

CAPITAL BUDGETING

PLANNING AND CONTROL
OF CAPITAL EXPENDITURES

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PREFACE

The field of capital budgeting is both comprehensive and challenging. It clearly plays a vital role in assisting most business firms to achieve their various goals (e.g., profitability, growth, stability, risk reduction, social goals, etc.). Recognizing the importance of capital budgeting and the diversity in backgrounds and interests among the readers, we developed various objectives with respect to content, organization, and teaching effectiveness.

The text includes all the traditional topics associated with capital budgeting. Based on this foundation we extend our discussion to include theoretical topics such as portfolio theory and the capital asset pricing model, and finally to the frontiers of long-range asset selection and management.

The text is organized to serve the needs of senior-level undergraduate students, graduate students doing advanced work toward their master's or doctoral degrees, and as a reference for business practitioners at all levels of the organization. Throughout the book, only a working knowledge of algebra and basic statistics is assumed. Many sections of the book (particularly in Chapters 8 and 12) begin with a review of statistical and programming tools that will later be applied to capital budgeting decision areas. In addition, one of the key features of the text is that each chapter includes a number of detailed examples that illustrate the application of theory and analytical methods to specific problem settings. Discussion questions and problems are found at the end of each chapter, with selected answers offered in Appendix E. To facilitate preparation of research papers and study for comprehensive examinations, we have included Appendix A, an extensive bibliography (classified by topic) which includes the most current journal articles as well as the classics.

The text is divided into four sections. Part I, consisting of Chapters 1 through 7, covers the fundamentals of capital budgeting. The impact of the depreciation method selected and taxation on project cash flows is treated extensively. Next, the mathematics of the discounting process is presented, followed by two chapters on traditional evaluative models for capital investment proposals. This entire section relies heavily on conventional wisdom, which has the advantage of wide usage by business firms. We allude frequently to business practice and alert the reader to the traps inherent in the application of such well-known techniques as payback, average rate of return, net present value, and internal rate of return. The section concludes with a chapter dealing with the resolution of conflicts that can arise in project ranking. In general, we

provide evidence of the superiority of the net present value approach in selecting the set of projects that maximizes shareholders' wealth.

Part II, Chapters 8 through 11, treats the various types of risk encountered in long-term asset management when investors are free to place funds according to their risk–return preferences. This segment draws heavily upon the work of Dr. Harry M. Markowitz and Dr. William F. Sharpe, elaborated by a plethora of empirical articles. The theoretical discussion illustrates how the capital asset pricing model may be employed to calculate the cost of equity capital, evaluate capital projects, measure the impact of project selection on the firm's debt capacity, and value the firm.

Part III, Chapters 12 through 14, is devoted to mathematical programming and simulation, which offer a powerful set of tools to capture and manipulate the many decision variables and restrictions in the capital budgeting area. These techniques are applied to the capital budgeting problem under conditions of certainty and uncertainty in a multiperiod framework. These chapters provide the reader with an in-depth treatment of the work of Dr. H. Martin Weingartner in mathematical programming applied to the capital budgeting problem setting, and Dr. David B. Hertz in the application of Monte Carlo simulation to the capital expenditure decision. The importance of incorporating multiple goals and objectives in such problem settings is discussed and treated in several models. Much of the discussion centers on newly developed techniques and applications.

Part IV, Chapters 15 through 17, applies capital budgeting analysis to the multinational firm, leasing, and mergers and acquisitions. This section of the text also includes a discussion of reorganization of the firm's financial structure as a capital budgeting decision, thus tying together the questions of firm valuation, capital expenditure, and financing. Chapter 18 concludes the work with a discussion of forecasting, capital abandonment, and the necessity to make capital budgeting systems cost effective.

The text is designed to be adaptable to course objectives at various instructional levels. The flexible organization permits instructors to select topic areas and assign text problems and/or research consistent with audience background and interest.

The final text benefited significantly from the recommendations and discussions that were forthcoming from reviewers and our students at Drexel University, where the text was extensively class-tested at both the undergraduate and graduate levels. We would like to express special appreciation to the following reviewers:

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Comments from readers are welcomed and encouraged.

