Donald W. Kiefer*
Library of Congress

The Effects of Alternative Regulatory Treatments of the Investment Tax Credit in the Public Utility Industry

This paper examines the effects of alternative regulatory treatments of the investment tax credit on utility rates, tax payments, cash flow, and rate of return in the public utility industry, both with regard to a single asset and to a growing firm. The paper contends that a type of normalization which is not presently allowed in the U.S. tax code can provide appropriate rate reductions to customers and cash flow benefits to utilities but would avoid providing a rate of return higher than that intended by the regulatory authority.

A recent paper by Thompson and Weygandt (1977) evaluated the alternative regulatory treatments of the investment tax credit (ITC) in the public utility industry and concluded that flow-through treatment "is the only proper method for treatment of the investment credit, given that the investment function should be regulated by the need of the ratepayer and not by providing excessive profits to the utility through the investment tax credit" (p. 509). This article expands the earlier analysis in several directions and draws a different conclusion.

Thompson and Weygandt's analysis was based on a model which compared the aggregate reduction in utility rates and increase in return to stockholders resulting from the alternative rate-making treatments of the ITC over the life of a single utility asset. Rather than using mathematical derivations, as Thompson and Weygandt did, this article employs a simulation model which permits full consideration of how the effects of the regulatory treatments change over time. The simulation analysis focuses on the cash flow and tax payments of the utility

* The views expressed in this paper are solely those of the author and should not be interpreted as the positions of the Congressional Research Service of the Library of Congress.

(*Journal of Business*, 1981, vol. 54, no. 4)

0021-9398/81/5404-0001$01.50

(the effect on tax payments was the reason given by Congress for requiring normalization treatment) as well as on the utility rates charged to customers and the rate of return earned by stockholders. The analysis of regulatory treatments is expanded to include a possible treatment—herein termed "economic normalization"—which was suggested but not evaluated by Thompson and Weygandt. Finally, the simulation model is used to evaluate the effects of the alternative rate-making treatments of the ITC on a growing utility firm, and it is shown that conclusions drawn from the single-asset case do not extend to analysis of the firm. This article contends that economic normalization is consistent with the logic of the regulatory process, provides appropriate utility rate reductions to customers, and benefits utility companies through higher cash flow while avoiding provision of "excessive profits" to the utility.

I. The Alternative Rate-making Treatments of the Investment Tax Credit

The rules regarding allowable treatment of the investment tax credit in rate making for public utilities by regulatory agencies were enacted in the Revenue Act of 1971. These rules will be exposited through use of a simplified financial model of a regulated firm. The model necessarily portrays a highly abstracted view of the regulatory process. Whereas actual regulatory policy involves an intricate blending of economic, social, political, and environmental objectives through a variety of regulatory instruments, the model characterizes the process as largely mechanistic, involving the application of established rules to determine allowable utility rates. Since the debate over regulatory treatment of the ITC has focused almost exclusively on economic and financial implications, this approach would not seem to impose serious restrictions on the analysis. The model also assumes that the overall rate of return actually attained is always equal to the allowed rate of return; this is the strongest possible version of assuming no regulatory lag.

A. The General Model

The general utility regulatory formula used to determine allowed revenue, and the expressions for taxable income, income tax, cash flow, and book profits for a utility which uses straight line depreciation for both book and tax purposes (assumed to focus the analysis on the ITC) and receives no investment tax credit, can be written as follows:

Case 1

$$R_{1t} = r_{1t} \cdot \left[V_t - \sum_{j=t-n}^{t} D_j^s \right] + D_t^s + C_t + T_{1t}, \qquad \text{(1a)}$$

$$y_{1t} = R_{1t} - D_t^s - C_t - i_{1t}, \tag{1b}$$

$$T_{1t} = z \cdot y_{1t}, \tag{1c}$$

$$F_{1t} = y_{1t} - T_{1t} + D_t^s, \tag{1d}$$

$$P_{1t} = y_{1t} - T_{1t}, \tag{1e}$$

$$r_{1t} = u_t \cdot d_t + re_t \cdot (1 - d_t), \tag{1f}$$

$$i_{1t} = u_t \cdot d_t \cdot \left[V_t - \sum_{j=t-n}^{t} D_j^s\right], \tag{1g}$$

where:

the subscript 1 designates case one with no ITC,
the subscript t designates time,
R = allowed or required revenue,
r = overall allowed rate of return,
re = allowed rate of return on common equity,
V = average gross value of assets,
D^s = annual straight line depreciation,
$\sum_{j=t-n}^{t} D_j^s$ = total amount of straight line depreciation taken through year t on assets included in V_t (n = life of utility's assets),
C = cash operating costs (except interest and income taxes),
y = taxable income,
i = interest expense,
T = Federal income tax,
z = Federal income tax rate (assumed to be a flat rate),
F = cash flow,
P = book profits,
u = interest rate paid on long-term debt,
d = portion of assets financed by long-term debt.

Thus, the allowed revenue, R_{1t}, is equal to: (1) the overall allowed rate of return, r_{1t}, multiplied by the rate base, $[V_t - \Sigma_{j=t-n}^{t} D_j^s]$, which equals the depreciated value of the utility's assets; plus (2) the cost of service, which equals depreciation, D_t^s, plus operating costs, C_t, plus income taxes, T_{1t}. The equations for taxable income and income tax are standard and self-explanatory. The equations for cash flow and book profits are, in fact, derived expressions. They are stated in terms of the tax variables, rather than in their more traditional format, because of the focus of this paper on tax treatment. The interest cost is a function of the embedded cost of long-term debt, u_t, multiplied by the debt ratio, d_t, and the rate base. The overall allowed rate of return is an average of the interest rate paid on long-term debt and the rate of return allowed on equity weighted by their proportions of the capital structure of the utility.

This model, referred to as case 1, is used for comparative purposes throughout the analysis that follows. Because the equations for alternative regulatory treatments always refer to the situation in a given year, the t subscripts will be dropped for simplicity and merely understood to be present. In this shorthand, $\Sigma_{j=t-n}^{t} D_j^s$ will be expressed as $\Sigma_j D^s$.

B. Present Rate-making Treatments of the Investment Tax Credit

The three principal regulatory treatments of the investment tax credit specified in the Revenue Act of 1971 are portrayed in the three equation systems displayed below:

Case 2, Flow-Through

$$R_2 = r_1 \cdot \left[V - \sum_j D^s\right] + D^s + C + T_2 \tag{2a}$$

$$y_2 = R_2 - D^s - C - i_1 \tag{2b}$$

$$T_2 = z \cdot y_2 - I^a \tag{2c}$$

$$F_2 = y_2 - T_2 + D^s \tag{2d}$$

$$P_2 = y_2 - T_2 \tag{2e}$$

where: I^a = actual amount of investment tax credit

Case 3, Rate-Base Normalization

$$R_3 = r_m \cdot \left[V - \sum_j D^s - B\right] + D^s + C + T_3 + I^a, \tag{3a}$$

$$y_3 = R_3 - D^s - C - i_m, \tag{3b}$$

$$T_3 = z \cdot y_3 - I^a, \tag{3c}$$

$$F_3 = y_3 - T_3 + D^s, \tag{3d}$$

$$P_3 = y_3 - T_3 - I^a, \tag{3e}$$

$$i_m = u \cdot d \cdot \left[V - \sum_j D^s\right] - u \cdot e \cdot B, \tag{3f}$$

$$r_m = u \cdot \left[\frac{d \cdot \left[V - \sum_j D^s\right] - e \cdot B}{\left[V - \sum_j D^s - B\right]}\right] + re \cdot \left[\frac{(1-d) \cdot \left[V - \sum_j D^s\right] - (1-e) \cdot B}{\left[V - \sum_j D^s - B\right]}\right], \tag{3g}$$

$$B = \sum_t (I^a - I^n), \tag{3h}$$

$$I^n = \Sigma_j \frac{I^a}{n}, \tag{3i}$$

where:

r_m = overall allowed rate of return under ITC normalization,
B = accumulated deferred investment tax credits,
i_m = interest expense under ITC normalization,
e = portion of B used to replace debt financing,
I^n = normalized amount of investment tax credit.

Case 4, Cost-of-Service Normalization

$$R_4 = r_m \cdot \left[V - \sum_j D^s\right] + D^s + C + T_4 + (I^a - I^n), \tag{4a}$$

$$y_4 = R_4 - D^s - C - i_m, \tag{4b}$$

$$T_4 = z \cdot y_4 - I^a, \tag{4c}$$

$$F_4 = y_4 - T_4 + D^s, \tag{4d}$$

$$P_4 = y_4 - T_4 - (I^a - I^n). \tag{4e}$$

The equations in case 2 represent flow-through regulatory treatment of the ITC, which may be used only with regard to utility property which qualifies for flow-through treatment under the accelerated depreciation rules in the Tax Reform Act of 1969.[1] The equations in this case are similar to case 1, except that the investment tax credit, I^a, is, of course, subtracted from the tax computation. The equations for interest and rate of return are identical and are not repeated. Under flow-through treatment, the amount of actual taxes paid is included as a cost of service in the rate formula; thus, the reduction in taxes due to the ITC directly reduces the utility's required revenues. In fact, the reduction is required revenues, compared to case 1, is greater than the ITC by a factor of $1/1 - z$ due to the simultaneity of required revenues and tax payments.

