A COMPUTER SIMULATION ANALYSIS OF ALTERNATIVE METHODS OF ACCOUNTING FOR UTILITY CONSTRUCTION WORK IN PROGRESS

By

GORDON DOUGLAS QUICK

A DISSERTATION PRESENTED TO THE GRADUATE COUNCIL OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1974

This dissertation is dedicated to--

My parents, who have always given unselfishly,

and

Jeanelle, who means everything to me.

ACKNOWLEDGMENTS

I would like to thank the University of Florida and countless outstanding professors for making this dream a reality. There are many professors that provided instruction, stimulation, and friendship who cannot be named individually; to them I express my most sincere appreciation.

I am most grateful to the members of my supervisory committee, Dr. Eugene F. Brigham, Dr. Russ Fogler, Dr. Sanford Berg, Dr. Rick Jesse, and Dr. Milford Tysseland for their time and effort on my behalf. A most respectful and sincere special thanks is extended to Dr. Brigham, who as chairman provided the guidance, criticism, and encouragement necessary to the preparation of a dissertation.

The Public Utility Research Center and its members are gratefully acknowledged for their financial support and the facilities made available. I am indebted to Messrs. James Taggart and Dick Koble of the Tampa Electric Company for their most capable assistance in the developmental stages of the project.

I would like to thank Dr. Normal Keig who, perhaps unknowingly, has been so helpful. His frank opinions, advice, and friendship have been most rewarding.

A special note of thanks goes to Barbara Brown, for her excellent typing and her thoughtful assistance in so many ways.

My acknowledgments would be incomplete unless three other people are mentioned. To my parents I owe more than I can express. Were it not for their constant prompting and encouragement, understanding and support, I would not have aspired to, let alone achieved, this degree. Finally, and most important, is my wife, Jeanelle, who read drafts, edited, and helped in numerous other ways. Her greatest contribution, however, was her tolerance, understanding, and encouragement, not only in the preparation of the dissertation, but in the years before the dissertation was even considered.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF FIGURES

LIST OF FIGURES (CONTINUED)

Abstract of Dissertation Presented to the
Graduate Council of the University of Florida in Partial
Fulfillment of the Requirements for the Degree of
Doctor of Philosophy

A COMPUTER SIMULATION ANALYSIS OF
ALTERNATIVE METHODS OF ACCOUNTING
FOR UTILITY CONSTRUCTION WORK IN PROGRESS

By

Gordon Douglas Quick
December, 1974

Chairman: Eugene F. Brigham
Major Department: Management

Are the quality and stability of utilities' earnings significantly influenced by the choice of the construction accounting method? Are cash flows and coverage ratios affected by construction accounting? These and many related questions are being raised with increasing frequency. The purpose of this investigation was to examine the impact of several construction accounting methods in order to provide some of the information necessary to begin answering these and related questions. Hopefully, this information will help utilities and their regulators choose the "best" construction accounting method.

Under regulatory theory, service rates should be set at levels which allow investors a fair rate of return on the investment needed to

provide that service. The theory also states that if a part of the plant is not being used for the benefit of current customers, i.e., it is not currently "used and useful," then current customers should not be required to provide a return on this unused plant. Since plant under construction is not directly serving customers, it does not meet the used-and-useful rule. Yet, investors have funds tied up in construction programs, and both fairness and the need to acquire capital require that such funds earn competitive rates of return.

Several construction accounting methods were investigated, including two basic methods which represent the "polar cases" between which the results of the other cases lie. Under one of these basic methods (referred to as method RB), construction work in progress (CWIP) is included in the rate base and earns a rate of return equal to that earned on used and useful assets. Under the other basic method (referred to as method IDC), CWIP is excluded from the rate base, and to provide a fair return on CWIP, an imputed return (IDC) is calculated and reported as income. IDC income is not cash income, but a credit added to the cost of the asset and eventually recovered over the useful life of the asset.

Accounting practices almost always involve compromises; rarely is one method superior in all respects. Method IDC is clearly superior on theoretical grounds, but may have serious practical drawbacks. Method RB is not as theoretically appealing, but it has many practical advantages. To illustrate the long-run effects of the alternatives, a computer simulation model was developed and run for a wide range of assumptions and conditions. Some of the significant findings include the following:

1. In theory, method IDC avoids the need for current customers to pay the capital costs of assets under construction. Given real-world conditions of rela-

tively steady growth, this result may not hold in practice.

2. Method RB minimizes fluctuations in utility rates and, thus, may provide customers with the best information about future price trends.

3. Method RB has no IDC earnings and, thus, none of the undesirable implications of high IDC to earnings and IDC to dividends ratios.

4. Method RB produces higher cash flows and cash flows per share.

5. Method RB produces higher coverage ratios.

Several more general results are:

1. The more discontinuous the construction program, the greater is the fluctuation in all the variables for all the methods.

2. With a discontinuous construction program, the capitalization of IDC increases the fluctuation in all the variables such that the higher the IDC rate, the greater the fluctuation.

3. With respect to the differences found: a) the higher the growth rate, the greater the differences and b) the longer the average construction period, the greater the differences.

4. The results are more significant for some firms than for others. The higher the IDC to earnings ratio, the greater the differences are likely to be. For some firms, the differences will be quite substantial.

CHAPTER 1

INTRODUCTION

Is the quality of earnings of many utility companies comparable to the quality of earnings of nonregulated firms? Are utility companies' earnings subject to instability because of construction accounting? Are the cash flows and coverage ratios of the utilities affected by construction accounting? These are a sample of the questions which are being raised by financial analysts, academicians, regulators, and others concerning the construction accounting method currently used by most utilities. Although this method is generally regarded as the "theoretically correct" approach to providing a return on funds invested in construction, these questions are being raised with increasing frequency. While the investment community, utility managements, regulators, and others each have their own feelings regarding these questions, definite answers cannot be found. Furthermore, little has been done to evaluate alternatives to the traditional construction accounting method.

Fortunately, much of the criticism has been followed by the suggestion of alternative methods which may eliminate, or at least alleviate, some of these criticisms. Much of the attention has been directed toward one alternative which represents a sharp departure from the traditional procedures for accounting for construction. In theory, the method employed by most utilities and this often-mentioned alternative are the two basic approaches to providing a return on funds invested in construction. In practice, they represent two extremes along a continuum and, consequently, a number of alternative procedures have been suggested which lie between the two extremes. These intermediate alternatives are either derived from one of the two basic approaches or represent a combination of them.

Objective of the Study

The objective of this study is to examine alternative construction accounting methods for providing a return on public utility construction work in progress (CWIP). In light of the current criticisms of the construction accounting method most firms now use, four questions are posed which suggest a format for exploring these alternatives:

1. Do the alternatives result in differences with respect to certain variables?

2. If they exist, are the differences significant enough to be of concern?

3. Are these differences such that the cost of capital could be affected by the choice of the construction accounting method?

4. What impact will the complexities of utility regulation and the economic environment have upon the basic theoretical results?

This study is aimed primarily at answering the first two questions. To definitively answer the third would require an extensive empirical investigation; consequently, only a tentative answer to this question is offered. The final question could also be the subject of a separate investigation, and we merely offer some insights into this area based on the understanding of the alternatives developed in this study.

Although this is primarily a theoretical study rather than an empirical investigation, our primary concern is with the real-world implications of the alternatives for public utilities. Thus, a secondary objective of this study is to provide enough information to allow the reader to draw his own conclusions about the alternatives, depending on his environmental expectations at any point in time.

Scope of Interest

This study will examine the factors which cause differences between firms using different construction accounting treatments and the key variables which create these differences. Regulators, customers, and management will be concerned with these differences because they may influence the firm's cost of capital. Investors will be interested in the differences between firms because of the potential impact on the riskiness of the firm. The differences will be of concern to academicians inasmuch as different accounting treatments may alter the homogeneity of subgroups used for study.

Regulators

The monopolistic nature of the utility industry implies the absence of the competitive forces that tend to eliminate less than optimal construction accounting methods. Thus, regulatory bodies must thoroughly understand the impact of construction accounting practices on the firm. This is necessary to assure that investors are fairly compensated if risk differentials exist and that consumers are not required to pay for operating or financial inefficiencies.

Customers

The customer's desires are adequately expressed in terms of two objectives: 1) Other things being equal, the customer would like service provided at the lowest cost and 2) he would like rates established on an equitable basis. Unfortunately, these may be conflicting goals, with one being attainable only by partially sacrificing the other.

Management

Utility managements do not want to adopt practices which may create risk differentials and which may raise their cost of capital. This would place some managements at a disadvantage in the capital markets. Capital-intensive utility companies which require large sums for capital investment could experience serious problems in attracting capital.

Investors

Investors will be interested in whether significant differences exist between the construction accounting methods which might alter the riskiness of the firm. Such a risk differential would justify a difference in the rate of return allowed on equity funds. Hopefully, investors will better understand why differences occur, and this will assist them in making the proper assessment of the importance of these differences.

Academicians

Academicians are often in need of homogeneous samples for testing hypotheses about cost of capital and other variables. Different construction accounting methods may result in significant differences between the firms which would alter the comparability of the firms.

Plan of the Study

Chapter 2 is designed to provide the reader with a brief but fairly complete background to the problem of providing a return on CWIP. This is accomplished by examining the return on CWIP, briefly introducing and comparing the two basic alternatives, and by exploring some of the problems which have provided the impetus for this investigation.

In Chapter 3 the five alternatives are introduced and then explained in detail using a highly simplified model. By reviewing the results of this simplistic model and a slightly more realistic model, we see that these alternatives will result in differences with respect to certain variables. However, the simple models are not detailed enough for us to assess the magnitude of these differences. Thus, Chapter 4 describes a computer simulation model which provides enough realism to allow these magnitudes to be considered. This detailed explanation is necessary, since the model is the tool used to evaluate the alternatives, and the credibility of the model determines the credibility of the results.

Chapter 5 presents a detailed explanation of the results of the model and explains the causative factors affecting the variables. In addition to the basic results, several other cases are examined to provide a broader base from which conclusions may be drawn. The final chapter contains the summary and conclusions of Chapter 5, along with the implications of the findings.

CHAPTER 2

PROVIDING A RETURN ON CONSTRUCTION WORK IN PROGRESS

Providing a return on the funds invested in construction is nothing new in public utilities. Since the early 1900's, regulators in some jurisdictions have provided some form of compensation to investors for funds allocated to non-revenue producing construction activities. Why, then, has construction accounting recently become of interest to all those concerned with public utilities? Two factors have combined to create this current interest. However, before we examine these two factors, it is necessary to present some general background information concerning the return on construction work in progress (CWIP).

The Return on Construction Work in Progress

A brief discussion covering four topics will provide the necessary background concerning the return on CWIP. We first discuss the rationale for providing a return on CWIP and then describe it as consisting of two components, relating to the sources of capital used to finance construction. These components are then used in exploring the foundation of a return in regulatory history. Finally, we indicate why a separate provision for the return on CWIP is necessary.

Is a Return on Funds Allocated to Construction Warranted?

The primary justification for a return on CWIP is founded in basic economic theory. Throughout the construction period, funds are invested in assets which produce no current revenues. However, the individuals who supplied the funds must be compensated. There is an opportunity cost long recognized in economics which is based on the fact that these funds could have been otherwise invested in current revenue-producing activities. This foregone return should be recognized as a legitimate cost of converting capital into a productive asset. This cost is as valid as if funds were actually paid out to acquire the asset.

A commercial lender, such as a bank or savings and loan, that makes a construction loan charges interest during the construction period. The funds which utilities use for construction must be provided by someone, whether it be equity holders, bond holders, or banks. These investors must be compensated for providing these funds. Without this compensation these sources of funds will seek other revenue-producing investments.

Having established that compensation must be provided, it is useful to think of the return as consisting of two components, debt and equity. The following discussion of these components further supports the contention that compensation must be provided.

The Components of the Return on Funds Invested in CWIP

Debt Component. There is little controversy surrounding the debt component of the return on CWIP. This is because out-of-pocket cash expenditures result from the contractual interest on borrowed funds and, perhaps, the dividends on preferred stock. These are real obligations which the company must meet as a result of some of the sources of capital used during construction.

Equity Component. Some feel that a real distinction should be made between the debt and equity components.[1] With debt there is a contractual obligation, while with equity no such contractual obligation exists. The equity component is merely an "imputed" return to common equity funds and some have questioned the legitimacy of "creating" such a return.

This practice is not as questionable as it may first appear. Rarely, if ever, can debt be obtained without some form of collateral to guarantee repayment of the loan. In a going concern, the "collateral" is provided by the equity holders. In the event of default or business failure, the bond holders are paid in full before the equity holders are even considered. In addition to providing some of the capital, equity holders bear nearly all of the risks of construction. Without the equity holders to assume the risks, debt capital would not be available. It seems obvious that equity holders must also receive fair compensation.

The preceding discussions have illustrated the need for a return on CWIP. Initially, regulatory agencies allowed only a return on the debt component. The following discussion indicates that some provision for the equity component has been allowed by most regulators only in the last 30 years.

The Foundation of a Return in Regulatory History[2]

In 1909 uniform accounting systems for electric and gas utilities

---

[1]For example, see John H. Bickley, "Can Construction Create Income and Profit?", Public Utilities Fortnightly, Vol. 88, No. 2 (July 22, 1971), pp. 32-33.

[2]Litke, Arthur L., "Allowance for Funds Used During Construction," Public Utilities Fortnightly, Vol. 90, No. 7 (September 28, 1972), pp. 21-22.

were adopted in New York and Wisconsin. Both systems provided for capitalizing interest paid on debt attributable to CWIP. However, until 1914 no provision was made for the equity component of CWIP. At that time the Interstate Commerce Commission first released the Uniform System of Accounts for Steam Railroads. In 1922 the state regulatory commissions, through the National Association of Railroad and Utilities Commissioners and in cooperation with the utilities, developed a classification of accounts which recognized an allowance for both debt and equity capital devoted to construction. Also in 1922, the Federal Power Commission (FPC) prescribed an accounting system which provided for an allowance for both debt and equity components. Similar provisions were made in the system of accounts adopted in 1936 by the FPC for electric utilities and in 1939 for gas companies.

The relatively late acceptance of a return on CWIP is perhaps part of the reason why a separate provision for the return is necessary. The following discussion will briefly discuss why funds invested in CWIP are not compensated directly, thus forcing regulators to use another method to compensate investors for funds allocated to CWIP.

Why a Separate Provision for the Return on CWIP is Necessary

Because of the monopolistic nature of the industry, utilities are regulated by public authorities. These regulators govern the prices utilities may charge for their services, thereby regulating the profit, within limits, which utilities may earn. Historically, regulators have used the net amount of plant currently in service as an indicator of the funds "prudently" invested. These "used and useful" assets are designated as the base upon which investors are entitled to a return. The regulators also specify a rate of return which the utility company may earn on the base. The "fair rate of return" and the "rate base" are then used to determine the rates utility companies may charge and, consequently, the profits they earn. By definition, "used and useful" plant excludes plant under construction. Therefore, the funds devoted to construction are not being offered any return. If a return is to be provided on CWIP, some other allowance must be made.

The Increasing Interest in Construction Accounting

Having provided the reader with some background concerning the return on CWIP, we can now explore the reasons construction accounting has generated so much interest in the last several years. There are essentially two reasons: 1) The return on construction has become a significant component of the total earnings of many utilities and 2) the method currently used by most utilities has apparently created some problems. Each factor considered individually would not present a problem for utilities. The problems resulting from the construction accounting method used by most firms have always existed. However, as the size of the return on construction increases relative to the total earnings of the firm, the resulting problems become increasingly significant. As the following discussion reveals, the return on CWIP has become an increasingly large proportion of the total earnings of utilities.

The Increasing Significance of the Return on CWIP Relative to Total Earnings

The ratio of the return on CWIP to total earnings is directly related to the bases upon which these earnings are computed; that is, the ratio CWIP to total assets. If CWIP is large relative to total assets, then the return on CWIP is large relative to the total earnings of the firm. While aggregate statistics on CWIP as a percentage of total assets are not currently available, there is every reason to believe that the percentage has been increasing in recent years, and that this increase will continue in years ahead.

The size of CWIP relative to total investment depends primarily upon two factors: 1) the annual investment in construction relative to total assets and 2) the average length of the construction period. Suppose annual construction expenditures are 5 percent of net assets, and the construction period is one year. In this case CWIP will represent about 5 percent of total assets and the income from CWIP will be about 5 percent of total income.

Now suppose increased demand, stepped up environmentally-related expenditures, and inflation combine to double investment as a percent of net assets, to 10 percent. If the construction period remains constant, then CWIP as a percent of total assets will double, as will CWIP income. However, if the construction period also doubles, to two years, the combined effect will be a four-fold increase in CWIP, and income from CWIP will increase from 5 to 20 percent of total income. Thus, CWIP and its related income increase exponentially with increases in construction expenditures and in the length of the construction period.

Construction expenditures have increased dramatically in recent years; for the electric companies, construction expenditures as a percent of net assets rose from about 7 percent in 1962 to almost 14 percent in 1972.[3] In view of the fact that the industry's reserve ratio was lower

[3]These percentages are based on 104 electric companies listed on the S&P Compustat tapes.

at the end than at the beginning of the period, the forecast of much higher environmentally-related expenditures, plant modifications made necessary by the energy crisis, and so on, it seems safe to assume that construction expenditures as a percent of net assets will remain high if not actually continue to rise.

We have no aggregate statistics on the length of the construction period, but from all reports this period has risen dramatically and will continue to rise. The construction period for distribution facilities has increased significantly, largely because of a trend toward underground lines. Nuclear plants represent an increasing percentage of generation expenditures, and these plants have very long construction periods. Fossil fuel plants today are larger than in the past, and larger plants take longer to build. Both increased plant sizes and environmental considerations are causing plants to be located further from power users, and this factor and the trend toward interties has caused an increase in transmission construction. Finally, and probably most important of all, is the shift in construction expenditures from distribution to generation:[4]

Percentage of construction budget devoted to:	1962	1971
Generation	35%	56%
Transmission	24	21
Distribution	41	23
	100%	100%

Since generating plants take much longer to construct than transmission lines and distribution facilities, this shift in the construction budget,

[4]Source: Statistical Year Book, Edison Electric Institute, 1972, p. 59.

even without the changes in the individual construction categories, would have lengthened the construction period appreciably. When all factors are combined, it would be easy to visualize a doubling or even tripling of the average construction period.

As noted earlier, direct evidence on the trend in the ratio of CWIP to total assets is not currently available. However, the evidence presented indicates that the primary determinants of this ratio, construction expenditures as a percentage of total assets and the length of the construction period, have both increased substantially. As a result, it seems clear that the ratio CWIP to total assets must have risen dramatically. And as the CWIP/assets ratio rises, so must the ratio of CWIP income to total income.

If CWIP is excluded from the rate base, and IDC[5] is computed and used as compensation for funds invested in CWIP, then the ratio of IDC to operating income provides a direct measure of the increasing importance of construction accounting. The average ratio of IDC to earnings for the electric companies for the period 1964 to 1972 is shown in Table 1. These figures also suggest that the importance of construction accounting has increased markedly in recent years.

These facts have demonstrated that the return on CWIP has become an increasingly significant component of the total earnings of utilities. If the construction accounting method used by most utilities produced satisfactory results, there would still be little interest in construction accounting. However, this widely-used method has some shortcomings, and as the return on CWIP becomes more important relative to the total

[5] A formal explanation of IDC is provided later, but at this point it is sufficient to say that IDC is the return on CWIP.

TABLE 1

RATIO OF IDC TO EARNINGS BASED ON 114 ELECTRIC COMPANIES

Year	IDC/Earnings
1964	4.03%
1965	4.09
1966	5.15
1967	7.17
1968	10.00
1969	14.14
1970	19.64
1971	25.03
1972	29.28

Source: S&P Compustat tapes.

earnings of the firm, the shortcomings of this method become much more noticeable. But before we can explore these problems, it is necessary to explain the construction accounting procedure used by most firms. Thus, the next section provides a brief introduction and comparison of the basic methods for providing a return on CWIP.

Providing a Return on CWIP

There are three basic ways a return on CWIP may be recognized. The first method would be to allow a rate of return higher than would normally be allowed, after the plant has been placed in service. The second way would be to allow a return currently, by including CWIP in the rate base as the investment in CWIP is made. The third method would be to allow the return to be capitalized during the construction period, with it being included as part of plant cost when computing allowable depreciation and as part of the rate base in future rate determinations.

The first method would require the determination of an increment to the normally allowed rate of return. This higher return would be maintained until adequate to provide a return on funds invested during construction. The objective is simply to allow a higher return in the future; the increment would presumably be equivalent to the return foregone during the construction period, adjusted for the time value of money. While this is a feasible alternative, it has rarely been suggested for use by regulated companies. As a result, a detailed proposal of this nature is not available. Thus, this method is excluded from further consideration in this study.

The second method has been advocated quite frequently. By including the costs of construction in the current rate base, investors immediately receive full fair compensation on funds allocated to construction.[6] The rate of return provided on assets "used and useful" is also provided on CWIP.

The third method is the one most commonly used today. This method provides for an immediate return, in the form of a credit, which may or may not represent a full fair return to investors. Whether or not it does depends on the rate at which the return is to be calculated. This return is also a part of the cost of the asset, which is eventually recovered through depreciation.

Thus, we are left with two basic procedures for providing a return on CWIP. These two procedures are briefly explained and compared in the discussions which follow.

Method One: Include CWIP in the Rate Base

This method is the easier of the two remaining basic methods to

[6]This assumes, of course, that the currently allowed rate of return is equitable.

understand. CWIP is included in the "rate base" which is used by regulators to determine the rates necessary to provide a "fair rate of return" to investors. The same rate of return allowed on "used and useful" assets is also allowed on CWIP. To the extent that the fair rate of return is adequate, investors are fully compensated for their investment in CWIP. Under this method, current customers bear the capital costs of construction. Under current regulatory interpretations, this could be justified if CWIP could be defined as "used and useful." Defining CWIP as "used and useful" would be possible if the construction were: 1) to lower operating costs, 2) to provide assurance of continued service, or 3) to meet expanded needs of old customers. Making the current rate payer bear the costs of capital would appear to be unjustified if the construction were primarily to meet the needs of new customers. It can be argued that current rate payers should not have to pay for assets which will be "used and useful" to others in the future. This is often countered by noting that construction is seldom for entry into completely new areas previously without service. New construction is mainly to replace or upgrade service in existing areas. Then, it is argued, there is little distinction between present and future customers. This argument must assume that people do not move, which is clearly an invalid assumption. However, a short construction period will minimize the problem since the return would be small.

The question of shifting the burden is an important consideration where CWIP is included in the rate base. To avoid this problem, the capital costs of construction may be capitalized so that payment of these costs is deferred to future periods. This is the essence of the other basic approach to providing a return on CWIP.

Method Two: Capitalize the Return on CWIP

As an alternative to the previous method, CWIP could be segregated and excluded from the rate base. In this way current customers will be charged only for the investment in plant currently in service. To meet the obligation to investors, a return could be calculated at some rate (probably the "fair rate") and this amount would be capitalized. This return is commonly referred to under this method as "interest during construction," or IDC.[7] The essence of this approach is as follows. First, the amount of funds invested in CWIP must be determined. Then the return, or IDC, is computed as the product of CWIP and the rate of return allowed on CWIP. This return is then credited to income on the income statement.[8] In addition, at the end of the period IDC is added to the cost of construction (CWIP). Therefore, when construction is completed and the asset is included in the rate base, the total cost of the asset exceeds the actual dollar outlay by the amount of IDC accumulated over the construction period. The total cost of the asset (including IDC) is finally depreciated over its useful life. Obviously, the total cost of the asset, or book value, is greater under this method than when CWIP goes directly into the rate base.[9]

[7]The term "interest" in IDC is unfortunate and has created numerous misconceptions about IDC. A more descriptively appropriate term is "allowance for funds used during construction," or AFDC. "Interest" implies that the construction program is debt financed; in reality, it is financed by the same debt-equity mix as the "used and useful" plant.

[8]Two methods have been employed in the past to account for IDC. One is to add (credit) IDC to income as mentioned above. The other is to use the interest credit to reduce the interest expense. The net result, in terms of earnings, is the same.

[9]The cost of the asset, including IDC, is presumably close to what it would be if the asset was purchased on a "turn-key" basis. Here the

A Comparison of the Two Basic Methods

In comparing these two methods we will examine the effect of each on three key variables: 1) the size of the rate base, 2) customer charges (revenues), and 3) investors' returns. This comparison is provided to begin to familiarize the reader with the basic construction accounting methods which are fully developed in the next chapter.

The rate base. Given the same initial plant, then during the construction period the rate base will be higher for the method which includes CWIP in the rate base (hereafter the rate base method is referred to as method RB). This is because this method includes CWIP in the rate base as soon as the funds are used in construction. Conversely, where IDC is capitalized (hereafter referred to as method IDC), no costs relating to construction are included in the rate base during the construction period. Therefore, for method IDC, the rate base will be lower by the amount of CWIP throughout the construction period. The situation is reversed once construction is completed and the asset is placed in service. For method RB, there is no change in the rate base. But for method IDC, the total amount of CWIP, which includes accumulated IDC, is now included in the rate base. Therefore, for the period following construction and until the asset is fully depreciated, the rate base will be larger for method IDC. The difference will always be the net amount of accumulated IDC.

---

contractor would add a profit, as well as a cost of debt used during the construction period, that would be roughly equivalent to IDC.

Customer charges (revenues). The cost to the customer is determined, in part, by multiplying the rate base by the allowed rate of return. Since the rate base is higher when CWIP is included in it, customer charges will also be higher during the construction period for method RB. Once the asset goes "on line," customer charges will be higher for method IDC, in direct proportion to the amount of IDC included in CWIP. From this we see that current customers bear part of the asset cost under method RB, while future customers pay the full cost under method IDC.

Investors' returns. Investors will be fairly compensated by either method as long as these methods are handled properly.[10] Using method RB, investors receive an immediate return at a rate identical to the fair rate of return on funds invested in "used and useful" assets. Under method IDC, investors receive a deferred return, or credit, at the rate specified for calculating IDC. If this rate is equal to the fair rate of return, the compensation under both methods is the same.

Table 2 presents a summary of the comparison and is sufficient to illustrate that significant differences exist between the two basic methods of providing a return on CWIP. We shall now explore the usage of these methods by regulated and nonregulated firms.

Use of the Two Basic Methods

This section explores the available data on the actual usage of the

[10] "As long as these methods are handled properly" is a critical qualification which may not be met in the real world. In later chapters we discuss some of the implications when this qualification does not hold.

TABLE 2

SUMMARY COMPARISON OF METHODS RB AND IDC

	RB	IDC
Include CWIP in the rate base during construction	Yes	No
Capital costs borne by	Present customers	Those who benefit from the asset
The rate of return on CWIP is equal to	Rate of return on the rate base	The IDC rate

basic methods of providing a return on CWIP by regulated firms. Unfortunately, complete and timely data are not readily available. However, these data provide some idea of the relative use of the two methods.

A study by Goodbody and Company in 1964 indicated that approximately 90 percent of the gas and electric utility companies in this country use method IDC.[11] Another study by Haskins and Sells found similar results: Of a group of 138 gas and electric companies with revenues in excess of $20 million each, 124 companies, or 89.9 percent, capitalized interest during construction in 1963 and 1964.[12] After a detailed examination of reports filed by 212 electric utilities with the Federal Power Commission in 1966, another writer reported that 171, or 80.7 percent, of these companies capitalized IDC, while 41 did not.[13] In 1968, of these same

[11]Sayad, Homer E., "An Accountant Looks at Capitalized Interest," Haskins and Sells--Selected Papers, 1966, p. 122.

[12]Ibid.

[13]Morris, Everett L., "Capitalization of Interest on Construction: Time for Reappraisal?", Public Utilities Fortnightly, Vol. 87, No. 5 (March 4, 1971), p. 24.

212 companies, the number which capitalized IDC had increased to 174, or 82.1%.

These studies indicate that the large majority of utility companies follow method IDC. None of the studies reported mentioned how many companies followed method RB; most of those which did not capitalize IDC apparently did not make any provision for a return on CWIP. Presumably most of these are smaller companies which do not have substantial construction programs. However, a few may have used method RB.

It is interesting to contrast these findings with similar statistics on industrial companies. Of a sample of 77 companies from Fortune's 500, 61 responded and not one reported any capitalized interest in 1968.[14] The accounting procedures applicable to nonregulated firms do not permit an investment to generate a reported profit, so this finding is not surprising. Industrial companies can adjust prices, hence rates of return, within the limits of the free market, to compensate investors for funds employed during construction. Because of the restrictions imposed on regulated firms, they cannot adjust prices and rates of return to recoup the return foregone during construction. Consequently, regulated firms are permitted to capitalize the return and report it as profit.

Problems Encountered in Providing a Return on CWIP

Among utility companies, IDC is the most widely used method for providing a return on CWIP. Unfortunately, the use of IDC is beset with several problems, some concerning implementation and others relating to the firm's performance. There are three problems in implementing method

[14] Ibid.

IDC which are best expressed as questions: 1) What is the proper rate of return on CWIP?, 2) What is the proper base for computing IDC?, and 3) Are the goals of financial reporting helped or hindered by the use of method IDC? While these problems have arisen primarily in connection with the use of IDC, when appropriate we also briefly indicate how method RB compares with regard to each issue.

<u>What is the Proper Rate of Return on CWIP?</u>

As a practical matter, determining a specific rate of return on CWIP is difficult enough even if the theoretical rate is agreed upon, and although the IDC method has been in use for many years, no agreement has been reached on what the theoretical rate of return on CWIP should be. This issue must be resolved before a comprehensive, final evaluation of the methods can be achieved.

Arguments have been made in favor of a rate as low as the after-tax cost of short-term debt up to a rate as high as the current (or marginal) weighted cost of capital. Since all funds have a cost, the lower limit is set by the least expensive source of funds. This lower limit can generally be regarded as the after-tax cost of short-term debt. Conversely, equity is usually the most expensive source of funds, and equity is fully taxable. Since common equity holders assume most of the risks of construction, they must also be compensated. In general, most people argue for a rate which is a weighted average of the after-tax cost of debt and the equity rate.[15]

Method RB does not require the specification of a separate rate of

[15]Discussion of a more specific rate of return on CWIP is deferred to the next chapter.

return on CWIP since CWIP is included in the rate base and earns the same rate as funds invested in "used and useful" plant.

What is the Proper Base for Computing IDC?

This issue is related to the previous discussion in that they both affect the compensation investors receive on CWIP. Logically, it would appear that all construction investment not included in the rate base should be included in the base for computing IDC. However, this is not always the case. IDC is generally computed only on projects which extend over a specified period of time (e.g. a month) or exceed a certain dollar amount. If a large number of projects do not meet these specifications, a significant amount of CWIP will not earn a return.

Are the Goals of Financial Reporting Helped or Hindered by the Use of Method IDC?

The accounting procedures currently specified by regulatory agencies fail to separate the impact of construction activities from the operating results of the company.[16] This makes it difficult to assess the operating results of the company apart from its construction activities. The separation of utility and construction results is even less clear under method RB than under method IDC.

Another accounting principle, matching costs and revenues, is accomplished through the use of method IDC but not RB. Under the IDC method, the capital costs of construction (IDC) are deferred until the plant is placed in service and revenues to offset these costs are being gener-

[16]Frazer, R. E. and R. C. Ranson, "Is Interest During Construction 'Funny Money'?", Public Utilities Fortnightly, Vol. 90, No. 13 (December 21, 1972), pp. 23-27.

ated. Method RB would not satisfy this requirement, since the capital costs of construction are paid out of current revenues and are not derived from the plant under construction.

Concerning the performance of utility companies, four areas have been mentioned where problems might exist: 1) cash flows, 2) times-interest-earned ratios, 3) earnings instability, and 4) the quality of earnings. Although the implementation problems are quite important, they are not as amenable to objective evaluation as are utility performance measures. Thus, this study is more concerned with the problem areas which can be explored objectively. Although these problems have also arisen primarily from the use of method IDC, we again provide some comments, where appropriate, about the impact of method RB on these problem areas.

Reduced Cash Flows

During periods of large, sustained construction activity, a cash flow problem may develop. This is caused by a number of related factors, the primary one being that IDC is non-cash income. When dividends are paid based on total earnings (including IDC credits), the size of the dividend and thus the cash outflow are larger because of IDC. There is not a corresponding inflow of cash from IDC to offset the outflow. In addition, construction itself results in increased cash expenditures. Finally, increased interest payments result in reduced taxes, which in turn cause operating income to be overstated.[17] To avoid this overstatement, utility rates might be reduced, further reducing cash flow.

[17] A more thorough discussion of this syndrome is provided in the next chapter.

As a consequence of these factors, cash flow is reduced more by construction programs if the IDC method is used. When projects go "on line," full revenues are generated (given adequate demand) and cash flow is increased. Under method RB, operating revenues are provided on both "used and useful" plant and CWIP, and the result is that the cash flow problem is eased.

Lower Times-Interest-Earned Ratios

Since IDC earnings are "imputed" credits which do not result in cash inflows, they are frequently excluded when computing coverage ratios on bond interest. If these ratios become too low, the utility's bonds may be downgraded, and this would raise the rates for future bond issues, thus raising the overall cost of capital to the company.

The use of method RB will not result in a similar interest coverage problem. Provided rates are set at the appropriate levels, full cash revenues are generated on CWIP investment causing no reduction in fixed charge coverage ratios.[18]

Earnings Instability[19]

Financial analysts are particularly concerned over the potential instability of earnings when IDC is capitalized. Earnings instability may occur because IDC credits boost reported earnings as long as CWIP exists,

[18]However, lags or other problems may prevent rates from being set at the appropriate levels resulting in a fixed charge coverage problem similar to that encountered when using method IDC.

[19]For a good discussion of impact of earnings instability on the firm, see Richard Schramm and Roger Sherman, "Profit Risk Management and the Theory of the Firm," Southern Economic Journal, Vol. 40, No. 3 (January 1974), pp. 354-357.

but when the project is completed and IDC is no longer being earned, earnings fall until demand is sufficient to provide full use of the new plant. If demand builds up slowly, as often occurs, sufficient revenues will not be generated immediately to offset the loss of IDC credits. Earnings could be maintained through a rate increase, but this is unlikely if demand is expected to rise enough to provide adequate returns in the future, and in any event, lags will be encountered. The problem can become quite severe if construction is discontinuous or "lumpy." On the other hand, this problem does not exist if new construction projects, and thus IDC credits, arise continually.

Method RB may result in a different earnings instability problem. Under this method, CWIP is included immediately in the rate base. With significant amounts of investment in construction, the rate base will increase to the point where the earnings from current operations are no longer sufficient to provide a fair return on the rate base (including CWIP). To generate a fair return from the existing operating base, customer rates may have to be increased. After construction is complete and the plant goes "on line," earnings will increase since the operating base is larger and demand is growing. Since the rate base does not increase when the plant goes "on line," the increased revenues from growing demand provide a return in excess of the fair return. This necessitates a reduction in customer rates. This procedure will produce a rise in earnings when demand is constant and reduction in earnings when demand is expanding. Again, this potential instability problem will be minimal if the construction program is stable and continuous.

Whether or not an instability problem will occur depends upon a number of other factors, including the pattern of growth in demand and economies of scale. It is quite possible that the pattern of demand growth could differ from firm to firm. As a result, one firm could have an earnings instability problem while another, using the same construction accounting method, may not. For example, if demand grew at a pace identical to the growth in investment, revenues would grow at a rate sufficient to provide a fairly constant return on investment, using method RB. The same could be true depending on the economies of scale the firm achieves during expansion.

Reduced Quality of Earnings

Some have argued that the quality of earnings when IDC is capitalized is inferior to that of companies with no IDC credits. The reasons for this assertion include several of the issues previously discussed, such as cash flow or earnings instability. But the real criticism is directed primarily at the fact that IDC earnings are merely "imputed" credits. These credits are claims to future revenues and as such are not as highly regarded by investors and analysts as are operating revenues. There is no absolute guarantee, even with regulated industries, that future revenues will be generated. The railroad industry provides the best example of this fact.

Several statistics reflect the severity of this problem and indicate why analysts are questioning the quality of the earnings of many utility companies. Table 3 presents figures on privately owned electric utilities that report to the Federal Power Commission (FPC). Between 1965 and 1971, net income increased 49 percent ($2.6 billion to $3.8 billion). During this same period, capitalized interest increased 863 percent ($93.7 million to $808.8 million). In other words, 57 percent ($715.1 million) of

TABLE 3

NET INCOME AND INTEREST CAPITALIZED FOR PRIVATE OWNED ELECTRIC UTILITY INDUSTRY 1965-1971*
($ Millions)

		Interest Capitalized	
Year	Reported Net Income	Amount	% Net Income
1965	2,580.7	93.7	3.6
1966	2,749.1	127.5	4.6
1967	2,908.3	186.3	6.4
1968	2,995.5	274.7	9.2
1969	3,196.0	402.9	12.6
1970	3,407.5	588.4	17.3
1971	3,842.7	808.8	21.0

*Source: Based on E. L. Morris, "The Interest on Construction Dilemma--A Proposed Solution," Investment Dealers' Digest--Public Utility Survey, Section Two, Vol. 38 (August 29, 1972), p. 20.

the $1.262 billion increase in net income was attributable to capitalized interest. While reported earnings grew at an annual compound rate of 7 percent, the rate was only 3.2 percent when capitalized interest is excluded.[20] Looking at another set of data, this same result can be viewed in another way. Table 1, presented earlier, listed the aggregate IDC/earnings ratios of 114 companies listed on the Standard and Poor Compustat tapes. Between 1964 and 1972 the ratio of IDC to earnings rose continuously from 4 percent to over 29 percent. Thus, in the aggregate,

[20] Morris, Everett L., "The Interest on Construction Dilemma--A Proposed Solution," Investment Dealers' Digest--Public Utility Survey, Section Two, Vol. 38 (August 29, 1972), p. 20.

capitalized IDC has become a very significant part of the utility industry's total reported earnings.

The problem is even more severe for many individual companies. Table 4 shows the percentage of earnings per share represented for 20 selected companies. The portion of earnings represented by IDC credits ranges from 17 percent all the way up to 60 percent. And the situation continues to worsen as indicated by the increase in the average IDC to

TABLE 4

RELATIONSHIP OF INTEREST DURING CONSTRUCTION TO EARNINGS AND DIVIDENDS FOR SELECTED UTILITY COMPANIES IN 1970*

	A	B	C	D	E	F
	Earnings Per Share				Dividends as a % of Column B	
Company	Interest During Const. (IDC) Income	All Other (non-IDC) Income	Total Net Income	Column A as a % of Column C	Common	Preferred
No. 1	$.82	$1.48	$2.30	36%	116%	115%
2	.81	.75	1.56	52	198	166
3	.24	1.14	1.38	17	142	134
4	.74	1.68	2.42	31	105	104
5	.80	2.15	2.95	27	102	102
6	.57	1.73	2.30	25	104	103
7	.50	1.65	2.15	23	96	98
8	.95	.62	1.57	60	225	173
9	.86	1.26	2.12	41	129	123
10	.56	1.27	1.83	31	125	125
11	.34	.97	1.31	26	90	95
12	.30	1.18	1.48	20	93	94
13	.48	.68	1.16	41	140	130
14	.70	1.71	2.41	29	99	99
15	.33	1.34	1.67	20	95	96
16	.67	1.30	1.97	34	123	117
17	.57	1.27	1.84	31	130	125
18	.42	1.87	2.29	18	106	105
19	.38	1.11	1.49	26	103	102
20	.68	1.32	2.00	34	97	97

*Source: Based on Richard Walker, "The Capital Cost of Utility Construction," <u>Arthur Andersen Chronicle</u>, Vol. 31, No. 4 (September 1971), p. 34.

earnings ratio for the industry.

These non-cash earnings may also cause firms to be unable to meet their preferred and common stock dividends. Although earnings per share (EPS) are unaffected by IDC,[21] more shares of stock will be outstanding when construction is partially equity financed. In addition, part of the earnings are now in the form of IDC credits. Companies may find that they are unable to earn adequate cash income from operating revenues to cover the payment of cash dividends on preferred and common stock. This could seriously impair the ability of these companies to raise sufficient capital for construction to satisfy public demand. The severity of this problem is illustrated by columns E and F of Table 4 above.

For these reasons, investors may value IDC earnings, and the value of the company in general, less highly than when IDC credits are not present. To the extent that this is true, a company with large IDC credits will have to offer a higher return on its common equity to have securities as attractive as those of firms which do not capitalize IDC. This results in a higher overall cost of capital and, thus, higher costs for consumers.

Issues Relating to Method RB

There are also several issues relating to method RB which are important and should be considered. One writer has argued that since we are currently facing increasing costs in the production of utility services,

---

[21]The impact of IDC on EPS is often misunderstood. For a thorough discussion of this subject, see R. E. Frazer and R. C. Ranson, "Is Interest During Construction 'Funny Money'?", Public Utilities Fortnightly, Vol. 90, No. 13 (December 21, 1972), pp. 20-27.

using method RB is preferable because it results in higher prices initially.[22] These higher prices more accurately reflect the current trend which may serve as a signal to consumers who can plan their expenditures accordingly.

Method RB includes CWIP in the rate base as investments are made. If these investments are being made continually throughout the construction period, which is usually the case, the rate base changes continually. A changing rate base may require changing utility rates if a fair return on CWIP is to be assured. This would require a rapid rate adjustment process. With the usual regulatory lag, the actual compensation ultimately received by investors may be insufficient.

Finally, with method RB, rates may increase at a time when no new services are being provided. Given the political nature of regulation, raising rates as this method requires may be difficult. With the increasing costs of construction and the lengthening construction periods faced by most utilities, this problem could be severe.

Summary

This chapter has provided a brief but fairly complete introduction to the issues involved in providing a return on CWIP. Two conclusions were reached early in the discussion. First, it was shown that investors must be compensated for funds allocated to CWIP. Second, current regulatory procedures require that the provision of a return on CWIP must be considered separately. We also discussed the reasons construction ac-

---

[22]Olson, Charles E., "Interest Charged Construction: Economic, Financial, and Regulatory Aspects," Public Utilities Fortnightly, Vol. 88, No. 4 (August 19, 1971), pp. 31-32.

counting has generated so much interest in recent years. We then examined the two basic construction accounting methods which form the basis for the evaluation presented in later chapters. The final section introduced a number of problems which have evolved mainly from the use of capitalized IDC. These problems are important in that they provide some framework around which the alternatives are evaluated. Subsequent chapters explore these issues more thoroughly and further define the specific alternatives for providing a return on CWIP.

CHAPTER 3

THE PROTOTYPE FIRMS

Chapter 2 introduced the two basic methods for providing a return on construction work in progress (CWIP). By altering and combining these two basic methods, several additional methods for providing a return on CWIP are available. These alternatives require different accounting procedures which are explained in considerable detail using a simplified set of assumptions. Once the reader has become familiar with the alternatives, a more complex model is developed, and the results of both models are examined. These limited results are sufficient to demonstrate that the different alternatives will produce different results.

Depreciation policy also influences many of the variables which are examined in the analysis of the firms. Thus, we also differentiate between straight line depreciation accounting and two procedures for handling accelerated depreciation. In effect, 15 prototype firms are established which are analyzed in subsequent chapters.

Derivation of the Alternative Firms

A number of suggestions have been made which represent variations on the two basic methods. Figure 1 illustrates the derivation of six alternative firms from the two basic methods and the mnemonic symbols that will be used when referring to each of the firms.[1] The derivation of these firms is presented below.

---

[1]It seems most useful to think of a number of similar firms which differ only in the method chosen for handling the return on CWIP. Thus, rather than speak of alternative methods for providing a return on CWIP, we shall speak of alternative firms which employ these methods.

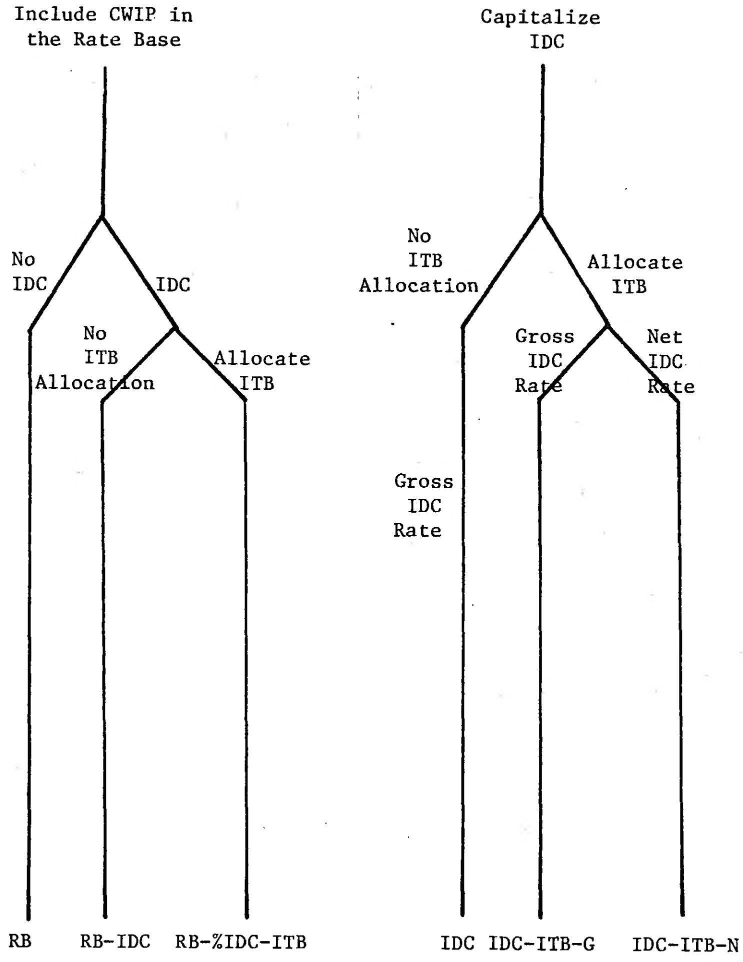

FIGURE 1

DERIVATION OF ALTERNATIVE FIRMS

Firm RB

Firm RB employs one of the two basic methods for providing a return on CWIP. This firm includes the full amount of CWIP in the rate base and, therefore, theoretically earns the same rate of return on CWIP as is earned on used and useful assets. There is no capitalization of IDC, and, thus, only the actual dollar investments are included in CWIP and, eventually, the rate base.

Firm RB-IDC

Like Firm RB, Firm RB-IDC includes CWIP in the rate base and earns a rate of return on CWIP equivalent to the rate of return on used and useful assets. However, this firm also capitalizes IDC at the gross[2] rate and includes IDC "above the line" for rate making purposes. "Above the line" means that IDC is included as a part of operating income for the purposes of determining the revenues required to provide an adequate return on the rate base. For example, if net operating income of $1,000 were required to provide the allowed rate of return on the rate base and the amount of IDC was $200, then only $800, rather than $1,000, would have to be generated from the firm's customers. This does not provide a double return on CWIP, since the income generated in the form of IDC reduces what must be generated through customer revenues.

Firm RB-%IDC-ITB

Like the previous two firms, this firm includes CWIP in the rate

[2]The term "gross," as used in connection with the IDC rate, means that IDC is capitalized at the before-tax cost of capital, however determined. The "net" rate is the after-tax cost of capital.

base and earns a rate of return on CWIP equivalent to the rate of return on used and useful assets. This firm also capitalizes IDC and, like Firm RB-IDC, includes capitalized IDC above the line. However, this firm capitalizes IDC at a very low rate, at a rate equal to the debt component of the IDC rate. For example, if CWIP were financed equally by debt and equity, and the interest rate was 8 percent, then the debt component of the IDC rate would be 4 percent (8 percent x .5). This figure would be the rate at which IDC is computed. But Firm RB-%IDC-ITB also allocates the interest-tax benefit (ITB) which results from construction. Table 5 illustrates the origin of the interest-tax benefit. Part A of Table 5 shows the income statement of a firm which has no CWIP. Assets are $1,000, financed equally by debt and equity, with debt requiring 8 percent interest and equity earning a 12 percent return. Part B shows the same firm with $100 of CWIP, financed equally by debt and

TABLE 5

ILLUSTRATION OF THE INTEREST-TAX BENEFIT

	Income Statements			
	A Firm With No Construction		B Firm With Construction	
Revenues		$410.00		$410.00
Operating Expenses (including depreciation)	$250.00		$250.00	
Taxes	60.00		58.00	
Interest-Tax Benefit*	-0-	310.00	2.00	310.00
Net Operating Income		$100.00		$100.00
IDC				10.00
Adjusted NOI				$110.00
Interest Expense		40.00		44.00
Net Income		$ 60.00		$ 66.00

*Normally the interest-tax benefit is simply a debit to the income tax expense. It is shown this way merely for emphasis.

equity. With increased debt due to construction, interest payments have risen \$4, and as the tax calculation reveals, taxes are \$2 less. Since nothing else changed in the example, the reduction in taxes must be caused by construction. It can be argued that this tax saving, which is caused by the interest payments on funds borrowed to finance construction, should be allocated (credited) to the CWIP account. Since the tax saving results from the construction program, it should be used to reduce the cost of construction. The effect of the procedures followed by this firm is to capitalize IDC at an effective rate equivalent to the after-tax cost of debt times the debt ratio, or 2 percent for the example used above. The return on CWIP financed by debt is provided by IDC credits, while the return on CWIP financed by equity is generated from operating revenues.

The first basic method and two variations on it have yielded three alternative firms. These firms have significant differences which will become more clear when each firm is fully illustrated using the single asset model. The final three firms discussed in this section derive from the procedure whereby IDC is capitalized as a means of providing a return on CWIP.

Firm IDC

Firm IDC includes no CWIP in the rate base, but computes IDC on CWIP at the "gross"[3] IDC rate. This imputed amount is the only means by which a return is provided on CWIP. IDC also becomes a part of the cost of the asset and is, therefore, included in CWIP. The most difficult and still

[3]As defined in footnote 2.

unresolved question which arises for this and the next two firms is the rate at which to capitalize IDC.

<u>IDC rate</u>. From the viewpoint of the stockholders, the IDC rate is a crucial issue for Firms IDC, IDC-ITB-G, and IDC-ITB-N. In these firms the amount of capitalized IDC is the only return investors receive. Firms RB, RB-IDC, and RB-%IDC-ITB include CWIP in the rate base, and in doing so earn a rate of return on CWIP equal to the rate of return earned on used and useful assets. For these firms the amount of IDC reduces merely the amount of revenues which must be generated through customer payments. Therefore, the IDC rate is crucial mainly to Firms IDC, IDC-ITB-G, and IDC-ITB-N, for the rate at which IDC is computed determines the rate of return earned on CWIP. If IDC is computed at a rate of 10 percent of CWIP, investors earn a rate of return of 10 percent on CWIP.

The IDC rate is important for another reason. The proper rate is necessary to accurately reflect the cost of the plant under construction. IDC becomes part of the base upon which future rates are determined and is part of the base to be depreciated and charged against future revenues.

As indicated in Chapter 2, regulators have allowed a rate of return on CWIP large enough to cover debt payments on funds borrowed for construction and to provide some return on equity funds invested in construction. However, they have not systematically specified, in theory, what the <u>rate</u> of return on equity funds allocated to construction should be. There are two systematic approaches to determining the IDC rate. Both approaches have considerable merit, and both implicitly assume that the construction program does not alter the riskiness of the entire investment.

One approach to determining the IDC rate is to use the current, or marginal, cost of capital. The current cost of capital is computed as the weighted average cost of those funds used specifically for construction. The cost of debt sources is the effective interest rate, and the cost of equity sources is the equity rate of return allowed on used and useful assets. Assuming the firm's currently allowed rate of return provides the proper return to investors before construction, then the return for funds invested in CWIP should be set at the marginal cost of those funds. The marginal rate may be above or below the currently allowed rate of return, but in either case the return would be just sufficient to meet the debt payments and provide a return to equity holders at the specified rate.[4] At some future time when the sources of capital used to finance CWIP are included in the determination of the allowed rate, the rate of return on CWIP should be set equal to the rate allowed on used and useful assets. This approach requires the assumption that the sources of capital used for construction can be segregated for the purposes of determining the marginal cost of capital. For many firms this would be a difficult and arbitrary process. Thus, a more practical approach may be necessary.

Another approach is to set the IDC rate equal to the average cost of capital for the firm, or the allowed rate of return on used and useful assets. From a practical standpoint, this approach has considerable

[4]Current conditions make it likely that the marginal cost will exceed the allowed rate of return for a utility in a net investment rate base jurisdiction. This is because the embedded cost rates of senior security capital may well be below those in current capital markets. However, should rates begin falling, marginal costs could be below embedded costs.

merit. Regulatory bodies would not be burdened with specifying two rates, one for used and useful assets and another for CWIP. The same rate would apply to CWIP as well as used and useful assets. Also, firms would not have to be able to identify the sources of capital used for construction, thereby eliminating a possible source of conflict between management and regulators. However, one disadvantage of this approach is that the rate of return on CWIP would be incorrect when the current cost of capital differed from the embedded cost. This situation could be remedied by initiating rate hearings if the difference in cost rates became serious.

There appears to be no justification for a rate which does not provide a return to equity holders equal to the rate of return earned on used and useful assets. If regulators allow 12 percent for equity holders for investment in used and useful assets, it would be difficult to justify a lower rate of return for that portion of CWIP financed by equity. Using the allowed rate of return on used and useful assets as the IDC rate has two advantages. First, it requires no additional work for regulators or management. Second, this amount is the return effectively provided for firms which include CWIP in the rate base. Use of the allowed rate provides consistency among the different methods for providing a return on CWIP. However, firms should be able to petition for rate changes any time the marginal cost of capital increases the embedded cost of capital.

For the illustrations in this chapter, the IDC rate is set equal to the allowed rate of return on used and useful assets.[5] This equality

[5]In the simplified examples used in this chapter, the costs of debt and equity are constant, making the marginal cost and the embedded cost the same.

makes the firms which only capitalize IDC comparable to the firms which include CWIP in the rate base for the analysis provided later. The last two firms, which are variations of Firm IDC, are discussed next.

Firm IDC-ITB-G

Firm IDC-ITB-G follows the same procedures as Firm IDC but also allocates the ITB. The arguments brought out earlier regarding the ITB apply here as well. It can be argued that since IDC is used to place the burden of construction on those who benefit from it, any saving which results from construction should be passed on to those who bear the cost. The allocation of the ITB makes the effective IDC rate lower for this firm than for Firm IDC.

Firm IDC-ITB-N

Firm IDC-ITB-N is similar to the previous firm except that the net rate for capitalizing IDC is used. The ITB is automatically allocated to CWIP since by using the net rate, it is never added into the construction cost. The tax saving is listed on the income statement under other income as an income tax credit.

The two basic methods and the variations of them have yielded five firms which employ different methods for providing a return on CWIP. Table 6 summarizes the key differences between these firms. It is the different formulas for the variables shown in this table which create the differences in revenues, taxes, profits, and the other variables. These formulas will be useful when the procedures followed by each firm are presented in detail. But first it will be helpful to think of the firm from the perspective described below.

TABLE 6

SUMMARY OF THE KEY DIFFERENCES BETWEEN THE FIRMS

	RB	RB-IDC	RB-%IDC-ITB	IDC	IDC-ITB-G[1]
Construction Work in Progress Included in the Rate Base	Yes	Yes	Yes	No	No
Rate for Computing Interest During Construction[2]	IDC-1	IDC-2	IDC-3	IDC-2	IDC-2
Rate for Computing the Interest-Tax Benefit[3]	ITB-1	ITB-1	ITB-2	ITB-1	ITB-2
Revenue Requirements[4]	RR-1	RR-2	RR-2	RR-1	RR-1

Notes:
1. As demonstrated later, the last two firms produce identical results and it is only necessary to consider one of them.
2. IDC Rate Formulas
   IDC-1: zero (do not capitalize IDC)
   IDC-2: (debt ratio x interest rate) + (1.0 - debt ratio) x equity rate
   IDC-3: debt ratio x interest rate
3. ITB Rate Formulas
   ITB-1: zero (do not allocate the ITB)
   ITB-2: debt ratio x interest rate x tax rate (allocate the ITB)
4. Formulas for Revenue Requirements
   RR-1: Firms which include IDC below the line for rate making purposes:
   1/1 - TX [DBK + AR x RB) + ITB - TX (DTX + INT)]
   RR-2: Firms which include IDC above the line for rate making purposes:
   1/1 - Tx [DBK + (AR x RB) - IDC + ITB - TX (DTX + INT)]
   where DBK = book depreciation, AR = allowed rate of return, RB = rate base, ITB = interest-tax benefit, IDC = interest during construction, DTX = tax depreciation, and INT = interest expense.

The Firm as an Aggregation of Assets

To facilitate the explanation of the alternative procedures for providing a return on funds invested in CWIP, it is useful to think of the firm as an aggregation of numerous individual assets, or "units of plant." Every unit of plant must be financed, and they all generate revenues, depreciation, and output over their useful lives. In every case a unit of plant constructed by the firm goes through a cycle of construction and then depreciation.

Table 7, which depicts the growth of a hypothetical firm over a three-year period, is founded on the following two assumptions: 1) The firm has no construction work in progress prior to the first year shown and 2) each asset requires an investment of $100 during each year of its construction period. In the first year, construction is initiated on four assets, A, B, C, and D. The first asset (A) requires two years for construction and has a useful life of four years. The other three assets (B, C, and D) begun in year one have construction periods of two, three, and four years, and useful lives of six, eight, and ten years, respectively. With an investment of $100 required for each asset, the

TABLE 7

LIFE CYCLES OF ASSETS FOR A FIRM
OVER A THREE-YEAR PERIOD OF GROWTH

Assets	Years															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A	C	C	D	D	D	D										
B	C	C	D	D	D	D	D	D								
C	C	C	C	D	D	D	D	D	D	D	D					
D	C	C	C	C	D	D	D	D	D	D	D	D	D	D		
E		C	C	D	D	D	D									
F		C	C	D	D	D	D	D	D							
G		C	C	C	D	D	D	D	D	D	D	D				
H		C	C	C	D	D	D	D	D	D	D	D				
I		C	C	C	C	D	D	D	D	D	D	D	D	D	D	
J			C	C	D	D	D	D	D	D						
K			C	C	C	D	D	D	D	D	D	D	D			
L			C	C	C	C	D	D	D	D	D	D	D	D	D	D

Notes: 1. The "C's" represent the years in which the asset is under construction and costs are being incurred.
2. The "D's" represent the years in which depreciation occurs and inflows accrue.

total investment for year one is $400.

In the second year, construction is begun on five additional assets. These assets have construction periods and useful lives similar to those assets begun in year one. Thus, nine assets are under construction in year two. With a $100 investment required for each asset, the total investment for year two is $900. At the end of year two, the amount of CWIP accumulated in each asset begun in year one is $200, and the amount of CWIP accumulated in each asset begun in year two is $100. The total amount of CWIP at the end of year two is $1,300.[6]

At the beginning of the third year, construction begins on three additional assets. At the same time, two of the assets begun in year one are completed and go on line. This leaves ten assets still under construction in year three, and will again require an additional investment of $100 for each of them. Thus, the total investment outlay for the year is $1,000. The two remaining assets under construction from year one each represent $300 of accumulated CWIP, while each asset begun in year two represents $200 of accumulated CWIP, and each asset begun in year three represents $100 of accumulated CWIP. Therefore, the total CWIP at the end of year three is $1,900. The $200 invested in each of the completed assets begun in year one is now included in the rate base and no longer represents CWIP.

This hypothetical example was designed to illustrate the independence of each asset. As the preceding discussion revealed, to determine the total CWIP for the firm as a whole, it is only necessary to aggregate,

[6]Throughout this illustration we ignore IDC since it would complicate the example and add nothing to the point we are trying to make. The procedures for dealing with IDC are explained later.

or sum, the amounts of CWIP associated with each asset. Similarly, the total investment required by the firm in any period is simply the sum of the investments required for each asset. Though not illustrated, this independence also holds for items such as depreciation and maintenance costs. More importantly, for regulated companies, this independence exists for items such as revenues and IDC. Thus, to determine the value of any of these variables for the firm, it is only necessary to sum the value of the variables for each of the individual assets. Given this independence of assets, the procedures followed by the various firms can be illustrated using a single asset. Consequently, to get a complete picture of each firm, a single asset which goes through the complete cycle of construction and depreciation is all that is necessary.

Illustration of the Alternative Firms With the Single Asset Model

Using the single asset model greatly simplifies the explanation of the alternatives and should allow the reader to more easily follow the presentation. The illustrations which follow consist of a series of beginning and ending balance sheets and income statements for selected years during the asset's life cycle. These illustrations require a number of assumptions.

General Assumptions

1. On January 1, 1971, each firm is incorporated and assigned a group of customers for whom it must provide service beginning January 1, 1973. The service requirement for each firm is identical, and service must be provided for four years, from January 1, 1973 to December 31, 1976.

2. Customers may be billed beginning January 1, 1971, depending on the requirements of the individual firm.

3. The construction period is two years, from January 1, 1971 to December 31, 1972. A total investment of $200 is required for each firm to complete construction. Half of the investment is made on January 1, 1971, and half on January 1, 1972.

4. The depreciable life is four years, and the depreciation policy followed is straight line. Cash generated by depreciation is used to retire debt and equity in equal proportions.

5. Revenues are based on the rate base at the beginning of the year.

6. The return on equity is determined on equity held at the beginning of each year. The return on equity is always 12 percent. Equity holdings may be increased or reduced with no flotation costs.

7. Operating expenses for each firm are identical and, therefore, omitted from the income statements.

8. All profits are paid out in dividends.

9. The capital structure is always maintained at 50 percent debt and 50 percent equity.

10. The interest rate on all debt is 8 percent. Debt may be increased or reduced at no cost, other than the interest expense.

11. The average cost of capital is 10 percent, which is also the allowed rate of return. The gross IDC rate is 10 percent, and the net rate is 8 percent.

12. The tax rate is 50 percent. IDC is not taxable income.

These assumptions result in firms with identical commitments, financial requirements, and service requirements. They differ only in the method of providing a return on CWIP. For each firm, beginning and ending balance sheets and income statements are provided for 1971, 1972, 1973, and 1976. The first two years represent the construction period, the third year is the year the asset goes on line, and 1976 is the last year of the useful life of the asset. Nothing uniquely significant occurs during 1974 and 1975; consequently, the data for these years are not provided. The important procedures followed by each firm are fully revealed in the years for which data are presented. For each year, the beginning balance sheet, income statement, and ending balance sheet are discussed and significant changes noted. The objective is to illustrate the complete cycle of an asset and show how the different policies of each firm are reflected in the balance sheets and income statements. By the end of 1976, the asset constructed by each firm during 1971-1972 is fully depreciated, the service requirement has been fulfilled, and the cycle is complete.

Firm RB

Firm RB invests $100 at the beginning of 1971, as shown in the balance sheet for January 1, 1971, in Table 8. Since Firm RB includes CWIP in the rate base, the firm has a base upon which operating revenues may be earned. The customers of Firm RB begin making utility payments in 1971, though service has not yet begun. This simplified example illustrates that, under the procedures followed by Firm RB, current customers must pay part of the cost of an asset from which they do not currently benefit. As the income statement shows, sufficient operating revenues must be generated to cover taxes, interest, and profit. Net operating income (NOI), as always, is 10 percent of the rate base. The balance sheet at the end of the year is the same as the balance sheet at the beginning of the year.

