Attachment 1

Exhibit 16 A-4

INFLATION AND RATE OF RETURN REGULATION

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ABSTRACT

Inflation creates serious problems for current rate of return regulation procedures. The chief problem with the commonly used *original cost* (OC) rate base is a "front-end load" in capital charges that can cause serious resource misallocation. Both historical and recent discussions of a *trended original cost* (TOC) rate base misstate the pros and cons of this alternative, which gives inflation compensation in rate base write-ups instead of in current income. While TOC would be better in almost all respects than OC if starting from scratch, special procedures are needed to avoid windfalls in a transition between rate base methods

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I. INTRODUCTION

This paper began in a research project examining rate base and rate of return methodology for oil pipelines. The project led to testimony in Phase I of the Williams Pipe Line Company proceeding before the Federal Energy Regulatory Commission (FERC).[1] This proceeding sought to determine regulatory methods for the oil pipeline industry, which previously had been regulated by the Interstate Commerce Commission (ICC) according to a unique rate base formula.[2] Transfer of regulatory authority to FERC created a clean slate, and prompted a new look at conceptual and practical issues that had been thought settled.

Almost all professional opinion and regulatory practice prefer the *original cost* (OC) rate base methodology. Under OC regulation, the rate base essentially equals the net book value of assets and is not adjusted for inflation. However, OC regulation creates serious problems when inflation is rapid and unpredictable. The alternative is a long-known (but never applied) rate base concept in which an index is used to write up asset values to reflect inflation. We call this approach *trended original cost* (TOC).

Our study of the oil pipeline industry led to the following conclusions.

1. In part the preference for OC is based on the common view that TOC gives the regulated firm "something for nothing." However, TOC regulation properly administered will give the same overall "fair return" as OC.
2. OC causes a "front-end load" of capital costs whenever there is inflation That is, "fair" profits are too high when an asset is young and too low when it is old.
3. OC regulation therefore distorts investment and asset use in many regulated industries, such as transportation, where the carrier must compete directly with unregulated carriers or with other regulated carriers holding assets of a different vintage.
4. Other distortions from OC regulation are (a) an inequitable shift of costs from future users to present users, (b) unnecessary fluctuations in tariffs during periods of changing inflationary expectations, and (c) difficulties in assuring investors the opportunity to earn a fair return, either because of consumer resistance to fair but dramatic rate increases or the reluctance of regulatory commissions to grant rates sufficient to cover the true cost of capital during high inflation.
5. The purported benefits of OC regulation over TOC are often nonexistent or based on confused analysis.
6. However, transitions from one approach to another may create large administrative costs and large windfall gains or losses to companies and their customers. Problems in transition may outweigh arguments for improved methodology.

In this paper, we first show that TOC and OC give the same expected total return to the investor under fair regulation. We then address the differences in the two approaches which should determine the choice between them. We emphasize the consequences of the front-end load and compare the likely administrative costs of TOC vs. OC regulation.

It is fair to ask why another paper on inflation and rate of return regulation is needed, given the long record of debate on that topic. The answer comes when we look at the literature in Section IV of this paper, especially the last round of debate in the 1960s. First, that debate was usually not about TOC as we define it, but about regulation based on, for example, engineering estimates of "fair value." Second, inflation in the 1960s was relatively modest and predictable; some writers seemed more concerned about prior inflation, in the 1940s and early 1950s, than in expected future inflation. Third, the link between fair return to the firm and the equilibrium expected rate of return on its securities had not been fully worked out. In 1985 it is not controversial to equate fair rate of return and the opportunity cost of capital prevailing in capital markets; it would have been so in 1962, when the field of financial economics was just getting on its feet.

Our goal here is to set out TOC as a consistent regulatory system, explain its advantages, and survey the main arguments for and against implementing it. We cover the highlights of the historical debate, and the most important issues raised recently; even some of the most recent discussion remains confused about the economic standard against which regulated rates should be tested.[3]

II. FAIR RETURN UNDER ORIGINAL COST AND TRENDED ORIGINAL COST REGULATION

In most cases, regulators seem to be concerned with three objectives:

1. *Fairness*—Investors should earn, or at least have the opportunity to earn, a fair return on their investment.
2. *Cost efficiency*—The firm should produce its product or service in the cheapest way available.
3. *Price efficiency*—The price of the firm's product or service should reflect the true cost of producing it.

Cost and price efficiency are necessary if the economy's resources are to be conserved and appropriately allocated. In addition, they assure that consumers are treated fairly, in the sense that the price they pay represents the minimum cost under an ideal allocation of resources. As a practical matter, however, regulators seem more concerned with the first goal than the latter two. "Fair regulation" means that the firm be given a reasonable opportunity

to earn investors' opportunity cost of capital, defined as the expected rate of return prevailing in capital markets on assets of comparable risk.[4] The nominal opportunity cost of capital determines the total *dollar* return to investors.[5] This return can come entirely from current earnings, or it can be distributed between current earnings and write-ups of the rate base. The form that return on investment takes depends on the rate base to which it is applied.

OC regulation compensates investors for inflation by increasing the return allowed as current earnings on the rate base. TOC compensates investors for inflation by writing up the rate base. Consequently, the time patterns of the cash flows received by investors are different. OC results in a front-end load of charges to consumers in times of inflation; investors receive a higher initial cash return under OC than under TOC regulation, but a lower cash return when the asset is older. However, the ex ante present values of the cash returns generated over the life of an asset are identical under fair OC or TOC regulation. The time patterns differ, but the values are the same.

Readers who accept these statements may wish to skip the next subsection, which demonstrates the essential equivalence of OC and TOC from the point of view of "fair regulation." Our demonstration of this equivalence is made necessary by the common confusion that TOC somehow permits, or should permit, "double-dipping" for inflation.

A. Inflation and Fair Return

Compensation for inflation does not necessarily come in current income. It can come just as easily in the form of a write-up in the rate base. The write-up gives investors part of their total return as a capital gain.

The requirements for fair return on assets owned at time t can be formally expressed in the following "fairness rule".

$$CE_{t+1} + DEP_{t+1} + (B_{t+1} - B_t) = kB_t, \tag{1}$$

where CE_{t+1} ≡ current earnings allowed at period $t + 1$,
DEP_{t+1} ≡ depreciation recognized as a cost of service in calculating regulatory revenue requirements at $t + 1$;
B_t, B_{t+1} ≡ rate base at t and $t + 1$;
k ≡ the nominal cost of capital.[6]

The sum of CE_{t+1} and DEP_{t+1} is the cash flow allowed by regulators at $t + 1$ on the rate base at t, and $(B_{t+1} - B_t)$ is the change in the value regulators assign to assets owned at t.

Now consider an asset purchased at $t = 0$. The asset's cost is its initial rate base under either TOC or OC regulation. If the firm can *expect*[7] to earn a fair return on this investment, then its present value should equal the asset's cost and thus equal its rate base. Consistent application of the fairness rule [Eq. (1)] gives this result.

Let V_t be value at t, which is determined by expected cash flow and value at $t + 1$:

$$V_t = \frac{CE_{t+1} + DEP_{t+1} + V_{t+1}}{1 + k}. \tag{2}$$

If T is the end of the asset's life, so that $V_T = 0$,[8] and if Eq. (1) holds, then

$$\begin{aligned} V_{T-1} &= \frac{CE_T + DEP_T + V_T}{1 + k} \\ &= \frac{(1 + k)B_{T-1}}{1 + k} = B_{T-1}. \end{aligned} \tag{3}$$

That is, value at $T - 1$ equals rate base at $T - 1$. This is true for $T - 2$ and for any t, if Eq. (1) holds in each period:

$$\begin{aligned} V_{T-2} &= \frac{CE_{T-1} + DEP_{T-1} + V_{T-1}}{1 + k} \\ &= \frac{CE_{T-1} + DEP_{T-1} + B_{T-1}}{1 + k} \\ &= \frac{(1 + k)B_{T-2}}{1 + k} = B_{T-2}. \end{aligned} \tag{4}$$

By the same logic applied to $T - 3$, $T - 4$, etc., we finally obtain

$$\begin{aligned} V_0 &= \frac{CE_1 + DEP_1 + V_1}{1 + k} \\ &= \frac{(1 + k)B_0}{1 + k} = B_0. \end{aligned} \tag{5}$$

Equation (1), the fairness rule, only specifies the *sum* of current earnings, depreciation, and change in rate base. *Any* level of current earnings is fair so long as this sum is fixed.

Under OC regulation, $CE_{t+1} = kB_t$. Also $DEP_{t+1} = B_t - B_{t-1}$; that is, the rate base changes only because of depreciation. Under TOC regulation, $CE_{t+1} = rB_t$, where r is the *real* opportunity cost of capital,[9] and the rate base is written up to reflect inflation (at rate i) but reduced by depreciation $B_{t+1} = B_t(1 + i) - DEP_{t+1}$. This satisfies the fairness rule for any depreciation schedule, because

$$\begin{aligned} CE_{t+1} + DEP_{t+1} + (B_{t+1} - B_t) &= rB_t \\ &+ DEP_{t+1} + B_t(1 + i) - DEP_{t+1} - B_t \\ &= B_t(r + i) = kB_t. \end{aligned} \tag{6}$$

Table 1 Cash Flow and Rate Base Under Net Original Cost and Trended Original Cost Regulation (20-year straight-line depreciation)[a]

	Net Original Cost Regulation				*Trended Original Cost Regulation*			
Year	*Current Earnings*	*Depreciation*	*Cash Flow*	*Rate Base*	*Current Earnings*	*Depreciation*	*Cash Flow*	*Rate Base*
1	$150.00	$50.00	$200.00	$1000.00	$90.00	$ 53.00	$143.00	$1000.00
2	142.50	50.00	192.50	950.00	90.63	56.18	146.81	1007.00
3	135.00	50.00	185.00	900.00	91.01	59.55	150.56	1011.24
4	127.50	50.00	177.50	850.00	91.11	63.12	154.24	1012.36
5	120.00	50.00	170.00	800.00	90.90	66.91	157.81	1009.98
6	112.50	50.00	162.50	750.00	90.33	70.93	161.26	1003.67
7	105.00	50.00	155.00	700.00	89.37	75.18	164.55	992.96
8	97.50	50.00	147.50	650.00	87.96	79.69	167.65	977.36
9	90.00	50.00	140.00	600.00	86.07	84.47	170.54	956.31
10	82.50	50.00	132.50	550.00	83.63	89.54	173.17	929.21
11	75.00	50.00	125.00	500.00	80.59	94.91	175.50	895.42
12	67.50	50.00	117.50	450.00	76.88	100.61	177.49	854.23
13	60.00	50.00	110.00	400.00	72.44	106.65	179.09	804.88
14	52.50	50.00	102.50	350.00	67.19	113.05	180.23	746.52
15	45.00	50.00	95.00	300.00	61.04	119.83	180.87	678.27
16	37.50	50.00	87.50	250.00	53.92	127.02	189.94	599.14
17	30.00	50.00	80.00	200.00	45.73	134.64	180.36	508.07
18	22.50	50.00	72.50	150.00	36.35	142.72	179.07	403.92
19	15.00	50.00	65.00	100.00	25.69	151.28	176.97	285.43
20	7.50	50.00	57.50	50.00	13.62	160.36	173.97	151.28

[a] Assumes a 9% real cost of capital and a 6% inflation premium. Assumes that the investment is made at the start of year 1 and that cash flows are received at the end of each year.

