of time, it is appropriate that the firm recover the costs of its capital inputs over a similarly extended period of time. Correspondingly, because the benefits from expense inputs accrue over a short period of time, it is appropriate that the costs of expense inputs be recovered over a short period of time.

The challenge for this analytic process is to determine the appropriate time flow of payments to recover capital costs. This flow of payments needs to recover three different components of overall capital costs. The first component is to reimburse for the monies that the firm pays directly to its suppliers of capital goods (*e.g.*, payments to Lucent for switches, to Corning for optical fiber, *etc*.). The second component is to reimburse the firm's investors and debt financiers for the time value and risk of funds they have supplied to the firm and were used to purchase these capital goods (*e.g.*, interest on debt borrowings, or dividends and capital gains on equity). The third component recovers the taxes paid to the government on the profits that are earned by the equity owners. The first of these three components of the overall "cost" of using capital

[2] Although the benefits from the advertising campaign or the repair may last beyond one year, it is extremely difficult to quantify the duration of these benefits, so their costs are generally recovered immediately (expensed) and are not capitalized.

goods is called "depreciation," the second is called "return," and the third is called "taxes." The following discussion will focus only on the depreciation component of capital costs.[3]

2. Economic Depreciation

Depreciation is the stream of charges that are intended to recover the outlays that are made in order to acquire capital goods for use by the telecommunications firm. There are several different frames of reference from which to measure these depreciation streams. These include "economic" depreciation, "financial" depreciation, "regulatory" depreciation and "tax" depreciation. Although each of these measurement methods is intended to meter the same thing (the component of capital costs associated with the purchase of capital goods), each method was developed to serve a somewhat different set of purposes.

Economic depreciation is intended to meter the change in economic value of the capital equipment as time passes. There are three different reasons why the economic value of capital equipment may change over time. The first is due to physical wear and tear on the equipment that results from the passage of time or the degree of its use. While physical wear and tear may be an important component of the depreciation for a piece of capital like a metal stamping die that degrades with each impression that it makes, wear and tear tend to be a less significant component of the depreciation of telecommunications capital equipment. In particular, with the advent of fully electronic (as opposed to electro-mechanical) telecommunications central office equipment, there is

[3] "Return" issues relating to TELRIC are covered in a companion essay by Glenn Hubbard and William Lehr.

practically no degradation in the capability of such equipment due to its degree of use. There may, however, be some wear and tear that accumulates through the passage of time on telecommunications equipment that is placed out-of-doors like cables and remote terminals. Exposure to freeze-thaw cycles, moisture, repeated punchdowns on wiring terminals, *etc*., can cause connections to oxidize and insulation to crack – all degrading the performance of this equipment over time.

The second source of economic depreciation derives from technological obsolescence. As time passes, the types of telecommunications services both demanded, and capable of being supplied, may change (*e.g*., from voice services to IP data services). It matters little whether these changes in telecommunications services result from new capabilities being developed from technological innovations (supply-push) or from changes in customer tastes and desires (demand-pull). The result of either of these changes may be that older capital equipment that is less capable of providing these new services is reduced in value, and older capital equipment that is more capable of providing these new services is increased in value. For example, increased customer demand for data Internet services has tended to reduce the value of telecommunications equipment designed explicitly to provide circuit-switched voice services (traditional Class 5 switches) and increased the value of telecommunications equipment that excels at providing IP services (packet routers). And, because it is easier to provide broadband access over all-copper loops than loops served by digital loop carrier, the value of all-copper loops may have been enhanced by these changes in technology and tastes.

The final source of economic depreciation derives from the opportunity cost of capital equipment use. The opportunity cost of using older capital is based on the price it would fetch in the secondhand market if it were redeployed to an alternative use.[4] Thus, if steadily declining prices for microchip components have made new Class 5 circuit switches cheaper than equally functional older Class 5 circuit switches, this reduction in the opportunity cost of an older switch causes economic depreciation of its value. Note that the opportunity cost effect may also go in the reverse direction. If rights-of-way that were acquired "early," are superior (*e.g.*, cheaper and shorter) than rights-of-way that are currently available, the opportunity cost of these older rights-of-way would exceed their initial cost because of the now higher costs involved in securing comparably efficient rights-of-way. Thus, it is possible for this effect to cause economic appreciation, rather than depreciation.

Because economic depreciation covers all of the known sources of depreciation, and because it represents the loss in value of capital equipment that efficient output prices must appropriately recover; the Telecommunications Act's prescription that the prices of UNEs must be based on their cost generally has been interpreted to mean that the TELRIC pricing methodology for UNEs must incorporate economic depreciation. Indeed, the Federal Communications Commission's TELRIC rules make just such a specification.[5] The central debate about the application of depreciation to TELRIC is whether the regulatory depreciation methods that have commonly been adopted for use in

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[4] If a company has made efficient decisions concerning the deployment of new capital, the opportunity cost of this new capital should match exactly its purchase cost. Thus, the opportunity cost component of economic depreciation for new capital should be zero.

[5] *See* 47 CFR § 51.505(b)(3), "The depreciation rates used in calculating forward-looking economic costs of elements shall be economic depreciation rates."

TELRIC rate development match reasonably the economic depreciation of capital used to supply UNEs. In my opinion, these regulatory depreciation methods conform closely to the dictates of economic depreciation – and certainly these regulatory depreciation methods provide a better proxy for economic depreciation than would financial depreciation methods.

3. Financial, Regulatory and Tax Depreciation

To better understand why regulatory depreciation has worked well to proxy economic depreciation, it is useful to understand better the purposes and mechanics of financial and regulatory depreciation.

There are two primary purposes of financial depreciation. One is to measure the streams of capital recovery funds necessary to reimburse promptly the investors who supplied the funds to purchase the capital – and so that the value of the "collateral" offered by the firm (which is resale of the capital good itself), always exceeds comfortably the undischarged obligation that the firm has to reimburse its investors. The second purpose is to provide the owners of a firm with a clearer view as to whether the firm is making an appropriate level of profit. By converting capital acquisition costs into a stream of annual payments, it is possible to make more informative comparisons with annual revenue streams than if capital acquisition costs are viewed simply as a lump sum.

But both of the above purposes tend to bias financial depreciation to recover capital costs much faster than would economic depreciation. Securities regulators and accounting standards boards are always concerned that investors not be deceived by too rosy a picture of a firm's profitability and not have the value of their collateral (the

capital goods) dissipated before being reimbursed for its purchase. Thus, the general watchword for financial depreciation is conservatism.[6] This desire for conservatism generally translates into practices whereby it is better to overestimate depreciation flows than to underestimate them. By doing this, profits will be stated conservatively low rather than aggressively high, and it will be more likely that the capital goods will be completely paid for before their value is dissipated. Although not an explicit purpose of financial depreciation, companies may also wish to display their books in a fashion that shows them to be earning a high return on assets. By increasing financial depreciation flows or other capital write-offs, a company can depress its reported net assets over time, and appear to be receiving a higher ratio of revenues to assets or earning a higher percentage return on assets.

Regulatory depreciation is intended to ensure that the ratepayers who are receiving the benefit of the telecommunications services provided by a set of capital goods are the same ratepayers tasked with providing the firm with revenues to reimburse for the purchase of these capital goods. Thus, for regulatory depreciation, it is essential that the flow of depreciation charges for the capital goods correspond closely to the flow of service value from the goods. Otherwise, there will be a mismatch between the customers that are reimbursing the firm for its purchase of capital goods and the customers who are receiving the benefits of these goods' production.

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[6] *See,* Federal Communications Commission, *Report and Order in CC Docket No. 98-137* and *Memorandum Opinion and Order in ASD 98-91*, (released December 30, 1999) ¶ 48, 15 FCC Rcd 242 (1999) and 15 FCC Rcd at 262-263.

For completeness, I mention that there is one further depreciation methodology observed by firms: tax depreciation. Tax depreciation schedules are developed by the Internal Revenue Service pursuant to laws passed by Congress. Because Congress views capital creation as a valuable spur to economic growth, it has tended to set tax depreciation policy so as to reduce firms' costs of capital acquisition.[7] It generally does this by setting artificially short depreciation lives for capital equipment. If these lives are short, then early year depreciation charges are very high. This reduces the early year "profits" that a firm reports to the Internal Revenue Service, and thus reduces the firm's early year tax obligations. Although this front-loading of tax depreciation results in higher late year profits (and tax obligations), because the firm has depreciated away much of its plant during the early years, the present value of the firm's lifetime tax obligations is reduced because the present value of its higher tax payments late does not cancel fully the present value of its lower tax payments early. And in the meantime, the national economy may have been temporarily spurred by increased capital purchases. In any event, tax depreciation can be ignored for the purposes of this TELRIC analysis because it is not intended to reflect the same economic principles.[8]

4. Regulatory Depreciation and Economic Principles

A depreciation schedule is characterized primarily by its slope and average life. While a great deal of emphasis has been placed on the slope pattern of a depreciation

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[7] While Congress may believe that encouraging more capital creation is good, economists are not agreed that this policy is the most efficient way to spur economic growth.

[8] Tax depreciation's main relevance to TELRIC is because it does decrease the real present value of tax payments made by firm. Therefore, tax depreciation's reducing effect on the present value of a telecommunications firm's tax obligations must be accounted for in correctly determining the amount of tax gross-up necessary to be included in the TELRIC of a UNE.

schedule, this emphasis is largely misplaced.[9] The slope of the depreciation curve at particular intermediate points only has relevance if a businessperson, investor or regulator is focused principally on short-run decision making and welfare – or if the firm has a real opportunity to dispose of its investments at such intermediate points. For the most part, short-run analysis is rejected as uninformative by business persons who are seeking long-run profits and competitive advantage for their company, by investors who are interested in long-run wealth accumulation, and by regulators who are focused on securing enduring improvements to the economic efficiency and customer satisfaction generated by their industries.[10] Furthermore, because it may be difficult to redeploy telecommunications equipment prior to the end of its useful life (*i.e.*, the equipment is "sunk"), the depreciated value of this equipment at intermediate points tends to be less relevant than its overall lifetime depreciation performance.

Some parties have suggested that it is unlikely that depreciation practices as they are implemented by regulators or are incorporated into popular TELRIC models could possibly reflect economic depreciation. This, these parties argue, is because regulatory depreciation is straight-line, while economic depreciation is a curve that falls fastest in

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[9] *See*, David M. Mandy and William W. Sharkey, "Dynamic Pricing and Investment from Static Proxy Models," Federal Communications Commission, OSP Working Paper No. 40, September 2003, *("Mandy and Sharkey").*

[10] Of course there certainly may be some business people ("Chainsaw" Al Dunlap is a popularly cited example) who appear to focus primarily on short-run profitability goals; and some investors (day-traders are again examples) who focus entirely on short-run results; and there may even be some regulators who focus on short-run results over an election cycle, *etc*., but such analysis tends to be misguided.

the early years and slower in later years.[11] These divergent characteristics are illustrated in the following two charts.

[Insert Chart 1]

[Insert Chart 2]

As illustrated in Chart 1, classic straight-line depreciation results in the same percentage of the original plant depreciating away each year; thus net plant declines with a constant slope. In contrast, Chart 2 depicts "economic" depreciation as being higher in earlier years than in later years; thus, net plant declines quickly early, and more slowly, late. Unfortunately, neither of the above characterizations is apposite.

First, it is incorrect to assume that classic straight-line depreciation reflects accurately current regulatory practice. The classic straight-line method was abandoned by the Federal Communications Commission (FCC) in 1981 and by most state regulators in favor of a methodology called "equal life groups" with Gompertz-Makeham survivor curves.[12] Although this methodology may assume straight-line depreciation within each

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[11] *See, e.g.*, David M. Mandy, "TELRIC Pricing with Vintage Capital," *Journal of Regulatory Economics*, Vol. 22, No. 3, pp. 215-249.

[12] *See* Federal Communications Commission, *Tenth Report and Order*, CC Docket Nos. 96-45 and 97-160, (released November 2, 1999) ¶¶ 422-424, 14 FCC Rcd 20,156 (1999) and 14 FCC Rcd at 20342-20344 and accompanying footnotes. In this Order, the FCC notes the widespread acceptance that equal-life group depreciation has received from incumbent local telephone companies and regulatory commissions. For a more complete description of the equal-life group methodology, see American Telephone and Telegraph Company, *Engineering Economy*, 3rd ed., McGraw-Hill, 1963, pp. 345-365. Equal-life group depreciation is the default methodology assumed in the FCC's Synthesis Model, the HAI Model and the BCPM.

equal-life vintage group, the net effect of the overall equal-life group methodology is a set of depreciation schedules that resemble rather closely the curves in the economic depreciation example shown earlier in Chart 2.

[Insert Chart 3]

As Chart 3 clearly demonstrates, suggestions that the regulatory equal-life group depreciation incorporated into TELRIC is inconsistent with expected patterns of "economic" depreciation are simply misplaced.[13]

Second, there is no reason why economic depreciation need conform with the "economic" depreciation pattern illustrated in Chart 2 whereby loss in plant value is most severe early, and tails off late. While certain pieces of electronic telecommunications equipment (e.g., digital circuit equipment) may display such a characteristic, other pieces (e.g., copper cables or conduit systems) may not. Because of increases in civil engineering costs over time, such equipment may enjoy economic appreciation effects that attenuate any loss in value due to physical wear and tear.

