Before the

FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Review of the Commission's Rule	)	
Regarding the Pricing of Unbundled	)	
Network Elements and the	)	WC Docket No. 03-173
Resale of Service by Incumbent	)	
Local Exchange Carriers	)	

REPLY DECLARATION OF MICHAEL D. PELCOVITS ON BEHALF OF MCI

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I. INTRODUCTION

My name is Michael D. Pelcovits. I am a principal with the consulting firm of Microeconomic Consulting and Research Associates (MiCRA). I prepared a declaration on behalf of MCI, which was submitted along with MCI's initial comments in this proceeding on December 16, 2003.

The purpose of my reply declaration is to address some of the issues raised in the comments of several of the ILECs and in the economists' declarations sponsored by these parties. The issues and arguments raised in these filings are not new. There are no new economic concepts or discoveries, or a previously untapped well of data that bring new light to the arguments that the ILECs and their economists have made time and time again over the last eight or more years. Therefore, I will not attempt to cover every one of the ILECs' arguments, but instead focus on a few key conceptual points that have become the ILECs' *arguments du jour*.

My declaration is organized as follows. Section II will address several issues related to the underlying theoretical construct of TELRIC. I will rebut three of the fallacies propounded in the ILECs' comments and declarations.

<u>Fallacy #1</u>: TELRIC is inconsistent because it assumes that the ILEC can achieve all of the efficiency benefits of being a monopolist, but requires them to price at the same level as a competitive firm.

Fallacy #2: TELRIC assumes a level of efficiency that could never be achieved by any real-world firm.

Fallacy #3: Economically meaningful cost estimates can be developed based upon contemporaneous measures of ILEC incremental investments.

In Section III I will address the ILECs' argument that TELRIC costs must be bumped up to include an allowance for the real option value of their irreversible investments in the network. The ILECs made this argument in 1996, where Professor Hausman claimed that TELRIC costs would be underestimated by a factor of two or three because of the exclusion of the option value.[1] The Commission rejected this argument then, and it should reject it now. The Declaration and accompanying paper by Professor Pindyck provide no new evidence supporting a real option add-on. Indeed, the real option model, which is the "new" evidence presented in Pindyck's paper, proves the opposite of his assertion. The real option add-on estimated by the model is simply a mechanism to guarantee the ILECs' profits when they are faced with competition in the retail market from more efficient CLECs.

II. THEORETICAL ATTACKS ON TELRIC

The ILECs' arguments fail to raise any new conceptual problems with TELRIC. In large part, the conceptual attacks on TELRIC attack a strawman that does not exist, and propose an alternative hypothetical costing approach that would turn the clock back to the bad old days of "trust me, I'm the phone company and I know best" approach to costing.

[1] See, Reply Affidavit of Jerry A. Hausman, Attachment 1 to USTA Reply Comments, CC Docket 96-98.

A. Fallacy Number 1: The FCC was wrong to apply a competitive market standard to a monopoly's regulated rates

The ILECs claim that there is a serious internal contradiction in the current TELRIC methodology in that it assumes "that the carrier whose cost has to be estimated has a ubiquitous market presence and enjoys all the economies of scale and scope associated with such a carrier, yet the methodology also assumes a competitive marketplace…"[2] According to the ILECs, TELRIC constitutes a "heads you win, tails I lose" scenario.[3] On the one hand, they must abide by a pricing standard derived from the behavior of firms in a competitive market. On the other hand, the cost-basis for the price controls must come from a model of a monopoly that enjoys all of the benefits of scale and scope economies.

At its most basic level, the ILEC position ignores the entire rationale for public utility regulation. The primary purpose of regulation is to control the market power of a monopoly or highly dominant firm in its industry. Absent regulation, the monopoly or dominant firm will restrict output and raise prices in order to maximize its own profits. In economic parlance, the monopolist will set inefficient prices and cause the industry to perform sub-optimally. In plain terms, the monopoly will harm consumers and distort competition in adjacent markets.

The goal of regulation, therefore, is to force the monopoly firm to set prices at efficient levels, to maximize social welfare, not profits. This is achieved when prices are set at marginal cost, because at any price in excess of marginal cost, consumers are being

[2] Declaration of NERA Economic Consulting On Behalf of BellSouth, at v.
[3] BellSouth Comments, at 11.

denied the ability to buy something for which their desire-to-pay exceeds the cost of production. There are many nuances to this rule relating to the fact that prices must be set above marginal cost to allow the regulated firm to recover its fixed cost. Nevertheless, the regulator should target the price controls to the most efficient outcome possible, and in shorthand we can say that the goal of price regulation is cost-based pricing.

Economics also describes certain features of a competitive market. When there is robust competition in a market, we should expect that efficient, cost-based prices will prevail. This is a result of the "invisible hand" of marketplace forces, which cause the entrepreneur, who, as recognized by Adam Smith in 1776, "neither intends to promote the public interest, nor knows how much he is promoting it" but "intends only his own gain," and is "led by an invisible hand to promote an end which was no part of his intention."[4] Another way of putting this point is that the competitive entrepreneur is no more interested in the public welfare than the monopolist. The difference between the two is that the competitive entrepreneur has no choice but to sell at cost-based rates, and thereby, unintentionally promote the public interest.