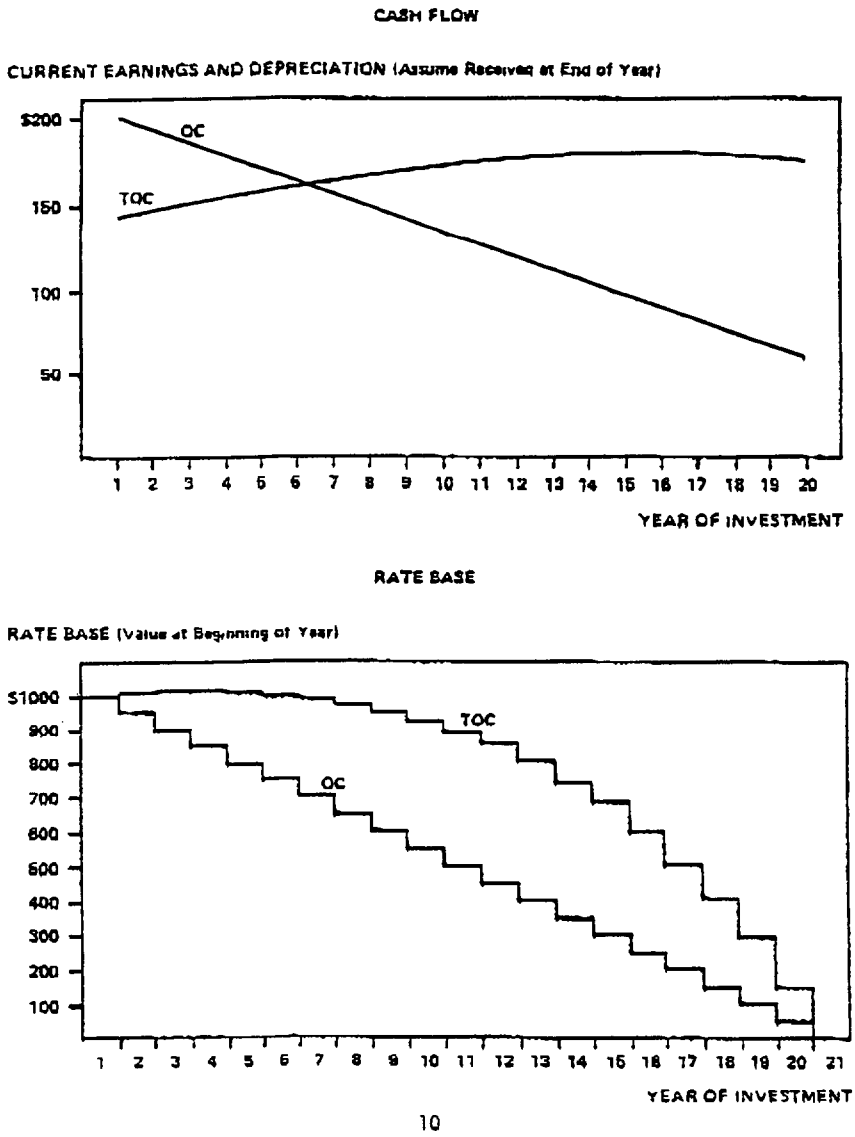

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Figure 1. Cash Flow and Rate Base Under Original Cost and Trended Original Cost (20-year straight-line depreciation).

Under OC regulation, depreciation is calculated by applying a schedule $d_1, d_2, \ldots, d_T$ to gross book value B_0: $DEP_t = d_t B_0$. Under TOC, the same schedule can be applied to gross book value *expressed in current dollars:* $DEP_t = d_t B_0 (1 + i)^t$. Since the depreciation schedule is applied to gross book value, any schedule that exhausts an OC asset in period T will exhaust a TOC asset in the same period.

Example. Suppose $1000 is invested in a new asset. The nominal cost of capital is 15 percent, consisting of a 6 percent inflation premium and a 9 percent real return. Under OC regulation, investors should receive the entire cost of capital in current income each year, or $150. Under TOC, investors should receive only the real rate of return (i.e., 9 percent) in current income and receive the inflation premium (i.e., 6 percent) in a write-up of the rate base.

In the first year, this amounts to a $90 return in current income and a $60 increase in the value of the rate base. This $60 must be viewed as a reinvestment of after-tax income in the rate base itself, because it is simply an alternative way of taking the income that would have been granted as current income under OC regulation.

Since the $60 is reinvested income, investors are allowed to earn the cost of capital on this investment in the following year. Investors also must be allowed to recover this reinvested amount in later years through higher depreciation charges than would accrue under OC regulation. If the rate base is depreciated by $75, but investors are only allowed $50 when allowed current revenue is computed, investors are shortchanged.

It is important to distinguish between rate base depreciation (the depreciation deducted from the rate base and used in calculating required current revenues for regulatory purposes) and book depreciation (depreciation used in reports to shareholders or to the Internal Revenue Service).[10] Rate base and book depreciation need not be equal.[11]

Suppose the investment in our example is subject to 20-year straight-line depreciation. The example is given in Table 1 and Figure 1. In the OC case current earnings equal 15 percent of the rate base, which declines by $50 per year. Total cash flow equals current earnings plus depreciation. The TOC case is conceptually just as easy, but looks more complicated. Current earnings always equal 9 percent of the rate base. Depreciation equals $50 inflated at 6 percent for each year that has passed. Regulators set tariffs to generate the expected cash flows shown, which include recovery of capital reinvested in the rate base. The present value of both the OC and TOC cash flows equals $1000 when discounted at 15 percent. Thus both these cash flows incorporate a fair return.

B. Choice of Index

So far we have drawn no distinction between the overall rate of inflation—the inflation *investors* are worried about—and price changes for specific

assets. In principle, rate base write-ups should be based on asset- or industry-specific indexes, not the general price level. If this is done, the rule for assessing fair return under TOC regulation has to be interpreted a little differently.

Suppose i is defined as the rate of change of *replacement* cost.[12] Then current earnings, depreciation, and rate base write-up can be computed exactly as described above, providing that r, the real opportunity cost of capital, is *defined* as k − i. For example, suppose the replacement cost index is forecasted at 8 percent and general inflation at 6 percent. In Table 1, we used a 9 percent real cost of capital based on a 15 percent nominal return and the 6 percent general inflation rate. However, if we give investors an extra 2 percent write-up, we must give them 2 percent less in current income. The first three years under TOC regulation would then look like those shown in the accompanying tabulation (compare Table 1). Thus investors get less than the real opportunity cost of capital in current earnings, but they make up the shortfall by a larger rate base write-up. This is exactly what should happen in equilibrium in a competitive industry where asset prices are expected to increase at more than the rate of inflation.

Year	*Current Earnings*	*Depreciation*	*Cash Flow*	*Rate Base*
1	70.00	54.00	124.00	1000.00
2	71.82	58.32	130.14	1026.00
3	73.48	62.99	136.47	1049.76

Current income should be based on the current nominal cost of capital and *expected* inflation; however, the rate base write-up occurs at the end of the period and should, in principle, reflect experienced inflation. Think again of what happens under competition, say, to the owner of an apartment house. Rents for the next period, t to t + 1, are forced to the level at which current income plus expected appreciation just covers the nominal opportunity cost of capital, but actual current income and appreciation may be more or less than expected. The apartment owner must bear the risk of unanticipated changes in apartment values *relative to other assets*.

The regulated firm's output price should likewise be calculated so expected current income plus appreciation just covers the nominal cost of capital. Actual current income may be higher or lower, depending on demand and operating costs. The actual write-up may be higher or lower depending on the actual change in the replacement cost index.

This leads us to a possible problem in *not* using an industry- or asset-specific index. If the rate base write-up reflects the ex post rate of *general* inflation, then investors in regulated firms are insulated from changes in *relative* prices. This raises practical questions that are taken up later in the paper.

III. THE FRONT-END LOAD AND ITS CONSEQUENCES

Earlier we noted three goals of regulators: fairness, cost efficiency, and price efficiency. Both OC and TOC regulation can allow a fair return, if market conditions permit. In fact, regulation using *any* consistent and systematic rate base definition yields a fair rate of return as long as investors expect to earn the cost of capital on the rate base chosen. Therefore, the choice between regulatory systems must rest on other issues.

In this section we discuss the chief disadvantage of OC regulation. its front-end load and its balancing tail-end shortfall. In the following section we will consider whether TOC regulation is a practical alternative.

A. The Front-End Load

When inflation is rapid, OC regulation leads to prices to consumers that are far out of line with what a competitive firm would charge. This is a grave fault, because the aim of regulation is not only to offer investors a fair rate of return, but also to assure that consumers pay fair prices.

The source of the problems created by OC regulation is that historical cost accounting does not approximate the value assets actually have in competitive, unregulated industries. Values based on historical costs can be grossly misleading when inflation is rapid, particularly for long-lived assets.

Example. The distortions created by OC regulation involve Big Money. Consider a new electric generating plant costing $1 billion. Assume that the plant is depreciated linearly over 40 years, initial tax-deductible interest expense is $60 million, the marginal tax rate is 50 percent, the real cost of capital is 6 percent, and inflation is steady at 10 percent. Each year's capital charges must cover current earnings, depreciation, and taxes. Capital charges in the first year under OC equal $(.16)(1000) + (1000/40) + (.5)[(.16)(1000) - 60] = \$235$ million. Under TOC, first year capital charges are $(.06)(1000) + (1.1)(1000/40) + (.5)[(.06)(1000) + (1.1 - 1)(1000/40) - 60] = \$88.75$ million. The front-end load is $146.25 million. Initial OC capital charges are over 2.6 times the TOC capital charges.