In any event, the most important feature of a depreciation schedule is its length, not its curvature. In a world of modest interest rates, it matters relatively little if the

[13] The equal-life group example in Chart 3 assumes the Gompertz-Makeham survivor curves associated with Digital Circuit Equipment in the FCC's Synthesis TELRIC model – adjusted to represent a five year projection life that matches the lives portrayed in the examples provided in Charts 1 and 2.

curvature of a schedule varies slightly from one's concept of an economic ideal.[14] What really matters is whether the time period over which depreciation is recognized corresponds to the time period over which the equipment maintains its economic value. Thus, to ensure that this correspondence is maintained, rather than manipulating the curvature of depreciation schedules, regulators have generally chosen to adjust directly the economic lives over which the depreciation flows are required to recover the cost of the equipment.[15]

Beginning in the 1980s, regulators generally have adjusted downward their allowed depreciation lives to reflect the effects of economic depreciation that go beyond normal wear and tear. Thus, for example, allowed regulatory depreciation lives for electronic switching were reduced from 30 years in the 1970s down to 19 years in 1985, to 16 years by the mid-1990s and to as little as 12 years in 1999. The effect of these changes has been to accelerate dramatically the recovery of local network capital costs into the early years of its deployment. This is because regulatory depreciation lives have allowed recovery of the full original purchase cost of most telecommunications equipment years before it is actually retired from service. For example, the Bell Companies currently appear to be keeping their digital switch investments in service for

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[14] If interest rates are of substantial size relative to depreciation rates, changes in the time pattern of depreciation can have more significant effects on the present value of depreciation flows.

[15] In this regard, regulators do perform exactly the "*ad hoc* adjustments of assumed asset lifetimes" that *Mandy and Sharkey* (pp. 2 and 9) formalize into depreciation rate adjustment factors. Because *Mandy and Sharkey* investigate situations where regulators directly reset assumed plant costs to reflect current replacement values, the adjustment factors developed by *Mandy and Sharkey* must be applied only to depreciation rates based on the actual service lives of the plant – and not to lives that have already been adjusted downward to reflect changes in plant replacement cost. Applying *Mandy and Sharkey*'s adjustment factors to these already-shortened lives would result in double-recovery of depreciation expense.

16 or more years, but under the FCC's guidelines, they are able to depreciate these investments over as little as 12 years.[16] Similarly, Bell Companies appear to be keeping their buried cable investments in service for 29 or more years, but under the FCC's guidelines, they are able to depreciate these investments in about 20 years. Hence even if a regulator was employing classic straight-line depreciation (which it generally is not), this reduction in allowed depreciation lives to levels far below the "used and useful" lives of the plant permits recovery of equipment purchase costs at roughly the same speed as would be suggested by economic depreciation.

Chart 4 illustrates how a downward adjustment of a category of plant's projection life has the effect of making even a straight-line depreciation path track closely an economic depreciation path that incorporates acceleration.

[Insert Chart 4]

The final issue relates to "levelization." Regulatory practice is generally to "levelize" capital recovery so that "early" telecommunications customers do not subsidize "late" customers' identical use of the same equipment.[17] This practice is

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[16] A similar analysis of service life indications for Verizon-California is provided in "Declaration of Richard B. Lee on behalf of the United States Department of Defense and All Other Federal Executive Agencies" in California Public Utilities Commission Docket Nos. R.93-04-003 and I.93-04-002, filed November 3, 2003;.

[17] Levelization is the title given to ratemaking processes that smooth revenue collections into "level" streams. Typically, levelization is performed by calculating the present value of a stream of unequal costs, then developing a rate that recovers in each year the level annuity value of this cost stream. Note that the more front-loaded the cost stream, the larger is its present value – thus the larger is the level annuity that must be collected to recover it.

especially important when TELRIC models are used to determine capital equipment requirements because these models must assume the placement of all new plant. Modeled without levelization, this would result in massive "early" collections of return revenues because there would be no substantial amounts of accumulated depreciation to subtract from the firm's capital stock in the early years. And in later years, there would need to be very little collection of return revenues because nearly all of the firm's initial capital stock would have depreciated away.[18] But in actuality, large telecommunications firms maintain portfolios of various vintages of particular types of capital equipment. Some pieces have been purchased recently, and other pieces are of much older vintage. Thus, by maintaining a portfolio of multi-vintage equipment, the firm's recovery of its total capital costs is levelized naturally. Thus, TELRIC models' practice of levelization helps these models to match more closely actually anticipated depreciation collections.[19]

In any event, even if there was no efficiency need to levelize collection of depreciation costs, statutory requirements that rates be nondiscriminatory compel its use, or use of other methods that would have very similar effect.[20] Thus, any attempt to

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[18] Note that regulators typically require the levelization of total capital costs collected from customers. Thus, even if depreciation flows are equal across years, because these flows are combined with return on net capital and tax obligations, implicit depreciation collections may become slightly skewed by the overall levelization process. In any event, levelization is much more driven by needs to even out recovery of return on capital and taxes than it is to even out recovery of depreciation.

[19] Levelization of pricing would also occur naturally in a competitive industry facing declining costs over time. For a firm to ensure that it would not be priced out of the market today by its competitors, it would need to set a level price that reflects its lower average cost over the particular time horizon – and not a price that reflects only its immediate higher flow of costs.

[20] A rate design would be discriminatory if it directs that one class of customers (e.g., UNE purchasers or today's buyers) should pay more for the same service as another class of customers (e.g., retail purchasers or tomorrow's buyers).

accelerate artificially the collection of depreciation charges risks creating a subsidy flow that telecommunications law's dictates of nondiscriminatory rates is directed to prevent.

4. Conclusions

Critics of TELRIC have suggested that it fails to incorporate economic depreciation, and that financial depreciation schedules would provide a superior representation of these costs. By and large, these criticisms are based on substantial misunderstandings as to the purpose of economic depreciation and as to how depreciation is actually incorporated into regulatory and TELRIC model practice. When these misunderstandings are disabused, it becomes clear that regulatory equal-life group depreciation methodology, coupled with an informed selection of economic equipment lives, has resulted in TELRIC models capturing extremely accurately the reduction in plant value that is the touchstone of economic depreciation. In contrast, financial depreciation practices have no obligation to live up to these same goals, and would provide a far poorer proxy for the effects of economic depreciation on plant values.

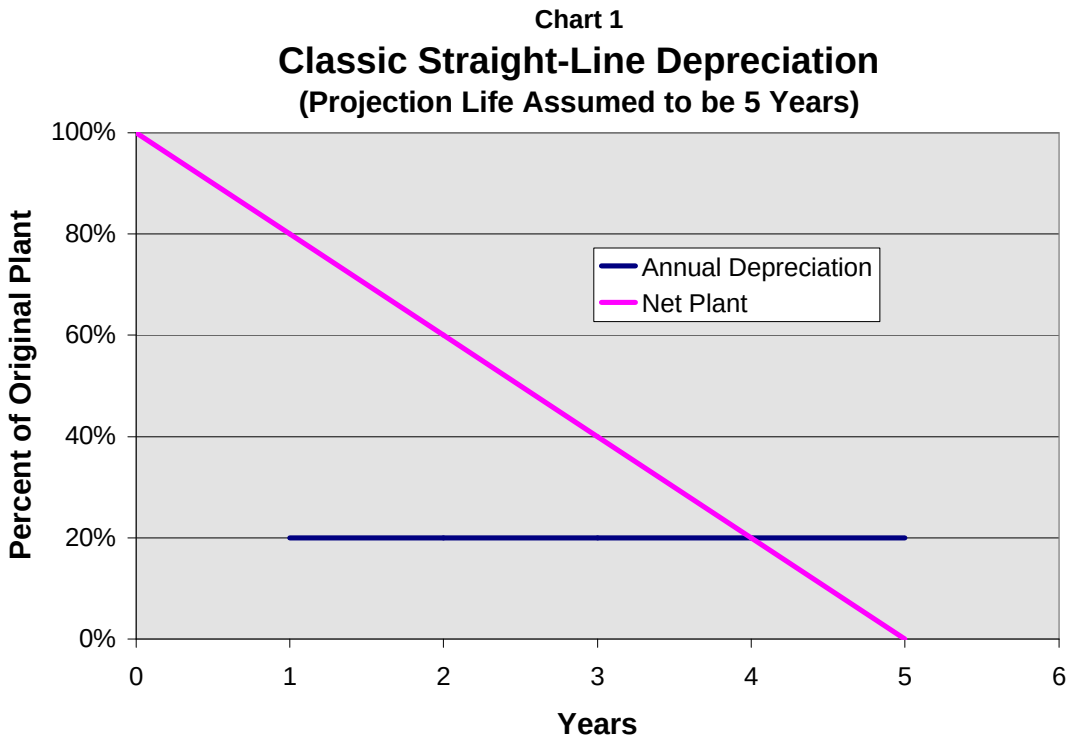
Chart 1
Classic Straight-Line Depreciation
(Projection Life Assumed to be 5 Years)
100%
80%
60%
40%
20%
0%
Percent of Original Plant
Annual Depreciation
Net Plant
0
1
2
3
4
5
6
Years

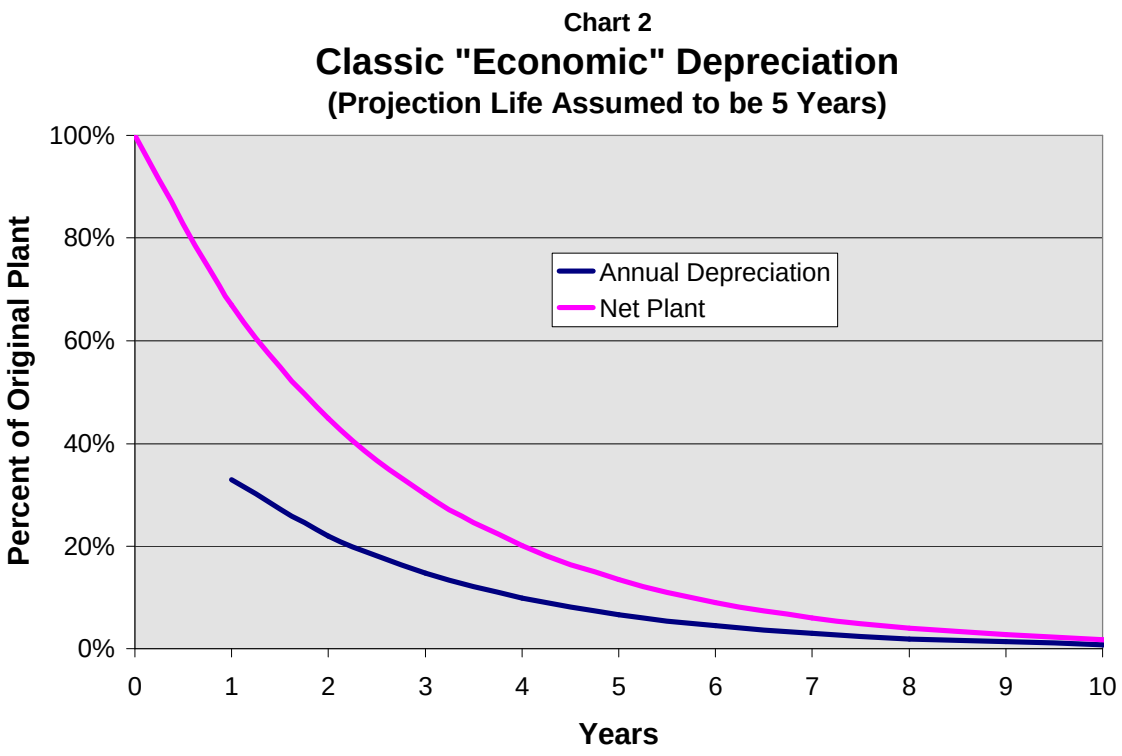
Chart 2
Classic "Economic" Depreciation
(Projection Life Assumed to be 5 Years)
100%
80%
60%
40%
20%
0%
Percent of Original Plant
Annual Depreciation
Net Plant
0
1
2
3
4
5
6
7
8
9
10
Years

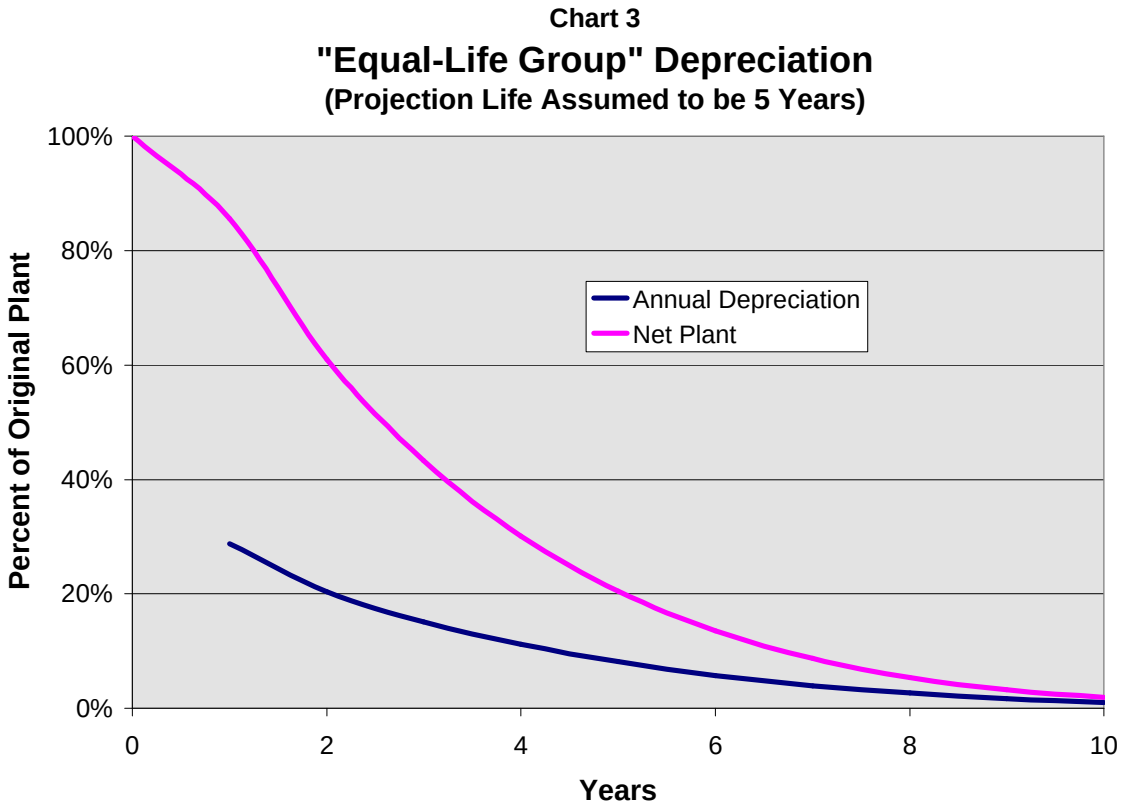
Chart 3
"Equal-Life Group" Depreciation
(Projection Life Assumed to be 5 Years)
100%
80%
60%
40%
20%
0%
Percent of Original Plant
Annual Depreciation
Net Plant
0
2
4
6
8
10
Years