JOHN J. CLARK
THOMAS J. HINDELANG
ROBERT E. PRITCHARD

For Margaret, Chris, Jody

CONTENTS

<i>Preface</i>	vii
I THE ESSENTIALS OF CAPITAL BUDGETING	1
1 Introduction to Capital Budgeting	3
2 Taxation and Depreciation	7
3 Cash Flows	21
4 Mathematics of Discounted Cash Flow	34
5 Evaluation of Alternative Investment Opportunities	46
6 Discounted-Cash-Flow Evaluation Methods	56
7 Conflicts in Project Ranking and Their Resolution	69
<i>Appendix 7A: Multiple Internal Rates of Return</i>	104
II INTRODUCTION TO RISK ANALYSIS IN CAPITAL BUDGETING	115
8 Introduction to Risk Analysis	117
9 Portfolio Effects	149
10 Capital Asset Pricing	166
11 Cost of Capital	187

III	MATHEMATICAL PROGRAMMING AND MULTIPERIOD ANALYSIS	213
12	Introduction to Mathematical Programming	215
13	Multiperiod Analysis Under Conditions of Certainty	234
14	Multiperiod Analysis Under Conditions of Uncertainty	284
IV	SPECIAL APPLICATIONS OF CAPITAL BUDGETING	315
15	Capital Budgeting for the Multinational Firm	317
	<i>Appendix 15A: Simulation-Based Multinational Capital Budgeting Approach</i>	326
16	Leasing	341
17	Corporate Reorganization: Acquisitions and Readjustment of Financial Structures	357
18	Project Review and Control: Forecasting and Abandonment	381
APPENDIXES		
A:	Detailed Bibliography	401
B:	Comparative Depreciation Tables	422
C:	Compound Interest and Annuity Tables	431
D:	Table of the Normal Distribution	453
E:	Answers to Selected Problems	454
AUTHOR INDEX		459
SUBJECT INDEX		461



THE ESSENTIALS OF CAPITAL BUDGETING

1 INTRODUCTION TO CAPITAL BUDGETING

Capital budgeting is the decision area in financial management which establishes goals and criteria for investing resources in long-term projects (two or more fiscal periods). Capital investment projects commonly include land, buildings, facilities, equipment, vehicles, and the like. These assets are extremely important to the firm because, in general, *nearly all of the firm's profit is derived from the use of its capital investments; these assets represent very large commitments of resources; and the funds will usually remain invested over a long period of time.* The future development of the firm hinges on the selection of capital investment projects, the decision to replace existing capital assets, and the decision to abandon previously accepted undertakings which turn out to be less attractive to the firm than was originally thought.

Generally, the subject matter of capital budgeting is concerned with projects that cover two or more periods, although obviously very short term projects do not pose the same degree of complexity found in projects of 10 to 20 years' duration.

The term *project* also requires some explanation. Too frequently, capital budgeting is believed to be synonymous with investment in new plant and equipment. The expansion or contraction of physical assets naturally is a major topic for the application of capital budgeting techniques. But these techniques apply equally to the valuation of advertising commitments, to the management of the company's financial structure (refunding of a bond issue, for example), to the decision of whether to own or lease an asset, to the valuation of *other* firms for purposes of combination, and to the management of research and development funds. Conversely, the decision to continue in business or to terminate a project is also a capital budgeting decision.

We should also note that capital budgeting offers a method of analysis and decision criteria that can be employed in government as well as in private enterprise and in the evaluation of both civilian and governmental projects. In the latter instance, the technique is generally referred to as *cost-effectiveness analysis* or, when placed in a broader context, as *systems analysis*. This has been applied mostly by the Department of Defense, but has since spread to other agencies of the federal government and is now filtering down to the state and local level.

