Prices Based on Current Cost or Historical Cost: How Different Are They?

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by

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Abstract

In 1996, The Federal Communications Commission (FCC) prescribed total element long-run incremental cost (TELRIC) to determine rates incumbent local exchange carriers (ILECs) charge for most mandated wholesale services. TELRIC, which bases prices on a hypothetical incumbent that serves current volumes with completely new equipment, was a major departure from the predominant use of historical (or original) costs for regulated prices. The FCC made two exceptions: total service resale of local exchange services and rental of space by cable television providers and competitive local exchange carriers on poles and conduit owned by electric utilities and ILECs are based on original cost calculations.

The FCC's use of both current cost and historical cost methodologies recalls the fierce debates over whether regulated rates should be based on replacement (current) costs or original (historical costs) that preceded the US Supreme Court's 1944 *FPC v Hope* decision. Parties advocating low rates favored replacement costs when equipment costs were expected to decrease, but original costs when such asset prices would be expected to increase. The *Hope* decision upheld the Federal Power Commission's use of original costs, which subsequently were widely used by federal and state regulators.

While rates based on current costs have, indeed, differed in the expected way from the corresponding rates based on historical costs, this paper demonstrates that (1) the large differences expected by conventional wisdom are the result of faulty application of the current cost methodology and (2) proper application substantially narrows the difference between the rates produced by the respective approaches.

Keywords Regulatory costs, current cost, original cost, wholesale inputs

JEL Classification L51 L96 L97 L98

1. Introduction

In response to the 1996 Telecommunications Act, the Federal Communications Commission (FCC) ordered that the rates incumbent local exchange carriers (ILECs) could charge for certain wholesale services (unbundled network elements, or UNEs) that they were required to offer to new competitive local exchange carriers (CLECs) be based on a methodology labeled total element long-run incremental cost (TELRIC). That methodology based wholesale prices on a hypothetical incumbent that served the entirety of its current volumes with completely new equipment (as opposed to the mixture of equipment of different vintages in its actual network). As such it was a major departure from the historical (or original) cost basis that had been used for decades to set regulated retail prices and since 1984 as the basis for wholesale inputs (carrier access) provided to long-distance carriers (Tardiff, 2000).[1]

The FCC made two exceptions to its prescription of a current cost methodology for wholesale services used by competitive carriers. First, the Telecommunications Act required total service resale—an arrangement by which a new competitor would essentially rebrand a local exchange service provisioned over the incumbent's facilities. The wholesale rates for these resold services are determined "on the basis of retail rates charged to subscribers for the telecommunications service requested, excluding the portion thereof attributable to any marketing, billing, collection, and other costs that will be avoided by the local exchange carrier." (Telecommunications Act, § 252(d)(3)) Retail rates were typically based on historical costs and the FCC's rules for determining avoided costs were also based on historical costs.[2]

Second, while current costs were used for UNEs, e.g., the wires connecting customers and the telecommunications network, the FCC continued to prescribe the use of historical costs for placing wires on utility poles and in conduit owned by ILECs and electric utilities. In addition to differences in legislative history, the FCC's choice of historical costs for pole attachments appeared to be motivated by the objective of providing potential new entrants with relatively low prices for wholesale inputs in order to promote entry. In particular, since major components of telecommunications networks benefit from cost-reducing technological progress, there was a common belief that prices based on current costs would be lower than costs based on historical costs.[3] Conversely, because the costs of acquiring, placing, and maintaining utility poles and conduit tend to *increase* over time (because of their relatively low technology-intensity and

[1] Throughout this paper, the terms "current cost," "replacement cost," and "forward-looking cost" are used interchangeably. Similar to Lehman and Weisman (2000, p. 61, note 2), the terms "historical costs," "embedded costs," "accounting costs," book(ed) costs," "actual costs," and "original costs" are synonymous.

[2] In practice, state commissions implementing this rule typically prescribed a percentage discount off of the retail rate. For example, if an incumbent offered residential local service for $20 per month and a commission prescribed as 20 percent wholesale discount, a competitor would be able to obtain the service at a wholesale price of $16.

[3] An anonymous referee stated that by at least the early 1990s, the published literature and regulatory practice had recognized that the use of historical or current costs could produce similar prices. The courts, as well as economists and lawyers, both academic and practicing, nonetheless have operated as if the two approaches typically produce widely disparate results. Indeed, when it upheld the FCC's authority to prescribe TELRIC, the US Supreme Court characterized TELRIC rates as "novel ratesetting designed to give aspiring competitors every possible incentive to enter local retail telephone markets, short of confiscating the incumbents' property." (*Verizon v FCC* 535, 2002, p. 489). Similarly, in his comprehensive view of infrastructure regulation in a leading economics journal, Guthrie (2006, p. 964) described how basing rates on historical versus current costs can result in different investment incentives, presumably because of the different rates that result from real-world applications of the alternative approaches. Most recently, Neuchterlein and Weiser (2013, p. 60) described the FCC's methodology as follows:

> This means that when a competitor leases an incumbent's network assets to provide services of its own, the rates it pays the incumbent are calculated on the basis of what it would cost today to obtain those assets or their functional equivalent, not what it actually cost the incumbent to obtain the particular facilities at issue, as recorded on its books…
>
> This approach sometimes produces "cost" estimates for network elements—and thus prescribes rates at which CLECs may lease those elements—far below the ILEC's historical costs.

relatively high labor-intensity), the use of historical cost pricing was widely believed to produce lower rates than would the use of current cost-based pricing.