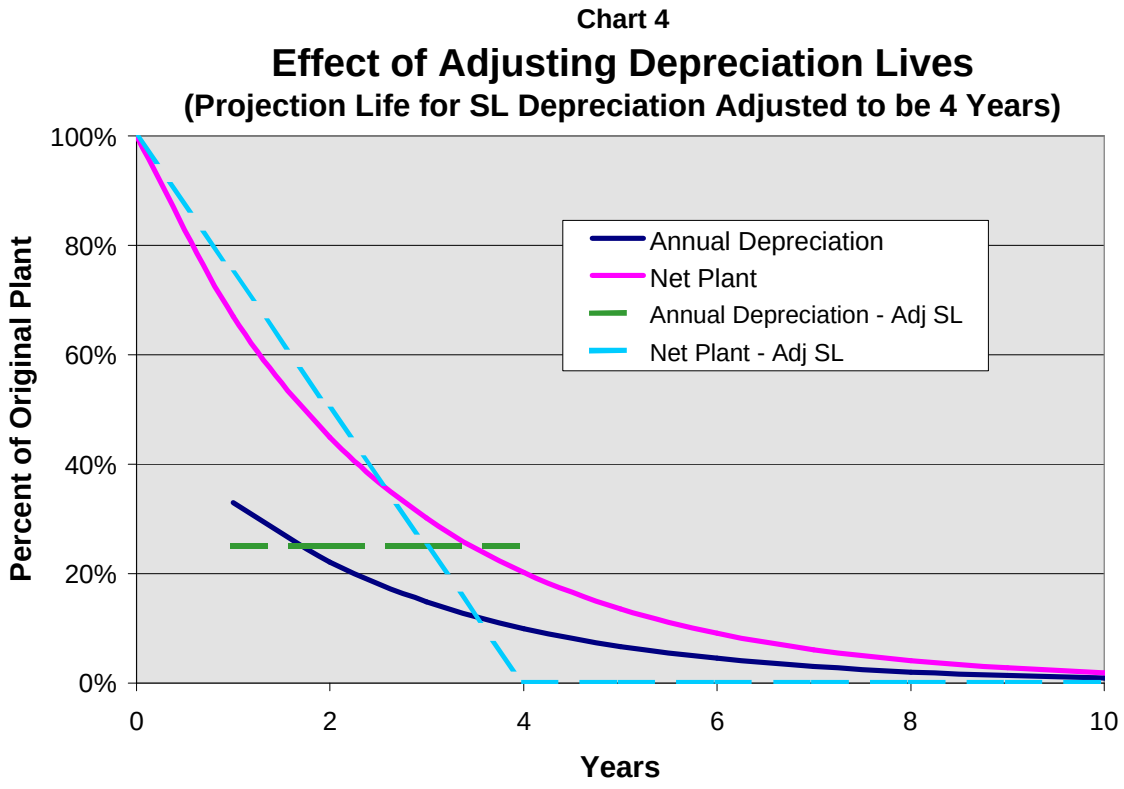
Chart 4
Effect of Adjusting Depreciation Lives
(Projection Life for SL Depreciation Adjusted to be 4 Years)
100%
80%
60%
40%
20%
0%
Percent of Original Plant
Annual Depreciation
Net Plant
Annual Depreciation - Adj SL
Net Plant - Adj SL
0
2
4
6
8
10
Years

UTILIZATION OR FILL FACTORS IN TELRIC

Terry L. Murray[1]

1. Overview

"Real-world" telephone companies – incumbents and new entrants alike – build facilities with capacity that exceeds, at least to some extent, the current demand. As a result, even the most efficient provider typically will use something less than 100% of its total capacity at any given time.

For the purpose of setting prices for unbundled network elements (UNEs), incumbent local exchange carriers (ILECs) have claimed that certain parts of their networks (especially the distribution portion of their local loop plant) consistently experience capacity utilization rates (or "fill factors")[2] of as low as 30 to 40%. They further claim that the persistence of such low utilization after many years of price-cap-style regulation demonstrates that these utilization rates are, in fact, efficient. Competitors and consumer groups have responded that such low fill factors have no place in a forward-looking cost study of an efficient provider and that persistent low utilization provides strong evidence that price-cap regulation has not led to fully efficient behavior

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[1] President, Murray & Cratty, LLC.

[2] As defined by the FCC, "[a] fill factor represents the percentage of the capacity of a particular facility or piece of equipment that is used on average over its life." WC Docket No. 03-173, *Notice of Proposed Rulemaking*, In the Matter of Review of the Commission's Rules Regarding the Pricing of Unbundled Network Elements and the Resale of Service by Incumbent Local Exchange Carriers, released September 15, 2003 ("*TELRIC NPRM*") at ¶ 73.

by the monopoly incumbents, who have remained substantially insulated from competitive pressures.

The heated debate on this topic reflects the perceived stakes. The FCC recently observed:

> Increasing fill factors has the effect of lowering costs by reducing the amount of spare capacity that must be allocated to working units. For example, if the investment in loop plant is $1 million and there are 1000 total loops, the investment per working loop would be $2000 if the fill factor were 50 percent, but only $1429 per loop with a 70 percent fill factor.[3]

The magnitude of differences in this example – with respect to both the fill factors and the cost impact – typifies the range of dispute encountered in cost proceedings when fill factors are used in a simplistic manner to calculate unit costs.

Faced with such divergent proposals, some state commissions have agreed with incumbents, often citing purported "real-world" evidence that seems to support low fill factors. Other commissions have selected higher fill factors, noting the potential for far higher plant utilization than the incumbents may so far have achieved. And, of course, many states have "split the baby," adopting fill factors that are higher than those advocated by the incumbents, but still considerably lower than those recommended by consumers and competitors.

The fundamental questions in this dispute are as follows. First, what level of capacity utilization should one reflect in modeling the forward-looking cost of an efficient provider of local telecommunications services? Second, how should modelers

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[3] *TELRIC NPRM* at ¶ 73.

assign among users the costs of any spare capacity included in the forward-looking network design?

The answers to both questions depend in large part on the reason for less-than-100% capacity utilization. Some "spare" capacity is necessary and unavoidable in any efficient network. Copper cables, for example, are manufactured only in certain discrete sizes (*i.e.*, number of wire pairs). Available cable sizes rarely permit an exact match to consumer demand; there are usually several spare pairs left over. No one seriously disagrees with including the cost of such truly unavoidable spare capacity in a forward-looking cost study and sharing it among all users of that facility. Spare capacity may also be necessary to accommodate customer "churn" and plant maintenance and to be available immediately to replace plant (in this case, wire pairs) that becomes defective. Again, no one seriously disputes that some spare capacity needs to be maintained to address these "buffer" needs.

But, other spare capacity is built to serve future customers or to provide services or elements not available as UNEs. These costs may be efficient, in the sense that building capacity today in anticipation of future need reduces the expected present value of the costs to provide the total bundle of services to all customers, present and future. But, the costs of such spare capacity should be attributed to the future customers or the non-UNE services/elements, because they are the ones who cause the extra capacity to be installed and who will benefit from its use. Failure to attribute these costs to the cost causer leads to cross-subsidies and improper price signals that undermine the

fundamental goals of encouraging efficient competitive entry in the local exchange market and ensuring economic prices to retail customers.

The discussion that follows explains the logic underlying these broad conclusions and provides illustrations based on "real-world" cost and demand conditions. Specifically, I explain that the determination of the appropriate fill factor to use in a forward-looking cost study requires careful consideration, and appropriate treatment, of the various types of spare capacity. They fall into three broad categories: (1) allowances for "buffer" needs; (2) "breakage"; and (3) growth. The examples I use in my discussion of these categories of spare capacity relate primarily to copper distribution cable, in part because the fill factors for such cable have been among the most hotly contested telecommunications cost study inputs.

Following this consideration of the various types of spare capacity, I describe the effect of network modernization efforts, such as SBC's "Project Pronto," on plant utilization rates (in this case, feeder cable utilization). Consideration of such "real-world" examples illustrates why current observed fill factors do not necessarily represent long-run efficient utilization, despite the existence of price-cap regulation. Moreover, such network modernization projects illustrate the importance of attributing the cost of spare capacity to the uses that cause it and to the users that benefit from it.[4]

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[4] The FCC's recent decision to exclude certain loop functionalities from the unbundling requirements of the Telecommunications Act of 1996 makes such cost allocation more important today than was previously the case. Without careful assignment of costs to the cost causers or beneficiaries, competitors could be forced to subsidize the cost of installing facilities to which they will not have access.

2. A UNE Cost Study Should Only Include the Spare Capacity Attributable to Current Demand for the Element Being Studied

As I noted above, the appropriate treatment of spare capacity costs in a forward-looking cost study varies based on the cause of the spare capacity. In this section, I consider the proper treatment of costs for three types of spare capacity: (1) allowances for "buffer" needs; (2) "breakage"; and (3) growth. I show that the cost of spare capacity to meet most growth needs is not attributable to current demand and should not be attributed to current UNE subscribers. I also show how cost model cable sizing factors should be calibrated to ensure efficient levels of achieved fill and to avoid double-counting.

A. Accommodation of "Buffer" Needs

Even a carrier building plant to serve current demand only would include at least some spare capacity for "buffer" needs – although, as explained below, the "breakage" spare that results inevitably from "lumpy" investments (*e.g.*, in cables that come only in discrete sizes such as 50-pair and 100-pair cables) may often be adequate to address buffer needs. The two buffer needs most commonly cited are "churn" and maintenance spare, the latter being primarily spare to substitute for defective facilities.

Churn "Churn" or "demand uncertainty" occurs because existing customers may relocate or change the number of facilities (typically, loops) they require at a given location or on a given route. All carriers must keep a certain amount of spare capacity to deal with variations in demand caused by the movement of customers from one location to another. In general, the need for spare capacity to accommodate churn depends on the

extent to which variations in demand are self-canceling within a specific geographic area (*e.g.*, among the residences served by a single distribution terminal). Churn becomes less and less significant as a driver of spare capacity requirements as one approaches the central office, because variations in demand are increasingly averaged over a wider geographic area. In feeder plant, churn is only relevant to the extent that demand migrates between entire feeder routes. At the central office, churn becomes practically irrelevant as the switch can serve a particular maximum level of demand regardless of how the demand fluctuates throughout the area served by the wire center.

Churn in residential demand may have relatively little significance for outside plant planning, particularly on a forward-looking basis. Residential lines are typically engineered so that each primary residential line is "hard wired" to the residence. When a residential customer deactivates a main line, for example, the line commonly remains active on a limited basis so that the new resident can order service or call 911. This practice has the additional benefit of reducing non-recurring loop installation costs. Thus, for loops to residential locations (the majority of all voice-grade loops), churn is typically limited to the fluctuation in second and additional lines between and among locations. Going forward, the demand for second and additional lines may be curtailed as a result of line-shared (or line-split) broadband services provided over the primary line and alternatives such as cable modem and wireless services that require no additional telephone loop facilities. This moderated demand for additional lines translates directly into lower variation (churn) in the location-specific demand for residential loops.

Churn in business demand often occurs in dense central business districts where loop facilities may be highly fungible and/or the affected plant may not be owned by the incumbent. For example, the overall demand for ILEC-owned outside plant facilities to a high-rise building may be fairly constant, even though demand at any individual office suite varies as tenants move in and out. If the incumbent does not own the inside wire that provides distribution facilities within the building, the churn inside the building may be largely irrelevant to the demand for the loop facilities being provided under UNE pricing arrangements.[5]

Spare for Defective Equipment Some "real-world" carriers have nontrivial amounts of idle capacity because the facilities in question are defective. But, the percentage of spare capacity due to defective equipment in embedded plant (much of which may occur in loop plant that has long ago been fully depreciated) does not provide a reasonable benchmark for the expected level of such spare capacity in an efficient, forward-looking network.

Telecommunications carriers demand, and present-day equipment manufacturers supply, plant and equipment at high-quality standards with low failure rates.[6] Even if an

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[5] Some of the greatest uncertainty in business demand is a direct result of the incumbents' decision to market Centrex-type services as an alternative to Private Branch Exchange ("PBX") services. The Centrex approach uses telephone company loops to provide the "intercom" portion of the service, whereas a PBX service typically uses customer-owned inside wire to accomplish the same function. Depending on the level of potential call blocking considered acceptable by the PBX customer, a PBX application could use as little as one-tenth of the amount of loop facilities as are used to provide an equivalent Centrex-type service. Thus, if a business converts from Centrex to PBX service (or the reverse), the demand for loop facilities at that location could change significantly.

[6] Even Verizon acknowledges that "newer copper should result in lower maintenance expenses than the copper that Verizon CA has installed in the past." Verizon California, Inc., Panel

incumbent carrier is using older plant to provide service, that incumbent must be able to match the price of an efficient new entrant, using modern facilities. This efficient entrant would not require large amounts of spare capacity for defective facilities; indeed, experienced outside plant engineers have estimated that the requisite spare for defective facilities is as low as one percent. Hence, the forward-looking cost should not increase measurably as a result of spare capacity related to defective facilities.