Of course, this front-end load is eventually offset by a tail-end shortfall. After 30 years capital charges are $77.5 million under OC regulation and $1092.4 million under TOC regulation, a tail-end shortfall of $1,014.9 million, or $58.2 million in constant ($t = 0$) dollars.[13]

Table 2 shows order-of-magnitude projections of tariffs for the proposed Alaska natural gas pipeline. The front-end load in transportation charges is clearly evident.

Table 2. Projected Capital Charges and Transportation Costs of Alaska Natural Gas Transmission System (figures in billions of dollars)

	1987	*1997*	*2007*
Depreciation at 4% of initial rate base ($40 billion)[a]	1.6	1.6	1.6
Income and interest at 14.9% of net rate base	5.5	2.4	0.7
Taxes at 50% of net income	1.6	0.7	0.2
Total	8.7	4.7	2.5
Fuel, operating, and maintenance costs[a]	0.7	1.4	2.7
Total transportation cost	9.4	6.1	5.2
Cost per thousand cubic feet (MCF) at 780 million MCF throughput[c]	12.00	7.80	6.70
Cost per MCF in constant 1987 dollars[b,c]	12.00	3.90	1.73

[a] Starting in 1987. Rate base includes accumulated allowance for interest during construction.
[b] 7% inflation assumed.
[c] Transportation cost only. Does not include wellhead price.
Source. Figures supplied by Jerome Haas, Cornell University. These forecasts are not based on a detailed simulation of the project and therefore should be taken as rough approximations.

B. Mixing Assets of Different Vintages

In these examples, as in all our discussion so far, we have traced income over the life of a single asset. Many regulated ventures are essentially single assets—think of the Alaska oil or gas pipelines. Others make extremely large, lumpy capital outlays—think of an electric utility bringing an atomic generating station into the rate base. However, other regulated firms—a local telephone company, for example—are smooth mixtures of assets of different ages. And some industries, such as trucking, combine the assets of many firms in a single rate bureau in calculating the rate base and rate of return. Does the front-end load go away in these cases?

The answer is maybe: a firm in a steady state under OC regulation may end up with a net front-end load or a net tail-end shortfall. As Table 3 illustrates, it depends principally on whether the TOC inflation index is growing faster or slower than the general rate of inflation. If the TOC index is growing faster (Panel A), an OC firm in equilibrium will probably have a permanent front-end load. For example, in Panel A, if the real rate of annual investment growth is zero and assets last 10 years, OC firms will overprice

Table 3. Deviation of Original Cost from Trended Original Cost Equilibrium Cash Flow with Different Inflation Rates*
(percent of the most recent annual investment)

Panel A: Rate of TOC Write-up = 12%

Durability of Each Investment (years)	*Real Annual Rate of Investment Growth (%)*				
	−12	0	4	6	8
10	−4	13	15	16	16
20	−101	16	23	25	26
40	−1257	14	32	35	36

Panel B: Rate of TOC Write-Up = 8%

Durability of Each Investment (years)	*Real Annual Rate of Investment Growth (%)*				
	0	2	6	8	25
10	−31	−21	−18	−14	0
20	−81	−43	−31	−22	5
40	−221	−82	−50	−30	8

Panel C Rate of TOC Write-up = 10%

Durability of Each Investment (years)	*Real Annual Rate of Investment Growth (%)*				
	0	4	6	8	12
10	−8	−2	0	2	5
20	−26	−6	0	4	10
40	−75	−13	0	8	15

* Assumes a real rate of return of 6%, a general inflation rate of 10%, and a (real) straight-line depreciation schedule.

Source. Calculations in the Appendix.

their capital assets by 13 percent in equilibrium, given the other assumptions. If the TOC index is growing more slowly (Panel B), OC prices tend to be too low in equilibrium. If the TOC index and inflation are identical (Panel C), the answer depends on the real rate of investment growth relative to the real cost of capital. Even in this case, it is only when the steady real growth rate exactly equals the real cost of capital that OC regulation yields the right price—the price that equals the true cost of the product or service provided.

The odds of reaching this ideal, in which OC and TOC yield the same price to consumers, seem pretty low even in a steady-state world. The odds that OC regulation distorts consumer prices in the steady state are corre-

spondingly high. The odds of distortion are even higher in the real world. For example, even a large firm may have distinct subparts of its business regulated by separate local commissions, so that its assets are fragmented for rate-making purposes. Also, we show below that an increase in the rate of inflation causes a discrete jump in capital charges under OC regulation. If one were in an ideal steady state with OC and TOC charges the same, an increase in the inflation rate would add an immediate front-end load to OC firms, and the return to the steady state would take years.

In what follows we concentrate on regulation of single assets. Most of our points apply also to a regulated mixture of assets, except in the unlikely case that mixing eliminates the distortions of OC. We continue to label these distortions as "front-end load" and "tail-end shortfall," recognizing that these expressions may not be strictly accurate for regulated mixtures of assets.

C. Consequences

The first and most obvious problem caused by the front-end load is that charges to customers are greater than the true economic value of the asset's services in the early years of its life. This imposes a heavy burden on consumers when inflation is rapid. Of course, exactly the reverse situation would occur after the asset has been in service for many years. In this case, customer charges under OC regulation are below the true cost of service.

If the utility is completely protected from competition, it may be able to charge distorted prices without having much effect on consumption or the allocation of resources. This ideal is hard to find in practice, however. Even if no effective competition exists in the immediate market, competition in a later stage of production may limit the prices a regulated firm can charge. (Think of the Alaska oil or gas pipelines.) And many regulated companies, such as those in transportation, face significant competition in the immediate market from both within their industry and from alternative sources of transportation.

With high inflation, OC regulation eventually must encourage over-utilization of older assets and discourage utilization of newer ones. This could lead to poor investment decisions, since investors will realize that demand for a new entrant will be artificially reduced by OC pricing. (Consider the difficulties facing the Alaska gas pipeline.)

The long lives of many capital-intensive investments such as pipelines amplify the distortions caused by prices based on OC rate bases. In industries with rapid asset replacement, the book value of assets will stay closer to their true economic value, simply because less time passes before the assets are retired and new assets purchased.

IV. FEASIBILITY OF REGULATION BASED ON TRENDED ORIGINAL COST

This section considers possible administrative impediments to regulation based on TOC and responds to the practical and theoretical arguments that have been advanced against it. We believe that the impediments can be overcome and the arguments answered. However, we do not conclude that TOC is best for all regulated industries. We have considered its application in detail only for oil pipelines. There may be hidden problems lurking in its application to, say, electric utilities. Also, we do not consider the administrative costs of switching to TOC from an established methodology. These costs might outweigh the advantages that TOC regulation would generate once installed.[14]

A. The Traditional Literature

The discussions of OC vs TOC in the standard textbooks of regulatory economics do not address the front-end load of OC regulation.[15] Further, they often address not TOC as we have defined it, but historical regulatory practice, in which "fair value" and "reproduction cost" often relied on engineering judgments. Although Bonbright and Kahn recognize the distinction between a trended rate base and an engineering estimate of fair value,[16] their arguments against the latter are used even today against the former.[17] In particular, a TOC rate base is often referred to as "fair value," suggesting regulation as practiced before the *Hope* decision, and as may still be practiced in some states. The phrase "fair value" is unfortunate, because it contributes to confusion between a sensible procedure such as TOC (as defined here) and regulatory schemes based on ad hoc and probably inconsistent adjustments.

We concentrate on serious potential objections to TOC and ignore objections directed against "fair value" approaches.[18] For the moment we will assume TOC uses an index of reproduction costs to trend the rate base, since the strongest objections are directed at this case.[19]

The argument against TOC seems to run as follows. TOC attempts to replicate perfectly competitive pricing, but it cannot do so except in long-run equilibrium. We live in an imperfect world which is not in long-run equilibrium, so that "second best" considerations suggest that perfectly competitive pricing may not be right even in principle. Even in long-run equilibrium, TOC will not give the right price in the presence of economies of scale and technological change. Finally, TOC regulation is costly and difficult to administer. Therefore, society is better off sticking with OC.

Thus, three major issues are raised to show that TOC cannot achieve competitive pricing: economies of scale, technological change, and disequilibrium in the real world. There has also been debate over whether and

how to compensate investors for inflation, and whether equityholders deserve write-ups on the debtholders' share of the rate base. We address these issues in turn.

1. *Economies of Scale*

Where scale economies exist, long-run average costs exceed long-run marginal costs. Optimal prices are below long-run average costs. TOC regulation attempts to set price equal to long-run average cost, higher than the optimal price. OC regulation is alleged to set prices that are lower, and thus closer to the optimum. Why lower? Because the OC rate base is smaller than the TOC rate base.[20]

The argument misses the front-end load of OC regulation. Early in an asset's life, OC tariffs will be *farther* above long-run marginal costs than TOC tariffs. Furthermore, the relative (real) distance between regulated price and long-run marginal cost will change every year under OC, even in equilibrium (where it remains constant under TOC). Thus achieving socially optimal pricing would seem to be *more* difficult under OC than TOC because the optimal subsidy must be recalculated each year.[21]

2. *Technological Change*

This argument asserts that TOC with a reproduction cost index aims at the wrong target. The goal should be to measure the value the rate base would have in a perfectly competitive industry. This would be the replacement cost of those assets: the cost of duplicating the productive capacity of those assets using the most efficient available technology. Since the cost of reconstructing the existing assets is different than (and usually assumed to be greater than) the cost of replacing the productive capacity of those assets, TOC is a bad idea in principle.

Our response is threefold. First, whether or not technological change introduces serious differences between reproduction and replacement cost is an empirical issue. We advocate a serious reexamination of TOC on an industry-by-industry basis, not a blanket adoption of it. Where technological change is especially significant, it obviously should be considered in deciding whether to adopt TOC. Second, some kinds of technological change can be incorporated in a reproduction cost index For example, the ICC's index of reproduction costs for oil pipelines is in part based on cost bids by pipeline construction companies using today's construction methods. There is no law of economics saying that decent approximations to replacement cost are forever out of reach.

