FINANCING TECHNOLOGICAL CHANGE IN THE PUBLIC UTILITY SECTOR

Eugene F. Brigham

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University of Florida

A few years ago, poor telephone service in New York and other cities was a topic of conversation across the country. Then talk turned to the electric power industry's outages and brownouts. Industry leaders knew these events were symptoms of a larger problem, but only recently have the true proportions of the problem been generally recognized.

Very clearly, a crisis is at hand, and something must be done to avoid a catastrophic breakdown. But what? In the past, American technology and know-how have enabled us to overcome most of our difficulties, and the national hope is that these factors will overcome the crisis facing the utility industries today. However, we need to do more than just hope, and my purpose here is to consider the steps that must be taken if the needed technological improvements are to occur.

WHAT IS "TECHNOLOGICAL CHANGE"?

What is meant by the term "technological change"? In the electric industry, nuclear power obviously represents a technological change, but improving oil-fired generating plants can also represent new technology. If an electric company builds a large plant to replace several smaller plants, and if this change increases the system's efficiency--where efficiency is measured either by btu's required to generate one kwh or by the total cost per kwh--this would constitute an improvement in the industry's technological processes. In other words, technological change for a utility involves both <u>developing</u> new technologies and also <u>installing</u> plants that use these technologies.

WHAT TYPE OF TECHNOLOGICAL CHANGES ARE NEEDED?

If the United States is to survive in its present form, the utility industries must make massive technological changes. At the risk of oversimplification, I have broken these changes down into two major categories, long run and short run.

Long run

The long run might be defined as 1980 or beyond. During this period we must make major technological breakthroughs in the generation and transmission of electricity. Breeder reactors, solar and geo-thermal generating systems, and the like are included. Also included are coal gasification and/or liquification and shale oil development.[1]

Short run

Although we must ultimately depend upon new technological developments, we live in the short run, and we simply cannot wait for long-run developments to solve our current problems. In the short run, utility companies must (1) improve existing processes and (2) use the best of the present technologies to a greater extent. To get the most out of our existing fuel supplies, utility companies should replace inefficient equipment with new, more efficent types, and they must install the most efficient equipment available to meet expanding service demands.

FINANCING TECHNOLOGICAL IMPROVEMENTS

The long-run solution to the utilities' problems will require massive

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[1]For new generating processes to be most effective, more efficient systems for transmitting energy are also necessary. As plant size increases, the distance between generating plant and ultimate user also tends to increase, and this adds significantly to the importance of reducing energy losses during transmission.

expenditures on R & D.[2] How should this R & D be financed? From all indications, some degree of governmental support is necessary. However, governmental financing tends to breed bureaucratic control, so I would hope that we can develop a system under which government and industry share in the financing and control of research programs.

In contrast to the long-run situation, short-run technological improvements are dependent upon private financing, especially financing by the utility companies themselves. Consider the nature of the short-run problem. The companies must modernize their systems, which means not only installing the most efficient available equipment to meet expansion needs, but also undertaking many smaller projects associated with increasing the efficiency of existing plants. These costs have traditionally been borne by utility companies, and ultimately by their customers; I hope and expect this pattern to continue, for the alternative is government ownership and control. However, as shown below, there are serious problems associated with the traditional financing pattern in today's economy.

THE REGULATORY PROCESS AND ITS EFFECTS ON UTILITY INVESTMENT POLICY

Utility companies, by definition, provide essential services under monopolistic or at least oligopolistic conditions. In the absence of regulation, the companies would be in a position to exploit their customers, and to prevent potential abuses, a system of price regulation has been developed. The regulatory system actually evolved during an era when technological improvements and economies of scale were combining to produce a trend of declining utility service rates. Utility companies' profits were, in general, adequate to attract

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[2]Following this basic research, utility companies will need huge amounts of capital to construct plants utilizing the new technologies. The financial requirements needed for this construction program will have to be raised by the utility companies, but this is some years down the road.

the capital needed for expansion, and returns on capital investments were high enough to induce companies to invest in the most modern, efficient equipment available. Now, however, just at the time when the most massive expenditure programs of all time are necessary, there is a serious danger of a breakdown that could impare the companies' ability to attract capital.

Capital Expenditure Analysis

Figure 1 presents what might be called the traditional view of the capital budgeting process. Potential investment projects originate in the operating departments and are transmitted to the capital budgeting coordinator. Here the rate of return on each project is determined, and projects are ranked by their expected rates of return. The line in Figure 1 labelled IRR represents a plot of ranked investment proposals. The very best project returns about 20 percent, but only a limited amount of funds can be invested in this high-return project. As additional funds are invested, the company must accept lower and lower rates of return on capital projects.

The firm also has a cost of capital, or cost of money; in Figure 1 we assume that all the required capital can be raised at a cost of 9 percent. The firm will take on projects so long as their expected returns exceed the cost of capital; in Figure 1, the optimal capital budget for the firm is I*. Every project out to I* increases the value of the firm because returns exceed costs. Obviously, the area labelled "producer's deficit" should be rejected, as these projects do not cover their costs.