Public utility regulation shares the same intended endpoint, i.e. cost-based pricing, as is achieved automatically in a competitive market. This is not the same as saying that the goalposts of regulation are set by hypothesizing that the regulated market is fully competitive. Rather, the goal of regulation is to compel the monopolist to set prices (and provide the quantity and quality of services) that promote the public interest. The

[4] Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations*, Modern Library Edition , at 423.

intended market outcome has similar, if not identical, efficiency properties as a competitive industry, but that does not mean that the regulator can actually change the structure of a market from monopoly to competition.

Therefore, it is a mistake to say that there is an inherent contradiction in the TELRIC rules, because the ILEC should not and cannot be compelled to be a monopoly and competitive firm all at one time. Rather, the FCC should expect the ILEC to remain a monopoly (or dominant firm), precisely because of its unique economies of scale and scope. Otherwise, there would be little point in regulating the ILECs. And the cost-based pricing standard that the FCC should continue to impose on the ILECs is derived, and should continue to be derived, from the principles of economic efficiency. TELRIC pricing will mimic the pricing outcome of a competitive market, but it does not change the status of the ILEC from one type of firm into another.

B. Fallacy #2: TELRIC assumes a level of efficiency that could never be achieved by any real-world firm

TELRIC models have been attacked as hypothetical and inapplicable to the "real world" where the ILECs are constrained in their future choices by existing, long-lived assets that "cannot be instantaneously replaced every period."[5] This criticism is leveled at several features of the TELRIC models, especially in their choice of outside plant type, routes, and fill factors. But the so-called "hypothetical" nature of TELRIC is an inevitable part of any valid model. The only possible alternative to the hypothetical nature of TELRIC is to accept spoon-fed assertions by the ILECs about the nature of their so-called "actual network."

[5] See, for example, Debra Aron and William Rogerson, "The Economics of UNE Pricing," filed with SBC's Comments in Docket 03-173, at 7.

One variant of this argument against TELRIC is that it is inappropriate to use the cost of the latest generation equipment to value the existing network, because their choice of new equipment is constrained by their existing network. To take an example, the ILECs claim that it is improper to value digital loop carrier equipment based upon the more recent IDLC equipment, because their existing switches can only accommodate the older UDLC equipment. They say that it is cheaper for them to buy UDLC equipment and keep their existing switches, than to replace their switches entirely and then buy IDLC equipment.

The fallacy of this argument is that it ignores the fact that the correct economic value of the old switch/UDLC combination declines when the new technology becomes available. For example, the value of an old computer will decline if it becomes incompatible with new peripherals. To the extent the ILECs are attempting to capture the original value of the computer in their models, they are attempting to capture embedded costs. To the extent they are saying that a cost model should account for possible future decreases in value, I would agree that this effect should be reflected in the depreciation factors used in a TELRIC study. But it does not imply that anything is wrong with the TELRIC methodology.

As I explained in my initial declaration, the purpose of TELRIC is to estimate the current market value of a local telephone network. This task can be approached in two ways. The first way, which is the TELRIC way, is to model a replacement network using the current, observed prices for the capital equipment. The second way is to estimate the market value of the embedded ILEC plant. There is no inherent conflict between these

two approaches, because the value of an existing asset, in a fully competitive or contestable market, is determined by its replacement cost. The primary reason that regulatory cost models use replacement cost as a valuation technique is that it is completely impractical to revalue all of the types and vintages of equipment used by existing networks and because only the ILECs have the necessary information about their networks. In addition, revaluation of the existing network could only fulfill the regulatory goal of setting prices at efficient levels if the existing network was properly sized to provide the quantity and type of network elements actually needed. Finally, revaluation of the existing network based on market prices of existing equipment sized correctly, even if performed with perfect information, would not necessarily correctly value the network. If, for example, there were a severe shortage of copper, the cost of replacing copper loops would not properly reflect their economic value in a telecommunications network if these loops could more cheaply be replaced with fiber.

The critics' attack on TELRIC as a hypothetical construct, thus, misses the point. TELRIC models do not assume that the existing network will be constantly ripped out and replaced. Rather, the TELRIC methodology uses the blueprint of a newly placed network to develop a market-defined value of the network that now exists.

The more sophisticated critics attack the efficiency assumption of TELRIC, and claim that the models fail to capture the ever-changing nature of the marketplace and actions taken by real-world firms to optimize production in a market where the conditions for which they are planning can change in unexpected ways. There is some degree of truth to the criticism. The models are based on an engineering blueprint of a hypothetical

network. However, this does not invalidate the use of models for regulatory rate setting. The reason for modeling abstractions is not to "put one over on the regulated firm," but that it is simply impossible to capture much of the dynamic nature of markets in a workable model. This would be comparable to trying to capture a year-long movie on the memory card of a digital still camera. Models are just not that good. They must resemble a snapshot of the world, captured in a single 128 Megabit memory card. Assumptions and simplification are necessary to develop a workable and tractable model of local telecommunications networks.

The proper question is whether the TELRIC models actually in use in the states have made reasonable assumptions. The answer is yes, with respect to all of the major criticisms. I will attempt to demonstrate this point by referring to the way in which the models handle the fill factors for distribution cable.