B. Breakage

"Breakage" (sometimes called modularity spare) occurs because a modern telecommunications network requires "lumpy" investments. The difference between the capacity needed to meet a given level of demand and the capacity of the smallest available piece of equipment that could serve that demand is known as breakage.[7] For example, a single line card for a switch may have a capacity of eight lines. Unless the total number of lines that the switch serves is evenly divisible by eight, the "last" line card in the switch will not be fully utilized, resulting in some breakage spare.

Breakage has a more dramatic effect on the utilization of the copper cables used for distribution and feeder. Currently, the standard engineering design for basic voice-grade loops requires one pair of twisted copper wires for each loop.[8] Commonly available copper cables range from 6 to 4,200 pairs. Cables come in discrete sizes; there

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Testimony on Recurring Costs, California Public Utilities Commission Docket Nos. R.93-04-003, I.93-04-002, November 3, 2003, p. 151.

[7] Thus, "breakage" refers not to the fact that equipment may become defective, but rather that there are "break points" in the available sizes of telecommunications equipment, and that engineers must always round up their installed capacities to the next available size.

[8] This standard design may change in the near future as it is technically feasible today to provide multiple voice channels over, *e.g.*, DSL-capable copper pairs.

is no cable manufactured to serve exactly, *e.g.*, 29 customers. Thus, there often is no close match between the number of pairs desired on a particular cable route and the available cable sizes. If there is a demand for 29 loops along a particular distribution route, the smallest single cable that could serve that demand is a 50-pair cable. In this example, the breakage spare would be 21 pairs (50 – 29).

Stated another way, the 50-pair cable would have a 58% utilization rate because only 29 of the 50 pairs (58%) were actually required to provide service. The capacity utilization rate is often called a "fill" factor because it describes the fraction of available capacity that is "filled" by actual working telecommunications services.

Table 1 below illustrates the effect that breakage alone has on achieved fill factors. For each commonly available cable size, it reports the average fill that will be achieved on that cable assuming that each level of demand that the cable is intended to serve is equally likely (*i.e.*, for a 50-pair cable, fills are calculated assuming demands of 26, 27, . . ., 49 and 50 pair, and an average of these fills is reported).[9]

[9] "Achieved fill" refers to the actual percentage of the cable capacity that is "filled" with current usage. Therefore, achieved fill corresponds to the concept of "fill factor" as that term is used by the FCC and in most ILEC cost studies.

Table 1

Effect of Breakage on Copper Cable Utilization

Cable Size	Average Achieved Fill
6	58.3%
12	79.2%
25	76.0%
50	76.0%
100	75.5%
200	75.3%
400	75.1%
600	83.4%
900	83.4%
1200	87.5%
1800	83.4%
2400	87.5%
3000	90.0%
3600	91.7%
4200	92.9%
Average over all cable sizes	**87.0%**

Except for the smallest cable sizes, breakage does not cause the fill or utilization of any cable to drop below 50%. The next smallest cable size is always at least half as large as the cable size in question, giving the engineer the ability to match any demand level less than 50% of that cable size with a smaller cable, which would have a higher fill.

The breakage-related achieved utilization rates in Table 1 average 87% across all demand levels and cable sizes. The smaller cable sizes typically associated with the distribution portion of the loop (closest to the customer's premises) have somewhat lower breakage-related utilization than this average. The reverse is true for the larger cable sizes typically associated with the feeder portion of the loop (closest to the wire center).

Not every part of the telecommunications network is as "lumpy" as copper cable. Nonetheless, other components of the telecommunications network are deployed at less than full capacity due to similar "lumpiness" issues. As examples, Serving Area Interfaces ("SAIs"), Digital Loop Carrier ("DLC") systems, switch line units and other network components are all available in a limited array of sizes. Each of these types of equipment, therefore, typically will be operated at less than 100% capacity because of breakage.

It is critical to recognize the important interrelationship – in both the "real world" and the world of cost modeling – between breakage spare and other forms of spare capacity. Breakage spare is virtually always unavoidable, but that does not mean it is unusable. An efficient carrier would expect a significant amount of breakage spare and use that spare capacity to accommodate other needs, such as its requirements for buffer spare. Indeed, the breakage spare that inevitably exists in most distribution cables may often be sufficient to accommodate *all* buffer needs.

C. Growth

Each of the causes of spare capacity that I have discussed thus far relates, at least in part, to costs incurred to serve current customers. "Growth" spare, in contrast, is explicitly a cost incurred today for plant expected to serve future demand.

If demand growth is expected, an efficient carrier will likely install some additional capacity beyond that needed to supply current demand. The amount of growth spare that the carrier will place depends on several variables, including the timing, level and degree of certainty of expected demand growth and the relative cost of adding

capacity as demand materializes ("plant reinforcement") versus the carrying cost of spare capacity. Faster and more certain demand growth suggests the placement of more spare capacity to accommodate future demand, all other things being equal. Similarly, as the cost of reinforcing plant increases, relative to the carrying cost of spare capacity, it makes more sense to place spare capacity in anticipation of demand growth. Thus, incumbents often argue that distribution plant is built for "ultimate demand" over the useful life of the plant because the additional cost of a larger first cable is small in comparison to the cost of putting a second cable in place (*e.g.*, cost for digging up streets) when demand growth materializes.[10] Conversely, carriers rarely install "plug-in" cards for digital loop carrier electronics more than six months in advance of expected demand because the cost of carrying the additional units is high relative to the cost of an additional truck roll to install facilities when they are actually required to serve demand.

Placing facilities in anticipation of demand is always a gamble. Demand may not grow as much or as rapidly as was expected, or new technology may produce even less expensive means of satisfying that demand growth. A carrier can limit its risk of being unable to recover the costs of spare capacity by building just enough plant to meet current demand and augmenting its facilities on a "just-in-time" basis. UNE pricing that reflects this approach could be described as a "current/current" approach because unit costs (and therefore prices) would reflect the cost of building a network sized efficiently to serve current demand (including breakage and any additional "buffer" needs) divided by current demand.

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[10] Note that to the extent the ILEC believes plant depreciation to be rapid, it makes less and less economic sense for the ILEC to deploy significant amounts of plant to serve future ("growth") demand.

Alternatively, UNE prices could reflect a two-step "future/future" approach. First, one would determine the efficient amount of "growth" spare to place in advance of demand, taking into account expected growth rates, the relative costs of placing plant in advance of need vs. reinforcing plant later to meet demand,[11] the appropriate discount rate for converting future costs into a present value, and depreciation rates. Second, one would calculate the unit cost of plant based on the present value of all of the demand – present and future – that the plant has been built to serve. In this regard, it would be clear error to include growth spare, but then to estimate unit costs based solely on present demand. It is future demand, not current demand, that causes carriers to place growth spare. Hence, including the cost of growth spare in UNE prices based upon present demand is inconsistent with the fundamental principle of cost causation. Current customers should not be required either to subsidize the cost of building plant for future customers or to insulate incumbents from the consequences of their decisions as to how much plant to build and when to build it. Certainly, no competitive carrier is able to extract such a guarantee from its current customers.

It is also important to recognize that, properly calculated, this "future/future" approach should yield even lower unit costs, over time, than the "current/current" approach, because the basic objective of the "future/future" approach is to minimize the present value of the cost of installed cable over the economic life of the cable. If building particular spare capacity now to serve anticipated growth in demand (and thereby

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[11] All other things being equal, the substantial economies of scale for installed telecommunications plant provide an incentive for carriers to install plant in anticipation of demand because the cost per unit of installed capacity decreases as the scale of the plant increases.

incurring carrying costs to maintain that spare capacity until it is needed) is not expected to reduce unit costs, then an efficient provider would not build that spare capacity in advance of demand. Thus, reliance on the "current/current" approach tends to produce conservatively high UNE prices.

The "current/current" approach also appropriately puts the responsibility for the complex and uncertain dynamic optimization calculation on the ILEC, which has far better access to the relevant information than does the regulator. If an incumbent's decisions to build in advance of demand are efficient, then it will reap the benefits of those decisions through the lower costs it will experience in serving future customers.

Several considerations make it more important than ever to exclude growth spare from UNE cost calculations. The growth of traditional circuit-switched lines (and therefore the growth of circuit-switched ports) has slowed significantly. Many recent developments may lead one to expect little or no growth in the foreseeable future. As examples, the recent capability to expand the use of a single copper pair to include voice and broadband services reduces the demand for additional copper loops. Technologies supporting additional voice paths over broadband on copper distribution will accelerate this trend. Cable telephony and other competitive facilities-based options may also slow the growth in demand for copper cable capacity. Moreover, to the extent that the local telecommunications carrier anticipates its own future deployment of fiber or wireless broadband technologies to the home, it would plan to meet future demand using those facilities, rather than building additional copper capacity. The competitive market value of growth spare is likely to be very low under these conditions. Hence, any pricing

scheme that values the incumbent's network in light of the current market value of that network should heavily discount the cost of spare capacity.

All of these factors make it especially difficult for regulators to evaluate whether building capacity in anticipation of demand makes sense. Furthermore, a current/current approach to fill factors that excludes growth spare from UNE price calculations more than adequately compensates ILECs for the forward-looking costs of providing UNEs.

D. Calibrating Cable Sizing Factors to Reflect Appropriate Fill

As shown above, a network's achieved fill reflects the reduction from 100% utilization resulting from the combination of buffer spare, breakage spare and growth spare. At times, the achieved fill factor has been mistakenly equated with an input value in certain TELRIC cost models known as a "cable sizing factor."

A "cable sizing factor" such as appears in the FCC's Synthesis Model or the HAI Model is an input value designed to ensure that a sufficient amount of spare capacity above and beyond current demand is available for all buffer needs. Thus, a cable sizing factor of 75% ensures that each cable "placed" by the model will include enough pairs to serve 1.333 (= 1 / 0.75) times current demand (*i.e.*, no cable is placed without having at least 25% of its pairs available as spare).

But, due to conventions in TELRIC model design, cable size requirements are "grossed up" to accord with the cable sizing factor without any consideration being given to the level of breakage spare that might additionally result. Thus, application of a particular cable sizing factor will result in a far lower achieved fill than may appear to be implied by the sizing factor because breakage will produce additional spare capacity,

lowering utilization. An example will make this clearer. Assume demand exists for 45 pairs. Application of a 75% cable sizing factor yields a minimum cable capacity requirement of 60 (= 45 / 0.75) pairs. The smallest available cable to meet a 60-pair requirement is a 100-pair cable. Thus, due to the cable sizing factor in combination with breakage, the achieved fill is not 75%, but rather 60% (= 60 / 100).

Table 2 illustrates the effect of applying a 75% cable sizing factor *plus* the resulting breakage to determine the net fill actually achieved from the combination of these two effects.

Table 2

Combined Effect of Cable Sizing Factor of 75% and Breakage on Copper Cable Utilization

Cable Size	Average Achieved Fill
6	41.7%
12	62.5%
25	56.0%
50	56.0%
100	56.5%
200	56.5%
400	56.4%
600	62.6%
900	62.6%
1200	65.7%
1800	62.5%
2400	65.6%
3000	67.5%
3600	68.8%
4200	69.7%
Average over all cable sizes	**65.2%**

As the above table indicates, the combination of these two effects results in an average achieved fill of 65.2% – well less than the 75% resulting solely from the cable

sizing factor or the 87.0% from the breakage-only example in Table 1. As a practical matter, the achieved fill that results from a 75% cable sizing factor plus breakage for distribution cable will typically be well below the 65.2% average achieved fill shown in Table 2. This is because the distribution portion of the network tends to be dominated by relatively lower capacity cables (*e.g.*, 100 or 200-pair cables as opposed to 3,600 or 4,200-pair cables) that, as Table 2 shows, achieve lower fill levels than the overall average.

Two conclusions follow directly from this discussion. First, the cable sizing factors used in a forward-looking cost study should reflect only the minimum amount of spare required for buffer purposes because inevitable breakage spare will provide substantial additional capacity in the vast majority of cables.[12] Second, because the costs of growth spare should not be included in TELRIC, and because unavoidable breakage spare already provides the carrier with spare to use for growth purposes, the very low levels of fill that ILECs have often advocated in UNE cost proceedings are highly inappropriate.[13]

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[12] Because of the modest needs that modern networks have for buffer spare, I believe that the default cable sizing factors in most TELRIC models generally provide far more spare capacity than is necessary to meet buffer needs and implicitly, therefore, provide additional spare capacity for what is sometimes a significant amount of growth. In my opinion, this is inappropriate and leads to an overstatement of the forward-looking economic cost of loop plant.

[13] The FCC's 271 orders document instances of incumbents advocating distribution fills as low as 30% to 40%. *See*, for example, *Memorandum Opinion and Order* in CC Docket No. 01-9, FCC 01-130, (released April 16, 2001) at ¶ 39 ("For copper distribution cable, which affects loop rates, Verizon used a fill factor of 40 percent for metro, urban, and suburban zones. In the *SWBT Kansas/Oklahoma Order*, the Commission found that a fill factor of 30 percent for distribution cable was too low because it assumed that too large a percentage of capacity would be idle for an indefinite time, contrary to TELRIC's presumption of an efficient network.")

3. "Actual" or Embedded Utilization Levels Do Not Provide a Valid Benchmark for Efficient, Forward-Looking Costs

Incumbents frequently argue that fill levels should reflect the "actual" fill in their existing networks. Not only was this approach rejected by the FCC's Wireline Competition Bureau in its *Virginia Arbitration Order*,[14] there is simply no basis in fact for the presumption that the incumbents' actual achieved fill factors are indicative of the utilization rates that an efficient carrier would achieve in the long run. Under decades of rate-of-return regulation, the ILECs had strong incentives to construct excess plant if the return allowed on this rate base departed even slightly from their true economic cost of capital.[15] Even carriers that have operated under price caps for a decade or more may have significant amounts of plant (especially loop plant) in place that was built in this rate-of-return era. Because the presence of sunk, underutilized plant capacity has a strong deterring effect on competitive entry, price-cap regulation did not eliminate the monopoly ILECs' incentives to deploy such excess capacity.