The benefits of a capital project are received over some future period, and the *time element* lies at the core of capital budgeting. The firm must time the start of a project to take advantage of short-term business conditions (construction costs, for example, vary with the stage of the business cycle) and financing of the project to capitalize on trends in the money markets (such as the pattern of short- and long-term interest rates). In addition, the longevity of capital assets and the large outlays required for their acquisition suggest that the estimates of income and cost associated with the project be *discounted* for the time they are received or paid out. Moreover, investment decisions are always based upon incomplete information using *forecasts* of future revenues and costs. We know from experience that such forecasts will always err on one side or the other, and the *degree of error* may correlate (but not always) with the duration of the project. Short-term forecasts (1 year or less) generally display greater accuracy than long-term estimates (5 years or more). The future dimly seen entails *risk*, and any appraisal of a capital project, therefore, must necessarily comprehend some assessment of the *risk* accompanying the project. Finally, investment decisions must be matched against future outcomes to ascertain the accuracy of the forecasts and the viability of evaluative criteria. This is an aspect of capital budgeting too little examined in professional journals. A substantial body of literature exists on “how to forecast,” but one sees few follow-up articles on the successes or inadequacies of the method recommended. *In summary, the components of capital budgeting analysis involve a forecast of the benefits and costs of the project, discounting the funds invested in the project at an appropriate rate, assessing the risk associated with the project, and following up to determine if the project is performing as expected.*

The applications of capital budgeting techniques are many and varied. In theory, a very large number of problems lend themselves to analysis by the methods described in the following pages. However, analysis absorbs time and money, especially the more sophisticated techniques of ranking and risk management. The cost of these approaches must be justified by the perceived benefits. Theory adapts to circumstances. Conceptually appealing but costly techniques of analysis do not merit across-the-board application. Accordingly, in establishing a capital budgeting program within the firm, the first rule involves establishing a cutoff by size of expenditure; that is, projects requiring an investment over a specified amount will be subject to searching scrutiny; below this amount, less costly criteria of acceptance will be applied.

The capital budget, thus, concentrates on the benefits and costs of projects, and the decisions made determine the composition of total assets and the business-risk complexion of the enterprise. The capital budget *shapes operating plans for several years into the future*—is future-oriented—in contrast to short-term budgets, which guide the current operations of the firm.

Nonetheless, it is not the project that is central to our planning but the firm—its continued existence and development. Hence, although the analysis may yield “reliable” estimates on the project’s expected rate of return and risk, the question arises as to what impact these have on the firm’s return on assets and risk posture. If the project enhances the rate of return on the firm’s assets but makes the operation more risky or increases the possibility of insolvency, do we want the project? The answer may still be affirmative, but the question must be

faced, nevertheless. Investors do not simply add new shares to their portfolios without regard to their current holdings; in like manner, financial managers do not (or at least, should not) simply add projects without regard to the firm's overall financial performances. *A high rate of return on a project is not enough to justify its acceptance. The key question is: Does the acceptance of the project increase the market value of the common shares?*

The analysis for long-term asset management is made on a cash-flow basis, as opposed to the determination of project accounting income. By the end of the project's life, of course, the cash and accounting basis will reconcile, but in any given fiscal period the net return calculated on a cash or accounting basis may diverge quite significantly. A project that appears favorable in the long run may show negative results in the early periods. This can create important political problems for management if the latter believes that accounting reports influence stock prices and investor decisions. As we shall see, the evidence on this point is not conclusive. In any event, the analyst must bear in mind the effects of the project on each period's accounting results.

Finally, every capital project has to be financed, and there are no free sources of capital. Most firms strive to maintain a capital structure (a combination of debt capital and equity capital) that will minimize their financing costs. Accordingly, we need to know not only whether the adoption of this or that project increases the market value of the common shares but also the related question of whether the acceptance of the project increases the debt-carrying capacity of the firm.

These and other questions constitute the subject matter of our text and we shall approach them from a dual aspect: using techniques generally accepted as conventional wisdom and employed in various guises by business managers; and also from the perspective of the Capital Asset Pricing Model (CAPM), which, for the first time, offers a comprehensive, integrated theory of the financial manager's decision-making process and the behavior of the investor, as well as many insights into the firm and security market behavior.

Also contributing to the uniqueness of the text is a set of chapters on such topics as mathematical programming techniques applied to the selection of preferred solutions to the questions raised above; the special problems of capital budgeting in multinational corporations; and the place of capital budgeting techniques in the decision to expand by means of combination with other firms. These represent a set of topics not normally found in a capital budgeting text, but given the setting of modern business, failure to deal with them would constitute a serious lapse of coverage on the subject matter.