If utility property does not qualify for flow-through treatment it must receive normalization treatment to be eligible for the ITC. The tax code provides two principal methods of normalizing the investment tax credit. The equations in case 3 represent the "general rule" (option 1) in the tax law, which will be referred to here as the rate-base method (this is Thompson and Weygandt's Option B). Under rate-base normalization the utility makes adjustments to its rate base by subtracting the actual amount of the ITC, I^a, from its rate base and then adding the normalized ITC amount, I^n,[2] back into the rate base annually over the life of the asset. This procedure amounts to subtracting the accumu-

1. Public utility property which qualifies for flow-through treatment of accelerated depreciation is property of the same or similar kind for which the utility used flow-through treatment for assets most recently placed in service in its July 1969 accounting period (see Internal Revenue Code sec. 167[1][2][c]).

2. The normalized investment tax credit is the cumulation of the pro rata shares (based on the utility's asset lives) of the ITC received each year (see eq. [3i]).

lated deferred investment tax credits (ADITC)[3] from the rate base. It yields the same results, so far as the rate base is concerned, as if the original cost of the assets had been reduced by the amount of the ITC. The taxes taken into account in determining the cost of service are the "normalized" taxes, that is, actual taxes paid plus the amount of the ITC. Any reduction in the utility's cost of service due to the ITC is prohibited under rate-base normalization.

The deferred tax credits under normalization serve as zero-cost capital for the utility and substitute for a portion of private capital which otherwise would be required. A different term for interest expense appears in the normalization equations to allow for debt replacement by the ADITC. The overall allowed rate of return may also change under normalization if the ADITC does not substitute proportionately for debt and equity (eq. [3g]).

The equations in case 4 represent the "ratable flow-through" method (option 2), which will be referred to here as cost-of-service normalization (Thompson and Weygandt's Option C). This is the normalization method which apparently has been selected by most firms which normalize the ITC. Under this method the amount of taxes taken into account as a cost of service ignores the actual amount of ITC and is reduced by the normalized ITC. Any reduction in the utility's rate base due to the ITC is prohibited under cost-of-service normalization. As in the previous case, different terms for the rate of return and interest appear in the first two equations to allow for external capital replacement by the ADITC. The equations for i_m, r_m, B, and I^n are the same as for case 3. Thompson and Weygandt drew attention to the fact that the congressional committee reports on the Revenue Act of 1971 called for allowance of the equity rate of return on the ADITC, rather than the overall rate of return, under cost-of-service normalization. However, in the interim the final Treasury regulations on this provision have been adopted, and they permit allowance of the overall rate of return on the ADITC.[4] Equation (4a) is consistent with the regulations.

A third type of normalization treatment is available to a utility only "if any agency or instrumentality of the United States having jurisdiction for ratemaking purposes with respect to such taxpayer's trade or business . . . determines that the natural domestic supply of the product furnished by the taxpayer in the course of such trade or business is insufficient to meet the present and future requirements of the domestic economy."[5] This treatment, which will be referred to here as shortage normalization, forbids any adjustment—to either the utility's rate base

3. The accumulated deferred investment tax credit (ADITC) is the cumulated difference between the actual ITC and the normalized ITC (see eq. [3h]).

4. Internal Revenue Service, T.D.7602, Final Regulations on Investment Credits for Public Utility Property, March 20, 1979.

5. Internal Revenue Code, sec. 46(f)(1).

or cost of service—to reflect the ITC (this is Thompson and Weygandt's Option A). The Federal Energy Regulatory Commission has permitted this type of ITC normalization for natural gas pipeline companies since 1972.[6] Equations (5a)–(5e) represent shortage normalization:

$$R_5 = r_m \cdot \left[V - \sum_j D^s\right] + D^s + C + T_5 + I^a, \tag{5a}$$

$$y_5 = R_5 - D^s - C - i_m, \tag{5b}$$

$$T_5 = z \cdot y_5 - I^a \tag{5c}$$

$$F_5 = y_5 - T_5 + D^s, \tag{5d}$$

$$P_5 = y_5 - T_5 - I^a. \tag{5e}$$

Under this treatment the ADITC is not excluded from the rate base and the taxes included as a cost of service are actual taxes paid plus the amount of the investment tax credit.

C. Economic Normalization

Since there are two standard (i.e., nonshortage) methods of normalizing the ITC allowed by the tax code—rate-base normalization and cost-of-service normalization—the question arises as to which form of normalization, if either, is appropriate from an economic perspective. One of the purposes of regulation is to force the regulated industries, to the extent possible given the peculiarities of public utility economics, to emulate the economic results of a competitive industry. To this extent it is relevant to consider the economic effects of the investment tax credit on unregulated industries.

The investment tax credit is a grant received when new capital investment is made which, in effect, reduces the cost of the investment to the recipient company. Thus, the ITC has the same impact on the company (ignoring carry-overs) as if it had received a price reduction on the capital assets it purchases. A price reduction on capital assets will have two effects on a firm: by decreasing the amount of investment capital required by the firm it decreases the necessary amount of return to capital, and it also reduces the subsequent amount of annual depreciation.[7] In a competitive market these influences will be reflected in lower prices for the firm's output, and this is the result which should be emulated in the regulated industries.

However, this competitive result is not permitted by the methods of

6. See Federal Power Commission Order No. 448, 47FPC, 141, January 24, 1972.

7. When the ITC was first adopted in 1962 it included a requirement that the basis of benefiting assets be adjusted downward by the amount of the credit in determining the amount of future tax depreciation. In 1964, to increase the subsidy associated with the ITC, the basis adjustment was repealed.

normalizing the investment tax credit which are presently allowed by the tax code. Present law permits the recognition of one or the other of the economic effects of the investment tax credit on a regulated company, but not both effects. Rate-base normalization (case 3) recognizes the lower amount of invested capital and required return to capital through the exclusion of the ADITC from the rate base but disallows a reduction of annual depreciation charges to reflect the lower-cost capital assets. Cost-of-service normalization (case 4) allows an annual reduction in cost-of-service charges (the reduction is in the form of a ratable flow-through of the reduced tax charge, but accomplishes the same thing as if depreciation charges were reduced to reflect the lower-cost assets), but it forbids any reduction in the rate base to recognize the lower amount of invested capital and required return to capital. Therefore, neither allowed form of normalization of the investment tax credit in the regulated industries is appropriate from an economic perspective. "Economic normalization" of the ITC would require both exclusion of the ADITC from the rate base *and* adjustment of annual depreciation charges to reflect the lower-cost assets. Such a form of normalization of the ITC can be represented in equations as follows:

$$R_6 = r_m \cdot \left[V - \sum_j D^s - B\right] + (D^s - I^n) + C + T_6 + I^a, \quad \text{(6a)}$$

$$y_6 = R_6 - D^s - C - i_m, \quad \text{(6b)}$$

$$T_6 = z \cdot y_6 - I^a, \quad \text{(6c)}$$

$$F_6 = y_6 - T_6 + D^s, \quad \text{(6d)}$$

$$P_6 = y_6 - T_6 - (I^a - I^n). \quad \text{(6e)}$$

This system of equations is the same as for rate-base normalization (see eqq. [3a]–[ei]) except for the I^n term, subtracted from the depreciation charge in the equation for required revenues, and the I^n term which appears in the equation for book profits as a result. Interestingly, this normalization method was suggested by Thompson and Weygandt but was not included in their analysis. It was also suggested in Kiefer (1979), has been the subject of two sets of hearings before the Ways and Means Committee, and has been endorsed by the Treasury.[8]

II. Simulation Analysis

A. *The Single Asset*

In their book on the effects of accelerated depreciation in the public utility industry, Brigham and Pappas (1970) comment that "the compli-

8. See U.S. Congress 1979, 1980. The Treasury Department testified in favor of economic normalization of the ITC at both hearings.

cated interrelationships among these variables make algebraic analysis virtually impossible, but they do lend themselves to simulation . . . ."[9] The same statement could be made with regard to the investment tax credit. While Thompson and Weygandt's analysis is algebraic, such an analysis of this issue is necessarily limited and may yield misleading conclusions. Hence, this study employs a simulation model, the basic structure of which is provided in the Appendix, to explore the impact of the alternative regulatory treatments of the ITC. Initially, the effects of the credit with regard to a single utility asset (the case studied by Thompson and Weygandt) are evaluated. In the following subsection the financial characteristics of the regulatory treatments in a growing utility firm are assessed.