Moreover, achieved fill levels in the incumbents' networks today do not represent the long-run utilization levels that one would expect the incumbents to achieve once they complete the transition from nearly all-copper loop plant to loop plant with a substantial portion of fiber facilities. For example, an incumbent may have placed copper feeder to

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[14] *Memorandum Opinion and Order*, In the Matter of Petition of WorldCom, Inc. Pursuant to Section 252(e)(5) of the Communications Act for Preemption of the Jurisdiction of the Virginia State Corporation Commission Regarding Interconnection Disputes with Verizon Virginia Inc. and for Expedited Arbitration (CC Docket No. 00-218); In the Matter of Petition of AT&T Communications of Virginia Inc., Pursuant to Section 252 Preemption of the Jurisdiction of the Virginia State Corporation Commission Regarding Interconnection Disputes with Verizon Virginia Inc. (CC Docket No. 00-251), DA 03-2738, (released August 29, 2003) at ¶¶ 246-249.

[15] Harvey Averch and L. L. Johnson, "Behavior of the Firm Under Regulatory Constraint," *American Economic Review*, December 1962, pp. 1052-1069.

serve a distribution area in 1970 and placed a fiber cable to serve growth or demands for higher quality data services in that same area in 2000. The original copper facilities had sufficient capacity to accommodate *all* demand in the distribution area. The new fiber also has sufficient capacity to serve *all* demand in the same distribution area, including the eventual migration of the existing customers now served over copper feeder. Typically, new customers are placed on the fiber instead of the copper, which causes the copper fill to plummet as churn occurs. This example is by no means hypothetical. In California and elsewhere, SBC has acknowledged that situations paralleling this example are occurring as it upgrades its network to expand its ability to offer DSL-type services to a greater array of customers and to achieve the maintenance cost savings attributable to fiber facilities.

In this transitional network architecture, the capital costs of the copper facilities being "overlaid" and eventually replaced by fiber facilities are, for all intents and purposes, sunk costs. Applying the low achieved fill on sunk facilities (which are already fully or largely depreciated) during a transition away from those facilities to a long-run network architecture based on a much higher proportion of fiber is not a valid method for determining forward-looking costs. Clearly identifying and removing the effect of low fill reported in embedded copper cables due to such transitions becomes doubly important when competitors are denied access to the newer "overlay" facilities. Otherwise, competitors can be forced to subsidize the ILECs' deployment of facilities that will not be unbundled.

Note that this discussion in no way implies that an incumbent's decision to have parallel fiber and copper facilities in place during a transition period is somehow an unwise business decision. The decision may represent the most profitable path for the ILEC to follow in transitioning from its embedded network built during the monopoly era (which was predominantly copper-based) to a future, predominantly fiber-based network. But, a carrier operating in a competitive market could not charge current customers for both the reproduction costs of its embedded, sunk copper facilities *and* the long-run forward-looking cost of its new fiber and digital loop carrier facilities – and both at low utilization rates to boot! Thus, the low current utilization rates for the transitional network architecture, which includes duplicative, embedded facilities, are irrelevant to a long-run, forward-looking economic cost analysis of UNEs.

4. Conclusion

The foregoing analysis considers the numerous causes of spare capacity in a telecommunications network and identifies instances in which spare capacity is properly attributable to current demand for UNEs. Focusing on what is probably the most controversial segment of the local telecommunications network, distribution facilities, I have shown that there is little or no justification for including the cost of spare capacity beyond the spare required to meet buffer needs related to churn and maintenance – especially when the extra spare that results from breakage is considered. Finally, based on a discussion of "real world" network architectures, I have explained why the actual fill achieved by incumbents in their networks today do not provide an accurate guide to the utilization rates that an efficient carrier would incur in the long run.

A competitive market would not allow carriers to recover the costs of construction in anticipation of future growth or the costs of duplicative networks from current customers. In keeping with that competitive market standard, the prices for UNEs similarly should reflect only efficient, long-run utilization rates and should exclude the cost of growth spare.

TELRIC MODELS PROPERLY ACCOUNT FOR REAL WORLD COSTS

Mark T. Bryant[1]

1 Introduction

Total Element Long-Run Incremental Cost (TELRIC) models have been widely employed by the Federal Communications Commission (FCC) and state regulatory commissions to fulfill the requirement of the Telecommunications Act of 1996 that rates charged by Incumbent Local Exchange Carriers (ILECs) for use of unbundled network elements (UNEs) be based on their economic cost. Some critics had faulted these TELRIC models for failing to recognize local conditions and local obstacles that may influence the cost of building local telecommunications networks. Further, these models have been criticized for positing a "hyper-efficient" network that might never be constructed or operated in the real world. In the view of these critics, the accounting records of the ILECs more accurately represent the "actual" configuration and "actual" costs of an efficient local exchange network, and, if adjusted to reflect forward-looking configurations and cost, these records could provide a superior basis for establishing UNE rates.[2]

For many reasons, the ILECs' accounting records are an unsuitable basis for setting UNE rates. In contrast, the TELRIC models employed today are extremely

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[1] Consulting Economist.

[2] A companion essay by Janusz Ordover explains why the embedded costs that these accounting records do represent are not an appropriate basis for the pricing of UNEs.

flexible, provide the granular cost detail needed to address relevant real world conditions and cost drivers, and provide a superior tool for establishing cost-based UNE rates.

2. Why the ILECs' Accounting Books Don't Reflect "Reality"

A. Accounting Records Lack Geographic Specificity

To set UNE rates accurately, it is important to recognize geographic variations in cost. Such variations may result from differences in population density or terrain, labor or materials cost, to name only a few factors. These differences explain why the cost of unbundled loops in densely populated urban areas may be as low as $3 or $4 per month while the cost of such loops in the very rural areas may reach several hundred dollars per month.

Failure to recognize geographic cost differences in UNE prices may have an adverse effect on competition and on an ILEC's ability to recover its cost of providing service throughout its service area. Rates based on costs averaged over too wide a service area could encourage uneconomic entry by CLECs in urban areas and excessive ILEC sale of UNEs at uncompensatory rates in rural areas. For these reasons, the FCC has recognized the importance of appropriate geographic deaveraging of UNE rates.[3]

Unfortunately, the accounting cost records maintained by the incumbent LECs lack geographic specificity. Information filed by the ILECs generally is aggregated to the "study area" level – in most cases representing the ILECs operations in an entire state. As such, these records cannot reflect cost variations within a state and thus cannot

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[3] Federal Communications Commission, *First Report and Order in CC Docket Nos. 96-98 and 95-185,* (released August 8, 1996), at ¶ 764.

support the geographic deaveraging of rates that is essential for competitive pricing of UNEs.

B. Accounting Records Lack Service/Element Specificity

Many of the components of the local telecommunications network – copper and fiber cable, digital circuit equipment, telephone poles and conduit – vary in cost depending on the specific network function for which they are used. While copper cable of a given size may be available from the manufacturer for a particular price per foot, the final cost of that cable on a per-line basis will depend on whether it is installed as part of the drop line that connects an individual customer to the network, as part of the distribution network that connects the customer locations in a particular serving area, or as part of the feeder network that connects serving areas to central office switches. These per-line cost differences will depend both on the "fill" obtained on these different network segments as well as the overall size of the particular facility. The smaller cable sizes used in drop wire and distribution networks are more costly on a per-line basis than the larger cable sizes used in feeder and interoffice networks. In much the same way, the per-line cost of supporting structures such as telephone poles and underground conduit depends on whether the structure supports only a few lines, as is the case in the distribution portion of the network, or a great many lines, as is the case in the feeder and interoffice network.

Setting an appropriate price for unbundled loops and sub-loop elements such as loop feeder or loop distribution thus requires disaggregated information on the characteristics of the cables and supporting structures used to provide each different

component of the loop. The plant and cost accounting records kept by ILECs do not provide the detail necessary to support such a granular development of the cost attributable to each network function. Rather, these records are maintained only for broad categories of plant. For example, all aerial copper cable is recorded in a single account without distinguishing between aerial cable used in loop distribution, aerial cable used in loop feeder, and aerial cable used in interoffice transport networks.

C. Accounting Records Are of Questionable Reliability and Relevance for the Purpose of Estimating the Cost of a Forward-Looking Network

The plant and cost accounting records maintained by the ILECs reflect investments made over a very long period of time – for some plant items perhaps spanning fifty years or more. These accounts incorporate a mix of plant of various vintages and technologies, some of which are decades old and obsolete. New plant may be shown in the accounting records at close to its original cost of purchase and installation. Depreciated older plant that remains in service may be carried on the ILEC's books at only a tiny fraction of its original cost, or of the cost of replacing such plant today.

Because the ILECs have faced little or no competition in their core local exchange markets, they have had little incentive to ensure that the value of assets recorded on their balance sheets reflect accurately the economic value of those assets. Consequently, the accounting records of the ILECs may contain investments related to assets that are

overvalued – either because they are obsolete or provide services for which demand has failed to live up to initial expectations.[4]

Given the scale of operations of the ILECs, and the long period of time over which their accounting records have been compiled, error is inevitable. Recent evidence gathered by the FCC for the Regional Bell Operating Companies' hardwired central office equipment gives a sense of the scale of that error. After conducting an audit of these property records, the Accounting and Audits Branch of the FCC concluded that "book costs may be overstated by approximately $5 billion."[5] This amounts to over 20% of the equipment in these accounts.

D. Information Asymmetry

All companies hold information regarding their network configurations and costs close to the vest. In competitive markets, cost information generally is communicated to the market in the form of prevailing market prices, because the competitive process forces prices to be closely aligned with costs. However, where markets are less competitive and prices must be administered by a regulator, open information regarding a firm's costs is crucial to the price-setting process.

Although the ILECs are required to submit regular information on their investments and expenses to the FCC and state regulatory bodies, such information

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[4] Examples of such overvalued investment may be Centrex or ISDN. Both of these services have faced unanticipated competition from services provided through superior technologies, such as private branch exchange systems for Centrex and digital subscriber line for ISDN.

[5] Federal Communications Commission, *Second Report and Order in CC Docket No. 99-137 and Order in CC Docket No 99-117 and AAD File No. 98-26*, 16 FCC Rcd 4083, (released November 7, 2000), ¶ 12.

generally is reported only at a very high level of aggregation, and the trend in recent years has been to reduce the level of detail required to be reported.[6] Accounting information regarding the costs of specific services is either unavailable, or highly proprietary, and provided to regulators and interested parties under confidentiality restrictions that limit severely its use for price-setting.

This situation creates a disparity in the UNE cost information available to the ILECs versus to regulators and potential intervenors. Because of the ILECs' sole possession of these detailed data and the ILECs' interest in obtaining high prices for its UNEs, ILECs have a strong incentive to manipulate this cost information to suggest excessively high costs associated with the provision of UNEs.

It is important that the process used to estimate the cost of UNEs for ratesetting be transparent. This means that all of the inputs and algorithms used in the estimation of costs should be equally available to all parties. While engineering/economic cost models tend to be quite open to independent analysis, the accounting records of the ILECs are opaque. Because of the greater confidence that attaches to open processes, the FCC has properly decided that to the maximum extent possible, all UNE data and ratesetting processes should be open and accessible to all interested parties.

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[6] *See*, Federal Communications Commission, *Report and Order in CC Docket Nos. 00-199, 97-212 and 80-286*, 16 FCC Rcd 19911 (released November 5, 2001), (eliminating 132 out of the 296 accounts previously reported by Class A carriers).

3. What Is an Engineering/Economic Cost Model and How Is It Used in Estimating Network Costs?

This section discusses briefly important aspects of cost models and how they take actual data and circumstances into account in developing cost estimates that are purposefully realistic and not at all hyper-efficient. More detailed explanation may be found in the Appendix to this essay.

Engineering/economic cost techniques initially were developed by the Bell companies in the 1970s and '80s to support ratemaking for their competitive services.[7] Similar techniques have been adopted by state regulatory commissions to determine prices for UNEs in compliance with the Telecommunications Act's requirement that such prices be developed without reference to rate-of-return based ratemaking.[8]

The ILECs also use these cost modeling techniques to guide their internal business decisions – such as deciding whether to offer a new service or product. Engineering/economic cost models allow the ILEC to estimate the incremental cost that it

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[7] Because the Bells were required to show that their competitive service were priced above cost, and due to many of the difficulties described thus far in this paper, the Bells developed incremental cost models to demonstrate that these prices were subsidy-free. The Bells' research arm, Bellcore (now Telcordia), developed many of these costing techniques. Indeed, the Bells continue to use Telcordia's Switching Cost Information System (SCIS) to estimate switching costs in UNE rate proceedings.

[8] Thus, UNE cost models were not created out of whole cloth just to carry out the FCC's orders implementing the provisions of the Telecommunications Act – rather, engineering/economic cost modeling pre-dated the Act by decades and relies on well-established economic cost principles. It is important to recognize that the TELRIC cost standard adopted by the FCC is considerably more inclusive than the standard previously advocated by the ILECs for estimating the cost of their competitive services. While TELRIC requires that UNEs recover both fixed and variable costs directly attributable to the service as well as a share of shared and common costs, the LRIC methodology typically employed by the ILECs for estimating the cost of their competitive services generally only included the incremental cost associated with an incremental increase in demand. This methodology did not require recovery any of the joint or common costs of the firm as a whole. See the companion essay by William Baumol for a more detailed discussion of these issues.

would incur to provide varying levels of these new services in conjunction with varying levels of its existing services. Accounting and plant records are of little use in providing estimates of incremental costs and of practically no use when it is necessary to perform "what-if" analyses of costs at various levels and mixes of demand. Only engineering/economic cost models are capable of providing this necessary information.

The key to these models' accurate depiction of loop costs is data on customer location. In some TELRIC models, such as the FCC's Synthesis Model or Qwest's Integrated Cost Model, customer locations are distributed uniformly along the road network within the area served by an ILEC wire center. Other models, such as the HAI Model and BellSouth's BSTLM, use actual customer address locations derived from telephone company records or lists of addresses compiled for use by direct mail advertisers and directory services.