DISCUSSION QUESTIONS

1. What are the basic components of capital budgeting analysis?
2. Explain what is meant by nondiscretionary capital budgeting projects and assess their significance.
3. What is the importance of a business establishing well-defined acceptance criteria for capital investment projects?

6 *Part I: The Essentials of Capital Budgeting*

4. How can you, as financial manager, explain the possibility of inaccuracies in a forecasted cash flow for a given project?
5. The novice to capital budgeting may interpret the term “project” to mean only a new investment in plant and equipment. Evaluate this assumption as it relates to the overall theory of the firm.
6. What are the basic assumptions underlying capital budgeting theory?
7. If a project that enhances the rate of return on a firm’s assets is rejected because it increases the possibility of insolvency, other goals of the firm have been brought into the decision process. What are some of the goals of a firm that should be considered in evaluating a capital investment project?

2 TAXATION AND DEPRECIATION

Proposed capital expenditures are evaluated by comparing the expected after-tax costs with the estimated after-tax revenues they are expected to generate. In order to compare costs with revenues, it is necessary to establish a systematic managerial process for collecting, summarizing, and analyzing pertinent financial and nonfinancial data. Commencing with this chapter, the authors will undertake a rigorous study of the data required in the decision-making process and indicate how the information may be used in the capital investment process.

Given the various types of requests for capital expenditures that management can anticipate, it is necessary to understand the depreciation and taxation procedures applicable in each instance, since depreciation and taxation impact profits and both cash inflows and outflows. Profits and (especially) cash flows are of particular importance to the process of evaluating capital expenditures.

In this chapter we shall discuss the methods used to determine depreciation and the effects of depreciation and taxation on profitability and cash flows. The reader must be aware of the constantly changing tax structure: altered by revision to statute, IRS rulings, and tax court decisions. The material presented herein forms only a base for analysis; the reader is cautioned to incorporate changes as they are forthcoming.

DEPRECIATION

When an asset is purchased, it is necessary to match the expense with revenues during the period in which it is used. *Depreciation* is a systematic recognition of such expenses in a historical framework in order to match the expense with revenues while the asset is being used. Depreciation recognizes the eventual wasting of the asset through wear, obsolescence, or the like, and provides for the recognition of the expense before or no later than its retirement.

The federal tax laws permit inclusion of depreciation as a tax-deductible expense. To be eligible for depreciation, an asset must have a useful life of 1 or more years and be used in a trade or business or held for production of income. Since depreciation does not require a cash outlay, it is categorized as an *implicit* expense; other expenses requiring payment are explicit costs.

To determine the depreciation for an asset, it is necessary to know three things:

1. *The depreciable value of the asset:*

$$\text{depreciable value} = \text{total capitalized cost} - \text{salvage value} \quad (1)$$

where the salvage value consists of the estimated resale value reduced by any costs of its removal or sale.

2. *The useful life of the asset.* The useful life is the period over which that asset may reasonably be expected to function in a business. The useful life may be estimated based on experience or by adopting one of the useful life standards formulated by the Internal Revenue Service. One method provided by the IRS is the “Class Life Asset Depreciation Range System.” To employ this system, the useful life is selected from a range of years designated for that particular asset. Tables providing life ranges for numerous assets are contained in IRS Publication 534, “Tax Information on Depreciation.”

3. *The method of depreciation to be used.* The method of depreciation selected depends on management objectives with respect to use of accelerated depreciation, and the method of depreciation allowable by law for the particular asset. The law allows any reasonable method for depreciation and explicitly recognizes the following methods as applicable to the types of property indicated:

Straight-line: All new and used property.

Twice declining balance (double-declining): New residential real estate and property other than real estate acquired new and having a life of 3 years or more.

One and one-half declining balance: New real estate other than residential and property other than real estate acquired used and having a life of 3 or more years.

One and one-quarter declining balance: Used residential real estate with a life of 20 years or more.

Sum-of-the-years' digits: Same as twice declining balance.

Methods of Depreciation

1. *Straight-line depreciation* is computed by dividing the depreciable value by the number of years in the asset's life. This is expressed in equation form as follows¹:

$$D = \frac{C - S}{n} \quad (2)$$

¹For tax purposes, when S (salvage value) is less than 10% of the asset's cost, it may be ignored for computing depreciation.