The FCC's use of both current cost and historical cost methodologies recalls the debates that preceded the US Supreme Court's 1944 *FPC v Hope* decision.[4] Prior to *Hope*, there had been fierce debates over whether regulated rates should be based on replacement (current) costs or original (historical costs), with parties advocating low rates favoring replacement costs when equipment costs were expected to decrease, but original costs when such asset prices would be expected to increase (Kahn 1988, Vol. I, pp. 39-40). The *Hope* decision upheld the Federal Power Commission's use of original costs, which subsequently were widely used by federal and state regulators to establish rates for telecommunications and other utility services (*Verizon v. FCC* 2002, p. 484; Makholm 2012, pp. 129-132).

While rates proposed (and sometimes adopted) that are based on current costs have indeed differed in the expected way from the corresponding rates based on historical costs,[5] the purpose of this paper is to demonstrate that (1) the large differences expected by conventional wisdom and often produced in practice result from faulty application of the current cost methodology and (2) proper application—namely, accounting for inflation in asset prices and the difference between current and historical cost levels when calculating annual "out-of-pocket" expenses such as maintenance and administrative costs—substantially narrows the difference between the rates produced by the respective approaches.[6] Accordingly, practical considerations, particularly the relative costs and resources imposed on the regulatory process, would appear strongly to favor original cost methodologies.

The paper is organized as follows. In section 2, the *Hope* decision (and its descendants) and the FCC's wholesale rate decisions pursuant to the 1996 Telecommunications Act are reviewed as illustrations of the conventional wisdom that (1) when long-lived asset values are decreasing, rates based on current costs are lower than rates based on original costs, but (2) when asset values are expected to increase, rates based on current costs are expected to be higher. Section 3 reviews economic analyses that (1) identified commonly occurring errors in current cost applications that are the likely source of the different rate outcomes expected under the conventional wisdom and (2) employed current cost calculations to narrow the gap between rates based on current versus original costs. Using this analysis section 4 illustrates that rates based on original and current costs should be very similar if the current cost calculation is correctly applied. Section 5 concludes the paper.

[4] *FPC v. Hope Nat. Gas Co.* (1944).
[5] For example, Tardiff (2002, p. 139) describes how rates proposed by CLECs were less than one-half of the rates that an original cost calculation would produce.
[6] This conclusion complements the findings of Lehman and Weisman (2000, Chapter 6) and Rogerson (2011).

2. The Conventional Wisdom

The following two subsections describe historically significant legal and regulatory decisions which addressed the large discrepancy in rates based on current and original cost calculations expected by conventional wisdom.

2.1. Hope

The *Hope* decision illustrates the large apparent differences between rates based on historical versus current costs. Upon complaint by the cities of Cleveland and Akron that the interstate natural gas rates Hope was charging its retail affiliate that served these cities were unreasonably high, the Federal Power Commission ordered a rate reduction, based on historical cost calculations. While the federal appeals court overturned the FPC's decision (on the grounds that the constitution demanded rates be based on "fair market value"), the Supreme Court reversed the lower court's decision and upheld the Commission's authority to base rates on historical costs. In the process, the Supreme Court noted that (1) Hope had calculated a current cost rate base that was almost double the Commission's original cost rate base, and (2) coupled with the somewhat higher cost-of-capital advocated by the gas company, the income approved by the Commission was considerably lower than what the company was seeking. Nevertheless, the Court observed (*FPC v. Hope Nat. Gas Co.* 1944, p. 605):[7]

> In view of these various considerations, we cannot say that an annual return of $2,191,314 is not "just and reasonable" within the meaning of the Act. 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, even though they might produce only a meager return on the so-called "fair value" rate base. In that connection, it will be recalled that Hope contended for a rate base of $66,000,000 computed on reproduction cost new.[8] The Commission points out that, if that rate base were accepted, Hope's average rate of return for the four-year period from 1937-1940 would amount to 3.27%. During that period, Hope earned an annual average return of about 9% on the average investment. It asked for no rate increases. Its properties were well maintained and operated. As the Commission says, such a modest rate of 3.27% suggests an "inflation of the base on which the rate has been computed."

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[7] The Court observed earlier in the opinion (p. 602):

> It is not theory, but the impact of the rate order, which counts. If the total effect of the rate order cannot be said to be unjust and unreasonable, judicial inquiry under the Act is at an end. The fact that the method employed to reach that result may contain infirmities is not then important. Moreover, the Commission's order does not become suspect by reason of the fact that it is challenged. It is the product of expert judgment which carries a presumption of validity. And he who would upset the rate order under the Act carries the heavy burden of making a convincing showing that it is invalid because it is unjust and unreasonable in its consequences.