Figure 1 represents the way most economists conceptualize the capital budgeting process. However, according to traditional regulatory theory, this conceptual model is not completely applicable for utility companies. To see why, consider Figure 2, which shows realized and allowed rates of return for

FIGURE 1. CONCEPTUAL MODEL OF THE CAPITAL BUDGETING PROCESS FOR AN UNREGULATED FIRM

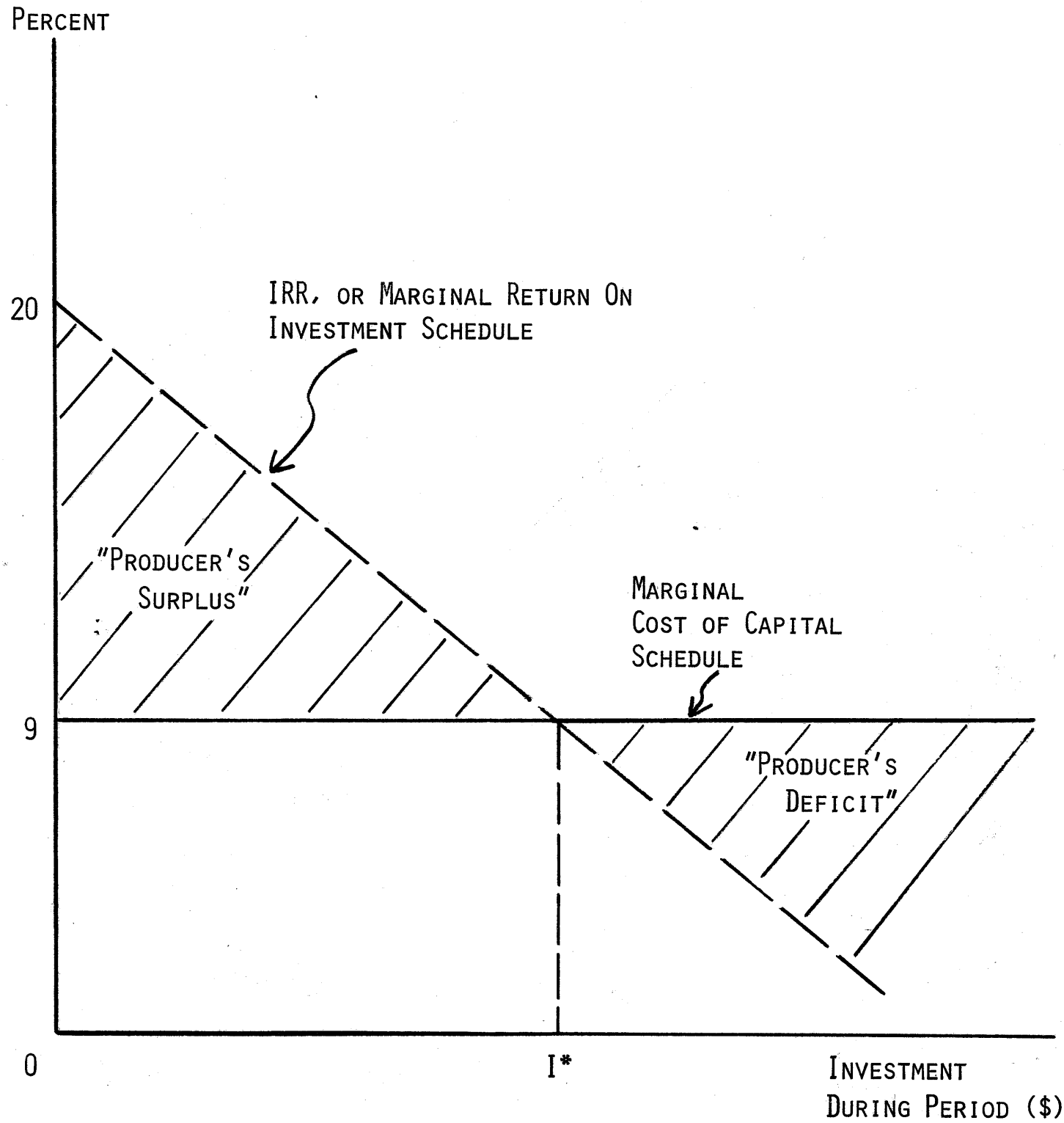
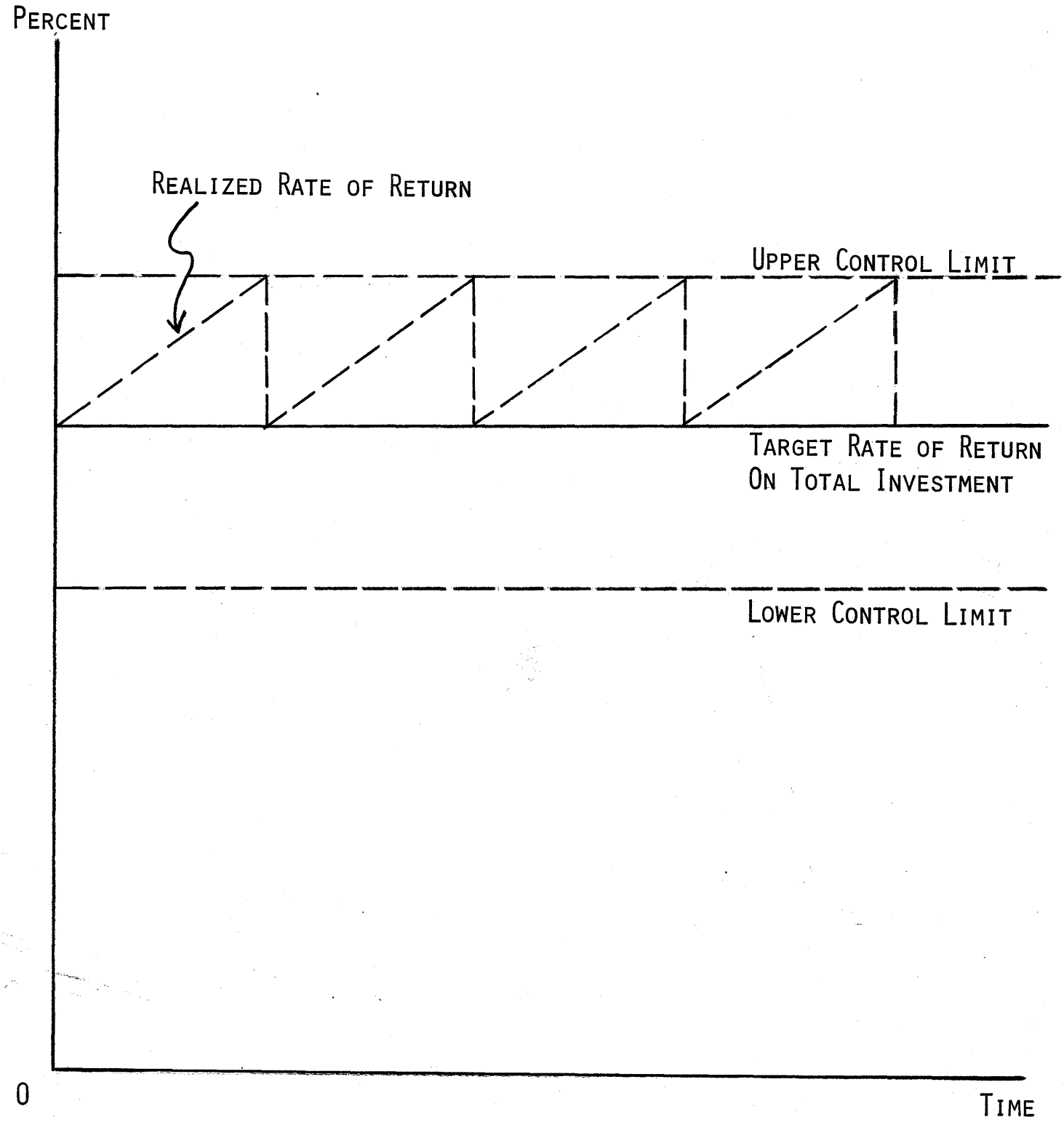