Our fundamental objection to this argument, however, is that it makes no sense whatsoever to argue that technological change implies that OC regulation is better than TOC regulation The appropriate response to assets that

are becoming rapidly obsolete is a replacement cost index or, if that is infeasible, more rapid depreciation.[22] If an appropriate depreciation schedule is chosen, there is no need to try to jerry-rig a proper end result through choice of OC.

OC regulation in practice creates two distinct problems: (1) biases due to inflation (the front-end load) and (2) biases from overlooking technological change. TOC regulation can cure the first problem. Any cures for the second problem can be applied just as easily under TOC as under OC regulation.

3. *Disequilibrium*

We read Kahn's second best argument against TOC[23] as follows: most industries are cyclical and imperfect in practice; setting prices equal to long-run average costs (i.e., using TOC regulation) for regulated industries need not be right in this circumstance, by traditional second best theorems; and to find the "right" price, one would need to know all relevant own-price and cross-elasticities of demand; therefore, the apparent theoretical case in favor of TOC falls apart.

If this is in fact a correct reading of his argument, it is true but incomplete. Obviously, we cannot claim that TOC would yield the "right" price in such circumstances. But the relevant question is not whether TOC gives the theoretically perfect price, but whether the TOC price is closer to perfection than the OC price. As Kahn notes earlier, the differing time path of OC from unregulated industries is likely to introduce serious market distortions.[24] Second best arguments do not justify OC; the status quo may be third best or worse. Thus, while TOC is not necessarily "right," there are strong reasons to believe that OC will necessarily be "wrong."

4. *"Protection" from Inflation or Deflation*

In his examination of the history of regulation, Kahn finds the advocates of OC or TOC switching sides, depending on whether the economy is in an inflationary or deflationary phase. Regulated companies want TOC in inflationary times and regulatory commissions want TOC in deflationary times. Why do they care? Each method can give a fair return. Answer: the debaters typically assumed the same rate of return would be used, regardless of the rate base. Thus the debate was not so much between OC and TOC as between OC and something else.

An early debate between Morton and Bonbright was concerned with whether investors had an inherent right to the protection of the real value of their property from inflation, regardless of the rate of return or rate base methodology.[25] Morton argued that they had such a right. The position of Bonbright and Kahn is revealed in the following statement from Kahn's book: "as long as investors are informed in advance of whether they will be

explicitly protected against inflation (or, by use of an original cost rate base, against deflation), they can in fairness be left to take that fact into account in the prices they paid for the stock at the time of purchase."[26]

Try to see this debate as the participants saw it in, say, 1960. The inflation rate was trivial by today's standards. Nevertheless, reproduction costs exceeded historical costs, because of the rapid inflation in the 1940s and early 1950s. Moreover, interest rates were held down by the Federal Reserve System through 1952. Investors in utilities had not received inflation compensation in current income. Thus, reproduction cost's advocates were calling for a write-up of the rate base to cover experienced inflation, and to compensate a group of investors that *had* suffered relative to investors in unregulated firms. Kahn and Bonbright's response goes against retroactive rate-making, not against TOC.[27]

5. *Trending All of the Rate Base*

Bonbright and Kahn are willing to accept trending provided a general inflation index is used. Kahn, for example, says:[28]

> If, nonetheless, the government does want to adjust stockholder returns, in the interest of fairness, it can do so just as well and with far less damage to the efficiency of the regulatory process by varying (their part of) the permissible rate of return, or by applying some sort of price index number to the total dollars of permitted net income [i.e., *equity* income] as opposed to using the reproduction rate base.

Bonbright takes the position that the equity portion of the rate base should be trended if regulators find it difficult to offer a high enough rate of return to ensure fair compensation under original cost.[29] Thus, both recommend trending equity only. This brings us to a different issue.

It is widely viewed as unfair for equity investors to receive write-ups on the part of the rate base that is debt-financed. However, this view overlooks the inflation compensation embedded in the interest rate. For example, if the real interest rate is 3 percent and the inflation premium is 10 percent, bondholders will demand 13 percent. Equity investors, as the firm's owners, must pay the full market interest rate, including this inflation component, out of the firm's current operating earnings. Under OC regulation, they recoup the inflation premium paid to bondholders from the inflation premium in current operating earnings. Under TOC, they recoup from write-ups of the debt-financed portion of the rate base. It is not "unfair" to allow only a real rate of return on the debt-backed portion of the rate base, provided that inflation is compensated for in the rate base itself. Where the compensation for inflation takes place (that is, in the rate base or in the rate of return) makes no more difference to what is "fair" for the debt-backed portion of the rate base than it does for the equity-backed portion of the rate base.

If the rate of inflation changes after initial financing, equityholders gain (if interest rates go up) or lose (if interest rates go down) relative to bondholders. Such risks are routinely borne by equityholders in the unregulated sector. While equityholders have gained more than lost over the postwar period, there is no guarantee that they can continue to do so. The inflation premium in a bond's interest rate clearly is fair *at the time the bond is issued.* The bondholders lend voluntarily, presumably after a rational look at the prospects for inflation.[30]

Finally, note that trending only the equity portion of the rate base is equivalent to regulating the equity portion on a TOC basis and the debt portion on an OC basis. That is, since the debt-backed portion of the rate base does not grow with inflation, the firm's inflation compensation on this part of the rate base must come in higher current earnings as in OC. If TOC makes sense, we ought to go whole hog with it

B. Administrative Costs of TOC

Perhaps the most telling argument against TOC has been the charge that it is costly and difficult to administer. Essentially, the previous arguments that TOC is less than perfect are only a preface to the conclusion: "and since it costs so much, it is not worth the effort."

There are three administrative steps required under TOC that are not required under OC. After describing these steps, we will point out a serious administrative burden of OC that has not been addressed in the traditional discussions.

1. *Finding the Index*

TOC regulation requires a reproduction or replacement cost index (or indexes) for the assets of the regulated industry. The ideal is an index matching what the assets of competitive, unregulated firms in this industry would be worth on average. In some cases, it is possible to approach this ideal and administrative procedures may already exist that do so. For example, the ICC has routinely reported a disaggregated cost index for oil pipelines since the 1940s.

A substantial initial investment could be required to create a good reproduction or replacement cost index. In some cases, there may be no practical way to devise such an index. If so, one could look for a publicly available index of a broader sector of the economy that is a reasonable approximation of construction costs in the regulated industry. Finally, one could drop the goal of a reproduction or replacement cost rate base and simply trend the assets using a general inflation index, adjusting depreciation schedules if necessary to capture technological change or shifts in relative

asset prices. This last option seems simple and straightforward, and it does solve the front-end load problem created by changes in the general price level.

2. *Calculating the Real Rate of Return*

The second administrative step is calculating a real rate of return to be applied to the TOC rate base. Current regulatory hearings devote the bulk of their effort to calculating a nominal rate of return for the OC rate base. This task is truly difficult. It is often solved with what is politely called "expert judgment." Nevertheless, rationally derived estimates are available Given an acceptable estimate of the nominal cost of capital, one must then deduct the inflation premium to obtain the real cost of capital. There is less uncertainty in estimates of the inflation premium than in estimates of the nominal cost of capital.[31]

Another approach is simply to estimate the real opportunity cost of capital directly. This is rarely if ever done in regulatory proceedings, but there is no reason why it could not be, and several reasons why the task may be easier than it appears, once teething pains are over:

1. The so-called "DCF" models for estimating the opportunity cost of capital should work just as well with real as with nominal data.
2. The widely used "comparable earnings" method *cannot* be used to set a fair nominal rate of return when there is significant inflation. A switch to TOC regulation would remove *one* of the serious objections to this method. This issue is discussed further below.
3. The opportunity cost of capital is likely to be more stable in real than in nominal terms.
4. Regulators administering a TOC system would have the same check they rely on now (the reliance is not always explicit). We know that market value equals rate base value when investors expect the firm to earn its cost of capital on its rate base.[32] Under OC regulation rate base approximately equals net book value. Thus, if stock price exceeds book value per share for firms under OC regulation, the regulators have good grounds for reducing the allowed rate of return. Although this rule cannot be applied mechanically,[33] it is an invaluable benchmark. Regulators could just as well compare the market value of a firm's securities[34] to its TOC rate base

3. *Trends in Relative Prices*

We have generally assumed that the expected rate of general inflation and the expected rate of inflation of reproduction or replacement cost are equal on average. If so, the rate of current earnings on the TOC rate base should equal the real cost of capital. If not, the TOC current earnings rate

should equal the real cost of capital plus the difference between the average rate of general inflation and the average rate of reproduction cost inflation. For example, if the real rate of return is 8 percent, the expected future average rate of general inflation is 12 percent, and the expected average rate of reproduction cost inflation 11 percent, the rate of current earnings which should be allowed a TOC regulated firm should be $8 + (12 - 11) = 9$ percent. Conversely, if reproduction cost is expected to grow more rapidly than the general rate of inflation, the rate of current earnings should be lower than the real cost of capital.

The problem, of course, is to forecast the expected rates of general and reproduction cost inflation when they differ. Such forecasts may be difficult and costly. Even if they are easy and cheap they are likely to be controversial.

We cannot reach a general conclusion on this issue. Asset prices grow at different rates in different industries in different periods. Trying to forecast trends in relative asset prices would indeed involve some administrative costs. On the other hand, the use of a well-constructed reproduction cost index will result in better relative pricing decisions than use of a general inflation index, and these benefits are greatest in precisely the case where this additional forecasting step is most likely to be needed.

One practical approach to this problem is to initiate TOC using the best available estimate of the real cost of capital, and monitor the industry's performance over time to see if adjustments are needed. If the market believes that long-run general inflation will fall short of long-run TOC inflation (and if the real cost of capital is estimated correctly), there will be a systematic excess of the market value of the firm's securities over the rate base value. Given such evidence, the commission could then reduce the rate of current earnings.

Note that this test is the same offered above to see if the real cost of capital has been estimated correctly. A systematic excess of market over rate base value signals that the overall return is too high; but it cannot distinguish whether the overall return is too high because the real cost of capital has been overestimated, or because TOC inflation is expected to exceed general inflation. Fortunately, the remedy is the same for either explanation: reduce the rate of current earnings.

The fallback position is to trend the rate base by a general inflation index. This would still eliminate the pricing distortions from the impact of general inflation under OC regulation.