Once wire center serving areas have been defined, a network must be designed to provide the quantities of services demanded at each customer location in the serving area. The network design must take into account the length of cables required to reach all customers in the serving area and sizes and types of cable required to provide the types and quantities of service demanded. A variety of approaches may be followed in determining the length and sizes of cable necessary to connect the customer locations. These include techniques such as right-angle routing, restriction of cable paths to identified roads, etc.[9] But the net effect of all of these assumptions is generally to arrive

[9] "Right-angle routing" assumes that cables must follow a series of straight runs, and can change direction only by turning at a right angle. Engineering assumptions such as right-angle routing or restricting cable paths to roads are all less than perfectly efficient. Real world plant designers

at a conservatively high estimate of the cable lengths and sizes needed to connect customers to their serving wire center.[10]

While engineering/economic cost models may calculate operating expenses based on current expenses adjusted to reflect the productivity enabled by the use of 100% modern technology, more typically these expenses are based simply on the use of historical expense-to-investment ratios. Some expenses, primarily the plant-specific operating expenses, can be directly assigned to network elements. Others of an "overhead" character must be assigned using some allocation method, such as proportionately based on directly-assigned expenses, or proportionately based on the number of lines in service. In any event, the resulting expense levels are not hyper-efficient, rather, they reflect closely the actual expenses incurred by the ILECs either on an historical or current basis.

4. How Cost Models Are Used in UNE Rate Proceedings

State commissions have generally required the cost models used in their UNE rate proceedings to be open and auditable so that all of their formulae, inputs and intermediate calculations are visible and adjustable. This permits both the commission, as well as interested parties, to test the sensitivity of the model to changes in its inputs or

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will typically be able to find shorter, more efficient cable routes through the use of an occasional diagonal run or ability to string cables over or under some obstacle such as a highway or small stream.

[10] It is revealing that a comparison of cable route distances produced by the HAI Model and the FCC's Synthesis Model with BellSouth's BSTLM model (which uses detailed proprietary information on customer locations, service counts at each location, and which routes cables only along the road network within each serving area) shows that the BSTLM actually estimates *less* cable route mileage than the other two models, which rely upon more approximate customer location data. *See*, *ex parte* letter from Mike Lieberman, AT&T to Ms. Magalie Roman Salas, FCC, in CC Docket Nos. 96-45 and 97-160, (October 4, 2000).

engineering formulae and to propose alternative inputs or formulae to replace the model's "defaults."

Requiring cost models to be transparent ensures that all stakeholders possess reasonably symmetric information and no party is able to manipulate the process through use of information that is unknown to other parties. The extensive discovery and analysis that accompanies these proceedings acts powerfully to eliminate model errors and to uncover any biases in input data or model algorithms.

Several competing models may be presented in a proceeding, each supported by expert witnesses on economics, network design and component costs. The models themselves are entered into the public record or are made available for inspection pursuant to a confidentiality agreement (if proprietary input data are incorporated). Before using a proffered model to set rates, state commissions commonly replace many of a model's default inputs with ones of their own choosing.[11] And a state commission may end up choosing a single model to set all of its UNE rates, or may use cost estimates from one model to set some rates and estimates from another model to set other rates.

5. Can a Cost Model Really Reflect Reality?

Engineering/economic TELRIC models have been criticized for assuming the costs of a "hyper-efficient" network that could never be constructed or operated by a carrier operating in the "real world." These critics claim that TELRIC models ignore many of the real world factors that affect network costs, and that the incumbent's

[11] Indeed, disputes over the appropriate inputs to use in a model frequently are more hotly contested than choice of the model design itself.

embedded network costs and planned enhancements are a more accurate reflection of the actual cost of providing service.[12]

Far from failing to take account of the "real world" constraints facing local telephone companies as they build and operate their networks, TELRIC models estimate extremely accurately economic costs because they incorporate extraordinarily rich detail regarding local conditions that affect network costs.

The condition that determines most strongly per-line local network cost is population density. If an area is densely populated, per-line costs of plant placement are low because cable runs are short and they serve many customers. In less densely populated or rural areas, per-line costs of plant placement are high because cable runs are long and they serve only a few customers. While early versions of TELRIC models may have examined only large geographies (particularly in less densely populated rural areas), and masked the varying population density within those areas, today's models use more sophisticated techniques to pinpoint the location of individual residences and businesses. This permits modern TELRIC models to capture with extreme precision the network costs associated with very small geographies.

This approach not only provides accurate information on customer location, it also carries information about natural obstacles that could complicate the placement of telephone network plant. Clusters of customers occur where terrain is suitable for

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[12] *See* Alfred E. Kahn, "Whom the Gods Would Destroy, Or How Not to Deregulate," AEI-Brookings Institute Joint Center For Regulatory Studies, Washington, D.C., 2001; and John Thorne, "The 1996 Telecommunications Act: What Went Wrong and Protecting the Broadband Buildout," unpublished manuscript, 2001. These claims are refuted by Janusz Ordover in a companion essay.

building – and likely also suitable for cable placement. Customers will not be located where there are natural features such as lakes or mountains that prevent building, and modern TELRIC models will not force the placement of telephone plant in these areas. Furthermore, because these models also incorporate information regarding local soil conditions and water table depths, the models adjust cable placement costs to reflect the difficulties associated with plant placement in particular types of terrain.

TELRIC models can also accommodate differences in operating expenses and labor rates in areas under study. Operating expenses can be based upon historical expense-to-investment ratios specific to a telephone company and state. Thus, if aerial cable is especially expensive to maintain in areas subject to hurricanes, such as Florida, this higher expense will be reflected in the model's cost calculations for Florida. Or, if labor rates are especially high in New York, this, too, can be accommodated and reflected in New York cost results.

What TELRIC models do not contain is the inaccurate picture of forward-looking network costs that might be inferred from the ILECs' accounting records. As noted earlier, these records are a hodgepodge of plant that may be overvalued due to inefficient placement, undervalued relative to its replacement cost due to accumulated depreciation, and so forth. Because TELRIC models start from scratch in designing a network to serve current demand, they reflect much more closely the cost that would be incurred by an efficient firm to construct and operate such a network today.[13]

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[13] Actually, TELRIC models used to set UNE rates do not start from scratch in their network design. Instead, they are instructed by FCC rules to start from the set of pre-existing ILEC wire

6. Conclusion

TELRIC engineering/economic models are superior to the ILECs' accounting records for calculating economic costs. Accounting records lack the geographic specificity to permit their use in establishing geographically deaveraged UNE rates and they lack the functional specificity to allow them to identify the costs of particular UNEs. They are of questionable reliability, and reflect obsolete plant, inefficient plant and investments made in anticipation of service demand that may not have materialized.

In contrast, engineering/economic TELRIC models capture very granular cost information that permits development of accurately deaveraged rates for UNEs. By their nature, TELRIC models are constructed to identify the costs of network components used to provide each network function, as well as identify costs that are shared among network functions. They reliably identify only those costs that would be incurred by an efficient carrier constructing and operating a network to a serve given level of demand, and exclude obsolete plant and plant not needed to meet such demand. By using precise customer location data, TELRIC models can identify the particular quantities and sizes of telephone plant required to provide service, while at the same time accounting for natural obstacles that may affect the cost of network construction. These models also account for local demographic and terrain conditions that affect placement and operations costs. Claims that TELRIC models fail to capture the "real world" costs that are actually faced by an efficient network operator, or that they posit a "hyper-efficient" operation that is

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center locations. This requirement of "scorched node" rather than "greenfield" engineering further restricts TELRIC calculations away from assuming maximum efficiency.

unattainable in reality, are unfounded – because these models are designed to reflect precisely these real world properties.

Appendix

DESCRIPTION OF ENGINEERING/ECONOMIC COST MODELS

1. Overview

TELRIC models currently being used by state and federal regulators to estimate the costs associated with the provision of UNEs are referred to as engineering/economic cost models. They are engineering models in the sense that they employ techniques similar to those employed by network engineers to estimate the material and construction costs that would be incurred to provision a particular network function to serve a particular level of demand. They are economic models in that they estimate the unit prices that are required to recover the capital costs and operating expenses produced by the engineering estimates. Their development process involves:

1) determining the locations and quantities of the network functions that are required;
2) designing network facilities required to serve the posited demand;
3) selecting the physical components that will be placed, determining the prices that vendors charge for those components and the cost that will be incurred in installing the components;
4) determining what network components will be shared among multiple functions and establishing a method for assigning shared investment and expense among functions;
5) estimating the capital cost associated with the investment in plant facilities, including depreciation, return on invested capital, interest on borrowed funds and taxes payable on investors' returns;
6) estimating the operating expenses associated with the plant facilities;
7) estimating the cost of overhead functions such as management, human resources, legal and accounting, and;
8) assigning estimated capital costs, operating expenses and overhead expenses to units of UNE demand.

2. Determining Customer Locations and Demand

The first step in estimating network costs is to determine the location of customers and the types and quantities of services they purchase. Because TELRIC models can use granular data to associate particular service quantities and mixes with particular wire centers – or even particular customers, TELRIC model cost calculations are much more detailed than estimates available from accounting books that are kept only at the study area level. TELRIC models have used a variety of techniques to develop this information – and these techniques have gained in sophistication and precision as the models have evolved. The earliest generation of network cost models used broad-gauge data on population density, such as that reported publicly by the U.S. Bureau of the Census. Because Census Block Groups and Census Blocks are designed to capture a minimum number of households, the geographic areas for which the Census Bureau reports population figures vary considerably – with urban Census Blocks covering an area as small as a single city block, while rural Census Blocks may cover many hundreds of square miles.

Due to the limitations of Census Bureau data, cost models increasingly have turned to the use of geocoded customer location data.[14] In some models, such as the FCC Synthesis Model or Qwest's Integrated Cost Model model, a known number of customer locations is distributed uniformly along the road network within the area served by an ILEC wire center. Other models, such as the HAI Model and BellSouth's BSTLM, use

[14] Geocode data generally consist of very precise latitude and longitude coordinates for the customer location.

actual customer address locations derived from telephone company records or from lists of addresses compiled for use by direct mail advertisers or business directories.

Because information on service demand quantities below the study area level generally is proprietary to the ILECs, early models distributed statewide line counts to household and business locations based on more granular demographic information.[15] Increasingly, models have been adapted to use ILEC-proprietary line counts by wire center (recent versions of the HAI Model) or service demand by customer location (the BSTLM is capable of processing these data).

The fine detail captured in these customer location data provides a clear view of the number of customer lines, their location within the area served by the wire center, and the quantities of various types of services that must be provisioned by the local network.

3. Definition of Serving Areas Within Existing Wire Centers

Telephone customers are not connected directly from their locations to the ILEC wire center. Rather, they are grouped into serving areas served by distribution plant. Each serving area is then connected back to the wire center by feeder plant. Once customer locations and demand quantities have been established, the next step in estimating costs is to define clusters of customers that may comprise a single serving area. Some TELRIC models may define the customer serving areas using mathematical clustering algorithms together with engineering rules governing the maximum length of copper cable and the maximum number of customers that can be connected to a digital

[15] With this technique, more affluent Census Block Groups would be assumed to have a higher second-line penetration than lower-income Census Block Groups. Similarly, business locations heavily dependent on telephone usage (travel agencies, insurance companies) would be assigned more lines than businesses with lower telephone usage (manufacturing plants, for example).

loop carrier remote terminal or serving area interface. Other models may use the actual locations of existing serving area interfaces.

4. Network Design

Once serving areas have been defined, a network must be designed to provide the quantities of services demanded at the particular customer locations in the serving area. This network design must take into account the length of cables required to reach all customers, and sizes and types of cable required to provide the types and quantities of service demanded. A variety of approaches to network design have been taken in engineering/economic cost models, including the assumption of an arbitrary grid overlaying the serving area, calculating the distance along the road network within the serving area, and use of minimum spanning tree algorithms to calculate the length of cable necessary to connect customer locations within the serving area. In each case, the result is a collection of cable lengths and sizes needed to provide the demanded services within the serving area. A similar process is followed to calculate the cable lengths and sizes required to connect serving areas to central offices via the feeder network. It is important to recognize that these TELRIC models tend to assume less efficiency than is actually realizable by real world telephone engineers. Because the models use estimation techniques, such as road surrogates for customer locations and right-angle routing for cable paths, plant distances, and hence costs, are conservatively high.

In addition to calculating cable lengths and sizes, the model also must design supporting structures such as poles, trenches and conduit, as well as any electronic components such as switches needed to provide service. Supporting structure types

generally are specified by user-adjustable inputs, but some models also perform optimization routines to select among alternative structure types. These routines take into consideration the nature of the terrain in which plant is constructed and the relative cost of the various structure types.

A key engineering decision is to determine whether service can be provided using all copper cable or digital loop carrier technology, which transports signals to and from serving areas using fiber optic cable. In making this decision, the cost model must consider the total distance from customer locations within the serving area to the central office and the nature of services demanded by these customers.

5. Estimation of Network Component Investments

Having designed and catalogued the distribution and feeder components required to extend the local network to and within each serving area, the TELRIC model next refers to a list of prices charged by suppliers for the different network components.[16] Costs of engineering and installing these network components and the components required for switching, transport and signaling also must be added. The result is a price-out of all the investments required to place the network into service. This information typically is compiled by the model on a very granular level – with cost calculations available for each serving area, wire center and study area. Because the TELRIC model relates individual investments to the network's specific UNEs and services, the model can then provide an appropriate TELRIC price for each item in each geographic area.

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[16] It should be noted that these input prices typically are based on currently deployed equipment types and current and past input prices charged by manufacturers. That is, they are not based on hypothetical future prices.