In 1972, another $100 is invested, financed equally by debt and equity, raising CWIP to $200. The full $200 is included in the rate base, and sufficient revenues must be generated to cover interest, taxes, and profit. As the income statement for 1972 shows, NOI is 10 percent of

TABLE 8

SINGLE ASSET
BALANCE SHEETS AND INCOME STATEMENTS FOR FIRM RB

1971 — Invest $100 for Construction

Balance Sheet 1/1/71

CWIP	$100.00	Debt	$ 50.00
		Equity	50.00
Total Assets	$100.00	Total Liab.	$100.00

Income Statement Year Ending 12/31/71

Revenues		$16.00
Depreciation	-0-	
Taxes	6.00	6.00
NOI		$10.00
Interest Expense		4.00
Net Income		$ 6.00

Balance Sheet 12/31/71

CWIP	$100.00	Debt	$ 50.00
		Equity	50.00
Total Assets	$100.00	Total Liab.	$100.00

1972 — Invest $100 for Construction

Balance Sheet 1/1/72

CWIP	$200.00	Debt	$100.00
		Equity	100.00
Total Assets	$200.00	Total Liab.	$200.00

Income Statement Year Ending 12/31/72

Revenues		$32.00
Depreciation	-0-	
Taxes	12.00	12.00
NOI		$20.00
Interest Expense		8.00
Net Income		$12.00

Balance Sheet 12/31/72

CWIP	$200.00	Debt	$100.00
		Equity	100.00
Total Assets	$200.00	Total Liab.	$200.00

TABLE 8 (Continued)

1973

Balance Sheet
1/1/73

Oper. Plant	200.00	Debt	$100.00
Depreciation	-0-	Equity	100.00
Net Plant	$200.00		
Total Assets	$200.00	Total Liab.	$200.00

Income Statement
Year Ending 12/31/73

Revenues		$82.00
Depreciation	50.00	
Taxes	12.00	62.00
NOI		$20.00
Interest Expense		8.00
Net Income		$12.00

Balance Sheet
12/31/73

Oper. Plant	200.00	Debt	$ 75.00
Depreciation	50.00	Equity	75.00
Net Plant	$150.00		
Total Assets	$150.00	Total Liab.	$150.00

1976

Balance Sheet
1/1/76

Oper. Plant	200.00		Debt	$25.00
Depreciation	150.00		Equity	25.00
Net Plant		$50.00		
Total Assets		$50.00	Total Liab.	$50.00

Income Statement
Year Ending 12/31/76

Revenues		$58.00
Depreciation	50.00	
Taxes	3.00	53.00
NOI		$ 5.00
Interest Expense		2.00
Net Income		$ 3.00

Balance Sheet
12/31/76

Oper. Plant	200.00		Debt	$-0-
Depreciation	200.00		Equity	-0-
Net Plant		$-0-		
Total Assets		$-0-	Total Liab.	$-0-

the rate base. Customers are again required to make payments in 1972 though service has still not begun. The balance sheet at the end of 1972 is unchanged.

At the beginning of 1973, the asset which had been under construction goes on line. The balance sheet for January 1, 1973 no longer lists the assets as CWIP, but as operating plant. The rate base is unchanged since the investment, as CWIP, was included before, and, as operating plant, is included in the rate base now. The income statement for 1973 indicates that sufficient revenues must be generated to cover not only taxes, interest and profits, but depreciation as well. NOI is again 10 percent of the rate base. The balance sheet at the end of 1973 includes some depreciation which accumulates over the life of the asset. Debt and equity are reduced as the net asset value falls.

By the start of 1976, accumulated depreciation has reduced the net plant to $50, which is also the rate base. Debt and equity are both $25. The income statement is generated as usual, with NOI 10 percent of the rate base. By the end of 1976, the asset is fully depreciated, and the cycle is complete.

Firm RB-IDC

Firm RB-IDC, like Firm RB, includes CWIP in the rate base, but also capitalizes IDC at the gross rate of 10 percent. The amount of IDC is then included above the line for rate making purposes. Since IDC is included above the line, adjusted net operating income, rather than net operating income, must always be 10 percent of the rate base. In 1971, $100 is invested in construction, which is financed equally by debt and equity. As shown in Table 9,[7] IDC is calculated as 10 percent of CWIP, or $10. Since adjusted NOI must be equal to 10 percent of the rate base, NOI must be zero. With NOI zero, profits, for tax purposes (i.e., excluding IDC), are minus $4, or a $4 loss. Consequently, taxes are minus $4, or a $4 credit, and revenues are minus $4.[8] At the end of 1971, the $10 of IDC is added to CWIP and debt and equity are both $5 larger. Table 10 illustrates the "T-accounts" which help explain what actually occurs with the creation of IDC. First, IDC is credited to other income and simultaneously added to CWIP as a construction expense. Next, $4 in cash is used to pay the interest expense and another $6 in cash is used to pay dividends. Finally, $10 in cash is raised by increasing debt and equity by $5 each to meet the $10 cash expenditure for interest and dividends. All the T-accounts balance, and the balance sheet at the end of 1971 is as shown in Table 9. Similar transactions occur in every instance in which IDC is capitalized.

At the beginning of 1972, another $100 is invested in construction. The rate base is now $210, so that adjusted NOI must be $21. IDC is calculated as 10 percent of CWIP, or $21 and, therefore, NOI is again zero. For tax purposes, an $8.40 loss results, since IDC is not taxable income. An $8.40 tax credit is incurred, making revenues minus $8.40 for 1972. At the end of 1972, IDC is added to CWIP and debt and equity are again increased.

---

[7]Table 9 shows the balance sheets and income statements for Firm RB-IDC and Firm IDC. As explained after the discussion of Firm IDC, the results for these two firms are identical, and Table 9 is used for the illustration of both firms.

[8]In a more realistic situation with an on-going firm, revenues would be $4.00 less, rather than negative. Also, taxes would simply be lower, rather than having a credit.

TABLE 9

SINGLE ASSET
BALANCE SHEETS AND INCOME STATEMENTS FOR FIRMS RB-IDC AND IDC

1971
Invest $100 for Construction

Balance Sheet
1/1/71

CWIP		$100.00	Debt	$ 50.00
			Equity	50.00
Total Assets		$100.00	Total Liab.	$100.00

Income Statement
Year Ending 12/31/71

Revenues		-$4.00
Depreciation	-0-	
Taxes	-4.00	-4.00
Net Oper. Income (NOI)		-0-
IDC		10.00
Adjusted NOI		$10.00
Interest Expense		4.00
Net Income		$ 6.00

Balance Sheet
12/31/71

CWIP	100.00		Debt	$ 55.00
IDC	10.00		Equity	55.00
Total CWIP		$110.00		
Total Assets		$110.00	Total Liab.	$110.00

1972
Invest $100 for Construction

Balance Sheet
1/1/72

CWIP	200.00		Debt	$105.00
IDC	10.00		Equity	105.00
Total CWIP		$210.00		
Total Assets		$210.00	Total Liab.	$210.00

Income Statement
Year Ending 12/31/73

Revenues		-$8.40
Depreciation	-0-	
Taxes	-8.40	-8.40
NOI		-0-
IDC		21.00
Adjusted NOI		21.00
Interest Expense		8.40
Net Income		$12.60

Balance Sheet
12/31/72

CWIP	200.00		Debt	$115.50
IDC	31.00		Equity	115.50
Total CWIP		$231.00		
Total Assets		$231.00	Total Liab.	$231.00

TABLE 9 (Continued)

1973

Balance Sheet
1/1/73

Oper. Plant	231.00		Debt	$115.50
Depreciation	-0-		Equity	115.50
Net Plant		$231.00		
Total Assets		$231.00	Total Liab.	$231.00

Income Statement
Year Ending 12/31/73

Revenues		$102.46
Depreciation	57.75	
Taxes	21.61	79.36
NOI		$ 23.10
IDC		-0-
Adjusted NOI		$ 23.10
Interest Expense		9.24
Net Income		$ 13.86

Balance Sheet
12/31/73

Oper. Plant	231.00		Debt	$ 86.625
Depreciation	57.75		Equity	86.625
Net Plant		$173.25		
Total Assets		$173.25	Total Liab.	$173.25

1976

Balance Sheet
1/1/76

Oper. Plant	231.00		Debt	$28.875
Depreciation	173.25		Equity	28.875
Net Plant		$57.75		
Total Assets		$57.75	Total Liab.	$57.75

Income Statement
Year Ending 12/31/76

Revenues		$74.74
Depreciation	57.75	
Taxes	11.21	68.96
NOI		$ 5.78
IDC		-0-
Adjusted NOI		$ 5.78
Interest Expense		2.31
Net Income		$ 3.47

Balance Sheet
12/31/76

Oper. Plant	231.00		Debt	$-0-
Depreciation	231.00		Equity	-0-
Net Plant		$-0-		
Total Assets		$-0-	Total Liab.	$-0-

TABLE 10

T-ACCOUNTS FOR FIRM RB-IDC FOR 1971
TRANSACTIONS REGARDING IDC

Account	Debit	Credit
Other Income (IDC)		10 (1)
CWIP	(1) 10	
Cash	(4) 5	4 (2)
	(5) 5	6 (3)
Dividend Expense	(3) 6	
Interest Expense	(2) 4	
Debt		5 (4)
Equity		5 (5)

At the beginning of 1973, the asset goes on line with a book value of $231. This amount is higher than the book value of the asset of Firm RB by the amount of accumulated IDC. The income statement is derived in the usual manner, with one exception. For tax purposes, depreciation is calculated only on the net-of-IDC value of the asset, or $200. To allow the IDC part of the asset to be depreciated for tax calculations would make the IDC income of 1971 and 1972 tax free. This procedure would provide unjustifiable benefits to firms which capitalize IDC. The tax calculation for Firm RB-IDC for 1973 is illustrated below:

Revenues		$102.46
Depreciation	50.00*	
Interest Expense	9.24	59.24
Taxable Income		$ 43.22
Taxes @ 50 percent		$ 21.61

*Book Value	$231.00
Less Accumulated IDC	31.00
	$200.00 over four years equals
	$ 50.00 per year

Straight line depreciation, for tax purposes, is \$50 per year, not \$57.75, which is book depreciation. This procedure for calculating taxes is used for all firms which capitalize IDC. The income statement for 1973 shows that adjusted NOI is 10 percent of the rate base. The balance sheet at the end of 1973 reveals that net plant is reduced by accumulated depreciation as it accrues over the life of the asset. Debt and equity are correspondingly reduced.

At the beginning of 1976 net plant is \$57.75, as is the rate base. Debt and equity have been periodically reduced, corresponding to the net value of the asset. The income statement is derived as usual, with NOI 10 percent of the rate base. The final balance sheet shows the asset fully depreciated, and the cycle is complete.

Firm RB-%IDC-ITB

Firm RB-%IDC-ITB also includes CWIP in the rate base. Like Firm RB-IDC, this firm capitalizes IDC and includes it above the line. This again requires that adjusted NOI be equal to 10 percent of the rate base. Firm RB-%IDC-ITB differs from Firm RB-IDC in two important respects. First, Firm RB-%IDC-ITB calculates IDC at a lower rate of 4 percent. Second, the ITB is allocated to the CWIP account. In 1971 the firm invests \$100 in construction, as shown in Table 11. As shown in the income statement, IDC is computed at 4 percent. Since adjusted NOI is 10 percent of the rate base, of \$10, NOI must be \$6. With taxes of \$4 and the ITB of \$2, revenues are \$12. This firm, like Firm RB, requires its customers to make payments in 1971, even though service has not yet begun.

TABLE 11

SINGLE ASSET
BALANCE SHEETS AND INCOME STATEMENTS FOR FIRM RB-IDC-ITB

1971
Invest $100 for Construction

Balance Sheet
1/1/71

CWIP		$100.00	Debt	$ 50.00
			Equity	50.00
Total Assets		$100.00	Total Liab.	$100.00

Income Statement
Year Ending 12/31/71

Revenues		$12.00
Depreciation	-0-	
Taxes	4.00	
ITB	2.00	6.00
NOI		$ 6.00
IDC		4.00
Adjusted NOI		$10.00
Interest Expense		4.00
Net Income		$ 6.00

Balance Sheet
12/31/71

CWIP	100.00		Debt	$ 51.00
IDC	2.00		Equity	51.00
Total CWIP		$102.00		
Total Assets		$102.00	Total Liab.	$102.00

1972
Invest $100 for Construction

Balance Sheet
1/1/72

CWIP	200.00		Debt	$101.00
IDC	2.00		Equity	101.00
Total CWIP		$202.00		
Total Assets		$202.00	Total Liab.	$202.00

Income Statement
Year Ending 12/31/72

Revenues		$24.24
Depreciation	-0-	
Taxes	8.08	
ITB	4.04	12.12
NOI		$12.12
IDC		8.08
Adjusted NOI		$20.20
Interest Expense		8.08
Net Income		$12.12

Balance Sheet
12/31/72

CWIP	200.00		Debt	$103.02
IDC	6.04		Equity	103.02
Total CWIP		$206.04		
Total Assets		$206.04	Total Liab.	$206.04

TABLE 11 (Continued)

1973

Balance Sheet
1/1/73

Oper. Plant	206.04		Debt	$103.02
Depreciation	-0-		Equity	103.02
Net Plant		$206.04		
Total Assets		$206.04	Total Liab.	$206.04

Income Statement
Year Ending 12/31/73

Revenues		$85.98
Depreciation	51.51	
Taxes	13.87	
ITB	-0-	65.38
NOI		$20.60
IDC		-0-
Adjusted NOI		$20.60
Interest Expense		8.24
Net Income		$12.36

Balance Sheet
12/31/73

Oper. Plant	206.04		Debt	$ 77.265
Depreciation	51.51		Equity	77.265
Net Plant		$154.53		
Total Assets		$154.53	Total Liab.	$154.53

1976

Balance Sheet
1/1/76

Oper. Plant	206.04		Debt	$25.755
Depreciation	154.53		Equity	25.755
Net Plant		$51.51		
Total Assets		$51.51	Total Liab.	$51.51

Income Statement
Year Ending 12/31/76

Revenues		$61.26
Depreciation	51.51	
Taxes	4.60	
ITB	-0-	56.11
NOI		$ 5.15
IDC		-0-
Adjusted NOI		$ 5.15
Interest Expense		2.06
Net Income		$ 3.09

Balance Sheet
12/31/76

Oper. Plant	206.04		Debt	$-0-
Depreciation	206.04		Equity	-0-
Net Plant		$-0-		
Total Assets		$-0-	Total Liab.	$-0-

The payments required are not as large as those required by Firm RB since some IDC is capitalized and included in earnings. The balance sheet at the end of 1971 reveals that IDC is added to CWIP and the ITB has also been credited to CWIP. With IDC of $4 and an ITB of $2, the net addition to CWIP is $2. Consequently, debt and equity are increased by $1 each.

At the beginning of 1972, another $100 is invested in construction. The rate base is now $202, and adjusted NOI is 10 percent of this, or $20.20. As shown, revenues are again positive, requiring customers to make payments in 1972 even though service has not yet begun. IDC is calculated at 4 percent, and the ITB is allocated to CWIP. Rather than the CWIP increasing by the total IDC of $8.08, the allocation of the ITB of $4.04 makes the net increase in CWIP only $4.04. As a result, debt and equity are increased by $2.02 each.

In 1973 the asset goes on line and depreciation begins. The book value of the asset is greater than for Firm RB since some IDC is capitalized, but the book value is less than for Firm RB-IDC since IDC is capitalized at a lower rate. The rate base is $206.04, NOI is $20.60, and there is no IDC or ITB since CWIP is now zero. Depreciation, for tax purposes, is determined as explained earlier. The balance sheet at the end of 1973 shows the net value of the asset being reduced by depreciation. Debt and equity are reduced correspondingly.

By the start of 1976, the net plant has been reduced substantially by accumulated depreciation. Adjusted NOI is 10 percent of the rate base, and there is no IDC or ITB. By the end of 1976, the asset is fully depreciated and the cycle is complete.

Firm IDC

Firm IDC does not include any part of CWIP in the rate base, but capitalizes IDC at the gross rate as a means of providing a return on funds invested in CWIP. Given this procedure, NOI must always be equal to 10 percent of the rate base. In 1971, $100 is invested in construction as shown in Table 9.[9] The rate base is equal to zero, since CWIP is excluded from the rate base. With NOI equal to 10 percent of the rate base, or zero, and IDC being non-taxable, profits, for tax purposes, are minus $4. Taxes are also minus $4, or a $4 credit, and, therefore, revenues are minus $4. At the end of 1971, IDC has been added to CWIP and debt and equity have been increased.

In 1972 another $100 is invested in construction. The rate base is still zero, making NOI zero. IDC is 10 percent of CWIP, or $21, but not taxable income. For tax purposes, profits are minus $8.40, and the tax credit for 1972 is $8.40. IDC is again added to CWIP, and debt and equity have both been increased by $10.50. For both 1971 and 1972, the customers of Firm IDC are not required to make any utility payments. The total return to funds allocated to CWIP is provided by the IDC credit.

In 1973, the asset goes on line and the rate base is $231. The book value of the asset for Firm IDC is higher than the book value for Firm RB by the amount of accumulated IDC. The income statement for 1973 reveals that NOI is 10 percent of the rate base and IDC is zero. Here again, as with earlier firms, depreciation, for tax purposes, is allowed only on the net-of-IDC cost of the asset. Depreciation accrues this year, and by the end of 1973 the net plant has been reduced. Debt and equity are reduced

[9]As noted earlier, Table 9 illustrates the results for Firm RB-IDC and Firm IDC.

accordingly.

As with the other firms, by 1976 the net plant has been reduced by accumulated depreciation. NOI is 10 percent of the rate base, and IDC is zero. By the end of 1976, the asset is fully depreciated and the cycle for the asset of Firm IDC is complete.

As mentioned earlier, Firms RB-IDC and IDC produce identical results. This is only true, however, when the IDC rate is equal to the allowed rate of return on used and useful assets, as is true in the illustrations of this chapter. Any difference between the IDC rate and the allowed rate will produce different results for the two firms. This is illustrated in Table 12, where the IDC rate for Firm RB-IDC is now 8 percent rather than the original 10 percent. Using the data for 1971, Table 12 shows that taxes and revenues now differ for the two firms. Both are still providing a 12 percent return on equity. Firm RB-IDC still has an adjusted NOI equal to 10 percent of the rate base, but $8 is in the form of IDC credits and $2 is generated from revenues after taxes. Previously, the entire $10 was in the form of IDC credits. While the two firms produced identical results for the assumptions specified earlier, the two firms could produce quite different results under different assumptions.

Firm IDC-ITB[10]

In addition to capitalizing interest at the gross IDC rate, Firm IDC-ITB allocates the interest-tax benefit to the construction account.

[10]Though the accounting procedures differ slightly, Firms IDC-ITB-G and IDC-ITB-N produce identical results. This is illustrated in the appendix to the chapter. Therefore, we shall deal only with Firm IDC-ITB-G, and it will be referred to as Firm IDC-ITB in the remainder of this paper.

TABLE 12

COMPARISON OF RESULTS WHEN THE RATE FOR COMPUTING IDC DIFFERS FROM THE ALLOWED RATE OF RETURN FOR FIRM RB-IDC

		Firm RB-IDC		Firm IDC
Allowed Rate		10%		10%
IDC Rate		8%		10%
		Income Statement Year Ending 12/31/71		
Revenues		$ -0-		-$ 4.00
Depreciation	-0-		-0-	
Taxes	-2.00	-2.00	-4.00	-4.00
NOI		2.00		-0-
IDC		8.00		10.00
Adjusted NOI		10.00		10.00
Interest Expense		4.00		4.00
Net Income		$ 6.00		$ 6.00

In 1971, $100 is invested in construction and is financed equally by debt and equity. Table 13 shows that NOI is 10 percent of the rate base, which is zero since CWIP is excluded from the rate base. IDC is calculated as 10 percent of CWIP, and the ITB is allocated as illustrated in the income statement. Taxable income is -$4.00, which makes taxes -$2.00. Adding the ITB to the tax expense makes net taxes zero and thus, revenues are zero also. The ending balance sheet shows that $10 of IDC has been added to CWIP, which, with the ITB allocation of $2, makes the net addition to CWIP $8. Debt and equity are both increased by $4.

In 1972, another $100 is invested in construction. The rate base is still zero, making NOI zero. IDC is again computed as 10 percent of CWIP and the ITB is allocated to the income statement. Taxable income is -$8.32, which makes taxes -$4.16. The allocation of the ITB of $4.16 makes net taxes zero and again revenues are zero. The procedures followed

TABLE 13

SINGLE ASSET
BALANCE SHEETS AND INCOME STATEMENTS FOR FIRM IDC-ITB

1971
Invest $100 for Construction

Balance Sheet
1/1/71

CWIP		$100.00	Debt	$ 50.00
			Equity	50.00
Total Assets		$100.00	Total Liab.	$100.00

Income Statement
Year Ending 12/31/71

Revenues		$ -0-
Depreciation	-0-	
Taxes	(2.00)	
ITB	2.00	-0-
NOI		-0-
IDC		10.00
Adjusted NOI		$10.00
Interest Expense		4.00
Net Income		$ 6.00

Balance Sheet
12/31/71

CWIP	100.00		Debt	$ 54.00
IDC	8.00		Equity	54.00
Total CWIP		$108.00		
Total Assets		$108.00	Total Liab.	$108.00

1972
Invest $100 for Construction

Balance Sheet
1/1/72

CWIP	200.00		Debt	$104.00
IDC	8.00		Equity	104.00
Total CWIP		$208.00		
Total Assets		$208.00	Total Liab.	$208.00

Income Statement
Year Ending 12/31/72

Revenues		$ -0-
Depreciation	-0-	
Taxes	(4.16)	
ITB	4.16	-0-
NOI		-0-
IDC		20.80
Adjusted NOI		$20.80
Interest Expense		8.32
Net Income		$12.48

Balance Sheet
12/31/72

CWIP	200.00		Debt	$112.32
IDC	24.64		Equity	112.32
Total CWIP		$224.64		
Total Assets		$224.64	Total Liab.	$224.64

TABLE 13 (Continued)

1973

Balance Sheet 1/1/73

Oper. Plant	224.64		Debt	$112.32
Depreciation	-0-		Equity	112.32
Net Plant		$224.64		
Total Assets		$224.64	Total Liab.	$224.64

Income Statement Year Ending 12/31/73

Revenues		$98.26
Depreciation	56.16	
Taxes	19.64	
ITB	-0-	75.80
NOI		$22.46
IDC		-0-
Adjusted NOI		$22.46
Interest Expense		8.99
Net Income		$13.47

Balance Sheet 12/31/73

Oper. Plant	224.64		Debt	$ 84.24
Depreciation	56.16		Equity	84.24
Net Plant		$168.48		
Total Assets		$168.48	Total Liab.	$168.48

1976

Balance Sheet 1/1/76

Oper. Plant	224.64		Debt	$28.08
Depreciation	168.48		Equity	28.08
Net Plant		$56.16		
Total Assets		$56.16	Total Liab.	$56.16

Income Statement Year Ending 12/31/76

Revenues		$71.31
Depreciation	56.16	
Taxes	9.53	
ITB	-0-	65.69
NOI		$ 5.62
IDC		-0-
Adjusted NOI		$ 5.62
Interest Expense		2.25
Net Income		$ 3.37

Balance Sheet 12/31/76

Oper. Plant	224.64		Debt	$-0-
Depreciation	224.64		Equity	-0-
Net Plant		$-0-		
Total Assets		$-0-	Total Liab.	$-0-

by Firm IDC-ITB do not require customers to make payments during the 1971-1972 period. The entire return for funds invested in CWIP is provided by IDC credits. The ending balance sheet shows that IDC has been added to CWIP and the ITB has been credited to CWIP, making the net addition $16.64. Debt and equity increase by $8.32 each.

When the asset goes on line in 1973, the book value of the asset for Firm IDC-ITB is less than for Firm IDC since a smaller net amount of IDC was added to CWIP. The rate base is now $224.64, and NOI is 10 percent of the rate base, or $22.46. Depreciation begins this year and, for tax purposes, is computed on the book value of the asset, excluding accumulated IDC. The balance sheet at the end of 1973 shows the declining value of net plant as depreciation accumulates.

By the beginning of 1976, net plant has been reduced to $56.16, due to accumulated depreciation. NOI is again 10 percent of the rate base. By the end of 1976, the asset is fully depreciated and the cycle is again complete.

While the explanation of the procedures followed by each firm requires only a single asset model, the evaluation of the different methods for providing a return on CWIP requires that the firm as a whole be examined. It is the cumulative effects of rapid, fluctuating growth which create problems. In the next section, another model is briefly described which is somewhat more realistic and begins to demonstrate these cumulative effects.

The Continuous Growth Model

The continuous growth model is simply an extension of the single asset model. Most of the assumptions of the single asset model are retained, but a few modifications are required. First, the service requirement, which is identical for all firms, is such that capacity must be expanded by a constant amount. After the first two years, an asset similar to the asset in the single asset model must go on line each year. This assumption requires construction to begin on a new asset each year. With a two-year construction period, an investment of \$200 must be made in each year after 1971, while the first year still requires only a \$100 investment. Of the \$200, \$100 is allocated to the construction of an asset begun in the previous year, and \$100 is allocated to the construction of an asset begun in the current year. This process is assumed to go on indefinitely.

Another major change is that the funds generated by depreciation are now used to maintain the asset at full use and value. The maintenance cost of each asset is \$50 per year, which is the same for each firm. This change means that the "IDC part" of the asset is depreciated and "retired" over the asset life. An example should make this result clear. The book value of an asset, excluding IDC, is \$200. Thus, over four years, depreciation, excluding IDC, is \$50. The book value of an asset for each firm differs, depending on the amount of IDC capitalized. Using Firm IDC for the illustration, an asset has a book value of \$231, \$31 of which is IDC. Book depreciation, calculated on \$231, is \$57.75 each year. Of the \$57.75, \$50 is used to maintain the full usefulness of the asset and \$7.75 is depreciated and "retired." The funds generated by depreciated IDC are used to reduce debt and equity in proportion to the debt ratio. At the end of four years, an asset maintained in this way will have a book value of \$200, rather than \$231, since \$7.75 per year, or $31 over four years, is written off. The part which is written off is always the amount of accumulated IDC for each firm. This procedure allows the rate base to be maintained, without altering the comparability of the various firms.

The final modification for the continuous growth model specifies that each firm begins with an asset base of $1,000, rather than zero. Thus, each firm has a beginning rate base of $1,000.

As demonstrated earlier, the firm can be viewed as an aggregation of assets. This model illustrates the impact of adding a series of single assets, similar to the asset in the single asset model, to an existing firm. This model is one step closer to the more complex computer model which is described in the next chapter. Since the procedures followed by each firm were adequately demonstrated by the single asset model, only the results are presented for this model.

Examination of the Results

This section reviews the results of the two models with respect to two variables, revenues and times-interest-earned ratios. The single asset model indicates how the variables change over the complete life cycle of a single asset. The continuous growth model illustrates the cumulative effects on each variable of adding a series of such assets to an existing firm. Each model provides unique insights into the various methods for providing a return on funds invested in CWIP.

The Single Asset Model Results

Revenues. The single asset model best illustrates two facts regarding the revenues generated by each firm. First, the revenues required over a complete life cycle indicate the cost to the customer of the procedures followed by each firm. Second, revenues indicate the timing of payments required by each firm, since the service requirement (or customer group size) is the same for all firms. Table 14 shows the revenues required by each firm over the life cycle. Of particular interest to customers is the overall cost they incur under the procedures followed by each firm. Since the timing of payments differs for each firm, it is necessary to compare the net present value (NPV) of the revenue requirements of each firm.[11] As Table 14 reveals, the NPV of revenue requirements for each firm is identical. This equivalence means that the cost to the customers is the same over a complete life cycle. Consequently, the importance of cost considerations in evaluating the

TABLE 14

REVENUE REQUIREMENTS
SINGLE ASSET MODEL

Year	Firm				
	RB	RB-IDC	RB-%IDC-ITB	IDC	IDC-ITB
1971	16.00	-4.00	12.00	-4.00	-0-
1972	32.00	-8.40	24.24	-8.40	-0-
1973	82.00	102.46	85.98	102.46	98.26
1974	74.00	93.22	77.74	93.22	89.28
1975	66.00	83.98	69.50	83.98	80.29
1976	58.00	74.74	61.26	74.74	71.31
Net Present Value of Revenue Requirements at 8 Percent					
	243.20	243.20	243.20	243.20	243.20

[11]The rate used to discount the stream of revenues is the net (after-tax) rate of return. The allowed after-tax rate is 8 percent in these illustrations.

firms is secondary. The timing of payments, cash flows, and other variables become more important.

The timing of payments is important to individual customers. Current customers want to pay only for those assets which benefit them. Two of the firms examined, Firms RB and RB-%IDC-ITB, require customers to make payments during the construction period. In an on-going firm, this result means that current customers pay part of the cost of assets which are not currently used to their benefit. On the other hand, Firms RB-IDC and IDC both show negative revenues during the construction period. In an on-going firm, present customers would be receiving a benefit from construction. This benefit results from the failure to allocate the tax savings, or ITB. This reduces revenues currently required, which benefits present customers, and raises the revenues required in later years, to the detriment of future customers. Firm IDC-ITB, which capitalizes IDC and allocates the ITB, has revenues of zero during construction. This result means that present customers pay no part of the cost of assets that are to be used in the future. Firm IDC-ITB is the only firm which fully reflects the exact capital costs of construction in the cost of the asset.

Figure 2 is a graph of the revenue requirements of each firm from the single asset model. Firm RB produces the least extreme changes in revenue requirements. During construction revenues for Firm RB are the highest, and after construction they are the lowest. Firm RB-%IDC-ITB, which capitalizes a small amount of IDC, produces slightly more extreme results. Firm IDC-ITB, which, in effect, capitalizes IDC at the net rate, produces still more extreme results. Finally, Firms RB-IDC and IDC, which capitalize the most IDC, produce the widest fluctuations in

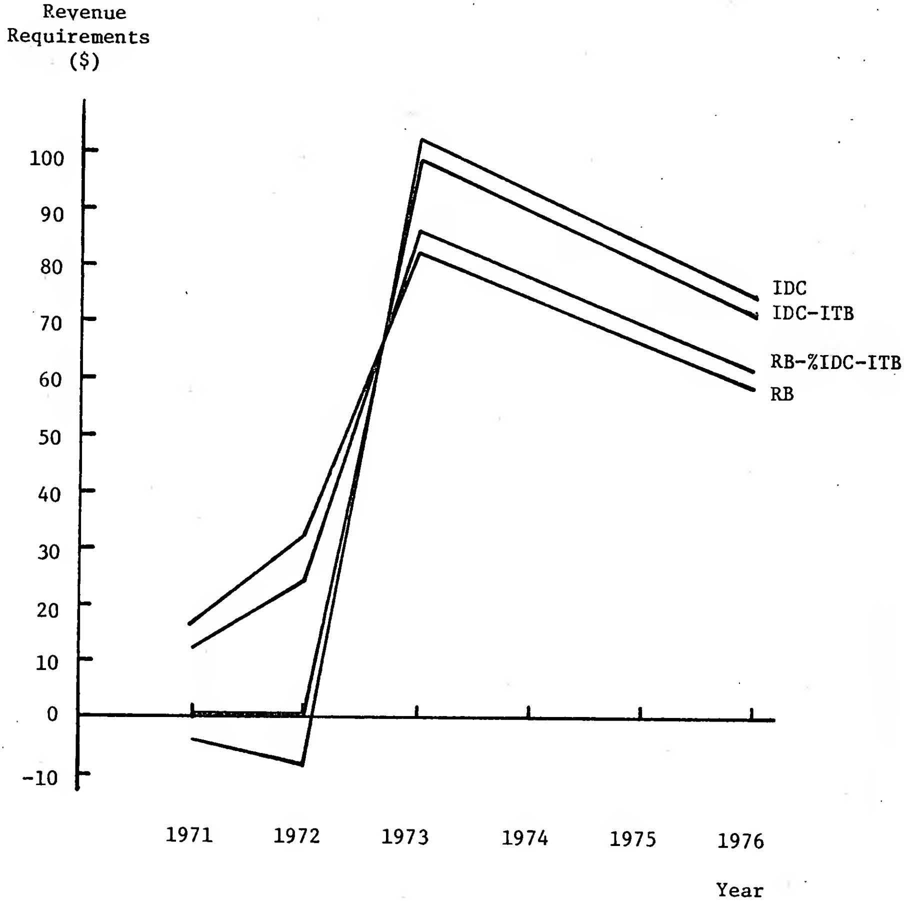

FIGURE 2

REVENUE REQUIREMENTS: SINGLE ASSET MODEL revenue requirements. In general, the more IDC capitalized, the greater the fluctuation in revenue requirements. The importance of this fluctuation depends on many other factors, particularly demand and other cost considerations. At this point, we merely recognize this fluctuation, leaving its evaluation to subsequent discussions.

Times-Interest-Earned Ratios.[12] In addition to indicating the coverage of interest charges, the times-interest-earned ratio provides a rough indication of cash flow. Table 15 summarizes these ratios for each firm in each year. Figure 3, which graphs these ratios, indicates that they respond in a manner similar to revenues. Firm RB has a constant coverage ratio. Firm RB-%IDC-ITB, which capitalizes a small amount of IDC, has relatively lower ratios during construction and somewhat higher ratios after construction. Firm IDC-ITB, which capitalizes more IDC, has more widely fluctuating ratios before and after construction, while Firms RB-IDC and IDC have ratios which fluctuate the most. Like revenues, the fluctuation increases as the amount of capitalized IDC increases. This fluctuation results from the fact that during construction, cash revenues are replaced by IDC credits, in a proportion of two-to-one. That is, for every dollar of IDC, revenues can be reduced by two dollars, since IDC is not taxable. After construction, or during the asset's useful life, an opposite effect occurs. The larger rate base of the firms which capitalize IDC cause larger cash flows relative to interest payments and the ratios are higher. Consequently, for the single asset model, more IDC

[12]Times-interest-earned is calculated as the ratio of income before taxes to interest charges. Since IDC is not cash income, it is excluded from the calculation of the coverage ratio.

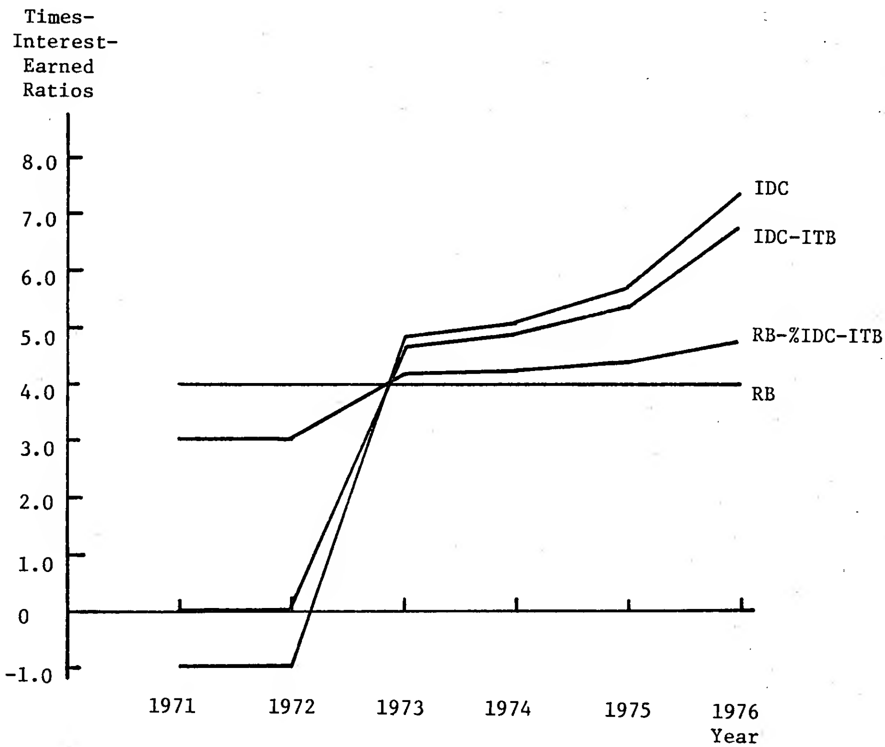

FIGURE 3

TIMES-INTEREST-EARNED RATIOS: SINGLE ASSET MODEL

TABLE 15

TIMES-INTEREST-EARNED
SINGLE ASSET MODEL

Year	Firm				
	RB	RB-IDC	RB-IDC-ITB	IDC	IDC-ITB
1971	4.00	-1.00	3.00	-1.00	-0-
1972	4.00	-1.00	3.00	-1.00	-0-
1973	4.00	4.84	4.18	4.84	4.69
1974	4.00	5.12	4.24	5.12	4.91
1975	4.00	5.68	4.37	5.68	5.37
1976	4.00	7.35	4.73	7.35	6.74

during construction makes the times-interest-earned ratios relatively low during construction and relatively high after construction ends.

The examination of these two variables has revealed that the larger the amount of IDC, the greater is the fluctuation in both revenues and times-interest-earned ratios. These results, particularly for the period after construction, are somewhat exaggerated by the use of a short depreciable life. They are further exaggerated by the absence of continued construction and growth. The results for the continuous growth model, though still not entirely realistic, more accurately depict what might be found in the real world.

Continuous Growth Model Results

Revenues. Table 16 summarizes the revenues generated in the continuous growth model, and Figure 4 illustrates them graphically. The pattern during the initial construction period resembles the pattern established in the single asset model. Also like the single asset model results, Firm RB has the highest revenues initially but the lowest later

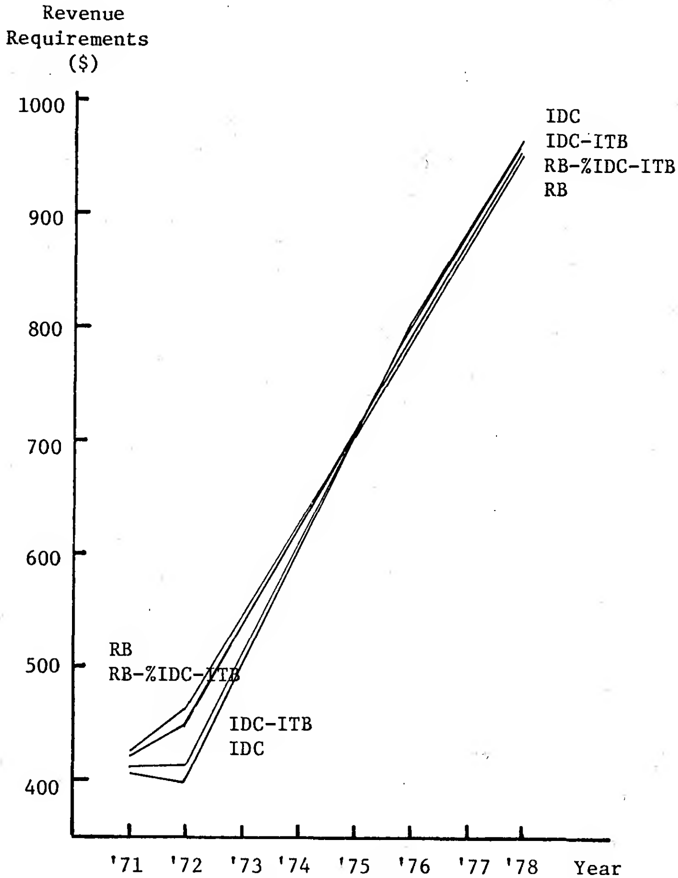

FIGURE 4

REVENUE REQUIREMENTS: CONTINUOUS GROWTH MODEL

TABLE 16

REVENUES
CONTINUOUS GROWTH MODEL

Year	Firm				
	RB	RB-IDC	RB-IDC-ITB	IDC	IDC-ITB
1970	410.00	410.00	410.00	410.00	410.00
1971	426.00	406.00	422.00	406.00	410.00
1972	458.00	397.60	446.24	397.60	410.00
1973	540.00	500.06	532.23	500.06	508.26
1974	622.00	601.28	617.97	601.28	605.54
1975	704.00	701.26	703.47	701.26	701.83
1976	786.00	800.00	788.74	800.00	797.14
1977	868.00	882.00	870.74	882.00	879.14
1978	950.00	964.00	952.74	964.00	961.14

on. The other firms follow the same relative pattern. But with continued investment, the shifts in relative position are less extreme and take longer to occur. Once a full cycle has been completed, by 1976, the annual increase in revenues is $82 for all firms. This constant increase in revenues is due to the pattern of constant growth specified in the assumptions.

Times-Interest-Earned Ratios. Table 17 summarizes the times-interest-earned ratios, which are graphed in Figure 5. Firm RB still has a constant ratio of income to interest charges. The ratios for each of the other firms decline during the first two years in proportion to the amount of IDC capitalized by each. The ratios for these firms then begin to rise and asymtotically approach the level of Firm RB as the percentage of CWIP to other assets falls. That is, as the percentage of CWIP to other assets falls, IDC as a percentage of earnings falls, and times-interest-earned ratios approach the level of Firm RB, where no IDC

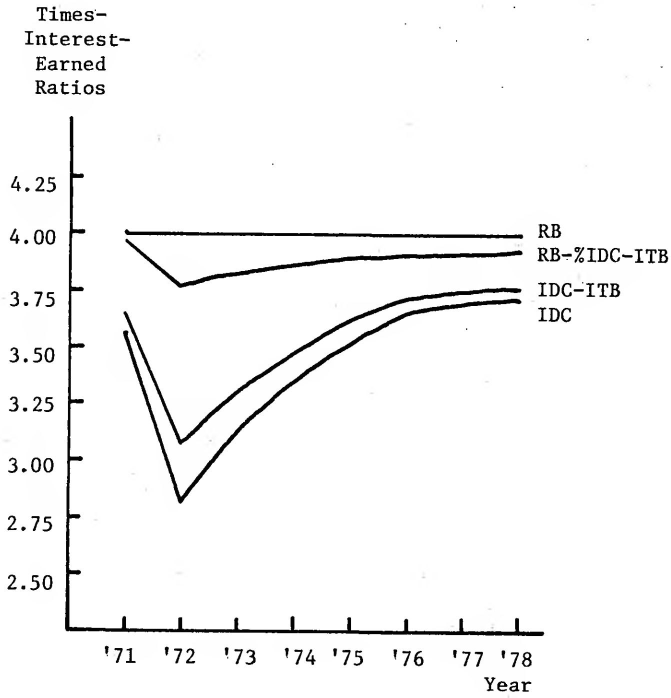

FIGURE 5

TIMES-INTEREST-EARNED RATIOS: CONTINUOUS GROWTH MODEL

TABLE 17

TIMES-INTEREST-EARNED
CONTINUOUS GROWTH MODEL

Year	Firm				
	RB	RB-IDC	RB-IDC-ITB	IDC	IDC-ITB
1970	4.00	4.00	4.00	4.00	4.00
1971	4.00	3.55	3.91	3.55	3.64
1972	4.00	2.82	3.77	2.82	3.06
1973	4.00	3.12	3.82	3.12	3.30
1974	4.00	3.34	3.87	3.34	3.47
1975	4.00	3.51	3.90	3.51	3.61
1976	4.00	3.65	3.93	3.65	3.72
1977	4.00	3.68	3.93	3.68	3.74
1978	4.00	3.70	3.94	3.70	3.76

is capitalized.

The examination of the results of both models has revealed that significant differences will result for each firm. The simplified models examined in this chapter were designed to illustrate the various firms and provide some insight into the results which might be expected. The final section of this chapter adds another degree of realism before the full computer simulation model is examined in the next chapter.

Depreciation Policies

Under the assumptions specified earlier, the firms examined followed a straight line depreciation policy. While some firms use a straight line depreciation policy for both book and tax purposes, the majority of utility companies use some form of accelerated depreciation for tax purposes. The benefits of accelerated depreciation can be handled by two basic accounting procedures. Under the flow through method, the tax savings which occur early are flowed through to reported profits. Under the normalization method, the savings are not included in reported profits but are segregated in a reserve for deferred taxes. Arguments have been made for both procedures, and both are widely used.[13] The importance of depreciation policy to this study stems mainly from the differences in the patterns of cash flow which result. Since the timing of cash flows differs due to depreciation policy,[14] and also differs depending on the policy followed for providing a return on CWIP, it will be useful to examine whether these factors are compounding and create a serious cash flow problem or, perhaps, are offsetting and minimize any potential cash flow problem. Consequently, the combination of three depreciation policies with the five methods for providing a return on CWIP produces 15 firms which are analyzed using the computer simulation model.

Summary

This chapter explained each of the various methods for providing a return on funds invested in CWIP. This was done using the single asset model, which was shown to be sufficient for the purpose of illustrating these procedures. In addition to the single asset model, a continuous growth model was presented, and the impact on revenues and times-interest-earned ratios was examined for each firm. The results indicated that significant differences between the various firms could be expected. The last section indicated that different depreciation policies are followed by firms, and these have different impacts on variables of interest to

---

[13] Brigham, E. F. and J. L. Pappas, Liberalized Depreciation and the Cost of Capital, 1970 MSU Public Utilities Studies, MSU, 1970, pp. 1-2 and 113-115.

[14] *Ibid*, Chapter 4.

this study. The result of this chapter is to suggest 15 prototype firms which are to be analyzed by the computer simulation model.

APPENDIX

As pointed out in Chapter 3, Firms IDC-ITB-G and IDC-ITB-N produce identical results and, therefore, only one of these firms needs to be analyzed. This is demonstrated below using the values of the gross and net IDC rates as specified for the single asset model.

To illustrate the equality of these two firms, Table 18 outlines the accounting treatment, the income statement effects, and the effect on the construction account, of IDC and the ITB. Part A of Table 18 illustrates the accounting treatment. For Firm IDC-ITB-G, construction is debited 10 percent and IDC income is correspondingly credited 10 percent. For the ITB, income tax expense is debited 2 percent,[15] and the construction account is credited 2 percent. For Firm IDC-ITB-N, construction is debited at the net rate of 8 percent and IDC income is credited 8 percent. The income tax expense is again debited 2 percent, but for Firm IDC-ITB-N, the offsetting transaction is a 2 percent credit to income taxes, listed under other income.

Part B of Table 18 shows the income statement effects. Income taxes are raised by 2 percent for both firms as illustrated by the accounting transactions. For Firm IDC-ITB-G, other income is raised 10 percent due to the IDC credit of 10 percent making net income 8 percent. Firm IDC-ITB-N raises other income by 10 percent also, but only 8 percent is IDC

[15]The income statements shown in Tables 10 and 13 of Chapter 3 list the ITB separately from the income tax expense. This is done merely to emphasize the ITB.

TABLE 18

ILLUSTRATION OF THE EFFECTS OF IDC AND THE ITB
FOR FIRMS IDC-ITB-G AND IDC-ITB-N

(A)
Accounting Treatment

Firm IDC-ITB-G

Debit Construction	10 Percent	
Credit IDC Income		10 Percent
Debit Income Tax Expense	2 Percent	
Credit Construction		2 Percent

Firm IDC-ITB-N

Debit Construction (Net)	8 Percent	
Credit IDC Income		8 Percent
Debit Income Tax Expense	2 Percent	
Credit Income Taxes-Other Income		2 Percent

(B)
Income Statement

	Firm IDC-ITB-G	Firm IDC-ITB-N
Income Tax	2 Percent	2 Percent
Other Income		
IDC	10 Percent	8 Percent
Income Tax Credit	-	2 Percent
Total	10 Percent	10 Percent
Net Income	8 Percent	8 Percent

(C)
Construction Account

	Firm IDC-ITB-G	Firm IDC-ITB-N
Construction Cost		
IDC	10 Percent	8 Percent
Income Tax Credit	(2 Percent)	-
Net IDC Cost	8 Percent	8 Percent

income while the other 2 percent is in the form of an income tax credit. Net income is again 8 percent, the same for both firms.

Looking next to the construction account, Part C shows that the cost of construction for both firms rises by 8 percent. For Firm IDC-ITB-G, IDC of 10 percent is added to construction, but the allocation of the 2 percent tax credit makes the net addition 8 percent. Firm IDC-ITB-N only adds IDC of 8 percent to the construction account, making the net increase the same for both firms.

As shown, the net addition to the income statement is 8 percent for both firms, as is the net addition to the construction account. Thus, both firms produce the same net results, making it necessary to examine only one of them.

CHAPTER 4

THE SIMULATION MODEL

The models of the previous chapter are too simplified to provide the kind of information necessary to evaluate the alternatives. A more realistic model which tracks the effects of the alternatives over an extended period is too cumbersome to deal with manually. Consequently, a computer simulation model is used which provides the necessary realism and flexibility for a thorough analysis.

The validity of the results and the conclusions subsequently drawn are directly related to the assumptions used in the development of the model. Rather than simply list the assumptions, this chapter provides a broad overview of the computer model, allowing the assumptions to be discussed as they arise. The chapter itself is primarily a verbal description of the model, with the important equations provided in Appendix A.

The first discussion examines some of the important considerations designed to assure that the model is both realistic and valid. Along with the assumptions, the input variables determine the usefulness of the results. The discussion of the input options illustrates the flexibility and range allowed in evaluating the alternatives. The output variables are quite numerous and indicate the measures of performance to be used in the analysis. Appendix B is the result of efforts to validate the model, and Appendix C provides a listing of the actual computer program.

General Features of the Model

This section discusses four important features of the simulation model. The model incorporates a start-up period which is necessary to avoid cycling and unrealistic beginning values. Another important aspect is the establishment of the proper timing of events to avoid a "return lag" or a built-in construction period. It is also crucial that investment is determined in a manner which maintains the comparability of the firms. Finally, and perhaps the most important aspect, is the modeling of the construction program. The realism of this feature greatly affects the usefulness and validity of the model.

The Start-Up Period

The model has been designed to allow a start-up period of 100 years. The start-up period assumes a construction period of zero,[1] which results in all firms beginning with the same initial values. The only difference in the firms at the beginning of the first year of interest is that the normalizing firms have a reserve for deferred taxes included in their capital structure. With depreciation being reinvested each year, the start-up period minimizes the cycling that would otherwise be significant. The initial 100 years also allows the cumulative reserve for deferred taxes to be established, rather than unrealistically starting it at zero. Beginning in the first year of interest, the construction activities generally assume non-zero construction periods, and this change causes the differences in firms. With respect to providing a return on CWIP, a construction period of zero would produce identical results for

[1]This is equivalent to saying that all facilities are purchased on a turn-key basis throughout the start-up period.

all firms since there would not be any construction work in progress.

Having a start-up period eliminates some potential problems and makes the model more realistic, thereby improving the quality of the results. Establishing the proper timing of events is also crucial to a realistic model.

Timing

All of the stock variables represent either beginning-of-period values or end-of-period values. Beginning-of-period values always reflect the investment made during the period. That is, all investment is made at the beginning of each period. End-of-period values reflect all the changes which occurred during the period, particularly with respect to the flow variables associated with the income statement. While flow variables represent flows which occur throughout the period, these are accounted for at the end of each period, and, for convenience, may be referred to as end-of-period values. Thus, we focus on two points in time in each period, the beginning of the period and the end of the period. With regard to the computation of such variables as interest, rate of return on equity, rate base, and others, beginning-of-period values are used. Since investments are made at the beginning of the period, there is no "return" lag built into the model. That is, all funds invested receive a full return from the moment of their commitment.

The Determination of Investment

Having assured that investments receive a full return, it is necessary to examine the procedure which determines the size of the investment made by the firms in each period. The amount of investment must be the same for all firms so that they remain comparable for evaluation. Since firms including IDC in the cost of the assets will have assets which have a higher dollar cost and, consequently, a higher book value, it is necessary to think of growth in terms of physical units. Since Firm RB includes no IDC in the cost of the asset, book value is equivalent to the actual dollar outlay of the firm. Therefore, if the assets of Firm RB grow at a rate of 10 percent, assets in physical units also grow at a 10 percent rate. This amount is then taken as the measure of investment to be made by all firms. In this way, all firms grow at a specified rate in physical units, the dollar outlay is the same for all firms, and they are comparable.

In addition to this new investment, depreciation which occurs in one year is reinvested in the following year. Since the book value of the assets will vary depending upon the amount of capitalized IDC, book depreciation will also vary for each firm. Since investment must be the same for each firm, it is necessary to reinvest a similar amount of depreciation for each firm annually. Identical investments are established by calculating depreciation on the value of the asset, excluding accumulated IDC.[2] This figure would be the same for all firms since the difference in the book value of an asset between firms is the amount of accumulated IDC. The difference between book depreciation and the figure used for reinvestment in a given year is the amount of accumulated IDC divided by the depreciable life of the asset. Table 19 illustrates a simple case

[2]The value of an asset, excluding accumulated IDC, is the value which is used in computing depreciation for tax purposes. The "IDC part" of book value is not deductible for tax purposes. This amount is equivalent to book depreciation for Firm RB, since no IDC is added to the cost of the asset for that firm.

TABLE 19

COMPARISON OF DEPRECIATION OF FIRMS RB AND IDC

	Firm RB	Firm IDC
Actual Dollar Outlay	$200.00	$200.00
Accumulated IDC	-0-	31.00
Book Value	$200.00	$231.00
Depreciable Life	4 years	4 years
Book Depreciation	$50.00	$57.75
Reinvested Depreciation based on the Value of the Asset Excluding IDC	50.00	50.00
IDC "Component" of Depreciation Written Off Each Year of the Asset Life	$ -0-	$ 7.75

using Firms RB and IDC. As shown, both firms have to make the same capital outlay, $200. The book value and, therefore, book depreciation are higher for Firm IDC due to accumulated IDC. Since the physical asset is the same for both firms, the cost to maintain it should be identical. Thus, in the example, only $50.00 is reinvested and for Firm IDC, the remainder of depreciation (the IDC part) is written off over the useful life. This procedure maintains the comparability of the firms.

The amount of depreciation reinvested annually is assumed to be immediately available for use. Therefore, it is included in the rate base in the year that it is reinvested and begins to be depreciated immediately.[3] This procedure amounts to using the depreciation which occurs in each period to maintain the full use and value of the assets. In effect,

[3]It might be helpful to think of each asset as consisting of a number of components where one component wears out each year. The component is then replaced, and the new component has a useful life of the same duration as all other assets. This simply allows the asset base to be maintained rather than being allowed to decline.

the assets last indefinitely and there is no build-up of accumulated depreciation.

We have now explored how the level of investment is determined for all the firms. The final part of this section examines how these funds are employed by the firm. The construction program is the single most important aspect of the model, since it creates the differences between the various firms.

<u>The Construction Program</u>

The importance of the construction program to a valid evaluation of the different construction accounting treatments cannot be overemphasized. The computer simulation model must accurately reproduce an actual construction program to assure realistic results upon which an evaluation may be founded. Since almost every firm will have a construction program unique in some respects, it is necessary to determine those aspects of a construction program which could influence the results. That is, we are interested in those factors which influence the pattern and magnitude of the return on CWIP, relative to the total earnings of the firm. As explained earlier, the relative importance of the return on CWIP is directly related to the ratio of CWIP to total assets. The first of these factors is the size of the annual investment in construction relative to the total assets of the firm, or the growth rate. As a variable in the model, its impact is easily examined. This factor is described more completely in the discussion of the input variables. The other factor illustrated to be of importance was the average length of the construction period.

Different types of assets require different periods for construction as well as different amounts of capital, as exemplified by the electric utility industry. While distribution facilities require relatively short periods of about one year for construction, generating plants typically require five years or more. These differences are extremely important in the accumulation of CWIP and the amount of IDC capitalized during a period. To accommodate these differences, the computer model simulates the activity of three distinct construction activities. The amount of the new investment in each period that is allocated to each activity may vary between activities and may vary through time for a particular activity. Again using the electric utility industry as the example, this recognizes the different percentages of investment allocated to distribution, transmission, and generating equipment as noted in Chapter 2. The three construction activities simulated by the model also allow the different construction periods to be recognized, which also may vary through time. This allows rather complex combinations of construction activities to be simulated.

There is one last factor which primarily influences the <u>pattern</u> of CWIP to total assets ratios. This factor is the continuity of the construction program. At one extreme is a firm which undertakes construction once over some long period. This is essentially a one-shot construction program. At the other extreme is a very large firm which continually has assets of all types going on line. With a construction period of one year or more, this firm must begin construction on each type of asset every year. The continuity of construction and the pattern of CWIP to total assets ratios will be quite different for these two firms.

The one-shot construction program is illustrated by the single asset model. However, few firms will actually fall into this category, and in any event, we are interested in the effects of a more continuous construction program. Similarly, only the very large firms will have construction programs resembling the completely continuous case. Consequently, it will be most useful to explore an intermediate situation, referred to as the normal firm construction program (NFCP), which is probably applicable to the majority of firms. The NFCP assumes that construction is continually taking place, but assumes that construction does not begin on a new asset until construction is completed on the previous asset of the same type.

The pattern of CWIP for a hypothetical firm using the NFCP is illustrated in Figure 6. The firm has three construction activities with the following investment allocations and construction periods:

Activity	Investment Allocation	Construction Period
A	.35	1
B	.15	2
C	.50	5

These could correspond to distribution, transmission, and generating equipment, respectively, for an electric utility company. The 50 percent of investment allocated to Activity C produces a sharp increase in CWIP in the first five years. CWIP builds up to a peak just before the asset goes on line and construction begins on a new one. Construction Activity A illustrates the other extreme. With a one-year construction period, CWIP does not have an opportunity to accumulate since an asset goes on line each year.

For most of the analyses presented in the following chapter, the normal firm construction program will be used since it is probably applicable to the majority of firms. However, it will also be useful to ex-

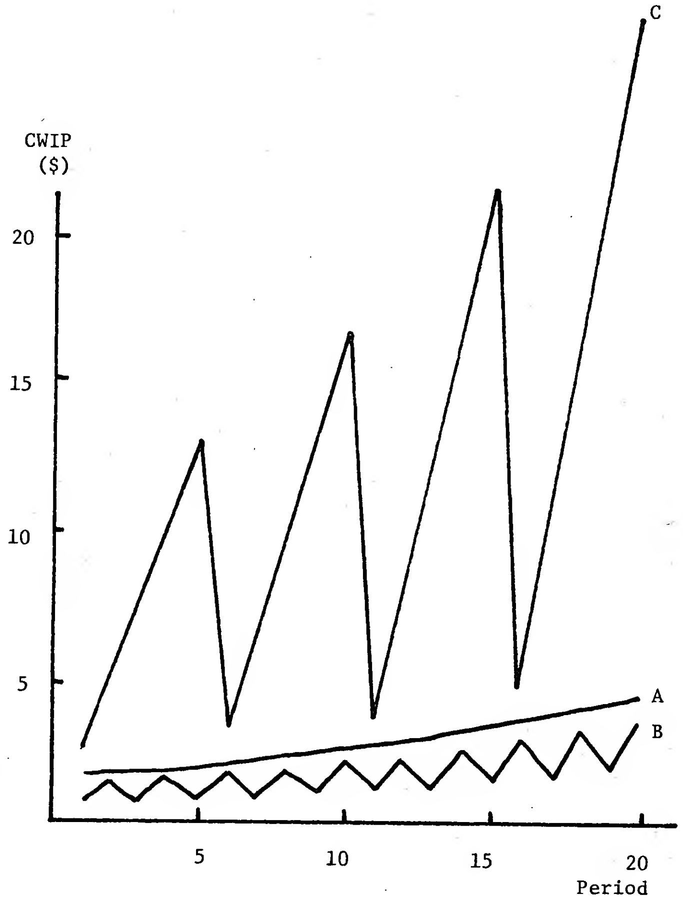

FIGURE 6

PATTERN OF CWIP FOR THREE CONSTRUCTION ACTIVITIES plore the more continuous case described earlier. This additional analysis will provide a more complete base upon which conclusions may be drawn. The computer simulation model has been designed to simulate both construction programs.

The large firm construction program (LFCP) represents the completely continuous case and assumes that construction begins in each period on each type of asset. This assumption is necessary to have new assets of each type going on line continuously. Furthermore, we assume that each asset under construction requires some investment in each period. Therefore, it is necessary to allocate funds to each of the projects under construction for each asset type. For example, a construction activity with a five-year construction period will always have five assets under construction in any period. Thus, the funds allocated to this activity must be divided between the five on-going projects.[4]

The importance of the ratio of CWIP to total assets on the output variables of the firms has been emphasized continuously. Thus, it will be useful to illustrate and compare the patterns of ratios for both construction programs. The ratios generated by the computer model are shown in Figure 7. While the NFCP produces widely fluctuating ratios, the LFCP produces a constant ratio after the first five years. Obviously, variables related to the ratio of CWIP to total assets will assume quite different patterns depending on the construction program used.

[4]Until one full construction cycle is completed for each activity, assets of each type will not be going on line in every period. In the early periods, investments that would normally be allocated to on-going projects are included directly in the rate base. For example, in period 1, only one project within a given construction activity is under construction, rather than n, as in later periods, where n is the length of the construction period. The funds normally allocated to the other n-1 projects are included directly in the rate base. The same is true for periods 2 through n-1.

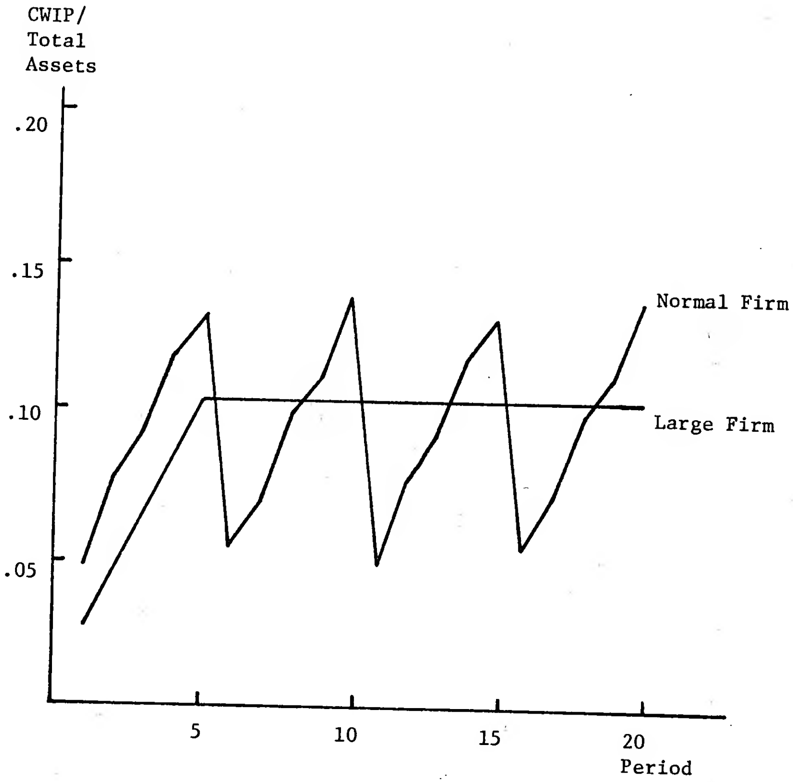

FIGURE 7

CWIP TO TOTAL ASSETS RATIOS (FIRM RB)

This discussion illustrates both the importance of the construction program and the measures taken to provide a suitable approximation of reality. The main factors which affect the pattern and magnitude of the ratio of CWIP to total assets are variable and can be considered, with the exception of the continuity of the construction program. Although the NFCP is used for most of the analyses presented in the next chapter, the impact of the LFCP is also examined to provide an adequate range of coverage for the continuity variable.

The features of the model described in this section enhance the realism and usefulness of the model. The construction program is the critical feature, and the realism of this feature determines the usefulness and validity of the model. The number of input options available in the model allow the models of the firm to be evaluated under a variety of conditions and assumptions. We now examine these input options and the restrictions on them.

Input Options

The input options were designed to provide the model with a maximum of flexibility. A value must be specified for every variable for each simulation run. Most of the variables are self-explanatory and require little discussion.

Allowed Rate of Return

The allowed rate of return is the rate of return on capital that regulatory commissions permit utility companies to earn. Since it is unnecessary for our purposes to become involved in the issues regarding a "fair" rate of return, two assumptions are made. First, we assume an original-cost method of rate base measurement, net of accumulated depreciation. Second, we assume that the allowed rate of return is equal to the weighted average cost of capital. The option does exist, however, for the allowed rate of return to be explicitly set rather than computed as the cost of capital. Both assumptions are sufficiently close to reality so as to be of little consequence.

In computing the cost of capital, the interest rate is taken as the cost of debt. For equity sources, both retained earnings and new common stock, the cost is equal to the required rate of return on equity,[5] or the stockholder discount rate. The cost of capital is then simply a weighted average of the cost of debt and the cost of equity.