There is a practical objection to using a general inflation index—say the Personal Consumption component of the GNP deflator—to write up the TOC rate base. We have assumed write-ups are ex post, based on experienced inflation. With a reproduction cost index, investors are exposed to uncertainty about relative prices, even if the *expected* rate of increase of the reproduction cost index equals the expected general inflation rate. Writing

up by the ex post change in general inflation eliminates uncertainty about relative prices *and* could make the regulated assets an attractive inflation hedge.[35] Thus, the regulated firm may receive too much protection from inflation—more than a comparable competitive firm would enjoy.

There are two responses if this problem is viewed as significant. One is to reduce the cost of capital.[36] The other is to "put some inflation risk back in" by writing up the rate base by the *expected* rather than ex post inflation. This gives the same degree of protection against inflation as under OC. (Note that the fair current return under OC includes a premium only for expected inflation.)

The second choice has something else going for it. Refer again to the problem of estimating the real cost of capital by subtracting an inflation premium from the nominal cost of capital. A misestimate of the expected inflation rate would lead to an unfairly high or low current return (assuming the nominal cost of capital is correctly measured in the first place). However, if the same estimate of expected inflation is used to write up the rate base, then any excess or shortfall in current income is exactly offset in the write-up. In fact *any* inflation estimate would still give a fair *overall* return, *providing* the nominal opportunity cost of capital is correctly measured. Of course, this does not imply the inflation estimate can be made arbitrarily. The better the inflation estimate, the less temporal distortion of prices charged consumers. Moreover, varying the inflation estimating procedure from year to year could result in arbitrary short-run cash flow fluctuations that are costly to both the company and its customers.

C. Administrative Costs of OC

The administrative costs of TOC regulation are offset by a quite different cost incurred under OC regulation. Nominal costs of capital fluctuate as the rate of inflation changes, even if the real cost of capital is strictly constant. This in principle requires a regulatory hearing to adjust the OC rate of return every time the rate of inflation changes. While a practical form of averaging could probably be worked out to reduce this administrative workload to some degree, the kinds of dramatic fluctuations in the rate of inflation which have been observed over the past decade strongly suggest that frequent regulatory hearings under OC regulation are virtually unavoidable.

Fair OC regulation also amplifies the impact of fluctuating inflation on consumer prices. Suppose the rate of inflation increases from 0 to 10 percent without changing the real cost of capital of 10 percent. Figure 2 shows the path of fair earnings under the two regulatory systems, assuming that inflation begins in year 5. Under TOC, the fair (dollar) return underlying next year's prices will be 10 percent higher than it would have been under zero inflation. Regulators must let the OC firm's rate of return rise from 10 to 20

percent or fail in their responsibility to offer regulated investors a chance to earn their cost of capital. But if regulators do so, they are likely to encounter vehement protests by consumers, who simply do not see such dramatic responses to inflation in the unregulated sector. One author questioned whether regulators actually would be able to raise rates of return to 20 percent or more and concluded, "[t]hey will have stout hearts if they do."[37]

What if regulators do not have stout hearts? What if there is regulatory lag? Specifically, what if rates are not adjusted until year 7? Under OC regulation, investors would lose $10 per year for two years. Under TOC regulation, these investors would lose $1 in year 5 and $2.10 in year 7. This illustrates a general point, that if regulators are slow in recognizing accelerating inflation, the loss to investors is less under TOC regulation.

Regulatory lag is a fact of life. If regulatory lag is constant (two years, for example), investors bear more of the risks of uncertain inflation under an OC system. If the regulatory lag is longer when inflation speeds up than when it slows down, investors will lose on average as inflation fluctuates, and they will lose more under OC. As a practical matter, the pressure on regulators

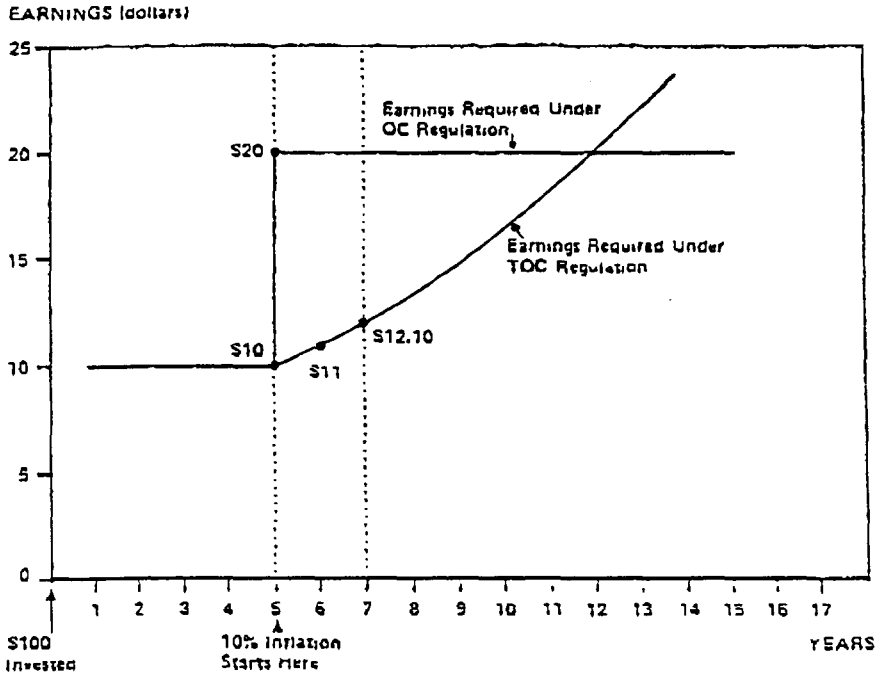

Figure 2 The Impact of Sudden Inflation on Earnings Required Under Original Cost and Trended Original Cost Rate Bases.

to resist rate increases is probably higher when inflation accelerates; regulatory lag may therefore be longer in that case.

Thus, an OC system poses a dilemma for regulators: they cannot treat both investors and consumers fairly. If they play by the rules of OC regulation, they sock consumers with a fluctuating front-end load. Consumers who are used to the way competitive prices behave naturally consider this not only painful, but also unreasonable. If regulators try to set prices that consumers would consider reasonable, they shortchange investors. In practice regulators seem to end up making neither side happy.

It is easy to exhort regulators to abandon this unhappy compromise and to sock it to consumers in order to give the firm a fair chance to earn its nominal cost of capital. It is more reasonable to junk the regulatory system that makes the compromise necessary.

D. Other Issues

Several further issues require brief discussion: (1) debt financing for firms regulated under TOC; (2) the longer payback period under TOC regulation; (3) the effect of income taxes under TOC; (4) whether TOC also exhibits a front-end load; (5) the possibility that current earnings are worth more than rate base write-ups; and (6) the interpretation of book earnings under TOC regulation.

1. *Debt Service Under TOC*

Inflation compensation for bondholders comes through an increase in the market rate of interest, just as inflation compensation comes in current income under OC regulation. Fair current earnings on a new asset under TOC are below the initial earnings under OC. In other words, there is a front-end load on debt service, but not in current earnings under TOC.

Of course, debt service under TOC regulation is no different than that faced by unregulated companies in the private sector. As shown earlier, TOC regulation most nearly replicates the pricing and asset value pattern achieved in competitive, unregulated industries. Firms in such industries successfully raise and service debt. TOC regulation by itself presents no problems of debt service that are not routinely solved in the private sector.

We can nevertheless anticipate at least a temporary pinch for regulated firms with young assets and high debt ratios. New oil pipelines, for example, have often been financed at debt ratios of 90 percent and higher. Table 4 gives an example assuming an 8 percent real cost of capital, 7 percent inflation, a 15 percent nominal cost of capital, a 90 percent debt ratio, and a 10 percent nominal interest rate. For simplicity we also assume no depreciation and no debt principal repayments. (This makes the table a "worst-case" example by

Table 4. Current Return vs. Interest Expense Under OC and TOC Regulation[a]

	Initial Year	*Sixth Year*[b]
TOC Regulation		
Rate base	1000	1501
Current return at 8%	80	120
Interest[c]	−90	−90
Net income	−10	+30
OC Regulation		
Rate base	1000	1000
Current return at 15%	150	150
Interest[c]	−90	−90
Net income	+60	+60

[a] Initial investment: $1000. No depreciation or debt principal repayments.
[b] Rate base appreciates at 7% per year for 6 years.
[c] 90% debt at 10% interest.

minimizing cash flow and keeping interest payments high.) Under OC regulation the firm shows a $60 book profit, but a $10 book loss under TOC. The TOC system gives a book profit later $30 in year 6, for example.

Of course, initial cash flow is more important than book income. In practice, the first year of TOC depreciation plus allowed current earnings should cover interest expense. In later years, cash flows under TOC grow more rapidly than under OC because both the rate base (and hence the current earnings on that rate base) and depreciation on the rate base are allowed to grow with the rate of inflation. In the long run lenders may be just as well protected under TOC regulation as under OC.

However, if the lower initial earnings and cash flow under TOC are viewed as a problem, loan contracts could be redesigned to reduce initial interest expense. Ideally, the firm would pay only the real interest rate, with the principal written up to reflect inflation. Less radical steps are to defer principal repayments, or to set a lower coupon rate at the start of the loan and a higher rate later. Of course these adjustments only help for new loans. Renegotiating existing bonds would be difficult.

It might help to recognize the rate base write-up in book income, in the same way that electric utilities report their allowance for funds used during construction (AFUDC) as current book income. The rate base write-up is in fact a reinvestment of income that otherwise could be taken as current book return under OC regulation. It should be treated as earned income that is immediately plowed back into the company.[38]

2. *Payback*

The payback of the initial investment is always slower under TOC regulation than under OC. This means that firms regulated under an OC rate base are less exposed to some forms of "regulatory risk." For example, an adverse change in regulatory procedure some years after construction would impose a smaller loss on an investment under an OC system. A greater proportion of the investment's cash flow would already have been received than would have been received under a TOC system.

The same point can be made about other risks, such as an unexpected fall in demand or in the supply of a necessary input. A good analogy is investment in countries known to be politically unstable, where quick paybacks are preferred, other things equal, because of the threat of expropriation.

If the prolonged "exposure" of assets under TOC regulation is a real problem, regulators can compensate by allowing either (1) a shorter depreciable life, (2) a nonlinear depreciation schedule with more rapid early rate base write-downs, or (3) a higher rate of return than would be allowed under OC regulation.

3. *Income Taxes and TOC*

Depreciation charges allowed for rate-making purposes grow at the same rate as the TOC rate base, but income tax laws permit only fixed book depreciation in computing tax liability. We should consider whether this invalidates our claim that TOC replicates the competitive market.