Distribution cable is among the most long-lived of all telephone company assets, and decisions made in the past constrain future choices very significantly. It almost never makes sense to re-size and replace distribution cable at regular intervals. Rather, the telephone company must size distribution cable to handle present and anticipated demand. Since, as the critics correctly argue, it is impossible to predict the future, because of growth and the stochastic nature of the demand for lines, the amount of distribution cable in place at any one time will not be optimal. They assert, therefore, that a model based upon an assumption that the hypothetical network is perfectly efficient to serve a snapshot of current demand will impose an unrealistic benchmark for any ILEC.

But TELRIC models do not impose this requirement on the "hypothetical network." Rather, they build in a reasonable level of spare capacity to handle the real-world limitations on efficiency, including even spare that accounts for some growth. For example, the most recent version of the HAI model uses distribution cable sizing factors of 75%.[6] This means that the distribution cable is designed to handle 33% additional lines above current demand,[7] which is very reasonable, particularly in light of two features of the model.

First, the model does not spread any of the cost of the spare capacity it includes for growth to future customers. If the models were not erring on the conservative side, they would have to estimate the precise amount of additional capacity needed for growth and then assign the additional cost of this capacity to future ratepayers. While the long-running video model could handle this complication, actual models are not that sophisticated. Therefore, they should not be criticized for neglecting growth spare (or for providing less growth spare than exists in the ILECs' networks), unless and until an alternative dynamic model is provided to capture both the demand and cost side of growth.

Second, the actual fill factors **achieved** in the models is much less than **design fill factor** of 75%. The reason is that the size of the actual cable installed in the model is "rounded up" to the nearest size cable **actually available to be used** in local telephone plant.[8] This will result in achieved fill in the range of 50% to 65%.[9] Translated into a

[6] HAI Model Release 5.3, Inputs Portfolio, HAI Consulting Inc. December 12, 2002, at 36.
[7] This is calculated by taking the ratio the total capacity of 100 units to the demand of 75 units, which is the meaning of a 75% fill factor.
[8] Copper cable is available in sizes of 6, 12, 25, 50, 100, 200, 400, 600, 900 pair, and so on.

measure of excess of capacity above actual demand, this implies that anywhere from a 54% to 100% increase in demand above current levels can be served on the network built by the HAI model. It is hard to imagine that this efficiency target is beyond the reach of a real-world local telephone company.

This is one example demonstrating that the TELRIC models actually used in state proceedings do not impose unrealistic efficiency assumptions.[10] The CLECs have already responded to other objections in many forums. The state commissions have heard the evidence about the models and have required changes to the model assumptions and inputs, where they believed it was necessary. The strawman of a impossibly efficient TELRIC model simply does not exist, and the Commission should ignore criticisms of TELRIC that do not apply to the actual models now in use.

C. Fallacy #3: Economically meaningful cost estimates can be developed based upon contemporaneous measures of ILEC incremental investments

The more things change, the more they stay the same. The ILECs began criticizing the "hypothetical" nature of forward-looking economic cost models even before passage of the 1996 Telecommunications Act and the Commission's decision in CC Docket 96-98.[11] There were two alternative cost model approaches available back then, and there are still only two available now: (1) embedded cost models, or (2) long

[9] HAI Model Release 5.3, at 36, n.9.
[10] I presented other examples in my declaration of December 16, 2003.
[11] For example, critics attacked the early Hatfield cost models as relevant only to Bosnia and Kuwait, because those were the only countries that were building a network from scratch. The retort to this claim is that it was disconcerting to think that a customer had to move to Bosnia or Kuwait to get inexpensive telephone service.

run incremental cost (LRIC) models. In the past, the ILECs blended these two costing approaches to suit their pricing goals. The embedded cost models were used to justify the residual pricing approach that guaranteed their revenue requirement and profit levels. LRIC models were used to set price floors for more competitive services (e.g. toll, Centrex, CPE).[12]

The ILEC's current proposals to replace TELRIC mirror these two approaches of the past. Alternative number one is to "revalue" the embedded network based on estimates of replacement cost.[13] Although theoretically attractive, in practice this approach would abandon efficiency properties and eliminate the ability of other parties or the Commission to validate or verify the "black box" nature of the ILECs' accounting and continuing property records. Any difference between this approach and the embedded cost models rejected by the Commission in the past is purely cosmetic.

Alternative number two, as described by Dr. Shelanski, is to estimate the "long-run incremental cost the incumbent will incur to add capacity to its network."[14] At first blush, Dr. Shelanski appears to be describing the time-honored method used by the ILECs to estimate the costs of their competitive services. As I explained in my initial declaration, prices set at long run incremental cost can encourage efficient use of a telephone network under the conditions in place after the Triennial Review Order. I

[12] The ILECs argued that so long as the price of a competitive service was set above long run incremental cost, it would satisfy the regulatory objectives of being compensatory (and therefore not burdening local ratepayers) and not predatory towards competitors.
[13] See, for example, Declaration of Howard Shelanski, Submitted in Support of the Comments of the Verizon Telephone Companies, in WC Docket No. 03-173, ¶¶21-26.
[14] *Id,* ¶27.

would be hard-pressed to disagree with Dr. Shelanski, if indeed, he were proposing to set UNE prices at LRIC.

A properly done LRIC study, however, should produce cost results well below TELRIC for two reasons. First, the ILECs' embedded network has substantial excess capacity, which is "free" on a going-forward LRIC-basis. TELRIC, on the other hand, estimates higher costs, because it assumes that the ILEC is starting from scratch with no existing, sunk capacity. Second, LRIC will exclude fixed, shared and common costs of the network, to the extent that there is no increase in these costs when demand changes by only a small increment starting from its current level.