Rate and Duration of Asset Growth

Regarding the growth rate, the model is designed so that four variables must be specified: 1) the initial growth rate, 2) the number of years to the final growth rate, 3) a final growth rate, and 4) a dummy variable which indicates the pattern that growth rates follow in the years between the first year and the year the final growth rate is to be in effect. This procedure allows the growth rate to begin at one level and change to a different level in some later period. The pattern that growth

[5]This implicitly assumes zero flotation costs, which is of little consequence for our purposes. If flotation costs were to be included, they could be handled in two ways. First, a weighted average cost of capital could be obtained by assuming different costs for internal (retained earnings) and external (new common stock) sources of equity. The differential would be the flotation costs. Another alternative would be to capitalize the flotation costs. The flotation costs are assumed to be an expense incurred in the development of "used and useful" assets. As such, the expense can be capitalized based on an infinite life, and included in the rate base. If properly handled, the results would be the same under either procedure.

rates follow in the intervening years may be of two types, a step-shift or an S-shaped pattern. The step-shift provides for a constant rate until the year of the change and then the new rate is assumed from that point until the end of the simulation. The S-shaped pattern provides a smoother transition from the initial rate to the final rate. Each pattern is illustrated in Table 20. A constant rate can be obtained by making the initial and final rates the same.

TABLE 20

GROWTH RATE PATTERN
Initial Growth Rate: 10%
Duration: 10 years
Final Growth Rate: 5%

Year	Step-Shift	S-Shaped
1	.1000	.1000
2	.1000	.0986
3	.1000	.0955
4	.1000	.0905
5	.1000	.0836
6	.1000	.0750
7	.1000	.0656
8	.1000	.0583
9	.1000	.0533
10	.0500	.0506
11	.0500	.0500
12	.0500	.0500
13	.0500	.0500
14	.0500	.0500
15	.0500	.0500

Length of the Simulation Period

The length of the simulation may be any integer from one to 50.

Asset Life

The model assumes all assets have the same useful life. The length may be any integer which is less than the length of the simulation period.

Construction Program

It is necessary to specify the type of the construction program the model is to assume. The two alternatives, the normal firm construction program and the large firm construction program, were explained sufficiently above.

Percent of New Investment in a Construction Activity

As indicated earlier, the percentage of new investment allocated to a construction activity may vary between construction activities and between periods for a specific activity. The only restriction is that the sum of the percentages for all construction activities in a given year must be equal to one.

Allocation of a Construction Activity's Funds to On-Going Projects

With the LFCP, the funds allocated to a specific construction activity must be divided between the on-going projects. For each activity, n projects are in progress, where n is the length of the construction period. The allocations may be made in any way between the n projects, but the sum must equal 100 percent for each activity.

Length of the Construction Period

The length of the construction period must be an integer which may vary between construction activities and may change through time for a specific construction activity. The only restriction is that the value specified for the construction period of a specific construction activity must not change during a construction cycle. For example, if the initial construction period is five years, then the value specified for the construction period should not change before year six. Then, if the construction period is to increase to six years beginning in year six, the value of the construction period should be six at least until year 11. It is possible to specify a single construction period for each construction activity, and the construction period will be constant throughout the simulation period. Conversely, the entire pattern of construction periods may be specified as indicated above.

Beginning Assets

The level of beginning assets must be specified, and this amount will be the level of assets for all firms in the first year of interest.

Debt Ratio

Any positive debt ratio[6] may be specified, and enough bonds will be sold each year to maintain this exact ratio. The debt ratio may differ for normalizing and straight line firms vis-a-vis the flow through firms; hence, two rates must be specified.

Interest Rate

The interest rate is a constant and must be specified at some positive level. Again, a different rate may be set for normalizing and straight line firms vis-a-vis the flow through firms, and two rates must

[6] The debt ratio is defined as debt/(net assets - cumulative reserve).

be provided.

Equity Rate of Return

Two equity rates must be specified since the rates may differ between the normalizing and straight line firms and the flow through firms. The rates specified apply to both retained earnings and common stock.

Tax Rate

The tax rate may assume any value from zero to less than one.

Discount Rate

The discount rate may be specified or computed as the after-tax cost of capital. The discount rate is used for discounting the stream of revenues required by each firm. Given an interest rate of 8 percent, an equity rate of 12 percent, a debt ratio of .5, and a tax rate of 50 percent, the discount rate would be 8 percent (4% x .5 + .12% x .5 = 8%).

Price-Earnings Multiplier

A P/E multiplier must be specified and is used to provide a starting point for the iterative procedure which determines the number of shares of stock outstanding, the market price of stock, and the dividends per share. The final P/E ratio will fluctuate and usually differ from that initially specified.

Beginning Shares

Some level of the beginning number of shares of stock outstanding must be specified. An adjustment is automatically made for the normalizing firm, since part of the beginning assets is financed by the deferred tax reserve.

Numerous input options allow the alternative models of the firm to be examined under a wide variety of situations. On the other hand, a wide variety of output variables allow the firms to be evaluated from a number of different perspectives.

Output Variables

The output variables provide the means for evaluating the alternative models of the firm. These variables are grouped into five categories: 1) balance sheet and related variables, 2) sources and uses of funds variables, 3) income statement variables, 4) market variables, and 5) other performance variables. Although these are not mutually exclusive categories, they are useful for expositional purposes. As with the input variables, the output variables are self-explanatory; hence, the discussions are brief.

Balance Sheet and Related Variables

The variables listed below are those normally found on a balance sheet, although due to the simplicity of the model, they are fewer in number. In addition, several other related variables are included in this part.

Rate base. The rate base is used by regulatory agencies as the measure of "prudent" investment. This amount represents the base upon which the allowed rate of return, specified by the regulatory body, is applied. The product of the rate base and the allowed rate of return represents the return to debt and equity. This product, when expanded by the revenue expansion factor,[7] yields the revenues required by the firm to cover the cost of capital after expenses.

In the simulation model, the rate base is based on the original cost of assets, less accumulated depreciation, which is in accord with the initial assumptions. All assets, except construction work in progress, are considered used and useful. For firms which include CWIP in the rate base, the rate base is equal to beginning assets. For those firms which exclude CWIP from the rate base, the rate base is equal to beginning assets, less CWIP at the beginning of the period. The rate base is always a beginning-of-period value.

<u>The addition to the rate base</u>. In any given period, the addition to the rate base represents the total amount of assets that are to go on line. This value consists of two items, newly completed assets and reinvested depreciation. Newly completed assets are those assets upon which construction was completed in the previous period. This figure may represent the finished products of one, two, or all three construction activities. Reinvested depreciation is that part of the depreciation expense from the previous period that is invested in the current period. As explained earlier, reinvested depreciation is assumed to be available for use immediately and, therefore, ready to go on line at the

[7]The revenue expansion factor is a number which increases required revenues to a level sufficient to cover not only the return to debt and equity, but also such items as state and local taxes, working capital, and miscellaneous items. In the model, the revenue expansion factor would be highly simplified, as we abstract from these kinds of variables.

start of the period in which the investment is made.

The addition to the rate base also represents the increment to the rate base at the start of a period for those firms which exclude IDC from their rate base. Finally, since the addition to the rate base represents the total new assets to go on line in a period, it is also the amount to be depreciated, for book purposes, over the next n years, where n is the asset life.

Beginning and ending assets. These variables represent the total assets of the firm, net of accumulated depreciation, at the beginning and end of each period. Beginning assets will always include any investments made at the start of that period. Ending assets then reflect any other changes in assets which occur during the period, such as IDC or depreciation.

Beginning and ending debt. These variables reflect the total debt outstanding at the beginning and end of each period. They reflect the changes in beginning and ending assets, respectively.

Beginning and ending equity. These variables represent the total equity, both retained earnings and common stock, at the beginning and end of each period. Like debt, these variables change proportionately with changes in the level of assets.

Addition to the reserve. This variable represents the tax differential which results from the use of accelerated depreciation. For flow through firms it represents the amount flowed through to profits. For the normalizing firms it represents the addition to the cumulative deferred tax reserve and is used to partially finance new investment. This value may be either positive or negative and is a flow variable which is considered an end-of-period value in the model.

Cumulative reserve. This variable has relevance only to normalizing firms, as only these firms accumulate a reserve for deferred taxes. This value represents the accumulation of the savings from the use of accelerated depreciation for tax purposes. The cumulative reserve is part of the capital structure and is assumed to have zero cost. This is a beginning-of-period value.

Construction work in progress. CWIP totals are provided for each of the construction activities. These represent the total amount of funds currently invested in each of the construction activities at the end of the period.[8]

Sources and Uses of Funds Variables

The discussion of sources and uses of funds deals with aggregate amounts rather than individual accounts. The sources of funds discussed below are: 1) cash flow, 2) additional debt, and 3) additional stock.[9] The primary use of funds is for investment.

[8]To obtain beginning-of-period values for CWIP, simply subtract the amount of IDC and add in the amount of ITB for the period.

[9]Depreciation and additions to the reserve are also sources of funds. Both of these are more appropriately discussed elsewhere in this section.

Cash flow. Cash flow represents cash generated internally by the firm, less any necessary cash expenditures. This figure takes into account cash generated by depreciation, the deferred tax reserve, retained earnings, as well as adjustments necessary for IDC. For the model, cash flow is equal to revenues less interest, taxes and dividends. The figure listed under cash flow in any period represents the funds generated from the previous period (i - 1) and available for use at the start of the current period (i). Thus, it is a beginning-of-period value.

Additional debt. To maintain a constant debt ratio, some portion of the funds necessary to finance total investment must be raised through bond issues. Hence, some additional debt must be raised in each period for a continuously growing firm. Additional debt is a beginning-of-period figure and represents any changes in debt at the end of the previous period plus any changes at the start of the current period.

Additional stock. New common stock is issued only in the event that internal sources of funds and new debt funds (necessary to maintain a constant debt ratio) are not sufficient to meet the needs of new growth. Where internal sources of funds exceed those required to finance new asset growth, common stock may actually be repurchased. Additional stock is a beginning-of-period value and represents any changes in the level of stock at the end of the previous period as well as those changes required at the beginning of the current period.

Total investment. Total investment, as explained earlier, consists of two parts, new investment and reinvested depreciation. New investment is the growth in assets from year to year. Reinvested depreciation is the other component and is used to maintain the full use and value of the assets. All investment occurs at the start of the period and is included in beginning assets.

Income Statement Variables

These variables are typically found in an income statement. They are flows which accrue throughout the simulation period but are accounted for at the end of the period.

Revenues. Revenues represent the total income to the firm after operating expenses, such as labor, fuel, etc., have been deducted. Since the firms operate with identical physical asset bases, operating expenses are assumed to be identical and we therefore abstract from them. Revenues must be sufficient to cover depreciation, taxes, interest charges, the deferred tax reserve, and the return on equity. In addition, where they exist, adjustments must be made for IDC and the ITB. Required revenues are determined by applying the revenue expansion factor to the product of the rate base and the allowed rate of return.[10] In the model we assume that actual revenues are equal to required revenues. Thus, revenues are such that the remainder, after all deductions and additions, is just sufficient to provide the desired return on equity. In the next chapter, however, we will deal with some special situations where required revenues do not produce the target rate of return.

[10]The revenue expansion factor was explained briefly in an earlier footnote. Not only is the revenue expansion factor simplified in the model, but, in reality, other adjustments to required revenues may be necessary.

Book depreciation. Book depreciation is computed on a straight line basis and is charged as an expense each year during the life of the asset. This figure represents the total book depreciation of all assets whose useful lives extend into this period. This figure is also the amount of depreciation used by the straight line firms for tax purposes.

Accelerated depreciation. Sum-of-years-digits is used to compute accelerated depreciation. The base for this calculation is the book value of an asset, less accumulated IDC.[11] This net-of-IDC value is used by the normalizing and flow through firms for computing taxes.

Taxes. The amount of taxes a firm pays is a function of revenues, tax depreciation, interest, and the tax rate. Taxable income is equal to revenues less tax depreciation and interest charges. The product of taxable income and the tax rate equals the income tax expense.

Interest-tax benefit. The ITB represents a tax savings which occurs as a result of the interest payments on the debt used to finance construction. It is computed by multiplying the total CWIP at the beginning of the period times the product of the debt ratio, the interest rate, and the tax rate. The ITB is shown as a debit (increase) to income tax expense[12] and as a credit (decrease) to the CWIP account.

---

[11]As explained in Chapter 3, the "IDC part" of the asset cost is not allowed for tax depreciation purposes.

[12]Recall that in Chapter 3, the ITB was listed separately below the tax expense on the income statement. This was done to emphasize the effect of the ITB on the income statement.

Interest during construction. IDC is computed by multiplying the amount of CWIP at the beginning of the period times the IDC rate. IDC represents the return to investors for funds allocated to CWIP. Depending on the IDC rate, this return may represent only a part or all of the return on CWIP. IDC is classified as other income and as such is included in the income statement. IDC is not considered taxable income.

Interest. The interest expense is computed by multiplying the amount of debt at the beginning of the period times the interest rate.

Profit. Profit is a residual figure which represents the return to equity. In general, profit is equal to revenues plus IDC, less taxes, depreciation, interest, the ITB, and the addition to the reserve.

Market Variables

The market variables are those which are typically of concern in the capital markets. These are all end-of-period values except shares outstanding, which is a beginning-of-period value. The determination of these variables is straightforward except for market price and the variables related to it. A special iterative procedure is used to provide more realistic, fluctuating P/E ratios.

Dividends. Dividends are computed as a function of profits, or the return to equity, and the dividend payout rate. The dividend payout rate is computed as a function of the growth rate. Zero or negative growth rates provide the maximum payout rate of 100 percent. The minimum payout rate is 40 percent and occurs with growth rates of 10 percent or more.

Between these two extremes, the payout rate is a linear function of the rate of growth.

Retained earnings. Retained earnings is simply the difference between profits and the dividend payments in a period. The value shown for retained earnings is a one-period figure and not the typical cumulative balance sheet value.

Earnings per share (EPS). EPS represents the profit at the end of a period divided by the number of shares that were outstanding at the beginning of that period.

Dividends per share (DPS), shares outstanding (SO), and market price per share (MP). Due to the interrelationship between these variables, dividends per share, shares outstanding, and market price per share are determined simultaneously. The model proceeds through successive iterations to solve this simultaneous system of equations. To explain this procedure, it is necessary to first examine the valuation model for market price per share.

The stock valuation model employed is in the Gordon-Shapiro tradition[13] in that the value of a share is the present value of the future dividend flow. The model could be represented as follows:[14]

[13]Myron J. Gordon and Eli Shapiro, "Capital Equipment Analysis: The Required Rate of Profit," Management Science, October, 1956, pp. 102-110.

[14]Although we have tried to make this chapter entirely verbal, we felt that these few equations were necessary to permit even the most basic comprehension of the material presented above.

$$MP_n = \sum_{j=n+1}^{\infty} \frac{DPS_j}{(1 + k)^{j-n}} + \frac{DPS_{NN}(1 + g_1)/k - g_1}{(1 + k)^{NN-n}}$$

and

$$MP_{NN} = \frac{DPS_{NN}(1 + g_1)}{k - g_1}$$

where NN is the length of the simulation period, k is the stockholder discount rate, and g_1 is the growth in DPS from year NN to infinity. The formulation for the "appropriate value" follows directly from the Gordon-Shapiro framework when it is assumed that DPS grows at some constant annual rate starting in the last year of the simulation run. This future constant growth rate is set equal to the growth rate of DPS in the final two years.

At this point, we are unable to determine market price, since the DPS figures are required. To derive the DPS values, we need to know the number of shares outstanding in each period. The shares outstanding could be derived by dividing the amount of funds required from stock sales in each period by the market price of the stock. Once we have the values for SO, DPS figures can be generated and the market price of the stock can be determined. However, since the market price of the stock was needed to calculate SO, we have a simultaneous system of equations which is solved by an iterative procedure.

To solve this iteratively requires arbitrarily choosing a value for one of the three variables (SO, DPS, or MP). Since the beginning shares for period one is specified (an input variable), EPS for period one can be determined. By assuming some initial P/E ratio (also specified as an input variable), a market price for period one can be determined. As a function of EPS, market price is an end-of-period value. This figure can then be used to determine the shares outstanding at the start of year two. EPS can then be calculated, and again using the constant P/E ratio, market price for year two is established. By continuing in this way, SO and MP values can be derived for every period. Given SO in every period, the matrix of DPS values can be obtained.

The second iteration is somewhat different. Given the matrix of DPS values, the modified Gordon-Shapiro model is used to determine a new matrix of market prices. This permits the computation of a new matrix of values for SO and DPS. This procedure is followed for a total of 13 iterations until the change in the variables is minimal.

Market value. Market value is the product of the number of shares outstanding at the beginning of the period and the market price per share from the previous period. Since we are interested in a beginning-of-period figure, it is necessary to use a market price representative of the beginning of the period. Shares are sold at the beginning of a period, based on the price at the end of the previous period. Thus, we use the previous period market price in determining market value.

Other Performance Variables

These variables are ratios which can be used to evaluate the performance of the alternative models of the firm. Aside from the rate of return on equity, these variables reflect the impact of the construction program and IDC on variables of interest to the market.

Rate of return on equity. This figure is computed by dividing profit by equity and indicates whether the required rate of return on equity is being met.

Times-interest-earned ratio. This ratio is defined as revenues before taxes[15] divided by interest charges. It relates the interest charges to the firm's ability to service them and is used extensively by bond rating agencies.

CWIP/beginning assets. In this case, CWIP is a beginning-of-year figure and this ratio indicates the proportion of total assets represented by construction work in progress.

IDC/earnings. This ratio indicates what proportion of total earnings (including IDC earnings[16]) are composed of IDC credits. This kind of ratio has been used by stock analysts in appraising the value of utility companies.

IDC/dividends. This ratio reveals the relationship between IDC credits[17] and dividend payments and provides some indication of the ability of a firm to meet its dividend payments out of current earnings.

Utility rates. In a rate-making situation, utility rates are established so that the product of anticipated demand and utility rates

---

[15]This amount is equal to revenues less depreciation and operating expenses.

[16]The figure used for IDC is the net amount of IDC included in the cost of an asset. By net we mean the gross amount of IDC less the interest-tax benefit.

[17]As with the previous variable, the value used for IDC is the gross amount of IDC, less the ITB.

produces required revenues. Companies normally have a fairly good estimate of the revenues required to produce a fair rate of return. They also make forecasts of demand based on certain assumptions, including assumptions about the levels of utility rates. Given this knowledge of revenue requirements and demand, utility rates, in an aggregate sense, are established.

Thus, utility rates are a function of demand. However, economic theory has demonstrated that demand is also a function of utility rates. In the rate-making process there is an implicit recognition of this interdependence between utility rates and demand. That is, different assumptions of demand produce different utility rates, and different utility rates will, in turn, produce different demands for service. The exact form of this interdependence is not easily established, nor is it within the scope of this study to attempt to do so. If the demand function facing the firms was known, and revenue requirements established, a simultaneous solution procedure would uniquely determine the necessary utility rates and demand for each of the firms. Although this would be the most desirable solution, it requires that a specific demand function be defined. A detailed investigation of the influence of demand is outside the scope of this study.[18] However, rather than ignore utility rates altogether, we assume a completely inelastic demand function which eliminates the demand-utility rate interaction. This at least provides some

[18] All studies must restrict their scope of investigation, and so it is for this investigation as well. Demand could either be explored in detail or in a highly simplified manner. It was felt that a middle ground would not be a marginally productive alternative. Although we recognize the importance of demand, constraints force us to take a simplified approach. A more rigorous investigation of demand in this context would be a valuable supplement to this study.

indication of the impact of the different alternatives on utility rates.

Even with this assumption about demand, it is necessary to specify some pattern of growth in demand over time. The patterns of growth in demand and revenue requirements determine the pattern of growth in utility rates. Since the pattern of growth in revenue requirements is set by the financial requirements of the alternatives, the pattern of demand growth specified is quite important in determining the pattern of utility rates that will result. Any interpretation of the patterns of utility rates should recognize this relationship.

Given an inelastic demand, we can assume that the firms have identical demands for service. Given some arbitrary starting point for the quantity demanded, all that is left to specify is the growth in demand. The most defensible assumption seems to be a smooth increase in the demand base, at a rate of growth equal to the rate of growth in assets. In the absence of inflation, it would be unrealistic to assume that the rate of growth in assets would be different from the rate of growth in demand, especially in the long run. Furthermore, it would be difficult to justify some uneven pattern of growth in demand that would be generalizable to the entire simulation period. Thus, we simply assume that the rate of growth in demand is equal to the rate of growth specified for assets.

Given the pattern of revenue requirements set by the alternative construction accounting methods and the pattern of growth in demand specified above, the pattern of utility rates is determined. Although the assumption of an inelastic demand function is not entirely realistic, the resulting utility rates provide some information about the impact of the different construction accounting alternatives on the patterns of utility rates.

All of the output variables mentioned in this section are provided for each of the models of the firm. The large number of variables allows the firms to be evaluated in much the same way actual firms are evaluated. For the more interested reader, Appendix A provides the equations used to derive these output variables.

Summary

This chapter has accomplished three objectives. First, we indicated the important assumptions required in the development of the model and provided enough information to allow the model to be judged as to its usefulness for the purposes stated. Toward this end a verbal description of the model was presented which is supplemented by Appendices A and B. These appendices outline the equations used as well as the results of the validation of the key subroutines and equations within the model. A copy of the actual computer program is provided in Appendix C.

Secondly, we have shown that the model is sufficiently flexible to allow evaluation under a wide range of conditions. The many input options allow different types of firms to be examined under different conditions. This framework will enhance the generality of the conclusions which will be drawn from the evaluation of the models of the firm.

Finally, this chapter has described the output variables to be used in the evaluation of the firms. This discussion should minimize the explanation of these variables required in the next chapter.

APPENDIX A

The equations presented below are not necessarily in the same form as those found in the simulation model since a number of intermediate equations were used in the actual programming to give the model a logical consistency. In some cases the equations presented have been reduced to different forms through the substitution of intermediate equations into the equations of interest. This procedure reduces the number of variables and equations which have to be presented yet accomplishes the same purpose.

In defining the variables used in the equations, it is important to differentiate between those variables which reflect end-of-period (EOP) values and those which reflect beginning-of-period (BOP) values. In addition to these stock variables, a number of flow variables are presented, particularly those related to the income statement. Though they are actually flows, the flow variables are treated as end-of-period values.

The variables are defined below and those which may change from period to period are labeled with the subscript i. Also, the variables are assumed to be beginning-of-period values unless otherwise noted in the variable definitions. In a few cases, a variable defined as EOP may be redefined as BOP for a particular equation. When this redefinition occurs, a note will appear to that effect.

Variable Definitions

GR_i = growth rate

AR = allowed rate of return

RB_i = rate base

$RBAD_i$ = rate base additions

$DEPASS_i$ = same as rate base additions but with any IDC subtracted out[19]

BA_i = beginning assets

EA_i = ending assets (EOP)

BD_i = beginning debt

ED_i = ending debt (EOP)

BE_i = beginning equity

EE_i = ending equity (EOP)

R_i = additions to the reserve (EOP)

CR_i = cumulative deferred tax reserve

$CWIP_i$ = construction work in progress--total (EOP)

TI_i = total investment

NI_i = new investment

TX = tax rate

$BKDEP_i$ = book depreciation--straight line (EOP)

DTX_i = straight line tax depreciation (EOP)

AD_i = accelerated depreciation (EOP)

IDC_i = interest during construction (EOP)

IDCR = IDC rate

ITB_i = interest-tax benefit (EOP)

---

[19] Recall from Chapter 4 that for tax depreciation purposes, no IDC is allowed. $DEPASS_i$ is the base upon which straight line tax depreciation (DTX_i) and accelerated depreciation (AD_i) are calculated.

ITBR	=	ITB rate
DR	=	debt ratio
REV_i	=	revenues (EOP)
TAX_i	=	taxes (EOP)
INT_i	=	interest (EOP)
INTR	=	interest rate
PRO_i	=	profits (EOP)
DIV_i	=	dividends (EOP)
CF_i	=	cash flow
$ADSTK_i$	=	additional stock
$ADDET_i$	=	additional debt
DP_i	=	dividend payout rate
R/E_i	=	retained earnings (EOP)
SO_i	=	shares outstanding
DPS_i	=	dividends per share (EOP)
EPS_i	=	earnings per share (EOP)
MP_i	=	market price per share of stock (EOP)
MV_i	=	market value
ROR_i	=	rate of return on equity (EOP)
TIE_i	=	times-interest-earned ratio (EOP)
C/A_i	=	ratio of CWIP to beginning assets
IDC/E_i	=	ratio of IDC to earnings (EOP)
UR_i	=	utility rate (EOP)

Equations

Where different firms require different equations, the equations are listed individually under the firm to which they apply. Also, the equations are listed in the approximate order in which they appeared in Chapter 4.

Rate Base

Firms RB, RB-IDC, RB-IDC-ITB. $RB_i = BA_i$.

Firms IDC, IDC-ITB. $RB_i = RB_{i-1} + RBAD_i - BKDEP_{i-1}$.

Rate Base Additions--Normal Firm Construction Program

$$RBAD_{i+n,j} = \sum_{m=i}^{n+i-1} (PCTIN_{mj} * NI_m) * (1 + IDCR - ITBR)^{(n+i-m)}$$

where n = length of the construction period, j is the construction activity, and $PCTIN_{mj}$ = the percent of new investment in construction activity J in period M.

This equation represents the addition to the rate base for one construction activity only. Other construction activities may begin in another period (not period i) but conclude in the same year (i + n - 1). In this case, the CWIP total from that construction activity would also be added to RBAD. Finally, depreciation (DTX) from the previous year (i + n - 1) would be added to RBAD since depreciation goes into the rate base as soon as it is reinvested.[20]

A verbal explanation will help explain the second equation for rate base additions. For each construction activity, a percent of the total investment is allocated to it each year. These investments are provided

[20]In other words, reinvested depreciation has a construction period equal to zero.

a return at the end of each year which is added to the construction account. For a five-year construction period, the first year's investment gets a total return equal to the compounded annual rate for five years. The return for the second year's investment in the same activity is the compounded annual rate for four years, and so on. The sum of these investments and their returns is the value of the asset when it goes on line. The project goes on line at the beginning of the sixth year from the year construction began.

Rate Base Additions--Large Firm Construction Program

$$RBAD_{i+n,j} = \sum_{m-i}^{n+i-1} (PCTIN_{mj} * NI_m * PCT_{jk}) * (1 + IDCR - ITBR)^{(n+i-m)}$$

where n = length of the construction period, j is the construction activity, $PCTIN_{mj}$ = the percent of new investment in construction activity j in period m, and k = m - i is an indexing parameter indicating the percent of an activity's investment allocation which is invested in each of the n projects currently under construction.

This equation represents the addition to the rate base for one construction activity only. After the first five years, each construction activity has an asset going on line in every period. Also, depreciation from the previous year (i + n - 1) would be added to RBAD since depreciation goes into the rate base as soon as it is reinvested. Thus, the total RBAD is the sum of the RBAD for each construction activity, plus reinvested depreciation.

For this construction program, we assume construction begins in every period for each construction activity. Thus, for a construction period of n years, n construction projects will always be in process for each activity. Thus, investment in each activity must be divided between n projects and this is the reason for the PCT_{jk} in the equation above. The PCT_{jk} variable is the only difference between the equations for the NFCP and the LFCP. Otherwise, the computation of the returns and the total RBAD are the same.

Beginning and Ending Assets

$$BA_i = EA_{i-1} + TI_i$$

$$EA_i = BA_i - BKDEP_i + IDC_i - ITB_i$$

Beginning and Ending Debt

$$BD_i = ED_{i-1} + (TI_i * DR)$$

$$ED_i = BD_i + (IDC_i - ITB_i - BKDEP_i - R_i) * DR$$

Beginning and Ending Equity

$$BE_i = (1 - DR) * (BA_i - CR_i)$$

$$EE_i = (1 - DR) * (EA_i - CR_i - R_i)$$

Addition to the Reserve

$$R_i = (AD_i - DTX_i) * TX$$

Cumulative Reserve

$$CR_i = CR_{i-1} + R_{i-1}$$

Construction Work in Progress[21]

[21]CWIP on the left of the equal sign is an EOP value, while CWIP on the right of the equal sign is a BOP value. The BOP value for CWIP is determined by the following formula: $CWIP_i - IDC_i + ITB_i$.

$$CWIP_i = (CWIP_i) * (1 + IDCR - ITBR)$$

Cash Flow

$$CF_i = Rev_{i-1} - INT_{i-1} - DIV_{i-1} - TAX_{i-1}$$

Additional Stock

$$ADSTK_i = TI_i * (1 - DR) - DF_i + DR * (BKDEP_{i-1} + R_{i-1} - IDC_{i-1} + ITB_{i-1})$$

Additional Debt

$$ADDET_i = (TI_i + IDC_{i-1} - ITB_{i-1} - DEPBK_{i-1} - R_{i-1}) * DR$$

Total Investment[22]

$$TI_i = DTX_{i-1} + (BA_{i-1} * GR_i)$$

Revenues, Taxes, and Profits

Normalizing Firms RB, IDC, IDC-ITB. $Rev_i = \frac{1}{1 - TX} BKDEP_i + [AR(RB_i - CR_i)] + ITB_i - [TX * (DTX_i + INT_i)]$

Normalizing Firms RB-IDC, RB-IDC-ITB. $Rev_i = \frac{1}{1 - TX} * BKDEP_i + [AR * (RB_i - CR_i)] + ITB_i - IDC_i - [TX * (DTX_i + INT_i)]$

$$TAX_i = (Rev_i - AD_i - INT_i) * TX$$

$$PRO_i = Rev_i - BKDEP_i - TAX_i - INT_i + IDC_i - ITB_i - R_i$$

[22]Total investment is the sum of reinvested depreciation (DTX) and new investment (NI). Since new investment is calculated based on Firm RB, and these figures are used for all firms, this equation holds only for Firm RB and not the others.

Straight Line Firms RB, IDC, IDC-ITB. $Rev_i = \frac{1}{1 - TX} * BKDEP_i + (AR * RB_i) + ITB_i - [TX * (DTX_i + INT_i)]$

Straight Line Firms RB-IDC, RB-IDC-ITB. $Rev_i = \frac{1}{1 - TX} * BKDEP + (AR * RB_i) + ITB_i - IDC_i - [TX * (DTX + INT_i)]$

$$TAX_i = (Rev_i - DTX_i - INT_i) * TX$$

$$PRO_i = Rev_i - BKDEP_i - TAX_i - INT_i + IDC_i - ITB_i$$

Flow Through

The initial calculations for the flow through firms are the same as the straight line firms, but recalculations are then necessary to achieve the flow through effect. These are the same for all flow through firms and are shown below.

$$Rev_i = \frac{1}{1 - TX} * (PRO_i - AD_i + BKDEP_i + ITB_i - IDC_i) + INT_i + AD_i$$

$$TAX_i = (Rev_i - AD_i - INT_i) * TX$$

$$PRO_i = Rev_i - BKDEP_i - INT_i - TAX_i - ITB_i + IDC_i$$

Book Depreciation

$BKDEP_{i+n-1} = \sum_{k=1}^{i+n-1} RBAD_i/n$, where n = depreciable life

Accelerated Depreciation

$AD_{i+n-1} = \sum_{k=1}^{i+n-1} k - i + 1/[n/2 * (n + 1)] * DEPASS_k$, where n = depreciable life

Interest During Construction[23]

$IDC_i = CWIP * IDCR$

Interest

$INT_i = BD_i * INTR$

Interest-Tax Benefit[24]

$ITBR = DR * INTR * TX$

$ITB_i = CWIP_i * ITBR$

Dividend Payout Rate

if $GR_i \geq .1$, $DP_i = .4$

if $GR_i \leq 0$, $DP_i = 1.0$

$0 \leq GR_i \leq .1$, $DP_i = 1.0 - (6 * GR_i)$

Dividends

$DIV_i = DP_i * PRO_i$

Retained Earnings

$R/E_i = PRO_i - DIV_i$

Earnings Per Share

$EPS_i = PRO_i/SO_i$

[23] $CWIP_i$ in this equation is a BOP value.

[24] CWIP in this equation is a BOP value.

Shares Outstanding

$$SO_i = SO_{i-1} + (ADSTK_i/MP_{i-1})$$

Dividends Per Share

$$DPS_i = DIV_i/SO_i$$

Market Price Per Share of Stock

$$MP_i = EPS_i * P/E\ \text{Multiplier (1st iteration)}$$ [25]

Shares Outstanding

$$SO_i = SO_{i-1} + (ADSTK_i/MP_{i-1})$$

Market Value

$$MV_i = SO_i * MP_{i-1}$$

Rate of Return on Equity

$$ROR_i = PRO_i/BE_i$$

Times-Interest-Earned Ratios

$$TIE_i = (Rev_i - BKDEP_i)/INT_i$$

CWIP/Assets[26]

$$C/A = CWIP_i/BA_i$$

[25] Recall the iterative procedures outlined in Chapter 4, by which the values for market price are finally established.

[26] CWIP represents a BOP value in this equation.

IDC/Earnings

$$IDC/E_i = (IDC_i - ITB_i)/PRO_i$$

IDC/Dividends

$$IDC/DIV_i = (IDC_i - ITB_i)/DIV_i$$

Utility Rate[27]

$$UR_i = Rev_i/Demand$$

[27] The variable "demand" used in this equation is defined as explained earlier in this chapter.

APPENDIX B

In this appendix we seek to offer some proof of the validity of the simulation model. That is, we will show that the model performs in a manner consistent with our expectations and as we have explained the model in Chapter 4. Though there are a number of ways to validate a model, we have chosen to focus on the technique of hand simulation. In addition to hand simulation, internal checks can be programmed into the model to show that it performs properly. Internal checks can be made to some extent by determining the values for two related variables in different ways and then checking to see that the relationship between these two variables has held throughout a simulation run. Though these results are not reported, where this type of check was possible, the model conformed to our expectations. Finally, after careful checking of the results of a typical simulation run, gross errors reveal themselves. This check has also been made and again the basic results are in line with our expectations. Our main offering of validity, however, is the hand simulation. Below we provide the results of the hand simulation of key subroutines and almost all of the equations in the model. The equations are those found in Appendix A and the values presented coincide with the order of the variables in those equations.

Since the equations used are the same for all firms in many cases, it will not be necessary to validate each equation for each firm. Thus, different firms are randomly selected to confirm different equations where it is convenient to do so. Similarly, the years chosen for validation are randomly selected. This procedure provides a thorough check without being exhaustive.

The results of three different simulation runs are used as a matter of convenience. In the second and third runs, only one variable is changed from Run I. The next section shows the combinations of input values used in the validation.

Input Value Combinations

Run I

Beginning Assets = 100.00

Debt Ratio = 50%

Interest Rate = 8%

Equity Rate of Return = 12%

Allowed Rate of Return = 10%

Consumers' Discount Rate = 8%

Beginning Shares = 1

P/E Multiplier = 15

Length of Simulation Run = 50 years

Asset Life = 30 years

Growth Rate = 10% (constant)

Construction Program = Normal Firm Construction Program

Tax Rate = 50%

Construction Activity Parameters
I - 20% of new investment, 1 year construction period
II - 30% of new investment, 2 year construction period
III - 50% of new investment, 5 year construction period

Run II

All values are the same as Run I except the asset life is four years in this instance.

Run III

All values are the same as Run I except that the construction program used is the LFCP rather than the NFCP.

The subroutines are all validated using Run II, with the exception of the subroutine which generates CWIP using the LFCP, which is validated using Run III. All the remaining equations are then validated using Run I.

Validation of Subroutines

Construction Work in Progress Subroutine--Normal Firm Construction Program

This subroutine is validated for all "IDC cases."[28] The first case covers seven periods, which is more than one complete cycle of the subroutine, and indicates that the subroutine functions properly. Two periods are then all that is necessary for the other cases to indicate their validity. New investment and straight line tax depreciation are given, and the other values shown in Table 21 can be calculated according to the equations given in Appendix A.

[28]The phrase "IDC cases" is used to refer to the firms which differ in their method of providing a return on CWIP, and not in their depreciation policy.

TABLE 21

VALUES DERIVED USING THE NFCP
(Dollars)

Period	NI	CWIP-1	CWIP-2	CWIP-3	IDC	ITB	DTX	RBAD
Firm RB								
1	9.09	1.82*	2.73	4.55	-0-	-0-	35.91	--
2	10.00	2.00*	5.73*	9.55	-0-	-0-	37.12	37.73
3	11.00	2.20*	3.30	15.05	-0-	-0-	39.28	44.85
4	12.10	2.42*	6.93*	21.10	-0-	-0-	39.69	41.48
5	13.31	2.66*	3.99	27.75*	-0-	-0-	43.28	49.04
6	14.64	2.93*	8.38*	7.32	-0-	-0-	52.26	73.69
7	16.11	3.22*	4.83	15.38	-0-	-0-	56.95	63.57
Firms IDC, RB-IDC								
1	9.09	2.00*	3.00	5.00	.91	-0-	35.91	--
2	10.00	2.20*	6.60*	11.00	1.80	-0-	37.12	37.91
3	--	--	--	--		--	--	45.92
Firm IDC-ITB								
1	9.09	1.96*	2.95	4.91	.91	.18	35.91	--
2	10.00	2.16*	6.42*	10.70	1.79	.36	37.12	37.87
3	--	--	--	--	--	--	--	45.70
Firm RB-IDC-ITB								
1	9.09	1.85*	2.78	4.64	.36	.18	35.91	--
2	10.00	2.04*	5.90	9.83	.70	.35	37.12	37.76
3	--	--	--	--	--	--	--	45.06

*The asterisk indicates that this value of CWIP goes into the addition to the rate base in the following period. In other words, that is the value of CWIP at the end of the construction period.

Construction Work in Progress Subroutine--Large Firm Construction Program

Only one firm (Firm RB) needs to be checked to validate this subroutine. Once the rates for IDC and the ITB have been shown to be correct, as the previous validation established, it is only necessary to validate the basic mechanisms of this subroutine. Table 22 provides the values used in the validation. New investment and straight line deprecia-

TABLE 22

VALUES DERIVED USING THE LFCP
(Dollars)

Period	NI	CWIP-1	CWIP-2	CWIP-3	IDC	ITB	DXT	RBAD
1	9.09	1.82	1.36	1.36	-0-	-0-	4.43	8.50
2	10.00	2.00	4.36	4.11	-0-	-0-	4.69	10.93
3	11.00	2.20	4.80	8.24	-0-	-0-	5.02	10.98
4	12.10	2.42	5.28	13.68	-0-	-0-	5.35	11.24
5	13.31	2.66	5.81	20.34	-0-	-0-	5.69	17.45
6	14.64	2.93	6.60	22.37	-0-	-0-	6.23	

tion are again given, and the others are derived from them.

Book Depreciation Subroutine

For this subroutine it is only necessary to examine one IDC case (Firm RB). Rate base additions (RBAD), derived earlier, are given and book depreciation is derived from it. Straight line depreciation is used, thus $1/n^{th}$ of the rate base addition is depreciated over n years, where n is the asset life. The results are presented in Table 23.

TABLE 23

VALUES DERIVED FROM THE BOOK DEPRECIATION SUBROUTINE
(Dollars)

Period	RBAD	$1/n^{th}$ of RBAD	BKDEP
1	34.72	8.68	--
2	37.73	9.43	--
3	44.85	11.21	--
4	41.48	10.31	39.69
5	49.04	12.26	43.27
6	73.69	18.42	52.26

Accelerated Depreciation Subroutine

The variable which is given in this validation is the value of an asset, less accumulated IDC (DEPASS). As explained before, the "IDC part" of the book value is not deductible for tax purposes. Sum-of-years-digits depreciation is the form of accelerated depreciation used. Again, only one firm needs to be examined, since DEPASS is the same for all firms. The values are provided in Table 24.

TABLE 24

VALUES DERIVED FROM THE ACCELERATED DEPRECIATION SUBROUTINE
(Dollars)

Period	DEPASS	Accelerated Depreciation
1	34.72	--
2	37.73	--
3	44.85	--
4	41.48	41.07
5	49.04	44.80
6	73.69	56.98

This completes the validation of the key subroutines in the model. In the next section, the equations found in Appendix A are validated, with the exception of those covered in the subroutine validation.

Validation of Equations

Since most of the equations are the same for each firm, only one IDC case is used, and the one used is indicated in parentheses. Also, where the normalizing depreciation policy is used, it is denoted by an N after the firm (e.g., Firm IDC-N). Otherwise, the flow through and straight line cases, which are generally identical, are used. Where these two differ, the one used is denoted by an F or an S, respectively. The period used in the validation is given first, then the values of the variables are presented in the order shown in Appendix A.

Rate Base (Firm IDC)

10 188.61 = 184.84 + 12.42 - 8.65

11 265.88 = 188.60 + 86.29 - 9.01

Beginning Assets (Firm RB)

2 110.01 = 95.73 + 14.28

3 121.01 = 105.55 + 15.46

Ending Assets (Firm IDC)

25 1108.95 = 1121.77 - 39.68 + 26.86 - 0

26 1205.98 = 1242.61 - 49.44 + 12.81 - 0

Beginning Debt (Firm IDC-ITB-N)

15 193.76 = 170.17 + (47.17 * .5)

16 215.00 = 189.12 + (51.75 * .5)

Ending Debt (Firm RB-IDC-N)

20 318.41 = 323.15 + (18.35 - 0 - 23.96 - 3.87) * .5

21 344.14 = 359.73 + (6.12 - 0 - 31.23 - 6.07) * .5

Beginning Equity (Firm RB-N)

1 45.33 = (1 - .5) * (100.00 - 9.35)

2 49.94 = (1 - .5) * (110.01 - 10.14)

Ending Equity (Firm RB-IDC-ITB)

49	4810.76 = (1 - .5) * (9621.52 - 0 - 0)
50	5311.16 = (1 - .5) * (10622.32 - 0 - 0)

Addition to the Reserve (Firm RB-IDC-ITB-N)

5	.88 = (7.23 - 5.47) * .5
6	1.28 = (9.19 - 6.63) * .5

Cumulative Reserve (Firm RB-N)

9	17.37 = 16.05 + 1.32
10	18.82 = 17.38 + 1.44

Construction Work in Progress (Firm IDC-ITB)

20	192.48 = 178.22 * 1.08
21	66.05 = 61.16 * 1.08

Cash Flow (Firm IDC)

40	225.67 = 687.19 - 169.91 - 101.94 - 189.67
41	209.74 = 687.51 - 187.47 - 112.49 - 177.81

Additional Stock (Firm IDC-ITB-N)

2	1.70 = 14.28 (.5) - 7.61 + .5 (4.28 + .79 - .91 + .18)
3	2.21 = 15.46 (.5) - 7.42 + .5 (4.46 + .76 - 1.79 + .36)

Additional Debt (Firm IDC-ITB-N)

10	11.71 = (29.57 + 4.77 - .95 - 8.54 - 1.44) * .5
11	13.64 = (32.05 + 6.87 - 1.37 - 8.89 - 1.39) * .5

Total Investment (Firm RB)

2 $14.28 = 4.28 + (100 * .1)$

3 $15.45 = 4.45 + (110.01 * .1)$

Revenues--Normalizing

Firms RB, IDC, IDC-ITB (Firm RB).

1 $$18.78 = \frac{1}{1 - .5} * 4.28 + [.1 * (90.65)] + 0 - [.5 * (4.28 + 3.63)]$$

Firms RB-IDC, RB-IDC-ITB (Firm RB-IDC).

3 $$18.56 = \frac{1}{1 - .5} * 4.87 + [.1 * (112.81)] + 0 - 2.20 - [.5 * (4.83 + 4.51)]$$

Taxes--Normalizing (Firm RB)

5 $7.16 = (26.90 - 7.23 - 5.36) * .5$

Profit--Normalizing (Firm RB)

10 $13.03 = 43.19 - 8.47 - 11.62 - 8.68 + 0 - 0 - 1.39$

Revenues--Straight Line, Initial Flow Through

Firms RB, IDC, IDC-ITB (Firm IDC).

2 $$18.61 = \frac{1}{1 - .5} * 4.46 + [.1 * (92.91)] + 0 - [.3 * (4.45 + 4.44)]$$

Firms RB-IDC, RB-IDC-ITB (Firm RB-IDC).

2 $$18.61 = \frac{1}{1 - .5} * 4.46 + [.1 * (110.91)] + 0 - 1.80 - [.5 * (4.45 + 4.44)]$$

Taxes--Straight Line, Initial Flow Through (Firm IDC)

2 $$4.86 = (18.61 - 4.45 - 4.44) * .5$$

Profit--Straight Line, Initial Flow Through (Firm IDC)

2 $$6.65 = 18.61 - 4.46 - 4.86 - 4.44 + 1.80 - 0$$

Revenues--Recalculation for Flow Through (Firm IDC)

2 $$17.08 = \frac{1}{1 - .5} * (6.65 - 5.98 + 4.46 + 0 - 1.80) + 4.44 + 5.98$$

Taxes--Recalculation for Flow Through (Firm RB-IDC)

$$3.33 = (17.08 - 5.98 - 4.44) * .5$$

Profit--Recalculation for Flow Through (Firm RB-IDC)

$$6.65 = 17.08 - 4.46 - 4.44 - 3.33 - 0 + 1.80$$

Interest During Construction (Firm RB-IDC-ITB)

40 $$43.99 = 1099.76 * .04$$

41 $$16.46 = 411.47 * .04$$

Interest (Firm RB-N)

2 $$3.99 = 49.93 * .08$$

3 $4.40 = 55.05 * .08$

Interest--Tax Benefit (Firm RB-IDC-ITB)

40 $22.00 = 1099.76 * .02$

41 $8.23 = 411.47 * .02$

Dividends (Firm RB)

30 $38.07 = .4 * 95.18$

31 $41.88 = .4 * 104.70$

Retained Earnings (Firm RB-IDC-ITB)

40 $151.97 = 253.29 - 101.32$

41 $167.44 = 279.07 - 111.63$

Earnings Per Share (Firm RB)

20 $22.65 = 36.70/1.62$

21 $24.32 = 40.37/1.66$

Dividends Per Share (Firm RB)

40 $36.71 = 98.75/2.69$

41 $39.36 = 108.63/2.76$

Shares Outstanding (Firm IDC)

2 $1.03 = 1.00 + (1.85/54.95)$

3 $1.07 = 1.03 + (2.40/60.96)$

Market Value (Firm IDC)

5 79.44 = 1.17 * 67.90

6 88.90 = 1.22 * 72.87

Rate of Return on Equity (Firm RB)

10 .12 = 14.15/117.90

11 .12 = 15.56/129.69

Times-Interest-Earned Ratios (Firm RB-5)

15 4.0 = (74.54 - 12.78)/15.19

16 4.0 = (86.60 - 16.76)/16.71

CWIP/Assets (Firm RB-IDC-ITB)

1 .0909 = 9.09/100.00

2 .1581 = 17.42/110.19

IDC/Earnings (Firm IDC-ITB-N)

25 .3415 = (26.06 - 5.21)/61.05

26 .1509 = (12.75 - 2.55)/67.59

IDC/Dividends (Firm IDC-ITB-N)

30 .9407 = (46.23 - 9.25)/39.31

31 .2910 = (15.86 - 3.17)/43.61

Utility Rate (Firm RB-N)