The asset simulation model assumes the asset is purchased and instantaneously becomes fully operative (and is brought into the rate base) at the beginning of the first year. The entire cost of the asset is assumed to qualify for a 10% investment tax credit. Straight line depreciation and zero salvage value are assumed. For the analysis reported here the simulation parameters are set at values intended to represent the electric utility industry in 1978; therefore, the allowed rate of return on equity = .113, the average interest rate on long-term debt = .0756, and the ratio of debt to total private capitalization = .625 (preferred stock is treated as long-term debt in the derivation of these data).[10] The simulations assume that the cost-free capital from deferred investment tax credits substitutes proportionately for debt and equity financing; a seemingly plausible assumption in view of the stability of the capital structures of the utilities during the period of existence of the tax credit. A 30-year asset life and a 46% tax rate are assumed. The simulations ignore cash operating costs (they are presumably independent of the alternatives being considered) and focus on the capital costs associated with the asset.

The utility revenues over the life of a hypothetical \$100 asset under the alternative regulatory treatments of the investment tax credit are shown in table 1 and graphed in figure 1. In the base case, with no investment tax credit, utility revenues are \$15.70 in the first year and decrease linearly to \$3.54 in the thirtieth year. It is a characteristic of utility regulatory accounting that the allowed revenues with regard to an investment decline over its life as the rate base declines. Under the other five regulatory treatments the asset benefits from a \$10 investment tax credit in its first year. In the case of flow-through treatment the impact on utility rates is dramatic. Since $I^a/(1 - z) = \$10/.54 = \$18.52$ is greater than the total allowed revenues in case 1 in the first year, the revenues for flow-through are actually negative; that is, aggregate revenues of the utility firm would be reduced from the level otherwise

9. Brigham and Pappas 1970, p. 5.
10. The data are derived from U.S. Department of Energy (1979), pp. 31, 34.

TABLE 1 **Hypothetical Example of Utility Revenues over the Life of an Asset under Alternative Regulatory Treatments of the Investment Tax Credit ($)**

		Utility Revenues					
				Normalization			
Year	Accumulated Deferred Investment Tax Credit (Average), Cases 3, 4, 5, 6	Base Case (1)	Flow-Through (2)	Rate-Base (3)	Cost-of-Service (4)	Shortage (5)	Economic (6)
1	4.83	15.70	−2.82	15.09	15.27	15.89	14.47
2	9.50	15.28	15.28	14.08	15.04	15.66	13.47
3	9.17	14.86	14.86	13.71	14.61	15.23	13.09
4	8.83	14.44	14.44	13.33	14.18	14.79	12.71
5	8.50	14.02	14.02	12.95	13.74	14.36	12.33
6	8.17	13.60	13.60	12.57	13.31	13.93	11.96
7	7.83	13.18	13.18	12.20	12.88	13.50	11.58
8	7.50	12.76	12.76	11.82	12.45	13.06	11.20
9	7.17	12.34	12.34	11.44	12.01	12.63	10.83
10	6.83	11.92	11.92	11.07	11.58	12.20	10.45
11	6.50	11.51	11.51	10.69	11.15	11.77	10.07
12	6.17	11.09	11.09	10.31	10.72	11.33	9.69

13	5.83	10.67	10.67	9.93	10.28	10.90	9.32
14	5.50	10.25	10.25	9.56	9.85	10.47	8.94
15	5.17	9.83	9.83	9.18	9.42	10.04	8.56
16	4.83	9.41	9.41	8.80	8.99	9.60	8.18
17	4.50	8.99	8.99	8.43	8.55	9.17	7.81
18	4.17	8.57	8.57	8.05	8.12	8.74	7.43
19	3.83	8.15	8.15	7.67	7.69	8.31	7.05
20	3.50	7.73	7.73	7.29	7.26	7.87	6.68
21	3.17	7.31	7.31	6.92	6.82	7.44	6.30
22	2.83	6.90	6.90	6.54	6.39	7.01	5.92
23	2.50	6.48	6.48	6.16	5.96	6.58	5.54
24	2.17	6.06	6.06	5.78	5.53	6.14	5.17
25	1.83	5.64	5.64	5.41	5.09	5.71	4.79
26	1.50	5.22	5.22	5.03	4.66	5.28	4.41
27	1.17	4.80	4.80	4.65	4.23	4.85	4.04
28	.83	4.38	4.38	4.28	3.80	4.41	3.66
29	.50	3.96	3.96	3.90	3.36	3.98	3.28
30	.17	3.54	3.54	3.52	2.93	3.55	2.90

NOTE.—Initial value of asset = \$100.00, asset life = 30 years, tax rate = .46, allowed rate of return on equity = .113, interest rate on long-term debt = .0756, debt ratio = .625, and portion of deferred taxes used to replace debt = .625.

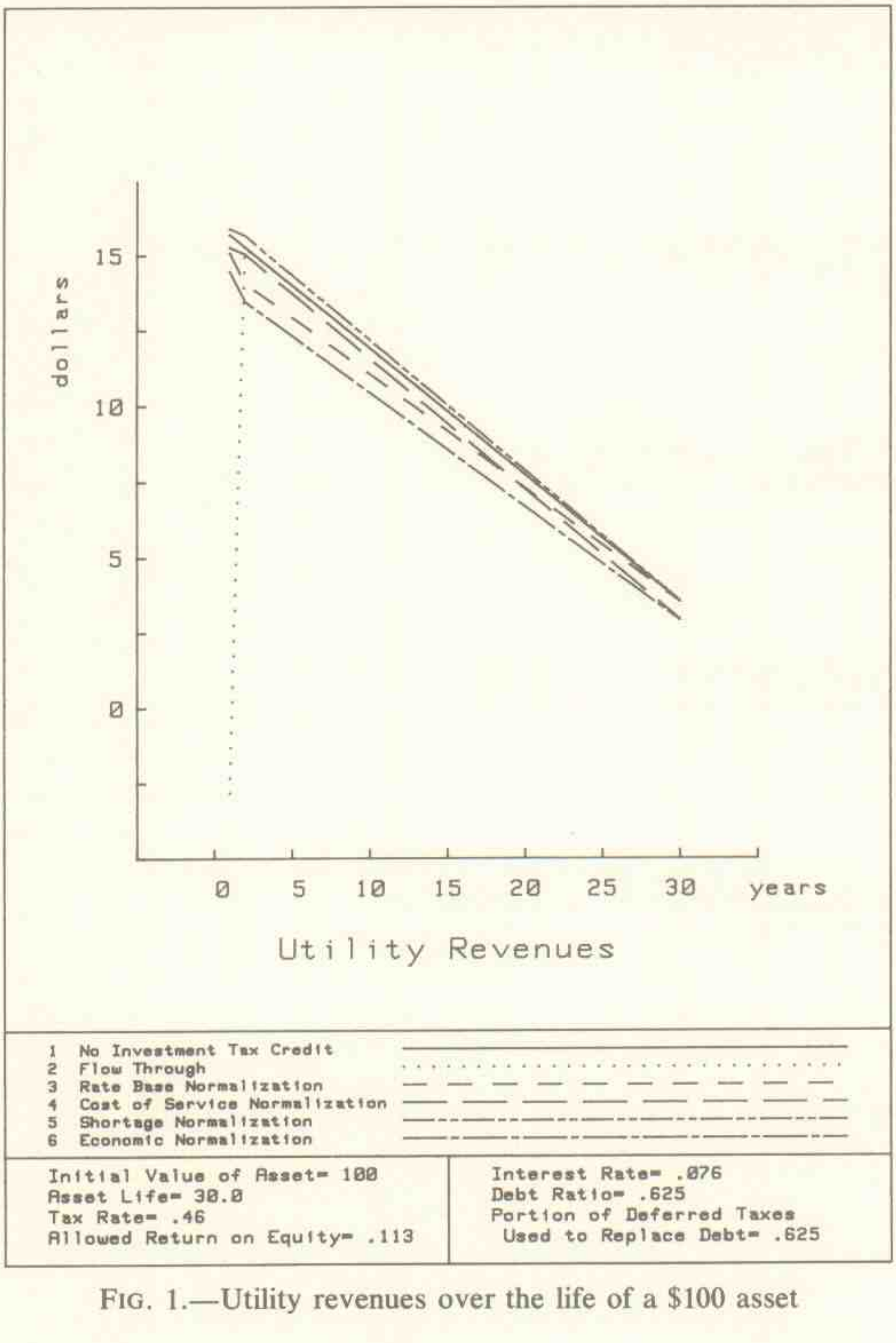

FIG. 1.—Utility revenues over the life of a $100 asset

allowable on its other assets. Every year after the first year, however, the utility revenues under flow-through treatment are identical to the base case.