Clearly, the ILECs have no intention of proposing lower prices for UNEs, so they have modified LRIC substantially by adding the "appropriate portion of the fixed, shared, and common costs attributable to the element,"[15] to the true long run incremental costs.[16] By doing this, the ILECs have abandoned any efficiency properties of LRIC and have returned to the same pricing approaches they used for decades and which the Commission rejected in 1996. As the Commission recognized, it is not in the interest of the ILECs to set economically efficient allocations of joint and common cost, for the simple reason that the ILECs will use this pricing freedom to harm competitors. Moreover, the Commission was not willing to undertake this job, because it "is difficult for regulators to determine an economically-optimal allocation of any such joint and

[15] *Id.*
[16] Dr. Shelanski's cites to Alfred Kahn's textbook definition of LRIC to support his proposal. *Id.,* n. 4. However, Kahn defines LRIC as the sum of average incremental variable costs of added sales plus additional capital cost per unit for additional capacity and makes no mention of adding an allocation of fixed, shared and common costs.

common costs…"[17] Finally, it would necessary to estimate the actual level of all joint and common cost, in order to determine how big the pot is that would need to be allocated across the rate elements. This would create the precise problems about replacement cost models that we discussed earlier. Unless the Commission is prepared to revamp its entire approach to costing and pricing, and engage in this complex optimization problem, it should not abandon TELRIC.

III. REAL OPTIONS

The ILECs claim that TELRIC-based UNE prices are too low, because they fail to include proper compensation for the real option value of the risks that accompany irreversible investments in the network. According to the ILECs, an option value premium must be added to the costs conventionally measured by TELRIC or else the incentives faced by the industry will be distorted. They argue that the ILECs will lack the proper incentive to invest in plant, and the CLECs will be given a false incentive to lease rather than to invest in their own networks.

The ILEC position is a rehash of the argument they made to the Commission during the initial implementation of the Telecommunications Act. In 1996, the RBOCs' economist, Professor Hausman, argued that the traditional measures of the cost of capital fail to reflect the risks associated with irreversible investments and that they are biased downward by a factor of three.[18] The Commission properly rejected this argument in 1996, stating that forward-looking methodologies can adjust the cost of capital to reflect

[17] *First Report and Order*, CC Docket 96-98, ¶678.
[18] Reply Affidavit of Jerry A. Hausman, Attachment 1 to USTA Reply comments, CC Docket 96-98.

the risks involved in making irreversible investments, and that there was no need for a special add-on real option factor to be included in proper TELRIC-based prices.

In this proceeding, Verizon has sponsored the Declaration of Professor Robert Pindyck, an acknowledged expert on real option theory. Dr. Pindyck's Declaration consists of a reiteration of the theory of real options and his conclusions about what would be the importance of real options in telecommunications —assuming the truth of a large number of sweeping generalizations that he makes about the industry and about how TELRIC has been administered. In addition, Dr. Pindyck attaches a paper, commissioned by Verizon, which elaborates the arguments in his Declaration, and includes an example of how to estimate the proper add-on for option value in TELRIC.

In this paper, I will discuss three aspects of Dr. Pindyck's submission. First, I will reply to his assertion that traditional measures of cost of capital only apply to reversible investments, and that the return required on irreversible (or sunk) investments must include an explicit add-on to account for option value. Second, I will respond to the fundamental misconceptions about telecommunications networks and pricing practices that Dr. Pindyck relies upon to draw his conclusion that UNE prices are too low, because they fail to account for the unique risk faced by the ILECs in leasing UNEs to CLECs. Third, I will explain how the model results that he presents in his paper prove the opposite of what he claims. The "add-on" he calculates for the UNE switching rate is not a result of neglected option value, but rather a payment calculated to make the ILEC whole when faced with a more efficient competitor in the retail market.

A. Cost of Capital and Real Options

Real options theory was developed to provide a planning tool for firms faced with complex choices among complex investment paths. As Dr. Pindyck explains, when an irreversible investment can be delayed to allow for current uncertainties to be resolved, there may be a value to waiting. The firm will then face a multi-part choice whether to: 1) invest now; 2) invest never; or 3) invest later. As he explains, the firm should not choose Option #1 – invest now – simply because it has a positive Net Present Value ("NPV"). Although an NPV calculation may prove that Option #1 is superior to Option #2 (invest never), it does not mean that it is better to invest now, rather than invest later. The option to invest later (Option #3) may be superior to the other two options, and a firm should weigh this option rather than blindly pursue any and all projects that present positive NPVs.

Up to this point, Dr. Pindyck's position is unremarkable and uncontroversial. His next assertion is remarkable. He states that a firm's weighted average cost of capital ("WACC") is the "expected return on a reversible investment with risk characteristics similar to those for the firm as a whole."[19] He asserts, therefore, that for irreversible investments (investments in any asset that is sunk), the cost of capital exceeds the traditional measures of WACC, including the discounted cash flow (DCF) and capital asset pricing models (CAPM) used by financial analysts to assess the attractiveness of firms' securities, and by this Commission and virtually every other regulatory agency to set the prices of all regulated services.

[19] Declaration of Robert Pindyck, at 7.