2 .2256 = 20.43/90.57

7 .2275 = 33.18/145.86

APPENDIX C

```
      DOUBLE PRECISICN ZINV(150,3),YINV(150,3),CWIPT1(150,3),
     1CWIPT2(150,3),CWIPT3(150,3),CWIP1(150),CWIP2(150),CWIP3(150),
     1DEPEK(150,3),ABEG(150,3),AENC(150,3),AMIDC(150,3),
     3                         RATBAS(150,3),XTBT(150,3),TINV(150,3),
     4READ(150,3) ,              TOTDPV(3),       BEGIN
      DIMENSICN PCTIN(50),                  BEGDET(150,3),ENDDET(150,3),
     1DRT(3),            XINTER(150,3),REVENU(150,3),TAXES(150,3),
     2PROFIT(150,3),GROW(150,3),                RTIDC(3),PTCWIP(50,3)
      DIMENSION EQUITY( 50,3),ROR( 50,3),FCC( 50,3),ENCEQ( 50,3)
      DIMENSION SUM(150,3),RESERV(150,3),CUMRES(150,3),DEPASS(150,3)
      DIMENSICN AINV(150,3),EINV(150,3),CEPTX(150,3)
      DIMENSION PCTIN1( 50),PCTIN2( 50),PCTIN3( 50),KONPR1( 50),
     1KONPR2( 50),KCNPR3( 50)
      DIMENSICN DPC( 50,3),DIV( 50,3),RETEAR( 50,3)
      DIMENSION SHARES(50,3),EPS(50,3),DPS(50,3),PRICE(50,3),
     1CSHFLC(51,3),           BADSTK(50,3),EADSTK(50,3)
      DIMENSION              VALMKT(50,3),EARIDC(50,3)
      DIMENSION DIVID(3),DIVIDC(50,3),CFCOMP(50,3),RVCOMP(50,3)
      DIMENSICN ADDSTK(50,3),ADDCET(50,3),HOLDCF(50,3),HOLDRV(50,3)
      DIMENSION CWIPA1(15),CWIPA2(15),CWIPA3(15),DEPAT1(15),CEPAT2(15),
     1DEPAT3(15),PCTA1(15),PCTA2(15),PCTA3(15),PCT(50)
      DIMENSION DEMANC(50),URATE(50,3),FXRATE(3),CFSHAR(50,3),AVEROR(3)
      DIMENSION HOLCFS(50,3),CFSCOM(50,3),RORRB(50,3),JLQ(3)
      DIMENSICN CPU(50,3),ACTPLT(50)
C
C  THIS REACS THE NUMBER OF TIMES THE PROGRAM IS TO RUN
C
      READ(5,1997)NCRUNS
 1997 FORMAT(I1)
C
      DO 1998 NOR=1,NCRUNS
C
      READ(5,2410)PCT1,PCT2,PCT3,KCN1,KON2,KON3,INVPAT,NUMIDC,JHIFT,
     1JGROW,JPCTCG,JKCNCG,IFXRAT ,IIYEAR,ITSTYR,BUPPER,BLOWER,NSKIP2,
     2NSKIP3,NSKIP4,NSKIP5,NEW1,NEW2,NEW3,NEW4,NEW5,IYRCHG,DPCT  ,
     3JPTINF,IPLLAG,MTSYR
 2410 FORMAT(3F3.2,3I2,2I1,I2,5I1,I2,2F3.3,9I1,I2,F2.2,2I1,I2)
      READ(5,2411)ABEG(1,3),P,P2,NN,N,CERATE,DRFLOW,ZINRTE,ZNFLOW,RN,RF,
     1RFLCW,RST,ZMULT,ZFLCW,TX,BEGSHA,CN,DF,PCTINF
 2411 FORMAT(F4.1,2F3.3,I3,I2,8F3.3,2F3.2,F3.3,F3.1,3F3.3)
      JJ=NN+100
C
C  TO HAVE VARIABLE PERCENTAGES CF INVESTMENT IN EACH CONSTRUCTION
C  PROGRAM, READ IN A VALUE CF JPCTCG = 1 AND PUT DATA ON CARDS IN
C  PRESCRIBED FORMAT TO EE READ IN
C
      IF(JPCTCG-1)4001,4002,4002
 4002 READ(5,4000)(PCTIN1(I),I=1,NN)
      READ(5,4000)(PCTIN2(I),I=1,NN)
      READ(5,4000)(PCTIN3(I),I=1,NN)
 4000 FORMAT(40F2.2)
      GO TC 4010
 4001 DC 4006 I=1,NN
      PCTIN1(I)=PCT1
```

```
      PCTIN2(I)=PCT2
 4006 PCTIN3(I)=PCT3
 4010 CONTINUE
C
C  TO HAVE VARIABLE CONSTRUCTION PERIODS, READ IN A VALUE OF JKONCG = 1
C  AND PUT DATA ON CARDS IN PRESCRIBED FORMAT
C******CAUTION*****IF THIS OPTION IS EXERCISED, DO NOT CHANGE THE VALUE
C  OF A CONSTRUCTION PERIOD WITHIN A CYCLE--FOR EXAMPLE--IF THE
C  CONSTRUCTION PERIOD IN PERIOD ONE IS SET = 5, DO NOT CHANGE THE VALUE
C  OF THE CONSTRUCTION PERIOD UNTIL PERIOD 6---OR IF THE CONSTRUCTION
C  PERIOD IS SET = 3 IN PERIOD SEVEN, DO NOT CHANGE THE VALUE OF THE
C  CONSTRUCTION PERIOD UNTIL PERIOD TEN
C
      IF(JKONCG-1)4003,4004,4004
 4004 READ(5,4005)(KONPR1(I),I=1,NN)
      READ(5,4005)(KONPR2(I),I=1,NN)
      READ(5,4005)(KONPR3(I),I=1,NN)
 4005 FORMAT(40I2)
      GO TO 4011
 4003 DO 4007 I=1,NN
      KONPR1(I)=KON1
      KONPR2(I)=KON2
 4007 KONPR3(I)=KON3
 4011 CONTINUE
      IF(JPTINF-1)4080,4081,4081
C
C  THIS SETS THE PERCENT INFLATION FIGURE TO THE INPUT VALUE
C
 4080 DO 4082 I=1,NN
 4082 PCTIN(I)=PCTINF
      GO TO 4083
C
C  THIS READS IN VARIABLE PERCENT INFLATION FIGURES
C
 4081 READ(5,4084)(PCTIN(I),I=1,NN)
 4084 FORMAT(20F4.4)
 4083 CONTINUE
      DO 2945 I=1,JJ
      DO 2945 J=1,3
      TINV(I,J)=0.0
 2945 ZINV(I,J)=0.0
      ABEG(1,1)=0.0
      ABEG(1,2)=0.0
      DO 2901 I=1,JJ
      DO 2901 J=1,3
 2901 GROW(I,J)=0.0
C
C  THIS SETS THE INVESTMENT  ALLOCATION FOR EACH CONSTRUCTION ACTIVITY
C  USING THE LFCP
C
      DO 4450 I=1,15
      PCTA1(I)=0.0
      PCTA2(I)=0.0
 4450 PCTA3(I)=0.0
```

```
      PCTA1(1)=1.
      PCTA2(1)=.5
      PCTA2(2)=.5
      PCTA3(1)=.3
      PCTA3(2)=.25
      PCTA3(3)=.2
      PCTA3(4)=.15
      PCTA3(5)=.1
C
C   SET GROWTH RATES FOR ENTIRE SIMULATICN RUN
C
      JJG=JHIFT+100-1
C
C   JGRCW = -- C=STEF-SHIFT, 1= S-SHAPE, 2= READ IN VALUES
C
      IF(JGRCW -1)24C5,2406,5507
 2405 DC 2407 I=1,JJG
      DC 24C7J=1,3
 2407 GROW(I,J)=P
      M=JJG+1
      DO 24C8 I=M,JJ
      DO 2408 J=1,3
 2408 GRCW(I,J)=P2
      GO TO 2409
 2406 INDEX=3
C
C  S-SHAPE ROUTINE MAKES THE CHANGE TO THE NEW GROWTH RATE SMOOTH,
C  RATHER THAN A STEF SHIFT
C
      CALL SSHAPE(P,JHIFT,P2,GROW,JJ,INDEX)
 2409 CCNTINUE
      GO TO 5511
 5507 DO 55C8 I=1,100
      DO 5508 J=1,3
 5508 GROW(I,J)=P
C
C  THIS READS IN VARIABLE GRCWTH RATES FOR THE LAST 50 PERIODS
C
      READ(5,5509)(GROW(I,3),I=101,JJ)
 5509 FORMAT(40F2.2)
      DO 5510 I=101,JJ
      DC 5510 J=1,2
 5510 GROW(I,J)=GRCW(I,3)
 5511 CONTINUE
      DRT(1)=DBRATE
      DRT(2)=DRFLOW
      DRT(3)=DBRATE
C
C   THE PAYCUT RATIC IS A FUNCTICN OF THE GROWTH RATE--IT FLUCTUATES
C   BETWEEN .4 FOR A GROWTH RATE OF 10 PER CENT OR HIGHER AND 1.0 FOR A
C   FIRM WITH A GROWTH RATE CF ZERC CR NEGATIVE
C
      DO 2699 I=1,NN
      DO 2699 J=1,3
```

```
      DPO(I,J)=1.0-(6.*GROW(I,J))
      IF(GROW(I,J)-.1)2601,2602,2602
 2601 IF(GROW(I,J)-.0)2603,2603,2699
 2602 DPO(I,J)=0.4
      GO TO 2699
 2603 DPO(I,J)=1.0
 2699 CONTINUE
C
C  THE ALLOWED RATE OF RETURN CAN BE SPECIFIED OR CALCULATED AS THE
C  WEIGHTED AVERAGE COST OF CAPITAL.  IF IT IS TO BE COMPUTED, READ
C  IN RN = 0.0
C
      IF(RN-0.0)4998,4998,4997
 4998 RN=DERATE*ZINRTE+(1.-DERATE)*RST
      RF=DRFLOW*ZNFLOW+(1.-DRFLOW)*RFLOW
 4997 CONTINUE
C
C   COMPUTE LIMITS WHERE EUPPER AND ELOWER ARE PERCENTAGE BOUNDS
C
      AUCL=RN *(1.+EUPPER)
      ALCL=RN *(1.-ELOWER)
C
C  DISCOUNTS BEGINNING ASSETS SO THAT THEY = 100. IN YEAR 101
C
      BEGIN=ABEG(1,3)/((1.+P)**101)
C
C
      DO 8002 I=1,NN
 8002 PCT(I)=0.0
      PLTLAG=0.0
      MO=0
C
C  THE USER MUST CONSIDER THE FOLLOWING IN USING THE PLANT LAG SITUATION
C   1. MO IS THE YEAR THE ASSET IS TO BE FINISHED AND MUST BE SET = I+ 100.
C   2.  MO CAN ONLY BE USED WITH THE THIRD CONSTRUCTION ACTIVITY AND MUST BE
C      SET AT THE END OF A CONSTRUCTION CYCLE, IE., FOR A FIVE YEAR CYCLE ANY
C  YEAR DIVISIBLE BY FIVE IS ACCEPTABLE (5,10, 15, ETC.).
C   3.  PCT(I) INDICATES THE PERCENT OF THE LAGGING ASSET UPON WHICH REVENUES
C      ARE NOT EARNED IN PERIOD I.
C
      IF(IPLLAG-1)8000,8001,8001
 8001 READ(5,8003)(PCT(I),I=1,NN)
 8003 FORMAT(40F2.2)
      READ(5,8004)MC
 8004 FORMAT(I3)
 8000 CONTINUE
C
C  THIS SETS THE YEAR THE CONSTRUCTION  ACCOUNTING TREATMENT IS TO
C  CHANGE
C
      MYRCHG=IYRCHG+100
C
C     FROM THIS POINT, RUNS THROUGH THE PROGRAM COMPLETELY FOR EACH IOC CASE
C*******NPASS = 1 IS THE CWIP IN THE RATE BASE CASE*********************
```

```
C*******NPASS = 2 IS THE IDC CAPITALIZATION CASE************************
C*******NPASS = 3 IS THE IDC-TAX ALLOCATION CASE************************
C*******NPASS = 4 IS THE RB-IDC CASE************************************
C*******NPASS = 5 IS THE RB-IDC-ITB CASE********************************
C
C
C  IF A CHANGE IN CONSTRUCTION ACCOUNTING TREATMENT  IS DESIRED FROM RB,
C  THIS PROVIDES FOR A SIXTH RUN SINCE THE FIRST RUN (NPASS=1) MUST BE
C  RUN IN THE NORMAL WAY
C
      IF(NEW1 .EQ. 1) GO TO 4102
 4103 NUMIDC=NUMIDC+1
 4102 CONTINUE
      DO 2899 NPASS=1,NUMIDC
C
C  THE PROGRAM MUST ALWAYS DO NPASS = 1 BECAUSE SOME VALUES ESTABLISHED
C  IN IT ARE NECESSARY FOR FUTURE CASES...  HOWEVER, TO SKIP ANY OF THE
C  OTHER CASES, SIMPLY SPECIFY NSKIP2, NSKIP3, NSKIP4, NSKIP5 EQUAL TO 1
C  CORRESPONDING TO NPASS=2 (IDC), NPASS=3 (IDC-ITB), ETC.
C
      GO TO (5500,5502,5504,5505,5506,5500),NPASS
 5502 IF(NSKIP2-1)5500,2899,2899
 5504 IF(NSKIP3-1)5500,2899,2899
 5505 IF(NSKIP4-1)5500,2899,2899
 5506 IF(NSKIP5-1)5500,2899,2899
 5500 CONTINUE
      DO 2950 J=1,3
      DO 2950 I=2 ,JJ
 2950 ABEG(I,J)=0.0
C
C     INITIALIZE VALUES
C
      DO 2509 I=1,50
      DO 2509 J=1,3
 2509 ADDDET(I,J)=0.0
      XTBN=0.0
      XTBF=0.0
      DO 2903I=1 ,JJ
      CWIP1(I)=0.0
      CWIP2(I)=0.0
      CWIP3(I)=0.0
      DO 2903 J=1,3
      BEGDET(I,J)=0.0
      ENDDET(I,J)=0.0
      AMIDC(I,J)=0.0
      CWIPT1(I,J)=0.0
      CWIPT2(I,J)=0.0
      CWIPT3(I,J)=0.0
      YINV(I,J)=0.0
      RATBAS(I,J)=0.0
      XTBT(I,J)=0.0
      DEPASS(I,J)=0.0
      CUMRES(I,J)=0.0
      RESERV(I,J)=0.0
```

```
      SUM(I,J)=0.0
      DEPTX(I,J)=0.0
 2903 DEPBK(I,J)=0.0
   41 ZINV(I,3)=BEGIN*GROW(1,3)
      ZINV(I,2)=BEGIN*GROW(1,2)
      TINV(1,3)=ZINV(1,3)
      TINV(1,2)=ZINV(1,2)
 2969 ABEG(1,3)=BEGIN+TINV(1,3)
      ABEG(1,2)=BEGIN+TINV(1,2)
      M1=0
      M2=0
      M3=0
      K1=0
      K2=0
      K3=0
      DAT1=0.0
      DAT2=0.0
      DAT3=0.0
      I=1
      DEPINV=0.0
 2890 DO 2927 M=1,3
      JLO(M)=0
 2927 RTIDC(M)=0.0
C
C  INVPAT SET = 0 CALLS SUBROUTINE CWIPS---SET = 1 CALLS CWIPS3
C
 2898 IF(INVPAT-1)93,94,94
   93 CALL CWIPS1(ZINV,PCTIN1,PCTIN2,PCTIN3,KONPR1,KONPR2,KONPR3,YINV,
     1CWIPT1,CWIPT2,CWIPT3,CWIP1,CWIP2,CWIP3,AMIDC,RTIDC,M1,M2,M3,I,
     2XTBT,            XTEN,XTEF,DEPASS,DAT1,DAT2,DAT3,K1,K2,K3,JJ,MO,
     3PLTLAG,DEPINV,DPCT)
      GO TO 97
   94 CALL CWIPS3 (ZINV,PCTIN1,PCTIN2,PCTIN3,KONPR1,KONPR2,KONPR3,YINV,
     1CWIPT1,CWIPT2,CWIPT3,CWIP1,CWIP2,CWIP3,AMIDC,RTIDC,I,JJ,
     2XTBT,XTBN,XTEF,DEPASS,PCTA1,PCTA2,PCTA3,DEPINV,DPCT)
   97 RBAD(I,3)=YINV(I,3)
      READ(I,2)=YINV(I,2)
      CALL DEP (READ,DEPBK,I,N,JJ,BEGIN,DEPASS,DEPTX)
      AEND(1,3)=ABEG(1,3)-DEPBK(1,3)+AMIDC(1,3)-XTBT(1,3)
      AEND(1,2)=ABEG(1,2)-DEPBK(1,2)+AMIDC(1,2)-XTBT(1,2)
 2975 DO 2800 I=2 ,JJ
      IF(I-101)5408,5409,5410
 5409 MPASS=NPASS
      GO TO 5411
C
C  THE FOLLOWING SECTION THRU 5411 SETS THE NEW. CONST. ATG. TREATMENT
C  TO BE USED.  SIMPLY SPECIFY NEW1,NEW2,ETC.. TO THE CORRESPONDING
C  NEW CONST. ATG. METHOD --EG.. TO CHANGE FORM RB TO IDC SET NEW1=2,
C  FROM IDC TO RB. SET NEW2=1,ETC.
C  TO KEEP THE SAME CONST. ATG. METHOD THROUGHOUT. SIMPLY SET NEW1=1,
C  NEW2=2, NEW3=3,ETC.
C
 5410 IF(MYRCHG-I)5408,5414,5408
 5414 CONTINUE
```

```
      GO TO (5408,5416,5417,5418,5419,5420),NPASS
 5416 MPASS=NEW2
      GO TO 5411
 5417 MPASS=NEW3
      GO TO 5411
 5418 MPASS=NEW4
      GO TO 5411
 5419 MPASS=NEW5
      GO TO 5411
 5420 MPASS=NEW1
      GO TO 5411
 5411 CONTINUE
C
C  THIS SETS THE RATE FOR IDC AND THE ITB USED FOR EACH OF THE FIRMS
C
      GO TO (5401,5402,5405,5406,5407,5401),MPASS
 5401 DO 5404 J=1,3
 5404 RTIDC(J)=0.0
      XTBN=0.0
      XTBF=0.0
      GO TO 5400
 5402 RTIDC(1)=DBRATE*ZINRTE+(1.-DBRATE)*RST
      RTIDC(2)=DRFLOW*ZNFLOW+(1.-DRFLOW)*RFLOW
      RTIDC(3)=DBRATE*ZINRTE+(1.-DBRATE)*RST
      GO TO 5400
 5405 RTIDC(1)=DBRATE*ZINRTE+(1.-DBRATE)*RST
      RTIDC(2)=DRFLOW*ZNFLOW+(1.-DRFLOW)*RFLOW
      RTIDC(3)=DBRATE*ZINRTE+(1.-DBRATE)*RST
      XTBN=DBRATE*ZINRTE*TX
      XTBF=DRFLOW*ZNFLOW*TX
      GO TO 5400
C
C   IF A RATE OTHER THAN THE CALCULATED IDC RATE IS DESIRED, CHANGE THE
C    VALUE OF  PASS4
C
 5406  PASS4=DBRATE*ZINRTE+(1.-DBRATE)*RST
      RTIDC(1)= PASS4
      RTIDC(2)= PASS4
      RTIDC(3)= PASS4
      GO TO 5400
 5407 XTBN=DBRATE*ZINRTE*TX
      XTBF=DRFLOW*ZNFLOW*TX
      RTIDC(1)=ZINRTE*DBRATE
      RTIDC(2)=ZNFLOW*DRFLOW
      RTIDC(3)=ZINRTE*DBRATE
      GO TO 5400
 5400 CONTINUE
 5408 CONTINUE
C
C     INVESTMENT FOR ALL CASES IS THE SAME--IT IS THE AMOUNT DETERMINED
C     IN THE FIRST IDC CASE
C
   42 IF(NPASS-1)2946,2946,2947
 2946 ZINV(I,3)=ABEG(I-1,3)*GROW(I,3)
```

```
      ZINV(I,2)=ABEG(I-1,2)*GROW(I,2)
C
C     DEPTX IS THAT PART CF INVESTMENT (REINVESTED DEPRECIATICN) WHICH
C     GCES CIRECTLY INTO THE RATE BASE
C
 2840 TINV(I,3)=ZINV(I,3)+DEPTX(I-1,3)
      TINV(I,2)=ZINV(I,2)+DEPTX(I-1,2)
 2947 ABEG(I,3)=AEND(I-1,3)+TINV(I,3)
      AEEG(I,2)=AEND(I-1,2)+TINV(I,2)
      DEPINV=DEPTX(I-1,3)
C
C  INVPAT SET = 0 CALLS SUBROUTINE CWIPS---SET = 1 CALLS CWIPS3
C
      IF(INVPAT-1)95,96,96
   95 CALL CWIPSI(ZINV,PCTIN1,PCTIN2,PCTIN3,KONPRI,KONPR2,KONPR3,YINV,
     1CWIPT1,CWIPT2,CWIPT3,CWIP1,CWIP2,CWIP3,AMIDC,RTIDC,M1,M2,M3,I,
     2XTBT,            XTBN,XTBF,DEPASS,DAT1,DAT2,DAT3,K1,K2,K3,JJ,MO,
     3PLTLAG,DEPINV,DPCT)
      GO TO 99
   96 CALL CWIPS3 (ZINV,PCTIN1,PCTIN2,PCTIN3,KONPR1,KONPR2,KONPR3,YINV,
     1CWIPT1,CWIPT2,CWIPT3,CWIP1,CWIP2,CWIP3,AMIDC,RTIDC,I,JJ,
     2XTBT,XTBN,XTBF,DEPASS,PCTA1,PCTA2,PCTA3,DEPINV,DPCT)
   99 CCNTINUE
C
C  THIS ALLOWS CEPRECIATICN TO BE USED FOR CONSTRUCTION OR GO INTO THE
C  RATE BASE IMMEDIATELY--IF INVDEP = 1. DEPRECIATION IS USED FOR CONSTRUCTION
C  IF INVDEP = 0. DEPRECIATICN GOES INTO THE RATE BASE DIRECTLY
C
C
C  DEPTX IS PART CF TCTAL INVESTMENT, IE.. REINVESTED DEPRECIATION.
C  DPCT OF DEPRECIATICN IS INVESTED IN CONSTRUCTION WHILE (1 - DPCT)
C  GOES DIRECTLY INTO THE RATE BASE.
C
   98 READ(I,3)=YINV(I,3)+(DEPTX(I-1,3)*(1.-DPCT))
      RBAD(I,2)=YINV(I,2)+(DEPTX(I-1,2)*(1.-DPCT))
      DEPASS(I,3)=DEPASS(I,3)+(DEPTX(I-1,3)*(1.-DPCT))
      DEPASS(I,2)=CEPASS(I,2)+(DEPTX(I-1,2)*(1.-DPCT))
 2741 CONTINUE
      CALL CEP (READ,CEPBK,I,N,JJ,BEGIN,DEPASS,DEPTX)
      AEND(I,2)=ABEG(I,2)-DEPBK(I,2)+AMIDC(I,2)-XTBT(I,2)
 2800 AEND(I,3)=ABEG(I,3)-DEPBK(I,3)+AMICC(I,3)-XTBT(I,3)
C
C  THIS SETS VALUES FCR CTHER CEPRECIATION CASES WHEN EQUAL TO THE
C  STRAIGHT LINE VALUES
C
      DO 2941 I=1,JJ
      ABEG(I,1)=ABEG(I,3)
      AEND(I,1)=AEND(I,3)
      ZINV(I,1)=ZINV(I,3)
      TINV(I,1)=TINV(I,3)
      RBAD(I,1)=RBAD(I,3)
      DEPBK(I,1)=DEPBK(I,3)
      AMIDC(I,1)=AMICC(I,3)
      XTBT(I,1)=XTET(I,3)
```

```
      CWIPT1(I,1)=CWIPT1(I,3)
      CWIPT2(I,1)=CWIPT2(I,3)
      CWIPT3(I,1)=CWIPT3(I,3)
      YINV(I,I)=YINV(I,3)
 2941 DEPTX(I,1)=DEPTX(I,3)
C
      MPASS=NPASS
      DO 5430 I=1,JJ
      DO 5429 J=1,3
      IF(MYRCHG-I)5427,5428,5427
 5428 GO TO (5427,5422,5423,5424,5425,5426),NPASS
C
C  THIS PART, UP TO 5427, SETS THE NEW METHOD FOR DETERMINING THE RATE
C   BASE WHEN THE CONST. ATG. METHOD CHANGES
CC
 5422 MPASS=NEW2
      GO TO 5427
 5423 MPASS=NEW3
      GO TO 5427
 5424 MPASS=NEW4
      GO TO 5427
 5425 MPASS=NEW5
      GO TO 5427
 5426 MPASS=NEW1
      GO TO 5427
C
C  THIS PART , THRU 5430, DETERMINES THE RATE BASE FOR EACH CASE
C
 5427 GO TO (5440,5441,5441,5440,5440,5440),MPASS
 5440 RATBAS(I,J)=ABEG(I,J)
      GO TO 5429
 5441 IF(I-1)5431,5431,5432
 5431 RATBAS(1,J)=BEGIN+RBAD(1,J)
      GO TO 5429
 5432 RATBAS(I,J)=RATBAS(I-1,J)+RBAD(I,J)-DEPBK(I-1,J)
 5429 CONTINUE
 5430 CONTINUE
C
C  DETERMINES ACCELERATED DEPRECIATION AND CUMMULATIVE RESERVE FOR THE FIRM
C
 2933 CALL ACCDEP (DEPASS,SUM,N,JJ,BEGIN)
      DO 2920 I=1,JJ
 2920 RESERV(I,1)=(SUM(I,1)-DEPTX(I,1))*TX
      CUMRES(1,1)=0.0
      DO 2921 I=2,JJ
 2921 CUMRES(I,1)=RESERV(I-1,1)+CUMRES(I-1,1)
      CALL DEBT (ACCDET,        BEGDET,ENDDET,TINV,DRT,AMIDC,XTBT,DEPBK,
     1RESERV,JJ,BEGIN)
C
C  THIS DETERMINES THE INTEREST IN EACH PERIOD
C
      DO 2949 I=1,JJ
      XINTER(I,1)=ZINRTE*BEGDET(I,1)
      XINTER(I,2)=ZNFLCW*BEGDET(I,2)
```

```
 2949 XINTER(I,3)=ZINRTE*BEGDET(I,3)
 2415 DC 2802 I=1,JJ
C
C  PAT, PLTLAG, ETC., ALLOWS SOME PART OF REVENUES TO BE DEDUCTED FROM
C    WHAT THEY WOULD CTHERWISE BE, AS IF THERE EXISTED SCME LAG IN THE ABILITY
C    OF AN ASSET TO GENERATE FULL REVENUES.
C
      IF(I-100)333,333,334
 333  PAT=0.0
      GO TO 335
  334 M=I-1C0
      PAT=PCT(M)
  335 CCNTINUE
C
C  THIS SECTICN CALCULATES REVENUE,PROFITS, AND TAXES
C
C     STRAIGHT LINE CCMPANIES
C
      IF(NPASS-3)2815,2815,2816
C
C      CASES RB, ICC, ICC-ITB
C
 2815 REVENU(I,3)=(1./(1.-TX))*(DEPBK(I,3)+RN*RATBAS(I,3)+XTBT(I,3)-TX*
     1(DEPTX(I,3)+XINTER(I,3)))
      GO TO 2817
C
C       CASES RB-IDC ANC RE-ICC-ITB
C
 2816 REVENU(I,3)=(1./(1.-TX))*(DEPBK(I,3)+RN*RATBAS(I,3)-AMIDC(I,3)+
     1XTBT(I,3)-TX*(DEPTX(I,3)+XINTER(I,3)))
 2817 CONTINUE
      REVENU(I,3)=REVENU(I,3)-((1./(1.-TX))*RN*PLTLAG*PAT)
      TAXES(I,3)=(REVENU(I,3)-DEPTX(I,3)-XINTER(I,3))*TX
      PROFIT(I,3)=REVENU(I,3)-DEPBK(I,3)-XINTER(I,3)-TAXES(I,3)+
     1AMIDC(I,3)-XTET(I,3)
C
C       FOR NORMALIZING COMPANIES
C
      IF(NPASS-3)2818,2818,2819
C
C       CASES RB,ICC,ICC-ITE
C
 2818 REVENU(I,1)=(1./(1.-TX))*(DEPBK(I,1)+RN*(RATBAS(I,1)-CUMRES(I,1))+
     1XTBT(I,1)-TX*(DEPTX(I,1)+XINTER(I,1)))
      GO TO 2820
C
C      CASES RB-IDC AND RE-IDC-ITB
C
 2819 REVENU(I,1)=(1./(1.-TX))*(DEPBK(I,1)+RN*(RATBAS(I,1)-CUMRES(I,1))-
     1AMIDC(I,1)+XTBT(I,1)-TX*(DEPTX(I,1)+XINTER(I,1)))
 2820 CCNTINUE
      REVENU(I,1)=REVENU(I,1)-((1./(1.-TX))*RN*PLTLAG*PAT)
      TAXES(I,1)=(REVENU(I,1)-SUM(I,1)-XINTER(I,1))*TX
      PROFIT(I,1)=REVENU(I,1)-DEPBK(I,1)-TAXES(I,1)-XINTER(I,1)+
```

```
     1AMIDC(I,I)-XTET(I,I)-RESERV(I,I)
C
C        FOR FLOW THROUGH COMPANIES
C
C        AS IF THEY WERE STRAIGHT LINE COMPANIES
C
      IF(NPASS-3)2821,2821,2822
C
C       CASES RB, IDC, IDC-ITE
C
 2821 REVENU(I,2)=(1./(1.-TX))*(DEPBK(I,2)+RF*RATBAS(I,2)+XTBT(I,2)-TX*
     1(DEPTX(I,2)+XINTER(I,2)))
      GO TO 2823
C
C        CASES RB-IDC AND RB-IDC-ITB
C
 2822 REVENU(I,2)=(1./(1.-TX))*(DEPBK(I,2)+RF*RATBAS(I,2)-AMIDC(I,2)+
     1XTBT(I,2)-TX*(DEPTX(I,2)+XINTER(I,2)))
 2823 CONTINUE
      REVENU(I,2)=REVENU(I,2)-((1./(1.-TX))*RN*PLTLAG*PAT)
      TAXES(I,2)=(REVENU(I,2)-DEPTX(I,2)-XINTER(I,2))*TX
      PROFIT(I,2)=REVENU(I,2)-DEPBK(I,2)-XINTER(I,2)-TAXES(I,2)+
     1AMIDC(I,2)-XTBT(I,2)
C
C         RECALCULATIONS FOR FLOW THROUGH COMPANIES
C
      REVENU(I,2)=(1./(1.-TX))*(PROFIT(I,2)-SUM(I,2)+DEPBK(I,2)+
     1XTBT(I,2)-AMIDC(I,2))+XINTER(I,2)+SUM(I,2)
      TAXES(I,2)=(REVENU(I,2)-SUM(I,2)-XINTER(I,2))*TX
      PROFIT(I,2)=REVENU(I,2)-DEPBK(I,2)-XINTER(I,2)-TAXES(I,2)-
     1XTBT(I,2)+AMIDC(I,2)
 2802 CONTINUE
      XTBNI=DBRATE*ZINRTE*TX
      XTBFI=DRFLOW*ZNFLOW*TX
C
C    IF THE DISCOUNT RATE IS NOT SPECIFIED IT IS COMPUTED BASED ON THE
C    DEBT RATIO, THE INTEREST RATE, AND  THE RATE OF RETURN FOR EQUITY
C
      IF(DN-0.0)2417,2418,2417
 2418 DN=DERATE*ZINRTE+(1.-DERATE)*RST-XTBNI
      DF=DRFLOW*ZNFLOW+(1.-DRFLOW)*RFLOW-XTBFI
 2417 CONTINUE
C
C   THIS MERELY SHIFTS THE VALUES FROM PERIODS 101-150 TO 1-50
C
      DO 2967 I=1,NN
      LO=I+100
      DO 2967 J=1,3
      YINV(I,J)=YINV(LO,J)
      BINV(I,J)=ZINV(LO,J)
      DEPASS(I,J)=DEPASS(LO,J)
      AINV(I,J)=TINV(LO,J)
      ABEG(I,J)=ABEG(LO,J)
      AEND(I,J)=AEND(LO,J)
```

```
      RATEAS(I,J)=RATEAS(LO,J)
      DEPBK(I,J)=DEPBK(LC,J)
      SUM(I,J)=SUM(LC,J)
      RESERV(I,J)=RESERV(LC,J)
      CUMRES(I,J)=CUMRES(LO,J)
      CWIPT1(I,J)=CWIPT1(LO,J)
      CWIPT2(I,J)=CWIPT2(LC,J)
      CWIPT3(I,J)=CWIPT3(LO,J)
      CWIP1(I)=CWIP1(LO)
      CWIP2(I)=CWIP2(LO)
      CWIP3(I)=CWIP3(LO)
      AMIDC(I,J)=AMIDC(LC,J)
      RBAD(I,J)=RBAD(LC,J)
      XTBT(I,J)=XTBT(LO,J)
      BEGDET(I,J)=BEGDET(LO,J)
      ENDDET(I,J)=ENDDET(LO,J)
      XINTER(I,J)=XINTER(LO,J)
      REVENU(I,J)=REVENU(LC,J)
      PROFIT(I,J)=PROFIT(LO,J)
      TAXES(I,J)=TAXES(LC,J)
      DEPTX(I,J)=DEPTX(LO,J)
 2967 GROW(I,J)=GROW(LC,J)
C
C   THIS SECTION DETERMINES THE DEMAND
C
 4095 IF(NPASS-1)4092,4092,4093
 4092 DEMI00=REVENU(100,3)*4.
C
C  THE FOLLOWING DETERMINES THE DEMAND GROWTH  RATE,IE., WE ASSUME THAT
C  THE GROWTH IN PHYSICAL ASSETS IS PCTIN  GREATER THAN THE GROWTH
C  IN DEMAND.  THIS CAN REPRESENT EITHER AN INFLATIONARY FACTOR OF
C  PCTINF PERCENT PER YEAR OR A CONSTANT RISE IN COST PER UNIT OF SERVICE.
C  TO MAKE THE GROWTH RATE FOR DEMAND THE SAME AS ASSETS, SET PCTINF = 0.0.
C
      DEMAND(1)=DEMI00*(1.0+(GROW(1,3)/(1.0+PCTIN(I))))
 4096 DO 4090 I=2,NN
 4090 DEMAND(I)=DEMAND(I-1)*(1.0+(GROW(I,3)/(1.0+PCTIN(I))))
C
C   THIS SECTION DETERMINES UTILITY RATES
C
 4093 DO 4091 I=1,NN
      DO 4091 J=1,3
 4091 URATE(I,J)=REVENU(I,J)/DEMAND(I)
      DO 2720 I=1,NN
      DO 2720 J=1,3
      IF(J-2)2713,2714,2713
 2713 EQUITY(I,J)=(1.-DBRATE)*(ABEG(I,J)-CUMRES(I,J))
      ENDEQ(I,J)=(1.-DBRATE)*(AEND(I,J)-CUMRES(I,J)-RESERV(I,J))
      GO TO 2720
 2714 EQUITY(I,J)=(1.-DRFLOW)*ABEG(I,J)
      ENDEQ(I,J)=(1.-DRFLOW)*AEND(I,J)
 2720 CONTINUE
C
C  IF IFXRAT = 1, REVENUES ARE CALCULATED USING A FIXED UTILITY RATE
```

```
C    AND TAXES AND PROFITS ARE RECALCULATED---IF IFXRAT = 0 SKIP THIS SECTION
C
      IF(IFXRAT-1)4074,4075,4075
 4075 DO 4070 J=1,3
C
C    IIYEAR = 0 SETS FIXED UTILITY RATE AT VALUE ESTABLISHED IN YEAR 0 --
C    IIYEAR = 1 SETS FIXED UTILITY RATE AT VALUE ESTABLISHED IN YEAR 1 --
C
      IF(IIYEAR-1)4077,4078,4078
 4077 FXRATE(J)=REVENU(100,J)/DEMICO
      GO TO 4070
 4078 FXRATE(J)=REVENU( 1,J)/DEMAND(1)
 4070 CONTINUE
      DO 3101 J=1,3
      I=0
 3100 CONTINUE
      I=I+1
      IF(I- 50)3106,3106,3107
 3106 URATE(I,J)=FXRATE(J)
      REVENU(I,J)=DEMAND(I)*URATE(I,J)
      IF(J-2)3102,3103,3104
 3102 TAXES(I,1)=(REVENU(I,1)-SUM(I,1)-XINTER(I,1))*TX
      PROFIT(I,1)=REVENU(I,1)-DEPBK(I,1)-TAXES(I,1)-XINTER(I,1)+
     1AMIDC(I,1)-XTET(I,1)-RESERV(I,1)
      GO TO 3105
 3103 TAXES(I,2)=(REVENU(I,2)-SUM  (I,2)-XINTER(I,2))*TX
      PROFIT(I,2)=REVENU(I,2)-DEPBK(I,2)-XINTER(I,2)-TAXES(I,2)+
     1AMIDC(I,2)-XTET(I,2)
      GO TO 3105
 3104 TAXES(I,3)=(REVENU(I,3)-DEFTX(I,3)-XINTER(I,3))*TX
      PROFIT(I,3)=REVENU(I,3)-DEPBK(I,3)-XINTER(I,3)-TAXES(I,3)+
     1AMIDC(I,3)-XTBT(I,3)
 3105 CONTINUE
      GO TO (3350,3350,3351,3352,3352),NPASS
 3350 RORRB(I,J)=(REVENU(I,J)-DEPBK(I,J)-TAXES(I,J)-RESERV(I,J))/
     1(RATBAS(I,J)-CUMRES(I,J))
      GO TO 3353
 3351 RORRB(I,J)=(REVENU(I,J)-DEPBK(I,J)-TAXES(I,J)-XTBT(I,J)-
     1RESERV(I,J))/(RATBAS(I,J)-CUMRES(I,J))
      GO TO 3353
 3352 RORRB(I,J)=(REVENU(I,J)-DEPBK(I,J)-TAXES(I,J)-XTBT(I,J)+
     1AMIDC(I,J)-RESERV(I,J))/(RATBAS(I,J)-CUMRES(I,J))
 3353 CONTINUE
C
C    CHECK TO SEE IF THE RATE OF RETURN IS WITHIN ACCEPTABLE LIMITS
C   IF A CONSTANT UTILITY RATE IS DESIRED FOR THE ENTIRE PERIOD, SIMPLY
C    SET WIDE LIMITS---IE., SET BUPPER AND BLOWER = 1.0
C
      IF(I-NTSYR)3380,3381,3381
 3381 IF(RORRB(I,J).LT.ALCL.OR.RORRB(I,J).GT.AUCL) GO TO 3110
 3380 CONTINUE
      GO TO 3100
 3110 CONTINUE
      JLQ(J)=JLQ(J)+1
```

```
C
C   IF ITSTYR = -1  USE A PAST TEST YEAR TO SET THE NEW UTILITY RATE
C   IF ITSTYR =  0 USE THE CURRENT YEAR TO SET THE NEW UTILITY RATE
C   IF ITSTYR =  1  USE A FUTURE TEST YEAR TO SET THE NEW UTILITY RATE
C
      IF(ITSTYR-0)3120,3121,3122
 3120 M=I
      GO TO 3109
 3121 M=I+1
      GO TO 3109
 3122 M=I+2
 3109 CONTINUE
      IF(M-50)3385,3385,3386
 3386 M=50
 3385 IF(J-2)3111,3112,3113
 3111 IF(NPASS-3)3130,3130,3131
 3130 REV1        =(1./(1.-TX))*(DEPBK(M,1)+RN*(RATBAS(M,1)-CUMRES(M,1))+
     1XTBT(M,1)-TX*(DEPTX(M,1)+XINTER(M,1)))
      GO TO 3140
 3131 REV1        =(1./(1.-TX))*(DEPBK(M,1)+RN*(RATBAS(M,1)-CUMRES(M,1))-
     1AMIDC(M,1)+XTBT(M,1)-TX*(DEPTX(M,1)+XINTER(M,1)))
 3140 FXRATE(J)=REV1/DEMAND(M)
      GO TO 3114
 3112 IF(NPASS-3)3132,3132,3133
 3132 REV2        =(1./(1.-TX))*(DEPBK(M,2)+RF*RATBAS(M,2)+XTBT(M,2)-TX*
     1(DEPTX(M,2)+XINTER(M,2)))
      GO TO 3141
 3133 REV2        =(1./(1.-TX))*(DEPBK(M,2)+RF*RATBAS(M,2)-AMIDC(M,2)+
     1XTBT(M,2)-TX*(DEPTX(M,2)+XINTER(M,2)))
 3141 FXRATE(J)=REV2/DEMAND(M)
      GO TO 3114
 3113 IF(NPASS-3)3134,3134,3135
 3134 REV3        =(1./(1.-TX))*(DEPBK(M,3)+RN*RATBAS(M,3)+XTBT(M,3)-TX*
     1(DEPTX(M,3)+XINTER(M,3)))
      GO TO 3142
 3135 REV3        =(1./(1.-TX))*(DEPBK(M,3)+RN*RATBAS(M,3)-AMIDC(M,3)+
     1XTBT(M,3)-TX*(DEPTX(M,3)+XINTER(M,3)))
 3142 FXRATE(J)=REV3/DEMAND(M)
 3114 CONTINUE
      GO TO 3100
 3107 CONTINUE
 3101 CONTINUE
 4074 CONTINUE
      DO 4088 I=1,NN
      DO 4088 J=1,3
      IF(EQUITY(I,J)-0)4086,4087,4086
 4087 ROR(I,J)=0.0
      GO TO 4088
 4086 ROR(I,J)=PROFIT(I,J)/EQUITY(I,J)
 4088 CONTINUE
 4085 CONTINUE
C
C   THIS CALCULATES THE RATE OF RETURN ON THE RATE BASE
C
```

```
      IF(IFXRAT-1)3366,3367,3367
 3366 DO 3365 I=1,NN
      DO 3365 J=1,3
      GO TO (3360,3360,3361,3362,3362),NPASS
 3360 RORRB(I,J)=(REVENU(I,J)-DEPBK(I,J)-TAXES(I,J)-RESERV(I,J))/
     1(RATBAS(I,J)-CUMRES(I,J))
      GO TO 3363
 3361 RORRB(I,J)=(REVENU(I,J)-DEPBK(I,J)-TAXES(I,J)-XTBT(I,J)-
     1RESERV(I,J))/(RATBAS(I,J)-CUMRES(I,J))
      GO TO 3363
 3362 RORRB(I,J)=(REVENU(I,J)-DEPBK(I,J)-TAXES(I,J)-XTBT(I,J)+
     1AMIDC(I,J)-RESERV(I,J))/(RATBAS(I,J)-CUMRES(I,J))
 3363 CONTINUE
 3365 CONTINUE
 3367 CONTINUE
C
C  THIS CALCULATES THE PRESENT VALUE OF THE REVENUE REQUIREMENTS
C
      DO 2926 J=1,3
      TOTOPV(J)=0.0
      DO 2926 I=1,NN
      IF(J-2)2929,2940,2929
 2929 PREVAL=(1./((1.+DN)**I))*REVENU(I,J)
      GO TO 2926
 2940 PREVAL=(1./((1.+DF)**I))*REVENU(I,J)
 2926 TOTOPV(J)=TOTOPV(J)+PREVAL
C
C  CALCULATES FIXED CHARGE COVERAGE --INTEREST BEFORE TAXES/FIXED CHARGES
C
      DO 2709 I=1,NN
      DO 2709 J=1,3
      IF(XINTER(I,J)-0)2716,2717,2716
 2717 FCC(I,J)=0.0
       GO TO 2709
 2716 FCC(I,J)=(REVENU(I,J)-DEPBK(I,J))/XINTER(I,J)
 2709 CONTINUE
      DO 2600 J=1,3
      DO 2600 I=1,NN
 2605 DIV(I,J)=DPC(I,J)*PROFIT(I,J)
 2600 RETEAR(I,J)=PROFIT(I,J)-DIV(I,J)
      DO 3010 J=1,3
 3010 DIVID(J)=DPO(1,J)*PROFIT(100,J)
      DO 2909 I=1,NN
      DO 2909 J=1,3
 2909 PTCWIP(I,J)=(CWIPT1(I,J)+CWIPT2(I,J)+CWIPT3(I,J)-AMIDC(I,J)+
     1XTBT(I,J))/AEEG(I,J)
C
C  CASH FLOW REPRESENTS CASH GENERATED FROM OPERATIONS (EXCLUDES
C  EXTERNAL FINANCING)
C
      DO 2606 J=1,3
      CSHFLC(1,J)=REVENU(100,J)-XINTER(100,J)-DIVID(J)  -TAXES(100,J)
      XXX=DEPBK(100,J)+RESERV(100,J)
      YYY=0.0
```

```
      DO 2606 I=1,NN
      L=I+1
      CSHFLO(L,J)=REVENU(I,J)-XINTER(I,J)-DIV(I,J)-TAXES(I,J)
      SHORT      =AINV(I,J)-CSHFLO(I,J)
      BADSTK(I,J)=SHORT      -(AINV(I,J)*DRT(J))+XXX-YYY
      YYY=AMICC(I,J)-XTBT(I,J)
      XXX=DEPBK(I,J)+RESERV(I,J)
 2606 EADSTK(I,J)=ENDEQ(I,J)-EQUITY(I,J)
C
C  CALCULATES ADDITIONAL STOCK AND ADDITIONAL DEBT AS THOUGH ALL GENERATED-
C  AT THE BEGINNING OF THE YEAR
C
      ESN100=((1.-DERATE)*(AEND(100,1)-CUMRES(100,1)-RESERV(100,1)))-
     1((1.-DBRATE)*(ABEG(100,1)-CUMRES(100,1)))
      ESF100=(1.-DRFLOW)*(AEND(100,2)-ABEG(100,2))
      ESS100=(1.-DERATE)*(AEND(100,3)-ABEG(100,3))
      ADDSTK(1,1)=ESN100+BADSTK(1,1)
      ADDSTK(1,2)=ESF100+BADSTK(1,2)
      ADDSTK(1,3)=ESS100+BADSTK(1,3)
      DO 3030 J=1,3
      DO 3030 I=2,NN
 3030 ADDSTK(I,J)=EADSTK(I-1,J)+BADSTK(I,J)
C
C  SINCE NORMALIZING FIRM  IS  PARTIALLY FINANCED BY THE RESERVE FOR
C  DEFERRED TAXES, IT HAS LESS SHARES OUTSTANDING INITIALLY
C
      SHARES(1,1)=BEGSHA*(EQUITY(1,1)/EQUITY(1,3))
      SHARES(1,2)=BEGSHA
      SHARES(1,3)=BEGSHA
      DO 2610 J=1,3
      DO 2610 I=1,NN
      EPS(I,J)=PROFIT(I,J)/SHARES(I,J)
      DPS(I,J)=DIV(I,J)/SHARES(I,J)
      IF(J-2)2506,2507,2506
 2506 X=ZMULT
      GO TO 2508
 2507 X=ZFLOW
 2508 PRICE(I,J)=EPS(I,J)*X
      L=I+1
      IF(I-NN)2401,2610,2401
 2401 SHARES(L,J)=SHARES(I,J)+(ADDSTK(L,J)/(PRICE(I,J)))
 2610 CONTINUE
C
C  THE MARKET PRICE ROUTINE PRODUCES FLUCTUATING  P/E RATIOS BY AN
C  ITERATIVE PROCEDURE BASED PRIMARILY ON THE GROWTH RATE OF DPS
C
      IF(NPASS-1)7111,7111,7112
 7111 ACTPLT(1)=AEND(100,3)
      DO 7113 I=2,NN
 7113 ACTPLT(I)=ACTPLT(I-1)+DEPASS(I,3)-DEPTX(I-1,3)
 7112 CONTINUE
      CALL MKTPRC(DPS,EPS,PRICE,NN,RFLOW,RST,SHARES,EADSTK,DIV,PROFIT,
     1EADSTK)
      DO 2502 J=1,3
```

```
      DO 2502 I=1,NN
      CFSHAR(I,J)=CSHFLC(I,J)/SHARES(I,J)
      EARIDC(I,J)=(AMIDC(I,J)-XTBT(I,J))/PROFIT(I,J)
      DIVIDC(I,J)=(AMIDC(I,J)-XTBT(I,J))/CIV(I,J)
      IF(I-1)2502,2502,2000
 2000 VALMKT(I,J)=PRICE(I-1,J)*SHARES(I,J)
 2502 CONTINUE
      DO 2001 J=1,3
 2001 VALMKT(1,J)=EQUITY(1,J)
      IF(NPASS-1)1900,1900,1901
 1900 DO 1902 J=1,3
      DO 1902 I=1,NN
      HOLCFS(I,J)=CFSHAR(I,J)
      HOLDCF(I,J)=CSHFLC(I,J)
 1902 HOLDRV(I,J)=FCC    (I,J)
 1901 DO 1903 J=1,3
      DO 1903 I=1,NN
      CPU(I,J)=REVENU(I,J)/ACTFLT(I)
      CFSCOM(I,J)=CFSHAR(I,J)/HOLCFS(I,J)
      CFCOMF(I,J)=CSHFLC(I,J)/HOLDCF(I,J)
 1903 RVCOMP(I,J)=FCC    (I,J)/HOLDRV(I,J)
      PNN=NN
      DO 3371 J=1,3
      SUMLOG=0.0
      DO 3370 I=1,NN
      XLOGN=ALOG(1.+RCR   (I,J))
 3370 SUMLOG=XLOGN+SUMLOG
      AVELOG=SUMLOG/PNN
      ANTLOG=EXP(AVELOG)
 3371 AVEROR(J)=ANTLOG-1.
      IF(NPASS-1)2301,2301,2302
 2301 CALL PRINT1 (PCT1,PCT2,PCT3,KON1,KON2,KON3,INVPAT,NUMIDC,JHIFT,
     1JGROW,ABEG,P,F2,N,ZINRTE,ZNFLOW,RN,RF,RFLOW,RST,ZMULT,ZFLOW,TX,NN,
     2DRT,DN,DF,SHARES,JPCTCG,JKONCG,PCTIN1,PCTIN2,PCTIN3,KONPR1,KONPR2,
     3KONPR3,JJ,IFXRAT,EUPPER,ELOWER,IIYEAR,AUCL,ALCL,DPCT,
     4ITSTYR,GROW,IYRCHG,PCTIN ,NEW1,NEW2,NEW3,NEW4,NEW5,JPTINF)
      WRITE(6,4094)
 4094 FORMAT(21H1DEMAND FOR ALL FIRMS)
      WRITE(6,4097)(I,DEMAND(I),I=1,NN)
 4097 FORMAT(1X,I6,F14.7)
 2302 CONTINUE
 2503 DO 9999 J=1,3
      MP=0
 3000 IF(NPASS-1)2880,2880,2881
 2880 WRITE(6,2870)
 2870 FORMAT(1H1,55X,7HFIRM RB)
      GO TO 2886
 2881 IF(NPASS-2)2882,2882,2883
 2882 WRITE(6,2872)
 2872 FORMAT(1H1,55X,8HFIRM IDC)
      GO TO 2886
 2883 IF(NPASS-3)2884,2884,2885
 2884 WRITE(6,2873)
 2873 FORMAT(1H1,53X,12HFIRM IDC-ITB)
```

```
      GO TO 2886
 2885 IF(NPASS-4)2887,2887,2888
 2887 WRITE(6,2874)
 2874 FORMAT(1H1,53X,11HFIRM RE-IDC)
      GO TO 2886
 2888 WRITE(6,2875)
 2875 FORMAT(1H1,51X,15HFIRM RE-IDC-ITB)
 2886 IF(J-1)2889,2889,2891
 2889 WRITE(6,2871)RTIDC(1),XTBN
 2871 FORMAT(54X,11HNORMALIZING/52X,10HIDC RATE--,F6.3/52X,10HITB RATE--
     1,F6.3//)
      GO TO 2830
 2891 IF(J-2)2892,2892,2893
 2892 WRITE(6,2876)RTIDC(2),XTBF
 2876 FORMAT(54X,12HFLOW THROUGH/52X,10HIDC RATE--,F6.3/52X,10HITB RATE-
     1-,F6.3//)
      GO TO 2830
 2893 WRITE(6,2877)RTIDC(3),XTBN
 2877 FORMAT(53X,13HSTRAIGHT LINE/52X,10HIDC RATE--,F6.3/52X,10HITB RATE
     1--,F6.3//)
 2830 CONTINUE
      MP=MP+1
      IF(MP-2)3001,3002,3003
 3001 WRITE(6,2831)
 2831 FORMAT(120H PERIOD     TOTAL          NEW      BEGINNING     ENDING RATE B
     1ASE ADDITIONS BEGINNING  ENDING BEGINNING   ENDING     BEG.  ADD. TO/
     2120H           INVESTMENT INVESTMENT    ASSETS      ASSETS           TO
     3 R.B.      DEBT      DEBT      EQUITY    EQUITY RESERVE RESERVE/)
      WRITE(6,2833)(I,AINV(I,J),BINV(I,J),ABEG(I,J),AEND(I,J),
     1RATBAS(I,J),READ(I,J),BEGDET(I,J),ENDDET(I,J),EQUITY(I,J),
     2ENDEQ(I,J),CUMRES(I,J),RESERV(I,J),I=1,NN)
 2833 FORMAT(2X,I3,3X,F8.2,3X,F8.2,2X,F9.2,1X,2F9.2,1X,F9.2,2X,F8.2,1X,
     1F8.2,1X,F8.2,1X,3F8.2)
      GO TO 3000
 3002 WRITE(6,2834)
 2834 FORMAT(119H PERIOD REQUIRED     BOOK     ACCEL.    TAXES      IDC   INTERE
     1ST  PROFIT    ITB     ROR    CWIP-1   CWIP-2  CWIP-3   CPS    TIE    CF /
     28X,24HREVENUES DEPREC. DEPREC.,71X,17H          COM. COM. /)
      WRITE(6,2836)(I,REVENU(I,J),DEPBK(I,J),SUM(I,J),TAXES(I,J),
     1AMIDC(I,J),XINTER(I,J),PROFIT(I,J),XTBT(I,J),ROR(I,J),CWIPT1(I,J),
     2CWIPT2(I,J),CWIPT3(I,J),CPSHAR(I,J),RVCOMP(I,J),CFCOMP(I,J),
     3I=1,NN)
 2836 FORMAT(2X,I3,2X,F8.2,1X,5F8.2,1X,F8.2,F7.2,F6.3,   3F8.2,   F6.2,
     1F6.3,F6.3)
      WRITE(6,2837) TOTDPV(J)
 2837 FORMAT(41H PRESENT VALUE OF REVENUE REQUIREMENTS = ,F10.2)
      WRITE(6,5449)AVERCR(J)
 5449 FORMAT('0** THE AVERAGE RATE OF RETURN IS',F9.6)
      GO TO 3000
 3003 WRITE(6,2838)
 2838 FORMAT(120H PERIOD     CASH   ADD'L    ADD'L DIVIDEND   DPS  RETAINED
     1   EPS     MARKET    MARKET SHARES UTILITY   IDC/    IDC/   T.I.E.  ROR/
     2120H            FLOW     STOCK    DEBT   PAYMENT           EARNINGS
     3   PRICE      VALUE     OUT.     RATE      DIV.  EARN. RATIO       RB/)
```

```
      WRITE(6,2839)(I,CSHFLO(I,J),ADDSTK(I,J),ADDDET(I,J),DIV(I,J),
     1DPS(I,J),RETEAR(I,J),EPS(I,J),PRICE(I,J),VALMKT(I,J),SHARES(I,J),
     2URATE (I,J),DIVICC(I,J),EARICC(I,J),FCC(I,J),RORRE(I,J),I=1,NN)
 2839 FORMAT(2X,I3,2X,4F8.2,F7.2,2F8.2,1X,F8.2,1X,F8.2,F7.3,F7.4,F7.4,
     1F7.4,2F6.3)
      IF(IFXRAT -1)5995,5996,5996
 5996 WRITE(6,5998)JLQ(J)
 5998 FORMAT('0THE LIMITS ON THE RATE OF RETURN WERE EXCEEDED ',I4,
     1' TIMES.')
 5995 CONTINUE
      WRITE(6,5990)
 5990 FORMAT('1PERIOD  DEPASS  COST PER UNIT'//)
      WRITE(6,5991)(I,DEPASS(I,J),CPU(I,J),ACTPLT(I),I=1,NN)
 5991 FORMAT(' ',I3,1X,F10.4,5X,F10.5,5X,F10.4)
C
C  WHEN THE SECTION FOR COMPUTING CHANGES IS INCLUDED IT GOES BETWEEN THIS CARD
C   AND THE ONE BELOW MARKED  COMPUTE SECTION END...
C
C
C  COMPUTE SECTION END ....
C
 5999 CONTINUE
 2899 CONTINUE
 1998 CONTINUE
      STOP
      END
      SUBROUTINE DEP (READ,DEPBK,I,N,JJ,BEGIN,DEPASS,DEPTX)
      DOUBLE PRECISION READ(150,3),DEPBK(150,3),                 BEGIN
      DIMENSION DEPTX(150,3),DEPASS(150,3)
      ZN=N
      FTR=1./ZN
      IF(I-1)4,4,5
    4 PART=FTR*(READ(I,3)+BEGIN)
      PAR2=FTR*(RBAD(I,2)+BEGIN)
      PARTA=FTR*(DEPASS(I,3)+BEGIN)
      PART2=FTR*(DEPASS(I,2)+BEGIN)
      GO TO 6
 5    PART=FTR*RBAD(I,3)
      PAR2=FTR*RBAD(I,2)
      PARTA=FTR*DEPASS(I,3)
      PART2=FTR* DEPASS(I,2)
  6   M=I+N-1
      IF(M-JJ)2,2,3
 3    M=JJ
 2    DO 1 L=I,M
 7    DEPTX(L,3)=DEPTX(L,3)+PARTA
      DEPTX(L,2)=DEPTX(L,2)+PART2
 8    DEPBK(L,2)=DEPBK(L,2)+PAR2
 1    DEPBK(L,3)=DEPBK(L,3)+PART
 10   CONTINUE
      RETURN
      END
      SUBROUTINE CWIPS1 (ZINV,PCTIN1,PCTIN2,PCTIN3,KONPR1,KONPR2,KONPR3,
     1YINV,CWIPT1,CWIPT2,CWIPT3,CWIP1,CWIP2,CWIP3,AMIDC,RTIDC,M1,M2,M3,
```

```
2I,XTBT              ,XTBN,XTBF,DEPASS,CAT1,DAT2,DAT3,K1,K2,K3,JJ,
3MO,PLTLAG,DEPINV,DPCT)
 DOUBLE PRECISION ZINV(150,3),YINV(150,3),CWIPT1(150,3),
1CWIPT2(150,3),CWIPT3(150,3),CWIP1(150),CWIP2(150),CWIP3(150),
3AMIDC(150,3),XTET(150,3),XTB13,XTB12,XTB23,XTB22,XTB33,XTB32
 DIMENSION RTIDC(3),DEPASS(150,3),PCTIN1( 50),PCTIN2( 50),
1PCTIN3( 50),KONPR1( 50),KONPR2( 50),KONPR3( 50)
 IF(I-100)103,103,105
103 PCTINA=1.0
 PCTINB=0.0
 PCTINC=0.0
 KONPRA=0
 KONPRB=0
 KONPRC=0
 XTB13=0.0
 XTB12=0.0
 XTB23=0.0
 XTB22=0.0
 XTB33=0.0
 XTB32=0.0
 GO TO 102
105 PCTINA=PCTIN1(I-100)
 PCTINB=PCTIN2(I-100)
 PCTINC=PCTIN3(I-100)
 KONPRA=KONPR1(I-100)
 KONPRB=KONPR2(I-100)
 KONPRC=KONPR3(I-100)
102 CONTINUE
 CWIP1(I)=ZINV(I,3)*PCTINA+(PCTINA*DEPINV*DPCT)
 CWIP2(I)=ZINV(I,3)*PCTINB+(PCTINB*DEPINV*DPCT)
 CWIP3(I)=ZINV(I,3)*PCTINC+(PCTINC*DEPINV*DPCT)
 IF(KONPRA    -0)10,10,11
10  YINV(I,3)=CWIP1(I)+YINV(I,3)
 YINV(I,2)=CWIP1(I)+YINV(I,2)
 DEPASS(I,3)=CWIP1(I)+DEPASS(I,3)
 GO TO 4
11  M1=M1+1
 IF(K1-1)20,20,23
20  XTB13     =CWIP1(I)*XTBN
 XTB12     =CWIP1(I)*XTBF
 AMIDC(I,3)=CWIP1(I)*RTIDC(3)
 AMIDC(I,2)=CWIP1(I)*RTIDC(2)
 CWIPT1(I,3)=CWIP1(I)+AMIDC(I,3)-XTB13
 CWIPT1(I,2)=CWIP1(I)+AMIDC(I,2)-XTB12
 DAT1=CWIP1(I)
 GO TO 41
23  CWIPT1(I,3)=CWIPT1(I-1,3)+CWIP1(I)
 XTB13     =CWIPT1(I,3)*XTEN
 AMIDC(I,3)=CWIPT1(I,3)*RTIDC(3)
 CWIPT1(I,3)=CWIPT1(I,3)+AMIDC(I,3)-XTB13
 CWIPT1(I,2)=CWIPT1(I-1,2)+CWIP1(I)
 XTB12     =CWIPT1(I,2)*XTBF
 AMIDC(I,2)=CWIPT1(I,2)*RTIDC(2)
 CWIPT1(I,2)=CWIPT1(I,2)+AMIDC(I,2)-XTB12
```

```
      DAT1=DAT1+CWIP1(I)
41    IF(KONPRA    -M1)31,31,30
31    L=I+1
      IF(L-JJ)67,67,4
67    YINV(L,3)=CWIPT1(I,3)
      YINV(L,2)=CWIPT1(I,2)
      DEPASS(L,3)=DAT1
      K1=1
      M1=0
      GO TO 4
30    K1=2
4     CONTINUE
      IF(KONPRB    -0)12,12,13
12    YINV(I,3)=CWIP2(I)+YINV(I,3)
      YINV(I,2)=CWIP2(I)+YINV(I,2)
      DEPASS(I,3)=DEPASS(I,3)+CWIP2(I)
      GO TO 6
13    M2=M2+1
      IF(K2-1)21,21,28
21    XTB23     =CWIP2(I)*XTBN
      XTB22     =CWIP2(I)*XTBF
      AMIDC(I,3)=CWIP2(I)*RTIDC(3)+AMIDC(I,3)
      AMIDC(I,2)=CWIP2(I)*RTIDC(2)+AMIDC(I,2)
      CWIPT2(I,3)=CWIP2(I)*(1.+RTIDC(3))-XTB23
      CWIPT2(I,2)=CWIP2(I)*(1.+RTIDC(2))-XTB22
      DAT2=CWIP2(I)
      GO TO 51
28    CWIPT2(I,3)=CWIPT2(I-1,3)+CWIP2(I)
      AMTIDC=CWIPT2(I,3)*RTIDC(3)
      XTB23     =CWIPT2(I,3)*XTEN
      CWIPT2(I,3)=CWIPT2(I,3)+AMTIDC-XTB23
      AMIDC(I,3)=AMIDC(I,3)+AMTIDC
      CWIPT2(I,2)=CWIPT2(I-1,2)+CWIP2(I)
      AMTIDC=CWIPT2(I,2)*RTIDC(2)
      XTB22     =CWIPT2(I,2)*XTEF
      CWIPT2(I,2)=CWIPT2(I,2)+AMTIDC-XTB22
      AMIDC(I,2)=AMIDC(I,2)+AMTIDC
      DAT2=DAT2+CWIP2(I)
51    IF(KONPRB    -M2)61,61,60
61    L=I+1
      IF(L-JJ)68,68,6
68    YINV(L,3)=YINV(L,3)+CWIPT2(I,3)
      YINV(L,2)=YINV(L,2)+CWIPT2(I,2)
      DEPASS(L,3)=DEPASS(L,3)+DAT2
      K2=1
      M2=0
      GO TO 6
60    K2=2
6     CONTINUE
      IF(KONPRC    -0)14,14,15
14    YINV(I,3)=CWIP3(I)+YINV(I,3)
      YINV(I,2)=CWIP3(I)+YINV(I,2)
      DEPASS(I,3)=DEPASS(I,3)+CWIP3(I)
      GO TO 16
```

```
15  M3=M3+1
    IF(K3-1)22,22,29
22  XTB33     =CWIP3(I)*XTBN
    XTB32     =CWIP3(I)*XTBF
    AMIDC(I,3)=CWIP3( I)*RTIDC(3)+AMIDC(I,3)
    AMIDC(I,2)=CWIP3( I)*RTIDC(2)+AMIDC(I,2)
    CWIPT3(I,3)=CWIP3(I)*(1.+RTIDC(3))-XTB33
    CWIPT3(I,2)=CWIP3(I)*(1.+RTIDC(2))-XTB32
    DAT3=CWIP3(I)
    GO TO 71
29  CWIPT3(I,3)=CWIPT3(I-1,3)+CWIP3(I)
    XTB33     =CWIPT3(I,3)*XTEN
    AMTIDC=CWIPT3(I,3)*RTIDC(3)
    CWIPT3(I,3)=CWIPT3(I,3)+AMTIDC-XTB33
    AMIDC(I,3)=AMIDC(I,3)+AMTIDC
    CWIPT3(I,2)=CWIPT3(I-1,2)+CWIP3(I)
    XTB32     =CWIPT3(I,2)*XTEF
    AMTIDC=CWIPT3(I,2)*RTIDC(2)
    CWIPT3(I,2)=CWIPT3(I,2)+AMTIDC-XTB32
    AMIDC(I,2)=AMIDC(I,2)+AMTIDC
    DAT3=DAT3+CWIP3(I)
71  IF(KONPRC    -M3)62,62,63
62  L=I+1
    IF(I-MO)101,100,101
100 PLTLAG=CWIPT3(I,3)
101 CONTINUE
    IF(L-JJ)69,69,16
69  YINV(L,3)=YINV(L,3)+CWIPT3(I,3)
    YINV(L,2)=YINV(L,2)+CWIPT3(I,2)
    DEPASS(L,3)=DEPASS(L,3)+DAT3
    K3=I
    M3=0
    GO TO 16
63  K3=2
16  CONTINUE
    DEPASS(I,2)=DEPASS(I,3)
    XTBT(I,3)=XTB13+XTB23+XTB33
    XTBT(I,2)=XTB12+XTB22+XTB32
    RETURN
    END
    SUBROUTINE CWIPS3 (ZINV,PCTIN1,PCTIN2,PCTIN3,KONPR1,KONPR2,KONPR3,
   1YINV,CWIPT1,CWIPT2,CWIPT3,CWIP1,CWIP2,CWIP3,AMIDC,RTIDC,I,JJ,
   2XTBT            ,XTBN,XTBF,DEPASS,PCTA1,PCTA2,PCTA3,DEPINV,DPCT)
    DOUBLE PRECISION ZINV(150,3),YINV(150,3),CWIPT1(150,3),
   1CWIPT2(150,3),CWIPT3(150,3),CWIP1(150),CWIP2(150),CWIP3(150),
   3                XTBT(150,3),AMIDC(150,3)
    DIMENSION RTIDC(3),DEPASS(150,3),PCTIN1( 50),PCTIN2( 50),
   1PCTIN3( 50),KONPR1( 50),KONPR2( 50),KONPR3( 50)
    DIMENSION CWIPA1(15),CWIPA2(15),CWIPA3(15),DEPAT1(15),DEPAT2(15),
   1DEPAT3(15),PCTA1(15),PCTA2(15),PCTA3(15)
    IF(I-100)100,100,101
100 PCTINA=1.0
    PCTINB=0.0
    PCTINC=0.0
```

```
      KONPRA=0
      KONPRB=0
      KONPRC=0
      GO TO 102
101   PCTINA=PCTIN1(I-100)
      PCTINB=PCTIN2(I-100)
      PCTINC=PCTIN3(I-100)
      KONPRA=KONPR1(I-100)
      KONPRB=KONPR2(I-100)
      KONPRC=KONPR3(I-100)
102   CONTINUE
      IF(I-1)7,7,8
7     DO 9 J=1,15
      CWIPA1(J)=0.0
      CWIPA2(J)=0.0
      CWIPA3(J)=0.0
      DEPAT1(J)=0.0
      DEPAT2(J)=0.0
9     DEPAT3(J)=0.0
8     CONTINUE
      CWIP1(I)=ZINV(I,3)*PCTINA+(PCTINA*DEPINV*DPCT)
      CWIP2(I)=ZINV(I,3)*PCTINB+(PCTINB*DEPINV*DPCT)
      CWIP3(I)=ZINV(I,3)*PCTINC+(PCTINC*DEPINV*DPCT)
      IF(KONPRA    -0)1,1,2
1     YINV(I,3)=CWIP1(I)+YINV(I,3)
      YINV(I,2)=CWIP1(I)+YINV(I,2)
      DEPASS(I,3)=DEPASS(I,3)+CWIP1(I)
      GO TO 19
2     K1=KONPRA
      N1=K1+100
      IF(I-N1)11,12,12
11    NO1=I+1-100
      SUMPCT=0.0
      DO 13 M=NO1,K1
13    SUMPCT=SUMPCT+PCTA1(M)
      YINV(I,3)=YINV(I,3)+(SUMPCT*CWIP1(I))
      DEPASS(I,3)=DEPASS(I,3)+(SUMPCT*CWIP1(I))
      J1=I-100
      GO TO 14
12    J1=K1
14    DO 15 M=1,J1
      CWIPA1(M)=CWIPA1(M)+(CWIP1(I)*PCTA1(M))
      DEPAT1(M)=DEPAT1(M)+(CWIP1(I)*PCTA1(M))
      AMIDC1=CWIPA1(M)*RTIDC(3)
      XTBA1=CWIPA1(M)*XTEN
      CWIPA1(M)=CWIPA1(M)+AMIDC1-XTBA1
      XTBT(I,3)=XTBT(I,3)+XTBA1
      AMIDC(I,3)=AMIDC(I,3)+AMIDC1
15     CWIPT1(I,3)=CWIPT1(I,3)+CWIPA1(M)
      L=I+1
      IF(JJ-L)19,20,20
20    YINV(L,3)=YINV(L,3)+CWIPAI(K1)
      DEPASS(L,3)=DEPASS(L,3)+DEPAT1(K1)
      IF(K1-1)16,16,17
```

```
17   DO 18 M=2,KI
     LL=K1-M+2
     CWIPA1(LL)=CWIPAI(LL-I)
18   DEPAT1(LL)=CEPATI(LL-I)
16   CWIPA1(1)=0.0
     DEPAT1(1)=0.0
19   CONTINUE
     IF(KONPRB    -0)3,3,4
3    YINV(I,3)=CWIP2(I)+YINV(I,3)
     YINV(I,2)=CWIF2(I)+YINV(I,2)
     DEPASS(I,3)=DEFASS(I,3)+CWIP2(I)
     GO TO 29
4    K2=KCNFRB
     N2=K2+I00
     IF(I-N2)21,22,22
21   NO2=I+1-1C0
     SUMPCT=0.0
     DO 23 M=NC2,K2
23   SUMPCT=SUMPCT+PCTA2(M)
     YINV(I,3)=YINV(I,3)+(SUMPCT*CWIP2(I))
     DEPASS(I,3)=CEFASS(I,3)+(SUMFCT*CWIP2(I))
     J2=I-100
     GO TO 24
22   J2=K2
24   DO 25 M=1,J2
     CWIPA2(M)=CWIFA2(M)+(CWIF2(I)*PCTA2(M))
     DEPAT2(M)=DEPAT2(M)+(CWIP2(I)*FCTA2(M))
     AMIDC2=CWIPA2(M)*FTIDC(3)
     XTBA2=CWIFA2(M)*XTEN
     CWIPA2(M)=CWIPA2(M)+AMIDC2-XTBA2
     XTBT(I,3)=XTET(I,3)+XTBA2
     AMIDC(I,3)=AMIDC(I,3)+AMIDC2
25    CWIPT2(I,3)=CWIPT2(I,3)+CWIPA2(M)
     L=I+1
     IF(JJ-L)29,30,30
30   YINV(L,3)=YINV(L,3)+CWIPA2(K2)
     DEPASS(L,3)=CEFASS(L,3)+CEFAT2(K2)
     IF(K2-1)26,26,27
27   DO 28 M=2,K2
     LL=K2-M+2
     CWIPA2(LL)=CWIPA2(LL-1)
28   DEPAT2(LL)=DEPAT2(LL-1)
26   CWIPA2(1)=0.0
     DEPAT2(1)=0.0
29   CONTINUE
     IF(KONPRC    -0)5,5,6
5    YINV(I,3)=CWIP3(I)+YINV(I,3)
     YINV(I,2)=CWIF3(I)+YINV(I,2)
     DEPASS(1,3)=CEPASS(I,3)+CWIP3(I)
     GO TO 39
6    K3=KONPRC
     N3=K3+100
     IF(I-N3)31,32,32
31   NO3=I+I-100
```

```
      SUMPCT=0.0
      DO 33 M=NO3,K3
   33 SUMPCT=SUMPCT+PCTA3(M)
      YINV(I,3)=YINV(I,3)+(SUMPCT*CWIP3(I))
      DEPASS(I,3)=DEPASS(I,3)+(SUMPCT*CWIP3(I))
      J3=I-100
      GO TO 34
   32 J3=K3
   34 DO 35 M=1,J3
      CWIPA3(M)=CWIPA3(M)+(CWIP3(I)*PCTA3(M))
      DEPAT3(M)=DEPAT3(M)+(CWIP3(I)*PCTA3(M))
      AMIDC3=CWIPA3(M)*RTIDC(3)
      XTBA3=CWIPA3(M)*XTBN
      CWIPA3(M)=CWIPA3(M)+AMIDC3-XTBA3
      XTBT(I,3)=XTBT(I,3)+XTBA3
      AMIDC(I,3)=AMIDC(I,3)+AMIDC3
   35  CWIPT3(I,3)=CWIPT3(I,3)+CWIPA3(M)
      L=I+1
      IF(JJ-L)39,40,40
   40 YINV(L,3)=YINV(L,3)+CWIPA3(K3)
      DEPASS(L,3)=DEPASS(L,3)+DEPAT3(K3)
      IF(K3-1)36,36,37
   37 DO 38 M=2,K3
      LL=K3-M+2
      CWIPA3(LL)=CWIPA3(LL-1)
   38 DEPAT3(LL)=DEPAT3(LL-1)
   36 CWIPA3(1)=0.0
      DEPAT3(1)=0.0
   39 CONTINUE
      CWIPT1(I,2)=CWIPT1(I,3)
      CWIPT2(I,2)=CWIPT2(I,3)
      CWIPT3(I,2)=CWIPT3(I,3)
      YINV(I,2)=YINV(I,3)
      AMIDC(I,2)=AMIDC(I,3)
      XTBT(I,2)=XTBT(I,3)
      DEPASS(I,2)=DEPASS(I,3)
      RETURN
      END
      SUBROUTINE ACCDEP (DEPASS,SUM,N,JJ,BEGIN)
      DOUBLE PRECISION BEGIN
      DIMENSION SUM(150,3),DEPASS(150,3)
      ZN=N
      DENOM=ZN*(ZN+1.)/2.
      DO 1 I=1,JJ
      M=I+N-1
      MM=I+N-1
      IF(M-JJ)2,2,3
    3 M=JJ
    2 DO 1 K=I,M
      RLIFE=MM-K+1
      IF(I-1)5,5,6
    5 PART=RLIFE/DENOM*(DEPASS(I,3)+BEGIN)
      PAR2=RLIFE/DENOM*(DEPASS(I,2)+BEGIN)
      GO TO 1
```

```
 6    PART=RLIFE/DENCM*CEPASS(I,3)
      PAR2=RLIFE/DENOM*DEPASS(I,2)
      SUM(K,2)=FAR2+SUM(K,2)
 1    SUM(K,3)=PART+SUM(K,3)
      DO 10 J=1,2
      DO 10 I=1,JJ
      SUM(I,J)=SUM(I,3)
10    DEPASS(I,J)=CEFASS(I,3)
      RETURN
      END
      SUBROUTINE DEET (ACCDET,       BEGCET,ENDDET,TINV,DRT,AMIDC,XTBT,
     1DEPBK,RESERV,JJ,BEGIN)
      DOUBLE PRECISION TINV(150,3),AMIDC(150,3),DEPBK(150,3),
     1XTBT(150,3),BEGIN
      DIMENSION ADDDET( 50,3),                BEGDET(150,3),ENDDET(150,3),
     1DRT(3),RESERV(150,3)
      DO1 J=1,3
      BADDET     =TINV(1,J)*DRT(J)
      BEGDET(1,J)=BEGIN*DRT(J)+EADDET
      EADDET     =(AMIDC(1,J)-XTBT(1,J)-CEPBK(I,J)-RESERV(1,J))*DRT(J)
      ENDDET(1,J)=BEECDET(1,J)+EADDET
      DO 1 I=2,JJ
      BADDET     =TINV(I,J)*DRT(J)
      IF(I-101)2,3,3
 3    K=I-100
      ADDDET(K,J)=BADDET+EADDET
 2    BEGDET(I,J)=ENDDET(I-1,J)+EADDET
      EADDET     =(AMIDC(I,J)-XTBT(I,J)-DEPBK(I,J)-RESERV(I,J))*DRT(J)
 1    ENDDET(I,J)=BEGCET(I,J)+EADDET
      RETURN
      END
      SUBROUTINE MKTPRC (DPS,EPS,PRICE,NN,RFLOW,RST,SHARES,BADSTK,
     1DIV,PRCFIT,EADSTK)
      DIMENSICN DPS(50,3),EPS(50,3),SHARES(50,3),PRICE(50,3),
     1BADSTK(50,3),PRCFIT(150,3),DIV( 50,3),G(3),EADSTK(50,3)
C     USE PRICING EQUATION TO DETERMINE MARKET PRICE INSTEAD OF CONSTANT
C        P/E RATIO. THIS CAUSES THE P/E RATIO TO FLUCTUATE IN SAME
C        DIRECTION AS GROWTH RATE.
      IK=0
      R=RST
      SMPVL = 0.0
399   CONTINUE
      IK = IK + 1
      IF (IK - 13) 409, 409, 398
409   DO 62 JZ = 1,3
      IF(JZ-2)410,411,410
411   R=RFLOW
410   CONTINUE
      G(JZ)=  (DPS(NN,JZ)/DPS(NN-1,JZ))-1.0
      ID=1
      DO 401 I = 1,NN
      ID = ID + 1
      IF (I - NN) 105, 106, 105
C     DETERMINE PRESENT VALUE OF TOTAL CASH DIVIDENDS/SHARE OVER SIMULA-
```

```
C        TICN PERIOD + FRESENT VALUE OF MARKET PRICE IN EACH YEAR BY
C        DISCOUNTING THESE VALUES AT THE INVESTOR DISCOUNT RATE
C     SPECIFIED ON THE PARAMETER CARD.
  105 IVAL = 0
      DO 107 IC = ID, NN
      IVAL = IVAL + 1
      DFACTR = ((1. + R) ** IVAL)
      PV1 = DPS(IC,JZ) / DFACTR
  107 SMPVL = SMPVL + PV1
      DV2 = DPS(NN,JZ)*(1.+G(JZ))/(R-G(JZ))/((1.+R)**(NN-I))
      PRICE(I,JZ) = SMPVL + DV2
      SMPVL = 0.0
      GO TO 401
  106 PRICE(NN,JZ) = DPS(NN,JZ) * (1. + G(JZ)) / (R - G(JZ))
  401 CONTINUE
      R=RST
   62 CONTINUE
      DO 404 I=1,NN
      DO 404 J=1,3
      K=I+1
      IF(I-NN)1,2,1
    1 SHARES(K,J)=SHARES(I,J)+((BADSTK(K,J)+EADSTK(I,J))/(PRICE(I,J)))
    2 EPS(I,J)=PRCFIT(I,J)/SHARES(I,J)
  404 DPS(I,J)=DIV(I,J)/SHARES(I,J)
      GO TO 399
  398 CONTINUE
      RETURN
      END
      SUBROUTINE SSHAFE (P,JHIFT,P2,GROW,JJ,INDEX)
      DIMENSION GROW(150,3),GRO(50,3)
      GRO(1,INDEX)=P
      KN = JHIFT * 2 + 1
      K = JHIFT + 1
      X = 0.0
      D = JHIFT
      C = JHIFT
      DO 9 IYR = 2, KN
      KYR = IYR - 1
      ZYR = KYR
      IF(ZYR - D) 100, 100, 200
  100 GRO(KN,INDEX)=P-((P-P2)/2.)
      GRO(IYR,INDEX)=((ZYR)/(D*(D+1.)/2.)*(P-GRO(KN,INDEX)))*(-1.)+
     1GRO(KYR,INDEX)
      GO TO 300
  200 GRO(KN,INDEX)=P2
      Z = JHIFT*2-(JHIFT+1)
      GRO(IYR,INDEX)= GRO(KYR,INDEX)-((Z-X)/(Z*(Z+1.)/2.)*(GRO(K,INDEX)-
     1GRO(KN,INDEX)))
      X = X + 1.
  300 CONTINUE
    9 CONTINUE
      DO 8 I = 1, 100
    8 GROW(I,INDEX)=P
      J = 100
```

```
      DO 10 I = 1, KN, 2
      J = J + 1 .
      GROW(J,INDEX)=GRC(I,INDEX)
   10 CONTINUE
      J = J + 1
      DO 11 I = J, JJ
      GROW(I,INDEX)=P2
   11 CONTINUE
      DO 50 I=1,JJ
      DO 50 J=1,2
   50 GROW(I,J)=GROW(I,3)
      RETURN
      END
      SUBROUTINE PRINT1 (PCT1,PCT2,PCT3,KON1,KON2,KON3,INVPAT,NUMIDC,
     1JHIFT,JGROW,ABEG,P,P2,N,ZINRTE,ZNFLOW,RN,RF,RFLOW,RST,ZMULT,ZFLOW,
     2TX,NN,CRT,DN,DF,SHARES,JPCTCG,JKONCG,PCTIN1,PCTIN2,PCTIN3,KONPR1,
     3KONPR2,KONPR3,JJ,IFXRAT,EUPPER,ELOWER,IIYEAR,AUCL,ALCL,OPCT,
     4ITSTYR,GROW,IYRCHG,PCTIN ,NEW1,NEW2,NEW3,NEW4,NEW5,JPTINF)
      DIMENSION GROW(150,3),PCTIN(50)
      DIMENSION ABEG(150,3),DRT(3),SHARES(50,3),PCTIN1( 50),PCTIN2( 50),
     1PCTIN3( 50),KONPR1( 50),KONPR2( 50),KONPR3( 50)
      WRITE(6,2301)
 2301 FORMAT(1H1,40X,37H INPUT VALUES FOR SIMULATION ANALYSIS//21X,78HOF
     1 ALTERNATIVE METHODS FOR PROVIDING A RETURN ON CONSTRUCTION WORK I
     2N PROGRESS//)
      WRITE(6,2302)ABEG(1,3),NN
 2302 FORMAT(30H                    BEGINNING ASSETS,13X,1H$,F8.2,12X,20HLENGT
     1H OF SIMULATION,11X,I3,4X,5HYEARS)
      WRITE(6,2303)N,DRT(1),P,DRT(2),JHIFT,DRT(3),P2
 2303 FORMAT(26H                    DEBT RATIO--,38X,10HASSET LIFE,21X,I3,4X,
     15HYEARS/19X,11HNORMALIZING,17X,F6.3,11X,19HINITIAL GROWTH RATE,
     213X,F6.3/19X,12HFLOW THROUGH,16X,F6.3,11X,21HYEAR OF GROWTH CHANGE
     3,10X,I3   /19X,13HSTRAIGHT LINE,15X,F6.3,11X,17HFINAL GROWTH RATE,
     415X,F6.3)
      IF(JGROW-1)2315,2316,2341
 2315 WRITE(6,2304)ZINRTE
 2304 FORMAT(14X,15HINTEREST RATE--,35X,26HGROWTH PATTERN--STEP SHIFT/
     119X,11HNORMALIZING,17X,F6.3)
      GO TO 2319
 2316 WRITE(6,2305)ZINRTE
 2305 FORMAT(14X,15HINTEREST RATE--,35X,24HGROWTH PATTERN--S-SHAPED/
     119X,11HNORMALIZING,17X,F6.3)
      GO TO 2319
 2341 WRITE(6,2342)ZINRTE
 2342 FORMAT(14X,15HINTEREST RATE--,35X,24HGROWTH PATTERN--VARIABLE/
     119X,11HNORMALIZING,17X,F6.3)
 2319 IF(INVPAT-1)2317,2318,2318
 2317 WRITE(6,2306)ZNFLOW,ZINRTE
 2306 FORMAT(19X,12HFLOW THROUGH,16X,F6.3,11X,35HCONSTRUCTION PROGRAM---
     1SMALL FIRM   /19X,13HSTRAIGHT LINE,15X,F6.3)
      GO TO 2320
 2318 WRITE(6,2307)ZNFLOW,ZINRTE
 2307 FORMAT(19X,12HFLOW THROUGH,16X,F6.3,11X,35HCONSTRUCTION PROGRAM---
     1LARGE FIRM   /19X,13HSTRAIGHT LINE,15X,F6.3)
```

```
2320 CONTINUE
     WRITE(6,2308)RST,RFLOW,PCT1,RST,KON1
2308 FORMAT(14X,23HEQUITY RATE OF RETURN--,27X,20HCONSTRUCTION CLASSES/
    119X,11HNORMALIZING,17X,F6.3,16X,7HCLASS 1/19X,12HFLOW THROUGH,16X,
    1F6.3,18X,F6.3,3X,17HOF NEW INVESTMENT/19X,13HSTRAIGHT LINE,15X,
    2F6.3,17X,I3,7X,24HYEAR CONSTRUCTION PERIOD)
     WRITE(6,2309)RN,RF,PCT2,RN,KON2
2309 FORMAT(14X,24HALLOWED RATE OF RETURN--/19X,11HNORMALIZING,17X,
    1F6.3,16X,7HCLASS 2/19X,12HFLOW THROUGH,16X,F6.3,18X,F6.3,3X,17HOF
    2NEW INVESTMENT/19X,13HSTRAIGHT LINE,15X,F6.3,17X,I3,7X,24HYEAR CON
    3STRUCTION PERIOD)
     WRITE(6,2310)DN,DF,PCT3,DN,KON3
2310 FORMAT(14X,15HDISCOUNT RATE--/19X,11HNORMALIZING,17X,F6.3,16X,7HCL
    1ASS 3/19X,12HFLOW THROUGH,16X,F6.3,18X,F6.3,3X,17HOF NEW INVESTMEN
    2T/19X,13HSTRAIGHT LINE,15X,F6.3,17X,I3,7X,24HYEAR CONSTRUCTION PER
    3IOD)
     WRITE(6,2311)SHARES(1,1),NUMIOC,SHARES(1,2),SHARES(1,3)
2311 FORMAT(14X,18HBEGINNING SHARES--,32X,31HNUMBER OF METHODS FOR PROV
    1IDING/19X,11HNORMALIZING,16X,F6.2,12X,22HA RETURN ON C.W.I.P. =,
    2I2/19X,12HFLOW THROUGH,15X,F6.2/19X,13HSTRAIGHT LINE,14X,F6.2)
     IF(JPTINF-1)2345,2346,2346
2345 WRITE(6,2312)TX,ZMULT,ZFLOW,ZMULT,PCTIN(1)
2312 FORMAT(14X,18HPRICE MULTIPLIER--,32X,8HTAX RATE,24X,F6.3/19X,
    111HNORMALIZING,15X,F7.2/19X,12HFLOW THROUGH,14X,F7.2/19X,13HSTRAIG
    2HT LINE,13X,F7.2,12X,'ASSET COST INFLATION FACTOR',6X,F6.4)
     GO TO 2347
2346 WRITE(6,2348)TX,ZMULT,ZFLOW,ZMULT
2348 FORMAT(14X,18HPRICE MULTIPLIER--,32X,8HTAX RATE,24X,F6.3/19X,
    111HNORMALIZING,15X,F7.2/19X,12HFLOW THROUGH,14X,F7.2/19X,13HSTRAIG
    2HT LINE,13X,F7.2,12X,'ASSET COST INFLATION FACTOR IS VARIABLE')
2347 CONTINUE
     WRITE(6,2400)CPCT
2400 FORMAT(64X,F5.2,' OF REINVESTED DEPRECIATION GOES INTO CONSTRUCTIO
    1N'/64X,'AND THE REST GOES DIRECTLY INTO THE RATE BASE')
     AUPPER=100.*ELPPER
     ALOWER=100.*ELOWER
     IF(IFXRAT-1)101,102,102
102  WRITE(6,100)IIYEAR,AUPPER,ALOWER,AUCL,ALCL
100  FORMAT('0',91HREVENUES ARE COMPUTED USING A FIXED UTILITY RATE, WI
    1TH THE INITIAL RATE ESTABLISHED IN YEAR,I3/33H THE REGULATORY LIMI
    2TS ARE SET AT,F7.1,19H PER CENT ABOVE AND,F7.1,46H PER CENT BELOW
    3THE TARGET RATE OF RETURN, OR,/F7.3,4H AND,F7.3,14H, RESPECTIVELY)
     IF(ITSTYR-0)10,11,12
10   WRITE(6,15)
15   FORMAT(' **A PAST TEST YEAR IS USED TO SET THE UTILITY RATE')
     GO TO 101
11   WRITE(6,16)
16   FORMAT(' **THE CURRENT YEAR IS THE TEST YEAR USED TO SET THE UTILI
    1TY RATE')
     GO TO 101
12   WRITE(6,17)
17   FORMAT(' **A FUTURE TEST YEAR IS USED TO SET THE UTILITY RATE')
101  CONTINUE
     IF(NEW1.EQ.1.AND.NEW2.EQ.2.AND.NEW3.EQ.3.AND.NEW4.EQ.4.AND.
```

```
     1NEW5.EQ.5) GO TO 40
      WRITE(6,56)
 56   FORMAT('OTHE CONSTRUCTION ACCOUNTING METHOD USED BY THE FIRMS WAS
     1AS FOLLOWS--'//32X,'FIRMS'//15X,'RB      IDC      IDC-ITB      RB-IDC
     2      RE-IDC-ITB'/)
      WRITE(6,57)IYRCHG
 57   FORMAT(' BEFORE YEAR',I3,' 1',6X,'2',9X,'3',10X,'4',12X,'5'/)
      WRITE(6,58)IYRCHG,NEW1,NEW2,NEW3,NEW4,NEW5
 58   FORMAT(' AFTER YEAR',I4,I2,5X,I2,8X,I2,9X,I2,11X,I2//' WHERE THE M
     1ETHOD NUMBER STANDS FOR THE METHOD USED BY THE FOLLOWING FIRMS-'//
     210X,'1 = RB'/10X,'2 = IDC'/10X,'3 = IDC-ITB'/10X,'4 = RB-IDC'/10X,
     3'5 = RE-IDC-ITB')
 40   CONTINUE
      KOWNT=0
      IF(JPCTCG-1)2322,2323,2323
2323  WRITE(6,2321)
2321  FORMAT(14X,83HPER CENT OF NEW INVESTMENT IS ACTUALLY VARIABLE--VAR
     1IABLE AMOUNTS PRINTED OUT BELOW)
      KOWNT=KOWNT+1
2322  CONTINUE
      IF(JKCNCG-1)2324,2325,2325
2325  WRITE(6,2326)
2326  FORMAT(14X,76HLENGTH OF CONSTRUCTION PERIOD IS ACTUALLY VARIABLE--
     1VALUES PRINTED OUT BELOW)
      KOWNT=KOWNT+2
2324  CONTINUE
      IF(KOWNT-0)2327,2327,2328
2328  IF(KOWNT-2)2329,2330,2331
2329  WRITE(6,2332)
2332  FORMAT(1H1,43HPERIOD   PER CENT      PER CENT      PER CENT/8X,38HIN
     1VESTMENT-1 INVESTMENT-2 INVESTMENT-3)
      DO 2333 I=1,NN
2333  WRITE(6,2334)I,PCTIN1(I),PCTIN2(I),PCTIN3(I)
2334  FORMAT(2X,I3,1X,F10.2,3X,F10.2,3X,F10.2)
      GO TO 2327
2330  WRITE(6,2335)
2335  FORMAT(1H1,45HPERIOD CONSTRUCTION CONSTRUCTION CONSTRUCTION/10X,
     134HPERIOD-1       PERIOD-2      PERIOD-3)
      DO 2336 I=1,NN
2336  WRITE(6,2337)I,KONPR1(I),KONPR2(I),KONPR3(I)
2337  FORMAT(2X,I3,7X,I3,10X,I3,10X,I3)
      GO TO 2327
2331  WRITE(6,2338)
2338  FORMAT(1H1,84HPERIOD   PER CENT     PER CENT     PER CENT   CONSTR
     1UCTION CONSTRUCTION CONSTRUCTION/8X,75HINVESTMENT-1 INVESTMENT-2 I
     2NVESTMENT-3   PERIOD-1     PERIOD-2     PERIOD-3)
      DO 2339 I=1,NN
2339  WRITE(6,2340)I,PCTIN1(I),PCTIN2(I),PCTIN3(I),KONPR1(I),KONPR2(I),
     1KONPR3(I)
2340  FORMAT(2X,I3,1X,F10.2,3X,F10.2,3X,F10.2,9X,I3,10X,I3,10X,I3)
2327  CONTINUE
      IF(JGRCW-1)20,20,21
 21   WRITE(6,22)
 22   FORMAT('1PERIOD VARIABLE GROWTH RATES'//)
```

```
      WRITE(6,23)(I,GROW(I,3),I=1,NN)
23    FORMAT(' ',I3,12X,F6.4)
20    CONTINUE
      IF(JPTINF-1)110,111,111
111   WRITE(6,112)
112   FORMAT('1PERIOD   VARIABLE  INFLATION FACTOR'//)
      WRITE(6,113)(I,FCTIN(I),I=1,NN)
113   FORMAT(' ',I3,10X,F5.4)
110   CONTINUE
      RETURN
      END
```