FIGURE 2. ACTUAL AND ALLOWED RATES OF RETURN OVER TIME FOR A HYPOTHETICAL UTILITY COMPANY



a hypothetical utility company.[3] In the regulatory process, a target or allowed rate of return is specified. This return is generally regarded as being a point within a range of rates of return frequently called "the zone of reasonableness." If the actual rate of return exceeds the upper control limit, then a rate reduction is ordered, thus lowering profits to the point where the rate of return is "on target."

The situation shown in Figure 2 implicitly assumes that everything is held constant except the investment process, and that both investment opportunities and the cost of capital are as shown in Figure 1. However, if the control limits are set close to the target rate of return, and if the "regulatory lag" is short, then the "producer's surplus" implicit in the accepted view of capital budgeting will be nonexistent. In other words, the regulatory process will, to a greater or lesser extent, eliminate the "producer's surplus" shown in Figure 1.[4]

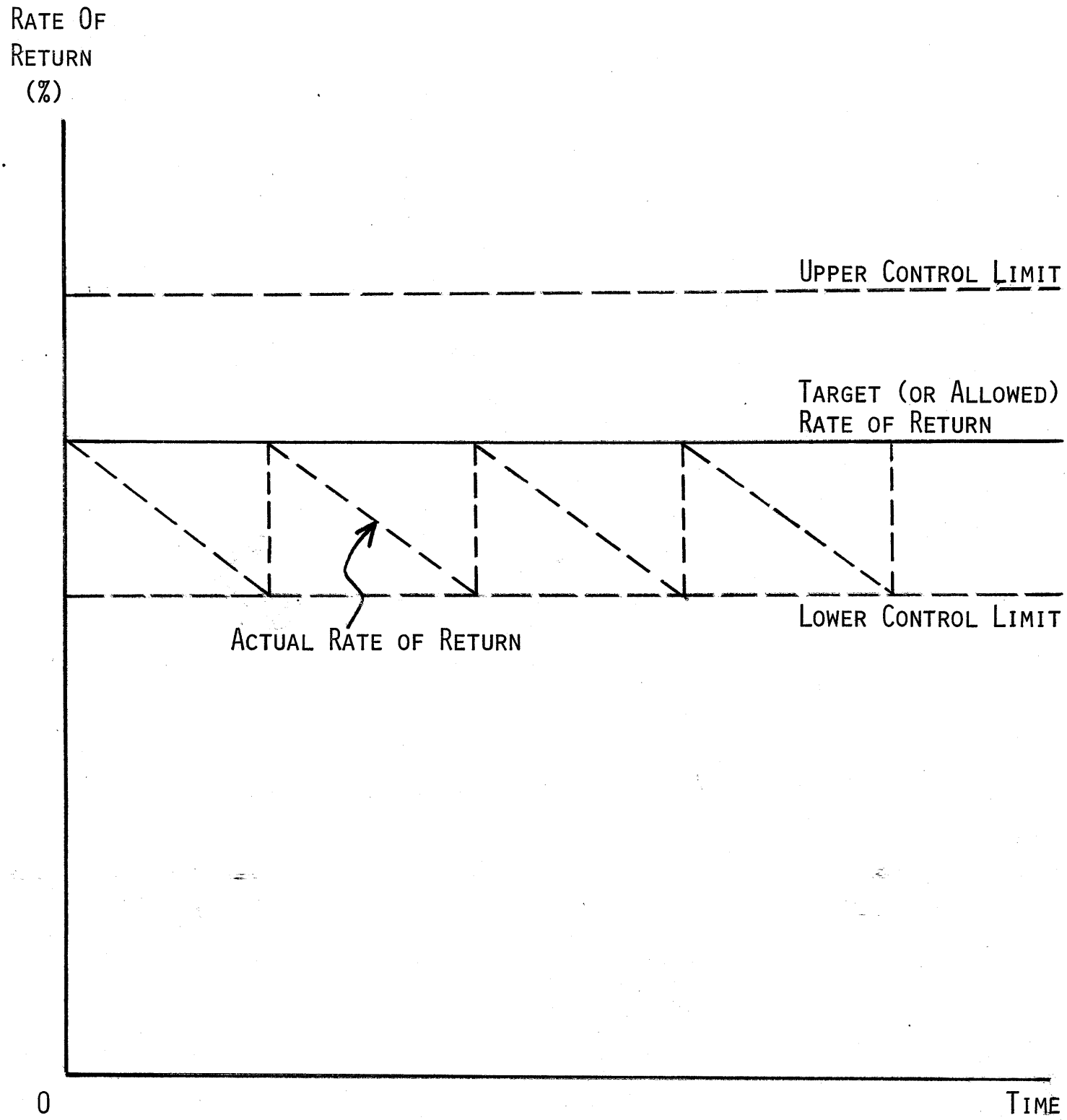
Public Utility Investment Decisions Under Inflation

The situation depicted in Figure 2 was realistic during the 1950's and early 1960's. However, Figure 3 is a better representation of the situation facing utility companies today. For the typical company, inflation is constantly driving costs up, but prices, which are set by regulatory action, are increased only after a lag. As operating costs rise, the realized rate of return on investment declines. When the lower control limit in Figure 3 is reached, rates are raised, causing the realized rate of return to rise back

[3]The rate of return is earned on the "rate base," which is approximately equal to total assets net of depreciation. As noted below, returns on specific individual assets can exceed or fall below the average (or overall) rate of return.

[4]This result is, of course, the same as would exist under theoretical perfect competition. Indeed, regulation is a substitute for competition, and in theory regulators are supposed to achieve a competitive price/output solution.

FIGURE 3. TYPICAL RATE OF RETURN PATTERN UNDER INFLATIONARY CONDITIONS



to the target level. However, continued inflation causes the cycle to be repeated, and the rate of return is again eroded. Thus, under inflation the average rate of return over a period of time lies below the target rate of return.[5]

A Rising Cost of Capital

Another problem faced by utility companies is the fact that they have, during the past few years, faced a rising cost of capital.[6] Controversy exists over the actual measurement of the cost of capital, but because of the general increase in interest rates, no one argues seriously that the cost of capital has not risen in recent years. However, because of regulatory lags, the target rate of return has generally been set somewhat below the actual cost of capital.