[8] Hope claimed the proper rate of return was at least eight percent, which would have produced and annual return of $5.28 million.

As noted earlier, a practical upshot of the Hope decision was the widespread use of historical cost rate making:[9]

> Although *Hope Natural Gas* did not repudiate everything said in *Smyth*, since fair value was still "the end product of the process of rate-making," federal and state commissions setting rates in the aftermath of *Hope Natural Gas* largely abandoned the old fair-value approach and turned to methods of calculating the rate base on the basis of "cost."

Significantly, while a *practical* effect of Hope was the widespread use of historical cost calculations, the decision did *not* mandate any particular methodology. Forty-five years later, while essentially upholding *Hope*, the Supreme Court pointedly declined to endorse the use of historical costs as the constitutional standard for rate making (*Duquesne Light Co. v. Barasch* 1989, p. 315):[10]

> We think that the adoption of any such rule would signal a retreat from 45 years of decisional law in this area which would be as unwarranted as it would be unsettling. Hope clearly held that "the Commission was not bound to the use of any single formula or combination of formulae in determining rates."[11]

2.2. FCC's Rationale for Different Pole Attachment and Unbundled Element Cost Methodologies

The conventional wisdom that prices based on historical are (1) higher than prices based on current costs when asset prices are expected to decrease, but (2) lower than prices based on current costs when asset prices are expected to increase is clearly illustrated by the positions advocated by various parties and the FCC's responses to those arguments when it established wholesale rates pursuant to the 1996 Telecommunications Act. In the case of unbundled elements, some ILECs argued for prices based on historical costs, with a primary argument that prices based on current (or forward-looking costs) would be confiscatory, and as a result unconstitutional (FCC 1996 ¶ 736) . While the FCC replied that the forward-looking cost resulting from the TELRIC methodology (which the FCC believed "represents the incremental costs that incumbents actually expect to incur" (FCC, 1996 ¶ 685)) may be higher or lower than historical costs (FCC 1996 ¶ 705), it appeared to essentially agree that prices based on current costs would indeed be lower when it concluded that "[t]he substantial weight of economic commentary in the record suggests that an 'embedded cost'-based pricing methodology would be

[9] *Verizon v. FCC* (2002, p. 484), which cites Kahn, (1988, Vol. I, pp. 40-41).
[10] Quoting *Hope* at p. 601.
[11] Quoting *Hope* at p. 320. Indeed, Weisman (2002, p. 100) noted that in *Verizon v FCC* (2002), the Supreme Court cited *Duquesne* and its precedents in rejecting the incumbent's takings claim on the ground that no putatively confiscatory rates had been presented to the Court: "This begs the question as to how the ILECs could ever have believed that they could prevail on a takings claim – at least one that required a showing of an earnings deficiency of such magnitude as to threaten their financial integrity – when no specific rate or financial information was presented to the Court."

pro-competitor -- in this case the incumbent LEC -- rather than pro-competition." (FCC 1996, ¶ 705)

In the FCC proceedings establishing pole attachment rates, facilities owners—the electric utilities, which own the majority of utility poles on which other parties attach their wires—again argued that the FCC's pricing methodology produced rates that were unconstitutionally low and as a result did not provide just compensation (FCC 2001, ¶ 16). However, this time the putative confiscation was thought to result from the use of historical costs, rather than current costs. The electric utilities also argued that the use of current costs was necessary so that a consistent methodology (namely basing price on current or forward-looking costs) be used for services subject to the 1996 Telecommunications Act (FCC 2001, ¶ 19).

The FCC disagreed, with the following explanations for its decision to continue to base maximum pole attachment rates on historical costs.[12] First, regulated maximum rates, in general, prevent utilities from charging monopoly rates (FCC 2001, ¶ 13). Second, the use of historical costs has accomplished the "key objectives of assuring, to both the utility and the attaching parties, just and reasonable rates; establishes accountability for prior cost recoveries; and accords with generally accepted accounting principles" (FCC 2001, ¶ 15). Third, prices for unbundled elements and pole attachment rates were motivated by different objectives. While TELRIC was designed to encourage efficient entry into the provision of competitive telecommunications services (FCC 2001, ¶ 20), the FCC did not anticipate competitive pole attachment arrangements, and thus focused on the objective of minimizing "the effect of unjust or unreasonable pole attachment practices" (FCC 2001, ¶ 21) and concluded that the "benefits of using a forward-looking cost methodology are less pronounced in the pole attachment context than in the universal service/interconnection context." (FCC 2001, ¶ 23). Fourth, because utility poles have not undergone the rapid technological change that have reduced the cost of acquiring and installing other network components, historical and forward-looking cost methodologies may produce similar results in the pole attachment context (FCC 2001, ¶ 24).