CHAPTER 5

ANALYSIS OF THE RESULTS

The model presented in the previous chapter was described in considerable detail. This detail was necessary in order to establish the credibility of the results and conclusions, since the model is the basis for analyzing the alternative construction accounting methods. A thorough understanding of the model and its assumptions must precede any interpretation of or the drawing of conclusions from the results.

In a further effort to enhance the credibility of the results and conclusions, this chapter examines the results for a number of situations and assumptions. The analysis, presented in the first part of this chapter, details the basic results and explains the cause and effect relationships which are found. The initial analysis is based on a set of input values for a "typical" electric utility company. This analysis is expanded and generalized by examining the effect of changing several of the model's basic assumptions. By examining a variety of circumstances, the conclusions may be founded on a broader base. The final section of this chapter presents another illustration which uses a set of input values and a combination of assumptions which reflect current economic conditions. This illustration does not represent the "average" firm, but is nonetheless representative of a large number of firms and provides a contrast to the basic results. Together, the results of the numerous individual cases support the conclusions drawn in the last chapter.

The Typical Firm Case

To begin the analysis, a set of input values representing a hypothetical average or "typical" utility company are estimated. The results generated using these input values provide a basic case which can be used to examine and explain the differences resulting from the alternative construction accounting methods. This case is explored at considerable length for two reasons. First, not only are the results reported, but the causes are also explained. Typically, these relationships are not obvious and require lengthy explanations. Second, it is useful to consider the results from different perspectives. That is, alternative assumptions are made and their impact on the results is explored. Where possible, only verbal summaries of these results are presented, with more detailed results presented in the appendices. Once the cause and effect relationships and the impact of the different assumptions are understood, the reader will be ready to consider the magnitude and importance of these differences.

The Input Values for the Typical Firm Case[1]

All of the firms begin with the same initial input values. Because of the start-up period, explained in Chapter 4, many variables begin with non-zero values. For example, the deferred tax reserve for the normalizing firms has a positive value. Consequently, the amount of debt and equity is less for the normalizing firms, although total assets are the same for all firms in the first year. Table 25 shows the input values

---

[1]The input values of the typical firm are rather conservative by design. It was felt and will be demonstrated later that higher values for most of the input parameters would increase the observed differences between the firms. If the results deviated from the norm, the preference was to underestimate these differences.

TABLE 25

INPUT VALUES FOR THE TYPICAL FIRM CASE

Beginning Assets	$100
Length of Simulation	50 years
Asset Life	30 years
Initial Growth Rate	5%
Final Growth Rate	5%
Debt Ratio	60%
Cost of Debt	6%
Cost of Equity	10%
Cost of Capital--Weighted Average	7.6%
Customers' Discount Rate--Weighted Average	5.8%
Tax Rate	50%
Beginning Shares	1.0
P/E Multiplier	10
Construction Program	normal firm

Construction Activities

	A	B	C
Percent of new investment invested annually	35	15	50
Length of construction period (years)	1	2	5

used for the "typical" firm case. This typical firm is merely a base situation from which the analysis can begin.

Results for the Typical Firm Case

If one method is clearly superior to others in some significant aspect, and at least equal in all other respects, then that method would be the best choice for providing a return on CWIP. However, the alternative procedures for providing a return on CWIP were designed to preclude that possibility. Theoretically, the alternatives are such that the end results are the same regardless of how the return on CWIP is accounted for by the firms. This theoretical result is supported by the basic simulation results, from both the consumer's and investor's points of view.

As illustrated in Chapter 3, the net present value (NPV) of the total revenue requirements is identical for each of the firms.[2] Since the NPV of revenue requirements represents the cost of service to the group of consumers, they should be indifferent as to the choice of the construction accounting method.[3]

Similar results are obtained from the point of view of the investor. The basic variables important to investors have identical values, period for period, for each of the firms. Specifically, earnings per share (EPS), dividends per share (DPS), and market price per share (MP) are identical for each of the firms. Thus, it might seem reasonable to infer that investors would also be indifferent as to the choice of the construction accounting method.

The theoretically desired results are apparently confirmed by the simulation model since the cost to the consumer and the return to investors are identical for each of the firms. On the surface these equalities may exist, but it is necessary to look more closely at the simulation results. When these results are examined, it is apparent that a number of qualitative factors have not been explicitly considered in the model, which in reality may be quite important. Brigham and Pappas[4]

---

[2]In this instance we are referring only to the firms which follow different construction accounting procedures. As demonstrated by Brigham and Pappas, the straight line firms have a larger NPV of revenue requirements than either the normalizing or flow through firms which are identical. E. F. Brigham and J. L. Pappas, <u>Liberalized Depreciation and the Cost of Capital</u>, 1970 MSU Public Utilities Studies, Michigan State University, 1970.

[3]Recall the discussion of utility rates in Chapter 4. This discussion also ignores the impact of utility rate differences on demand and revenues.

[4]<u>Ibid</u>.

demonstrated that although both normalization and flow through accounting require the same NPV of revenue requirements and provide the same return to investors, qualitative differences might significantly alter the basic results. The same principle may be involved in the case of construction accounting. That is, qualitative factors, not considered by the computer model, may significantly affect the firms so that, in reality, identical results are not achieved. Consequently, it will be useful to examine a number of such factors and consider the impact these will have on the theoretical results. We shall explore these factors from the consumer's and investor's points of view.

Before looking at these results, however, some introductory remarks will facilitate their presentation and the reader's comprehension. In the discussions which follow, it will be useful to distinguish between the firms which differ only in their choice of construction accounting methods and those which differ only in their depreciation policy. This distinction will be useful since it may not always be necessary to discuss each of the 15 unique firms individually. It will often be more efficient to discuss the impact of the different construction accounting treatments in general and then to discuss the impact of the different depreciation policies. Furthermore, we are primarily interested in the effect of the depreciation policy. Consequently, when we wish to distinghish only between construction accounting methods, we shall use the basic mnemonic symbols established earlier (e.g., Firm IDC, Firm RB). When we are speaking about the effect of depreciation policy in general, we shall refer to the normalizing, flow through, or straight line firms. Finally, when we wish to refer to a specific construction accounting treatment <u>and</u> a specific depreciation policy, we shall use the appropriate mnemonic symbol with an "N" for normalizing, "F" for flow through, and "S" for straight line appended to it [e.g., Firm RB(N), Firm IDC(F)].

In discussing the impact of different accounting treatments, we deal primarily with the results of the normalizing firms. In those instances where the depreciation policy causes significant differences, the results of the other depreciation policies are discussed also. When only the normalizing firms are discussed, it may be assumed that the choice of depreciation policy does not substantially affect the results.

Using constant values for the input parameters, the model approaches an equilibrium situation in the last 15 periods. Although the values of most variables vary from period to period, a certain cycle is apparent which repeats itself. This cyclical variation becomes consistent toward the end of the simulation period. The periods over which the cyclical pattern becomes repetitive provide a good base to use in comparing the results. Therefore, the discussion of the results and values quoted are based on these last 15 periods. When a range of values is given, the range is for the last 15 periods and not the entire 50 periods. A subsequent discussion attempts to generalize about the differences produced in the earlier periods.

The cyclical variation that is present for most variables is a result of the changing ratio of CWIP to total assets. The extremes in each cycle correspond to the beginning and end of the longest construction period because this is when the ratio of CWIP to total assets is a minimum and a maximum, respectively. Most variables are influenced by the amount of IDC relative to total earnings a firm capitalizes and, as stated before, the IDC/earnings ratio is a direct function of the ratio of CWIP to total assets. Thus, those variables with cyclical variation will have extreme values corresponding to the beginning and end of the longest construction period, which, in the discussions which follow, is five years. The two-year construction period has the same effect, but since CWIP is only accumulated over a two-year period, the impact on CWIP and the other variables is less pronounced.

In Chapter 3 we illustrated that the results for Firm IDC and Firm RB-IDC are identical when it is assumed that the allowed rate of return and the IDC rate are equal. Since these rates are equal for the typical firm case, the results for the two firms are again identical. Consequently, we deal exclusively with Firm IDC, realizing that the results and conclusions for Firm RB-IDC are identical.

The consumer

The consumer's interest is reflected in two related variables, revenue requirements and utility rates. Inasmuch as other factors affect these two variables, consumers will also be interested in them. However, we initially abstract from these other factors and focus on these two variables.

It is important to recognize that we are dealing with required revenues, that is, those revenues just sufficient to provide a return equal to the allowed rate of return. This same idea is reflected in utility rates. In each period utility rates are set so that the revenues generated are just adequate to provide the allowed rate of return.

Revenue requirements. As we have indicated, the NPV of revenue requirements is the same for all firms. However, the present valuing procedure ignores an aspect of the consumer's cost which may be quite important to individual consumers. Since consumers within a given system may change through time, the timing of payments for utility services is important. In essence, current customers wish to pay only for those assets which are of benefit to them. They do not want to pay any part of the cost of assets which are to be used at some future time when they may not be a part of the system.

The best way to illustrate this idea is by referring to the single asset model of Chapter 3.[5] Table 14 is reproduced in Table 26 and indicates the revenue requirements of each firm. As shown, two of the firms, Firms RB and RB-%IDC-ITB, require revenues to be generated during the construction period (1971-72). In an on-going firm, this means that those who were customers during that period would have to pay a portion

TABLE 26

REVENUE REQUIREMENTS
SINGLE ASSET MODEL

Year	RB	RB-IDC	RB-%IDC-ITB	IDC	IDC-ITB
1971	16.00	-4.00	12.00	-4.00	-0-
1972	32.00	-8.40	24.24	-8.40	-0-
1973	82.00	102.46	85.98	102.46	98.26
1974	74.00	93.22	77.74	93.22	89.28
1975	66.00	83.98	69.50	83.98	80.29
1976	58.00	74.74	61.26	74.74	71.31
Net Present Value of Revenue Requirements @ 8 Percent					
	243.20	243.20	243.20	243.20	243.20

[5]If he is not already, the reader should become familiar with the single asset model, its assumptions and results.

of the cost of the asset that is to go on line in 1973. That is, current customers are paying for part of the cost of an asset which is not currently being used to their benefit. Firms RB-IDC and IDC actually produce the opposite results since they both have negative revenue requirements during the construction period. In an on-going firm, negative revenue requirements mean that the method of construction accounting used by these two firms causes revenue requirements to be lower during the construction period than they would have been had there been no construction. Consequently, current customers will receive a benefit from construction which will have to be made up during the life of the asset at the expense of future customers. Firm IDC-ITB is the only firm which does not shift part of the burden of construction to current customers nor provide current customers with a benefit at the expense of future customers. As Table 26 illustrates, revenue requirements for this firm are zero during the construction period, indicating that the exact costs of construction are borne directly by those who benefit from that construction.

The cause of this timing difference is twofold. First, positive revenue requirements during construction in the single asset model mean that current customers are paying all or part of the capital costs of construction. That is, funds are invested in construction and the return on those funds, or part of it, is generated through customer revenues and thus paid by current customers. The main reason for using some IDC-related method is to defer the capital costs of construction to future periods when the asset is being used. This deferral is precisely what Firm IDC-ITB accomplishes as supported by the zero revenue requirements of the single asset model during the construction period. The second cause of a timing difference is deferring too large an amount for the capital cost of construction. Too large of a deferral results if IDC is computed at an effective rate greater than the net cost of capital. Those firms with negative revenues during the construction period are deferring excessive capital costs, such that current revenues may actually be lower than if construction were not in progress. This whole area of timing differences may influence the consumer's preference of construction accounting methods.

Another factor, important in the micro sense, is the discount rate of customers. In discounting the stream of revenue requirements, the net cost of capital was used as the firms' discount rate. Even if individual customers did not change over time, a higher or lower discount rate would change the NPV of revenue requirements for the firms. If for any reason consumers had a lower discount rate than the firms, the ranking of the NPV of revenue requirements for the firms from lowest to highest would be as follows: 1) RB, 2) RB-%IDC-ITB, 3) IDC-ITB, and 4) IDC, RB-IDC. Conversely, a higher discount rate for consumers will produce a reversed ranking of the firms. Consequently, the discount rate might be another consideration for the consumer.

<u>Utility rates.</u>[6] Figure 8 illustrates the utility rates which are necessary to generate revenues just sufficient to provide a return equal to the allowed rate of return for each of the firms. The graph illustrates that the larger the amount of IDC a firm capitalizes, the greater

---

[6]Recall from Chapter 4 that utility rates are defined as revenue requirements divided by demand. Again, we have ignored the utility rate-demand interaction by assuming an inelastic demand function.

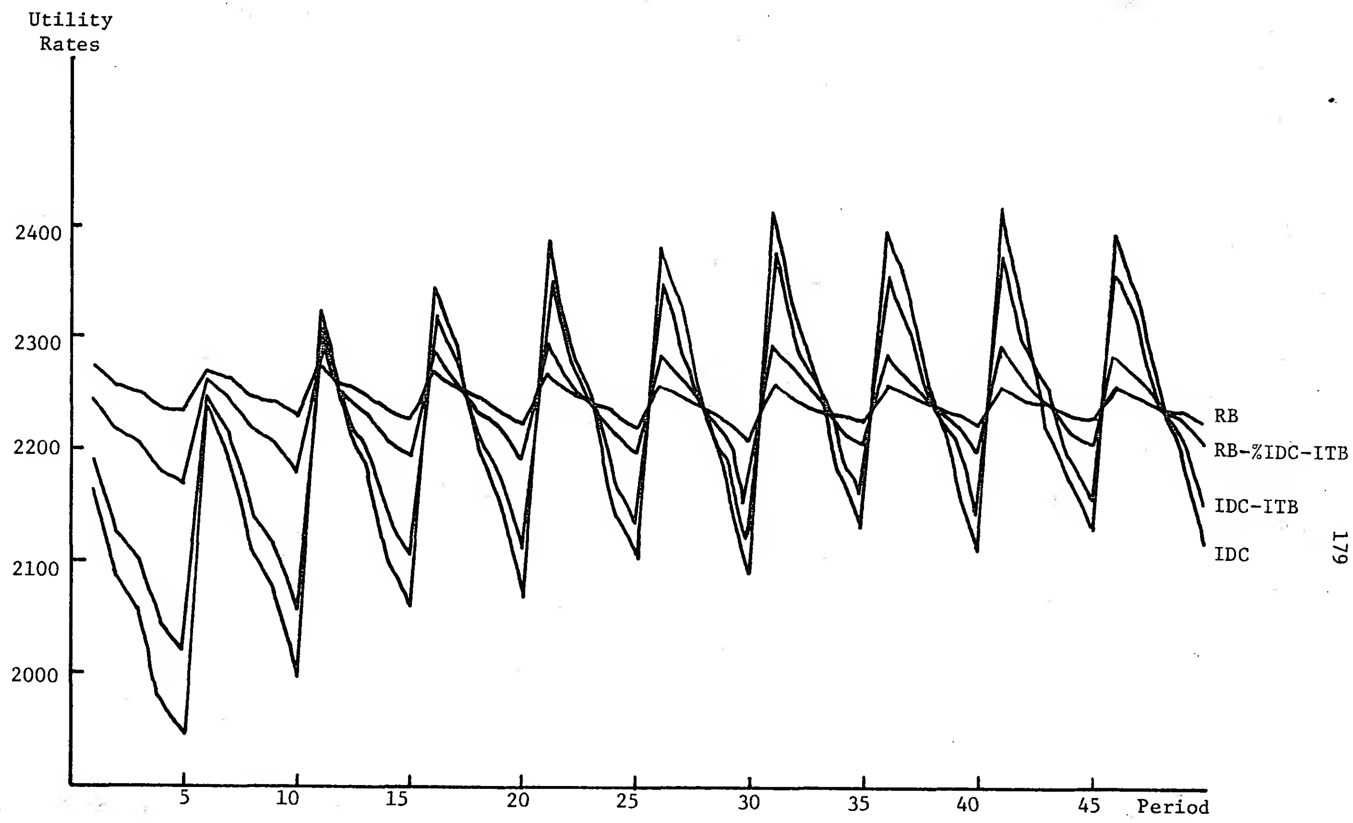

FIGURE 8

UTILITY RATES (NORM.)

the fluctuation in utility rates will be. Firm IDC computes IDC at a 10 percent rate and has the largest amount of fluctuation, while Firm RB, which capitalizes no IDC, has the least fluctuating utility rates. The other firms compute IDC at rates between these two extremes and have utility rates which fluctuate accordingly.

Although the basic cause of the fluctuation in utility rates is the same, the explanation of it for the firms differs depending on whether or not CWIP is included in the rate base. The underlying reason is that the firms which capitalize IDC are deferring payment of the return on certain investments to future periods. With a constantly increasing demand base from which to obtain revenues to meet these returns, proportionately higher returns in some periods than others causes the utility rate to rise and fall. In effect, the size of the cash (or non-credit) return and base upon which a cash return must be provided do not increase similarly in each period. To achieve a constant rate of return, these differences must be absorbed by changes in the utility rate. For those firms which exclude CWIP from the rate base, it is the base upon which a return must be earned which increases unevenly, or only as assets go on line. For those firms which include CWIP in the rate base and capitalize IDC, the base increases smoothly but the size of the cash return varies. Although the total return increases smoothly, the increase in the "cash" part of the return changes since the credit (IDC) part rises and falls as CWIP changes. In both cases, however, it is the difference in the increase in the size of the cash return and in the increase in the rate base which necessitates fluctuating utility rates. As the amount of capitalized IDC increases, this difference, and thus the fluctuation in utility rates, increases. On the other hand, Firm RB, which does not capitalize any IDC, has a constantly increasing rate base. Were it not for another destabilizing factor causing some fluctuation, the cash return for Firm RB would also be increasing smoothly and a constant utility rate would result. This other destabilizing factor is discussed below.

The impact of depreciation policy can most easily be illustrated by referring only to the extreme cases, i.e., Firms RB and IDC. Figure 9 shows the utility rates generated for these two firms for each depreciation policy alternative. Three facts are worth mentioning. First, an obvious result is that the straight line firms have higher utility rates than either of the firms taking advantage of liberalized depreciation. By not taking advantage of the tax deferral allowed by liberalized depreciation, the straight line firms must have higher utility rates than either the normalizing or flow through firms.

Second, the normalizing and straight line firms have very similar patterns of utility rates with approximately the same amount of fluctuation. There are two reasons for the fluctuation in utility rates. The cause of primary interest in this study is the capitalization of IDC as explained above. However, there is another source of fluctuation in utility rates affecting all the firms. This fluctuation is due to the pattern of depreciation caused by construction. With construction, investments are accumulated in an asset for the length of the construction period, for as much as five years in the case of the typical firm. This accumulation of investment over the construction period creates an uneven pattern of depreciation since the accumulated sum goes into the rate base all at once, rather than continuously as investments are made. To exactly meet the target rate of return, the fluctuation in depreciation expense must be offset by an opposite fluctuation in revenues. With a

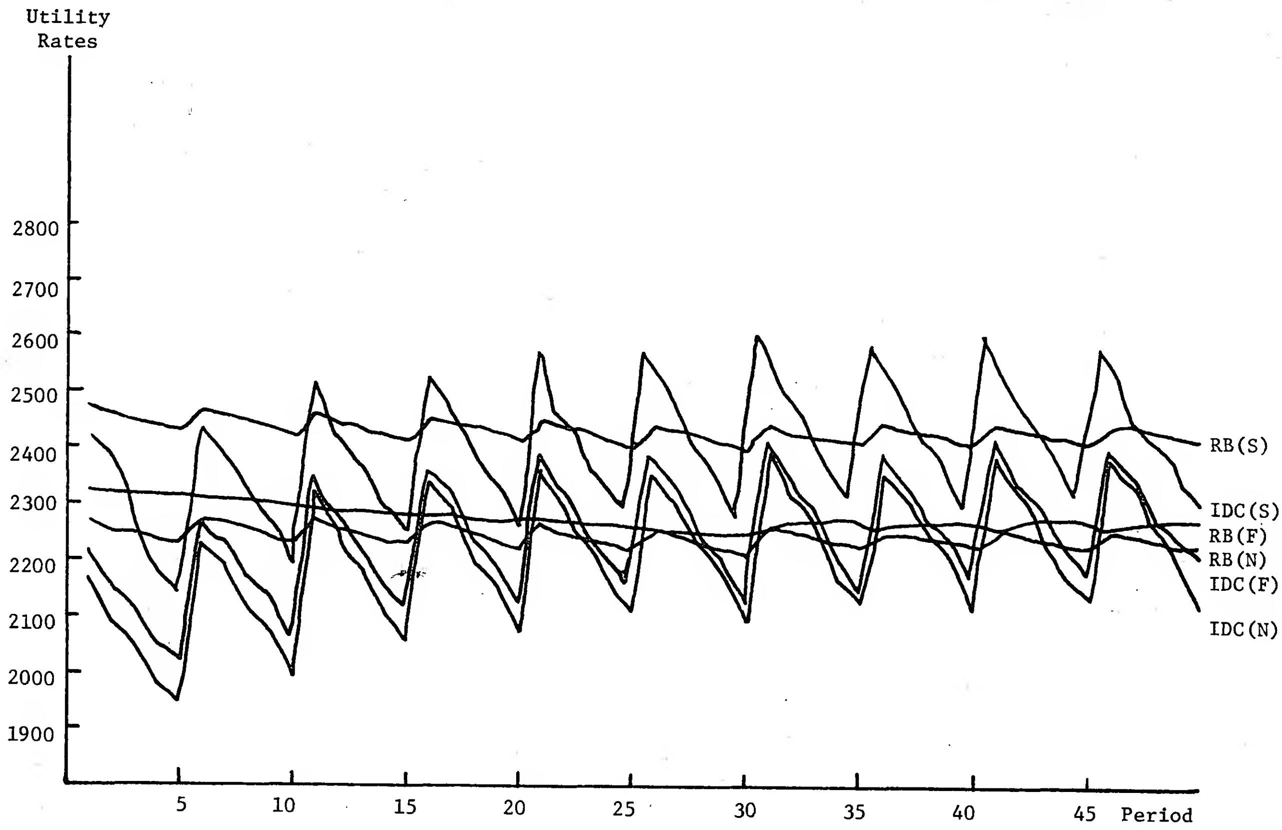

FIGURE 9

UTILITY RATES

constant increase in demand, the fluctuation in revenues must be created by changing the utility rate. This uneven pattern of depreciation is the reason that utility rates fluctuate for Firms RB(N) and RB(S). Furthermore, the fluctuation caused by this pattern of depreciation coincides with the direction of fluctuation caused by the capitalization of IDC. As a result, the fluctuation in utility rates for the normalizing and straight line firms is a result of these two compounding factors.

The third fact worth noting is that the flow through firms have less fluctuation than either the straight line or normalizing firms. This fact is easily verified by comparing Firm RB(N) with Firm RB(F). The impact of flow through accounting works opposite to the fluctuation for the other cases, particularly in the later years, producing some offsetting tendency. This tendency can be further verified by comparing the relative position of the rates for Firms IDC(N) and IDC(F) for periods 46 through 50.

The amount of fluctuation in utility rates may be of interest to the consumer, particularly if he uses the utility rate as a signal in planning consumption expenditures. Sharp fluctuations in the rate from one period to the next makes planning difficult, particularly in the short run. In the long run the highs and lows even out, but in general, fluctuating rates increase uncertainty and complicate planning. Other things being equal, consumers are likely to prefer as little fluctuation as possible. Consequently, these differences may also influence the consumer's preference of construction accounting treatments.

It will be useful to note one final point. When the interaction of utility rates and demand are considered, different demand and revenue patterns may result. We have ignored this implication by assuming an inelastic demand function. Although demand is an important consideration, it is beyond the scope of this study, as noted in Chapter 4.

The investor

As pointed out in the beginning of this section, the primary market variables of interest, EPS, DPS, and MP, are identical for all the firms. However, as explained in Chapter 4, MP is derived primarily as a function of DPS. In reality though, MP is a function of many other variables. The interrelationship between DPS, EPS, MP, and shares outstanding is such that some of these other variables are considered and others are not. The expectations of investors have a significant impact on MP, yet many of the factors which influence expectations are not implicitly or explicitly considered in the computer model. Many of the factors which influence expectations are not well defined and it is difficult to say what their impact will be. At best we can specify what some of these other variables are and indicate the direction their influence might take. In this way we can estimate how the balance of influence affects the theoretical equality of the firms.

A number of factors will fall into this category, but we shall deal mainly with the most tangible of these. That is, we shall focus on those factors for which we have generated some data in the model. The variables we shall examine are the following: 1) the ratio of IDC to earnings, 2) the ratio of IDC to dividends, 3) cash flow, and 4) the times-interest-earned ratio. This list is not complete but does contain those for which data can be provided. Included in the discussion of each variable will be a brief explanation of why it may be important to investors.

IDC/earnings ratio. It has been suggested that IDC earnings may not be valued as highly as earnings from operations. The discounting of IDC earnings occurs because they are imputed credits; that is, they are claims to future revenues and not cash earnings. As demonstrated by the railroad industry, even with regulated industries there is no guarantee that future revenues will be generated. For this and other reasons explored in Chapter 2, investors may tend to discount IDC earnings when examining the earnings of a firm. To the extent that this discounting occurs, in a comparison of two firms with the same EPS, the one with more IDC earnings may be valued less highly than the other firm. Thus, the IDC/earnings ratio could be a factor influencing MP which the model does not consider.

The IDC/earnings (I/E) ratios are illustrated in Figure 10, for all the firms which differ in their method of accounting for construction. As the graph reveals, the I/E ratios vary directly with the amount of IDC a firm capitalizes. Furthermore, these ratios fluctuate depending on the point in the construction cycle. The peaks and troughs in the pattern coincide with the end and beginning, respectively, of each construction cycle for the construction activity with the longest construction period. Also at these points, CWIP, as a percent of total assets, is a maximun and a minimum, respectively. This observation is in accord with the statements made earlier regarding the relationship between the ratio of CWIP to total assets and the ratio of the return on CWIP to the total earnings of the firm.

For Firm IDC, the I/E ratios are the highest and vary between about 9 and 30 percent. Firm IDC-ITB has a slightly lower effective IDC rate, which results in slightly lower I/E ratios. For this firm the ratios

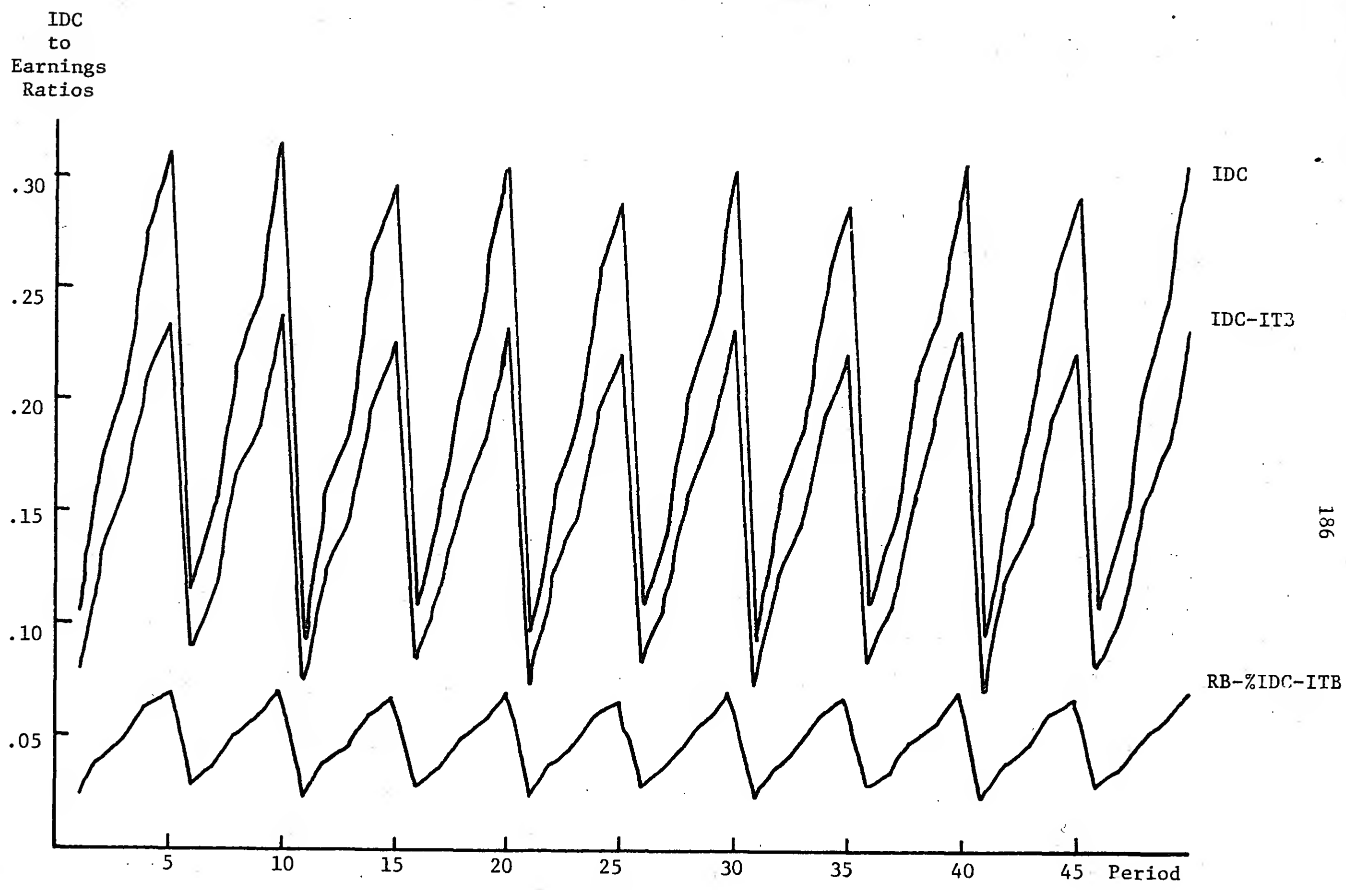

FIGURE 10

IDC TO EARNINGS RATIOS (NORM.)

range between about 7 and 23 percent. Firm RB-%IDC-ITB has a still lower effective IDC rate and, consequently, ratios which range between about 2 and 7 percent. Finally, Firm RB always has I/E ratios of zero since this firm never capitalizes any IDC.

The ratios for the flow through and straight line firms are identical and are generally about 10 percent below those of the normalizing firms. The ratios are higher for the normalizing firms since a portion of their capital structure (the deferred tax reserve) is cost free and, therefore, no earnings are generated for that capital. In effect, normalizing firms generate less earnings but the same IDC credits, which causes them to have higher I/E ratios.

IDC/dividend ratio. Another variable which investors may examine and which could influence their expectations is the ratio of IDC to dividends. This ratio is closely linked to the I/E ratio since dividends are simply a proportion of earnings. If dividends are computed as a function of earnings including IDC,[7] dividends are being paid on earnings for which no cash is being generated. With high I/D ratios, investors may become concerned about the firm's ability to meet its dividend payments. This concern may be reflected in investors' expectations and thus in market price.

Patterns similar to those generated for the I/E ratios are also generated for the I/D ratios, as indicated by Figure 11. Firm IDC has the highest ratios with a range from about 13 to 44 percent. The ratios

[7]This is how the computer model which generated the identical values for the key market variables was programmed.

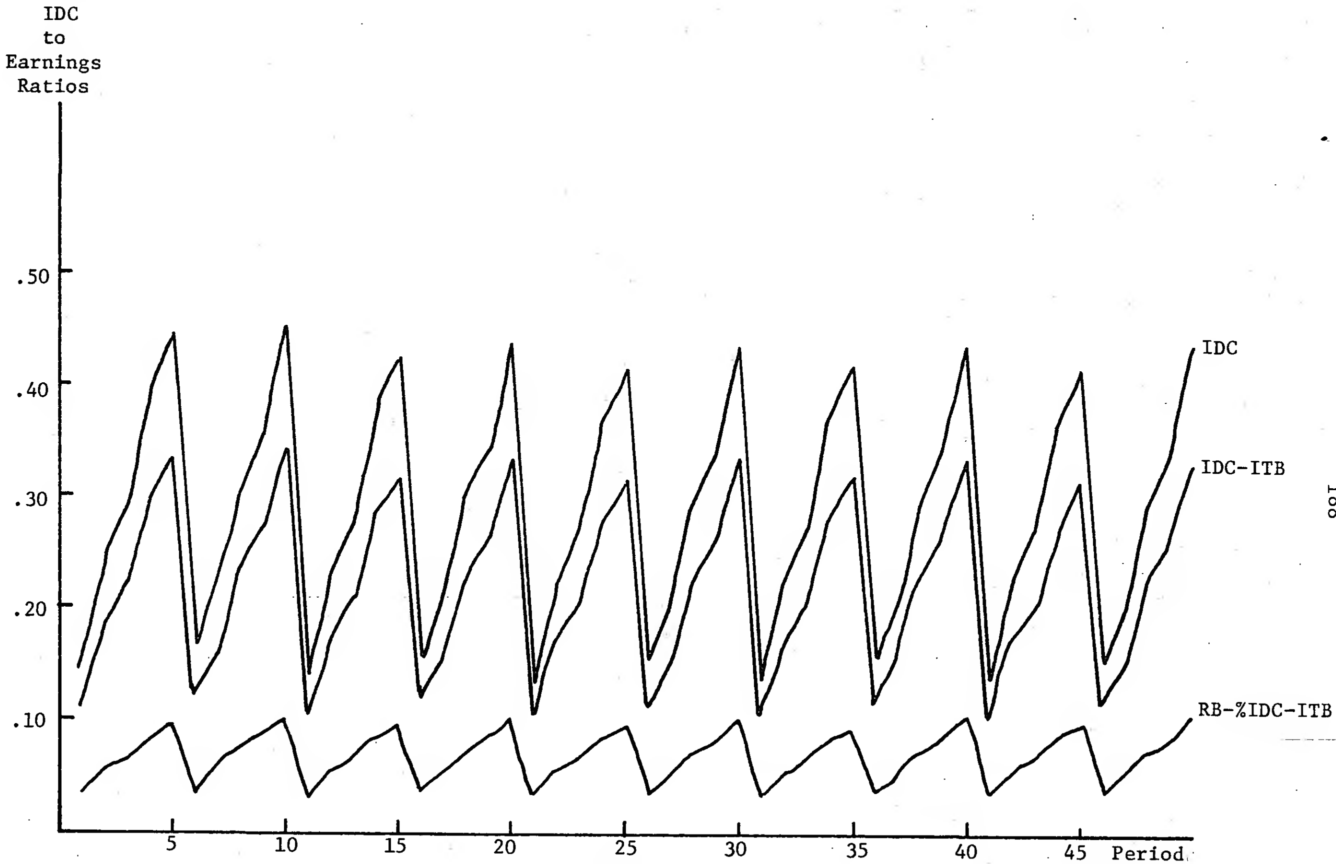

FIGURE 11

IDC TO DIVIDENDS RATIOS (NORM.)

for Firm IDC-ITB range from 10 to 33 percent and those of Firm RB-%IDC-ITB range between 4 and 10 percent. The I/D ratio for Firm RB is, of course, always zero. The results for the straight line and flow through firms are analogous to the results for the I/E ratios. The ratios for the normalizing firms are about 10 percent higher than those of the straight line and flow through firms.

Cash flows. Investors will frequently be concerned with the expected cash flows of the firm. Inability to meet fixed charges may result in financial insolvency. The larger and more stable the expected cash flows of the firm, the greater the debt capacity of the firm. This is obviously an important consideration should the firm need to assume more debt in its capital structure.

Figure 12 shows the cash flow of the firms as a percentage of the cash flow of Firm RB. In general, firms which capitalize IDC have a lower cash flow than those which do not, and the more IDC a firm capitalizes the lower the cash flow will be. As a percent of the cash flow of Firm RB, Firm IDC's cash flow ranges from 88 to about 102 percent. For Firm IDC-ITB the range is 91 to 101.5 percent, and for Firm RB-%IDC-ITB the range is from 97.5 to 100.5 percent. Looking at cash flow on a per share basis, similar patterns result. Figure 13 presents cash flow on a per share basis for each of the firms. The reduced cash flows of the firms which capitalize IDC is even more pronounced on a per share basis because the firms which capitalize IDC have more debt and equity.

Figure 14 illustrates the impact of depreciation policy on cash flow for Firms RB and IDC. In general, the flow through and straight line firms have identical patterns of cash flow and both have cash flows be-

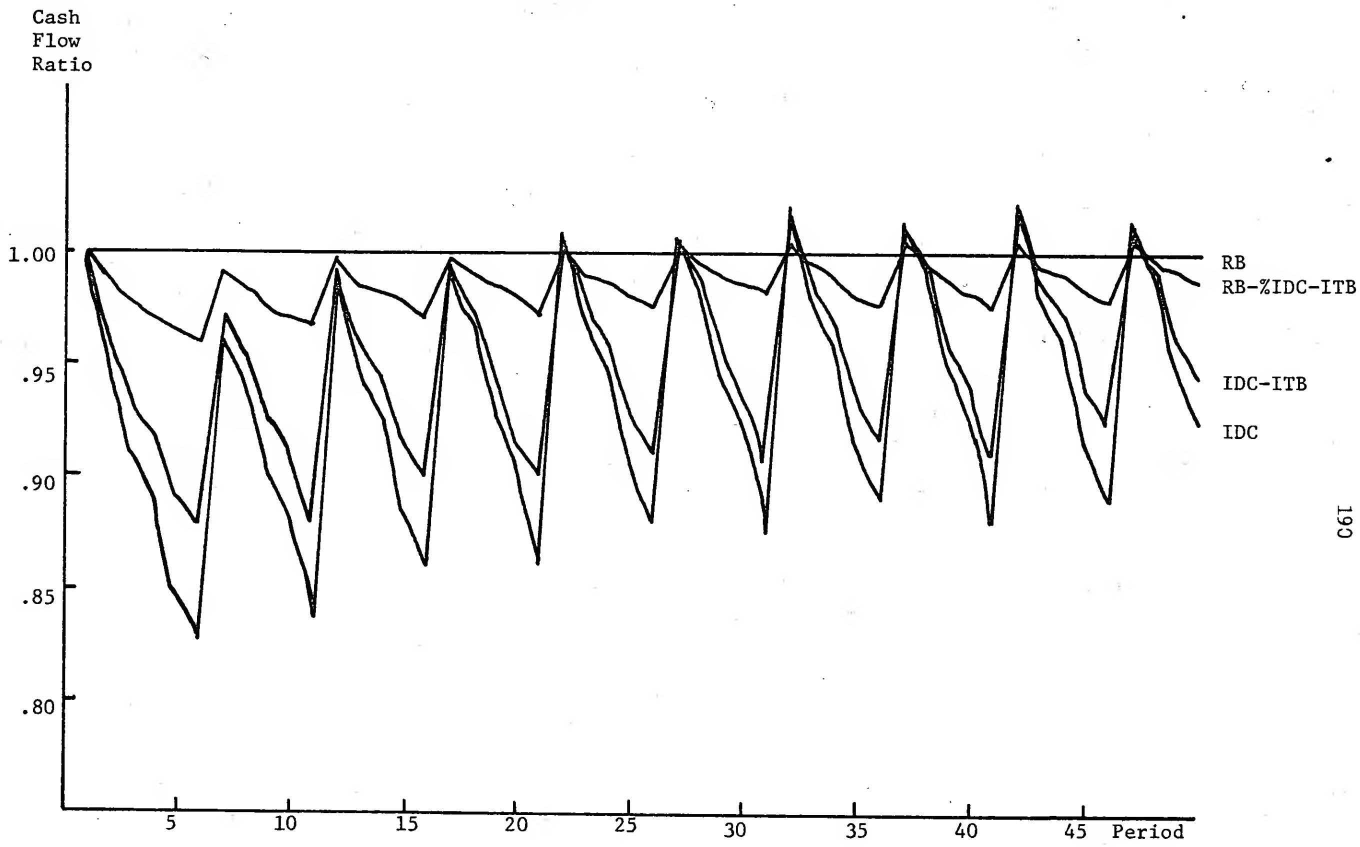

FIGURE 12

CASH FLOW OF EACH FIRM AS A PERCENT OF FIRM RB (NORM.)

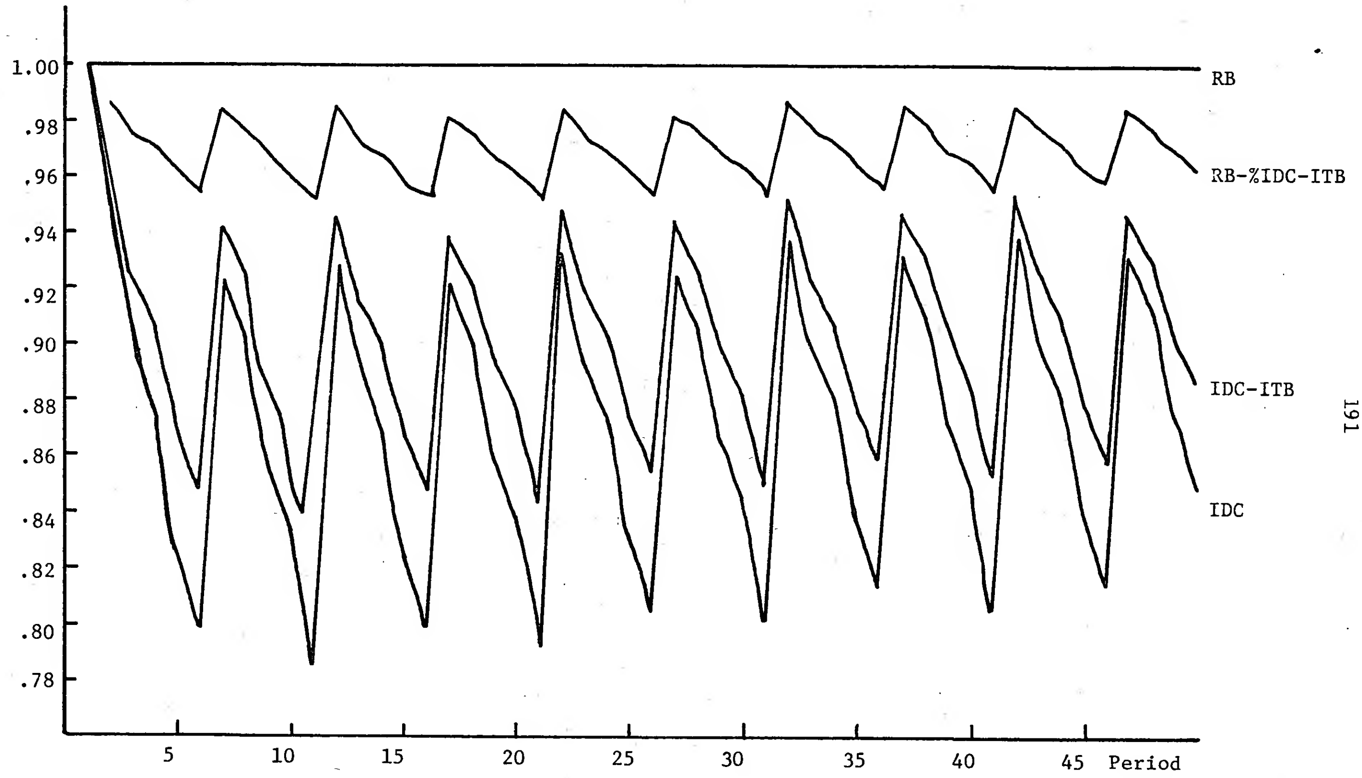

FIGURE 13

CASH FLOWS PER SHARE AS A PERCENT OF FIRM RB (NORM.)

low the level of the normalizing firms. The larger cash flows of the normalizing firms are due to the additions to the deferred tax reserve which the other firms do not have.

Another fact illustrated by Figure 14 is the relative stability of the patterns of cash flow. Firm RB has a smoother and more stable growth in cash flow than Firm IDC. The cash flow of Firm IDC is relatively constant over the longest construction cycle, then increases sharply at the beginning of the next cycle.[8] The other construction accounting methods simply produce results between these two extremes, depending on the amount of capitalized IDC.

As a result of lower patterns of cash flow, the firms which capitalize IDC must rely more heavily on external financing. This fact is illustrated by Figures 15 and 16, which graph the additional stock and additional debt, respectively, necessary for Firms RB and IDC. In general, Firm IDC requires larger absolute amounts of additional stock and additional debt than Firm RB. The other firms again produce intermediate results as a function of the amount of capitalized IDC.

Figure 17 depicts the additional stock necessary for the different depreciation policies for Firm RB. Again, straight line and flow through needs are identical and both require more additional stock than the normalizing firms. The absolute difference is constant across the different construction accounting treatments since the difference is due to the deferred tax reserve, which is identical for all normalizing firms. The deferred tax reserve of the normalizing firms also causes the amount

[8]Keep in mind that cash flow has a one-year lag in the model. That is, the cash flow of period i is generated in period i-1.

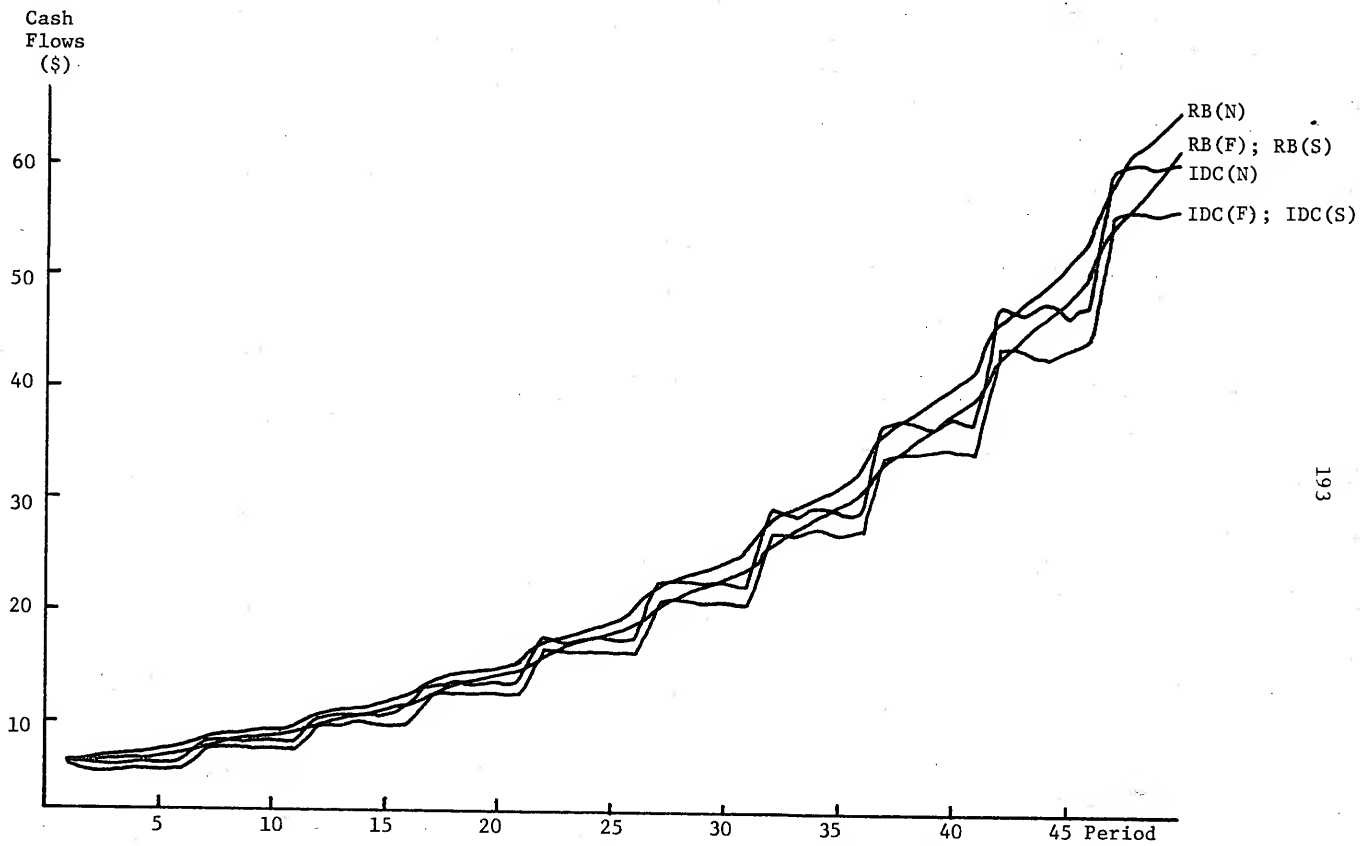

FIGURE 14

CASH FLOWS COMPARING DEPRECIATION POLICY

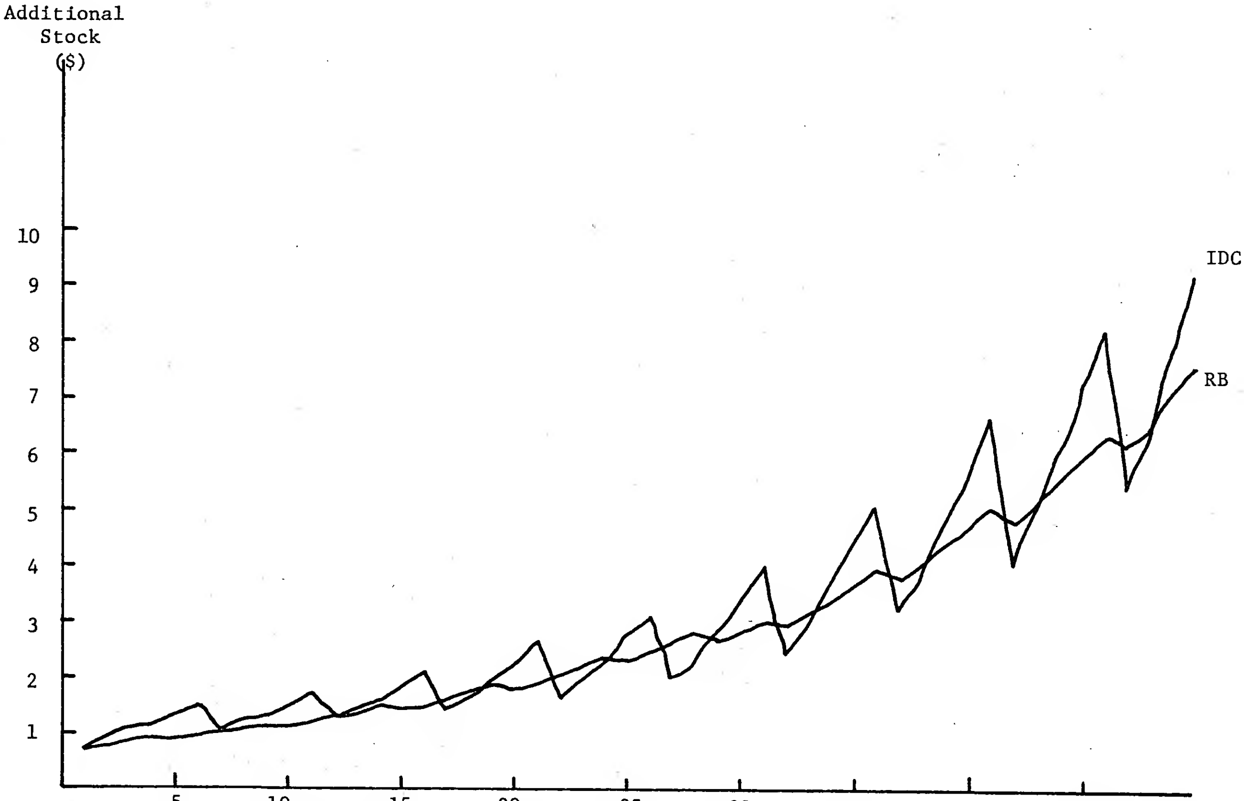

FIGURE 15

ADDITIONAL STOCK (NORM.)