Under the normalization treatments the ITC is not passed on through reduced utility rates in the first year; it is placed in the accumulated deferred investment tax credit (ADITC) account and amortized over the life of the asset. Rate-base normalization and cost-of-service normalization both yield utility rates which are lower than the base case (and flow through in every year but the first). Rate base normalization produces lower rates than the cost of service procedure at the outset, but the effect on revenues of flowing through a pro rata share of the ITC each year eventually exceeds the effect of excluding an ever-decreasing ADITC from the rate base, so, beginning in the twentieth year, rates under cost-of-service normalization become lower.

Interestingly, under the shortage-normalization treatment utility rates are higher each year than in the base case. Thus, the procedure not only prevents utility rates from decreasing as a result of the tax benefit, it actually forces a rate increase. This effect was missed by Thompson and Weygandt, who reported merely that this treatment had no effect on utility rates but increased the rate of return in the first year. This oversight occurred because Thompson and Weygandt ignored the effect on utility revenues which results from the interaction of the tax system and the changes in the utility's capital structure produced by normalization. Under normalization, deferred taxes replace a portion of private equity and debt financing. As a result interest payments are lower than in the base case, thus producing higher taxable income and tax payments, and, in turn, forcing higher revenue requirements than in the base case. Thus, even though the mechanics of shortage normalization are designed to disregard the direct effect of the tax credit on utility rates, the effect of normalization on the utility's capital structure produces an indirect effect. The resulting net effect on utility rates is even worse for customers than Thompson and Weygandt reported; customers receive less than no benefit at all.[11]

With the exception of flow-through treatment in the first year, the lowest utility rates each year are produced by economic normalization, the treatment which both excludes the ADITC from the rate base and decreases the cost of service each year by a pro rata portion of the ITC to reflect lower depreciation. At the outset economic normalization is at least \$.50 lower in annual revenues than the other normalization procedures; while this gap narrows with regard to cost of service normalization, it is maintained over the life of the asset with regard to the other normalization procedures. Interestingly, economic normalization in the last 2 years, and cost of service normalization in the last year, actually yield annual revenues which are less than depreciation (which equals \$3.33 per year). This is due to the negative effect on revenues of the normalized investment tax credit, I^n, and excluding the ADITC from the rate base [in the case of economic normalization], as well as negative tax payments which result from negative taxable income when depreciation exceeds revenues (even though equity capital still earns its allowed rate of return).

11. The net direction of the effect of shortage normalization on utility rates depends on the value of e, the portion of deferred taxes used to replace debt. In the example in the text, if $e = 0$, utility rates will decline rather than increase (see the discussion of fig. 5 in text).

Thompson and Weygandt used as their single criterion for evaluating the alternative rate making treatments of the ITC the sum of the utility rate reductions (unadjusted for time value) achieved over the life of the asset compared to the base case. Table 2 reports these sums for the data in table 1. On this basis economic normalization is clearly the treatment most preferential to ratepayers; it yields aggregate utility rate reductions equal to nearly twice those associated with flow-through treatment, which yields the next largest reductions. The aggregate rate reduction under flow-through barely exceeds that under rate-base normalization, but it more substantially exceeds cost of service normalization, and, of course, shortage normalization (which is negative).

But merely summing the utility rate reductions over the life of a 30-year asset is surely an inadequate judgment criterion. Is it not relevant that the entire rate reduction under flow-through occurs during the first year of the asset's life, whereas the rate reductions under the alternative treatments are spread over the entire asset life? One method of recognizing the differences in timing under the alternatives is to calculate discounted present values of the utility rates over the life of the asset. Results of such calculations for the example data are presented in table 3; they make clear that the discount rate determines

TABLE 2 **Sums of Utility Rate Reductions under Alternative Regulatory Treatments of the Investment Tax Credit over the Life of the Asset in the Hypothetical Example ($)**

Regulatory Treatment	Sum of Utility Rate Reductions
Flow-through	18.52
Rate-base normalization	18.23
Cost-of-service normalization	12.68
Shortage normalization	−5.84
Economic normalization	36.75

TABLE 3 **Discounted Present Values of Utility Rates under Alternative Regulatory Treatments of the Investment Tax Credit over the Life of the Asset in the Hypothetical Example ($)**

	Discounted Present Values		
Regulatory Treatment	Discount Rate = .05	Discount Rate = .0703	Discount Rate = .12
Base case	170.62	143.73	101.80
Flow-through	152.98	126.43	85.27
Rate-base normalization	159.28	134.07	94.87
Cost-of-service normalization	164.76	139.19	99.05
Shortage normalization	174.25	146.83	104.02
Economic normalization	149.79	126.43	89.89

which treatment yields the lowest utility rates in terms of present value. Using a high discount rate of 12%, which attaches a high value to early benefits, flow-through treatment has a lower present value of utility rates than economic normalization. A low discount rate of 5% produces the opposite result. Equivalent present values of utility rates over the asset life for flow-through and economic normalization are obtained using a discount rate of 7.03%. The rankings of the other treatments do not vary with the discount rate; in terms of increasing present value of utility rates the ranking is rate-base normalization, cost-of-service normalization, base case, and shortage normalization.

However, the extent to which present-value analysis provides information which is directly useful in evaluating the effect on consumers of the alternative regulatory treatments is uncertain for two reasons. The first is the ambiguity regarding the appropriate consumer discount rate to use in the evaluation. For some consumers (e.g., those whose marginal investment is a passbook savings account), the appropriate discount rate would be relatively low. For others (e.g., those whose marginal expenditure is financed by consumer credit), the rate would be quite high. Given the conceptual and data limitations, arriving at the appropriate weighted average discount rate to represent this array of circumstances would inevitably be, to a considerable extent, judgmental. This difficulty is a problem only in evaluating the consumer benefits under flow-through versus economic normalization, but this is an important relationship.

The lengthy time period necessarily involved in this analysis is the second factor which undermines its relevance for policy decisions. When alternative time streams of charges or benefits to a group of customers (who are not the whole population) span a short time period, say 5–10 years, present-value analysis offers a useful means of comparing the alternatives. However, the relevant time period in this case is the useful life of the utility asset, 30 years or perhaps 40 years or more (and when the focus of the analysis is on a utility firm, rather than on a single asset, the time period is indefinitely long, as the next subsection indicates). Such time periods stretch beyond the lifetimes of many present utility customers and are certainly long enough for substantial numbers of the original group of customers to have moved to other areas serviced by other utilities. Thus, it is probable that the original group of customers will not fully benefit from the time value of the deferred tax account which accumulates under normalization treatment or share in the higher utility rates after the first year under flow-through treatment. One might usefully inquire what the benefit of flow-through treatment is to a consumer who moves into the utility's service district during the second year of the asset's life. If one of the purposes of utility regulation is to avoid subsidizing one group of customers at the expense of another, this consideration reduces the usefulness of present-value analysis for this policy choice and emphasizes the importance of appropriate treatment on a year-by-year basis. It will be argued in the conclusion that this goal is accomplished by economic normalization.

The evaluation of the alternative rate-making treatments, of course, should be based on more than just the patterns of utility rates charged to customers. Other results which might be selected for scrutiny include the tax payments by the utility under the alternatives, the utility's cash flow, and the rate of return earned on equity. Simulation results for these variables, along with a smaller version of the revenues graph, are plotted in the four graphs in figure 2. Base-case tax payments are \$3.55 in the first year and decrease to \$0.06 in the thirtieth year. Tax payments under all the alternative treatments of the ITC are negative in the first year; the ITC more than eliminates the tax obligation. Under flow-through the first-year tax is −\$14.97; under the other treatments the first-year tax ranges from −\$6.26 (shortage normalization) to −\$6.91 (economic normalization). After the first year the pattern of tax payments tends to reflect the pattern of utility revenues, since revenue is the principal item in the taxable income equations which varies among treatments. Hence, tax payments under flow-through equal tax payments in the base case; tax payments are highest under shortage normalization and lowest under economic normalization, etc.

Interestingly, tax payments under cost-of-service normalization exceed those in the base case during the first 9 years of the simulation, then become lower than the base case, and eventually decrease below those of rate-base normalization. This is because the higher profit of the utility firm under cost-of-service normalization (compared to economic normalization) derives from inclusion of the ADITC in the rate base. The dollar magnitude of the profit benefit declines as the ADITC decreases over the life of the asset, hence the tax payments under this treatment decline over the life of the asset relative to the base case and economic normalization.