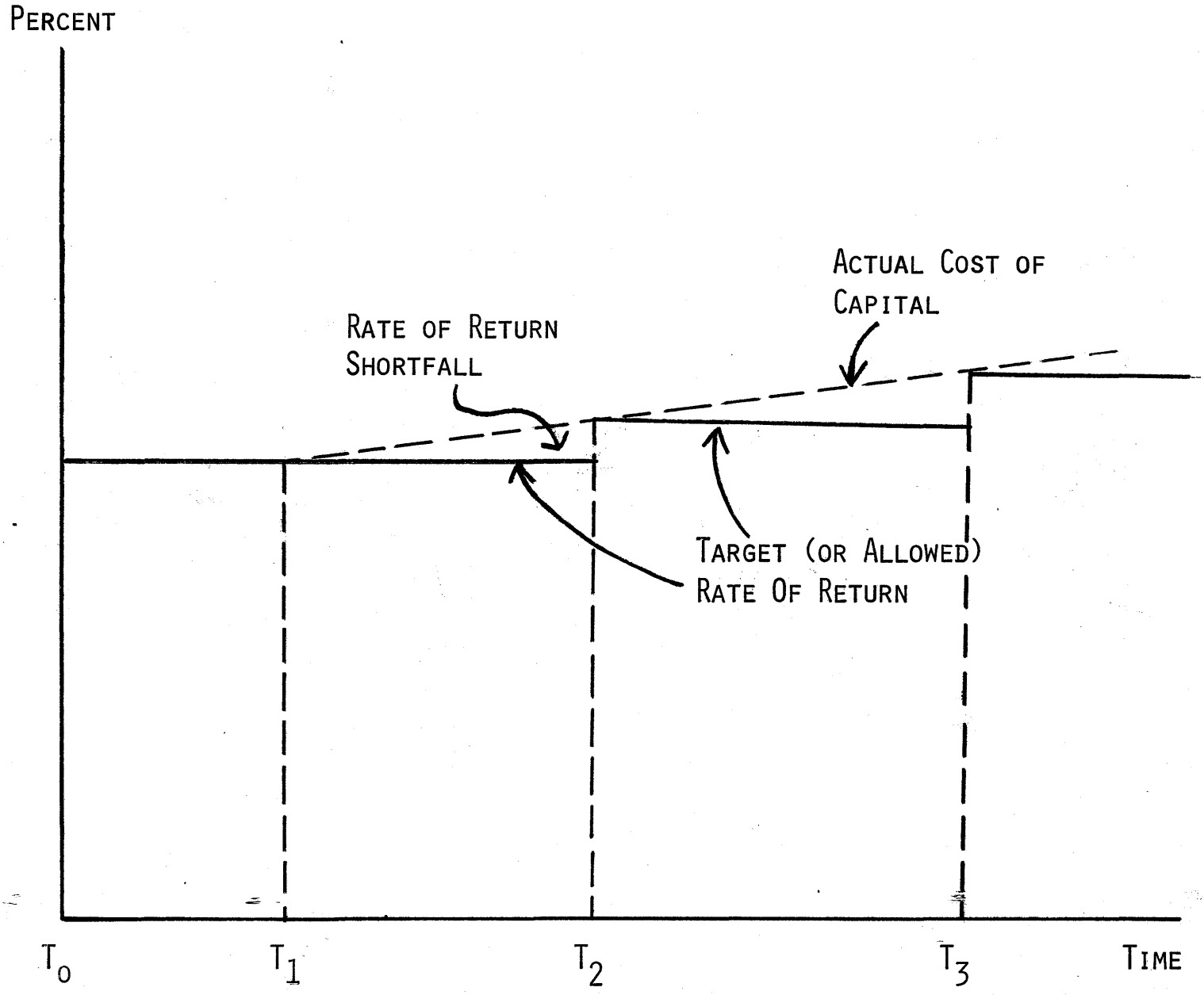
Figure 4 illustrates this situation. From T_o to T_1, the cost of capital is both stable and equal to the allowed rate of return. At T_1, the cost of capital begins to rise, and during the interval from T_1 to T_2 a rate of return shortfall develops. At T_2, a rate case is held, and the allowed rate of return is adjusted upward. However, the continuing increase in the cost of capital causes the cycle to be repeated, and over the entire period the actual rate of

[5]It would, of course, be possible for regulatory authorities to anticipate price increases--in utility parlance, this is called using a forward test year. Alternatively, the regulatory lag could be shortened by setting the control limits closer to the target rate of return. Such procedures are beginning to be employed by regulatory agencies--the automatic fuel adjustment clause, which permits certain electric utilities to raise prices automatically when fuel costs rise, is an example. Nevertheless, in the general case inflation has simply caused utility companies to earn a lower average rate of return than the target rate of return as prescribed by regulatory commissions.

We might note in passing that Figure 3 also describes the situation faced by many "unregulated" firms during Phases II and III of the price controls.

[6]Utilities should be concerned with three somewhat different costs of capital--an incremental cost, defined as the average cost of new debt and equity raised during the budgeting period, a marginal cost, defined as the cost of the last dollar raised during the planning period, and an historical average (or "embedded") cost which is the weighted average of the current cost of equity and the average cost of all outstanding debt and preferred stock.

FIGURE 4. ILLUSTRATION OF RISING COST OF CAPITAL COMBINED WITH LAGGED CHANGES IN THE ALLOWED RATE OF RETURN



return averages less than the cost of capital.[7]

Utility Investment Decisions

The combination of a rising cost of capital, rising operating costs, and regulatory lag has caused problems for the utility industry, and these problems are compounded by the nature of utility company operations. Utility companies' capital investments may be divided into two categories--mandatory investments, which are required to meet basic service demands, and discretionary investments, which primarily involve cost-reducing, efficiency-increasing investments. This breakdown is illustrated in Figure 5, which shows the cost of capital schedule as well as the rate of return schedules for both investment categories. As we have drawn it, mandatory investments are substantially larger than discretionary investments; this seems to be in accord with the actual situation.[8]

An example will perhaps illustrate what is involved here. In certain geographic areas, a telephone company may have excess switching capacity, permitting it to earn a relatively high rate of return on the investment needed to serve new customers. The monthly phone bill will be more than sufficient to cover operating costs and the return on the relatively small capital outlay needed to