Dr. Pindyck's attack on traditional cost of capital measurements for regulatory price setting should be rejected. To begin with, his position about what is included in a traditional cost of capital measurement (especially the CAPM) does not seem to be reflected in basic finance texts.[20] The capital asset pricing model estimates the return on a firm's equity as the sum of the return on a risk-free asset (i.e. Treasury bills) plus a risk premium reflecting the non-diversifiable risk associated with the firm's business. The risk premium used in CAPM for a specific stock is calculated by multiplying the stock market's average risk by the firm's beta, which is the measure of the riskiness of the firm relative to the market. The point to keep in mind is that the CAPM adjusts the cost of capital for the unique conditions (i.e. the nondiversifiable risks) faced by a firm (or industry). A firm that faces greater nondiversifiable risk, including the risks associated with irreversible investments or higher sunk costs, will have a higher beta and a higher cost of capital as measured by CAPM.[21] Therefore, I see no reason to abandon CAPM as the proper method to capture all of the risk typically associated with an industry' investments. Real options theory can be used to select among investment alternatives, but it does not require regulators to abandon traditional approaches to cost of capital estimation. Indeed, the standard financial approach for dealing with the "invest later" option is to evaluate separately the NPV of that cash flow stream. This option should be chosen if its NPV is the highest of any of the other options. Adding an arbitrary adjustment to a conventionally determined cost of capital used to evaluate the NPV of the "invest now" option is neither necessary nor wise.

[20] It is possible that he inadvertently overstated the case in the Declaration, and he does not intend to reject use of CAPM across-the-board.
[21] Richard Brealey and Stewart Myers, *Principles of Corporate Finance,* 7th Edition, 2003, at. 238.

B. Application of Real Options to UNEs

In practice, TELRIC models have relied on the same cost of capital models that the FCC and state commissions have used for setting retail or other wholesale rates (e.g. access charges). This raises an important question of whether CLECs have an "option" to use the ILECs' network that is markedly different than the option available to the traditional retail and wholesale customers of the ILECs. First, however, we will examine whether any option value actually exists for most of the network investments undertaken by the ILECs.

Consider an ILEC's decision whether to invest in an expansion of its network to serve a new housing development.[22] To serve this housing development, the ILEC will need to run new feeder and distribution cable and augment capacity at the central office that serves this housing development. The largest component of irreversible investment is the construction of the outside plant and accompanying structure, e.g. poles, conduit.[23]

What option does the ILEC face? Can it invest later and not now? And can the ILEC limit its investment in sunk cost facilities and thereby forego having the capacity to provide service to the CLECs (let alone its own retail customers) on demand. In other

[22] I believe that this example provides a good benchmark for evaluating the TELRIC pricing of UNEs. On the one hand, it considers forward-looking investment decisions, so it sidesteps the question of whether sunk facilities should even be priced based on TELRIC, rather than LRIC. At the same time, it allows us to consider investments in all the basic network elements, rather than a limited set of investments in network modernization.

[23] There may also be some sunk costs associated with the wire center and central office augmentation, but there is much more modularity in this part of the network, so it will account for a small portion of the irreversible investments. I would not expect the characteristics of the investment decision in regard to wire center and central office facilities to create different real options than the outside plant investments.

words, does the ILEC require an add-on to its traditionally measured cost of capital to account for a valuable foregone option to delay some or all of its irreversible investment?

I believe the answer to this question is no. The ILEC has a one-time opportunity to build the outside plant, and cannot choose to delay making the investment in sunk cost facilities. The most obvious reason is that customers will demand telephone service when they first move into the development. This means that the developers will demand to have telecommunications facilities installed along with the other infrastructure of the development. A second reason is that the cost of installing facilities will be much lower during the construction of the development than later. Further, in a competitive market, the ILEC – or any of its competitors – will obtain a first-mover advantage from building facilities and standing ready to provide service to customers right away.

There is also no option value to building a smaller scale network, and thereby not having capacity standing ready to serve incremental demand by CLECs or retail customers that may or may not be needed.[24] Most of the sunk cost investments in telecommunications networks are characterized by substantial economies of scale. This means that the incremental investment required to serve the less-certain and less-stable part of demand is very cheap, and the "burden" associated with being the "carrier of last resort" is greatly exaggerated. Moreover, it is relatively very expensive to install additional capacity in much of the network after the initial plant has been laid. The ILECs' are well aware of this phenomenon and have always built substantial excess plant

[24] In a previously-published paper, I have demonstrated that it pays for an ILEC to build a network that can serve 100% of the market, rather than 90% of the market, so long as it has at least a 40 percent chance of using these incremental facilities. See, Michael Pelcovits, "Application of Real Options Theory to TELRIC Models: Real Trouble or Red Herring," in *The New Investment Theory of Real Options and its Implications for Telecommunications Economics,* ed. Alleman and Noam, 1999.

to stand ready to serve residential customers with second-lines and business customers with Centrex or other line-intensive telephone service. The implication of this cost relationship is that for the most uncertain part of demand there is no realistic "invest later" option. And the "invest now" cost of having standby capacity is very low.