Cash flow of the utility under the base case declines linearly from \$7.50 in the first year to \$3.40 in the thirtieth year. Cash flow under flow-through treatment is equal to the base case in every year including the first. The utility firm receives no cash-flow benefit under flow-through; the entire benefit of the ITC flows through to reduce utility rates in the first year of the asset's life. Cash flow in the first year under the other treatments is higher by amounts ranging around \$10, the amount of the investment tax credit. The actual first-year cash flows under the normalization treatments range from \$16.96 under economic normalization to \$17.72 under shortage normalization. After the first year the pattern of cash flows is similar to the pattern of tax payments. Thus, shortage normalization yields cash flows which exceed those of

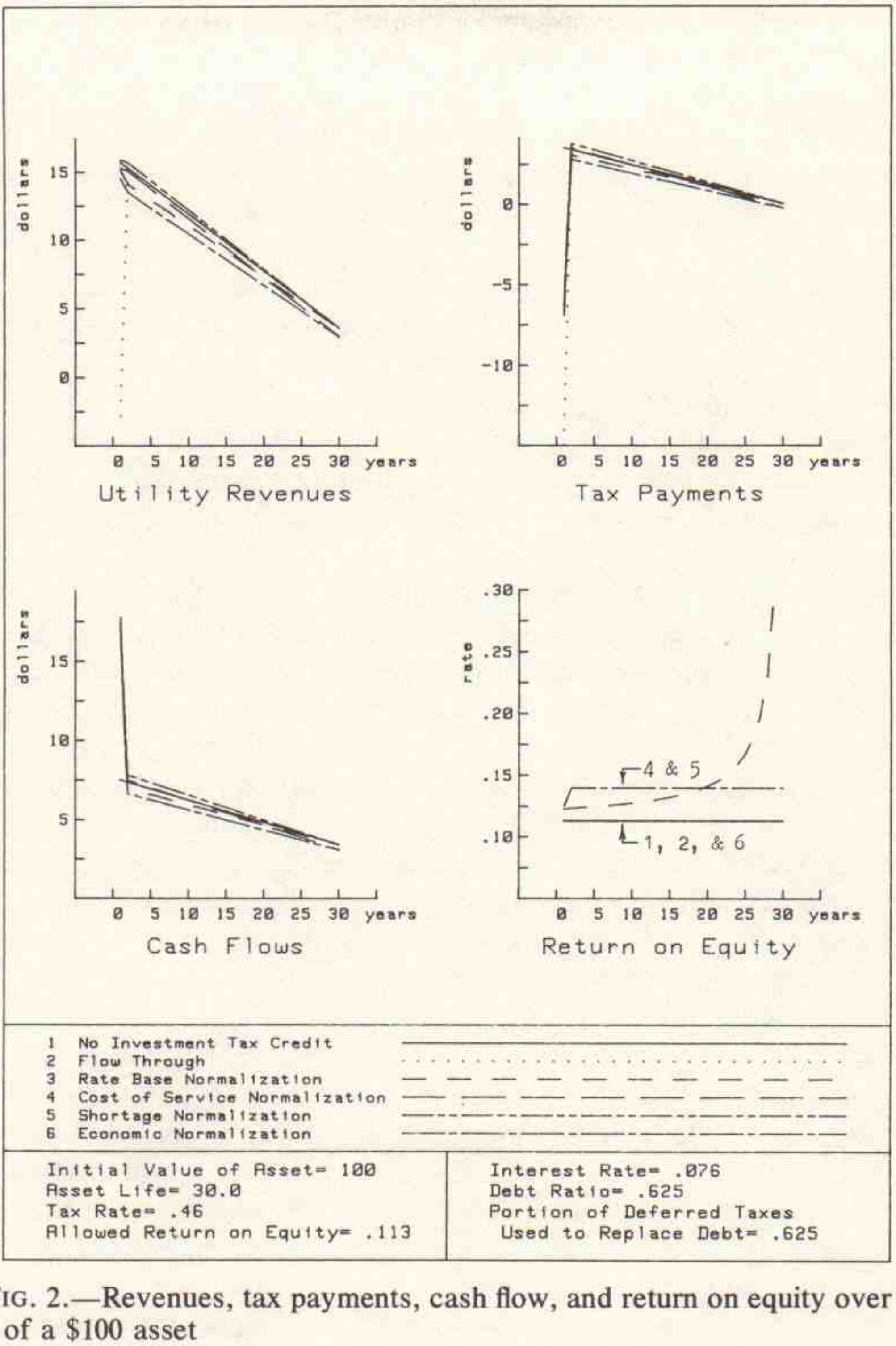

FIG. 2.—Revenues, tax payments, cash flow, and return on equity over the life of a $100 asset

the base case and flow-through, and economic normalization yields the lowest cash flows.

The final graph in figure 2 shows the rate of return on equity earned by the utility firm each year over the life of the asset under the alternative regulatory treatments. The rates of return are calculated by dividing the book profits by the average amount of equity financing each year. One seemingly reasonable standard for judging the correctness of the regulatory treatment of taxes (or other financial transactions) is the following: If the regulatory authority uses the appropriate market rate of return on equity in determining the allowed rate of return for a utility, does the regulatory formula yield utility rates which generate revenues that would, in fact, provide the market rate of return on equity (disregarding economic changes—e.g., inflation—which may invalidate the data or assumptions on which the regulatory decision was based)? In other words, if the regulatory authority uses the appropriate rate of return in its regulatory decision but the treatment of taxes in the regulatory equation is such that the actual return to equity would be lower or higher than the market rate of return on equity, then the regulatory treatment of the tax expense is incorrect. By this standard only flow-through and economic normalization are appropriate regulatory treatments of the investment tax credit (this standard, of course, is inappropriate for judging shortage normalization, which is intended to provide a special subsidy).

In the return on equity graph in figure 2, the lines for the base case, flow-through, and economic normalization are coincident; they are the horizontal line at .113, the allowed rate of return on equity. Flow-through treatment yields the appropriate rate of return because the entire tax credit is passed on immediately to customers and is not allowed to affect profits. Economic normalization yields the appropriate rate of return because, while the ITC is retained and amortized over the life of the asset, the financial benefits of this procedure are passed on to customers through exclusion of the ADITC from the rate base and the flow-through of the normalized investment tax credit.

Under the other three normalization treatments the actual rate of return is higher than the regulatory commission intended to allow. Under rate-base normalization, the rate of return begins at .123 and climbs steadily upward over the life of the asset. This upward trend occurs because the higher profit under this treatment results from not flowing through the normalized ITC each year. This provides a constant amount of "extra" profit (compared to economic normalization or the base case) to the utility firm each year, and since the amount of equity financing of the asset diminishes each year as the net asset value decreases, the rate of return on equity continuously increases. Interestingly, the simulation analysis reveals that the rates of return are identical under cost of service normalization and shortage normalization. This result, which is not otherwise apparent, is easily verified using the reduced forms of the book-profit equations for the two treatments. Thus, while shortage normalization yields higher cash flows than cost-of-service normalization, in the book-profits equation the positive effect of higher revenues is exactly offset by the negative effect of higher book taxes (resulting from both the higher revenues and not reducing the book tax expense by the normalized ITC).

The results for a single asset may now be summarized. Flow-through treatment passes on to customers the full benefit of the ITC immediately in reduced utility rates; no further rate reduction or effect on tax payments occurs after the first year. Under flow-through there is no effect on cash flow or profits of the utility firm. Economic normalization, on the other hand, allows the utility to retain the ITC and amortize it over the life of the asset. However, the utility firm is not allowed to profit from this procedure; the potential profit is passed through to customers by excluding the ADITC from the rate base and permitting the utility to depreciate only the privately financed portion of the asset (by reducing the annual cost of service by the normalized ITC). Economic normalization produces the lowest utility rates, except for flow-through in the first year of the asset's life, the lowest tax payments (with the same exception), and a rate of profit equal to that intended by the regulatory authority. It also yields the lowest cash flow for the utility firm after the first year, but this result should not be misinterpreted. All of the normalization procedures provide a jump in cash flow during the first year which enables the utility to finance 10% of the cost of the asset with the deferred tax credit, thus reducing the firm's reliance on the capital market for private financing. Economic normalization provides a cash flow which is just sufficient to maintain this 10% deferred tax credit financing over the life of the asset but which does not artificially increase the profit rate. The other normalization procedures also maintain the tax financing but also compel, through required rate making procedures, an increase in the profit rate above that intended by the regulatory authority. These higher profit rates are provided at the expense of higher utility rates and tax payments.

B. The Growing Firm

The most serious limitation of the analysis by Thompson and Weygandt is that it focuses exclusively on the regulatory effects regarding a single utility asset. But these results do not carry over directly in application to a utility firm. The plant and equipment of an ongoing firm is comprised of assets of different vintages. At any given time the tax and regulatory characteristics of a utility firm will depend, in part, on the age distribution of the utility's assets, which, in turn, depends on the utility's growth rate. Furthermore, with enactment of or eligibility for a tax benefit which applies only to new investment, such as the investment tax credit, the effect on the utility firm will change over time as an increasing proportion of the utility's capital assets have benefited from the tax provision. To explore these effects the financial characteristics of a growing utility firm under the alternative rate making treatments of the ITC have been simulated.