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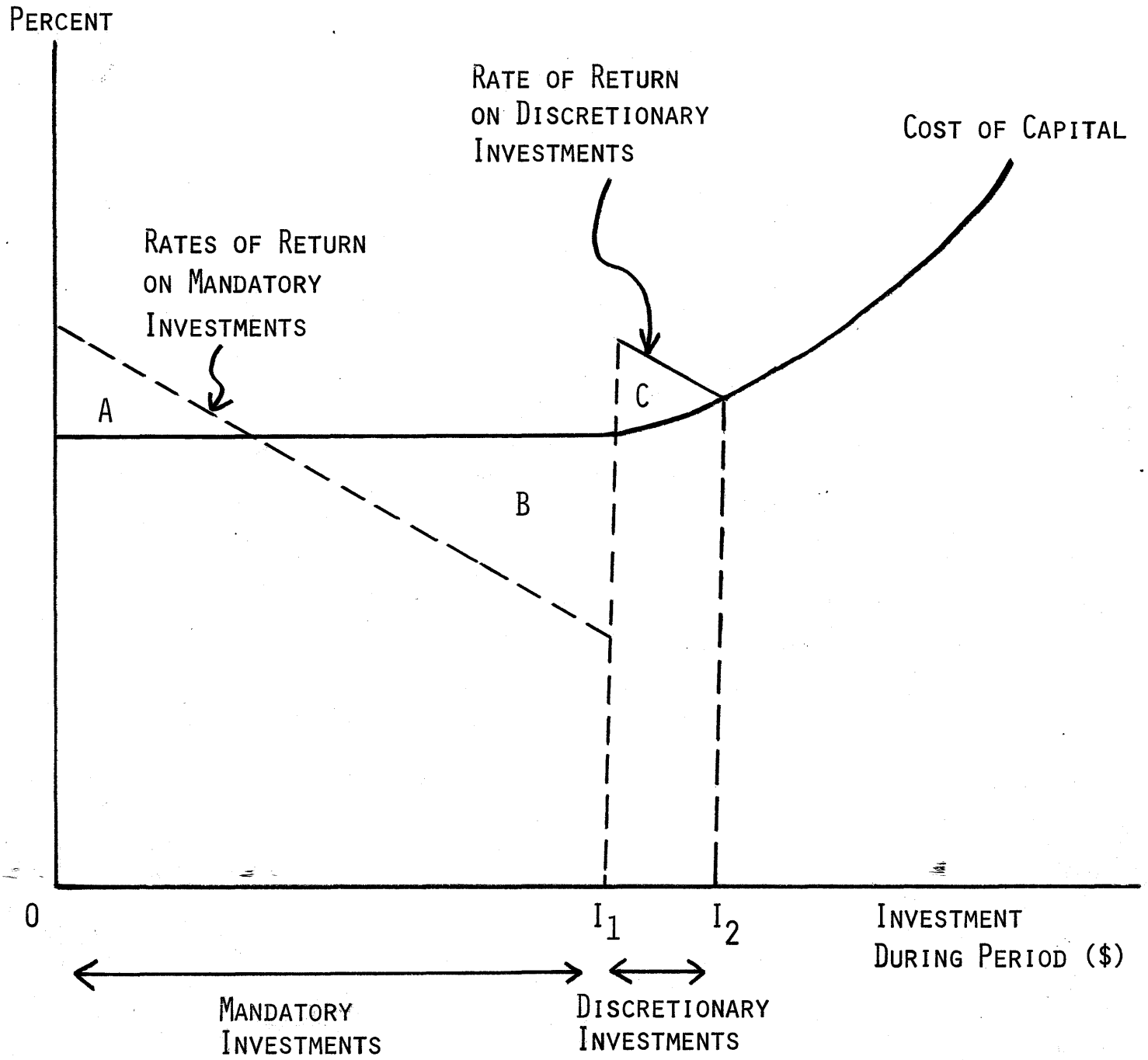
[7]One could argue that the cost of capital increases when the rate of inflation increases, i.e., interest rates jump when the rate of inflation increases but hold steady once a level of inflation has been established. Even if this was exactly true, utility companies' embedded cost of capital, which is used in regulatory procedures, would still continue to rise as high-rate new debt is added to the existing low-rate debt. Utility companies in recent years have been (1) selling substantial amounts of new high-rate debt to finance their investment programs and, at the same time, (2) refunding low-rate debt issued twenty or so years ago with much higher-rate debt.

[8]Although the relationships shown in the figure are hypothetical, they are reasonably consistent with the situation facing utility companies in 1972-1973. This point is discussed later in the paper.

In addition, it should be noted that Figure 5 may also apply to nonregulated firms. Investments made to meet pollution control standards or to satisfy pressure from powerful customers might be classified as "mandatory." However, the sum of areas A and C in Figure 5 for unregulated firms probably exceeds that of area B, so their average return on new investment exceeds their average cost of capital. For utilities in recent years, B has exceeded A + C.

FIGURE 5. CAPITAL BUDGETING WITH MANDATORY AND DISCRETIONARY INVESTMENTS



provide the service. Profitable investments of this type give rise to the area designated as A. On the other hand, in an area where existing capacity is fully utilized, to install new telephones might require an investment of $2,000 per phone versus an average plant cost of $1,000 for each telephone presently in service. Regulated prices are, in general, based on the $1,000 average investment, not the $2,000 marginal investment. In the absence of an immediate price increase to take account of the rising average plant cost per telephone in service, growth in the second area necessarily produces a declining rate of return on total investment. Thus, investment here will correspond to area B in Figure 5.

Not all utility investments are in the mandatory category. Companies do have a certain amount of discretion in supplying new types of service, or in making cost-reducing replacement decisions. For example, companies may install cost-reducing equipment, and the returns on such investments might exceed the cost of capital. Such discretionary investments give rise to the "producer's surplus" shown as area C in Figure 5.[9]

If area B exceeds the sum of areas A and C, and if regulatory lags are long, then there will be an erosion, or attrition, in a utility company's rate of return on investment. This situation is likely to occur during periods when both capital equipment costs and service demands are growing. This combination of events has occurred in recent years, and it has contributed to the pattern of below-target rates of return shown above in Figure 3.