With regard to the last point, the FCC's expectation that historical and forward-looking (current) cost methodologies should produce similar costs was correct, but not for the proffered reason. The key consideration is not the *pace* at which technology is changing, but the *effect* of that change on the relative purchase prices and installed costs of assets of different vintages. In the case of assets such as fiber optic electronics and switching equipment, technological change has been sufficiently rapid to make the installed cost of newer equipment lower than earlier vintages.[13] In contrast, even though utility pole technology has been relatively static, the installed costs of poles have been increasing at an average annual rate on the order of three

[12] Pole-owning utilities and companies seeking to attach their wires to these poles can negotiate rates lower than the maximum rate prescribed by the FCC's rules, as well as other terms and conditions.
[13] This has been the case, even though the total installed cost includes items such as installation labor and support structures, which may well have been increasing.

percent. As subsequent sections of this paper explain, whether or not historical and current cost methodologies produce similar results depends on whether the methodology properly represents the trend in installed asset costs (be it positive or negative) and not whether those trends are due to technology.

3. Cracks in the Conventional Wisdom

The following two sections describe economic analyses that critically evaluated (explicitly or implicitly) the large differences between rates produced by applications of the FCC's TELRIC methodology and rates based on original costs.

3.1. Methodological Issues

Almost immediately after the FCC established its TELRIC methodology, parties interested in purchasing wholesale elements began producing cost estimates for network components such as loops (the connection between a customer and the incumbent's network) and switching that were considerably lower than the corresponding retail costs and prices (based on historical costs) for the incumbent's services that utilize these components. At the same time, other parties argued that rote application of factors such as rate of return and depreciation rates used in historical cost methodologies would severely understate the cost of providing wholesale elements to new competitors. For example, in the proceeding that produced the FCC's TELRIC methodology, Hausman (1996) explained that properly accounting for factors such as demand uncertainty and declining asset prices would require the use of much higher rates of return than regulators typically used to establish regulated retail prices. In particular, consistent with the objective that TELRIC prices approximate those that would prevail if competition were feasible, with declining asset prices and demand uncertainty, a competitive firm would charge higher prices in the early years of the lifetime of an asset than would be the case for regulated prices, with the expectation of declining prices over the lifetime of the asset in response to the prospect of losing volume and/or competitors acquiring network facilities.[14]

For example, if asset prices are expected to change (increase or decrease) at a certain annual rate and the price for the service in question would track the change in the asset price, then the relationship between the competitive price for the first year of the asset's life and the price resulting from ignoring the expected asset price change is the following (under the assumption of no demand uncertainty and ignoring "out of pocket" costs):[15]

[14] Forty-five years before the Telecommunications Act, Fellner (1951) provided a qualitative explanation (anticipatory retardation) that paralleled the mathematical approach in Hausman's and subsequent similar analyses (see, for example, Mandy and Sharkey (2003)). Fellner explained how firms anticipating technological progress and the concomitant continuous price decline would set prices and output at levels sufficient to recover their expected costs.

[15] Derived from Hausman (1997, pp. 31-35 and Hausman (2003, p. 217). Hausman's result is based on an infinite asset life and continuous payments, i.e., PMT(x) = 1/x, but the logic can be extended to finite life, discrete time

$$(1)\ P_1^{\text{competitive}} = P^{\text{levelized}} \times \left(\frac{(1{+}a) \times \text{PMT}(r - a)}{\text{PMT}(r)}\right)$$

where PMT is the function that produces the levelized annual payments for a given discount rate, r is the nominal discount rate, and a is the annual rate of change in the asset price. Equation 1 can be interpreted as stating that the difference between the competitive price and the levelized price typically calculated in TELRIC studies is that the former is based on the appropriate payment function using a "real" discount rate, while the typical TELRIC result uses a nominal discount rate. According to Equation 1, the first-year competitive price is higher than the levelized price when asset prices are expected to decrease ($a<0$) and vice versa for increasing asset prices. In the subsequent years, the competitive price changes at the same rate (a) as the underlying asset price.[16]

3.2. The Difference Narrows

While the methodological critiques of Hausman and others necessarily implied that the apparent difference between prices based on historical costs and current costs was at least in part an artifact of the faulty methodology used to produce the latter, there was no quantification of how large any remaining difference might be. Other lines of inquiry provided some indication of the magnitude of such differences. Lehman and Weisman (2000, Chapter 6) presented stylistic comparisons between costs produced by properly applied historical and forward-looking cost analyses. Lehman and Weisman first distinguish between differences attributable to the methodologies versus different inputs into the methodologies. In particular, they note that a forward-looking study based on an accurate measure of current cost may well produce results much closer to historical costs than a study using more speculative (and perhaps overly-optimistic) investment cost estimates, e.g., estimates of costs expected at some future date. They then proceed to explore differences between historical and current costs with an accurate measure of current investment levels as the starting point.

The authors employ simulations in which a hypothetical firm adds plant (e.g., telephone lines) over a long period and then compare the steady-state historical and current costs results under alternative scenarios defined by differences in 1) investment cost levels, (2) the annual rate of change in investment costs, (3) economic and regulated depreciation lives, (4) cost of capital, and (5) operating expenses. The base case for this analysis was the scenario that assumed no inflation (or deflation) in plant costs and ignored operating costs. The key insight from the base case was that steady-states prices based on current costs would actually be about 20 percent

payment functions. Accounting for demand uncertainty introduces an additional positive multiplier ($M>1$) that produces a larger first year price than when there is no demand uncertainty.