With one possible exception, it does not. Unregulated firms face the same tax laws. In equilibrium, their prices must permit recovery of invested capital, including that part of their overall return taken as appreciation in asset value. If some of this return is taxed solely because inflation has rescaled the dollar, competitive firms' prices in equilibrium must recover these taxes also.

The potential exception arises because the economy is not in equilibrium. Feldstein has recently argued that a jump in inflation causes a one-time loss in stock values, because higher effective real tax rates result under current law.[39] Whether this is true depends on whether managers can pass along the higher real taxes to consumers through higher prices. Feldstein's model assumes they cannot.[40]

TOC is structured to permit such pass-through of taxes. If Feldstein's model proves valid (i.e., if unregulated managers for some reason cannot pass along some or all of the extra taxes), investors in TOC firms may receive somewhat better protection from this tax risk than unregulated investors. On the other hand, unregulated investors will gain more than TOC investors when inflation declines if this model is correct. Also, if the TOC industry faces competition from an unregulated industry and Feldstein's model is correct, it may prove impossible to pass along the full tax increase even under TOC

In any case, the long-run tendency for TOC to match unregulated prices remains. If the present income tax laws actually do result in capital losses and gains for unregulated investors when inflation changes, TOC investors may be exposed to less risk. This would result in a somewhat lower cost of capital, but does not seriously affect the other points we have made.

4. *Does TOC Have a Front-End Load?*

A recent paper by Navarro, Peterson, and Stauffer argues that rate-making methods should be judged against the standard of level real tariffs.[41] By this standard, they find TOC (which they call an "Escalated Utility Rates (EUR) formula") wanting because early real tariffs (before much depreciation of the rate base) are higher than later real tariffs. They provide a formula [their Eq. (3)] by which they say level real tariffs can be calculated, assuming pipeline throughput is constant and the useful life is known with certainty.

Level real tariffs clearly result from a special case of TOC, in which depreciation charges over time are adjusted so that the sum of before-tax return on total investment plus depreciation is constant in real terms (assuming other operating costs grow at the rate of inflation and throughput is in fact constant). However, it is not clear that level real tariffs could ever be applied strictly in practice, and in any case such a tariff schedule would be economically appropriate only in a very special set of circumstances.

The basic idea of level real tariffs is to treat the investment like a home mortgage in an inflationless world, and then escalate the resulting payments each year to reflect cumulative actual inflation. The chief practical problem, which the authors do not acknowledge, is that their procedure appears to require advance knowledge of future effective tax rates over the whole life of the asset in order to compute the correct level real capital charge. If effective tax rates change—perhaps because the company incurs a tax loss in a future year—then the "level" real tariffs must be adjusted to provide investors a chance to earn the real cost of capital thereafter. Navarro et al. were a bit naive to conclude that such changes can be reflected automatically once the initial tariff is set, with no further administrative burden.[42]

However, a procedure for making these tax adjustments could possibly be worked out. A more fundamental issue is their claim that level real tariffs ought to serve "as the normative standard . . . because they equalize real opportunity costs over all future output or throughput."[43] This standard is not generally correct, because the economically correct depreciation schedule is almost never the one that tries to equalize the real sum of current earnings, depreciation, and taxes in each year of the project's life.

Such a depreciation schedule is economically appropriate only under the very strong implicit assumptions of Navarro et al., which amount to the

Table 5. Economic Depreciation with Constant Rate of Technical Change[a] (percentage of initial investment)

	Rate of Technical Progress (d)				
Year	d = 0	d = .01	d = .02	d = .05	d = .10
1	0.6	1.5	2.4	5.1	10.0
2	0.7	1.5	2.3	4.9	9.0
5	0.8	1.6	2.3	4.2	6.6
10	1.1	1.7	2.2	3.3	3.9
20	2.0	2.1	2.2	2.1	1.4
30	3.5	3.1	2.6	1.6	0.5
40	6.3	4.8	3.6	1.4	0.2

[a] Assumptions. Asset life = 40 years, real cost of capital = 0.06

anticipation of no changes in capacity utilization (i.e., demand), no anticipated discrepancy between industry-specific capital goods prices and the general rate of inflation, and no anticipated technical progress. For example, consider a pipeline that expects constant expected throughput.[44] However, technical progress is expected to reduce the real costs of new assets relative to old assets. Then, in a competitive industry, real annual capital charges would decline at the rate of cost reduction, along a path that required the capital charges on old assets to match the initial capital charges on the new, more productive assets.

Table 5 shows how introducing technical change causes more accelerated depreciation charges. Ignore taxes for simplicity. Suppose real capital charges are expected to decline by d percent per year over the life of the asset (because there is a d percent rate of technical progress). Then the appropriate economic depreciation schedule for different values of d are shown in Table 5. The schedule shown for d = 0 reflects the zero rate of technical progress implicitly assumed by Navarro et al. Other assumptions lead to very different real depreciation schedules.

In general, the appropriate depreciation schedule is determined by the expected time-profile of productivity and real asset costs for each investment. Level real tariffs can be appropriate, but certainly are not in general. In an actual application, the "normative standard" is likely to require a faster write-off than that advocated by Navarro et al.

5. *Are Current Earnings More Valuable Than Rate Base Write-ups?*

In theory investors are indifferent between realizing cash earnings and allowing some of their earnings to compound. But many businessmen or

investors would, as a first reaction, prefer current earnings to rate base write-ups, solely on the grounds that "a bird in the hand is worth two in the bush." However, if they stop to think they will realize that the first reaction is wrong if this is its only justification. The reasons for this follow.

First, the rate base write-ups should not be thought of as a deferral of earnings but as a reinvestment of earnings. Firms willingly reinvest earnings when they find an investment opportunity offering an expected return equal to (or greater than) their opportunity cost of capital. Similarly, executives and investors in regulated firms will readily reinvest earnings in the rate base (by accepting a lower rate of current income) if they can expect to earn a fair return on the written-up rate base, assuming the fair rate does not change if a TOC approach is adopted.

Second, the sacrifice of current income under TOC regulation should be no greater than would occur in competitive, unregulated industries.

Third, there is no evidence that investors would pay less for a firm generating income from rate base write-ups rather than current earnings. The old Wall Street tradition that investors prefer dividends to capital gains is exceedingly difficult to prove in careful statistical studies.[45]

To summarize, there is no reason why current income is more desirable per se than appreciation in value due to rate base write-ups. The only crucial point is that the regulated firm must expect to be allowed a fair rate of return on whichever rate base is chosen.

6. *Comparison of Regulated and Unregulated Earnings*

It has been alleged that regulated earnings will be difficult to compare to earnings of unregulated companies unless OC regulation is adopted.[46] It is not clear what these comparisons are to be used for, but they would be no more difficult under TOC than under OC regulation.

In fact, the book earnings of firms under TOC may be more nearly comparable to those of unregulated firms than the book earnings of firms under OC regulation. The reason for this is simple: both TOC regulation and competition in the unregulated sector compensate investors for inflation partly or wholly through appreciation in asset values. However, not all of this appreciation shows up when book income is calculated.[47] But under OC regulation, *all* compensation for inflation shows up in book income—there is no asset appreciation. In addition, the time pattern of book earnings under OC regulation differs from the pattern found in competitive industries.

Book earnings are a biased measure of true earnings in inflationary times. But the kind and extent of book income biases under OC regulation differ from the book income biases of unregulated industries. Book earnings under OC regulation are therefore *not* directly comparable to book earnings in the unregulated sector. If one for some reason wished to compare past book

earnings of regulated and unregulated firms (e.g., for a "comparable earnings" test), it would be somewhat less difficult to do so for firms under TOC regulation since the kinds of biases in book earnings are more nearly comparable.

V. MIDSTREAM SWITCHES OF REGULATORY METHOD

A midstream switch between fairly applied regulatory approaches that starts the new rate base as though the new system had always been in effect will generate either a windfall gain or windfall loss for investors. Switches from OC to TOC generate windfall gains for investors at the expense of consumers. Switches from TOC to OC do the reverse. However, it is not difficult to develop procedures for switching that avoid windfall gains on either side of the fence

Example. OC and TOC rate bases are the same only for brand-new assets. For assets in use during periods of inflation, the rate base under TOC will always be larger than under OC because of past compensation granted to investors for past inflation (see Figure 1). Any "midstream" switch in regulatory method therefore creates either a windfall gain or a windfall loss to investors.

This is easily shown using the earlier numerical example. Assume the first nine years of the investment's life are under TOC regulation. The cash flows are as shown in Figure 1 and Table 1. If a switch is made to OC regulation in the tenth year, the rate base drops back to net book value, and the cash flow stream reverts to the return allowed under OC regulation.

The rate base in the tenth year under TOC regulation would have equaled $929.21, but the rate base is actually written down to $550, and cash flow decreases from $173.17 to $132.50.

If regulation offers a fair rate of return to investors, the market value of the regulated firm will equal its rate base. Therefore, any change in rate base alters the value of the firm to investors by the same amount. A switch from TOC to OC imposes a windfall loss on investors equal to the difference between the TOC and OC rate bases.

This windfall loss occurs even in cases where immediate current earnings are increased by a midstream switch from TOC to OC. Such an anomaly would occur if the shift occurred after the first year but before the "crossover point" shown in Figure 1 Such a midstream switch would appear superficially to benefit the investor at the expense of the customer because of the immediate increase in earnings. However, if a fair return is being allowed under TOC regulation, *any* midstream switch to OC regulation confiscates the

reinvested return that has been given in lieu of the higher immediate return granted under the first years of OC regulation.

Of course, a switch in the other direction, from fairly applied OC regulation to TOC regulation, would be just as unfair to consumers. In this case, after nine years of regulation in which consumers provided a front-end load in return, the rate base would be arbitrarily written up to $929.21. A 9 percent real return on this rate base would represent an increase in earnings to the investor at a time when consumers should legitimately be realizing the benefits of their past higher payments under OC.

Compensated Changes in Regulatory Approach

Compensation for switches in regulatory approach so that both investors and consumers are treated fairly is accomplished by simply setting the initial value of the rate base under the new approach at its final value under the old approach.

Such "compensated switches," however, require immediate changes in tariffs that firms, customers, and regulatory commissions may find puzzling and unacceptable. For example, a switch from ICC regulatory procedures for oil pipelines to OC regulation would require immediate tariff increases to maintain the same rate of return, because the ICC procedures give partial compensation for inflation through rate base write-ups. The converse is also true: a switch to a regulatory framework allowing a larger proportion of the total inflation compensation in the rate base must be accompanied by lower tariffs if the same rate of return is to be maintained. This may argue against such switches on old assets now under OC, since they would become even more underpriced than they are already.