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[9]The distinctions made in this section are, of course, somewhat arbitrary--most investments are in fact part mandatory and part discretionary. For example, an electric company may have to provide power to a new subdivision, but the company may have discretion as to the manner in which the power is supplied. It might use steel poles for overhead distribution lines rather than wooden poles, but the initial investment cost would be higher for steel poles. The difference between the minimum cost system and the system actually used could be regarded as a discretionary investment. Obviously, the additional investment outlay should be offset by lower costs over the expected life of the system.

Combined Effects: Actual Rate of Return Versus Cost of Capital

The combination of rising operating costs, a higher cost of capital, mandatory investments, and regulatory lags has produced a substantial divergence between the cost of capital and the actual rate of return on total investment. Figure 6 illustrates this situation, which is realistic for most utility companies today.[10] In the graph as well as in the real world, rates of return on invested capital are well below the cost of capital.

Table 1 presents some figures taken from a study recently done at the University of Florida. On average, in 1972 electric companies earned 7.2 percent on invested capital. This was below the so-called allowed rate of return, which in turn was below the average cost of capital and subsequently below the cost of new capital.[11] This rate of return shortfall has existed for several years now, and it will probably continue in the future if inflation persists and if regulatory lags continue.

The Relationship Between Asset Growth Rates and Stock Prices

Whenever the actual rate of return is less than the cost of capital, asset growth results in declining stock prices. At the University of Florida, we recently developed a set of equations to show the precise effects of growth on stock prices under different conditions.[12] It turns out that a spiraling,

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[10] Some might argue that utility companies have, in the past, earned a rate of return in excess of their cost of capital, and that the deterioration in their rate of return versus cost of capital position has simply served to bring about a more equitable balance between the interests of stockholders and customers. Figure 6 could be modified to show this situation by dropping the cost of capital line below the actual rate of return line.

[11] Eugene F. Brigham and Richard H. Pettway, "Capital Budgeting in the Public Utility Sector," University of Florida, Public Utility Research Center, Working Paper No. 3-73, October 1973.

[12] Eugene F. Brigham and Thomas A. Bankston, "The Relationship Between a Utility Company's Market Price and Book Value," University of Florida, Public Utility Research Center, Working Paper No. 4-73, November 1973.