[16] The present value of these prices, discounted at the nominal after-tax discount rate, equals the current investment level.

higher than price based on historical cost, with the difference completely explainable as an artifact of their methodology.[17]

The authors performed simulations in which they varied the five defining characteristics according to assumed underlying distributions and then calculated the difference between historical and current costs. The distribution of these differences was the basis for their "admissibility tests"—if a regulator selected (or a party proposed) a current cost calculation that was outside the range produced by their simulations, Lehman and Weisman concluded that the inputs to the current cost calculation were optimistic speculative estimates of what costs might be in the future, rather than real costs available in the present.

The admissibility range was indeed quite narrow (Lehman and Weisman 2000, pp. 69, 70 (Table 5)). Lehman and Weisman reported mean (and median) differences between historical and current costs of 8.5 percent, with 50 percent of the simulations having differences between 4 percent and 13 percent, 80 percent with differences between -0.5 percent and 17.5 percent, and 90 percent of simulations with differences between -4 percent and 19 percent. In contrast, state regulators chose forward-looking costs that *averaged* 22 percent lower than embedded costs and less than one-quarter of state regulators selected forward-looking costs that were within the authors' 90 percent admissibility interval. Based on these results, the authors observed (Lehman and Weisman 2000, p. 78):

> These regulatory decisions consistently reveal forward-looking cost estimates that are too far below embedded costs to result solely from applying a forward-looking methodology. These decisions are out of the bounds of reasonable deviations unless these numbers are intended to answer "what might it cost?" Of course, a speculative cost question has no validity check.

While Lehman and Weisman concluded that (apart from speculative optimistic plant investment inputs) historical and current cost estimates should fall within a fairly narrow range, Rogerson (2011) developed a model which can produce identical results for historical and current costs, provided that regulated depreciation schedules follow a specific pattern. In particular, Rogerson's model first produces a result comparable to Hausman's analysis, represented by Equation 1 above: properly calculated forward-looking costs for a particular time period (e.g., year) should be proportional to (but not necessarily equal to) the cost of acquiring and installing

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[17](Lehman and Weisman 2000, p. 69, Figure 2). In particular, the steady-state historical calculation produces costs based on one-half of the plant being depreciated (average "rate base") over the life of the plant, while the current cost calculation is based on the constant annual (monthly) amount that produces a present value equal to the amount of original plant investment. Because of discounting, this levelized amount produces a higher average "rate base." The current cost (levelized) calculations are equivalent to basing costs on plant that is less than 50 percent depreciated, e.g., the authors' base case is equivalent to a "rate base " calculation with plant being about 30 percent depreciated, i.e., the net plant (initial investment less accumulated depreciation) is about 70 percent of original plant. In the analysis presented later in this paper, the same ratio of net plant to original investment is assumed when comparing current cost and historical cost results.

new assets in the previous period (Rogerson, 2011, p. 15, Equations 21 and 22). Rogerson then explains that if the depreciation schedule is proportional to the product of the expected asset price times the expected survival rate (the relative replacement cost (RRC) allocation rule), historical costs will equal forward-looking costs (Rogerson 2011, pp. 19-20).[18] Rogerson's interpretation of this equivalence is instructive (Rogerson 2011, pp. 22-23):

> [R]egulators' intuition that the rapid pace of technological progress in the telecommunications industry required them to switch from basing prices on historical costs to basing prices on forward looking costs is not correct in the simple benchmark model of this paper. In theory, either method can be used to calculate efficient prices when technological progress is causing the replacement cost of assets to fall over time. Under a historical pricing method, increases in the rate of technological progress simply require the regulator to use a more accelerated allocation rule to correctly reflect the impact of technological progress on the marginal cost of production in each period.
>
> Furthermore, it can be argued that basing prices on forward looking cost is likely to create a whole host of extra problems that do not arise when prices are based on historic cost because of a factor not captured in the formal model. Namely, in reality, calculations of historic cost are likely to be based on much more objective data that are less subject to manipulation than are calculations of forward looking cost. Historic cost is based on the amount of money that was actually spent to purchase an asset. However, forward looking cost is based on the amount of money that the regulator *estimates* that it would cost to purchase *functionally equivalent* assets. In the formal model of this paper these problems are glossed over because it is assumed that the asset is a simple homogenous commodity that does not change over time that is sold at some easily measured market price. The reality of the situation is, of course, likely to be quite different. This creates two related problems. First, at a minimum, it is very expensive to conduct the sort of investigations required to determine what the current replacement cost of assets is. It is widely recognized that the regulatory proceedings in the United States used to determine forward looking cost have become highly adversarial and very expensive. Second, to the extent that forward looking cost is manipulable, this allows regulators the opportunity to essentially attempt to reneg [*sic*] *ex post* on their commitment to reimburse the firm for its investments in sunk assets. To the extent that some sort of *ex ante* commitment is necessary and desirable in order to alleviate the hold-up problem, the fact that a forward pricing rule weakens this commitment ability may be undesirable.

[18] The depreciation pattern under RRC can differ substantially from commonly used straight line depreciation, i.e., equal allocation of original cost over the economic life of the asset. For example, if the price of the asset is expected to decrease over time, the RRC produces a front-end loaded depreciation schedule.