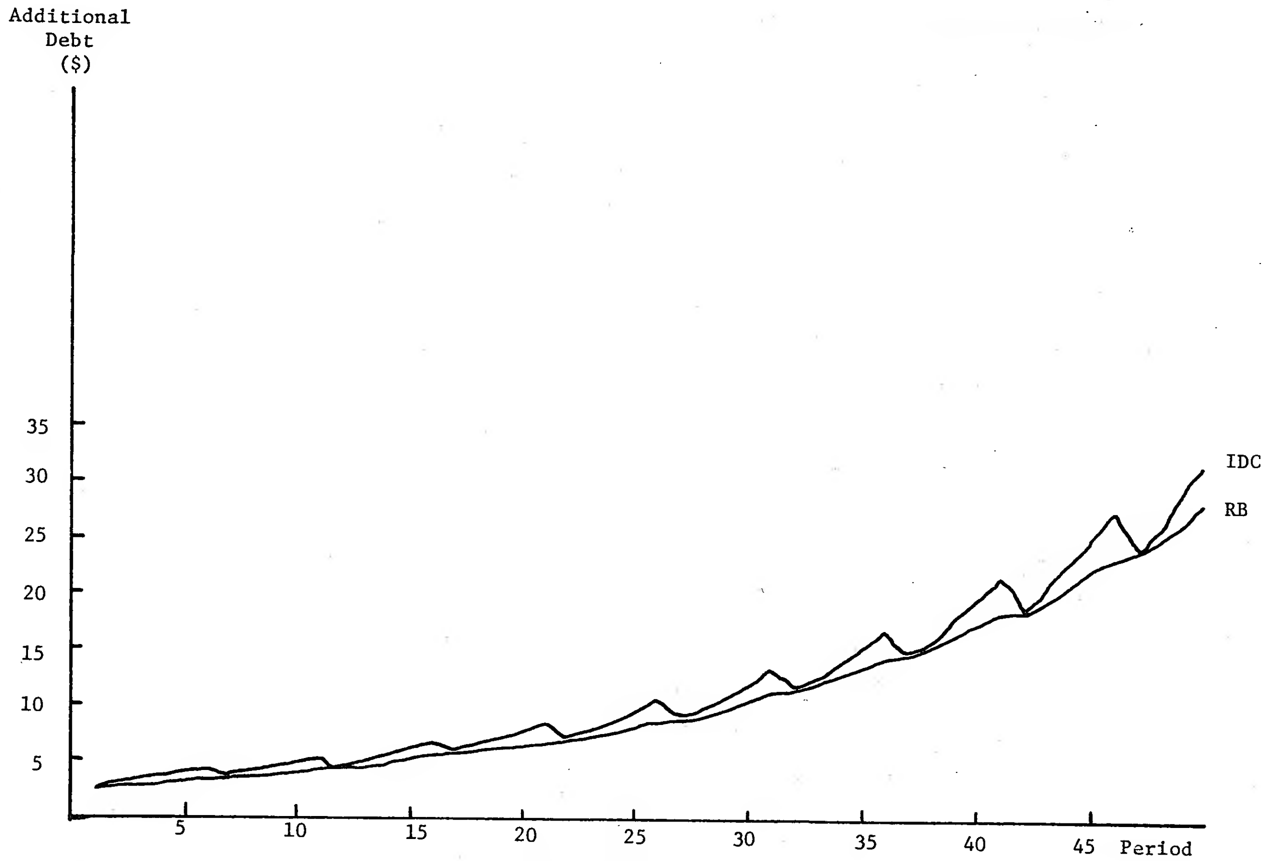

FIGURE 16

ADDITIONAL DEBT (NORM.)

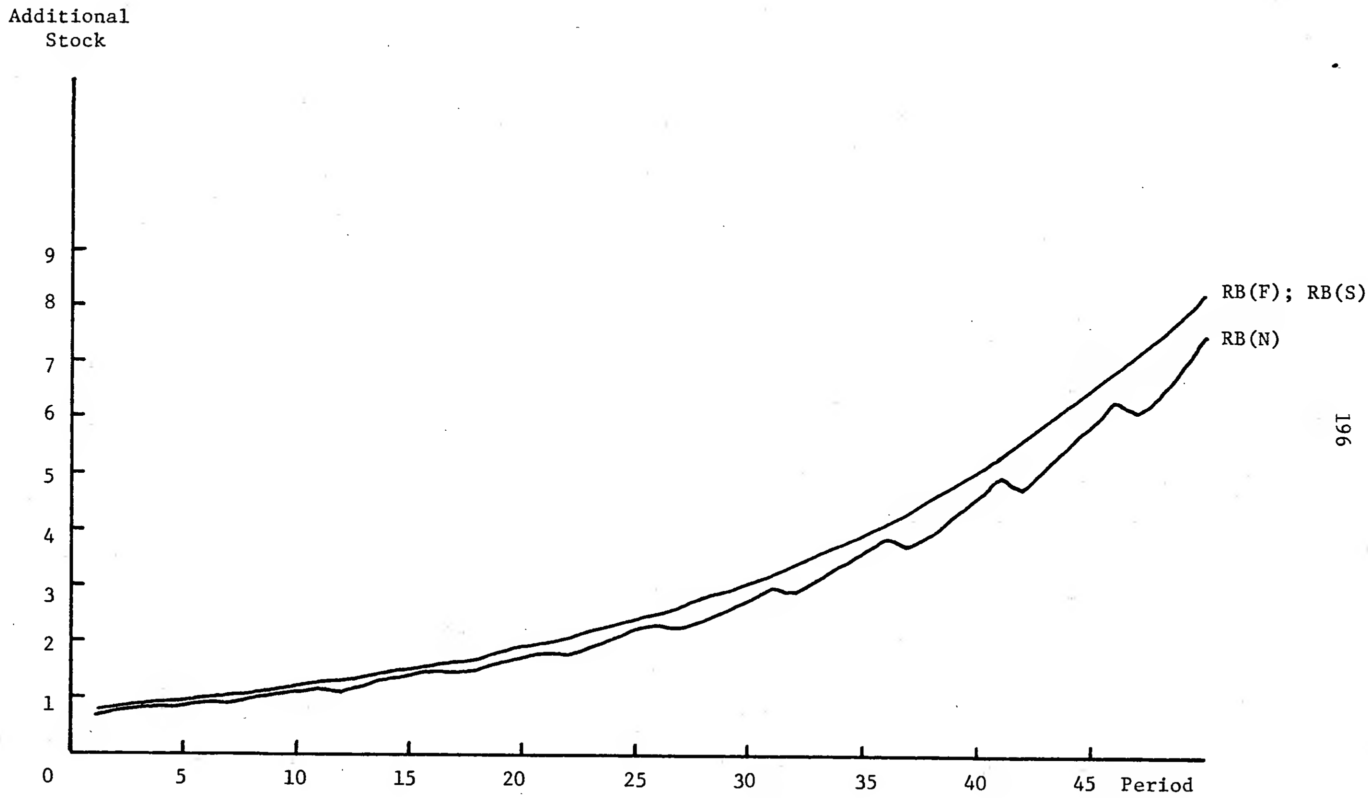

FIGURE 17

ADDITIONAL STOCK COMPARING DEPRECIATION POLICY of additional stock to increase in a less stable pattern than that of the other firms. At the end of the longest construction period, a large investment enters the rate base and begins being depreciated. The size of the tax savings is similarly large, which adds a large amount to the deferred tax reserve. The addition to the reserve reduces the need for external financing. Thus, every five periods the amount of additional stock necessary falls sharply, creating a cyclical pattern. Similar statements are applicable to the additional debt required by the firms.

Times-interest-earned ratios.[9] Stock analysts and bond rating agencies are particularly interested in the coverage ratios of the firm. These ratios provide information on the firm's ability to service its fixed charges and issue more debt. Reduced coverage ratios may make it difficult for a firm to issue more debt and/or may raise the cost of the debt it does issue.

Figure 18 shows the times-interest-earned ratios for the firms. Firm RB has a constant times-interest-earned ratio of 3.222 throughout the simulation period. The remaining firms, which capitalize varying amounts of IDC, have ratios which fluctuate from period to period and are always below those of Firm RB. Firm RB-%IDC-ITB, which capitalizes a relatively small amount of IDC, has ratios ranging between 96 and 99 percent of those of Firm RB. Firm IDC-ITB has still lower and more variable ratios, ranging from 86 to 98 percent of those of Firm RB. Finally, Firm IDC, which capitalizes the most IDC, has ratios ranging between 82 and 97 percent of the constant ratio of Firm RB. The fluctuation for each firm varies with the point in the construction cycle, with the lowest

[9] Recall from Chapter 4 that the computation of the times-interest-earned ratio excludes IDC credits.

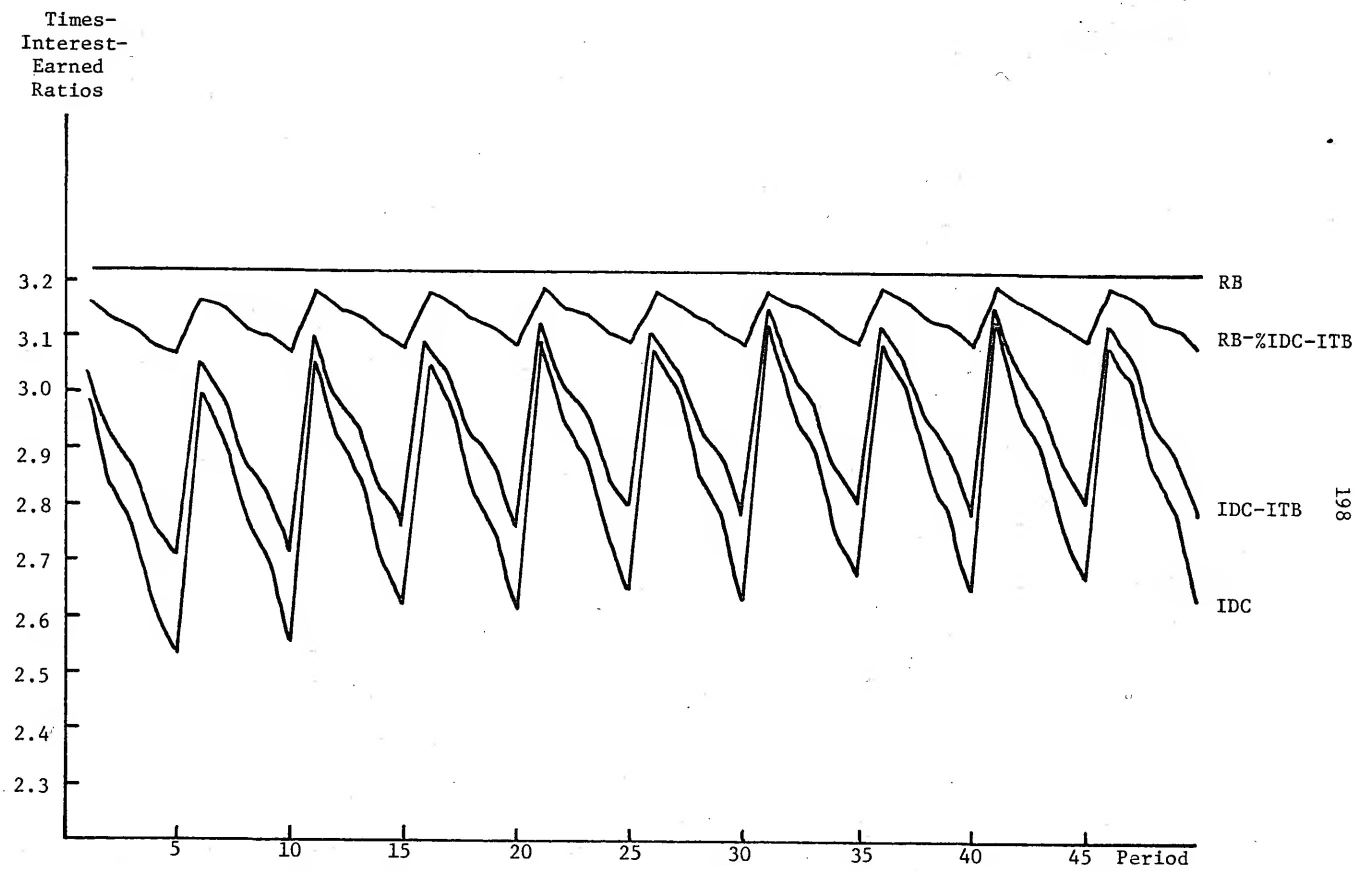

FIGURE 18

TIMES-INTEREST-EARNED RATIOS (NORM.)

ratio occurring at the end of the longest construction cycle and the highest ratio at the beginning of each cycle.

Figures 19 and 20 demonstrate the impact of the depreciation policy on the coverage ratios. The straight line firms have slightly higher ratios than the normalizing firms, except for Firm RB where they are identical. However, the flow through firms have significantly lower ratios in every case. For Firms RB and RB-%IDC-ITB, the ratios for the flow through firms are about 8 to 11 percent lower than those of the normalizing firms. For Firms IDC and IDC-ITB the ratios of the flow through firms are between 7 and 10 percent lower.

Comparing Firms RB(N) and RB(F) in Figure 19 clearly demonstrates the impact of flow through accounting on the times-interest-earned ratios. Whereas the capitalization of IDC produces ratios which decline over the construction cycle as illustrated by Firm IDC(N), flow through accounting has the opposite effect. The impact of these opposing tendencies has interesting results for the firms. For Firm RB, flow through accounting causes fluctuating ratios, whereas they are stable for the other depreciation policies. For Firms IDC and IDC-ITB, the fluctuation in ratios caused by capitalizing IDC is reduced for the flow through firms as compared to the normalizing and straight line firms. Firm RB-%IDC-ITB has a unique result. Apparently, the amount of IDC capitalized produces just enough fluctuation, so that by period 31,[10] the opposing tendencies exactly offset each other and produce a constant times-interest-earned ratio. This result is illustrated in Figure 20.

[10]By period 35, depreciation has completed a full cycle since construction was undertaken by the firms.

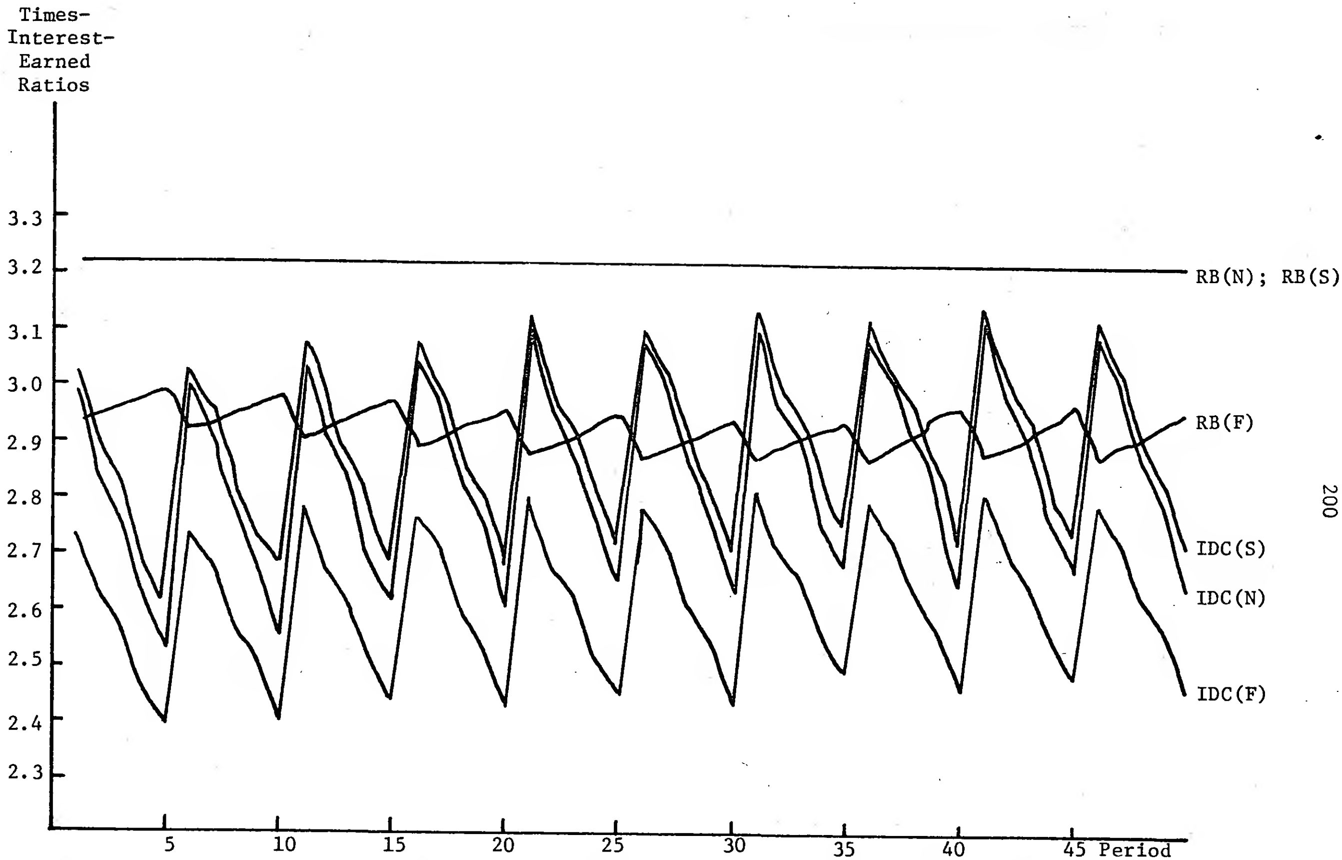

FIGURE 19

TIMES-INTEREST-EARNED RATIOS COMPARING DEPRECIATION POLICY

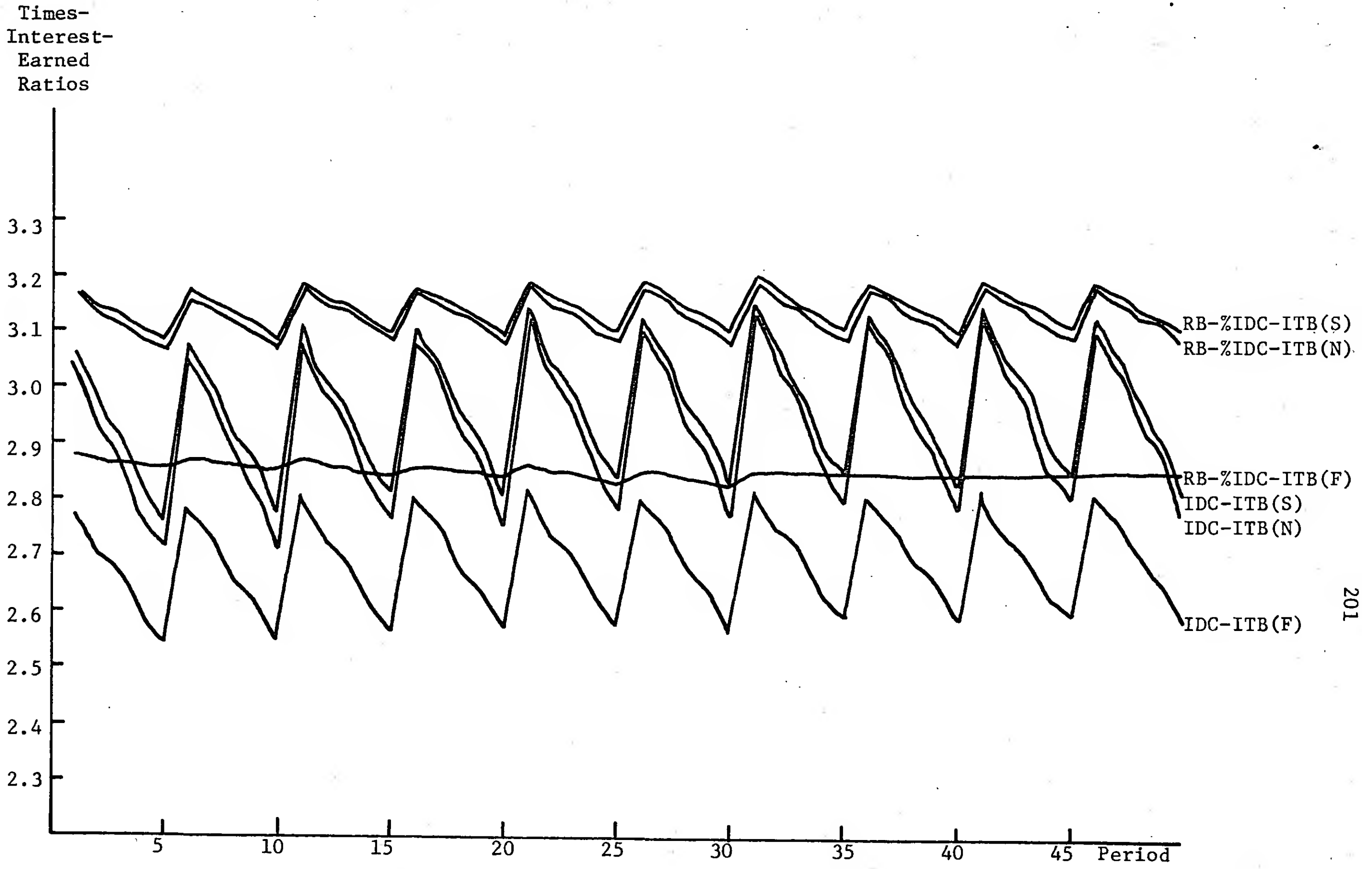

FIGURE 20

TIMES-INTEREST-EARNED RATIOS COMPARING DEPRECIATION POLICY

Summary

In general, Firms RB and IDC produce results at the extremes for all the variables. In effect, these firms may be considered the polar cases. The other firms produce results which lie somewhere between the extreme cases, depending on the amount of IDC the firm capitalizes (i.e., the IDC rate). For example, Firm RB capitalizes no IDC while Firm IDC has an effective IDC rate of 10 percent. Thus, Firm RB-%IDC-ITB, which has an effective IDC rate of 2 percent, has results closest to Firm RB. Conversely, Firm IDC-ITB has an effective IDC rate of 8 percent and thus has results closest to Firm IDC. Consequently, the rest of the summary will focus primarily on the extreme cases and allow the reader to place the other firms in the proper perspective.

From a macro standpoint, consumers should be indifferent between firms since the NPV of revenue requirements is the same for all firms. In the micro sense, however, two factors may be important. First, the timing of the payment of the capital costs of construction varies. Firms RB and RB-%IDC-ITB require current customers to pay a portion of the construction costs. Alternatively, Firm IDC provides current customers with a benefit by overcalculating the capital cost of construction for which payment is deferred to the future. Firm IDC-ITB fully allocates the costs of construction to those who benefit and is perhaps the most desirable from this standpoint. A second factor important in the micro sense is the appropriate discount rate. If it were felt that consumers had a discount rate different from that of the firm, it would probably be that the consumer's discount rate was lower. In this case, the NPV of revenue requirements would be the lowest for Firm RB and the highest for Firm IDC.

From the investor's perspective, all the typically important variables are the same, but as we have illustrated, several important variables have not been considered in the model. With respect to the variables examined, rather consistent results are found. Firm RB consistently produces the most desirable results, and Firm IDC consistently produces the least desirable results.

With respect to depreciation policy, the straight line firms are overall perhaps the least desirable, because the cost to the consumer is the highest for these firms. The flow through is the next least desirable, since cash flows and coverage ratios fall rather sharply. Overall, the normalizing firms are probably the most desirable, even though they have the highest I/E and I/D ratios. These higher ratios are not because the normalizing firms have more IDC, but simply because they have some cost-free capital upon which earnings are not generated.

This analysis has demonstrated that the construction accounting methods produce different results and explained why these differences occur. We also demonstrated the combined influence of different depreciation policies with the alternative construction accounting methods. In the next section, we shall briefly report on the results of a "sensitivity analysis" which is designed to show that the differences between the firms are not strictly a function of the input values used. Further on in this chapter, we shall demonstrate the importance of several of the basic assumptions of the model and how changes in these assumptions affect the results.

Sensitivity Analysis[11]

The sensitivity analysis was designed to examine the effect which the input variables have on the output variables of each firm. Some of the key input variables are increased 10 and 20 percent above the typical case, and the amount of change in the output variables is computed. This procedure provides a rough measure of the amount of change in several output variables as a result of a change in a single input parameter.

Because of several complicating factors influencing the results of the sensitivity analysis, it is not possible to form very precise generalizations about the impact among firms. To go beyond some rather broad generalizations, we would have to examine each variable for each individual firm for each of the input changes. Such a detailed explanation would be of little interest or, for that matter, of little use because of the uniqueness of each firm. However, it is possible to state several rather broad generalizations which are far more useful.

The primary generalization to be derived from the sensitivity analysis is that the basic relationships established in the preceding discussions will not change as a result of changes in the input variables. The results from the typical case demonstrated that the ranking of the firms with respect to the output variables is a function of the amount of IDC a firm capitalizes. More specifically, the firm with the higher IDC rate has: 1) higher IDC to earnings ratios, 2) lower cash flows per share, 3) lower times-interest-earned ratios, and 4) more widely fluctuating utility rates. These relationships will continue to exist for positive values of the input variables.

---

[11] The sensitivity analysis is explained in greater detail in Appendix A of this chapter. The data derived from it are presented in a series of tables, also in the appendix.

Two other generalizations are actually more explicit statements of the one discussed above. All other things being equal, any change which increases the IDC rate of one firm relative to another will increase the relative difference between the output variables of the two firms. For example, an increase in the equity rate of return increases the IDC rate of Firm IDC but not Firm RB-%IDC-ITB. If other things were unchanged, which they are not in the model, then the relative difference between these two firms would increase. Similarly, other things being equal, an increase in the absolute difference in IDC rates between firms, even if the relative difference decreases, will increase the absolute differences between the firms.

As the appendix points out, the ceteris paribus assumptions are rarely met, either in the model or in the real world. As a result, it is difficult to draw more specific generalizations from the results of the sensitivity analysis. In any event, we were primarily interested in assuring that the basic relationships established earlier would not change significantly as a result of changes in the input values.

The Early Periods

In comparing the firms, the base of comparison was data taken from the later periods (36-50), after the system becomes relatively stable.[12] The stabilized periods provide a more comparable base upon which the analysis can logically be founded. That is, the early periods (1-35) would not be as useful since they represent the impact of a firm starting

[12] This statement is not meant to imply that a single value is approached, but simply that the pattern of values a variable assumes becomes repetitive. For the input values used, one cycle is 10 periods.

out with no construction at all and then devoting all investment to construction. Using the early periods for the base may be realistic for a few firms but probably not for the majority. Consequently, it seemed more useful to examine the more stabilized situation.

At the same time, there are several reasons for examining the early periods. First, few firms will have constant rates of growth for 35 years, or long enough to reach the stabilized situation. Thus, it will be useful to examine the early periods and see what the implications might be for the results presented earlier. Second, the early periods indicate the kind of results one might find if the growth rate were to increase very sharply for several periods. Finally, it will be interesting to observe how quickly the model approaches these stabilized values. For these reasons, a brief discussion of the early periods is presented. For the more interested reader, data supporting the statements made below are presented in Appendix B.

Before discussing specific results, however, it will facilitate the presentation to first examine the basic influences operating in the early periods. There are two main reasons why the early periods differ from the stabilized periods. One has to do with depreciation and the other with the capitalization of IDC. Both of these are important and both can affect the variables we have examined.

The establishment of a new pattern of depreciation will alter the pattern which the output variables assume. Even with stable input values, the new pattern will have different effects until one full depreciation cycle has been completed. Although depreciation is occurring in the initial 100 periods used to initialize numerous variables,[13] a new pat-

[13]See Chapter 4.

tern of depreciation will occur as the firms begin to undertake their own construction programs. During the initializing period, depreciation is computed on all the investment made in each period since we assume assets are purchased on a turn-key basis. Once the firms begin to undertake construction of their own assets (period 1), depreciation is delayed on some investments for as long as five years. The accumulation of investment over a construction period creates an uneven pattern of depreciation where an even pattern existed before. This uneven pattern affects all the firms, but has its greatest impact on the flow through firms. By period 35, a full depreciation cycle has taken place, and with stable input values, repetition will occur. Although this result is somewhat artificial and occurs as a result of the model's development, similar results could occur in reality. That is, a firm which increases its rate of growth will have results analogous to those exhibited in the early periods.

The same is true of the adjustments which occur as a result of capitalizing IDC. Most firms already capitalize IDC, so that few will actaully start as the model did. However, increased rates of growth will affect the variables in a manner similar to the effects illustrated in the early periods. For this study, the impact of capitalizing IDC is probably the more interesting influence of the two. Throughout the analysis, we have demonstrated that the differences occurring between firms are a function of the amount of IDC a firm capitalizes, or the IDC rate. Earlier it was explained how the use of IDC credits deferred the need for additional revenues, creating differences in cash flows per share, utility rates, etc. These influences were demonstrated with respect to the more stable periods. A similar, but more extreme, influence is exhibited in the early periods. In the initial periods, IDC credits replace revenues that would otherwise be necessary, at a rate of about two to one. Whereas two dollars of operating revenues are necessary to yield one dollar of income after taxes, only one dollar of IDC credits is necessary since IDC credits are not taxable. It is not until one full depreciation cycle has been completed and the system comes into balance that the two-for-one impact is offset. This offset occurs because the "IDC part" of the cost of an asset is <u>not</u> tax deductible, so that two dollars of revenues must be generated to cover the depreciation expense of IDC.[14] The total offsetting impact is not fully realized until period 35, or one full depreciation cycle. Thus, the initial effects of capitalizing IDC are greater than the effects in the stabilized periods. Furthermore, the more IDC a firm capitalizes (i.e., the higher the effective IDC rate), the greater the early period impact will be. That is, Firm IDC has the highest IDC rate and, as a result, it has the most extreme differences between the early and stable periods. Conversely, Firm RB has a zero IDC rate and, consequently, there are no differences between the early and stable periods as a result of IDC. As the firms approach the stable periods, the differences that are caused by IDC become smaller.

These generalized results hold for each of the variables of interest, although the extent of this impact differs for each of the variables. The differences between the early and stable periods are considered for

[14]As explained earlier, the deferred capital costs of construction (IDC) are recovered in the future through depreciation, just like all other asset costs. The difference is that since IDC was not taxed as income, it is not tax deductible as a depreciation expense.

the following variables: 1) utility rates, 2) IDC to earnings (I/E) ratios, 3) cash flows per share (CFS), and 4) times-interest-earned ratios. Since dividends are a constant proportion of earnings, the statements made concerning the I/E ratios are also applicable to the IDC to dividends ratios.

Utility rates. In general, utility rates are lower in the early periods than in the more stabilized periods. Since revenues are replaced by IDC credits in disproportionately large amounts in the early periods, utility rates are also reduced rather sharply. Thus, periods of sharply increased construction activity could hold utility rates unusually low throughout a depreciation cycle.[15] Firms which capitalize IDC will not only have cyclically fluctuating utility rates, but they will also have rates which fluctuate over a longer period, as demonstrated by the difference between the early and stable periods. The more IDC a firm capitalizes, the more pronounced this impact will be. Firm RB, which does not capitalize IDC, has rates which are nearly stable over the longer period (i.e., comparing the early and stable periods).[16]

IDC/earnings ratio. The I/E ratios of all firms, except Firm RB, are higher in the early periods than in the stable periods. For Firm RB the ratio is zero throughout the simulation period. In addition, for the firms which do capitalize CWIP, the difference between the early and

[15]A fixed utility rate in this situation would cause income to be inflated during a period of increased construction activity.

[16]For Firm RB, the only difference between the early and stable periods occurs as a result of the new depreciation pattern, and its impact is minor.

stable periods increases as the amount of IDC (or the IDC rate) increases. That is, Firm IDC has the relatively highest early period ratios in addition to the absolute highest ratios throughout.

The I/E ratio is directly related to the ratio of CWIP to total assets, because IDC is a fixed percent of CWIP and earnings are a fixed percent of total assets. Thus, to explain why the I/E ratios are higher in the early periods, it is necessary to examine the ratio of CWIP to total assets. Without going into unnecessary detail, it is easy to see that once the firms begin to undertake construction in period one, CWIP increases sharply. That is, it goes from zero prior to year one to a positive value in the first year and the growth rate continues to be high throughout the early years. At the same time, total assets increase at the same constant rate throughout. Thus, the CWIP to assets ratio is larger in the early years and so is the IDC to earnings ratio.

Cash flows per share (CFS). CFS follow the same general patterns for the same reasons. The CFS of the firms which capitalize IDC are proportionately lower in the early periods, in inverse proportion to the IDC rate. The higher the IDC rate, the lower are the CFS of the firms, in both absolute amounts and relative to the stable periods. Thus, Firm IDC not only has the lowest CFS, but produces the most exaggerated effects in the early periods as well.

Times-interest-earned ratios. Results for the times-interest-earned ratios are completely analogous to those of CFS. The higher the IDC rate, the lower are the times-interest-earned ratios in both absolute and relative terms. Firm IDC again has times-interest-earned ratios in the early periods which are proportionately the lowest when compared to the stable periods.

In summary, the early periods produce the same results as the later periods except that the effects are exaggerated. That is, the capitalization of IDC creates differences between the firms with respect to the variables of interest and these differences appear relatively larger when the early periods are used as the base for comparison.

Modified Assumptions and Their Impact on the Typical Firm Case

The analysis of the typical firm case has demonstrated that different construction accounting methods will create differences in key variables used to evaluate the firms' performance. The sensitivity analysis illustrated that this result is not strictly a function of the input values. The examination of the early periods suggests that these results would be found using any periods for the base of comparison. These results can be further generalized by modifying some of the important assumptions in the model.

The results of any model are strongly influenced by the assumptions upon which the model is developed and the computer simulation model used in this study is no exception. These kinds of assumptions are always necessary in model building, but may have the unfortunate consequence of limiting the generality of the conclusions which can reasonably be drawn from the model's results. To circumvent the limitations of restrictive assumptions, it is necessary to relax these assumptions or examine a range of values or forms that these assumptions might take.

The assumptions can be divided into at least two classes. The first concerns the assumptions made in the construction of the model. The objective in building a model is to be able to explore a problem without having to examine the real world directly. Meeting this objective often requires that we abstract from reality by making certain simplifying assumptions. In the development of the computer simulation model it became apparent that two assumptions of this nature were significant. The first concerns the continuity of construction. As pointed out in Chapter 4, all of the factors important in the construction program are variable and can be considered, with the exception of the continuity of construction. Consequently, it is useful to examine an alternative assumption about the continuity of construction. The other assumption of this nature found to be significant concerns the use of funds generated by depreciation, and it too is examined below.

A second group of assumptions are those necessary for expositional purposes. In order to understand the effect of a procedure, in this case different construction accounting methods, it is more efficient to isolate the impact by abstracting from as many complicating factors as possible. We don't examine the real world directly because it is too difficult to separate the basic impact of a procedure from other complicating factors and also because the real world is not as easily manipulated as a model. In the basic analysis of the typical firm we abstracted from two factors which we would not like to reconsider. We are primarily interested in determining if these complications will substantially alter our basic findings. The first of these concerns the assumption of completely flexible utility rates, while the second concerns the assumption of equality between rates of return and the cost of capital.

This section deals with these four assumptions and the effect that changes in them will have on the results of the typical firm. By doing this we hope to provide more information and, consequently, a broader base upon which conclusions may be drawn. Except in the fixed utility rate case, the discussions are kept brief by putting available computer-generated data into appendices. This facilitates the presentations, yet provides additional data for the more interested reader.

The large firm construction program[17]

In Chapter 4 we discussed the difference between the normal firm construction program (NFCP) and the large firm construction program (LFCP). The NFCP was designed to exemplify average firms which do not have large-scale construction programs. That is, these firms do not begin construction of a similar type of asset (e.g., a generating unit) until construction is completed on the previous asset of the same type. On the other hand, larger firms often have construction in progress on several similar assets at the same time. At the extreme, construction begins in each period on each type of asset. This kind of program is what is referred to as the large firm construction program. By examining the LFCP as well as the NFCP, we have a broader base upon which conclusions may be drawn and to some extent avoid the restrictiveness of this assumption.

The assumption of the LFCP results in one important aspect generalizable to all the variables. The cyclical variation found in the NFCP is now eliminated. In Chapter 4, the ratio of CWIP to total assets was

[17]For a more thorough discussion of this area, refer to Appendix C. The relevant data and helpful figures are presented to support the statements contained in this discussion.

illustrated for each of the construction program continuity assumptions.[18] For the LFCP, the ratio of CWIP to total assets approaches a constant value very quickly. As we have repeatedly stressed, the output variables are directly related to this ratio. As a result, the output variables of interest also approach constant values quite rapidly. Thus, rather than having cyclical patterns as with the NFCP, a constant value is the rule when the LFCP is assumed. This discussion further illustrates the importance of the continuity of construction in establishing the pattern of values the output variables assume. The importance of this pattern difference depends on the output variable under consideration.

Utility rates. Utility rates are the most significantly affected of all the variables. One of the primary criticisms of utility rates in the NFCP case was the fluctuation which occurred. The LFCP assumption eliminates this fluctuation completely for all the firms. Thus, with respect to this criticism, the difference between the firms is practically eliminated. However, the other criticisms concerning utility rates are essentially unchanged.

IDC/earnings ratio.[19] There still exist substantial differences in the I/E ratios of the firms, but the cyclical fluctuations are eliminated. For all firms except Firm RB, the stabilized values approached in this case are typically larger than the average of the cyclical ratios

[18]See Figure 7 of Chapter 4.

[19]The discussion for the IDC to dividends ratios is completely analogous to the discussion of the I/E ratios.

in the NFCP case. For Firm RB the ratios are zero in both cases. The stabilized value approached in the LFCP case is a direct function of the IDC rate, as was the case using the NFCP. That is, the more IDC a firm capitalizes, the higher the stabilized IDC to earnings ratio. Thus, with respect to the I/E ratios, the differences still exist.

Cash flows per share (CFS). As with the NFCP, differences between the levels of CFS exist and these differences are related to the amount of IDC a firm capitalizes. The more IDC a firm capitalizes, the lower are the CFS of that firm. In this case, the differences are approximately constant, rather than cyclical. Here again, the LFCP eliminates the cyclical fluctuation. The elimination of this fluctuation is more important in the case of CFS. In the NFCP, CFS for the firms which capitalize IDC were criticized for being less stable. This instability of growth in CFS is eliminated when the LFCP is assumed. Thus, part of the problem concerning cash flows remains while another part is eliminated when the LFCP is assumed.

Times-interest-earned ratios. As with the other variables, the cyclical variation in the times-interest-earned ratios has been eliminated, but constant differences still remain. The firms which capitalize IDC have lower times-interest-earned ratios in inverse relation to the IDC rate. Firm IDC has the highest IDC rate and the lowest coverage ratios. Consequently, the assumption of the LFCP does not eliminate the principle differences in the times-interest-earned ratios.

Summary. The assumption of the large firm construction program produces some interesting results. From the consumer's point of view, the primary objections regarding the timing of payments and the discount rate differences are still quite valid. However, the cyclical fluctuation in utility rates, particularly for the firms which capitalized IDC, is eliminated.

From the investor's point of view, one major point is evident. In general, the differences in the variables examined remain significant, but the cyclical fluctuations are removed. That is, the value of each variable quickly approaches a stable level. The amount of difference which exists is a direct function of the amount of IDC a firm capitalizes. Although the cyclical variation is removed and the extremes in the variables are eliminated, significant differences still exist.

Including depreciation in the construction budget

In the preceding section we suggested that the results varied significantly depending on whether the large or normal firm construction program was assumed. A similar result can be illustrated with regard to the assumption concerning the use of the funds generated by depreciation. Throughout most of the analysis we have assumed that the funds generated by depreciation were reinvested and went directly into the rate base. Rather than having the funds go directly into the rate base, we could assume that the funds are allocated to construction projects in the same proportions as new investment. Placing all the funds generated by depreciation directly into the rate base or all the funds into the construction budget represents the two extremes with regard to this variable. Although the model can allocate the funds generated by depreciation to these two uses in any proportion, we examine both extremes to provide the full range of the output variables with regard to this assumption. Whereas the continuity of construction variable had a significant impact on the patterns produced by the output variables, the change in this assumption does not alter the basic patterns, but has a considerable impact on the magnitudes of the variables. Consequently, we do not illustrate the patterns of results, but simply deal with the extreme values for each output variable.

The discussion which follows is based on the results generated using the same input values as were used in the typical firm case. The only change is in the assumption about the use of the funds generated by depreciation. The discussion deals only with the normalizing firms, but the impact on the straight line and flow through firms is entirely analogous. The data supporting the discussion are presented in two tables in Appendix D. The typical firm case, presented at the beginning of this chapter, is the base from which comparisons are made.

Utility rates. Including the funds generated by depreciation directly in the rate base causes the fluctuation in utility rates to increase quite significantly. Using the range as the measure of fluctuation, the increase in fluctuation is at least 86 percent above the typical firm case for all of the firms. That is, if the range were .100 for a firm in the typical case, the range would be at least .186 for the current case. Though the fluctuation was significant in the typical firm case (Figure 8), it becomes even more significant when depreciation funds are included in the construction budget.

The absolute increase in the range is a direct function of the amount of IDC a firm capitalizes. Firm RB, which capitalizes no IDC, has the smallest increase in the range, while Firm IDC, which capitalizes the most IDC, has the largest increase in the range of utility rates.

IDC/earnings ratio. The I/E ratios are also quite significantly affected by the inclusion of depreciation funds in the construction budget. In every case, the I/E ratios increase at least 68 percent, except for Firm RB, where the ratio is always zero. While both the highest and lowest I/E ratios increase by at least this amount, the largest percentage increase occurs for the firms with the lowest non-zero I/E ratios.

Firm IDC still has the highest I/E ratios, with a maximum ratio of about 53 percent. Firm IDC-ITB again has the next highest I/E ratios, with a maximum ratio of about 41 percent, while Firm RB-%IDC-ITB has the lowest non-zero ratios, with a maximum of about 12 percent. As always, the I/E ratio of Firm RB is zero.

IDC/dividends ratio. The I/D ratios change by the same percentages as the I/E ratios since dividends are a fixed percentage of earnings. The basic relationships and the significance of the ratios are the same as those of the I/E ratios. Firms IDC and IDC-ITB have maximum I/D ratios of approximately 76 and 58 percent, respectively. Firm RB-%IDC-ITB has a maximum ratio of about 18 percent, while Firm RB's I/D ratios are zero, as always.

Cash flows per share. For CFS, the overall effect of including depreciation in the construction budget is considerably less than with the previous two variables. However, like the previous two variables, the impact is smallest at the beginning of a five-year construction cycle when the amount of IDC is small, then increases continuously until the final year of the cycle when the maximum change occurs. The overall effect is to reduce the cash flow of each of the firms, but some firms are reduced more than others.

Since we are interested in comparing the firms, we examine the ratios of the CFS of each firm to the CFS of Firm RB. The percentage decrease in the ratio is a direct function of the amount of IDC a firm capitalizes. That is, Firm IDC has the largest change in this ratio while Firm RB has the smallest change. Thus, the cash flows per share of Firm IDC decrease the most relative to Firm RB, while those of Firm RB-%IDC-ITB decrease the least relative to Firm RB.

The CFS of Firm IDC is now only about 90 percent of the CFS of Firm RB at the beginning of a construction cycle and continuously decreases until it is only 64 percent of Firm RB's CFS at the end of a cycle. The corresponding values for Firm IDC-ITB are 92 and 72 percent, while for Firm RB-%IDC-ITB, they are 97 and 91 percent, respectively. This indicates that the differences between firms increases and the increase is a direct function of the amount of IDC a firm capitalizes.

Times-interest-earned ratios. Times-interest-earned ratios change in the same way CFS changes. That is, the overall amount of change is less than the first two variables. The impact is smallest at the beginning of a construction cycle, then increases and reaches a maximum in the final year of the cycle. The maximum decrease occurs when the ratio is already at its lowest point from the typical firm case. The overall effect is to reduce the coverage ratios of all the firms, except Firms RB(N) and RB(S), which do not change. Finally, the percentage decrease is a direct function of the amount of IDC a firm capitalizes. The ratios for Firm IDC decrease the most, while for Firm RB, they decrease the least.

In general, the differences between firms in times-interest-earned ratios increases when depreciation funds are included in the construction budget. While the constant 3.222 ratio of Firm RB does not change, the firms which capitalize IDC have reduced coverage ratios in this situation. In the typical firm case, Firm IDC had times-interest-earned ratios which varied between 82 and 97 percent of the constant ratio of Firm RB. In this case, the percentages fall to 69 and 95 percent, respectively, of the unchanged 3.222 ratio of Firm RB. For Firm IDC-ITB, the corresponding percentages fall from 86 and 98 percent to 76 and 96 percent. For Firm RB-%IDC-ITB the percentages decrease from 96 and 99 percent to 93 and 99 percent. As with CFS, this discussion indicates that the differences between firms increase substantially when depreciation funds are included in the construction budget.

<u>Summary</u>. The inclusion of depreciation funds in the construction budget results in relationships exactly like those in the typical firm case. The important difference is that the magnitudes of the variables change significantly. The differences between the firms as established in the typical firm case are significantly larger in this case. Furthermore, the largest percentage changes occur at that point in the construction cycle where the differences are already at a maximum in the typical firm case. That is, for a given firm, the maximum I/E ratio increases the most, while the lowest CFS and the lowest times-interest-earned ratios decline by the greatest amounts. The differences between the

firms are exaggerated at their worst points when depreciation funds are included in the construction budget.

The previous two discussions have demonstrated how changing two important assumptions can influence the results. For both of these assumptions, we have tried to present variations from the original assumptions which are sufficiently realistic to be of interest, and at the same time which are sufficiently different so as to provide an adequate range of the forms that the assumptions might take. While these two assumptions are not the only assumptions in the model, they represent assumptions which could have a continuum of forms or values. There are, however, other assumptions in the model which were necessary for expositional purposes, but which cannot have a continuum of values or the continuum is not meaningful in the same sense.

In order to examine the alternatives from a strict theoretical perspective, it was necessary to allow utility rates to be completely flexible so that actual revenues were equivalent to required revenues. For the same reason it was necessary to establish the IDC rates in specific ways and set the allowed rate of return on the rate base equal to the weighted average cost of capital. Unfortunately, such assumptions may deviate substantially from reality. While it is often necessary and usually more efficient to abstract from real world complications, it is instructive to examine some of the effects of these real world complications. In the next two discussions we briefly explore the impact of two real world complications on the typical firm.

Fixed utility rates

Although completely flexible utility rates were quite useful for expositional purposes, it is quite unlikely that such flexibility is a practical possibility in the real world. Given the nature of the regulatory process, it is useful to observe the results for the firms using a fixed utility rate and to consider the implications of such a situation.

To simplify the discussion of this section, we focus on the results for two firms, Firm RB and Firm IDC. As we have demonstrated in a number of situations, these represent the extreme cases, with the results for Firms IDC-ITB and RB-%IDC-ITB falling between the results of these two cases. The reader can make his own assessment of the relative position of these other cases based on the relationships established in the typical firm case.

In order to further simplify the discussion, we deal only with the normalizing firms. These firms are sufficient to demonstrate the basic changes resulting from assuming a fixed utility rate. The different depreciation policies have basically the same influences as were demonstrated in the typical firm case and they are not discussed again in this section.

Setting the utility rate in period zero. Initially, it is useful to consider a utility rate which is the same for all the firms. In Chapter 4, we explained the start-up period and how it resulted in identical firms prior to the initiation of construction in period one.[20] Since the firms are identical prior to year one, we can fix the utility rate at the level

[20]The firms are identical except for the differences created by depreciation policy. Those with the same depreciation policy are identical at this point.

established in the last year of the start-up period, or what might be termed period zero, and each of the firms will have the same utility rate which is then held constant throughout the simulation period.

Figure 21 illustrates the rates of return on equity for Firms RB and IDC that result from fixing the utility rate in this manner. The first observation to make concerns the relationship between the pattern of rates of return on equity using a fixed utility rate and the pattern of utility rates from the typical case where the rate of return on equity is fixed. Comparing Figures 8 and 21, we see that the patterns for the firms in these two cases are nearly mirror images of each other. Considering the inherent relationship between utility rates and rates of return on equity, this result is not very surprising. In fact, it is simply another way of expressing the destabilizing influences of capitalizing IDC and the depreciation pattern caused by construction, as explained in the discussion of the typical firm.[21]

There is a difference between the typical case and the fixed utility rate case which may be of importance. As we have implied, the fluctuation which was necessary in utility rates for the typical firm case is transferred to the rates of return on equity when a fixed utility rate is used. Since the costs remain the same (i.e., depreciation, operating expenses, etc.) and since the debt holders receive a fixed rate of return, the fluctuation is passed on to the equity holders.[22] Proportionately, this fluctuation is much greater in the rate of return than it was in utility rates. Though identical forces are operating in both cases, the fluctua-

---

[21]Refer to the discussion of utility rates for the typical firm case for an explanation of these destabilizing influences.

[22]The tax burden will also vary but this is of little significance.

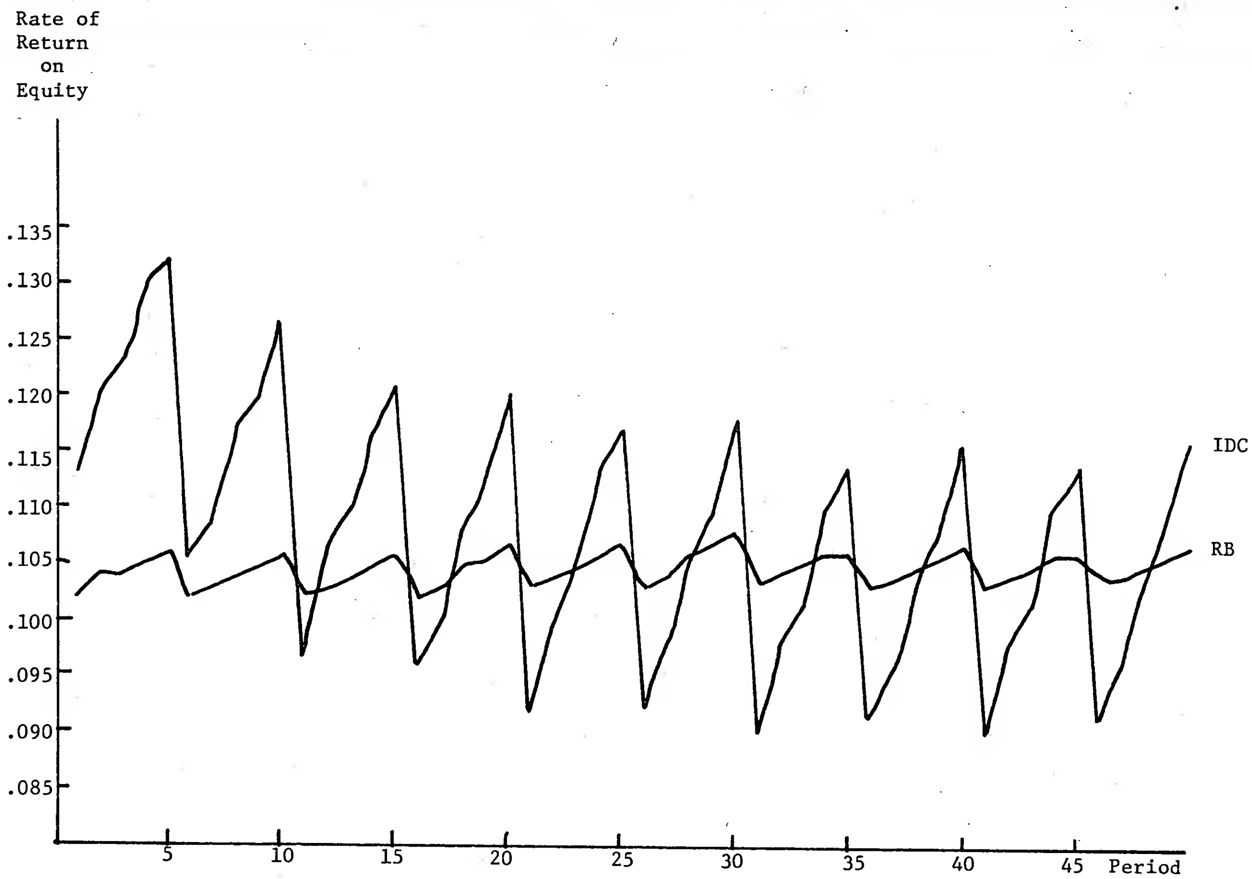

FIGURE 21

RATE OF RETURN ON EQUITY SETTING THE UTILITY IN PERIOD ZERO (NORM.)

tion is magnified with fixed utility rates since the base over which this fluctuation is spread is smaller. That is, the equity holders must absorb all the fluctuation rather than sharing it with the debt holders. In the typical firm case, the fluctuation in utility rates is spread over the entire demand base.

Figure 21 shows that Firm IDC has a higher rate of return in the early periods than Firm RB. This result is caused by the inclusion of IDC credits in income in the early periods, the effect of which is not being offset by non-tax deductible depreciated IDC, as it is in later periods.[23] Recall from earlier discussions that the IDC cost component of an asset is not tax deductible and how, in later periods, this factor works to mitigate the "early period" influence of IDC credits once a full cycle of depreciation has been completed. The absence of the IDC cost component of depreciation in the early periods causes the rate of return to be unusually high in the early periods for Firm IDC. However, were the firm to terminate construction, or sharply reduce the rate, this impact would be reversed. That is, if no new IDC credits were being included in income, the IDC part of the cost of assets not yet fully depreciated would cause the rate of return to be unusually low. Looking at the stabilized situation, Firm IDC produces a stabilized cyclical pattern of rates of return on equity, which fluctuate above and below the rates of return for Firm RB.

Another variable to consider in the fixed utility rate case, which has not been important before, is the rate of return on the rate base.

[23] Refer to the discussion of the early periods, particularly the first two pages of that section.

In earlier cases the rate of return on the rate base was always equal to the target rate, but in the fixed utility rate case the rate of return on the rate base will deviate from the target rate. This deviation will be of concern to regulating agencies in that the rate of return on the rate base is one of the variables they monitor in regulating utilities. If the deviation becomes too large, a revision of the firm's utility rates may be effected to bring the rate of return on the rate base back into line with the target rate. Figure 22 illustrates these rates of return for Firms RB and IDC. The same fluctuating patterns are produced in the rate of return on the rate base as occur for the rate of return on equity, but the fluctuation is substantially less. For the rate of return on the rate base the fluctuation is spread over the entire rate base, financed by both debt and equity, whereas the return on equity must eventually absorb all of this fluctuation because of the fixed rate of return on debt. Figures 21 and 22 are drawn on the same scale to illustrate the reduced fluctuation in rates of return on the rate base.

It is also useful to examine the other variables with which we have been concerned throughout the analysis. IDC to earnings (I/E) ratios, IDC to dividends (I/D) ratios, cash flows, and times-interest-earned ratios continue to differ among the firms as in the typical firm case, although the differences are slightly less. Furthermore, the fluctuation in these variables is less with fixed utility rates.

The I/E and I/D ratios of Firm IDC are still significant, ranging between approximately 10 and 26 percent and 15 and 38 percent, respectively. The average ratio and the range of ratios are lower than in the typical firm case.

Cash flows are still lower for Firm IDC than Firm RB, although the

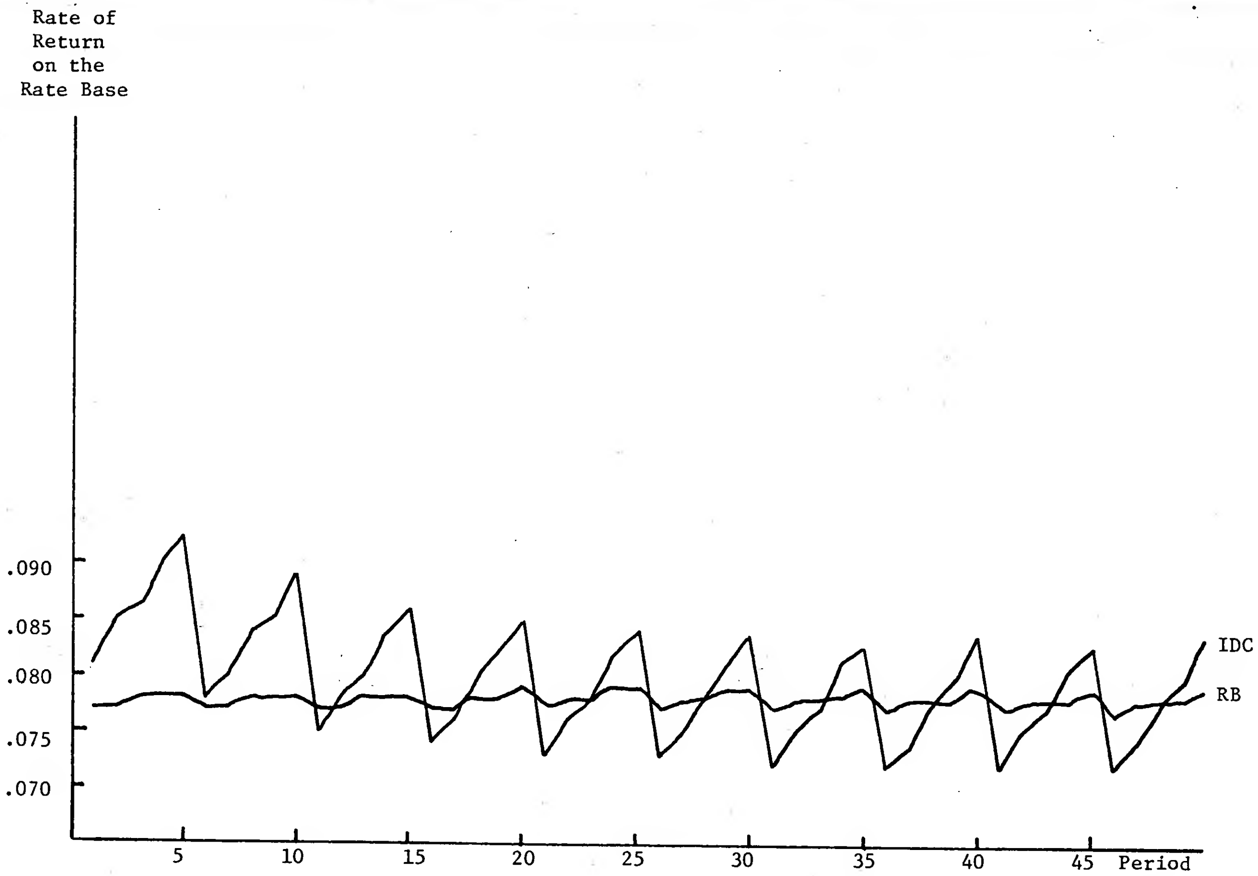

FIGURE 22

RATE OF RETURN ON THE RATE BASE SETTING THE UTILITY RATE IN PERIOD ZERO (NORM.)

variation is less. For Firm IDC, the cash flows vary between approximately 90 and 100 percent of those of Firm RB as compared to 88 and 102 percent in the typical firm case. The basic pattern of difference between the two firms is unchanged, with the cash flow of Firm IDC about the same as that of Firm RB at the beginning of a five-year construction cycle and differing by the greatest margin in the final year of the cycle. The primary cause of this difference over the five-year construction cycle is that cash dividends are paid on non-cash earnings (IDC), which become quite large at the end of a five-year construction cycle.

The pattern of times-interest-earned ratios generated in the fixed utility rate case is shown in Figure 23. The basic pattern is different from the pattern in the typical firm case. A fixed utility rate eliminates part of the impact of capitalizing IDC, since a smooth increase in operating revenues will result.[24] This effect is unlike the typical firm case, where IDC credits replace revenues in large proportions at the end of a construction cycle, which results in widely fluctuating revenues and, consequently, fluctuating coverage ratios. However, in the fixed utility rate case the influence of IDC is still noticeable in the early periods. For Firm IDC, the rate base, and a proportional amount of debt, are inflated by IDC credits in the later periods, but this occurs only gradually in the early periods. Thus, the times-interest-earned ratios are high at first, relative to Firm RB's ratios, then decrease to a stabilized cyclical pattern.

As we indicated above, most of the influence of IDC on the cyclical

[24]Since IDC is non-cash income and does not alter operating revenues in this case, it does not affect the times-interest-earned ratios.

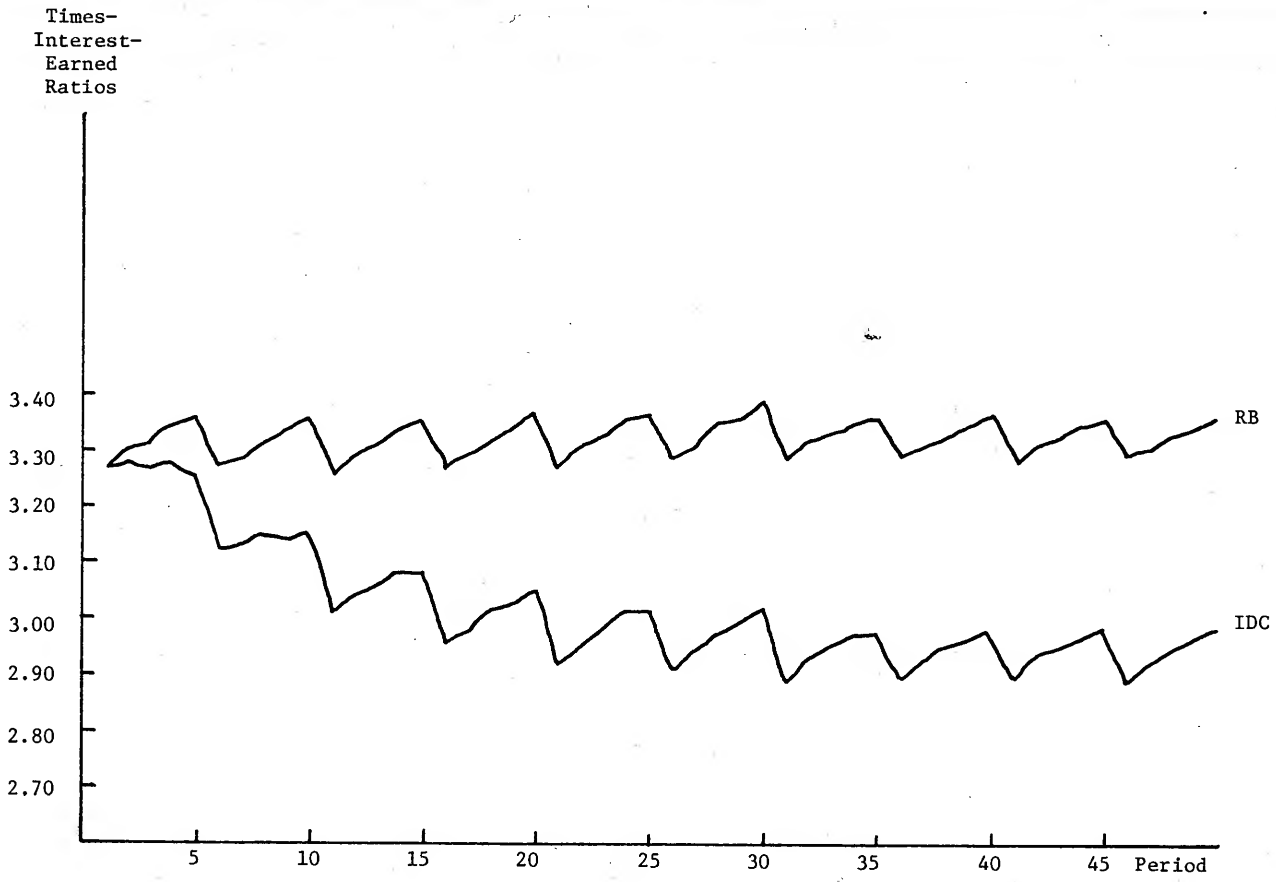

FIGURE 23

TIMES-INTEREST-EARNED RATIOS SETTING THE UTILITY RATE IN PERIOD ZERO (NORM.)

pattern of ratios is eliminated, yet some fluctuation still exists. This fluctuation is caused by depreciation and operates in a direction opposite to the fluctuation caused by IDC in the typical firm case. That is, in the fixed utility rate case, the ratios are low at the beginning of each five-year construction cycle and increase throughout the construction period. The reverse was true in the typical firm case. The fluctuation not only occurs for the firms which capitalize IDC, but now occurs for Firm RB as well.[25] This fluctuation is a result of the uneven pattern of depreciation explained earlier in this chapter. A fixed utility rate results in smoothly increasing operating revenues. Subtracting uneven depreciation expenses from smoothly increasing operating revenues and dividing this by smoothly increasing interest expenses will produce fluctuating ratios. In the typical case, utility rates could fluctuate and absorb this depreciation influence. Consequently, Firm RB had constant times-interest-earned ratios and the firms which capitalize IDC had ratios which fluctuated as a result of capitalizing IDC, in direct proportion to the amount of IDC the firm capitalized. With fixed utility rates and the elimination of the influence of IDC, the uneven pattern of depreciation expense causes the times-interest-earned ratios of all of the firms to fluctuate.