There are other implications of this reality (in contrast to the fictitious world depicted by Dr. Pindyck) for the real option debate. The impact of uncertainty on the value of an investment to an ILEC can be captured by the proper selection of utilization rates (or load factors), which as I discussed above is an area where the TELRIC models have been very conservative.. Uncertainty in the level of demand for a network element can be translated into a probability distribution across different utilization rates, and then collapsed into an expected utilization and an expected rate of return to the investment. It will also inform an analysis of the risk faced by the ILEC, and the selection of the proper beta to be used in a CAPM estimate of the cost of capital for the project.

As I mentioned earlier, estimation of cost-based prices for UNEs requires the same consideration to be taken into account as traditional cost-based regulation of the ILECs. Retail customers are given the same options as CLECs. Residential customers can freely choose to buy one line, two lines, or none at all from the ILEC – and they may cancel their purchases at will. A law firm with three hundred lawyers can choose to buy 50 analog trunks, 2 DS1s, or 300 analog Centrex lines. The cost of capital built into the prices for these services has always reflected whatever real option value investors have assigned to this business. No further "add-ons" are necessary. In fact, historically, the most network-intensive business customers, i.e. Centrex customers, received the best

prices, even though a lot of network capacity had to be available on "standby" to meet their needs. Verizon, and Dr. Pindyck, have provided no rationale why CLECs should be singled out as the unique ILEC customers to bear an additional real option cost.

C. The Model

In the paper, "Mandatory Unbundling and Irreversible Investment in Telecomm Networks," accompanying his Declaration, Dr. Pindyck presents an example to "further elucidate the sources of option value in a telecommunications network, and to show how it is missing from TELRIC."[25] In fact, as I will demonstrate, the example he provides does nothing of the sort. The so-called option value premium estimated in the model has nothing whatsoever to do with sunk costs, the value of postponing investment, or the opportunity cost of extinguishing that option. Rather, in the model as in the real world, the option value merely serves to guarantee the ILEC full recovery of all of its costs (even though, Pindyck assumes in the model that the ILEC has higher costs than the CLEC) and to impose a punitive tax on a more efficient CLEC sufficient to completely exclude it from competing with ILECs. Pindyck's example is thus a useful parable for the true role of "real options" as the ILECs propose that it be incorporated into TELRIC.

Pindyck's model presents the following scenario.[26] The ILEC needs to install a switch to serve any growth in demand above the current baseline level. The switch can serve 40,000 lines, costs $400,000, and has a useful life of 4 years. The ILEC knows that demand will grow by 20,000 lines next year (year 1) and will stay at that level in year 2.

[25] Attachment B to the Declaration of Robert Pindyck, at. 21.
[26] The description of the model is taken almost word-for-word from Attachment B, at 21-23.

Demand in years 3 and 4 is uncertain. In those years, demand will either grow by another 20,000 lines (so that it is 40,000 lines above the baseline level) or it will fall by 20,000 lines back to the baseline level.

Pindyck also assumes that the ILEC incurs fixed costs of $45,600 per year whenever the ILEC is providing retail service utilizing the new switch. That is, the ILEC incurs $45,600 in annual fixed costs in years one and two, and when demand is high in years three and four. If demand in years three and four falls back to the baseline level, these fixed costs are not incurred. Pindyck does not explain the source of these fixed costs. However, they are not related to the switch.[27] Since they are incurred only when the ILEC provides retail service using the new switch, and they are not switch costs, the logical inference is that the $45,600 fixed costs are associated with the ILEC's retail operations.[28] Both the CLEC and ILEC are assumed to have zero marginal costs for retailing. However, and this is very important to my discussion, Pindyck assumes that the CLEC also has zero fixed costs for retailing.[29] *Thus the CLEC is more efficient than the ILEC at servicing retail customers, by the amount of $45,600, which is the fixed cost the ILEC incurs but the CLEC does not incur.*

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[27] "For simplicity, we will also assume that the only cost associated with the switch is its $400,000 purchase price." *Id,* at 21.

[28] In the alternative, if contrary to the literal reading of the paper, the fixed costs are associated with operating the switch, then the TELRIC price has been computed incorrectly. It should include additional expected revenue sufficient to cover these fixed costs. This would cause the entire model to collapse into a conventional TELRIC analysis without even an artificial option value computed in the case where the CLEC provides half of the incremental retail sales.

[29] In Pindyck's equation for the CLEC's profits at the middle of page 23, the only costs incurred by the CLEC are its payments for switching UNEs it purchases at the TELRIC price from the ILEC. This is not a misprint. In the text, Pindyck states "The CLEC's NPV is the expected discounted value of the CLEC's revenues minus its TELRIC payments to the ILEC for customers added in year 3." (*Id,* at 23)

The obvious logical implication to this scenario from an economic efficiency perspective is that the ILEC should sell wholesale switching UNEs to the CLEC, and the CLEC should provide all retail services, while the ILEC withdraws from the retail market. Pindyck does not allow his model to evolve to this compelling economic result, however. Rather, under the guise of adding a so-called "real option" premium to the presumably properly calculated TELRIC price for switching, Pindyck in fact solves for the level of tax on the CLEC sufficient to foreclose its entry and leave the ILEC a monopolist. Since the CLEC is assumed to have zero costs for retailing, the "real option" tax is calibrated to increase the "TELRIC" wholesale price to the CLEC to just match the retail price level charged by the inefficient ILEC. This is in fact what Pindyck does – the "corrected TELRIC" price per line for switching in his model is the retail price per line! What Pindyck has achieved is to set a wholesale price based on the efficient component pricing rule (ECPR) that the Commission fully rejected in 1996.[30]

To see all this more clearly, we will examine Pindyck's model in greater detail. Pindyck first describes a zero profit constraint imposed by the regulator on the ILEC Given the demand and cost pattern described above, Pindyck "assumes" that the retail price per line (RPL in his terminology) is $7.50 per line. In fact, this price per line solves the expected zero profit equation for the switch investment at the top of page 22:[31]

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[30] *First Report and Order*, CC Docket No. 96-98, ¶709.