4. Proper Application of Current Cost Methodologies

The previous section discussed research—motivated by the FCC's "back-to-the-future" adoption of a current cost methodology—that demonstrates that large differences between current cost and historical cost calculations need not exist. Indeed, application of Rogerson's RRC depreciation schedule would result in identical historical and current cost results. However, (1) implementation of RRC depreciation may impose new burdens on regulators and regulated firms and (2) for that and other reasons, there may be few, if any, examples of its application. In other words, the books of account available for practical rate setting (such as pole attachment rates under the FCC's rules) continue to reflect long-standing conventions such as straight-line depreciation. The remainder of this section incorporates the insights from the research reviewed in the previous section to demonstrate that even with conventional depreciation practices, proper application of current cost methodologies should produce costs and prices reasonably close to the corresponding results from an historical cost methodology.

4.1. Comparison of Prices Produced by Current Cost and Historical Cost Calculations

Prices based on traditional historical cost approaches start with books of accounts, which are based on the original costs to purchase and install assets with lives longer than one year. The prices have two major components: (1) depreciation, return, and taxes—the capital-driven costs and (2) annual out-of-pocket expenses, such as maintenance and administration. These components are typically estimated by multiplying the undepreciated value of the assets in question by a factor that accounts for the capital-driven and out-of-pocket components (FCC 2001, Appendices D and E). For example, suppose the books of accounts indicated that (1) the average original cost of a utility pole was $500, (2) these poles were 50 percent depreciated, (3) depreciation was four percent of original cost, (4) the cost of capital was 8 percent, (5) income taxes were $7.35 per pole, and (6) other out-of-pocket expenses were $15 per pole. Then the annual cost of a pole, which is the starting point for establishing rental rates with formulas such as those used by the FCC, is shown in Table 1.[19]

[19]These formulas then typically assign a certain percentage of annual costs to the attachment rates. For example, before 2011, the FCC's formulas (with "default" inputs) established rates of 7.4 percent of annual cost for the attachments of cable television companies and 11.2 percent and 16.9 percent for the attachments of CLECs in urbanized and non-urbanized areas, respectively (FCC 2001, Appendices D and E). In 2011, the FCC (2011, ¶ 151) changed the formulas for CLEC attachments with the objective of assigning virtually the same percentage of annual cost that the attachment rates for cable companies recover.

Table 1: Annual Utility Pole Costs based on Historical Costs (Stylized Example)

Original Investment per Pole: $500/$250 undepreciated		
Component	Annual charge component	Cost contribution
Depreciation	8.00%	$20
Return	8.00%	$20
Taxes	2.94%	$7.35
Out-of-pocket	6.00%	$15
Total	**24.94%**	**$62.35**

Table 1 shows that the four percent depreciation rate, when multiplied by the original cost of $500, produces an annual cost contribution of $20. Thus, the depreciation component is eight percent of undepreciated original cost. For the other components, the eight percent return, taxes of 2.94 percent, and out-of-pocket expenses of six percent—all applied to an undepreciated original cost of $250, produce annual cost contributions of $20, $7.35, and $15, respectively. The sum of these individual contributions is the annual pole cost of $62.35, which is 24.94 percent of the average undepreciated investment of $250 per pole.

In calculating prices based on current costs, parties often employ the following approach: (1) determine the current cost of purchasing and installing the assets in question and (2) develop annual charge factors from historical accounting cost information. With respect to the first step, investment information could be available if sufficient new plant representative of operating conditions for which prices are needed has been recently installed and the relevant information, e.g., completed contracts, has been retained. For example, in the most recent year poles averaging $733 per pole—47 percent higher than original cost of $500—had been installed throughout the service area. To the extent that such information is not available and/or the most recent installations do not reliably represent the area in question, the resulting current cost estimates are likely to be unsupported by solid data and essentially speculative in nature. To complete this example, if the annual charge components calculated with historical data are mechanically applied to a current investment amount, the resulting annual cost would be higher than the corresponding annual cost contribution based on historical data by the ratio of current costs to historical costs, e.g., $91.40, or 47 percent higher than the $62.35 annual cost for the example shown in Table 1.

In fact, the application of annual charge factors based on historical data to current cost estimates will produce annual costs that are too high when the asset in question has experienced inflation and annual costs that are too low for assets whose installation costs are decreasing over time, e.g., network equipment experiencing technological advances. The reason for this observation is readily apparent for out-of-pocket expenses. In particular, in the example above, applying the annual charge component of six percent to current, rather than original, cost automatically increases those out-of-pocket costs proportional to ratio of current to original costs. There is no reason to expect that such costs should be higher simply because current installed costs are used. If anything, to the extent that using current costs is motivated by the rationale that prices should be based on a brand-new network (like the FCC's TELRIC methodology), out-of-pocket costs should be lower than those reflected on the books of account, because the assets deployed in the putative brand-new network would have less wear and tear than the real-world assets.