These combined influences cause the differences in the times-interest-earned ratios to be small initially, and reach a stabilized state where the differences are approximately constant. Specifically, the times-interest-earned ratios of Firm IDC are approximately 88 to 89 percent of the ratios of Firm RB in the stabilized situation.

[25]Recall that the times-interest-earned ratios for the normalizing and straight line cases of Firm RB were constant in the typical firm case.

Setting the utility rate in year one. As an alternative to setting the utility rate in period zero, it could be set so as to achieve the target rate of return on equity in the first period. The utility rate established in this way is then used to generate operating revenues in the remaining periods. This example illustrates one important consideration explained below.

The average rate of return on equity for the two firms will differ, as is obvious from Figure 24. The reason for this difference is clear when we recall the discussion of the early periods. Firm IDC's required utility rates in the typical firm case were abnormally low in the early periods because IDC credits replaced operating revenues at a ratio of approximately two-to-one. In later periods this influence was partially offset by the inclusion of IDC in depreciation for book purposes, although not allowed for tax purposes. Thus, by establishing the utility rate at an unusually low level, the revenues generated in the later periods will not be sufficient to achieve an average return at least equal to the target rate of return.

This case has a direct implication for firms which capitalize IDC. Such a firm, which is sharply increasing its rate of construction just prior to or during a rate setting situation, may establish a rate which could quickly prove too low to provide an adequate return on equity. Such a result would occur for any rate set during the first five years, given the input values of this case. It is also worth noting that the reverse may be true where the firm sharply reduces the investment in construction.

The other input variables in this case would have patterns of values quite similar to those of the previous case. However, since the average

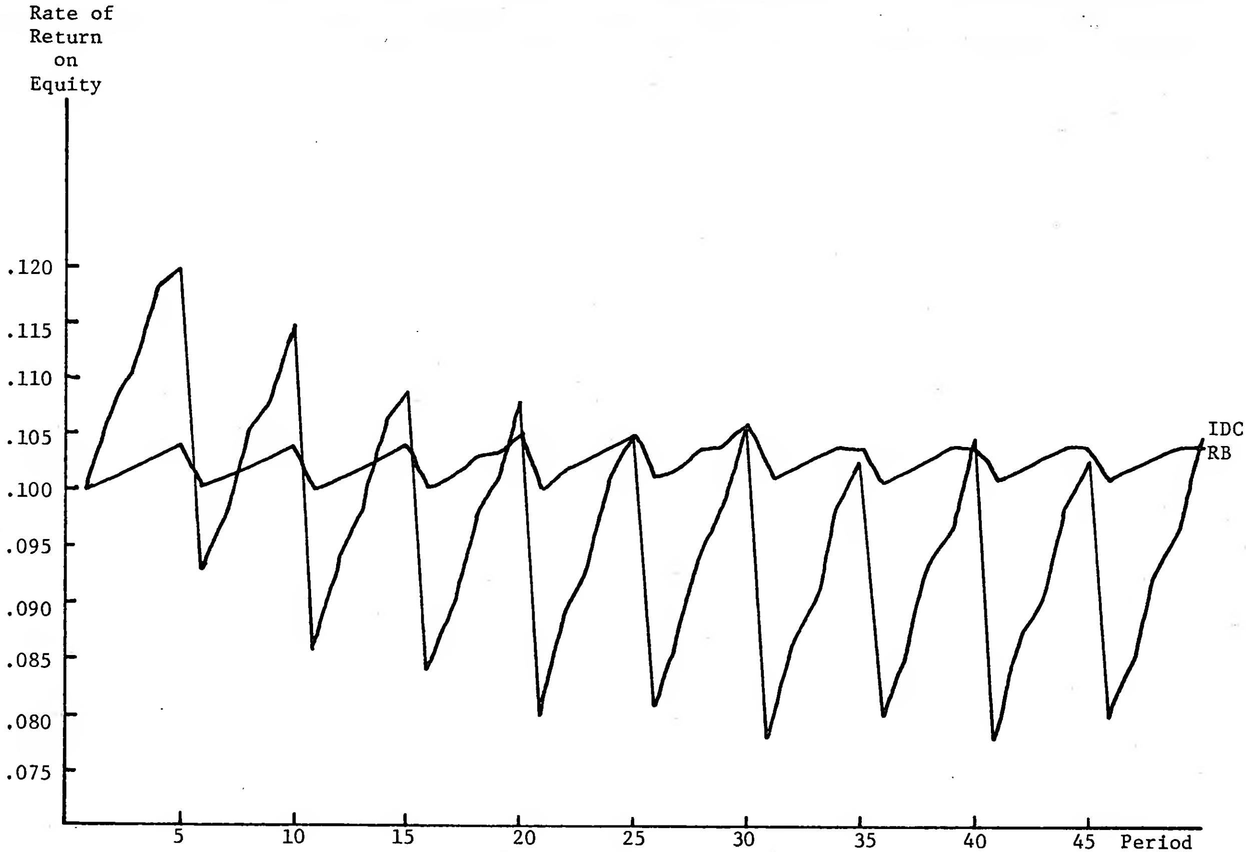

FIGURE 24

RATE OF RETURN ON EQUITY SETTING THE UTILITY RATE IN PERIOD ONE (NORM.)

revenues and the average rate of return is lower for Firm IDC, relative to Firm RB, the differences between the firms become more significant.

Summary. In general, the assumption of a fixed utility rate produces results similar to the results of the case using flexible utility rates (the typical firm case). While important differences exist, the fact remains, as established in the typical firm case, that the alternative construction accounting methods produce different results for certain key variables. These differences may have a substantial impact on the performances of the firms.

Fixed utility rates are a product of the regulatory process. Although they do not produce the theoretically desired results, it is not clear that it would be desirable or feasible to attempt to adjust rates in every period. Consequently, it seemed useful to examine the influence of this aspect of regulation on our basic results. Whether by design or by chance, regulation gives rise to yet another situation which differs from the desired theoretical situation. That is, very often the allowed rate of return on the rate base, the IDC rate, and the average cost of capital may differ substantially. This is particularly true with respect to the IDC rate and the cost of capital. Since these differences may also have a substantial impact on the choice of the best construction accounting method, it is necessary that the impact of these differences also be explored.

Rate of return difference

Throughout the analysis, the IDC rate and the allowed rate of return on the rate base (ARR) have been set equal to the weighted average cost of capital (ACC). Since the firm's cost of capital has been kept constant to simplify the computer model, the above equalities produced the desired rate of return on equity in every period. It is obvious that if the allowed rate of return on the rate base was below the ACC, none of the firms could achieve the target rate of return on equity. However, different relationships between the IDC rate, the ARR, and the ACC will produce different results for the firms.

Since the average cost of capital is given for any firm, it is interesting to consider deviations in the IDC rate and ARR from the ACC. Excluding equality between them, three different relationships between these three variables seem likely, given the nature and history of regulation, and, therefore, are of interest to this study: First, the IDC rate could be below the ACC and ARR, which are equal. Second, the IDC rate could be below the ARR, which, in turn, is below the ACC. Finally, the ARR and the IDC rate could be equal but below the ACC. It is not likely that the IDC rate would be set above the ARR, although current economic conditions could possibly justify this result.[26] We could examine situations where the relationships were reversed; however, by the end of this discussion it should be obvious that analogous results would be found. That is, the reader should be able to infer what the results would be under almost any circumstances.

In considering the impact of these relationships on the firms, we are primarily interested in the impact on the rate of return on equity. We could discuss the other variables, but it is obvious that if the rate of return on equity falls for one firm relative to another, then that

[26] If the current cost of capital exceeded the embedded cost of capital, an IDC rate above the ARR could be warranted.

firm will have relatively lower CFS and times-interest-earned ratios and relatively higher I/E and I/D ratios.

In the context of this discussion, it is most useful to consider the firms as being in two classes, those which include CWIP in the rate base (Firms RB, RB-IDC, RB-%IDC-ITB) and those which do not (Firms IDC and IDC-ITB). This distinction is useful because the size of the return that the firm gets, whether in the form of IDC credits or operating revenues, differs between these two classes, but not within the classes. That is, those firms which include CWIP in the rate base earn a return on CWIP equal to the return allowed on used and useful assets. The effective IDC rate for these firms simply determines how much of the return is in the form of IDC credits and how much is derived from operating revenues. On the other hand, for those firms which exclude CWIP from the rate base, the size of the return on CWIP that they earn is entirely dependent on the IDC rate. The IDC rate _is_ the rate of return these firms earn on CWIP. Thus, as pointed out in Chapter 3, the IDC rate is much more important to Firms IDC and IDC-ITB.

In discussing these two classes of firms, we shall use Firm RB-IDC to typify the firms which include CWIP in the rate base and Firm IDC to typify those firms which exclude CWIP from the rate base. In addition to illustrating the differences between these two groups of firms, these two firms also serve to illustrate a fact mentioned in Chapter 3. Firms RB-IDC and IDC produce identical results when the IDC rate and the ARR are equal, but the firms produce different results when they are not equal. This fact should become quite clear as we proceed through the discussion of these three situations and should also illustrate why these should be considered as separate alternatives, given the complications of the real world.

ACC = ARR > IDC rate. Suppose the IDC rate was arbitrarily set at some level below the average cost of capital, while the ARR was equal to the ACC. In this situation, Firm IDC would be earning a rate of return on CWIP which is below its cost of capital and below its rate of return on used and useful assets. The result of this would be to lower the overall return on equity earned by Firm IDC. Firm RB-IDC is not confronted with this problem. Since CWIP is included in the rate base, the overall return is equal to the ACC and the stockholders receive the target rate of return on equity. For this firm the lower IDC rate simply means that only a fraction of the return on CWIP is in the form of IDC credits, while the remainder of the return comes from operating revenues.[27] Firm RB-IDC is clearly preferable since its average rate of return on equity will be larger.

ACC > ARR > IDC rate. The IDC rate is again set below the ARR, but now the ARR is also set below the ACC. The rate of return on CWIP would again be below the rate earned on used and useful assets for Firm IDC. Consequently, the average return on all investments would be below the ARR. On the other hand, Firm RB-IDC is earning the ARR on both CWIP and used and useful assets, with an average return on all investment equal to the ARR. In this case both firms are not earning a return equal to their ACC which reduces the return to stockholders, but Firm IDC is again worse off than Firm RB-IDC.

[27]The fraction of the return in the form of IDC credits is equal to the ratio of the IDC rate to the ARR.

ACC > ARR = IDC rate. In this case, both firms earn identical average returns, but both are again below the cost of capital and result in reduced rates of return to stockholders. Since the return on CWIP and on used and useful assets is the same for Firm IDC, the average return is equal to the ARR. Since the return on all investment is equal to the ARR for Firm RB-IDC, the two firms produce identical results, which is as we indicated in Chapter 3.

The implications of this are straightforward. If a utility company's regulating agency typically establishes the IDC rate below the rate of return allowed on used and useful assets, a firm which includes CWIP in the rate base is clearly preferable from the stockholders' point of view.[28] Conversely, an IDC rate typically above the ARR would make firms which capitalize IDC preferable, other things being equal.

Consolidating the Typical Firm Results

At this point it will be useful to reflect upon the many results which have been discussed, try to bring them together and draw some initial conclusions. The primary purpose of the discussion of the typical firm case and the related discussions was to identify and explain the differences between the firms (or construction accounting methods) and to provide a good foundation for the final part of this chapter. We were not concerned with the significance of the differences, but simply wanted to provide the reader with enough information to enable him to assess the importance of these differences as we do so in the final discussions of this chapter.

[28] These conclusions do not take into consideration the differences between the firms that were discussed elsewhere in this chapter.

For the most part we have been concerned with the theoretical implications of the alternatives. This emphasis has been quite useful in developing a complete understanding of the alternatives. However, this limited scope does not really take us as far as we would like to go. In the final section on the typical firm, the discussion is from two perspectives. First, we consolidate the mass of results, still concerned with the theoretical results unencumbered by the complexities of the real world. Then, by adding a single element to the typical firm, a more pragmatic consideration of the results is presented. This additional element is rigid utility rates. The results of a case with rigid utility rates was presented in an earlier discussion, but the implications were not really considered. Thus, we go beyond the strict theoretical results and examine the influence of a very significant product of the regulatory process.

In the discussion which follows, we explore the results from the consumer's and investor's viewpoints. Table 27 presents a summary of the major results of the typical firm case and can be referred to throughout the following discussion. Where possible we shall deal only with Firms RB and IDC. We have demonstrated that Firm RB-IDC produces the same results as Firm IDC[29] and that the remaining two firms (Firms RB-%IDC-ITB and IDC-ITB) produce results between the two extremes of Firms RB and IDC. Remember that Firm RB-%IDC-ITB produces results closest to those of Firm RB and Firm IDC-ITB produces results closest to those of Firm IDC.

[29]We have shown when this is and is not true, and when necessary we shall deal with Firm RB-IDC separately.

TABLE 27

SUMMARY OF TYPICAL FIRM CASE RESULTS FOR DIFFERENT ASSUMPTIONS
(FIRMS RB AND IDC ONLY)

Variables	Basic Case	Early Periods	LFCP	Depreciation Funds in the Construction Budget	Fixed Utility Rates
		Cases			
Utility rates	Most fluctuation for Firm IDC, least for Firm RB	* *	* *	* *	Eliminates fluctuations
I/E ratios	Highest ratios for Firm IDC, lowest for Firm RB	* Exaggerates all the Results for the Basic Case	* Eliminates all the Fluctuations but the Differences are the Same As the Basic Case	* Exaggerates all the Results for the Basic Case	Highest ratios for Firm IDC, lowest for Firm RB
I/D ratios	Highest ratios for Firm IDC, lowest for Firm RB				Highest ratios for Firm IDC, lowest for Firm RB
Cash flow	Highest and most stable for Firm RB, lowest and least stable for Firm IDC	* *	*	* *	Highest for Firm RB, lowest for Firm IDC. Both stable.
Times-interest-earned ratios	Highest for Firm RB, lowest for Firm IDC	* *	* *	* *	Highest ratios for Firm RB, lowest for Firm IDC

The consumer

Revenue requirements. In theory, the two points concerning revenue requirements made earlier in this chapter are valid under all circumstances. First, any firms (e.g., Firms RB and RB-%IDC-ITB) which include CWIP in the rate base and do not compute IDC at a rate greater than or equal to the allowed rate of return on used and useful assets will require present customers to pay part or all of the capital costs of construction. On the other hand, firms (e.g., Firms IDC and RB-IDC) which do not allocate the interest-tax benefit (ITB), provide current customers with a benefit in the form of reduced revenue requirements. Only firms which compute IDC at a rate equal to the allowed rate of return on the rate base and allocate the ITB, such as Firm IDC-ITB, fully allocate the capital costs of construction to those who benefit from the asset being constructed.

A second factor consumers might be concerned with is the discount rate applied in determining the NPV of the revenue requirements of the firms. If the consumer has a discount below that of the firm, Firm RB will have lower revenue requirements on an NPV basis than Firm IDC. The reverse would be true if the consumer has a higher discount rate than the firm.

While these statements are theoretically valid, the arguments may be obscured by the complications of the regulatory process, i.e., rigid utility rates. The results were based on completely flexible utility rates which, unfortunately, do not exist in reality. For Firm IDC, utility rates should rise and fall over each construction cycle.[30] Since the rate base does not change during construction, increasing demand produces lower utility rates. But in reality, this change in utility rates in each period would not occur. The utility rate would remain fixed until the rate of return on equity exceeded certain limits. This situation was illustrated by the case described earlier in this chapter where the utility rate was established in period zero. Since the firms were identical in period zero, they had identical utility rates. If the utility's regulating agency was willing to tolerate a rate of return on the rate base which varied between 7.2 and 8.4 percent[31] around a target rate of 7.6 percent, then the identical utility rate of the firms would be unchanged throughout. This result has some interesting implications for the results just discussed.

If all the firms have the same utility rate throughout, other things being equal, the consumer should be indifferent as to which firm serves him. The idea of transferring the capital cost of construction becomes obscured when the utility rate is the same for all firms. Similarly, revenues would be identical for all the firms and the question of the appropriate discount rate becomes meaningless. Thus, while the transference of the capital costs of construction and the discount rate are theoretically valid issues, their meaningfulness becomes obscured by the realities of the regulatory process.

Depreciation policy is important for revenue requirements only in the sense that failure to take advantage of liberalized depreciation will

[30]The utility rates of both firms should rise and fall because of depreciation, but this consideration is ignored since it is unimportant for the point we are trying to make.

[31]We consider only the more stable periods because of the artificial influences affecting the early period results.

result in higher revenue requirements, hence higher costs to consumers. The normalizing and flow through firms have the same NPV of revenue requirements, while the straight line firms have a higher NPV of revenue requirements. This result is independent of the construction accounting method used.

Utility rates. It is quite clear that Firm IDC requires much more widely fluctuating utility rates than Firm RB. This result was demonstrated to be true in every case but one, the case with the large firm construction program. As the continuity of construction approaches the LFCP, the fluctuation in utility rates is reduced until it becomes minimal with a completely continuous construction program.

Depreciation policy does have some impact on the amount of fluctuation in utility rates. In the stabilized situation, the normalizing and straight line depreciation policies produce fluctuations in utility rates whose peaks and troughs coincide with those caused by IDC. Thus, the fluctuation for all the firms is even greater when the normalizing and straight line depreciation policies are used. On the other hand, flow through depreciation produces fluctuations whose peaks and troughs are opposite those caused by IDC, thereby reducing the fluctuation in utility rates.

The importance of the demand pattern in generating required utility rates cannot be overemphasized.[32] Both required revenues and demand are necessary to generate utility rates. We have assumed a growth in demand

[32]To be fully aware of the limitations of this discussion and to understand why these limitations were necessary, the reader is urged to reread that part of Chapter 4 dealing with utility rates.

similar to the growth in investment. However, a quite different demand pattern would result in different patterns of utility rates. The whole area of demand requires more careful consideration before highly defensible conclusions can be drawn with regard to utility rates. Unfortunately, this is beyond the purview of this study.

Reality again forces us to consider more rigid utility rates. Rigid utility rates shift the destabilizing influence of IDC to another variable, rates of return on equity. However, this result is more suitably pursued in the discussion of the investor's interests.

From a theoretical perspective, important differences exist between the firms with regard to the variables of direct interest to consumers. However, from the practical perspective these issues are, at best, obscured and, at worst, no longer important. We now turn to the investor's point of view, consolidate our findings and see if reality has a similar impact on these results.

The investor

Rate of return. Theoretically, all the firms earn the same rate of return on equity. Each construction accounting alternative, when properly applied, will provide the allowed rate of return on equity.

From a more practical perspective, two additional considerations were examined which could alter this theoretical result. First, we examined a situation in which the utility rate was constant throughout the simulation period. The result of a fixed utility rate is to shift the destabilizing influences of capitalizing IDC and the uneven depreciation pattern to the rate of return on equity. The residual nature of the return to equity makes it subject to these destabilizing influences. Furthermore, the fluctuation present in the pattern of rates of return is much greater than it was in the pattern for utility rates. As in the case of utility rates, the fluctuation which occurs for Firm IDC is much greater than for Firm RB.

As a practical matter, the other factor shown to influence the rate of return on equity is the IDC rate. If the IDC rate set by regulators is typically below the allowed rate of return on used and useful assets, then those firms which include CWIP in the rate base will have a higher overall return on equity than those firms which rely solely on capitalizing IDC. Conversely, if the IDC rate is typically above the allowed rate of return, then those firms which capitalize IDC and exclude CWIP from the rate base will have the higher overall return on equity.

<u>IDC/earnings ratio</u>. There exists a distinct difference between the firms with regard to I/E ratios under all the circumstances we examined. The ratios fluctuate rather widely for Firm IDC while there is no fluctuation for Firm RB since the ratio is always zero. The only exception is that the fluctuation for Firm IDC is reduced as the firm's construction program approaches the continuity found in the LFCP. The ratios are slightly higher for the normalizing firms in all cases because of the deferred tax reserve.

Similar results are found in the case of fixed utility rates. The only differences are that the average ratio and the range of ratios are lower than in the strict theoretical situation.

<u>IDC/dividends ratio</u>. Statements completely analogous to those made

concerning the I/E ratios are applicable to the I/D ratios. The only difference is that since dividends are a fraction (between zero and one) of earnings, the I/D ratios are higher than the I/E ratios.

Cash flow. In all the situations examined, the cash flows differed for each of the firms. In general, Firm RB produces a smoothly increasing pattern of cash flow. Firm IDC, on the other hand, produces a more uneven growth in cash flow which increases in a step-shaped pattern. The exception is in the LFCP case where Firm IDC also produces a smoothly increasing pattern of cash flow. In all the situations examined, including the LFCP, the cash flow of Firm IDC is, on the average, below that of Firm RB. The same kind of results are demonstrated on a per share basis but the differences are more extreme. In general, the normalizing firms have higher cash flows than either the straight line or flow through firms because of the reserve for deferred taxes.

Again, similar results are found in the fixed utility rate case. The primary difference is that the results are less varied. The average difference is about the same, but the range of difference over the construction cycle is smaller.

Times-interest-earned ratios. In all the situations examined, definite differences were found in the times-interest-earned ratios of each of the firms. Firm RB produces a constant ratio while Firm IDC has a fluctuating ratio which is typically below that of Firm RB. This is the typical pattern found in each case except the LFCP case. As with the other variables, the fluctuation is reduced as the LFCP is approached, but the differences still exist. The straight line firms have slightly higher ratios than the normalizing firms, whereas the flow through firms have distinctly lower ratios than either of the other two. The fluctuation caused by flow through accounting on the times-interest-earned ratios is opposite to the fluctuation caused by IDC and, therefore, works to reduce the fluctuation in ratios for the flow through firms.

From the investor's viewpoint, the assumption of a fixed utility rate has its greatest impact on the times-interest-earned ratios. A fixed utility rate eliminates the fluctuation in ratios caused by IDC. Instead, the destabilizing influence of the uneven depreciation pattern causes the times-interest-earned ratios of all the firms, including Firm RB, to fluctuate in a direction opposite to that caused by IDC. There still exists a difference in the level of ratios for the firms, with Firm RB having the highest ratios and Firm IDC the lowest. Firm IDC has lower ratios because it must issue more debt which results in higher interest payments and because book depreciation is larger. Thus, the differences still exist, but the difference is approximately constant rather than fluctuating.

Summary

From a strict theoretical perspective, there are very obvious differences between the firms. These differences are apparent in every variable examined in nearly every situation, from both the consumer's and investor's viewpoints. However, when we examine the consumer-oriented variables in a more realistic framework (i.e., rigid utility rates), these differences become obscured. In fact, it is quite conceivable that these differences are no longer significant. On the other hand, this reduction in importance is definitely not found when we examine the variables of interest to investors. The differences definitely exist, even in the more realistic case, though the magnitude of the differences is slightly less.

The typical firm has been examined in considerable detail in a number of situations. Not only have the theoretical results of each alternative been explored, but we have also considered the alternatives from a more realistic perspective. In both situations we have demonstrated that differences will result for firms using different construction accounting methods. What we have not examined is whether these differences are significant enough to be of importance. The input values of the typical firm are based on a conservative estimate of what the values would be for an average utility company. While an average firm is, in a sense, typical of all firms, it can be deceptive in certain situations. What is true for an average firm may not be valid for firms which depart from that average. Therefore, before discussing the significance of these differences and drawing final conclusions, it will be useful to examine a firm which, although it departs from the average, is still illustrative of many firms. This illustration is referred to as the atypical firm case.

The Atypical Firm Case

The discussion of the atypical firm is presented to provide a contrast to the results of the typical firm. The typical firm case does not reflect the importance of the differences illustrated earlier which exist for many firms as a result of the current environment faced by utility companies. The atypical firm is not an unusual firm in that unrealistic or extreme input values are assumed. On the contrary, the input values used are quite realistic and many of the variables could have values which would produce even more significant results. That is, many firms will have values for some of these input variables which would result in even greater differences between the firms. Thus, although the atypical firm is one which departs from the average firm, it is still representative of a significant number of firms.

For the typical firm a higher rate of growth is assumed similar to the rates many companies have experienced in recent years because of increased demand and sharply rising construction costs. This example also assumes a higher cost of debt and equity than the typical firm case. In addition, this illustration assumes that the funds generated by depreciation are used for construction, rather than going directly into the rate base. While the same construction periods are used in this case as were used in the typical firm case, many firms often have longer construction periods, particularly for nuclear generating units.[32] However, it was felt that using the same construction periods as were in the typical firm case would make the atypical firm representative of a larger group of firms. Table 28 presents a summary of all the important input values for the atypical firm case. We would again like to emphasize that these input values are not extreme, as inspection of Table 28 will verify, but were chosen simply to provide another perspective from which to examine the results produced by the alternative construction accounting methods.

Using this set of input values, the results are examined using both

[32]The reader might be interested in noting the significant impact of longer construction periods as demonstrated in Appendix A and considering how the results of the atypical case would be even more extreme if longer construction periods were assumed.

TABLE 28

INPUT VALUES FOR THE ATYPICAL FIRM

Beginning assets		$100	
Length of simulation		50 years	
Asset life		30 years	
Growth rate		8%	
Debt ratio		60%	
Cost of debt		7%	
Cost of equity		12%	
Cost of capital - weighted average		9%	
Discount rate - weighted average		6.9%	
Tax rate		50%	
Beginning shares		1.0	
P/E multiplier		8.93	
Construction program		normal firm	
Depreciation funds		allocated to construction	
	Construction Activities		
	A	B	C
Percent of new investment invested annually	30	15	55
Length of construction period (years)	1	2	5

flexible utility rates and a fixed utility rate. As before, the flexible utility rate case illustrates the basic theoretical results. In this situation the rate of return on equity is forced equal to the target rate by allowing utility rates to change as often as is necessary. The fixed utility rate is presented to demonstrate the impact of the alternative construction accounting methods on the rate of return on equity and the rate of return on the rate base.

To keep the discussion brief, we deal <u>only</u> with the <u>normalizing</u> cases of Firms RB and IDC, although the results are presented for all the firms in the tables. In the typical firm case, we adequately demonstrated the relationship of the results for the other firms relative to the results of Firms RB and IDC and also the impact of the other two depreciation policy alternatives. In this example we are more concerned with emphasizing the magnitudes of the output variables using these input values than in examining the patterns or the causes of relationships between an alternative and a variable. These latter factors were also covered sufficiently in the typical firm case. Thus, the important point to recognize in the atypical firm case is the increased magnitude of the differences found. To demonstrate these differences the extreme values are again presented for each of the variables and these results are briefly discussed in relation to the results of the typical firm case.

Results of the Atypical Firm Case with Flexible Utility Rates

Utility rates

As shown in Table 29, the fluctuation in utility rates has increased substantially from the typical firm case. For all of the firms, the fluctuation has more than tripled. The relationship between Firms RB and IDC remained about the same as in the typical firm case, with the range of utility rates for Firm IDC about 8.5 times the range for Firm RB in both cases.

IDC/earnings ratio

Table 30 shows the I/E ratios for the firms. The I/E ratio for Firm IDC now ranges between approximately 22 and 74 percent. In nine out of ten periods at least a quarter of the firm's earnings are in the form of IDC credits; in half the periods IDC accounts for more than 50 percent of the firm's earnings; while in some periods nearly three-fourths of the earnings of Firm IDC are credits. As always, the ratios for Firm RB are

TABLE 29

UTILITY RATES

Firms		N	F	S
RB	rates	.2281 - .2170	.2130 - .2135	.2397 - .2288
	range	.0111	.0095	.0109
IDC	rates	.2491 - .1550	.2340 - .1513	.2607 - .1668
	range	.0941	.0827	.0939
IDC-ITB	rates	.2434 - .1714	.2282 - .1677	.2549 - .1832
	range	.0720	.0605	.0717
RB-%IDC-ITB	rates	.2322 - .2043	.2171 - .2006	.2437 - .2162
	range	.0279	.0165	.0275

TABLE 30

IDC TO EARNINGS RATIOS

Firms	N	F	S
RB	0	0	0
IDC	.2229 - .7403	.2114 - .7005	.2114 - .7005
IDC-ITB	.1779 - .5711	.1684 - .5393	.1684 - .5393
RB-%IDC-ITB	.0594 - .1765	.0559 - .1658	.0559 - .1658

zero, and thus all earnings are cash earnings.

IDC/dividends ratio

Table 31 presents the I/D ratios for the atypical firm case. For Firm IDC these ratios range between approximately 56 and 185 percent. In three out of five periods IDC credits are larger than the dividends paid by the firm.

Cash flow

Table 32 shows the cash flow of each of the firms as a percent of the

TABLE 31

IDC TO DIVIDENDS RATIOS

Firms	N	F	S
RB	0	0	0
IDC	.5572 - 1.8506	.5284 - 1.7513	.5284 - 1.7513
IDC-ITB	.4448 - 1.4277	.4209 - 1.3483	.4209 - 1.3483
RB-%IDC-ITB	.1485 - .4411	.1398 - .4146	.1398 - .4146

TABLE 32

CASH FLOW AS A PERCENT OF THE CASH FLOW OF FIRM RB

Firms	N	F	S
RB	1.00	1.00	1.00
IDC	1.007 - .524	1.008 - .492	1.008 - .492
IDC-ITB	1.003 - .648	1.003 - .624	1.003 - .624
RB-%IDC-ITB	.999 - .901	.999 - .895	.999 - .895

cash flow of Firm RB. The cash flow of Firm IDC ranges between about 101 and 52 percent of the cash flow of Firm RB in the same periods. Reduced cash revenues and dividend payments on IDC credits cause Firm IDC to have sharply reduced cash flow. Table 33 expresses the same relationship on a per share basis. For the cash flow per share comparison, the differences between Firm IDC and Firm RB are even larger since Firm IDC issues more debt.

Times-interest-earned ratios

While the times-interest earned ratio of Firm RB is constant,[33] the

[33] We are considering only the normalizing firm.

TABLE 33

CASH FLOW PER SHARE AS A PERCENT OF CFS OF FIRM RB

Firms	N	F	S
RB	1.00	1.00	1.00
IDC	.858 - .440	.867 - .417	.867 - .417
IDC-ITB	.887 - .567	.894 - .551	.894 - .551
RB-%IDC-ITB	.962 - .865	.964 - .861	.964 - .861

value of the ratio for Firm IDC fluctuates below that of Firm RB. As shown in Table 34, Firm IDC has a ratio which varies between 2.933 and 1.707, which is approximately 89 and 52 percent, respectively, of the constant 3.286 ratio of Firm RB.

Results of the Atypical Firm Case with a Fixed Utility Rate

This case is presented to emphasize the impact of a fixed utility rate on the rate of return on equity and the rate of return on the rate base. The other effects of a fixed utility rate were adequately illustrated in the typical firm case, so all the results of this case are not discussed. As we shall demonstrate, the input values used in this case make the fluctuation in the rates of return quite severe.

Rate of return on equity

In the stabilized situation, the rate of return on equity for Firm IDC varies between approximately 10.8 and 18.5 percent, while for Firm RB the rate of return varies between 12.6 and 13.6 percent. Compared to the typical firm case, the range of rates for Firm IDC increases more than the range for Firm RB in both a relative and an absolute sense. The range for Firm IDC is 7.7 percentage points, or nearly three times the range in

TABLE 34

TIMES-INTEREST-EARNED RATIOS

Firms		N	F	S
RB	ratios	3.286	2.823 - 3.017	3.286
	as % of Firm RB	1.00	1.00	1.00
IDC	ratios	2.933 - 1.707	2.558 - 1.560	2.951 - 1.791
	as % of Firm RB	.893 - .519	.906 - .517	.898 - .545
IDC-ITB	ratios	3.002 - 2.069	2.609 - 1.897	3.017 - 2.136
	as % of Firm RB	.914 - .630	.924 - .629	.918 - .650
RB-%IDC-ITB	ratios	3.189 - 2.910	2.749 - 2.673	3.195 - 2.933
	as % of Firm RB	.971 - .886	.974 - .886	.972 - .893

the typical firm case, while the range for Firm RB is only one percentage point.

Rate of return on the rate base

The fluctuation in the rates of return on the rate base increases for both firms with the largest relative and absolute increase for Firm IDC. The range in rates of return for Firm RB is about a half percentage point, varying between 9.2 and 9.7 percent. For Firm IDC the rate of return fluctuates between 8.4 and 13.3 percent, making the range 4.9 percentage points, or a 400 percent increase in the range over the typical firm case.

The significance of these results can be expressed in another way. In the summary of the typical firm case, it was suggested that the fluctuation in the rate of return on the rate base might not be enough to cause a change in the utility rate. If the regulating agency felt that fluctuations of one percentage point on either side of the target rate could be tolerated, the utility rate would be constant for both firms. This result is illustrated in panel A of Figure 25 for the last

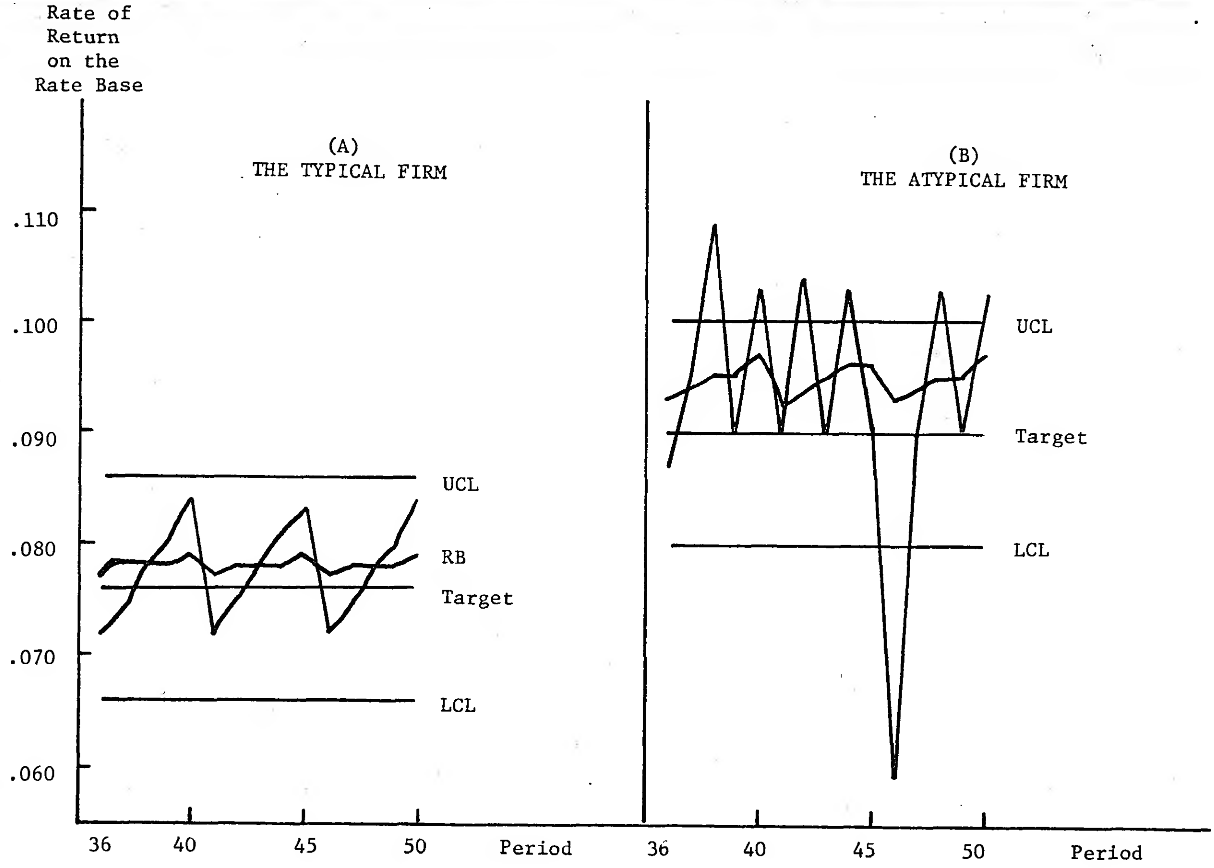

FIGURE 25

RATE OF RETURN ON THE RATE BASE WITH ONE PERCENTAGE POINT LIMITS

15 periods. In the atypical firm case, quite different results are found. With a range of 4.9 percentage points for Firm IDC the rate of return cannot stay within one percentage point limits. Recognizing this fact, consider a situation where the rate is changed with a lag as in the normal regulatory process. Suppose the regulating agency were to change the utility rate each time the limits were exceeded, and suppose that the procedure to effect a change was to choose a utility rate so that the target rate of return was exactly met in the following period. The result of such a policy is illustrated in panel B of Figure 25, where again only the last 15 periods are considered. Firm RB still has no difficulty staying within the limits and, as a result, will have a fixed utility rate throughout. On the other hand, Firm IDC will have to change the utility rate frequently. In the first two periods (36 and 37) the limits are not exceeded. However, in the remaining periods the utility rate must be changed every two periods. That is, the limit is exceeded in one period, then set so that the rate of return is equal to the target rate in the next period, and in the next period the limit is again exceeded. In the atypical firm case, Firm IDC would have to have frequent rate hearings, or the regulators would have to tolerate wide deviations from the target rate of return on the rate base.

Summary of the Atypical Firm

The atypical firm is a firm which departs from the average utility company, but is still representative of a large number of firms. This example has been presented to provide another perspective from which to evaluate the significance of the differences between the firms.

For every variable the differences between the firms increases substantially from the typical firm case to the atypical firm case. The high I/E and I/D ratios of Firm IDC relative to Firm RB result in a severely reduced cash flow of Firm IDC. In some periods, Firm IDC has only half the cash flow of Firm RB, and on a per share basis this impact is even more severe. The increase in external financing necessary for Firm IDC, the reduction in operating revenues, and the larger book value of assets cause Firm IDC to have fluctuating times-interest-earned ratios which are below the ratios of Firm RB. To achieve a target rate of return on either the rate base or on equity, both firms must have continuously changing utility rates, but the fluctuation for Firm IDC is much greater than for Firm RB. If we assume that utility rates will not change, or that they change only when certain limits on the target rate of return on the rate base are exceeded, then the rate of return on equity and the rate of return on the rate base will deviate from their target rates of return. The fluctuation in both variables for Firm RB is probably tolerable, but for Firm IDC, the fluctuation would probably be unacceptable. If the fluctuation were unacceptable, it would be necessary to have frequent rate changes.

In general, the same kinds of results are found in the atypical firm case as were found in the typical firm case. That is, similar patterns of results and similar relationships between results are found in both cases. The difference between the two cases is in the magnitude of the differences between firms. The differences between the firms found in the typical firm case are greatly magnified in the atypical firm case.

Conclusion

This chapter has presented the results of the analyses without attempting to draw any specific conclusions. The basic case served to illustrate the primary results of this investigation and also attempted to explain why these results occurred. In addition, numerous other cases were explored to demonstrate two other points. First, the results are quite general as shown by the similarity of the findings in each case. Thus, the conclusions should not be too restricted by the assumptions made in the model. The other point illustrated by the variety of cases deals with the different magnitudes of the results found under different assumptions. If a specific combination of assumptions was felt to be relevant, from the results presented one could get some idea of the pattern and magnitude of results that might be expected. The atypical firm case is simply a specific combination of assumptions which, though not representative of all firms, is representative of a large number of firms. Given the information presented to this point, the reader should be prepared to consider the significance and implications of the results of this investigation as explored in the final chapter of this report.

APPENDIX A

THE SENSITIVITY ANALYSIS

As stated in Chapter 5, we have attempted to develop a rough measure of the sensitivity of key output variables to changes in the primary input parameters. The complexity of the model and the interrelationships between the variables does not allow for a rigorous sensitivity analysis. Deriving the functions for the variables and computing first and second derivatives would result in a task whose costs would far exceed the benefits. Furthermore, such a precise sensitivity analysis would imply greater precision than is warranted or necessary. Consequently, we rely on a simpler, though less precise technique. A rough measure of sensitivity is obtained by making 10 and 20 percent changes in a single input variable and comparing these results with the results of the typical case. Some indication of the rate of change can also be obtained by comparing the amounts of change in the cases with the 10 and 20 percent changes.

There is a reason for confining the results of the sensitivity analysis to an appendix. A complete interpretation of the results of the sensitivity analysis is complicated by several factors which are not readily apparent. That is, differences in the percentage of change occur for reasons which are not obvious and the effort that would be required to explain these influences would greatly exceed any expected benefit from such an explanation. Consequently, we merely present the results which serve as the basis for the statements made in Chapter 5.

There is, however, one additional reason we felt it would be useful to present the results of the sensitivity analysis. The actual figures are useful in providing a rough idea of the magnitude as well as the direction of the changes resulting from a single parameter change. It would be possible, though difficult for some of the variables, to project the approximate value of a variable for relatively small changes in one input variable. We must emphasize, however, that simultaneous changes in two or more variables may have multiplicative rather than simple additive effects.

The impact of changes in the input variables is examined with respect to four output variables: 1) IDC to earnings (I/E) ratios, 2) cash flows per share (CFS), 3) times-interest-earned ratios, and 4) utility rates. For the I/E and times-interest-earned ratios the values presented in the tables represent the percent of change in the value of the variable from the typical case.[34] A positive value means that the ratio increased from the typical case. Because of certain problems with the cash flow per share variable, it is necessary to examine the impact on it in another way.[35] Since we are primarily interested in comparing the firms, the changes in CFS are evaluated in relation to the CFS of Firm RB. That is, the CFS of each firm is considered as a percent of Firm RB, and the changes in these ratios (e.g., CFS of Firm IDC/CFS of Firm RB) are the figures shown in the tables. A negative value indicates that the dif-

---

[34]The changes which occur for the ratios of IDC to dividends are the same as those for the ratios of IDC to earnings, since dividends are simply a proportion of earnings.

[35]As explained above, other influences affect some of the variables, and, in the case of CFS, a different kind of comparison is necessary to produce meaningful results.

ference between each of the firms and Firm RB is increasing, i.e., CFS for that firm decreases relative to the CFS of Firm RB. In the CFS comparison, Firm IDC(N) is compared to Firm RB(N), IDC(F) to RB(F), etc. Finally, since we are interested in the fluctuation in utility rates, the values in the tables represent changes in the range of utility rates from the typical case. A positive value indicates that the fluctuation in utility rates has increased for that parameter change.

For each of the variables except utility rates, the amount of change varies over the construction cycle. Therefore, to provide some indication of the range of change, the extreme values, which correspond to the first and last years of the longest construction period, are presented.[36] As before, the comparisons are made for the periods (36-50) in which the system is relatively stable.

The input parameters with which we deal are those which typically vary from firm to firm. The parameters considered in the sensitivity analysis are: 1) the growth rate, 2) the equity rate of return, 3) the interest rate, 4) the debt ratio, and 5) the length of the construction period. The changes in the output variables are computed for 10 and 20 percent changes in each of these input variables, with the exception of the construction period. Since the length of the construction period must be an integer, it is not possible to consider 10 and 20 percent changes. For this variable we simply increase the length of the construction period from five years to six and seven years and use these results to get some idea of the sensitivity of the output variables to

[36]CFS are the exception, and these follow a similar pattern with a one-year lag. The one-year lag occurs because the cash flow in period i is generated in period i-1.

changes in the length of the construction period.

For the reader interested in trying to fully understand the results of the sensitivity analysis, several of the complicating factors, to which we referred earlier, are mentioned briefly. The first problem is that internal financing occurs in the model. Internal financing is the reason CFS were examined relative to Firm RB rather than in absolute terms. This aspect creates difficulties mainly for equity and growth rate changes. The second, and most important factor, is the method by which IDC rates are determined for each firm. The rate for Firm IDC is affected by changes in the equity rate, the interest rate, and the debt ratio. The rate for Firm IDC-ITB is also affected by these three variables, but the rate at which the ITB is computed is not affected by equity rate changes. The IDC rate for Firm RB-%IDC-ITB is not at all affected by equity rate changes, but is affected by both the interest rate and debt ratio. The point is that the IDC rate does not change proportionately for all the input changes, causing the relationship between changes to vary in some cases, in unexpected ways. The third factor which complicates the results is that the variables of interest are at different levels in the typical case. Therefore, although one firm may have a higher proportional change, this result could be due to a lower initial value so that the basic relationships would still be unchanged. The final factor to consider is that a change in some variables has an impact in more than one place in the model. For example, a change in the equity rate of return affects both the allowed rate of return and the IDC rate. This change may have proportionately different impacts on these two items. Furthermore, the impact of these items may differ for each of the firms.

These complicating factors were mentioned simply to make the reader aware of the complexity of the interpretation of the sensitivity analysis. This discussion also illustrates the uniqueness of each firm and resulting lack of more specific generalizations. Having adequately cautioned the reader, the results are presented in a series of tables, one for each input variable.

TABLE 35

PERCENTAGE CHANGE IN VARIABLES AS A RESULT OF 10 AND 20% CHANGES IN THE EQUITY RATE OF RETURN

Variable	% Input Change		Firms											
			RB			IDC			IDC-ITB			RB-%IDC-ITB		
			N	F	S	N	F	S	N	F	S	N	F	S
I/E Ratios	10	B	0	0	0	-4.8	-4.7	-4.7	-3 .3	-3.2	-3.2	-9.1	-9.1	-9.1
		E	0	0	0	-4.1	-4.1	-4.1	-2.6	-2.6	-2.6	-9.1	-9.1	-9.1
	20	B	0	0	0	-8.8	-8.7	-8.7	-6.1	-6.0	-6.0	-16.7	-16.7	-16.7
		E	0	0	0	-7.6	-7.5	-7.5	-4.8	-4.7	-4.7	-16.7	-16.7	-16.7
CFS	10	B	0	0	0	-.2	-.1	-.1	-.3	-.1	-.1	0	0	0
		E	0	0	0	-.9	-.2	-.2	-.9	-.8	-.8	0	-.1	-.1
	20	B	0	0	0	-.4	-.3	-.3	-.5	-.3	-.3	0	-.1	-.1
		E	0	0	0	-1.7	-1.6	-1.6	-1.7	-1.6	-1.6	-.1	-.2	-.2
Times-Interest-Earned Ratios	10	B	6.9	7.7	6.9	7.0	7.8	7.0	6.9	7.8	6.9	7.0	7.8	6.9
		E	6.9	7.5	6.9	7.2	7.9	7.2	6.9	7.5	6.9	7.2	7.8	7.2
	20	B	13.8	15.5	13.8	14.0	15.6	13.9	13.9	15.6	13.8	13.9	15.6	13.9
		E	13.8	15.0	13.8	14.4	15.8	14.3	13.7	15.0	13.7	14.4	15.6	14.3
Utility Rates	10		0	0	0	5.9	6.8	5.6	6.9	8.3	7.4	0	0	0
	20		0	0	0	11.8	13.9	10.9	13.7	17.2	14.3	0	0	0

TABLE 36

PERCENTAGE CHANGE IN VARIABLES AS A RESULT OF 10 AND
20% CHANGES IN THE GROWTH RATE

Variable	% Input Change	Firms											
		RB			IDC			IDC-ITB			RB-%IDC-ITB		
		N	F	S	N	F	S	N	F	S	N	F	S
I/E Ratios	10 B	0	0	0	8.6	9.1	9.1	8.8	9.2	9.2	8.9	9.4	9.4
	E	0	0	0	7.8	8.2	8.2	7.9	8.3	8.3	8.1	8.6	8.6
	20 B	0	0	0	17.1	18.1	18.1	17.3	18.2	18.2	17.7	18.7	18.7
	E	0	0	0	15.3	16.2	16.2	15.5	16.4	16.4	16.0	16.9	16.9
CFS	10 B	0	0	0	-.4	-.4	-.4	-.4	-.3	-.3	-.1	-.1	-.1
	E	0	0	0	-.2	-2.0	-2.0	-1.3	-1.4	-1.4	-.4	-.3	-.3
	20 B	0	0	0	-.9	-.8	-.8	-.7	-.6	-.6	-.2	-.2	-.2
	E	0	0	0	-.4	-4.0	-4.0	-2.6	-2.8	-2.8	-.7	-.7	-.7
Times-Interest-Earned Ratios	10 B	0	-.7	0	-.5	-1.2	-.4	-.4	-1.1	-.4	-.1	-.9	-.1
	E	0	-.5	0	-2.0	-2.6	-1.8	-1.4	-2.0	-1.3	-.4	-1.0	-.4
	20 B	0	-1.5	0	-1.0	-2.3	-.9	-.8	-2.1	-.7	-.3	-1.8	-.2
	E	0	-1.0	0	-3.9	-5.1	-3.6	-2.8	-4.0	-2.6	-.8	-1.9	-.8
Utility Rates	10	13.9	-5.3	14.8	9.2	9.6	8.6	9.0	9.4	9.5	8.6	15.8	9.0
	20	25.0	-10.5	25.6	17.8	18.7	17.1	17.6	19.4	18.2	18.3	31.6	18.7

TABLE 37

PERCENTAGE CHANGE IN VARIABLES AS A RESULT OF 10 AND 20% CHANGES IN THE DEBT RATIO

Variable	% Input Change	Firms											
		RB			IDC			IDC-ITB			RB-%IDC-ITB		
		N	F	S	N	F	S	N	F	S	N	F	S
I/E Ratios	10 B	0	0	0	14.3	14.2	14.2	9.7	9.6	9.6	29.1	29.2	29.2
	E	0	0	0	13.8	13.8	13.8	8.9	8.9	8.9	29.5	29.6	29.6
	20 B	0	0	0	34.6	34.5	34.5	23.4	23.3	23.3	70.7	70.8	70.8
	E	0	0	0	33.5	33.5	33.5	21.7	21.6	21.6	71.7	71.8	71.8
CFS	10 B	0	0	0	0	0	0	.2	.2	.2	.2	.2	.2
	E	0	0	0	.1	.1	.1	.8	.8	.8	.6	.6	.6
	20 B	0	0	0	0	0	0	.4	.3	.3	.4	.3	.3
	E	0	0	0	.4	.1	.1	1.8	1.6	1.6	1.3	1.3	1.3
Times-Interest-Earned Ratios	10 B	-15.7	-16.5	-15.7	-15.8	-16.6	-15.8	-15.7	-16.5	-15.7	-15.8	-16.6	-15.8
	E	-15.7	-16.2	-15.7	-16.5	-17.1	-16.4	-15.6	-16.3	-15.6	-16.4	-16.9	-16.3
	20 B	-28.7	-30.2	-28.7	-29.0	-30.4	-28.9	-28.8	-30.3	-28.8	-29.0	-30.4	-28.9
	E	-28.7	-29.8	-28.7	-30.2	-31.3	-30.0	-28.7	-29.9	-28.7	-30.0	-31.0	-29.9
Utility Rates	10	0	0	0	-3.3	-4.0	-4.0	-6.9	-9.4	-6.9	-4.3	-15.8	-5.5
	20	0	0	0	-6.6	-8.0	-6.9	-13.7	-18.3	-13.4	-11.8	-31.6	-12.1

TABLE 38

PERCENTAGE CHANGE IN VARIABLES AS A RESULT OF 10 AND 20% CHANGES IN THE INTEREST RATE

Variable	% Input Change	Firms											
		RB			IDC			IDC-ITB			RB-%IDC-ITB		
		N	F	S	N	F	S	N	F	S	N	F	S
I/E Ratios	10 B	0	0	0	4.3	4.3	4.3	2.9	2.9	2.9	9.8	9.8	9.8
	E	0	0	0	4.9	5.0	5.0	3.2	3.2	3.2	10.1	10.1	10.1
	20 B	0	0	0	8.5	8.6	8.6	5.8	5.8	5.8	19.5	19.6	19.6
	E	0	0	0	9.8	9.9	9.9	6.4	6.4	6.4	20.2	20.3	20.8
CFS	10 B	0	0	0	-.3	-.2	-.2	-.2	-.1	-.1	-.2	-.1	-.1
	E	0	0	0	-1.2	-1.1	-1.1	-.6	-.5	-.5	-.5	-.4	-.4
	20 B	0	0	0	-.5	-.5	-.5	-.3	-.2	-.2	-.3	-.2	-.2
		0	0	0	-2.4	-2.4	-2.4	-1.1	-1.1	-1.1	-.9	-.9	-.9
Times-Interest-Earned Ratios	10 B	-6.3	-5.9	-6.3	-6.3	-5.9	-6.3	-5.9	-6.3	-6.3	-6.3	-6.0	-6.3
	E	-6.3	-6.0	-6.3	-6.6	-6.3	-6.6	-6.3	-6.0	-6.3	-6.5	-6.3	-6.5
	20 B	-11.5	-10.9	-11.5	-11.5	-10.9	-11.5	-11.5	-10.8	-11.5	-11.6	-10.9	-11.6
	E	-11.5	-11.1	-11.5	-12.2	-11.6	-12.1	-11.5	-11.0	-11.5	-12.0	-11.5	-11.9
Utility Rates	10	0	0	0	5.3	6.0	4.6	3.0	3.3	3.5	5.4	15.8	6.6
	20	0	0	0	10.2	12.0	9.9	6.0	7.2	6.5	11.8	31.6	13.2

TABLE 39

PERCENTAGE CHANGE IN VARIABLES AS A RESULT OF INCREASING THE CONSTRUCTION PERIOD TO SIX AND SEVEN YEARS

Variable	Input Changed to	Firms											
		RB			IDC			IDC-ITB			RB-%IDC-ITB		
		N	F	S	N	F	S	N	F	S	N	F	S
I/E Ratios	6 B	0	0	0	-1.5	-1.3	-1.3	-1.1	-.9	-.9	-.4	0	0
	E	0	0	0	15.6	15.9	15.9	15.1	15.3	15.3	13.9	14.1	14.1
	7 B	0	0	0	-3.0	-2.5	-2.5	-2.2	1.9	1.9	-.9	-.5	-.5
	E	0	0	0	31.1	31.8	31.8	30.0	30.4	30.4	27.2	27.6	27.6
CFS	6 B	0	0	0	-.2	0	0	-.2	0	0	-.1	0	0
	E	0	0	0	-4.5	-4.5	-4.5	-3.1	-3.1	-3.1	-.8	-.7	-.7
	7 B	0	0	0	0	.4	.4	-.1	.3	.3	0	-.1	-.1
	E	0	0	0	-9.3	-9.4	-9.4	-6.4	-6.5	-6.5	-1.7	-1.6	-1.6
Times-Interest-Earned Ratios	6 B	0	-.3	0	.5	.5	.5	.4	.3	.4	.1	-.1	.1
	E	0	.5	0	-3.8	-3.1	-3.4	-2.6	-2.0	-2.3	-.7	-.2	-.6
	7 B	0	-.2	0	1.3	1.7	1.2	1.0	1.3	.9	.3	.5	.3
	E	0	-.5	0	-7.6	-6.6	-6.8	-5.2	4.4	-4.7	-1.3	-.7	-1.2
Utility Rates	6	22.2	26.3	26.5	25.7	26.7	25.0	24.0	25.6	24.7	20.4	26.3	22.0
	7	80.6	31.6	85.3	60.2	69.7	59.5	58.4	71.7	58.9	59.1	234.2	61.5

APPENDIX B

THE EARLY PERIODS

This appendix is designed to supplement the discussion of the early periods presented in Chapter 5. The data provided support the statements made in the chapter as well as the additional statements made below. In discussing the actual differences between the stabilized and early periods, we simply discuss the percentage differences at certain points in time. In effect, we compare the extreme values in the early periods with the comparable extreme values in the stabilized periods.

It is necessary to explain what is meant by comparable periods. We want to compare values of similar points in a cycle. For the input values used, a cycle is 10 periods, even though the longest construction period is only five periods. The cycle is longer because the end points of each activity's construction period only coincide every 10 periods. This fact is verified by referring to Table 40. In period five the end points do not coincide as activity B is just beginning a new construction cycle. However, in period 10, the end points of all construction periods coincide. Thus, it would be inappropriate to compare periods five and 10, but comparing five and 15 would be acceptable. In the discussion of each of the variables, we actually compare periods five and 15 to period 45, and periods 10 and 20 to period 50.

In the discussion, four variables are examined: 1) utility rates, 2) IDC/earnings ratios, 3) CFS, and 4) times-interest-earned ratios. The percentages for the IDC/dividends ratios are the same as those for IDC/

TABLE 40

ONE COMPLETE CYCLE OF CONSTRUCTION PERIOD COMBINATIONS

Activities	Periods									
	1	2	3	4	5	6	7	8	9	10
A (1 year)	1	1	1	1	1	1	1	1	1	1
B (2 years)	1	2	1	2	1	2	1	2	1	2
C (5 years)	1	2	3	4	5	1	2	3	4	5

earnings. Throughout the discussion the reader will be referred to the appropriate graphs from previous discussions in order to make the percentages more meaningful.

Utility Rates

The interest in utility rates has been in terms of the fluctuation in rates required by each firm. Figures 8 and 9 illustrate the patterns of rates of the firms. The patterns for Firm RB for each depreciation policy are quite unlike the patterns for the firms which capitalize IDC. The values in the early periods for Firms RB(N) and RB(S) are never more than one percent different from those of the comparable later periods, as Table 41 indicates. As illustrated in Figure 9, Firm RB(F) has a rather unique pattern, caused by flow through accounting and the new depreciation pattern. Even for Firm RB(F), the deviation in the early periods is about one and one-half percent or less. For the firms which capitalize IDC, the early period differences are more substantial. Initially rates are pushed down, then rise and approach the values of the stable periods, as shown in Table 41. This pattern applies to all the remaining firms. The size of the initial fall in rates is a direct function of the IDC rate. That is, the more IDC a firm capitalizes, the

TABLE 41

PERCENTAGE DIFFERENCE IN UTILITY RATES
BETWEEN THE EARLY AND STABLE PERIODS

Firm		Period/Period 5/45	10/50	15/45	20/50	Higher (H) or Lower (L)
	N	.22	.22	.18	(.04)*	H
RB	F	1.54	.88	.40	(.18)	H
	S	.75	.37	.21	(.12)	H
	N	8.73	5.55	3.33	2.09	L
IDC	F	7.21	4.77	3.08	2.13	L
	S	7.55	4.88	3.06	1.92	L
	N	6.40	4.02	2.41	1.54	L
IDC-ITB	F	4.94	3.28	2.18	1.64	L
	S	5.42	3.52	2.22	1.46	L
	N	1.68	.95	.59	.14	L
RB-%IDC-ITB	F	.40	.36	.35	.62	L
	S	1.09	.75	.54	.50	L

*Parentheses indicate the value is opposite that indicated by the H or L in the table.

larger the initial drop below the stabilized pattern. Flow through firms show the smallest initial drop, while normalizing firms have the largest initial reduction in rates.

IDC/Earnings Ratios

The I/E ratios are higher in the early periods than in the stable periods, as illustrated by Table 42 and shown graphically by Figure 10. Firm RB has no IDC earnings, so there is obviously no difference. However, for the other firms, the more IDC they capitalize, the more extreme are the initial effects. In addition, the straight line and normalizing firms have identical initial effects which are lower than the initial effects of the normalizing firms because the normalizing firms generate lower operating revenues throughout.

TABLE 42

PERCENTAGE DIFFERENCE IN IDC/EARNINGS RATIOS
BETWEEN THE EARLY AND STABLE PERIODS

Firm		Period/Period 5/45	10/50	15/45	20/50	Higher (H) or Lower (L)
	N	-0-	-0-	-0-	-0-	-
RB	F	-0-	-0-	-0-	-0-	-
	S	-0-	-0-	-0-	-0-	-
	N	6.79	3.60	1.68	.65	H
IDC	F	5.38	2.94	1.49	.65	H
	S	5.38	2.94	1.49	.65	H
	N	5.35	2.76	1.31	.47	H
IDC-ITB	F	4.04	2.21	1.11	.48	H
	S	4.04	2.21	1.11	.48	H
	N	2.23	1.13	.45	.14	H
RB-%IDC-ITB	F	1.16	.79	.33	.16	H
	S	1.16	.79	.33	.16	H

Cash Flows Per Share

Since we are interested in comparing the firms, rather than deal with the absolute levels of cash flow per share, it is easier to use one firm as a base against which the others may be compared. Thus, Firm RB is used as the base and the relative differences in the early periods for the other firms are illustrated in this way. Table 43 presents the percentage differences[37] and Figure 13 illustrates these differences graphically.

The more IDC a firm capitalizes, the lower is the early period CFS as a percent of Firm RB's CFS, relative to the stable periods. Thus, capitalizing IDC reduces CFS relative to Firm RB, with the impact exaggerated in the early periods in direct proportion to the amount of IDC the firm capitalizes. The straight line and flow through firms have identical cash

[37]Since the cash flow in period i is generated in period i-1, periods 6 and 16 are compared to period 46 and periods 11 and 21 are compared to period 41, as these periods represent the extreme values for cash flows.

TABLE 43

PERCENTAGE DIFFERENCE IN CFS AS A PERCENT OF FIRM RB
BETWEEN THE EARLY AND STABLE PERIODS

Firm		Period/Period 6/46	11/41	16/46	21/41	Higher (H) or Lower (L)
	N	-0-	-0-	-0-	-0-	-
RB	F	-0-	-0-	-0-	-0-	-
	S	-0-	-0-	-0-	-0-	-
	N	1.97	2.24	1.84	1.49	L
IDC	F	2.82	2.61	2.21	1.74	L
	S	2.82	2.61	2.21	1.74	L
	N	1.28	1.41	1.28	1.06	L
IDC-ITB	F	1.86	1.76	1.51	1.17	L
	S	1.86	1.76	1.51	1.17	L
	N	.21	.31	.31	.31	L
RB-%IDC-ITB	F	.42	.42	.42	.31	L
	S	.42	.42	.42	.31	L

flows and their early period reductions are more extreme than the early period reductions of the normalizing firms. It should be noted that the differences are small in all cases, never exceeding 3 percent.

Times-Interest-Earned Ratios

The firms which capitalize IDC have lower times-interest-earned ratios in the early periods than in the stable periods, in inverse proportion to the amount of IDC a firm capitalizes. That is, the larger the IDC rate, the lower the early period ratios relative to the stable period ratios. The percentages are shown in Table 44 and this result may be seen graphically in Figure 18.