The effects of such tariff adjustments may make compensated shifts unacceptable. One compromise might be to apply the new rate base methodology only to new assets.

VI. CONCLUSION

The traditional debate on choice of rate base focused principally on the difference between estimated "fair value" and actual cost approaches. The actual cost standard is now universally accepted. The argument has shifted to whether these costs should be measured at their net book value (original cost) or whether this net book value should be trended for inflation (trended original cost). We have shown that the traditional arguments against trending the rate base are seriously deficient, particularly in times of high and

fluctuating inflation. If one were starting to regulate a new industry, TOC regulation would be preferable to OC regulation in almost all respects.

However, most regulated industries now use the OC method. The transition from this method to TOC could be costly. Whether these costs will exceed or fall short of the benefits from TOC regulation is an empirical issue. Each industry will no doubt face special problems in implementing TOC.

Nevertheless, it is clear that the costs of OC regulation and the benefits of TOC regulation have been badly misjudged in the past. Thus a closer examination of the costs and benefits of switching from OC to TOC regulation is warranted.

APPENDIX: RELATIVE ORIGINAL COST AND TRENDED ORIGINAL COST CASH FLOWS IN STEADY GROWTH EQUILIBRIA

The problems with OC cash flows are most dramatic when inflation rates change sharply or the rate of investment is sporadic. However, it is natural to ask whether the problems disappear in a steady-growth equilibrium. This appendix addresses this question.

We assume a steady real growth rate, g, inflation rate, i, real cost of capital, r, asset life, T, and a straight-line depreciation schedule for rate-making purposes. We further assume a continuous investment process has achieved equilibrium. This requires investments going back T periods, growing at a continuous rate g, so that investment is at the annual rate of $1.00 at this instant. All subsequent calculations are in constant last-instant dollars. We initially assume the rate of TOC rate base write-up equals i. The current TOC rate base in constant dollars is

$$\begin{aligned} RB^{TOC} &= \int_0^T \left[1 - \left(\frac{t}{T}\right)\right] e^{-gt}\, dt \\ &= \frac{1 - e^{-gT}}{g} - \frac{1 - (1 + gT)e^{-gT}}{Tg^2}, \end{aligned} \tag{A.1}$$

where depreciation is at rate 1/T. Thus, the depreciation cash flow per period is

$$\begin{aligned} DEP^{TOC} &= \int_0^T \left(\frac{1}{T}\right) e^{-gt}\, dt \\ &= \frac{1 - e^{-gT}}{Tg}. \end{aligned} \tag{A.2}$$

Expected cash flow per period under TOC is thus

$$\begin{aligned} CF^{TOC} &= rRB^{TOC} + DEP^{TOC} \\ &= r\left\{\frac{1 - e^{-gT}}{g} - \frac{1 - (1 + gT)e^{-gT}}{Tg^2}\right\} + \frac{1 - e^{-gT}}{Tg} \qquad \text{(A.3)} \\ &= \left(\frac{r}{g}\right) + \frac{(g - r)(1 - e^{-gT})}{Tg^2}. \end{aligned}$$

If the straight-line depreciation schedule correctly reflects the productivity and risk characteristics of the assets, (A.3) is also the expected equilibrium cash flow to a competitive, unregulated firm under these assumptions.

The corresponding OC rate base is

$$\begin{aligned} RB^{OC} &= \int_0^T \left[1 - \left(\frac{t}{T}\right)\right] e^{-gt} e^{-it}\, dt \\ &= \frac{1 - e^{-(i+g)T}}{i + g} - \frac{1 - [1 + (i + g)T]e^{-(i+g)T}}{T(i + g)^2}. \qquad \text{(A.4)} \end{aligned}$$

The OC depreciation per period is

$$\begin{aligned} DEP^{OC} &= \int_0^T \left(\frac{1}{T}\right) e^{-gt} e^{-it}\, dt \\ &= \frac{1 - e^{-(i+g)T}}{T(i + g)}, \qquad \text{(A.5)} \end{aligned}$$

and equilibrium OC cash flow is therefore

$$\begin{aligned} CF^{OC} &= (r + i)RB^{OC} + DEP^{OC} \\ &= \frac{r + i}{g + i} + \frac{(g - r)(1 - e^{-(i+g)T})}{T(i + g)^2}. \qquad \text{(A.6)} \end{aligned}$$

The deviation between the OC cash flow and the TOC cash flow is found by subtracting (A.3) from (A.6). Rearranging the terms of this expression yields

$$\begin{aligned} D &\equiv CF^{OC} - CF^{TOC} \\ &= \frac{r + i}{g + i} - \frac{r}{g} + \frac{g - r}{T}\left[\frac{1 - e^{-(g+i)T}}{(g + i)^2} - \frac{(1 - e^{-gT})}{g^2}\right]. \qquad \text{(A.7)} \end{aligned}$$

It can readily be seen that $D \equiv 0$ when $r = g$ (or if $i = 0$). If $g < r$, $D < 0$, so that OC implies cash flows that are permanently below the economic value of the rate base's services. If $g > r$, $D > 0$, and an OC firm has a permanent front-end load. Panel C of Table 3 in the main text shows values of D for alterative values of g and T, assuming $r = 0.06$ and $i = 0.10$.

The sign of D is less certain once the assumption of equal rates of general and TOC rate base inflation is relaxed. Letting h be the rate of TOC rate base write-up, and defining $p \equiv g + h - i$, (A.1) is modified to become

$$RB^{TOC'} = \int_0^T \left[1 - \left(\frac{t}{T}\right)\right] e^{-gt} e^{-(h-i)t}\, dt$$

$$= \frac{(1 - e^{-pT})}{p} - \frac{1 - (1 + pT)e^{-pT}}{Tp^2}. \qquad \text{(A.1')}$$

Depreciation is similarly redefined with p replacing g in (A.2).

The rate of return allowed on TOC in this case must offset any difference between general and TOC inflation. Defining $q \equiv r - h + i$, TOC equilibrium cash flow becomes

$$CF^{TOC'} = qRB^{TOC'} + DEP^{TOC'}$$

$$= \frac{q}{p} + \frac{(p - q)(1 - e^{-pT})}{Tp^2}. \qquad \text{(A.3')}$$

Then D becomes

$$D' \equiv CF^{OC} - CF^{TOC'}$$

$$= \frac{r + i}{g + i} - \frac{q}{p} + \frac{(g - r)(1 - e^{-(g+i)T})}{T(g + i)^2} - \frac{(p - q)(1 - e^{-pT})}{Tp^2} \qquad \text{(A.6')}$$

Note that $p - q = g - r + 2(h - i)$, so that no simple rule for finding $D' = 0$ is apparent. As a partial substitute, Panels A and B of Table 3 in the main text provide values of D' for $h = .12$ and $.08$, respectively, for various values of g and T, with $r = 0.06$ and $i = 0.10$ as before. For values of g close to r, it appears that $h < i$ implies OC cash flows that are too low, while $h > i$ implies OC cash flows that are too high, relative to the competitive equilibrium.

Obviously, one should not make too much of the numerical values in these tables nor of the precise assumptions underlying the formulas. What should be clear, however, is that the tendency of OC to generate the wrong prices does not evaporate even under steady growth. OC regulation gives the right price under inflation only for a restricted special case ($g = r$; $h = i$), or by accident.

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NOTES

1. Verified Statement and Rebuttal Statement of Stewart C Myers, U S Federal Energy Regulatory Commission, *Williams Pipe Line Company*, Docket Nos. OR79-1, *et al.*, sponsored by Marathon Pipe Line Company ("Myers Testimony") Although this paper draws heavily on that testimony, it ignores many of the specific problems encountered in that case Therefore it may not represent the views of Marathon Pipe Line Company After this paper was largely written, FERC issued an opinion in late 1982, upholding the continued application of the ICC methodology for oil pipelines as far as valuation of the rate base is concerned. But FERC proposed a change in the methodology for determining the allowed rate of return on that rate base Early in 1984, the U.S. Court of Appeals (DC Circuit) overturned the FERC Decision and criticized the continued use of the ICC methodology As this goes to press, the issues raised in this paper are again under review.

2. For a detailed description of ICC procedures, see the testimony of Jesse C Oak in Ex Parte 308 before the Interstate Commerce Commission, appended to the verified Statement of Thomas C Spavins in *Williams*, July 1979 The ICC procedures boil down to a complex mixture of original cost and trended original cost.

3. Several recent papers have discussed some aspects of TOC or price-level adjusted accounting. None attempts a comprehensive survey, or ends up favoring TOC as thoroughly as we do The papers include Myron J Gordon, "Comparison of Historical Cost and General Price Level Adjusted Cost Rate Base Regulation," *Journal of Finance* 32 (December 1977), 1501–1512, Robert E. Anderson and David E Mead, "A Comparison of Original Cost and Trended Original Cost Ratemaking Methods," unpublished, 1981; Ronald E. White, "The Economics of Price Level Appreciation," paper presented at the Iowa State University Regulatory Conference, May 1981, J. Rhodes Foster, "A Critique of the Historical-Current Cost Method of Earnings Regulations," *Earnings Regulation Under Inflation* (Washington, D C Institute for the Study of Regulation, 1982), J Rhoads Foster and Stevan R Holmberg, ed , J. Rhoads Foster, "Reform of Economic Regulation—Canadian Pipelines," *Pipeline Regulation and Inflation An Evaluation of Tariff Leveling* (Montreal McGill University, 1982), R. N. Morrison and R J. Schultz, ed , and P. Navarro, B Peterson, and T. Stauffer, "A Critical Comparison of Utility-Type Rate-Making Methodologies in Oil Pipeline Regulation," *Bell Journal of Economics* 12 (Autumn, 1981), 392–412 The last of these papers explicitly rejects TOC in favor of another approach, based on implicit assumptions that can be highly unrealistic. We discuss these assumptions below.

4 This corresponds to the legal standard of "comparable earnings," which stems from the Supreme Court's well-known statement that "[t]he return to the equity holder should be commensurate with returns on investments in other enterprises having corresponding risks " (See *Federal Power Commission et al.* v. *Hope Natural Gas Co.*, 320 U S. 591 at p. 603.) The interpretation and application of the *Hope* decision in terms of finance theory is given in Stewart C Myers, "Application of Finance Theory to Public Utility Rate Cases," *Bell Journal of Economics and Management Science* 3 (Spring 1972), 58–97.