As explained earlier (and shown by Equation 1), the capital-driven cost components (depreciation, return, and income taxes) are also biased for a somewhat different reason. In particular, when there is a trend in the installed costs of assets (either increasing or decreasing over time and prices are expected to follow the same pattern), correct calculations of the concomitant annual charge components should be based on an inflation-adjusted (positive or negative), i.e., real, rate of return, not the nominal rate of return used with the traditional historical cost approach.[20]

In summary, the commonly-applied, application of annual charge factors derived from historical costs to investment levels based on current costs produces results consistent with the conventional wisdom that rates based on current costs are higher than rates based on historical costs when long-lived asset prices are increasing over time, e.g., utility poles (and vice versa when asset prices are decreasing, e.g., electronic telecommunications equipment). Adjusting annual charge factors to account for the asset price changes would lower them when asset prices increase (and increase them when asset prices are decreasing), bringing rates based on historical and current costs into closer alignment. The example in the next section demonstrates that these adjustments can virtually offset the discrepancy between current and historical investment levels, resulting in broadly comparable rate levels.

4.2. Illustrative Example

That prices based on current costs (properly applied) are quite close to prices produced by the traditional historical cost approach can be illustrated by the following example.[21] Suppose the installed cost of new facilities, which have a current cost of $733 and an economic life of 25 years, is increasing at 3.5 percent per year. Ignoring the effects of expansion of those facilities (i.e., approximately the same number of poles [four percent of the total stock, representing removal of the inverse of the economic life each year] is deployed each year as older poles are removed from service), the average original cost of these facilities would be

$$(2)\ \text{Average original cost} = 733 \sum_{i=0}^{L-1}(1+a)^{-i}/L = 733\left(\frac{1+a}{a}\right)(1-(1+a)^{-L})/\text{L}$$

[20] See, for example, Hausman (2003), Mandy and Sharkey (2003), and Rogerson (2011). The latter two papers were authored or co-authored by an FCC staff economist and former FCC Chief Economist. While disputes over applying the FCC's TELRIC approach tended to focus on assets whose prices were decreasing over time, the basic principle applies when asset prices increase over time, e.g., Mandy and Sharkey (2003).

[21] The economic life, asset inflation rate, and cost-of-capital approximate values used to calculate rental rates for attachments of the facilities of other parties on the poles owned by an electric utility.

where a is the inflation rate (3.5 percent in this example) and L is the economic life (25 years).[22] Using these values with Equation 2 produces an average original cost of $500; therefore, the current cost of $733 is 1.47 (733/500) times the average original cost. Dividing the out-of-pocket component of the annual charge factor developed from historical data by this ratio of current cost to original cost would produce the same out-of-pocket expenses. In our example, the resulting component for use with current costs would be 4.09 percent (6.00%/1.47).

Turning to the other components (return, depreciation, and taxes), suppose the after-tax cost of capital is 6.57 percent. With facilities costs increasing at 3.5 percent per year, the corresponding real cost of capital is about 2.96 percent ((1+0.0657)/(1+0.035) - 1). The capital-driven cost component based on current cost (numerator of Equation 1) would be

(1+ 0.035) x PMT(0.0296,25,1) = 0.0592, where "PMT" is the annual payment for 25 years that produces a present value of $1 with a real cost of capital of 2.96 percent.

In contrast, the corresponding cost component based on historical cost (denominator of Equation 1), which is produced by the nominal cost of capital rate of 6.57 percent, would be

PMT(0.0657,25,1) = 0.0825

The ratio of these two capital-driven cost components, which is 0.72 (0.0592/0.0825), would then be multiplied by the original cost capital-driven cost components and then applied to a current cost amount.[23]

Table 2 compares the annual cost of $62.35 previously calculated using original costs to the calculation that applies the adjusted annual charge factors to current investment. The example suggests that if the deployment of the various vintages represented in a utility's books of accounts approximates the pattern displayed in Equation 2, the current cost approach, properly applied, should produce results quite similar to the traditional historical cost approach.

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[22] Equation (2) is a simple average of investment costs over L years, where the cost is increasing at 3.5 percent annually. In the illustrative example, the current cost is $733, the cost one year earlier is 708.21 (733/1.035), and so forth.

[23] As illustrated in the following table, (1 + asset inflation rate) x PMT(real cost of capital, life, 1)/PMT(nominal cost of capital, life, 1) ≥ original cost/current cost. Therefore, current costs are somewhat larger than the corresponding historical costs.

Table 2: Annual Utility Pole Costs: Historical versus Correct Current Cost Calculation

	Original Cost per Pole: $500/$250 undepreciated		**Current Cost per Pole: $733/$367 undepreciated**	
	Annual charge component	**Cost contribution**	**Annual charge component**	**Cost contribution**
Depreciation	8.00%	$20.00	5.74%	$21.03
Return	8.00%	$20.00	5.74%	$21.03
Taxes	2.94%	$7.35	2.11%	$7.73
Out-of-pocket	6.00%	$15.00	4.09%	$15.00
Total	**24.94%**	**$62.35**	**17.69%**	**$64.80**

Notes:

1. Historical investments and annual charge components are calculated from books of account (see, for example, FCC (2001, Appendices D and E).
2. Current cost annual charge out-of-pocket component = original cost annual charge out-of-pocket component x original cost investment/current cost investment
3. Current cost annual charge all other components = original cost annual charge all other components x (1 + asset inflation rate) x PMT(real cost of capital, life,1)/ PMT(nominal cost of capital, life,1)

The left side of Table 2 repeats the historical cost calculation shown in Table 1. The right side of the table shows the higher current cost investment ($733 current cost and $367 undepreciated current cost) being offset by the lower adjusted annual charge components to produce an annual cost of $64.80, which is much closer to the $62.35 annual cost produced by the historical cost calculation than the result of $91.40 produced by improperly applying annual charge factors calculated from historical data to current investment levels.. In particular, the 5.74 percent adjusted depreciation rate is multiplied by the current cost of $367, producing an annual cost contribution of $21.03. For the other component, the 5.74 percent return, taxes of 2.11 percent, and out-of-pocket expenses of 4.09 percent—all applied to an undepreciated current cost of $367, produce annual cost contributions of $21.03, $7.73, and $15, respectively. The sum of these individual contributions is the annual pole cost of $64.80, which is 17.69 percent of the undepreciated current investment of $367.

4.3. Discussion

The demonstration that the differences between prices produced by historical and properly applied current costs approaches can be quite small builds on previous research that identified potential errors in applying annual charge factors properly used with historical investment levels to current cost levels. To avoid such potential errors when using current investment levels, previous research clearly demonstrates that annual charge factors need to account for asset price trends (either positive or negative). The analysis employed in previous research assumed constant annual rates of asset price change, producing the result that the proper adjustment is based on the use of a real discount rate in place of a nominal rate in determining the capital-based components of the annual charge factor. The illustrative results in the previous subsection reflect the additional insight that application of the same rate of asset price change in conjunction with an assumption that the vintages of assets in the existing asset base are equally represented results in a relationship between current investment and historical investment that largely offsets the adjustment to the annual charge factor.

Like the approaches reviewed in the previous section, the illustrative example assumes a constant rate of asset price increase (or decrease) going forward.[24] This assumption greatly facilitates the development of the correct annual charge factors when rates are based on current costs. That is, if the pattern of asset price changes over time is more complicated than a constant rate of change, an exact analytical solution might not be forthcoming.[25] While the assumption of constant asset price change may be somewhat restrictive, the assumption facilitates a tractable solution to obtaining compensatory prices consistent with competitive outcomes. Further, this assumption offers a plausible explanation for why current cost levels can be substantially higher (or lower) than the corresponding original costs, i.e., the same rate of asset price change is also used to account for the different between current cost and original cost investment levels.

In addition to the rate of asset price inflation, the similarity of the rates based on current and original cost calculations also results from the use of a simple average of the vintage asset prices in Equation 2. Departures from this assumption could in principle widen the gap between the approaches. Departures from constant asset price change in Equations 1 and 2 and the simple averaging in Equation 2 would raise the question of which approach would be preferable in such circumstances. Basing rates on current cost calculations that fail to account for expected asset price changes can produce substantially biased results, which rates based on original costs may largely mitigate. Further, in addition to analyzing asset price changes, as discussed above, the use of current costs (1) requires information that may not be readily available, e.g., whether recently deployed assets are representative of the totality of assets for which a rate calculation is needed and (2) can introduce a degree of judgment and/or speculation that does not arise with rate calculations based on original costs.

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[24] The illustrative example considered a single asset class, i.e., utility poles. The approach can be generalized to several asset classes, each of which may have different rates of asset price changes, as well as asset lives. Calculations of the proper annual charge factors would then be done asset class by asset class, using asset lives and annual rates of asset price change that varied by asset class.

[25] The generalization of Equation 1 would be the value of $P_1^{\text{competitive}}$ that solved the equation $P_1^{\text{competitive}} \times \sum_{i=1}^{T} \frac{f(i)}{(1+r)^i} = P^{\text{levelized}} \times \sum_{i=1}^{T} \frac{1}{(1+r)^i}$, where $P^{\text{levelized}}$ = initial investment x PMT(r) and f(i) identifies the annual change in asset prices. Equation 1 is the solution when $f(i) = (1+a)^{(i-1)}$, where a is the annual rate of change in the asset price.

5. Conclusion

Changes in the cost of acquiring and deploying long-lived assets, e.g., as the result of technological progress, can clearly result in large differences between the current and original costs of the *stock* of a firm's capital assets. Such differences were the basis for the controversies that seemed to be settled when the Supreme Court upheld the use of original cost ratemaking in the *Hope* decision but which resurfaced upon the FCC's adoption of current cost ratemaking for unbundled network elements. Drawing upon recent research demonstrating that the large differences in *rates* typically produced by applications of current cost methodologies were the result of incorrect calculations of the annual costs associated with current cost capital stock, this paper has described how proper application of current cost methodologies should result in rates that are reasonably close to those produced by the much more widely-used original cost approaches. The long track record and regulators' familiarity with original cost approaches and the much greater reliability and verifiability of original cost data (arising from the link to the firm's audited books of account) would appear strongly to favor original cost methodologies.

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