[31] If one assumes that the cost of the switch is incurred at the beginning of the four year period, Pindyck has improperly calculated the RPL necessary to satisfy the zero profit condition. Note that in his equation the NPV of the $400,000 investment is divided by 1.1, which is what one would do if the switch costs were incurred at the end of the first year. If one assumes that the switch cost is incurred at the start of the first year, then the required RPL is $8.07358. This mistake really doesn't affect any point Pindyck is trying to make in the discussion of the vertically integrated monopoly case. In fact, the $7.50 RPL would be appropriate for a switch costing $363637 at the beginning of year one, and the whole exercise could be reinterpreted to assume a lower cost for the switch. However, Pindyck's mistake does create problems

$$NPV_0^{ILEC} = \frac{-400{,}000}{(1.1)} + \sum_{t=1}^{2} \frac{RPL * 20{,}000 - FC}{(1.1)^t} + 0.5 * \sum_{t=3}^{4} \frac{RPL * 40{,}000 - FC}{(1.1)^t} = \$0$$

when he compares the vertically integrated monopoly case with the competitive case where a CLEC purchases switching from the ILEC, because Pindyck correctly solved for the UNE price for switching assuming that the $400,000 switch investment was made at the beginning of year one. Thus, to compare monopoly and competitive cases on an apples-to-apples basis, one should correct Pindyck's RPL to $8.07358. Doing so would not affect any substantive point I will make, however, so to keep things simple I will continue to use $7.50 as the assumed retail price per line.

The table below summarizes the cash flows that the vertically integrated monopolist should expect from its investment in the switch.

High Demand Case	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**All Years – NPV**
Lines	$ 20,000	$ 20,000	$ 40,000	$ 40,000	
Revenue per line	$ 7.50	$ 7.50	$ 7.50	$ 7.50	
Total revenue	$ 150,000	$ 150,000	$ 300,000	$ 300,000	
Fixed cost	$ 45,600	$ 45,600	$ 45,600	$ 45,600	
Operating cash flow	$ 104,400	$ 104,400	$ 254,400	$ 254,400	
PV of Operating Cash Flow	$ 94,909	$ 86,281	$ 191,134	$ 173,759	$ 546,083
Investment	$ (400,000)				$ (363,636)
				NPV	**$ 182,447**

Low Demand Case	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**All Years - NPV**
Lines	$ 20,000	$ 20,000	$ -	$ -	
Revenue per line	$ 7.50	$ 7.50	$ 7.50	$ 7.50	
Total revenue	$ 150,000	$ 150,000	$ -	$ -	
Fixed costs	$ 45,600	$ 45,600	$ -	$ -	
Operating cash flow	$ 104,400	$ 104,400			
PV of Operating Cash Flow	$ 94,909	$ 86,281	$ -	$ -	$ 181,190
Investment	$ (400,000)				$ (363,636)
				NPV	**$ (182,446)**

In Pindyck's model, the ILEC just covers the zero-profit condition (including a competitive return on investment) when the NPV of the switch investment is zero. The constraint is applied at the beginning of year 1, to the expected profits averaged over two very different states of the world. Pindyck's ILEC will either earn a positive NPV of $182,446.8[32] on its switch investment if demand turns out to be high, or it will earn a negative NPV of $182,446.8 if the demand turns out to be low. But since each demand state has a 50% probability, the expected NPV for the ILEC is zero. Pindyck concludes

[32] The NPVs are based on Pindyck's mistaken calculation for the zero-profit RPL; i.e. in taking the NPV I have treated the switch as if it is incurred at the end of year one. If one treated the cost as incurred at the beginning of year one, the RPL would be $8.07358 and the NPVs would be plus and minus $198,900.7 in the high and low demand cases in order to satisfy the zero profit condition.

that under these conditions, the expected profits (including a competitive, risk-adjusted rate of return on investment of 10%) are just sufficient to induce the ILEC to invest in the switch.

Pindyck properly calculates the TELRIC price for the switch, given the rest of his assumptions. Using the standard formula for the present value of four-year annuity (assuming the investment occurs at the beginning of the first year), he first calculates, using a 10% discount rate, that $126,188 of annual capital recovery is necessary over the four years. Pindyck divides the total annual cost of the switch by the expected usage of the switch (20,000 lines per year).[33] The resulting UNE price is $6.3094 per line. This UNE price is calculated correctly. In particular, the price is based on the true expected fill rate for the switch (properly averaging the probabilities for high and low utilization). As a result, although Pindyck shows no awareness of the fact, an ILEC investing in the switch and hypothetically selling UNEs to both its own retail operation and/or the CLECs' would be given the proper incentive to make the investment in the switch. At this UNE price, the switch investment is worthwhile for the ILEC because it can expect to recover all its costs, including the cost of capital. To reiterate what I pointed out before, the model actually dictates that the ILEC should abandon retailing, because it is less efficient than the CLEC. If it did so, there would be no "option value" problem preventing the switch investment.