5 In principle, it determines the return to *all* investors, debt and equity taken together. In perfect capital markets the overall cost of capital does not depend on capital structure There are special problems created by traditional regulatory treatment of taxes and interest costs, but we ignore them until later in the paper.

6. We assume k to be constant over time, although this is not necessary to the proof.

7. Fairness is defined in terms of expectations, not realizations. Actual earnings may exceed or fall short of expected earnings, as long as the regulatory process is fair. The possibility of loss is compensated for by the risk premium built into the opportunity cost of capital. Of course, regulators could eliminate unexpectedly high or low rates of return after the fact, but only if they are willing and able to make the firm a risk-free investment.

8. We take DEP_T as including any salvage value.

9. In the text of the paper, we define r as $k - i$, where i is expected inflation. The precise relationship is $1 + k = (1 + r)(1 + i)$, so the r we use is actually $k - i = r(1 + i) = r + ri$. That is, we include the cross product ri in current earnings. This is proper and necessary, because with discrete compounding the current earnings on B_t is actually received at $t + 1$. A "real" return of $r(1 + i)$ has to be allowed to compensate for one period's inflation. Note that holding the inflation rate i constant is not necessary to the points made in this section.

10. We assume that book accounting procedures would be the same under TOC as under OC regulation. Choice of book accounting procedures should not be allowed to affect the choice between OC and TOC regulation. However, regulatory treatment of the investment tax credit and accelerated tax depreciation can worsen or slightly mitigate the OC front-end load.

11. See White, op. cit., for a detailed discussion of accounting problems that would be encountered in a switch to TOC regulation—the difference between book and rate base depreciation is one of many.

12. The ideal index would track what the firm's asset values would be if it were unregulated but operating in a competitive market. A carefully constructed replacement cost index is probably the closest we can get to this ideal. Reproduction cost indexes are easier to construct, but still further from the ideal.

13. The plant will contribute $(1000)(1 - .75) = \$250$ million to an OC rate base and $(1000)(1.1)^{30}(1 - .75) = \$4{,}362$ million to a TOC rate base. The fair dollar return, assuming debt also is being retired linearly over 40 years, is $(.16)(250) + (1000/40) + (.5)[(.16)(250) - 15] = \$77.5$ million for the OC rate base, and $(.06)(4362) + (1.1)^{31}(1000/40) + (.5)[(.06)(4362) + (1.1^{31} - 1)(1000/40) - 15] = \$1092.4$ million for the TOC rate base. These calculations ignore the possibility of a tax advantage based on accelerated depreciation or the investment tax credit, which should affect capital charges under OC and TOC by the same amount. The TOC calculation assumes the excess of rate base over book depreciation would be deemed taxable by the IRS. We address the problems of early debt service under TOC later in the paper.

14. In fact, TOC regulation is our *second* choice for oil pipelines. See Myers Testimony. First choice was a modified version of traditional ICC procedures. The ICC procedures have many of TOC's good features, although in watered-down form. It seemed easier to clean up ICC procedures than to switch to a new, pure system.

15. Our literature review is based primarily on three leading textbooks: James Bonbright, *Principles of Public Utility Rates* (New York: Columbia University Press, 1961), Charles Phillips, *The Economics of Regulation* (Homewood, Ill.: Irwin, 1969); and Alfred Kahn, *The Economics of Regulation*, Vol. 1 (New York: Wiley, 1970). Other sources are noted as necessary.

16. Bonbright, p. 161, and Kahn, p. 38. Bonbright criticizes indiscriminate use of the term "fair value," and Kahn specifically notes that the circularity arguments do not arise for a trended rate base.

17. See, for example, the direct testimony of Seymour Manheimer (pp. 3–6, 16–18), John W. Wilson (pp. 13–15), and Michael J. Ileo (p. 16), U.S. Federal Energy Regulatory Commission, Williams Pipe Line Co., Docket Nos. OR 79-1 et al.

18. For example, Manheimer criticizes the imprecision of engineering estimates. Wilson wrongly asserts that reproduction cost necessarily is a value of service (and therefore circular) concept, as does Ileo. These arguments are irrelevant for a rate base trended by an exogenous index.

19. A TOC rate base is sometimes referred to as reproduction cost new (RCN). We retain "TOC," because RCN can also mean an engineer's fair value estimate, which we do not defend.

20. See Kahn, pp. 118–121, and Bonbright, pp. 229–232. Bonbright also links this issue to tax policy, a tangent we will not pursue.

21. It is possible that the distortions of OC regulation could reduce the price charged to long-run marginal costs if a mixture of assets is regulated. The odds against this accident seem quite high. See pp. 93–95 above.

22. Kahn recognizes this (pp. 121–122).

23. Kahn, pp. 112–113.

24. Kahn, pp. 110–111. Kahn in this discussion assumes that an OC rate base which is lower than a TOC rate base necessarily implies OC tariffs, which are lower than TOC tariffs. This is not true because of the front-end load.

25. Bonbright, pp. 266–271, and Walter A. Morton, "Rate of Return and Value of Money in Public Utilities," *Land Economics*, Volume XXVII, No. 2 (May 1952), pp. 91–131.

26. Kahn, p. 116.

27. The arguments about economies of scale, technological change, and second-best also make more sense if we step back to 1960. The expected rate of inflation was low. The fair rates of current income under OC and TOC would have differed by a couple of percentage points, the first-end load for *new* assets was not as important as it is now. A switching to a reproduction cost rate base for existing assets surely would have raised the price charged consumers. Perhaps these prices would have been further away from the competitive ideal than the OC prices actually charged. Nonetheless, the arguments against an ex post switch to a reproduction cost rate base would not have applied to an ex ante switch to TOC—e.g., a switch to TOC for new assets only.

28. Kahn, p. 116. Kahn's alternative remedies (varying the rate of return or applying a price index to income) are very different. The former is what happens under OC regulation while the latter is apparently something like TOC applied to equity only. Of course Kahn and Bonbright did not work out the details of their trending procedures.

29. Bonbright, pp. 274–276.

30. A related issue is whether regulated earnings should be based on the market or embedded costs of debt. Use of embedded costs has the effect of transferring the risk of unanticipated changes in interest rates from stockholders (who bear the risk in the unregulated sector) to the regulated firm's customers, who gain when interest rates go up and lose when interest rates go down. Once again, while customers have gained more often than they have lost in the recent past, it is our view that stockholders should properly bear these risks ex ante.

31. Forecasting future inflation is not as difficult or controversial as forecasting future returns to investors. This is particularly clear when the forecasting horizon is relatively short—one year, say. It is generally easier to estimate the expected rate of inflation than the real or nominal expected rate of return demanded by investors.

32. This is demonstrated above in Section II.

33. For example, many firms have nonjurisdictional (unregulated) businesses, which could explain a divergence from the "ideal" market-rate base ratio of 1.0. Also, the market-book ratio may be difficult to interpret because it impounds investors' expectations of regulators' actions.

34. That is, its debt and equity securities against current asset value. Under traditional OC regulation, the comparison is confined to the equity account. Capital gains or losses in debt are passed to consumers by allowing only embedded debt costs in the overall rate of return.

35. The regulated firm would still be exposed to inflationary surprises. Its prices would be fixed between proceedings, but its costs would not be.

36. Whether any adjustment is needed depends in part on whether investors are able to hedge against inflationary surprises using available securities.

37. A J G Priest, *Principles of Public Utility Regulation* (Charlottesville, Va.: Michie, 1969), p. 170. It is hard to judge from the context of the quote whether Priest would agree with our way of treating inflation under OC.

38 It must be noted that AFUDC now has a reputation as "low quality earnings," presumably because investors do not expect to earn their cost of capital on the recorded amount TOC write-ups will avoid this reputation if they permit regulators to start offering investors a fair return.

39 M Feldstein, "Inflation and the Stock Market," *American Economic Review*, Vol. 70, No. 5 (December 1980), pp. 839–847

40. He does so in a footnote stating "This assumes that inflation does not affect the pretax profitability of capital" (Ibid , p 841) While we see no reason to believe *physical* productivity would be affected systematically by inflation, the assumption that managers cannot increase pretax prices enough to maintain after-tax profits would appear to need more justification than it receives. Such extra markups would presumably set off a second round of inflation, and the profit consequences of this second round need to be explored.

41 P. Navarro, B. Peterson, and T. Stauffer, op. cit. Similar points are made in T. Stauffer and P Navarro, "A Critique of Conventional Utility Rate-making Methodologies," *Public Utilities Fortnightly* (February 26, 1981), pp 25-31.

42 Op. cit , pp 406–407 They may have reached this conclusion through their approach to the tax liability, which is to consider a term representing the present value of the tax depreciation schedule in both their nominal and real base capital charge calculations. [See their Eqs (1) and (4)]

An alternative explanation is that they recognize the unacknowledged problems due to inflation, but that they actually do intend for investors to bear the risk of inflation-induced or other "surprises" in the real tax rate. If so, they miss some important consequences of such a policy

43. Ibid , p. 407. A similar statement is in Stauffer and Navarro, op cit , p. 28.

44 If the throughput pattern is known but not constant (e g , if the investment's full productivity is only gradually realized), level real tariffs could still be calculated (ignoring the income tax problem). Such known throughput variations should also be recognized under more general applications of TOC, either by adjusting the depreciation schedule or (in extreme cases) recognizing that, in effect, not all of the investment is yet in the rate base

45. Some studies, including R. Litzenberger and K Ramaswamy, "The Effects of Personal Taxes and Dividends on Capital Asset Prices: Theory and Empirical Evidence," *Journal of Financial Economics* (June 1979), indicate an *aversion* to dividends due to the lower effective tax rate on capital gains Other recent work finds no consistent preference one way or the other For example, see M. H. Miller and M. S. Scholes, "Dividends and Taxes Some Empirical Evidence," *Journal of Political Economy*, forthcoming

46. See, for example, the July 13, 1979, testimony of Herman G Roseman before the FERC in the case of Williams Brothers Pipe Line Company, Docket Numbers OR79-1 et al , p 40

47 Increases in corporate capital asset values do not usually appear in book earnings. However, nominal gains on inventories do appear Also, different accounting conventions can result in different proportions of the effects of inflation showing up in book earnings