FIGURE 6. COMBINED EFFECT OF RISING COSTS, A RISING COST OF CAPITAL, AND REGULATORY LAG

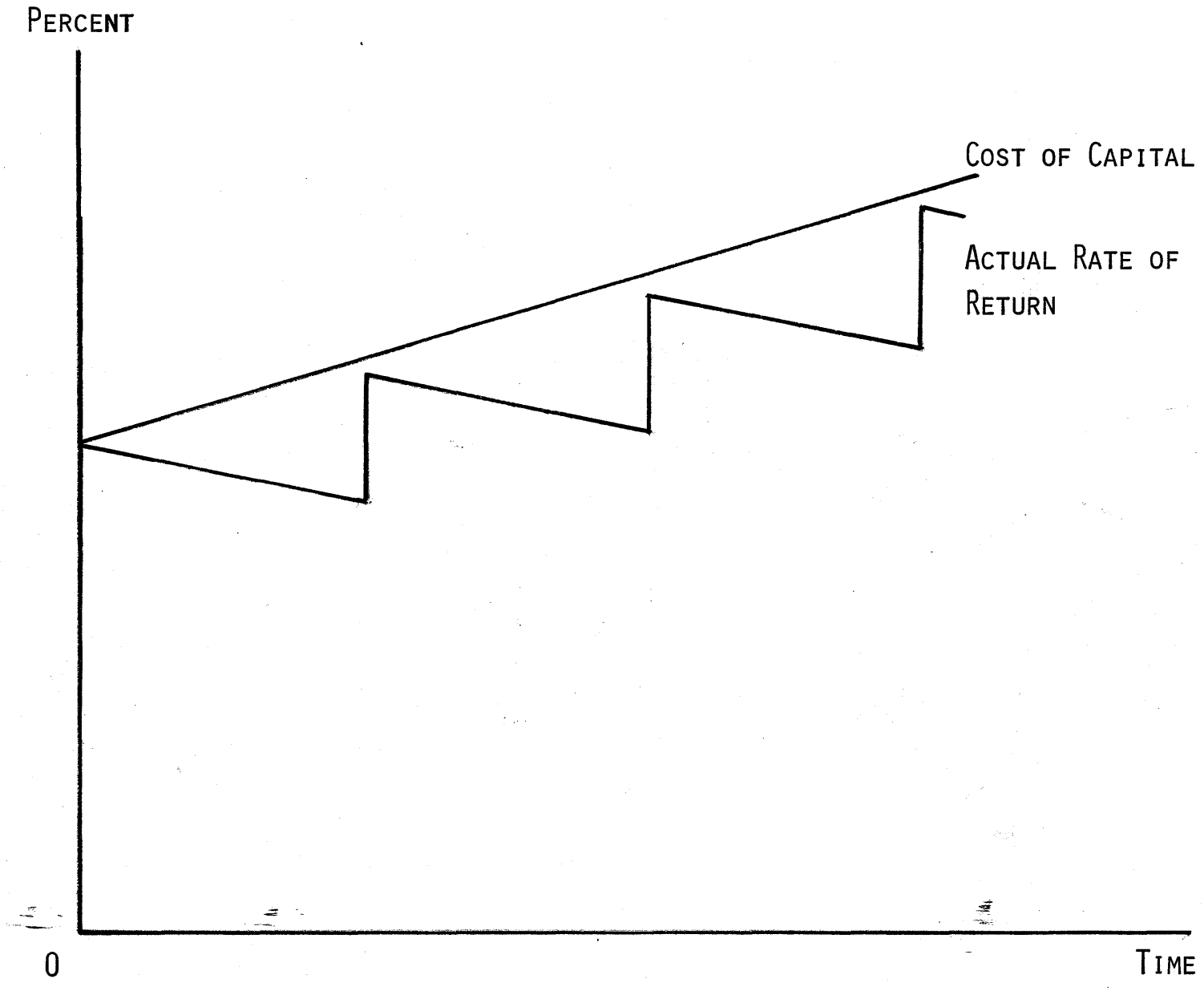

Table 1. COST OF CAPITAL, ALLOWED RATES OF RETURN, AND REALIZED RATES OF RETURN, ELECTRIC COMPANIES, 1972*

1.	Average After-Tax Current (or Marginal) Cost of Capital	9.3%
2.	Average After-Tax Embedded Cost of Capital	8.0%
3.	Allowed, or Target, Rate of Return as Prescribed by Regulatory Agencies	7.6%
4.	Current Actual Rate of Return on Investment	7.2%

*The cost of equity capital is defined as the rate of return on book equity that was authorized if a rate case was recently concluded, or the rate of return most likely to be allowed if a rate case were to be decided now. The problems encountered when attempting to measure the cost of equity are well known, and it is possible that Commission-determined costs of capital are seriously over- or understated. We have simply avoided this issue by accepting the Commission's estimates.

It should be noted that the figures given are returns on book equity, which may be different from investors' required rates of return on market values. For a discussion of this point, see the discussion of A. A. Robichek in the 1971 AT&T rate case (FCC Docket No. 19129) or E. F. Brigham in the 1972 Comsat rate case (FCC Docket No. 16070).

Also, it should be noted that different companies employ different rate base valuation methods (i.e., original cost vs. "fair value"), and different rates of return on these different rate bases are appropriate. Such differences were considered in the study upon which Table 1 is based.

Source: Eugene F. Brigham and Richard H. Pettway, "Capital Budgeting in the Public Utility Sector," University of Florida, Public Utility Research Center, Working Paper No. 3-73, October 1973.

snowball effect will set in if companies are forced to invest when the return on investment is less than the cost of capital. The rate of return shortfall drives stock prices down, and this requires companies to issue even more shares, which depresses prices still more, and so on. Depending on the severity of the rate of return shortfall, on the level of mandatory investments, and on how long it takes investors to see what is happening, a company can literally be driven to the point where it cannot obtain capital. Such a company could not meet regular service demands, much less make the types of innovative investments so vitally needed to overcome the current energy crisis.

The utility industry has not yet reached the point where firms are unable to finance, but this is a very real danger in the not-so-distant future. Investors' confidence has been seriously eroded, and it would not take much to destroy what confidence remains. If this financial situation develops, plants would not be maintained at desirable levels, and construction programs would be reduced, causing reserve ratios to decline further below the danger level. Obviously, service would deteriorate, and delays would be encountered when new customers seek hook-ups. All of this would lead to government intervention, and where we would go from there is anybody's guess.