6. Estimation of Capital Costs, Operating Expenses and Overheads

The final step in the modeling process is determining the capital costs and operating expenses associated with the operation of the network. Capital costs consist of the return on investors' equity in the telephone plant, corporate income tax on that return, interest on borrowed capital, and depreciation expenses. TELRIC models generally permit all of these parameters to be specified through user-adjustable inputs. Operating expenses consist of expenses for maintaining and repairing network plant ("plant-specific operating expenses"), expenses for office buildings and equipment, computers and computer programs, and the trucks, automobiles, and tools used by employees in operating the network ("general support expenses") and other overhead expenses for the operation of the company as a whole, such as supervision, accounting, human resources and the like ("corporate operations expenses"). Also included are expenses for wholesaling UNEs to CLECs and billing for the purchases of these elements.

Operating expenses may be estimated based on historical expense-to-investment ratios, or may be estimated based on current expenses adjusted for anticipated expense reductions due to the increased productivity enabled by 100% use of modern technology. Some expenses, primarily the plant-specific operating expenses, can be directly assigned to network elements. Others must be assigned using some allocation method, such as proportionately based on directly-assigned expenses, or proportionately based on the number of lines in service, etc. The resulting expense levels are not hyper-efficient. Rather, they reflect the actual expenses incurred, or that may reasonably be incurred, by the ILEC – and include joint and common overheads.

After the total capital costs and operating expenses are estimated for each network element, this total is divided by demand units related to the primary cost driver for each network element (*i.e.*, number of lines, minutes of use, bandwidth supplied) to produce a per-unit recurring cost for each network element. This generates an estimate for per-unit TELRIC that includes both the average incremental cost plus all appropriate joint and common costs.

ALTERNATIVES TO TELRIC ARE INFERIOR AS BASES FOR UNE PRICING

Janusz A. Ordover[1]

1. Introduction

Under the Telecommunications Act of 1996, the Incumbent Local Exchange Carriers (ILECs) are required to lease access to unbundled network elements (UNEs) to the Competitive Local Exchange Carriers (CLECs). The purpose of this unbundling requirement is to permit efficient competitive entry into the provision of local telephone services. For unbundling to accomplish these public-policy objectives, UNE prices must be set at the ILECs' properly calculated economic cost of providing the requested elements. Inefficiencies will inevitably arise if UNE prices are set above or below that level. Not surprisingly, TELRIC-based pricing has been subjected to vigorous critiques from numerous quarters. Various alternative pricing methodologies have been proposed that utilize other possible cost benchmarks in constructing UNE prices. In what follows, I explain why the alternative costing (and pricing) methods that have been offered are either inappropriate as a matter of basic economics or just less effective in accomplishing the objectives of the Telecommunications Act of 1996 than is the forward-looking TELRIC methodology for setting UNE prices.

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[1] Professor of Economics at New York University and former Deputy Assistant Attorney General for Economics at the Antitrust Division, United States Department of Justice.

Before critically analyzing the alternatives, I briefly review the basics of TELRIC methodology.

2. Brief Review of TELRIC Costing and Pricing Methodology[2]

When market forces cannot be relied upon to set market prices efficiently, regulation may be required to accomplish what unimpeded market forces cannot. In this instance, regulators should set prices that closely reflect the incumbents' forward-looking cost of providing the leased facilities while ensuring financial viability of the incumbent and providing proper signals for investments in network infrastructure. TELRIC is a "bottom-up" method of costing and pricing network elements designed to accomplish this goal. As has been demonstrated repeatedly in submissions to the FCC and to the state regulatory commissions, setting prices on the basis of TELRIC offers the best way to balance the goals of competitive entry and the legitimate needs of the incumbents to earn appropriate returns on their investments. Moreover, when properly applied, TELRIC pricing preserves the incentives for investment in the network and innovation in the development of new services.[3]

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[2] For more complete explanations of various aspects of the TELRIC methodology, see essays by William Baumol, Mark Bryant, Richard Clarke, Glenn Hubbard and William Lehr, John Mayo, Terry Murray and Robert Willig in this series.

[3] Briefly, here are the essential mechanics that define the parameters for calculating TELRIC-based prices. TELRIC models calculate the entire (*i.e.*, total) forward-looking cost of providing a network element. The term "long-run" means that all network inputs are variable. That is, long-run forward-looking costs do not depend on past monopoly practices or investments, but instead are calculated on the assumption that *all* costs are "variable" at the time the proxy cost model for the network is run. Under TELRIC, long-run forward-looking costing models reflect current technology and input prices. Generally, the most efficient network investments and practices should be assumed, but under the FCC implementation of TELRIC, existing network nodes are used to "build out" the network rather than using the most efficient network infrastructure throughout. In contrast to short-run cost methodologies, which tend to provide lower estimates of incremental cost for local telephone networks because they do not include fixed costs, TELRIC methodology incorporates all relevant incremental costs. Examples of local telephone costs that

The TELRIC methodology is based on the principle that the "economic cost" of a facility is the cost of replicating the facility's functions using the most efficient technology presently available. No one seriously disputes that the competitive marketplace values assets based on their forward-looking replacement value. In a fully competitive market, a firm cannot expect to recover more than this full economic cost of its operations.[4]

TELRIC incorporates all of the forward-looking costs of constructing and operating an efficient telephone network at a wholesale level. This includes proper charges for depreciation of the physical asset base, risk-adjusted cost of capital and any allowance for needed reserve capacity. As a result, TELRIC-based rates are, by definition, designed fully to compensate ILECs in a manner consistent with the competitive standard for use of their network elements.

Finally, TELRIC models are linked to real network operations. Demand and customer locations used in calculating TELRIC are based on real world data, much of it provided by the ILECs. The technologies assumed are those actually being deployed in ILEC networks. Input prices are derived from public sources. Thus, TELRIC models are

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do not generally increase substantially (or at all) with increased output are costs of poles, conduits, fiber cables, switch processors, etc. In addition, TELRIC methodology assumes that the network is optimally scaled to serve current demand with adequate reserve capacity and charges all users for the assets (network) in place.

[4] Obviously, in the presence of anticipated technological progress (which may entail falling prices for certain electronic components of infrastructure such as switches, and rising prices for outside plant components such as cables), adjustments to pricing have to be made in order to reflect these economic events. Such adjustments are not, however, contrary to the properly-construed TELRIC methodology. Economic costs incorporate those cost changes that are expected to result from technical progress, and because UNE pricing is directed to track economic costs, such concerns are already accommodated by the Commission's TELRIC rules.

firmly grounded in the real world through real-world inputs and real-world engineering assumptions.

3. Alternative Methods For Calculating UNE Prices Are Flawed

Several methodologies have been advanced as alternatives to TELRIC for the calculation of forward-looking economic costs.

A. Embedded Costs

At times, the ILECs have argued for an embedded cost methodology to determine network element prices.[5] But well-understood weaknesses of embedded cost methodologies have made them an unacceptable choice. A threshold problem plaguing all embedded cost methodologies is that they rely on ILEC books of account. These books are maintained for purposes different from providing the needed costing information for setting forward-looking prices. These accounting costs are subject to backward-looking accounting issues and other manipulations, and at best reflect the past costs of a network that may have been engineered for purposes different from a network that is efficient for leasing assets at wholesale.

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[5] As noted by the U.S. Supreme Court in *Verizon v. FCC,* 535 U.S. 467 (2002) at 26 (*"Verizon"):*

> The incumbents … claim that the cost of providing a competitor with a network element in the future must be calculated using the incumbent's past investment in the element and the means of providing it. They contend that "cost" in the statute refers to "historical" cost, which they define as "what was in fact paid" for a capital asset, as distinct from "value," or "the price that would be paid on the open market." Brief for Petitioners in No. 00-511, p. 19. They say that the technical meaning of "cost" is "past capital expenditure," *ibid.*, and they suggest an equation between "historical" and "embedded" costs, *id.*, at 20, which the FCC defines as "the costs that the incumbent LEC incurred in the past and that are recorded in the incumbent LEC's books of accounts," 47 CFR §51.505(d)(1) (1997).

ILECs have argued that the embedded cost models are superior because of their simplicity. However, embedded cost models are at least as complex as TELRIC models, rely heavily on simplifying modeling assumptions, and engender the same kinds of "battles of the experts" that may occur in any contested cost case. Indeed, embedded cost studies may be *more* complex and potentially *more* subject to manipulation than TELRIC studies. The main problem, as might be expected, is that the ILECs' books of account are not neatly maintained on an element-by-element basis. As a result, to make use of embedded cost data to derive UNE prices, regulators would be forced to employ complex modeling, sampling techniques, and ultimately arbitrary assumptions. Thus, it is wrong to claim that embedded cost studies conveniently reflect the expenditures that ILECs will have to incur to provide unbundled network elements.[6]

The ILECs also claim that embedded cost prices are superior because they result in revenues that match their embedded costs – in contrast to TELRIC prices that the

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[6] The Supreme Court put this erroneous line of argument to rest in *Verizon* when it concluded:

> Finally, as to the incumbents' accusation that TELRIC is too complicated to be practical, a criticism at least as telling can be leveled at traditional ratemaking methodologies and the alternatives proffered. "One important potential advantage of the TELRIC approach, however, is its relative ease of calculation. Rather than estimate costs reflecting the present [incumbent] network – a difficult task even if [incumbents] provided reliable data – it is possible to generate TELRIC estimates based on a 'green field' approach, which assumes construction of a network from scratch." To the extent that the traditional public-utility model generally relied on embedded costs, similar sorts of complexity in reckoning were exacerbated by an asymmetry of information, much to the utilities' benefit. And what we see from the record suggests that TELRIC rate proceedings are surprisingly smooth-running affairs, with incumbents and competitors typically presenting two conflicting economic models supported by expert testimony, and state commissioners customarily assigning rates based on some predictions from one model and others from its counterpart. At bottom, battles of experts are bound to be part of any ratesetting scheme, and the FCC was reasonable to prefer TELRIC over alternative fixed-cost schemes that preserve home-field advantages for the incumbents. (*Verizon* at p. 51)

ILECs allege to be well below their purported embedded costs. These claims are neither compelling, nor germane.[7]

To start, there is ample reason to doubt the accuracy of the ILECs' accounting records as they pertain to regulated services. Accounting separations between regulated and unregulated expenses and investment are inherently arbitrary, and the ILECs have incentives to shift costs into the "regulated" portion of their activities. Furthermore, due to widespread adoption of price cap regimes and other forms of pricing flexibility, less and less regulatory attention is directed to ensure the accuracy of the costs that ILECs enter on their regulatory accounting books.[8] Indeed, the ILECs themselves have been among the harshest critics of any reliance upon their regulatory accounting books for pricing their competitive services and have relentlessly (and successfully) pressed to decrease the amount of accounting information they report.[9]

Moreover, actual ILEC networks are configured to produce a whole range of services such as Centrex and long distance that are offered by the ILECs in addition to their wholesale local network services. It is not straightforward (even if feasible) to

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[7] If the reliance on TELRIC leads to some stranding of ILEC investment – a debatable proposition that the ILECs have declined to support with direct data – then these stranded costs should be recovered outside of the UNE-pricing process.

[8] Indeed, FCC audits have found that much equipment still listed on ILEC books of account could not be located. *See* Federal Communications Commission, *Notice of Inquiry in CC Docket No. 99-117 and ASD File No. 99-22*, 14 FCC Rcd 7019 (released April 7, 1999). The FCC terminated its investigation into these audits on the grounds that substantial rate cuts had occurred since the audits were performed. In doing so, however, the FCC explicitly did not preclude the state commissions from investigating further. Federal Communication Commission , *Second Report and Order in CC Docket No. 99-137 and Order in CC Docket No 99-117 and AAD File No. 98-26*, 16 FCC Rcd 4083, (released November 7, 2000), ¶ 12.

[9] *See*, Federal Communications Commission, *Report and Order in CC Docket Nos. 00-199, 97-212 and 80-286*16 FCC Rcd 4083, (released October 11, 2001) (eliminating 132 of the 296 accounts previously reported by Class A carriers).

develop accurately the cost of local network elements from ILEC accounting books that record only aggregate costs.

ILEC networks also include the expenses and investments associated with retail marketing, customer care and billing services. Existing accounting mechanisms are not capable of clearly disentangling these retail expenses from those incurred to provide local network elements.

Similarly, ILEC accounting books reflect investments well beyond those needed to supply UNEs. These extra investments can be substantial. Take the example of Centrex. This service requires a dedicated wire pair for each line served. When installing capacity to serve a commercial building, ILECs typically install a sufficient number of loops to provide Centrex service. In contrast, competing PBX-based services can serve multiple lines with many fewer loop facilities. Nevertheless, the ILECs have invested in additional loop facilities to give their customers the option of purchasing Centrex, even though providing this option is expensive and not properly recovered in UNE rates.

But the fact that such investment decisions by the ILEC may result in their embedded books displaying costs that exceed TELRIC for UNEs does not prove that TELRIC is defective. Rather, it confirms that the ILECs' "actual" networks cannot be an appropriate basis for determining the forward-looking economic costs of wholesale local network elements.

Additionally, accounting costs as carried on the books of an ILEC will reflect any existing inefficiencies in the network. Actual networks may involve construction and

design practices that evolved in a world where competitive and regulatory pressures to be efficient were inadequate – either under rate of return regulation or price cap regulation. Furthermore, these accounting costs may reflect the incentives that the ILECs have to shift costs to their regulated operations. The Supreme Court recognized that inherent inefficiencies and the incentive to shift costs compelled a finding that embedded cost methods are a flawed basis for the setting of UNE rates.[10] Ultimately, UNE prices set at embedded costs that would exceed TELRIC would have a negative impact on competitive entry, as the Supreme Court fully understood:

> . . . a lease rate that compensates the lessor for some degree of existing inefficiency (at least from the perspective of the long run) is simply a higher rate, and the difference between such a higher rate and the TELRIC rate could be the difference that keeps a potential competitor from entering the market. (*Verizon* at p. 38)

In sum, I believe that the FCC properly concluded TELRIC to be superior to embedded cost methodologies for the task at hand.