The utility firm growth-simulation model (described in the Appendix) assumes the utility grows at a constant annual rate. Investment sufficient to replace depreciated assets and sustain the specified growth in average net asset value occurs instantaneously, at the beginning of each year. Seventy percent of the utility's gross investment is assumed to qualify for the investment tax credit (only machinery and equipment qualify for the ITC, not structures). As for the single asset case, the simulation parameters are set at values representative of the electric utility industry in 1978.

The growth in total net utility plant of electric utilities for the most recently reported 5 years has averaged 10.3%.[12] The simulation results for a utility firm which grows at a constant 10% rate are graphed in figure 3. To standardize the results and facilitate comparisons among simulations, the dollar amounts of the variables in the first three graphs are divided by average net assets each year; thus, the graphs actually plot rates of required revenue (utility rates), tax payments, and cash flow per dollar of capital assets.

Utility rates in the base case remain constant throughout the simulation.[13] Despite the changing level of utility rates associated with each vintage of the utility's assets, the new investment each year maintains a constant relative distribution of asset vintages (under the constant growth-rate assumption) and, therefore, constant utility rates per dollar of capital assets. Utility rates under flow-through treatment decrease significantly the first year the ITC is in effect and remain constant at the lower level. While the rates are reduced only in the first year with regard to any single asset, the immediate flow-through of the tax credit received on each year's new investment maintains the reduced utility rates for the growing utility firm.

Under the four normalization procedures the level of utility rates gradually changes over the time period equal to the average asset life and then stabilizes. During this time period the ADITC and the value of the normalized tax credit increase as new vintages of assets qualify for the investment tax credit. However, beyond the time period equal to the asset life these values will be constant relative to total net assets as long as the utility growth rate and the ITC rate remain unchanged.

As is the case for a single asset, the highest utility rates for the firm occur under shortage normalization. Cost-of-service normalization yields rates which gradually decrease from the base-case level as the normalized ITC increases. Rate-base normalization produces larger reductions in utility rates; excluding the growing ADITC from the rate base—it increases to approximately 7% of the rate base in the thirtieth year—yields bigger rate reductions than flowing through the nor-

12. The growth rates have been: 1974, 12.0%; 1975, 9.4%; 1976, 9.7%; 1977, 10.1%; and 1978, 10.1% (calculated from data in U.S. Department of Energy, 1979).

13. The capital costs of the case 1 utility exhibit an oscillating pattern in the early years of the simulation due to the cyclic investment effects of replacing the utility's initial plant. In the simulations the ITC is actually introduced during the third asset life cycle (after capital costs have stabilized) and its initial year is labeled year 1.

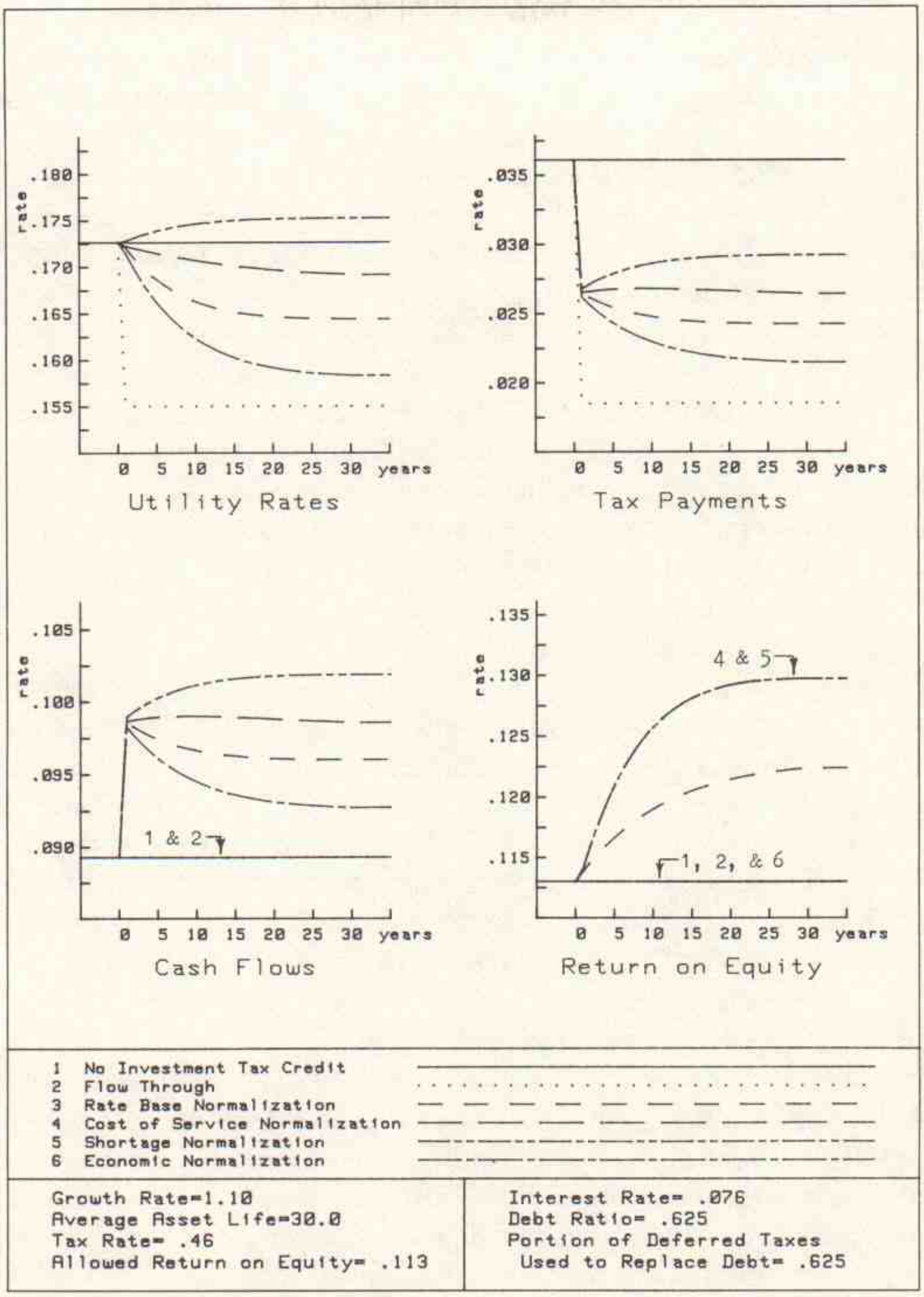

FIG. 3.—Utility rates, tax payments, cash flow, and return on equity for utility firm with a constant 10% growth rate

malized ITC. Economic normalization, which combines the two procedures, yields the lowest rates of the normalization treatments. However, for the parameters of the simulation reported in figure 3, flow-through treatment produces the lowest utility rates every year of the simulation and indefinitely into the future so long as the tax benefits continue and the parameters remain constant. This result contrasts sharply with the results for a single asset.

The implications of the alternative treatments for tax payments, cash flow, and return on equity follow from the effects on revenues. Tax payments in the base case, like utility rates, remain constant (per dollar of capital assets) throughout the simulation. The levels of tax payments for the other cases parallel the revenue levels; shortage normalization yields the highest tax payments (obversely, the smallest tax revenue loss), and flow-through yields the lowest. In the committee reports accompanying the Revenue Act of 1971 the reason for requiring normalization treatment was stated as follows: "To permit all of the benefits of the credit to be flowed through to the customer currently could have an impact on revenues which is approximately twice that applicable in other cases."[14] The tax payments graph in figure 3 shows this statement to be correct for the first year of effect of the ITC (to which all of the examples in the committee reports referred); for later years, however, the tax revenue loss under flow-through is always greater than that under normalization, but the extent of the difference depends on which normalization treatment is being considered (and other factors, as indicated below).

The revenue and tax effects, of course, determine the cash-flow impacts of the alternative regulatory treatments. Cash flow (per dollar of capital assets) remains constant throughout the simulation in the base case and under flow-through treatment of the ITC. Since the reduction in utility revenues under flow-through treatment is exactly equal to the reduction in tax payments, there is no cash-flow effect. Cash flow under the normalization treatments jumps substantially in the first year of the ITC and then follows patterns under the various treatments which reflect the utility rate movements. Unlike the results for a single asset, in this simulation assuming 10% growth, cash flow under all the normalization treatments remains permanently higher than under flow-through and the base case. In the rapidly growing firm the cash flow resulting from the additional tax credit on new investments each year more than offsets the negative cash flow effects of amortizing the credits received on prior investments.

The profit situation for the growing firm is somewhat analogous to that for the single asset. The rate of return on equity is constant throughout the simulation in the base case and under flow-through and economic normalization. Under flow-through, the entire benefit of the ITC is passed immediately on to customers. Under economic normalization the utility receives the cash flow benefits, but the potential profit from the ITC is passed on to customers through exclusion of the ADITC from the rate base and the flow-through of the normalized ITC. As in the single asset simulation, the other three normalization treatments all yield higher rates of return on equity than the regulatory

14. U.S. Congress 1971, p. 37.

commission intended to allow. Rate-base normalization yields a higher rate of return, rising in this case from 11.3% to 12.24%, because of the failure to flow through the normalized ITC. Cost-of-service and shortage normalization yield equal significantly higher rates of return, rising to 12.97% by the end of the simulation. These two types of normalization of the ITC, the two normalization treatments which are actually in use, provide a clear and substantial benefit to the stockholders of the utilities.