WHAT CAN BE DONE TO ALLEVIATE THE PROBLEM?

Massive utility investments are required to meet our energy and communication needs, but the regulatory system is in danger of a breakdown that would prevent the companies from obtaining the capital necessary to undertake this investment. If this breakdown occurs, it would have all sorts of undesirable economic and social impacts. Thus, it is vitally important that actions be taken to correct the situation.

Rate Relief

The most obvious action is rate relief. Utility commissions across the

nation are aware of what is happening, and they should permit price increases that would get rates of return up to the levels necessary to attract capital. As it is, those companies having the most serious financial problems are postponing important projects, and they are also accepting less capital intensive alternatives, with lower initial costs, that will aggravate the long-run problems. It is difficult for commissions to raise rates at a time when inflation is on everyone's mind, but such action is badly needed. Inflation should be brought under control, but by monetary and fiscal actions, not by refusing to allow utilities rate increases to offset increases in their own costs.[13]

Tax Relief

Adequate rate relief would solve the companies' financial problem in the most efficient way, but such action depends to a large extent upon state regulators, some of whom move rather slowly. Accordingly, some type of federal action will probably be necessary. A stepped-up program of federal support for R & D is needed, but this will not help much in the short run. In the short run, tax relief in the form of special investment tax credits, and perhaps also expanded programs along the lines of the tax-exempt pollution control bonds authorized a few years ago, would seem appropriate.

CONCLUSION

In summary, the utility industry--the companies, regulators, customers, and suppliers--face a massive challenge both today and in the years ahead. The long-run solution to the problem lies in R & D, which should be undertaken jointly by companies, suppliers, and the federal government. However, if we are to make it to the long run, we must overcome some serious short-run problems, and over-

[13] Regulators should also take steps to eliminate or at least reduce the regulatory lag; procedures for lag reductions are well known to both companies and commissions, and such procedures should be put into effect.

coming these problems will involve large investment outlays. These outlays must be financed, and the necessary capital will be forthcoming if and only if utility companies are permitted to earn adequate returns. Adequate returns will require rate increases, and such increases are bound to be painful. However, the other alternative--a seriously weakened utility industry--would be far worse.