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[10] As the Court stated:

> As for an embedded-cost methodology, the problem with a method that relies in any part on historical cost, the cost the incumbents say they actually incur in leasing network elements, is that it will pass on to lessees the difference between most-efficient cost and embedded cost. Any such cost difference is an inefficiency, whether caused by poor management resulting in higher operating costs or poor investment strategies that have inflated capital and depreciation. If leased elements were priced according to embedded costs, the incumbents could pass these inefficiencies to competitors in need of their wholesale elements, and to that extent defeat the competitive purpose of forcing efficient choices on all carriers whether incumbents or entrants. The upshot would be higher retail prices consumers would have to pay. There are, of course, objections other than inefficiency to any method of ratemaking that relies on embedded costs as allegedly reflected in incumbents book-cost data, with the possibilities for manipulation this presents. Even if incumbents have built and are operating leased elements at economically efficient costs, the temptation would remain to overstate book costs to ratemaking commissions and so perpetuate the intractable problems that led to the price-cap innovation. (*Verizon* at pp. 40-41, footnote and references to FCC Order omitted)

B. Efficient Component Pricing Rule (ECPR)

Some ILECs' economic experts have advocated the use of the efficient component pricing rule (ECPR) or a modified version of that rule (i.e., M-ECPR).[11] While the ECPR has many desirable features, and provides a plausible benchmark for wholesale rates when retail market pricing is already competitive, it is not a preferred methodology for UNE pricing,[12] as my colleagues, Professors William Baumol, Robert Willig, and I have shown in various submissions to the FCC.

ECPR sets wholesale rates based on retail rates that are in place. This is because the ECPR-based rates are "backed-out" of retail rates by subtracting those costs that would be avoided if the incumbent were to exit the retail function. For the ECPR to lead to efficient outcomes, retail rates must themselves be efficient and cost-based.

Unfortunately, retail pricing in the telecommunications network bears little relation to cost and therefore application of the ECPR would lead to a perpetuation of the existing inefficiencies rather than paving the way for efficient pricing, competitive entry and use of the existing network. Indeed, one of the beneficial effects of cost-based wholesale rates is that it would inevitably create pressures to rebalance retail rates to bring them closer in line with costs. We have enjoyed just such a result as CLECs have entered local markets using UNEs and induced ILECs to respond by lowering their

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[11] Sidak, G. and Spulber, D. *The Tragedy of the Telecommons: Government Pricing of Unbundled Network Elements Under the Telecommunications Act of 1996*, 97 Columbia Law Review 1081 (1997). For the purposes at issue in this analysis, there is no practical difference between the ECPR and the M-ECPR. Thus, I will refer to these methods strictly as the ECPR.

[12] Resale pricing under Section 252(d)(3) of the Act is based on ECPR.

prices. However, this salutary result from competition would not have occurred if UNE prices had been based on ECPR.

In my submission to the FCC with Professors William Baumol and Robert Willig in 1996 in the *Local Competition* proceeding, we explained in more detail why the ECPR is inappropriate in the current telecommunications environment.[13] Both the FCC and now the Supreme Court have agreed with this analysis. Indeed, the Supreme Court rejected ECPR as unlawful because it transmits existing inefficiencies in retail rates and provides no means for their elimination:

> We conclude that ECPR is an improper method for setting prices of interconnection and unbundled network elements because the existing retail prices that would be used to compute incremental opportunity costs under ECPR are not cost-based. Moreover, the ECPR does not provide any mechanism for moving prices towards competitive levels; it simply takes prices as given. In effect, the adjustment for opportunity cost, because it turns on pre-existing retail prices generated by embedded costs, would pass on the same inefficiencies and be vulnerable to the same asymmetries of information in ratemaking as a straightforward embedded-cost scheme. (*Verizon* at pp. 42-43, footnote and reference to FCC Order omitted)

C. Ramsey Pricing

Another alternative proffered by the ILECs, so-called "Ramsey pricing," was rejected by the FCC because it would tend to impose higher mark-ups over costs on loop-related network elements, due to the fact that demand for those facilities is relatively price inelastic. Under the Ramsey pricing principles, it is those services whose demand is the least sensitive to price changes that are required to contribute the most to the recovery of the supplier's joint and common costs. Since there are few (or no) alternatives to loop-

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[13] *See* Affidavit of William J. Baumol, Janusz A. Ordover and Robert D. Willig, May 14, 1996, filed as Appendix C with Comments of AT&T Corp. in CC Docket No. 96-98, May 16, 1996.

related services, the demand for these services is the most inelastic. But because the application of the Ramsey pricing rule would mark up to a greater degree prices for those network elements that are most required for competitive entry, it would run counter to the avowed, pro-competitive policy of the FCC.

As the Supreme Court has correctly observed,

> . . . this very feature appears to be a drawback when used as a method of setting rates for the wholesale market in unbundled network elements. Because the elements for which demand among entrants will be highest are the costly bottleneck elements, duplication of which is neither likely nor desired, high lease rates for these elements would be the rates most likely to deter market entry . . . (*Verizon* at p. 44)

Thus, the application of Ramsey pricing principles to network elements would have the perverse effect of discouraging the leasing of the network elements that are most critical to entrants because they are the least susceptible to competitive supply.

D. So-called "Actual" Costs

The ILECs have advocated yet another method for calculating the cost of UNEs that they have dubbed "actual forward-looking cost" or "actual incremental cost."[14] They claim that this method captures more realistically the "actual" costs that the ILECs incur to provide UNEs, and therefore is superior to TELRIC which they deride as calculating only "hypothetical" costs. Despite the superficial appeal implied by its title, "actual cost" methodologies are neither well-defined, nor are they reasonable – even as theoretical substitutes for TELRIC.

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[14] *See* Alfred E. Kahn, "Whom the Gods Would Destroy, Or How Not to Deregulate," AEI-Brookings Institute Joint Center For Regulatory Studies, Washington, D.C., 2001 ("*Kahn*"); and John Thorne, "The 1996 Telecommunications Act: What Went Wrong and Protecting the Broadband Buildout," unpublished manuscript, 2001.

First, it is unclear as to what the ILECs exactly mean when they speak of "actual cost." From an economist's perspective, economic costs *are* the firm's actual costs. Thus, "actual costs" would be the firm's forward-looking economic costs, or TELRIC. But because the ILECs have proffered the "actual cost" methodology as an alternative to TELRIC, they must have a different meaning of "actual" in mind.

The meaning of "actual cost" becomes even more unclear when it is understood that to its advocates this cost concept is intended to represent *incremental* costs, as in the "actual incremental cost."[15] But the only types of "actual" costs that are incremental are those that are either *currently* being incurred, or *will be* incurred over some given future time period, in connection with the provision of a well-defined increment of output. Depending on the firm's planning horizon, this time period could be as short as one year (i.e., a period during which all of the firm's capital is assumed to stay fixed), or even as long as thirty to fifty years (i.e., the time it takes for all of the firm's existing capital to depreciate away and to be replaced with properly scaled amounts of physical and other assets).

The two points to note from this are that: (1) incremental costs must be efficient costs – because it is implausible to assume that a firm will make suboptimal current or future investment decisions as long as it is not facing distorted market signals; and (2) costs associated with investments that are fixed (and sunk) and will not be replaced over the planning period can be disregarded and do not have to be reflected in short-term

[15] *Kahn*, p. 4.

prices.[16] Thus, in order to determine what the ILECs might possibly mean by "actual incremental costs" it is necessary to identify the time period over which they propose that such costs should be calculated. If the ILECs intend to suggest that "actual incremental costs" should be calculated only over the short-run, this would certainly be a competitively appropriate basis for pricing UNEs. However, it is doubtful that this is what the ILECs really mean, because in the telecommunications industry large amounts of investment must remain fixed over the short-run, and the costs of this fixed plant would not be permitted to be reflected in their pricing.[17] On the other hand, if the ILECs proposal means that "actual incremental costs" be measured over the long-run, then (because one must assume that the ILECs will deploy their investment efficiently in the future) "actual incremental costs" reduce to TELRIC.[18]

Thus, it is clear that "actual forward-looking" or "actual incremental" costs as viewed from an economist's perspective cannot be what the ILECs propose as a replacement for TELRIC – unless the ILECs intend for substantial portions of their fixed investments to be unrecompensed, or recompensed only through a massive, new subsidy fund. Rather, it is likely that the ILECs intend "actual forward-looking costs" to be an

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[16] To illustrate, assume that the ILEC has sunk K units of fixed capital and the current opportunity cost (rental rate) for the unit of capital is r. Hence, the ILEC incurs $\$rK$ in capital expenses. In addition, assume that non-capital variable cost of a unit of output is $\$m$. Hence, in the short-run, the price of the unit of output (lease rate for the UNE) can be also low as $\$m$, provided that the total demand does not exceed the capacity of ILEC's sunk capital base.

[17] *Kahn*, pp. 12-13 and accompanying footnotes, appears to propose that ILECs be afforded full recovery of any shortfall between their incremental costs and their embedded costs through some supplementary subsidy mechanism.

[18] Note that it matters little if the planning horizon over which "actual incremental costs" are calculated is shorter than the apocryphal "long run." Because the costs of any plant that need not be replaced over such an "intermediate" run are excluded from "actual incremental costs," either such costs would go unrecovered or will have to be recompensed from a separate subsidy fund.

amalgam of the short or intermediate run incremental costs they expect to incur *plus* some contrived calculation of the (embedded) costs of their fixed investments (that would not actually be replaced) over this planning period. This, of course, presents two problems. The first is that such putative investment costs surely are not incremental. Therefore, it is an abuse of terminology by the ILECs to incorporate such investment costs into an incremental cost pricing construct. The second is that there is no appropriate way to value these pre-existing investments, unless these investments are valued at their proper economic cost.

There are a few methods that the ILECs might propose to accomplish this impossible feat. One is to assume that this fixed investment will just be valued at its embedded cost, which I have already rejected as improper. Use of this unabashedly non-forward-looking valuation method would result in pricing that is based largely on nothing other than old embedded costs.[19] And embedded cost pricing, as I have pointed out earlier, is profoundly inefficient and uneconomic.[20]

A second method would be to value this investment at its reproduction cost. Reproduction cost is the cost that would be paid today to reproduce in exact form physical plant that would not otherwise be replaced over the planning period. Although this method eschews the use of embedded costs, and thus may appear to be forward-looking, it is plainly defective.

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[19] Rather than being 100% embedded cost pricing, this methodology would result in pricing that is partially forward-looking (for the near-term costs) and partially embedded (for the longer-term costs). Because the longer-term costs are likely to be very substantial, the net result is substantially embedded cost pricing.

[20] A matter of some interest would be whether the non-replaced plant would be valued at its full, original embedded cost – or whether this non-replaced plant would be valued only at its current depreciated embedded cost.

This is because telecommunications plant has "value" only because of what it can produce; it matters not at all what it cost was when it was installed – or what it would cost today to install exactly what was installed yesterday. While this fact alone makes reproduction cost inappropriate for pricing, this method has still further defects. Because of changes in the external environment or technology over time, firms would likely never choose to replicate the exact same network today (or in the future) as they selected in the past. Modern cable design and plowing technique make it efficient for pre-existing aerial cables to be replaced by buried cables, and advances in fiber optic technology make it efficient for this technology to replace many pre-existing copper cables. Furthermore, the cost of reproducing current embedded plant may bear little resemblance either to what it cost in the past to acquire this old plant, or to what it costs today to duplicate the capabilities of this plant.[21]

The final method that might be used to value the ILECs' investments that would remain fixed over their planning horizon is replacement cost. This is the cost that would have to be incurred to duplicate the product-producing functionality of these investments. But this brings us full circle. The economic cost to duplicate this functionality is based on the cost entailed in acquiring the cheapest, most efficient plant currently available that is capable of providing these services. But this, of course, is TELRIC. Thus, we are left

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[21] For example, many pieces of equipment in existing networks are no longer in production, and thus are no longer generally available. Other pieces may be in a dilapidated state such that no precise replicas exist for purchase. But in any event, calculating the reproduction cost of something makes sense only when that item has sentimental or artistic value that is all its own (*e.g.*, the cost of restoring the Palace of Versailles to its Louis XIV splendor or a Frank Lloyd Wright house to its original craftsman condition). Because telephone networks exist exclusively to provide telecommunications services and are not significant works of art or sentimental objects for their own sake, their value is based only on the facility and efficiency with which they offer telecommunications services – and not on the cost of reproducing their clone.

with the inexorable conclusion that if any "actual cost" concept is to have a sound economic basis and the ability to capture all fixed and variable costs associated with the provision of UNEs, this cost concept must reduce to TELRIC.

4. Conclusion

Many cost-cum-pricing methodologies have been proposed over the years in response to the Act's mandate that the ILECs lease their network elements. But under closer examination, all but TELRIC are shown to be deficient in properly identifying the efficient economic costs of providing UNEs. In contrast, TELRIC methodology, which has been subjected to immense scrutiny, has shown itself to be not only sound as a matter of economics and public policy but also readily implementable. Contrary to some critics, application of TELRIC methodology has not dissuaded investment by ILECs in the network and has not dissuaded CLECs from building their own facilities. And, unlike the embedded cost models and so-called "actual" cost concepts suggested by the ILECs, TELRIC methodology is less subject to data problems, gaming and manipulation. In my opinion, TELRIC is the best methodology for setting network element prices.

TELRIC-based UNE prices provide a sound public policy tool for balancing the need to open up a monopoly network to efficient competition while ensuring adequate compensation for risky investments. These facts have been adduced by proper economic analysis, noted by the FCC in its Local Competition Order, and have now been affirmed by the Supreme Court. While there may be some adjustments to the implementation of TELRIC that could improve its accuracy in representing the economic cost of UNE provision, these appear just to be minor tweaks in input values and methodology. There

is no question but that TELRIC pricing of interconnection and UNEs both should remain the bedrock foundation of the FCC's procompetitive policies designed to abolish the last bastion of monopoly in the provision of telecommunications services.