The overall pattern of the simulation results for the growing firm depends on the simulation parameters. In particular, the results depend heavily on the assumed growth rate and the assumed portion of deferred taxes used to replace debt. Figure 4 shows graphs of the results for a simulation with all parameters the same as in figure 3, except the growth rate has been reduced to 6%. With the recent decreased growth in the demand for energy, a future growth rate of 6% or lower for the electric utilities may not be an unreasonable expectation. The pattern of the results in figure 4 is similar to the earlier results with one important exception: the utility rates under economic normalization drop below the rates under flow-through treatment in the twenty-second year of the simulation and remain lower thereafter. For the rapidly growing utility firm, the effects on utility rates of immediately flowing through the tax benefit always exceed the effects of amortizing the accumulated past benefits; for the slower growing firm the latter eventually overcomes the former. Parallel results have been found for accelerated depreciation.[15] Slower growth rates produce results even more different from the earlier simulation. For example, with a 2% growth rate, utility rates under economic normalization drop below those under flow-through in the fourteenth year, and the difference in rates becomes substantial by the end of the simulation. Furthermore, at this lower growth rate, tax payments and cash flow under economic normalization also decline to levels below those resulting from flow-through treatment.

The simulation results also depend heavily on the assumed portion of deferred taxes used to replace debt. Figure 5 shows the simulation results assuming a 10% growth rate, with all of the tax deferrals used to replace equity capital (or, more accurately, the tax deferrals substitute entirely for equity capital which otherwise would have had to be raised). While credit market constraints may prevent this outcome, and there is no known evidence to suggest it has occurred, it is not an unreasonable outcome to expect the utility to attempt in an effort to increase its leverage and profitability. As the graphs make clear, the results are substantially different from figure 3. Under these assump-

15. See Brigham.

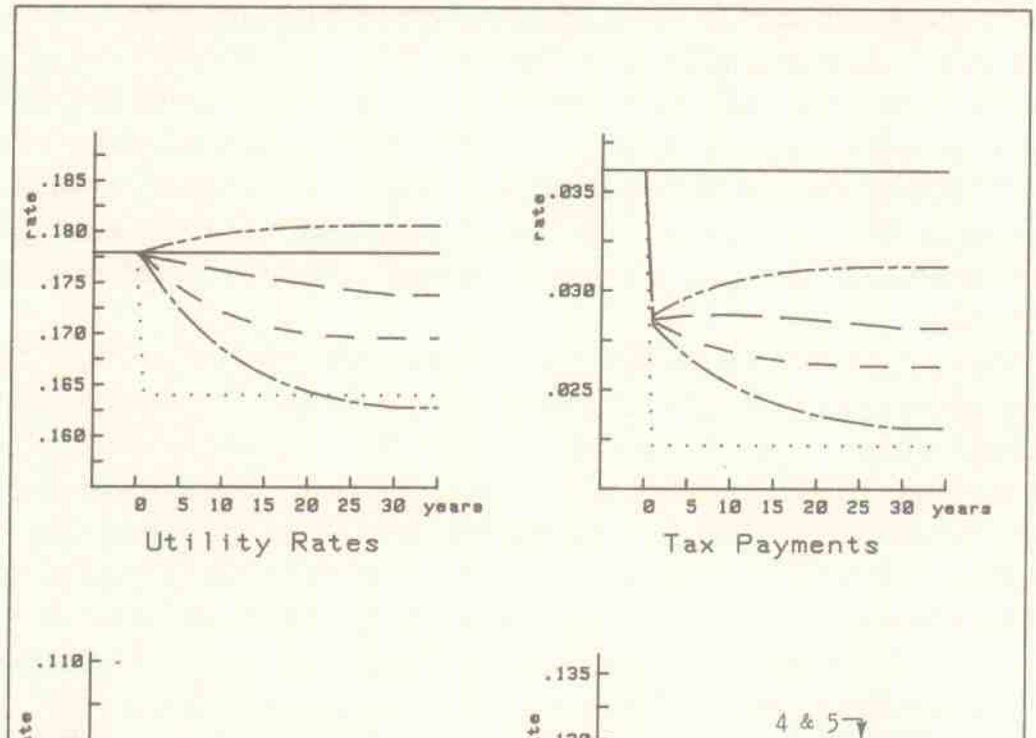

FIG. 4.—Utility rates, tax payments, cash flow, and return on equity for utility firm with a constant 6% growth rate

tions shortage normalization no longer produces higher utility rates than the base case. As in the 2% growth case, economic normalization yields lower stabilized levels of utility rates, tax payments, and cash flow than does flow-through treatment. The rate of return on equity in the base case and under flow-through and economic normalization are unchanged, but the profit rates for the other three normalization treatments are somewhat higher than in the earlier simulation.

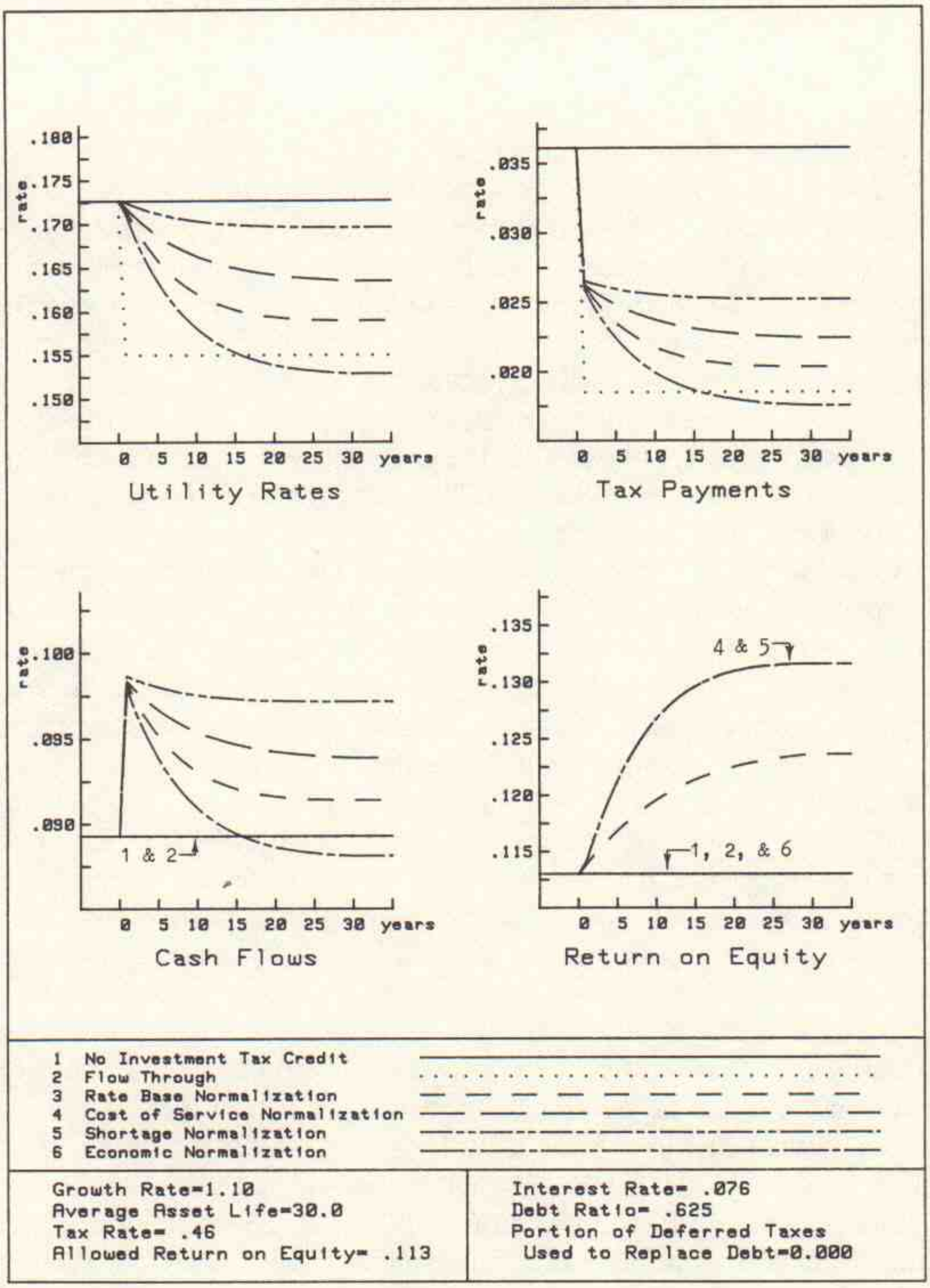

FIG. 5.—Utility rates, tax payments, cash flow, and return on equity for utility firm with a constant 10% growth rate; all tax deferrals substitute for equity capital

III. Conclusion

In adopting the investment tax credit, Congress had three goals: (1) to reduce the effective cost of acquiring new equipment, (2) to increase the profitability of new investment, and (3) that the financial assistance provided by the credit should itself be used for new investment.[16] In the unregulated sector of the economy the higher investment profitability was intended to temporarily raise the prospective rate of return above the cost of capital, thereby inducing additional investment. Once that additional investment occurred, of course, one would again expect the marginal rate of return on investment to equal the marginal cost of capital, but the reduced investment costs and cash-flow effects of the investment credit would remain. These results can be achieved in the public utility industry by the regulatory treatment referred to in this paper as economic normalization.