However, Pindyck does not consider the option of the inefficient ILEC getting out retailing. So Pindyck proceeds to analyze what he mistakenly thinks is an "option value"

[33] The assumed utilization is 20,000 lines per year in the first two years, followed by a 50/50 chance of either 40,000 lines or zero lines being utilized in the third and fourth year. Thus the overall expected utilization is 20,000 lines per year, and the expected utilization for each year separately is also 20,000 lines.

problem on the switch investment. He calculates the ILEC's expected return on that investment if the CLEC waits until year three to decide whether to enter, and then enters and gains half the market for years three and four only. When the CLEC enters, the ILEC loses half the retail revenues in years three and four, but picks up UNE revenues from the sale of switching to the CLEC. The ILEC's expected profits from the switch investment now become negative. Pindyck attributes this fact, incorrectly, to the CLEC's opportunism. But what is actually occurring is that the ILEC's regulated retail price of $7.50 per line assumes that all of the ILEC's $45,600 fixed retailing cost can be spread over the entire expected retail demand for switching. Now, with half of its retail sales gone, but with this retail price held constant, the ILEC has insufficient revenues to cover its fixed costs. In contrast, the CLEC, because it has no fixed costs, can operate profitably at the $7.50 retail price. Thus the CLEC has a profit incentive to enter, and the inefficient ILEC is losing money.

Pindyck diagnoses the CLEC entry as some sort of public policy problem when actually the only problem is that the ILEC's costs are above those of an efficient competitor. To fix this purported problem (it is a problem for the ILEC, of course, but inefficient incumbents are supposed to be made uncomfortable by the entry of more efficient competitors), Pindyck calculates the amount by which the UNE price would have to increase in order to restore the ILEC to a zero profit status. Pindyck characterizes this as necessary to give the ILEC the incentive to make the switch investment. This is only true if we take as given the ILEC's right to be a vertically integrated monopolist -- even when it is inefficient. Not surprisingly, the algebraic answer to this problem, given

that the CLEC is assumed to have no retailing costs, is to raise the UNE price to retail price level necessary to cover the ILECs fixed retailing costs. Thus, Pindyck identifies the "corrected TELRIC" price as $7.50 per line, the same as the retail price. At this price, the ILEC, since will earn the same revenue per line, regardless of whether it is wholesaling or retailing switch capacity, and it makes the same zero profit whether the CLEC enters or not.

While the result of this ECPR-like tax is to restore the ILEC's incentive to invest in the switch, this is at the expense of excluding a more efficient entrant in the market. The option value premium added to TELRIC is simply a tax on entry.[34]

Pindyck has simply misdiagnosed the problem in his model. There is no incentive for inefficient entry by the CLEC in that model if the CLEC and ILEC are assumed to be equally efficient. The TELRIC price fully compensates the ILEC for investing in the switch because it is properly calculated. There is therefore no need for any sort of "adder" to the cost of capital to cover the so-called real options.

Thus, when Pindyck set about to increase the UNE price for switching in his model, he was merely solving for the required increase in the CLEC's costs and ILEC's revenues via the UNE price that would fully offset the CLEC's cost advantage in

[34] To see this, consider what would happen if we assumed that both the CLEC and ILEC enjoyed the CLEC's lower retailing costs. Then the optimal RPL is the same as the UNE price for switching (since there are no retail costs in the model). The optimal solution is for the ILEC to sell UNE switching at $6.3094 per line, and for both or either the CLEC or ILEC to sell the service at retail at the same price. The ILEC has adequate incentives to invest in the switch (because Pindyck has correctly calculated that at this UNE price the full costs of switch, including a conventionally measured required return on investment, are recovered.) Alternatively, if the CLEC and ILEC are assumed to be equally efficient at the ILEC's higher cost – i.e. the CLEC also incurs $45,600 per year in fixed retailing costs, then the CLEC has no incentive to enter. Even with one-half the retail revenue in years three and four, the CLEC would lose money by entering if demand were high in years three and four. Its profits per period in the high demand world would be: ($7.50-6.3094)*20,000 - $45,600 = $23,812-$45,600 = -$21.788.

retailing. The problem Pindyck has in fact solved is the tax level necessary to deter the entry of a more efficient competitor. Pindyck's option value calculation is nothing other than a make-whole charge that allows the ILEC to recover part of its fixed costs that are not incurred by its competitors from its competitors. Although Pindyck does not appear to recognize it, his option value calculation does just this. It sets an artificially high TELRIC price so as to let the ILEC recover all its costs, not matter how inefficient it is. This is ILECs' view of the world, of course, but the tax has absolutely nothing to do with the so-called option value, and its imposition would certainly be contrary to the interest of regulators in encouraging supply by more efficient competitors.

The example is a very instructive parable for the current debate over TELRIC. What the ILECs want (but can't ask for directly so they call it "option value") is that the TELRIC prices be set high enough so that they are guaranteed the right to recover all their costs, no matter inefficient they are. Pindyck merely solves for the level of an ILEC tax on TELRIC sufficient to exclude competition. The tax discourages efficient entry and allows the ILEC to operate with its higher fixed costs -- and the precise level of the tax is determined, not by the cost or timing of the switch investment, but only by the magnitude of the ILEC's cost disadvantage.