While the ratios of Firms RB(N) and RB(S) are constant throughout, the ratios of Firm RB(F) are affected by the depreciation pattern change and flow through accounting. As Figure 19 illustrates, the ratios of Firm RB(F) are initially higher than the stable period ratios, then fall

TABLE 44

PERCENTAGE DIFFERENCE IN TIMES-INTEREST-EARNED RATIOS BETWEEN THE EARLY AND STABLE PERIODS

Firm		Period/Period 5/45	10/50	15/45	20/50	Higher (H) or Lower (L)
	N	-0-	-0-	-0-	-0-	-
RB	F	1.08	.64	.27	(.13)*	H
	S	-0-	-0-	-0-	-0-	-
	N	5.12	3.44	2.09	1.29	L
IDC	F	3.86	2.68	1.81	1.42	L
	S	4.21	2.89	1.79	1.11	L
	N	3.45	2.33	1.46	.90	L
IDC-ITB	F	2.30	1.66	1.19	1.04	L
	S	2.88	1.98	1.26	.78	L
	N	.81	.55	.36	.23	L
RB-%IDC-ITB	F	.25	.04	(.14)	(.39)	H
	S	.68	.48	.32	.19	L

*Parentheses indicate the value is opposite that indicated by the H or L in the table.

slightly below, and finally approach the stable period ratios. This demonstrates the influence of the change in the depreciation pattern and flow through accounting which affects all flow through firms. For all the firms which capitalize IDC except Firm RB-%IDC-ITB(F), the impact of capitalizing IDC dominates in the development of the pattern of ratios. For Firm RB-%IDC-ITB(F), a unique pattern emerges as shown in Figure 20. This depreciation-flow through effect results in the smallest early period differences for the flow through firms, while the normalizing firms have the greatest differences between the early and stable period ratios.

In general, the early period results do not suggest a change in the relationships found in the more stable periods. In fact, the differences found are more extreme in the early periods than they are after the system stabilizes.

APPENDIX C

THE LARGE FIRM CONSTRUCTION PROGRAM

This appendix is designed to supplement and support the statements made in Chapter 5 regarding the impact of the large firm construction program (LFCP). The normal firm construction program represents one assumption about the continuity of construction and the LFCP represents another. Together, these two assumptions are sufficient to illustrate the importance of considering the continuity of construction for a complete analysis.

In the LFCP, construction begins in every period for each type of asset. For the activity with a two-year construction period, it is assumed that the current year's investment allocation is evenly divided between the project begun last year and the project beginning in the current year. For the activity with the five-year construction period, investment is allocated among on-going projects as shown in Table 45. Even if the allocations shown in Table 45 were changed, the results would not be significantly different.

To facilitate the discussion of these variables several generalizations regarding the patterns of the results may be made. First, the cyclical fluctuations are no longer present in any of the variables. Second, depending on the variable, the pattern of results reaches a high (low) value within the first 10 years, then declines (rises) and approaches a stabilized value. Third, this stabilized value is usually reached by the thirty-fifth period. Just as the cyclical pattern was the rule for

TABLE 45

PERCENT OF THE ACTIVITIES ALLOCATION
DEVOTED TO THE VARIOUS PROJECTS

Period in Which the Project Began	Percent
i	30
i-1	25
i-2	20
i-3	15
i-4	10
Total	100

the NFCP, the pattern described above is typical for the LFCP. Consequently, a minimum of graphs can be used to represent the differences. Instead, the steady state, or constant, values will be presented in tables to demonstrate the differences.

Utility Rates

Figure 26 illustrates the utility rates for Firms RB(N), RB(F), RB (S), and IDC(N), which would be necessary to generate revenues just sufficient to produce the desired return on capital. Several facts are worth noting. First, the differences between the depreciation methods are similar to those established for the NFCP, for each of the construction accounting treatments. Second, the pattern of utility rates is considerably less volatile. Firms RB(N) and IDC(N) are used to illustrate this fact since they represent the extremes, between which the other cases lie. Firm RB(N) produces a fairly smooth pattern of utility rates throughout. Firm IDC(N) produces a pattern of rates which falls initially then rises and becomes fairly stable in the last 15 periods. In all cases, the cyclical fluctuation produced with the NFCP is eliminated. Since this

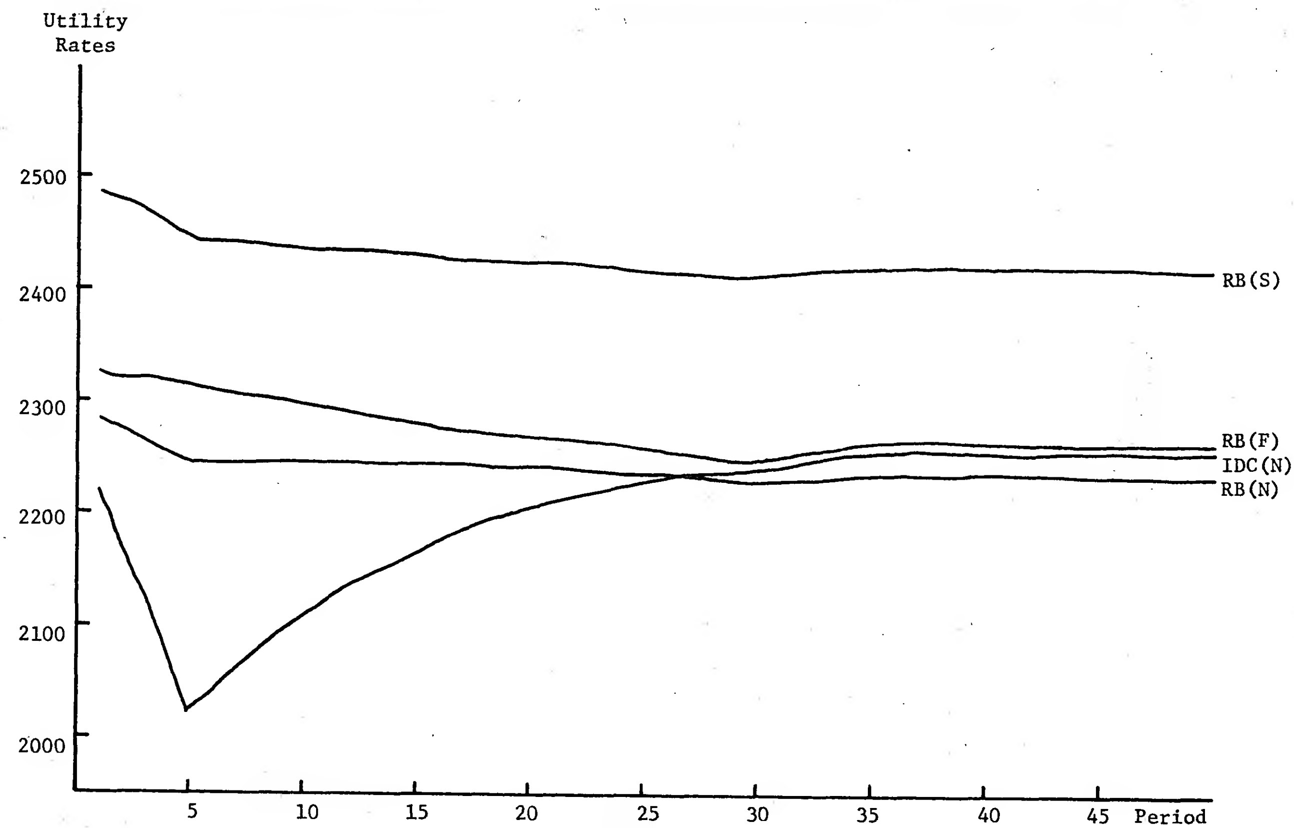

FIGURE 26

UTILITY RATES (LFCP)

cyclical variation was the primary source of difficulty for consumers, this problem is partially alleviated when the LFCP is assumed. Consequently, the difference between the firms with regard to this aspect is substantially diminished.

IDC/Earnings

The typical pattern of I/E ratios is illustrated in Figure 27 for Firm IDC(N). All of the other firms, except Firm RB, would have similar patterns, but the ratios would have lower values. As always, these ratios are a direct function of the IDC rate. This fact is illustrated in Table 46, which presents the stabilized values for each firm. Another fact to notice is that the normalizing firms have higher I/E ratios. Again, this is because total earnings are lower since part of their capital (the deferred tax reserve) is cost free and no earnings have to be generated on it. The differences between the firms are still significant, as they were for the NFCP.

IDC/Dividends Ratios

The pattern of results and the comments for these ratios are analogous to those of the IDC/earnings ratios. Table 47 gives the stabilized values of the results to provide some idea of the magnitudes involved.

Cash Flow

Rather than examine the absolute levels of cash flow and the cash flow per share of each firm, we examine cash flow per share only. The results for the absolute levels of cash flow are analogous to those using the NFCP. These results are presented in a slightly different manner to

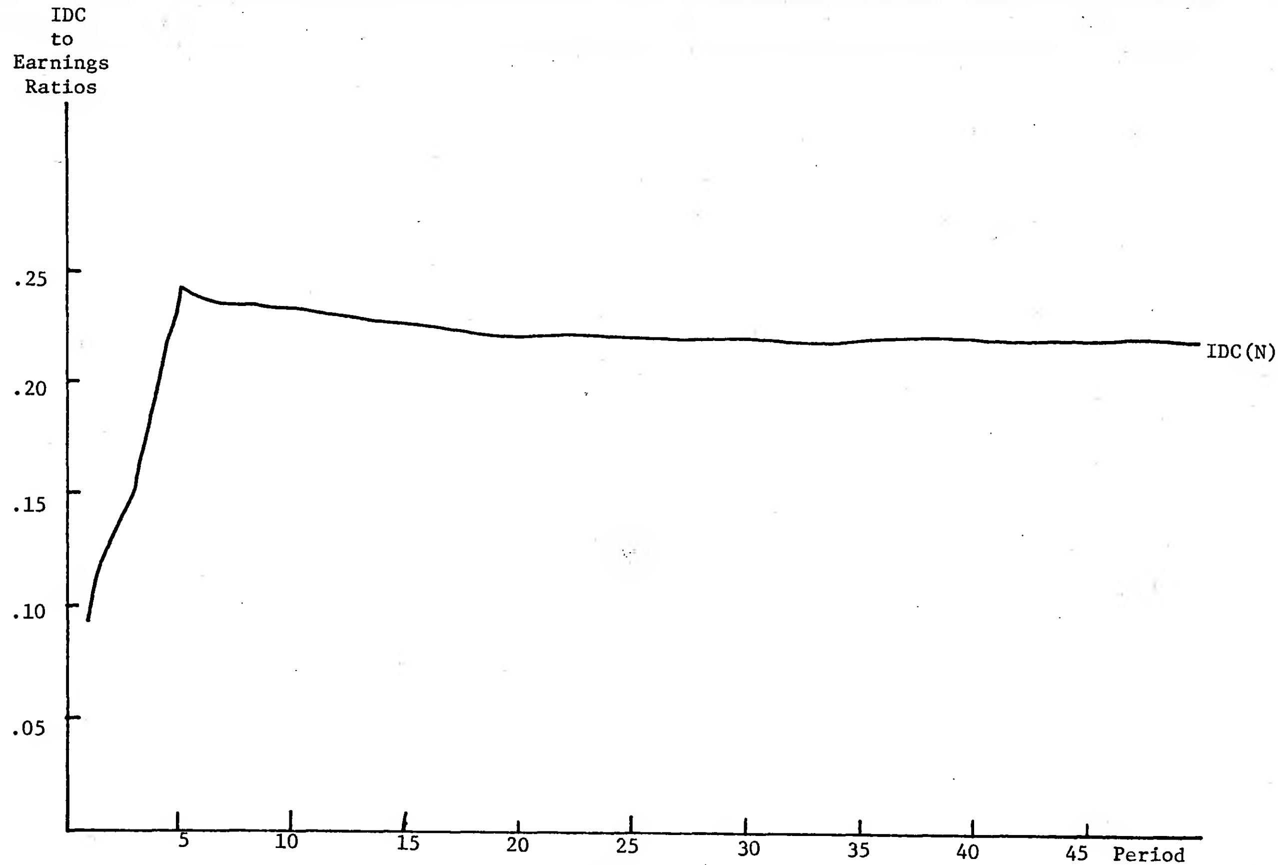

FIGURE 27

IDC TO EARNINGS RATIOS (LFCP)

TABLE 46

STABILIZED IDC/EARNINGS RATIOS

Firms	N	F	S
RB	-0-	-0-	-0-
IDC	.2205	.1988	.1988
IDC-ITB	.1688	.1518	.1518
RB-%IDC-ITB	.0527	.0472	.0472

TABLE 47

STABILIZED IDC/DIVIDENDS RATIOS

Firms	N	F	S
RB	-0-	-0-	-0-
IDC	.3150	.2840	.2840
IDC-ITB	.2411	.2169	.2169
RB-%IDC-ITB	.0753	.0674	.0674

facilitate the comparison. The results of Firm RB are presented and the other firms are then compared against these results.

Figure 28 depicts the pattern of CFS for Firm RB(N), RB(F), RB(S), and IDC(S). The pattern of CFS for Firm RB has been smoothed considerably by using the LFCP. This smoother pattern exists for the other firms as well, as illustrated by the graph of CFS of Firm IDC(S). Except for the initial drop in CFS, a smooth pattern results. A similar pattern exists for the other firms, except that the magnitude of the initial drop is less. The size of the drop is a direct function of the IDC rate. That is, the greater the amount of IDC capitalized, the larger the drop. However, the pattern for all firms becomes smooth fairly rapidly.

The flow through and straight line firms always have identical cash

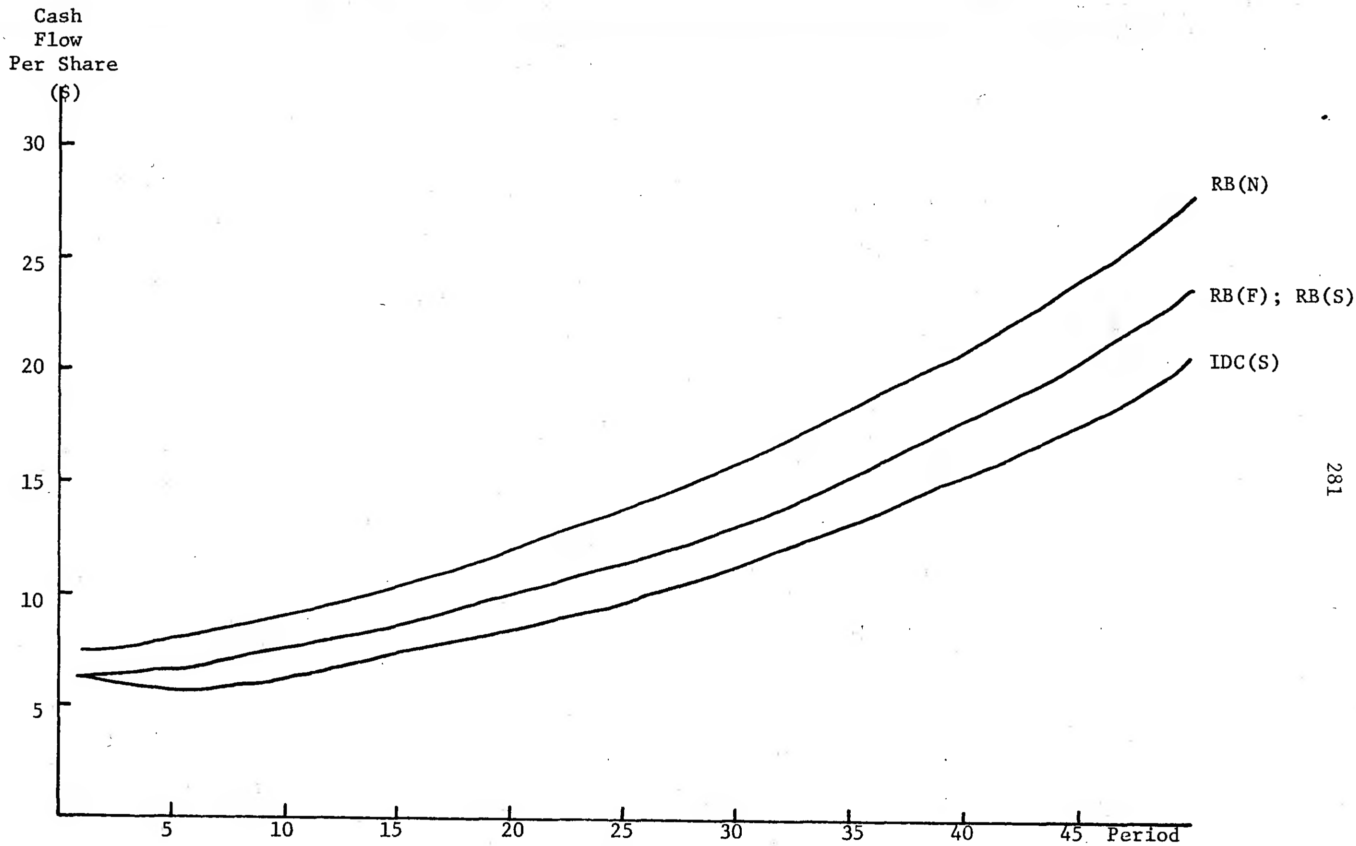

FIGURE 28

CASH FLOWS PER SHARE (LFCP)

flows, while the normalizing firms have typically higher ones. The normalizing firms have higher cash flows because the addition to the deferred tax reserve is available in each period.

Table 48 shows the CFS of the various firms as a percentage of their Firm RB counterparts. That is, Firm IDC(N) is compared to Firm RB(N) and Firm IDC(F) is compared to RB(F). The values compared are those of the last 15 periods where the relationship is stable. These figures again provide some indication of the magnitude of the differences involved. As before, the more IDC a firm capitalizes the lower is the CFS of that firm, in both a relative and absolute sense.

TABLE 48

CFS AS A PERCENT OF FIRM RB

Firm	N	F	S
RB	1.000	1.000	1.000
IDC	.860	.865	.865
IDC-ITB	.893	.897	.897
RB-%IDC-ITB	.967	.968	.968

Times-Interest-Earned Ratios

The times-interest-earned ratios of Firms RB and IDC for each depreciation case are illustrated in Figure 29. These two firms are again used to illustrate the basic patterns applicable to the other firms. Firm RB(N) has a constant ratio while Firm IDC(N) has a pattern of ratios which initially fall and then rise toward a constant value. The other firms produce patterns of ratios similar to the pattern of Firm IDC, but the ratios are higher. As always, the relative positions are related to the amount of IDC a firm capitalizes. This relationship is illustrated

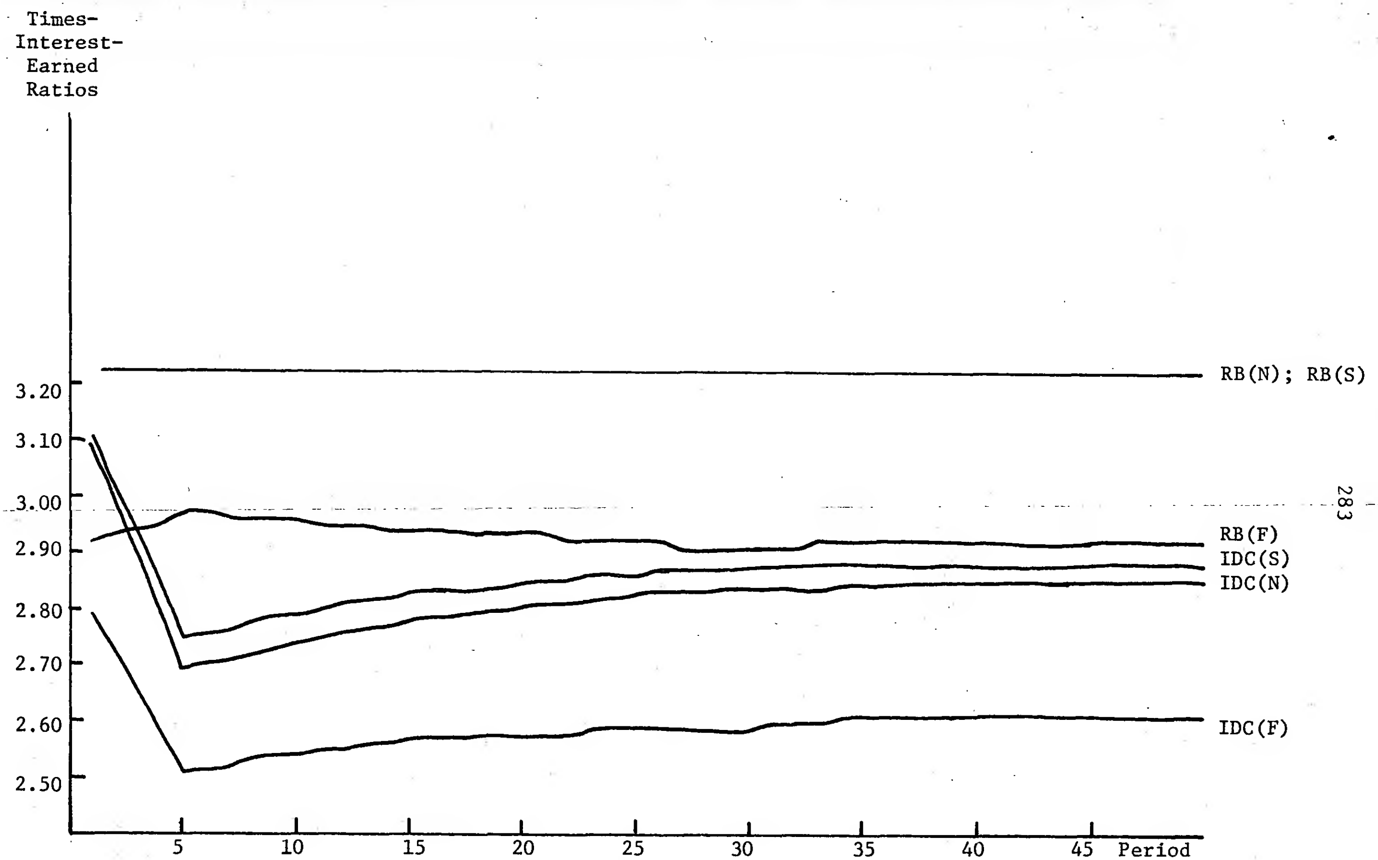

FIGURE 29

TIMES-INTEREST-EARNED RATIOS (LFCP)

in Table 49, which presents the stabilized values for the firms.

For Firm RB, the normalizing and straight line firms are identical, while the flow through firm has significantly lower ratios. For Firms IDC, IDC-ITB, and RB-%IDC-ITB, the normalizing ratios are slightly lower than those of the straight line firms, while those of the flow through firms are significantly lower than both the normalizing and straight line firms.

TABLE 49

STABILIZED TIMES-INTEREST-EARNED RATIOS

Firm	N	F	S
RB	3.222	2.924	3.222
IDC	2.851	2.614	2.888
IDC-ITB	2.938	2.687	2.967
RB-%IDC-ITB	3.134	2.851	3.143

APPENDIX D

INCLUDING THE FUNDS GENERATED BY DEPRECIATION IN THE CONSTRUCTION BUDGET

This appendix presents two tables which summarize the data generated by the computer model for the case where the funds generated by depreciation are included in the construction budget. Table 50 presents the lowest and highest values in the last 15 periods for each variable of interest. The numbers in the table indicate the range of values the variables may take during the periods used as the base of comparison. For example, during periods 36 to 50, the I/E ratio of Firm IDC(N) will vary between 16 and 53 percent. Table 51 then presents the percentage increase in each variable over the values generated by the typical firm case. That is, in the typical firm case, the I/E ratios of Firm IDC(N) ranged from 9 to 30 percent. The 16 to 53 percent range of the current case represents an increase of 68 and 73 percent, respectively, over the range found in the typical firm case. Table 51 presents similar percentages of change for each of the variables of interest.

TABLE 50

VALUES OF OUTPUT VARIABLES WITH DEPRECIATION FUNDS INCLUDED IN THE CONSTRUCTION BUDGET*

Variable		RB	IDC	IDC-ITB	RB-%IDC-ITB
I/E Ratios	N	0	.1562-.5286	.1237-.4063	.0417-.1283
	F	0	.1430-.4831	.1129-.3702	.0378-.1160
	S	0	.1430-.4831	.1129-.3702	.0378-.1160
I/D Ratios	N	0	.2231-.7551	.1767-.5805	.0596-.1833
	F	0	.2043-.6901	.1614-.5289	.0540-.1658
	S	0	.2042-.6901	.1614-.5289	.0540-.1658
CFS**	N	1.00	.899-.640	.920-.723	.973-.912
	F	1.00	.898-.641	.933-.724	.977-.913
	S	1.00	.898-.641	.933-.724	.977-.913
Times-Interest-Earned Ratios	N	3.222	3.074-2.221	3.102-2.459	3.180-2.981
	F	2.852-3.041	2.766-2.147	2.781-2.357	2.831-2.825
	S	3.222	3.068-2.307	3.112-2.522	3.184-3.004
Utility Rates	N	.2230-.2162	.2524-.1951	.2448-.2010	.2293-.2120
	F	.2199-.2236	.2493-.2022	.2417-.2080	.2262-.2191
	S	.2397-.2331	.2691-.2121	.2615-.2179	.2460-.2289

*These values represent the lowest and highest values during periods 36 to 50 for each variable.

**These values represent the ratios of CFS of each firm to the CFS of Firm RB.

TABLE 51

PERCENTAGE CHANGE IN OUTPUT VARIABLES FROM THE TYPICAL CASE WHEN DEPRECIATION FUNDS ARE INCLUDED IN THE CONSTRUCTION BUDGET*

Variable		RB	IDC	IDC-ITB	RB-%IDC-ITB
I/E Ratios	N	0	68.3-72.8	71.1-75.4	77.5-81.7
	F	0	71.1-75.6	73.7-78.0	80.0-83.8
	S	0	71.1-75.6	73.7-78.0	80.0-83.8
CFS**	N	0	(4.3)-(20.5)	(3.5)-(15.1)	(1.2)-(4.5)
	F	0	(5.4)-(20.5)	(2.8)-(15.1)	(1.0)-(4.4)
	S	0	(5.4)-(20.5)	(2.8)-(15.1)	(1.0)-(4.4)
Times-Interest-Earned Ratios	N	0	(1.8)-(16.0)	(1.5)-(11.9)	(.6)-(3.5)
	F	(.7)-(1.5)	(1.8)-(12.9)	(1.6)-(9.0)	(.9)-(1.1)
	S	0	(2.3)-(14.6)	(1.4)-(10.9)	(.5)-(3.2)
Utility Rates***	N	88.9	88.5	88.0	86.0
	F	94.7	87.7	87.2	86.8
	S	94.1	87.5	88.7	87.9

*These values represent the percentage increase in the lowest and highest values over the typical firm case, as a result of including depreciation funds in the construction budget.

**These changes represent the change in the ratio of CFS of each firm to CFS of Firm RB.

***This represents the change in the range of utility rates.

CHAPTER 6

CONCLUSIONS AND IMPLICATIONS

The results of Chapter 5 suggest specific conclusions that indicate which firm achieves the best results for each of the variables of interest. To assign some importance to each of the individual conclusions, the significance of the results for each variable is also considered. Since no one firm consistently produces the most desirable results, attaching some significance to each conclusion permits a weighing of the advantages and disadvantages of each alternative. Thus, is becomes a tradeoff; the advantages of one alternative can only be obtained at the expense of the advantages of the other alternative. To make the tradeoff more meaningful, the implications of each conclusion are explored. It then becomes clear what must be sacrificed when one alternative is chosen over another.

A Summary of the Results, Their Significance, and Some Conclusions

The previous chapter did not consider the significance of the results that were found. It was established that the use of the different construction accounting methods results in differences with regard to several performance variables, but the importance of these differences was not explored. A comparison of the results of the typical firm case and the atypical firm case illustrates that differences of quite varied magnitudes will be found, depending on the assumptions made. That is, while the differences may not be highly significant for an "average" firm, they could still be quite important for a large number of firms. The purpose of this section is to briefly summarize the results of Chapter 5, discuss the significance of these results, and finally, to draw some conclusions from them.

The significance of the results is considered from three perspectives. First, some differences may appear important in theory, but this importance may become obscured in a more realistic setting. In this case, the importance of these differences to the conclusions of this study is reduced. It is suggested that this situation exists for most of the variables of interest to consumers. Second, although quite subjective, it will be useful to specify a level where the differences are considered significant. Such a level is specified for the variables of interest to the investor. Finally, given a level of significance, the proportion of firms falling into the category where the differences are considered significant can be determined. The more firms in the significant difference category, the greater the importance of the results of this study.

To keep the discussion relatively easy to follow, we discuss only Firms RB and IDC. The way in which we approach the discussions which follow allows us to consider the results in a more abstract manner, particularly for the variables of interest to investors. At this point, it should be easy to place each method in the proper perspective for each discussion. We also do not consider the various depreciation policies for two reasons. Although the quantitative results used in this discussion are derived from the normalizing cases, the discussions are abstract enough to be applicable to all depreciation policies. Also, the typical firm summary covered the impact of depreciation policy on the variables and, therefore, it is not necessary to discuss it again.

Before exploring the significance of the variable differences, a brief discussion is presented which explains the fluctuation found in many of the output variables. This general discussion is a brief reiteration of a discussion in Chapter 4, but is important enough to be considered again.

The Fluctuation in the Variables

As we have shown, the fluctuation which results in many of the output variables is a direct function of the continuity of the construction program. A very discontinuous construction program produces the most extreme results. A one-shot construction program would be one extreme and would produce the widest fluctuation in results. Such a construction program would have extreme results during the construction period, as demonstrated by the early periods of the typical firm case, then would have the reverse effect (though less extreme) during the period of depreciation since no new IDC credits would be added to earnings. As the construction program becomes more continuous, the amount of fluctuation in all of the variables tends to decrease until the fluctuation is eliminated in the completely continuous case. Most of the analyses have dealt with an intermediate situation where it is assumed that for each construction activity, construction does not begin on a new asset until construction is completed on the previous asset. This discontinuity is what produces the fluctuation in all of the variables. Thus, the amount of fluctuation, or range of values, a firm can expect is an inverse function of the continuity of the construction program. The less continuous the construction program, the greater the fluctuation in the variables.

The Variables

Once again we are concerned with the results from the viewpoints of the consumer and of the investor. Of interest to the consumer are two closely related variables, revenue requirements and utility rates. From the investor's viewpoint, five variables are considered: 1) the rate of return on equity, 2) the IDC to earnings ratio, 3) the IDC to dividends ratio, 4) cash flow, and 5) the times-interest-earned ratio. In addition to these variables, one other variable, the rate of return on the rate base, is briefly mentioned which is mainly of interest to regulators.

The consumer

Revenue requirements. Two factors have been discussed which could be important to consumers. First, it was demonstrated that, in theory, some alternative methods (those employed by Firms RB and RB-%IDC-ITB) shift all or a part of the capital costs of construction to current customers, that others (Firms IDC and RB-IDC) provide current customers with a benefit as a result of construction, and finally, that only one method (Firm IDC-ITB) fully allocates the exact capital costs of construction to those who benefit from it. The obvious conclusion is that only method IDC-ITB should be used.[1]

It was also suggested that the discount rate could be important if the discount rate of the consumer differed from that of the firm. A

[1]A method which included CWIP in the rate base and capitalized IDC at the gross rate, like Firm RB-IDC, and also allocated the ITB to CWIP, which Firm RB-IDC does not do, would produce the same result as Firm IDC-ITB. This firm would be appropriate under the same assumptions that Firm IDC is equivalent to Firm RB-IDC.

lower discount rate for consumers would produce a lower net present value of revenue requirements for Firm RB than Firm IDC. Conversely, the reverse would be true if consumers had a higher discount rate than the firm.

The foregoing conclusions are based on revenue requirements and not on revenues, per se. Real world imperfections often cause the revenues actually earned to differ from the revenue requirements of the firm. It is these deviations and their causes which obscure the importance of these theoretical results and the conclusions drawn from them. Since the same imperfections are important for utility rates, we discuss the theoretical significance of the patterns of utility rates produced before exploring some of these factors and their impact.

Utility rates. It has been demonstrated that the fluctuation in utility rates is significantly greater for Firm IDC in every situation except the completely continuous construction case where the fluctuation is eliminated for all firms. Thus, from a theoretical standpoint, Firm RB would be preferable. However, as with revenue requirements, it is necessary to look beyond the strict theoretical results.

In the theoretical model, utility rates are a function of two variables, revenue requirements and demand. However, except in a rate setting situation, this process actually works in reverse. That is, utility rates are given and demand and revenues are a function of utility rates.[2] Since utility rates do not change unless they are explicitly changed by

[2]Although we do not explicitly recognize the demand-utility rate interaction in the model, we do recognize that it exists and will affect the results found in the real world.

regulators,[3] this reversed procedure often results in differences between actual revenues and revenue requirements. This difference makes it quite difficult to draw a direct parallel between the theoretical conclusions and their applicability to a more realistic situation. Though most of these issues are beyond the scope of this study, it will be useful to briefly indicate how some of them make it difficult to attach much significance to these theoretical conclusions.

As suggested in Chapter 4, demand is perhaps the most difficult and complicating factor to deal with and could easily be the subject of an entire investigation within the realm of the alternative construction accounting methods. The demand pattern assumed has very far-reaching effects on many variables. In theory, a correctly chosen demand pattern could produce nearly any pattern of utility rates. In a more realistic situation with inflexible utility rates, demand affects the pattern of revenues and, ultimately, the rate of return on the rate base and on equity. This influence will partially determine which firms require rate changes and when these rate changes are necessary. For example, the smoothly increasing demand pattern used in the simulation model produced relatively smooth utility rates for Firm RB and widely fluctuating rates for Firm IDC. On the other hand, if demand grew in a pattern similar to the growth in operating assets, then Firm IDC would have a fairly smooth pattern and Firm RB would have the more varied utility rates. Thus, the fluctuation which occurs in utility rates in theory, or in rates of return in reality, is at least partially a function of the demand pattern.

[3] Those automatic changes which do occur are for specific purposes, such as increased fuel costs, and not to accommodate changes necessitated by IDC.

Demand is also important with regard to the transference of the capital costs of construction and the discount rate. As demonstrated in the typical firm case, the demand pattern assumed produced revenues and thus rates of return on the rate base which allowed the utility rate to remain constant. Thus, the problem of transferring the capital costs of construction and the appropriate discount rate became unimportant. However, a different demand pattern could result in different rates of return on the rate base which would require utility rate changes. Or, IDC could become large enough to require utility rate changes as demonstrated by the atypical firm case. But, again a different demand pattern could produce more stable rates of return on the rate base and the importance of these factors might be reduced. Thus, demand is also important in assessing the significance of these factors in a more realistic setting.

There is yet another aspect of demand which could be important in both a theoretical and in a more realistic situation. In theory, fluctuating utility rates could affect demand and revenues depending on the elasticity of demand. In reality, utility rates are more inflexible, but where utility rates do change, demand elasticity could be important.[4]

We have discussed both the importance of demand and the complexities involved in dealing with it. However, the purpose of the discussion was to show how the significance of the issues, which are of concern to consumers, may be obscured by altering the assumption about demand in connection with inflexible utility rates. The conclusions with regard to the transferring of the capital costs of construction and the discount

[4]We must again emphasize that demand elasticity could have a significant impact on the results. Unfortunately, more explicit consideration of this factor is beyond the scope of this investigation.

rate are obvious in theory, but their significance in a more realistic setting is quite difficult to evaluate. In general, it would seem that these factors are much less important in reality than they are in theory.

The fluctuation in utility rates is also significant in theory, but far less important in light of inflexible nominal utility rates[5] and the possibility of a different demand pattern than the one we assumed. Considering the inflexibility of utility rates, the fluctuation which results occurs in the rate of return on equity and the rate of return on the rate base and is more appropriately discussed in connection with those variables. Thus, in reality, the fluctuation in utility rates is probably not as important a consideration as it is in theory.

In summary, the theoretically important variables from the consumer's viewpoint do not seem to have the same significance in a more realistic setting. However, before highly defensible conclusions could be drawn, it would be necessary to give much greater attention to the patterns of demand a firm might reasonably expect to face. On the other hand, the variables of interest to investors seem to have far more explicit implications.

The investor

The rate of return on equity. The basic theoretical result is that each of the alternative construction accounting methods will produce the target rate of return on equity in every period when properly applied.

[5]Although inflation will alter the real level of utility rates, time constraints have forced us to ignore inflation in our analysis. Inflation affects the results of the model in numerous ways, some of which are explored in an *a priori* manner in the section dealing with the implications.

As a result, this variable would not be important to investors. However, as pointed out earlier, inflexible utility rates shift the fluctuation to the rate of return on equity.

With inflexible utility rates the rate of return on equity fluctuates relatively widely for Firm IDC, while that of Firm RB is relatively smooth. As the atypical firm case illustrated, this fluctuation can become quite significant. The impact of this is better illustrated by examining the profits of Firms RB and IDC for the typical firm case with fixed utility rates. As shown by Figure 30, the profits of Firm RB increase fairly smoothly over time while those of Firm IDC increase sharply during construction, then fall sharply as an asset goes on line. Although both firms earn identical operating revenues, Firm IDC also has IDC credits to add to its earnings. Even though Firm IDC has more debt and higher interest payments than Firm RB, profits are still increasing over the construction cycle as IDC credits increase, then fall as IDC credits fall when an asset goes on line. With fixed utility rates, the addition of IDC to the firm's earnings is the cause of earnings instability often complained of with the use of IDC. Although Firm IDC appears to have higher average profits, it is because Firm IDC has more equity and must have higher absolute dollar profits to provide the same rate of return on equity. It is generally accepted that firms with a greater variability in earnings are more risky, other things being equal.[6] Thus, it would appear that Firm IDC is more risky, when inflexible utility rates are considered.

[6]Schramm, R. and R. Sherman, "Profit Risk Management and the Theory of the Firm," Southern Economic Journal, Vol. 40, No. 3 (January 1974), pp. 353-363.

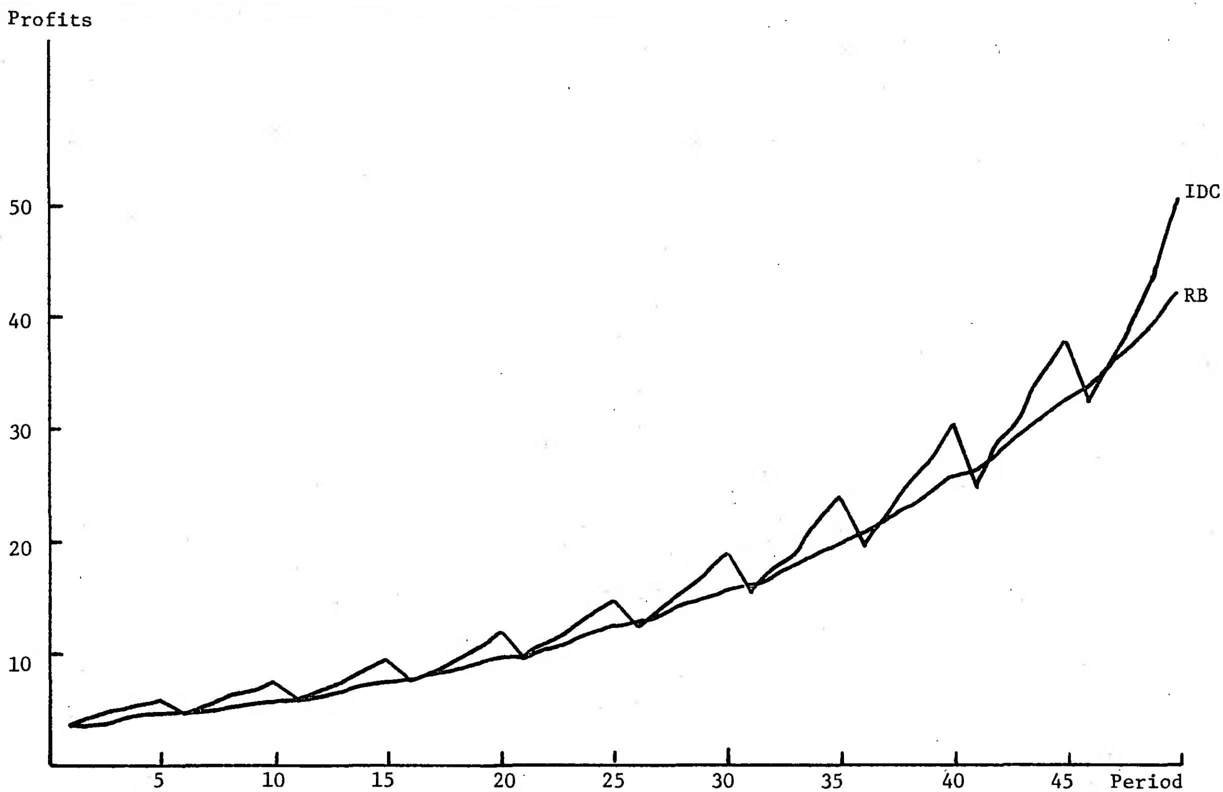

FIGURE 30

PROFITS WITH A FIXED UTILITY RATE (NORM.)

As pointed out in the discussion of utility rates, demand could assume a pattern other than the one assumed in the simulation model and, perhaps, alter the above results. However, to eliminate the fluctuation would require a highly specific pattern and such a result is unlikely. In any case, the basic impetus which creates a fluctuation in profits is still there as a result of capitalizing IDC.

One final factor important in considering the rate of return on equity is the IDC rate, as demonstrated in the typical firm case. An IDC rate below the rate of return on the rate base makes a method which includes CWIP in the rate base, even if IDC is still capitalized (like Firm RB-IDC), preferable to only capitalizing IDC. Conversely, an IDC rate larger than the rate of return on the rate base would make a method which only capitalizes IDC preferable, all other things being equal. This conclusion holds for any situation, whether utility rates are flexible or inflexible.

<u>The rate of return on the rate base</u>. All that was said in regard to the rate of return on equity is also applicable to the rate of return on the rate base. In theory, the target rate is always met, but in reality deviations occur. The key difference is the impact of these deviations. As we have said, the rate of return on the rate base is a variable monitored by regulating agencies. Significant deviations from the target will probably result in utility rate changes. As we demonstrated with the atypical firm case, Firm IDC would require either frequent utility rate changes or regulators would have to tolerate wide deviations in the rate of return on the rate base. On the other hand, Firm RB would have far more stable rates of return and less frequent, if any, utility rate changes.

<u>The remaining variables</u>. Rather than deal with the I/E ratios, I/D ratios, cash flows, and the times-interest-earned ratios separately, these variables are discussed together in a more general sense. As a general result, we have demonstrated that Firm IDC has values for each of these variables which are less desirable than Firm RB's values in every case, whether we assume inflexible utility rates, flexible utility rates, or the large firm construction program. The only situation where this result is not found is in periods of sharply decreasing construction activity. As the typical and atypical firm cases demonstrated, the magnitude of these differences is a function of the input variables and assumptions applicable to a particular situation.[7] However, what is also true is that the size of these differences is also related to the I/E ratios. As the I/E ratio gets larger, the differences in cash flow, cash flow per share, and the times-interest-earned ratio increase between Firms RB and IDC. These general conclusions are applicable to all relatively stable situations.

Thus, we can observe an I/E ratio and have some idea of the approximate differences in these other variables.

Deciding on a level of significance is obviously an arbitrary decision, but not one which is extremely important. We can simply choose a level, describe the differences between the firms which exist at that point, and then indicate the percentage of firms which fall into that category. A higher or lower level could be chosen and would simply decrease or increase the number of firms falling into the category where the differences are considered significant.

[7]This result was also demonstrated by the sensitivity analysis.

Table 52 presents data for 1972, taken from the S&P Compustat tapes, which show the number of firms falling into certain ranges with respect to I/E ratios for the 116 firms for which data were available. By choosing an I/E ratio where the differences are considered significant and using Table 52, we can get a rough idea of the percentage of firms for which the differences are important.

TABLE 52

IDC TO EARNINGS RATIOS OF 116 FIRMS IN 1972

Range of I/E Ratios	Frequency	% of Total	Cumulative % in the Range and Below	Cumulative % in the Range and Above
0	3	2.59	2.59	100.00
>0, <10	33	28.45	31.04	97.41
10 - <20	18	15.52	46.56	68.96
20 - <30	26	22.41	68.97	53.44
30 - <40	15	12.93	81.40	31.03
40 - <50	14	12.07	93.97	18.10
50 - <60	3	2.59	96.56	6.03
60 - <70	2	1.72	98,28	3.44
70 - <80	1	.86	99.14	1.72
80 - <90	1	.86	100.00	.86
90 - 100	0	0.00	-	-
Totals	116	100.00		

Source: S&P Compustat Tapes

Suppose, for the sake of discussion, that an I/E ratio of about 30 percent was the level chosen. At that point, based on the typical firm case results, the I/D ratio is about 44 percent. Compared to a similar firm which included CWIP in the rate base and did not capitalize any IDC (Firm RB), the firm would have a cash flow equal to about 88 percent of that of the other firm, while on a per share basis, the cash flow of the firm would be only about 80 percent of the cash flow of the firm which did not capitalize IDC. The times-interest-earned ratio of the firm with 30 percent IDC credits would be around 82 percent of the ratio of the other firm. Assuming these are considered significant differences, more than 30 percent of the firms, based on 1972 data, would fall into the category where the differences are significant. In a similar manner one could choose any level felt to be significant and get an approximate idea of the proportion of firms for which the differences are significant.

Three additional facts are worth mentioning. First, in 1974 the number of firms in the significant difference category would definitely be larger. The data used were 1972 figures, and as shown in Chapter 2, the average I/E ratio has increased in every year since 1964. As the average increases, it is likely that the number of firms in the higher I/E ratio categories will be larger and/or there will be more firms in the extremely high categories. Thus, it is very likely that these figures underestimate the number of firms for which significant differences exist.

Second, these figures represent a point in time, 1972. It is quite likely that in the following year many new firms might enter the group where the differences are considered significant. Thus, over some longer period, a much greater percentage of firms could, at some point, be in the significant difference category.

Finally, many of the firms have highly significant differences, such that some variables could have critically low values. As the atypical firm case demonstrated, I/E ratios around 70 percent can cause a firm to have cash flows and times-interest-earned ratios at a level of about 50 percent of a firm which does not capitalize IDC. It would be difficult to argue that such a reduction in cash flow is not significant!

A Summary of the Conclusions

In this discussion we briefly summarize the important conclusions which have evolved from this investigation. These conclusions are presented in a very succinct format to allow the implications discussed in the final section to follow directly from these conclusions. Once again we deal with the variables of interest to the consumer and the investor.

The consumer

Revenue requirements. In theory, only the alternative used by Firm IDC-ITB avoids shifting costs as a result of construction and is, therefore, preferable from the standpoint of this factor. This conclusion suggests that there is no justification for using the method followed by Firm IDC or Firm RB-IDC.[8] That is, the interest-tax benefit resulting from construction should always be allocated to CWIP when IDC is capitalized.

The consumer's discount rate could differ from that of the firm. A lower discount rate would mean that the lower the IDC rate, the lower the NPV of the revenue requirements would be. In this case, Firm RB, which capitalizes no IDC, would be the most preferred. Conversely, a higher discount rate would favor Firm IDC.

Utility rates. Theoretically, and in light of our assumptions of demand, Firm RB would have the most stable and, therefore, the most desirable pattern of utility rates. However, the reality of inflexible

[8] If Firm RB-IDC also allocated the ITB, this would produce results identical to those of Firm IDC-ITB, under the assumptions specified earlier.

utility rates and the possibility of alternative demand patterns suggest that this variable needs more study before defensible conclusions can be drawn.

The investor

The rate of return on equity. In theory, the rate of return will be identical for all firms, but inflexible utility rates suggest that two considerations are important. First, the rate of return on equity fluctuates much more for Firm IDC than for Firm RB. That is, profits vary much more widely for Firm IDC and, thus, Firm RB is more desirable. The second factor to consider is that the more continuous the construction program, the less the fluctuation will be for any of the firms. A final consideration concerns the IDC rate. If the IDC rate is different from the rate of return on the rate base, it is probably lower. This presumption suggests that any method which includes CWIP in the rate base will be preferable to one which only capitalizes IDC.

The rate of return on the rate base. Here again the reality of inflexible utility rates causes a difference between the target rate of return on the rate base and the actual rate of return. These deviations are much larger for Firm IDC than for Firm RB and this may require Firm IDC to have more frequent rate changes or require regulators to tolerate wide deviations in the rate of return on the rate base from the target rate. Once again, a more continuous construction program will reduce these fluctuations. In general, however, Firm RB seems to produce the most desirable results.

IDC to earnings ratio. A firm which capitalizes IDC may find that investors discount IDC earnings which places it at a disadvantage relative to a comparable firm with fewer or no IDC earnings. In this respect, Firm RB is preferable.

IDC to dividends ratio. The I/D ratio is another variable which may be a signal to investors that this firm is less desirable than one which has lower or no IDC credits. Firm RB is preferable in this respect also.

Cash flow. Firms which capitalize IDC will generally have lower cash flows and even lower cash flows per share than comparable firms which do not capitalize IDC. The lower and less stable cash flows may make it difficult for these firms to obtain additional debt or may raise the cost of debt. Once again, Firm RB is preferable.

Times-interest-earned ratio. Firms which capitalize IDC will also generally have lower times-interest-earned ratios. This could affect the firm's bond rating and raise its cost of debt. Firm RB seems to be more desirable in this respect also.

When weighted by the significance attached to them, the conclusions reached for the individual variables suggest one general conclusion: The performance of a firm which does not capitalize IDC (Firm RB) is significantly more desirable than the performance of a firm which does capitalize IDC (Firm IDC). This general conclusion seems well supported by the evidence produced in this investigation. The final section of this report explores some of the implications of the conclusions outlined above.

Implications

In the previous section a number of conclusions were reached concerning each of the variables which have been discussed in this study. In this final section, some specific implications relating to each variable are drawn which follow directly from these conclusions. All of these specific implications are then considered together in an attempt to make a specific suggestion based on all the information produced in this investigation.

Specific Implications for Each Variable

Concerning the revenue requirements of the firms, two factors have been discussed. With regard to the transfer of some of the costs associated with construction, in theory, a method which capitalizes IDC and allocates the ITB should be used. However, as we have demonstrated, the importance of this factor becomes obscured by the reality of inflexible utility rates. The second factor important with regard to revenue requirements concerns the appropriate discount rate. If any firm were favored, it would probably be Firm RB. With a lower discount rate for consumers, Firm RB would minimize the NPV of a customer's utility bills.

Given our assumptions, utility rates seem to be most acceptable for Firm RB. The more stable the utility rates facing a consumer, the better he can plan his consumption expenditures, and Firm RB produces the most stable pattern of utility rates. Furthermore, as noted in the discussion of the early periods, a period of increasing construction activity causes the utility rates of Firm IDC to fall initially while those of Firm RB are fairly constant. In a period of increased construction activity, it would be expected that utility rates would rise rather than fall, particularly when inflation is significant. The initial drop in utility rates for Firm IDC would be a false signal to consumers about the future level of utility rates. Firm RB's rates do not experience a similar drop and, therefore, would provide better information to the consumer. In general, the pattern of utility rates for Firm RB is more desirable.

Many variables are of interest to investors, but one important one is the rate of return on equity. Although the rates of return for all firms are identical in theory, several aspects of utility regulation may have important implications for the rate of return on equity. As we have demonstrated, with inflexible utility rates Firm RB will produce the least varied rates of return on equity and profits. This lower variance will probably mean that Firm RB will be considered less risky and, therefore, require a lower rate of return on equity. This result should in turn allow Firm RB to have a lower cost of capital and, ultimately, a lower cost to consumers.

Utility regulation also affects the effective rate of return on CWIP and, consequently, the rate of return on equity. The <u>effective</u> rate of return on CWIP may differ substantially between Firms RB and IDC as a direct result of regulatory action. The effect of this action may be considered in several ways. First, the IDC rate may be intentionally set below the allowed rate of return on used and useful assets. As a result, the overall rate of return for Firm IDC will be below that of Firm RB.

Second, very often companies are not permitted to compute IDC on IDC capitalized in prior years. There is no theoretical justification for this action. The only way the firms can produce equivalent rates of return is to permit the companies to compute IDC on capitalized IDC. The model used in this analysis allowed this compounding feature, and as a result, the basic theoretical results[9] demonstrated equality between the firms. The impact of not permitting the computing of IDC on IDC is to reduce the effective rate of return on CWIP. Even if the IDC rate was equal to the allowed rate of return on the rate base, not permitting compounding would reduce the effective rate of return on CWIP below the allowed rate of return on the rate base. Thus, the overall return for Firm IDC would be below that for Firm RB.

Inflation is another factor which may affect the effective rates of return on CWIP for Firms RB and IDC. In an inflationary situation, the marginal cost of capital typically exceeds the embedded cost of capital. Assuming the IDC rate accurately reflects the marginal cost of capital, Firm IDC would achieve a higher overall return. Since the rate of return on CWIP earned by Firm IDC (the marginal cost of capital) would exceed that rate earned by Firm RB (the embedded cost of capital), the average return of Firm IDC would be higher. The superiority of Firm IDC over Firm RB depends on the assumption that the IDC rate reflects the marginal cost of capital, or at least exceeds the rate of return allowed on used and useful assets. It is not at all clear that the situation ever exists where the IDC rate exceeds the allowed rate of return.

Thus, regulatory action can directly affect the rate of return on equity. That is, different construction accounting methods may result in quite different rates of return simply as a result of the IDC rate allowed by regulators. Such action could seriously impair a firm's ability to raise capital in the market, or it may increase the cost of capital the firm does raise.

---

[9] That is, ignoring the discussions of Chapter 5, the rates of return of the firms are identical when compounding is permitted.

As demonstrated earlier, the primary market variables of concern to investors (DPS, EPS, and market price) were the same for all firms. However, this result ignored the impact of investors' expectations influenced by a number of other variables. These variables also have direct implications on the theoretical equality between the firms.

Firms which capitalize IDC have credits in their earnings. If consumers discount these credits, the theoretical equality in EPS among firms will no longer hold. Instead, Firm RB will have higher EPS in the minds of investors. This inequality means that the firms which capitalize IDC will have to offer a higher return to investors, which again raises the ultimate cost to the consumer.

Similarly, a high I/D ratio can have an adverse effect on investors' expectations. With dividends being paid on credits, investors may become concerned about the firm's ability to meet its dividend payments. The importance of dividend payments to utilities is well known, and this adverse impact could again be reflected in the firm's cost of capital.

The capitalization of IDC, per se, dividend payments on these credits, and other factors cause the firms which capitalize IDC to have reduced cash flows and cash flows per share. These reduced and less stable cash flows may force these firms to offer higher interest rates to attract new debt. Similarly, the lower times-interest-earned ratios for firms which capitalize IDC can also result in higher costs of debt. Higher costs of debt also lead to a higher cost of capital and again, consumers must ultimately bear these higher costs. Thus, firms which capitalize IDC can have a higher cost of capital because of both higher equity costs and higher debt costs.

From the point of view of regulators also, Firm RB would seem to be preferable. With inflexible utility rates, firms which capitalize IDC will either have more frequent rate changes or regulators will have to tolerate wider fluctuations in the rate of return on the rate base. On the other hand, Firm RB produces substantially less fluctuation.

General Implications

For most problems with alternative solutions, all of the evidence will not support one alternative over another. Each available piece of evidence must be weighted to determine which alternative is supported by the majority of the evidence. So it is with the choice of the "best" construction accounting alternative. Simply stated, the choice of a construction accounting method reduces to a tradeoff between the theoretical advantages of capitalizing IDC and the practical attractiveness of including CWIP in the rate base. When properly applied, capitalizing IDC has the advantage of fully matching costs and revenues. This idea is the accountant's way of saying that current customers will not bear a portion of the cost of assets to be used by future customers. As pointed out, even this theoretically desired result may not be achieved in reality. On the other hand, including CWIP in the rate base and not capitalizing any IDC offers the practical advantages of higher cash flows, higher coverage ratios, and no IDC credits in earnings. Thus, the tradeoff is between a higher quality of earnings and lower cost of capital versus the matching of costs and revenues. Although the precise weights given to these factors may differ, the balance of support seems to clearly favor including CWIP in the rate base as the sole means of providing a return on construction work in progress.

From the conclusions we have demonstrated and the implications drawn from them, one obvious suggestion seems to evolve from this investigation. The less IDC a firm capitalizes, the better off the firm will be, and no IDC at all appears to be the optimal situation. Thus, we suggest that the capitalization of IDC be discontinued and, instead, firms should include CWIP in their rate base as a means of providing a return on funds invested in construction.

Concluding Comments

This study has been expanded as far as possible within the scope of the resources available. Nonetheless, there are issues which have not been adequately considered. Both the pattern of growth and the elasticity of demand require far more consideration than the brief coverage given in this analysis. Inflation is a factor of current interest which demands more study than the intuitive consideration afforded it in this analysis. In spite of the limitations on the results, we are convinced that our conclusions are generally applicable and would be supported by further investigations.

Finally, we are not suggesting that all firms which capitalize IDC will have problems. However, we are suggesting that those firms which do capitalize IDC will have values for all the variables examined which are less favorable than those firms which only include CWIP in the rate base. Firms with large IDC credits could, at times, have values for certain variables which might create problems. In periods of high sustained construction activity, these problems become most severe. As a result, the firm's ability to raise capital is impaired at a time when external sources of financing are needed most. Combined with other problematic conditions such as inflation, a utility could find itself in a most undesirable position. This situation is exactly that faced by utilities in late 1973 and 1974. Many companies have been unable to obtain the funds needed for continued construction. Efforts to meet these needs by reducing dividends have met with disastrous results. While we are not implying that the capitalization of IDC is the cause of these difficulties, we are suggesting that the capitalization of IDC is definitely a contributing factor and that many firms would be in a much better position were they not capitalizing IDC.

BIBLIOGRAPHY

Books

Bonbright, James C., Principles of Public Utility Rates, New York: Columbia University Press, 1961.

Garfield, Paul J. and W. F. Lovejoy, Public Utility Economics, Englewood Cliffs, N.J.: Prentice-Hall, 1964.

Meier, Robert C., et. al., Simulation in Business and Economics, Englewood Cliffs, N.J.: Prentice-Hall, 1969.

Van Horne, James C., Financial Management and Policy, Englewood Cliffs, N.J.: Prentice-Hall, 1971.

Articles and Monographs

Bickley, John H., "Can Construction Create Income and Profit?," Public Utilities Fortnightly, Vol. 88, No. 2 (July 22, 1971), pp. 29-35.

Brigham, E. F. and J. L. Pappas, Liberalized Depreciation and the Cost of Capital, 1970 MSU Public Utilities Studies, Michigan State University, 1970.

Bolster, Dennis R., "Should Plant Under Construction be Included in the Rate Base?," Public Utilities Fortnightly, Vol. 87, No. 11 (May 27, 1971), pp. 25-28.

Coughlan, Paul B., "Interest During Construction: A Little Appreciated Cost," Public Utilities Fortnightly, Vol. 90, No. 13 (December 21, 1972), pp. 20-27.

"1974 Annual Statistical Report," Electrical World, March 15, 1974, pp. 35-66.

Frazer, Robert E. and Richard C. Ranson, "Is Interest During Construction 'Funny Money'?," Public Utilities Fortnightly, Vol. 90, No. 13 (December 21, 1972), pp. 20-27.

French, Walter G., "Panel--Interest During Construction--Once Again, An Analyst's View," presented before Federal Government Accountants' Association, 22nd Annual National Symposium, June 14, 1973.

Gordon, Myron J. and Eli Shapiro, "Capital Equipment Analysis: The Required Rate of Profit," Management Science, October 1956, pp. 107-110.

Litke, Arthur L., "Allowance for Funds used during Construction," Public Utilities Fortnightly, Vol. 90, No. 7 (September 28, 1972), pp. 19-22.

Morris, Everett L., "Capitalization of Interest on Construction: Time for Reappraisal," Public Utilities Fortnightly, Vol. 87, No. 5 (March 4, 1971), pp. 19-29.

__________, "The Interest on Construction Dilemma--A Proposed Solution," Investment Dealers' Digest--Public Utility Survey, Section Two, Vol. 38 (August 29, 1972), pp. 20-23.

Olson, Charles E., "Interest Charged Construction: Economic, Financial, and Regulatory Aspects," Public Utilities Fortnightly, Vol. 88, No. 4 (August 19, 1971), pp. 30-34.

Peter, Frank A., "Interest During Construction--Accounting or Rate-Making Requirement?," Public Utilities Fortnightly, Vol. 89, No. 4 (February 17, 1972), pp. 35-41.

__________, "Interest on Construction--A New Look," Seminar No. 14--Trends in Regulatory Accounting, Federal Government Accountants' Association, 20th Annual National Symposium, June 1971.

Sayad, Homer E., "An Accountant Looks at Capitalized Interest," Haskins and Sells--Selected Papers, 1966, pp. 120-130.

Schedin, L. L., "Tax Effects of Construction Program--Ratemaking Implications," for presentation at Edison Electric Institute, Rate Research Committee, Spring meeting, May 1973.

Schramm, R. and R. Sherman, "Profit Risk Management and the Theory of the Firm," Southern Economic Journal, Vol. 40, No. 3 (January 1974), pp. 353-363.

Statistical Year Book, Edison Electric Institute, 1972, p. 59.

Utley, John F., "Another View of Interest During Construction," Public Utilities Fortnightly, Vol. 85, No. 9 (April 23, 1970), pp. 34-37.

Walker, Richard, "The Capital Cost of Utility Construction," Arthur Andersen Chronicle, Vol. 31, No. 4 (September 1971), pp. 30-37.

Material Prepared for the Public Service Commission Hearings

Testimony of Eugene F. Brigham relating to 1972 Comsat Rate Case, Federal Communications Commission, Docket No. 16070, 1972.

Testimony of Paul J. Garfield relating to Interest During Construction (for Southern Bell Telephone and Telegraph Company), Florida Public

Service Commission, Docket No. 72609-PV, 1973.

Testimony of Gulf Power Company relating to Interest During Construction, Florida Public Service Commission, Docket No. 72609-PV, 1973.

Testimony of W. H. Holsenbeck relating to Interest During Construction (for Southern Bell Telephone and Telegraph Company), Florida Public Service Commission, Docket No. 72609-PV, 1973.

Testimony of Forrest R. McPherson relating to Interest During Construction (for the Winter Park Telephone Company), Florida Public Service Commission, Docket No. 72609-PV, 1973.

Testimony of Southern Bell Telephone and Telegraph Company relating to Interest During Construction, Florida Public Service Commission, Docket No. 72609-PV, 1973.

Testimony of James K. Taggart relating to Interest During Construction (for Tampa Electric Company), Florida Public Service Commission, Docket No. 72609-PV, 1973.

Testimony of Richard Walker relating to Interest During Construction (for Arthur Andersen and Co.), Florida Public Service Commission, Docket No. 72609-PV, 1973.

BIOGRAPHICAL SKETCH

Gordon Douglas Quick was born in Rochester, New York, on February 29, 1948. He was educated in the public schools of Miami, Florida, where he graduated from Miami Central High School in 1965. On June 13, 1969, he married Jeanelle Lee.

In 1969, Mr. Quick graduated with honors from the University of Florida, receiving a Bachelor of Science degree in Business Administration with a major in Management. In 1970, he received a Master of Business Administration degree from the Management Department of the University of Florida. Mr. Quick continued his doctoral studies in that department. In 1971, he was awarded a Fellowship from the University of Florida for graduate study in Management. In 1973, he was awarded a Fellowship from the Public Utility Research Center in Gainesville, Florida, in connection with his doctoral dissertation.

In 1970, he was elected to the Honor Society of Phi Kappa Phi.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Eugene F. Brigham
Graduate Research Professor of Finance

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

H. Russell Fogler
Associate Professor of Management

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Sanford V. Berg
Assistant Professor of Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Richard R. Jesse, Jr.
Assistant Professor of Management

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Milford S. Tysseland
Associate Professor of Finance

This dissertation was submitted to the Graduate Faculty of the Department of Finance, Insurance, Real Estate and Urban Land Studies in the College of Business Administration and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Dean, Graduate School