Thompson and Weygandt favor flow-through treatment and object to normalization of the ITC for two reasons: normalization increases the rate of return of the utility above that intended by the regulatory authority, and it yields higher utility rates than flow-through treatment. They also suggest that it is inappropriate or futile to attempt to stimulate investment in the public utility industry because public utilities "are required to provide assets sufficient to provide service for those who demand it and this amount is independent of whether or not the utility can take advantage of the investment tax credit" (p. 508). The analysis in this paper shows that the rate-of-return objection is valid for the methods of normalization of the ITC presently allowed in the tax code[17] but not for economic normalization. This was acknowledged in the Thompson and Weygandt paper in a brief reference to what the present study has termed economic normalization: "Under this approach there would be no *additional* rate of return to the stockholder and the ratepayer would benefit by both the capital structure effects and the credit effect" (p. 517). By not providing the utility a higher rate of return, economic normalization avoids the criticism of inappropriately stimulating public utility investment, but it facilitates the high levels of utility investment by increasing cash flow and providing an interest-free source of capital.

By Thompson and Weygandt's criterion for evaluating the utility rate effects—the aggregate rate reduction over the life of a single asset—economic normalization is superior to flow-through. However, this study has questioned this criterion and demonstrated that in a more relevant setting—that of a growing utility firm—the regulatory treat-

16. See U.S. Congress 1962, pp. 11–12.

17. A higher rate of return is not a necessary result, however, of the methods of normalizing accelerated depreciation which are allowed in the tax code (see Kiefer 1979).

ment which provides lower utility rates in the long run depends on the growth rate of the firm and the effects of the deferred investment credits on the capitalization structure of the firm, among other variables. But price minimization is not the principal criterion for judging appropriate accounting or rate making treatment. If it were, several other transactions would be accounted for differently. For example, including plant removal expenses as a cost of service only when incurred would yield lower utility rates than the more standard practice of amortizing these costs over the life of the plant. But the logic of the accounting process requires that the costs of capital services be related to the income produced by the capital by amortizing the capital costs over the lives of the capital assets. This same logic requires that the investment tax credit, the receipt of which is intrinsically related to the acquisition of capital assets, be normalized over the lives of the benefiting assets.

Economic normalization is consistent with the logic of regulatory accounting. It spreads the financial effects of the investment tax credit over the lives of the underlying assets. It benefits the utility companies through higher cash flow, while avoiding a rate of return higher than deemed appropriate by the regulatory commission. And it provides appropriate utility rate reductions to customers on a year-to-year basis by reducing utility revenues by amounts which accurately reflect the provision of cost-free capital to help finance the utility's investments.

Appendix

This appendix summarizes the basic structure of the simulation models used in the analysis. Since the models share most of their equations, they are presented jointly and their differences are highlighted.

At the beginning of the first year of the simulation ($t = 1$) the gross asset value, G_t (of the asset, in the case of the asset simulation model, and of the firm, in the case of the firm growth simulation model), is set equal to an initial value. This initial value also equals investment in the first year, I_1. Gross asset value remains constant throughout the simulation in the asset model ($G_t = G_1$). In the growth model the values of G_t for years $t > 1$ are given by:

$$G_t = G_{t-1} + I_t \qquad A \geqslant t > 1,$$

$$G_t = G_{t-1} + I_t - I_{t-A} \qquad t > A,$$

where I_t is investment at the beginning of year t and A is the useful life of the utility's assets. These equations add each year's investment to the firm's gross asset value and deduct retired assets.

Net asset value at the beginning of year t, Nb_t, is determined by the following equations in the asset model:

$$Nb_1 = G_1$$

$$Nb_t = Ne_{t-1} \qquad t > 1,$$

where Ne_t is net asset value at the end of year t. In the growth model, Nb_t is determined as follows:

$$Nb_1 = I_1$$
$$Nb_t = Ne_{t-1} + I_t \qquad t > 1.$$

Since depreciation is straight line, its value, D_t^s, is determined by the following equation in both models:

$$D_t^s = \frac{G_t}{A}.$$

Accumulated depreciation through year t, Ad_t, is given by:

$$Ad_t = Ad_{t-1} + D_t^s \qquad A \geqslant t > 1$$
$$Ad_t = Ad_{t-1} + D_t^s - I_{t-A} \qquad t > A$$

Only the first equation is applicable in the asset model.

Net asset value at the end of year t, Ne_t, is yielded by:

$$Ne_t = G_t - Ad_t.$$

Average net asset value during year t, Na_t, equals:

$$Na_t = \frac{Nb_t + Ne_t}{2}.$$

The amount of the investment tax credit, I_t^a, is determined by:

$$I_t^a = c \cdot I_t \qquad t \geqslant t^*,$$

where c, the effective rate of the tax credit, is equal to .1 in the asset model and .07 in the growth model, and t^* is the first year of effectiveness of the tax credit. The normalized investment tax credit, I_t^n, is given by the following:

$$I_t^n = I_{t-1}^n + \frac{I_t^a}{A} \qquad t^* + A > t \geqslant t^*,$$

$$I_t^n = I_{t-1}^n + \frac{I_t^a}{A} - \frac{I_{t-A}^a}{A} \qquad t \geqslant t^* + A.$$

The accumulated deferred investment tax credit (ADITC) at the end of year t, Be_t, equals:

$$Be_t = Be_{t-1} + I_t^a - I_t^n.$$

The average ADITC during year t, B_t, is given by:

$$B_t = \frac{Be_{t-1} + Be_t}{2}.$$

In the growth model the amount of investment at the beginning of each year, I_t, is determined by:

$$I_t = \frac{2 \cdot Na_{t-1} \cdot R - Ne_{t-1} + Ad_{t-1} - G_{t-1} \cdot \left(1 - \dfrac{1}{A}\right)}{2 - \dfrac{1}{A}} \qquad t \geqslant 2,$$

where R is the specified growth rate in average net asset value of the firm.

Values for utility revenues, taxable income, tax payments, cash flow, and profits for each year under each regulatory treatment of the investment tax credit are calculated using the data generated by the simulation models described above and reduced forms of the equations displayed in the text.

References

Brigham, Eugene F. The effects of alternative tax depreciation policies on public utility rate structures. *National Tax Journal* 20, no. 2 (June 1967): 204–18.

Brigham, Eugene F., and Pappas, James L. *Liberalized Depreciation and the Cost of Capital*. East Lansing: Michigan State University Institute of Public Utilities, 1970.

Kiefer, Donald W. *Accelerated Depreciation and the Investment Tax Credit in the Public Utility Industry: A Background Analysis*. Columbus, Ohio: National Regulatory Research Institute, 1979.

Thompson, Howard E., and Weygandt, Jerry J. The rate-making treatment of the investment tax credit for public utilities. *Journal of Business* 50, no. 4 (October 1977): 508–19.

U.S. Congress, Senate, Committee on Finance. *Revenue Act of 1962: Report to Accompany H.R. 10650*. 87th Cong., 2d sess. Washington, D.C.: Government Printing Office, August 16, 1962.

U.S. Congress, Senate, Committee on Finance. *Revenue Act of 1971: Report to Accompany H.R. 10947*. 92d Cong., 1st sess. Washington, D.C.: Government Printing Office, November 9, 1971.

U.S. Congress, House, Committee on Ways and Means, Subcommittee on Oversight. *A Review of Selected Tax Expenditures: Investment Tax Credit*. Hearings, 96th Cong., 1st sess. March 22, 23, 27, and 28, 1979. Washington, D.C.: Government Printing Office.

U.S. Congress, House, Committee on Ways and Means. *Accounting Treatment of the Investment Tax Credit and Accelerated Depreciation for Public Utility Ratemaking Purposes*. Hearings, 96th Cong., 2d sess. April 15, 1980. Washington, D.C.: Government Printing Office.

U.S. Department of Energy, Energy Information Administration. *Statistics of Privately Owned Electric Utilities in the United States—1978*. Washington, D.C.: Government Printing Office, October, 1979.