THE CAPITAL BUDGETING DECISION

Economic Analysis of Investment Projects

SIXTH EDITION

Harold Bierman, Jr.
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Preface to the Sixth Edition

This edition follows the direction set by the previous revisions. When the first edition was published in 1960, we were convinced that the net present-value method was superior to other methods of making investment decisions. We still believe this. In the important area of uncertainty, however, our attitudes have undergone some changes that were first incorporated in the second edition. The greatest change from the first edition will be found in the choice of the rate of discount and general method of incorporating uncertainty in the investment decision process.

We continue to advocate the net present-value method, using a default-free discount rate to compute the present value. A dollar risk adjustment is added or subtracted from the present value of the expected cash flows. Thus investments with internal rates of return less than the firm's weighted average cost of capital may be considered to be acceptable. The procedure is more desirable than evaluating investments on the basis of the cost of capital implicitly combining a risk discount and a measure of time-value preference. For some investments the firm's borrowing rate may be a good minimum hurdle rate, if the cash flows of these investments are not uncertain.

We also continue to advocate the use of a default-free rate of interest as the basic tool to take the time value of money into consideration. The cost of capital cannot be used as a universally correct tool for evaluating investments. The cost of capital is a useful concept in handling the capital mix question, but it is not useful in evaluating all investment alternatives.

This edition differs from the fifth edition in the arrangement of material. We have moved all basic material into parts one and two and the more complex material into part four. Other changes include the addition of a substantial number of new problems and the addition of the cases found in Part Five. Some of the cases are complex and could easily be used more than once. Suggestions for using the cases are contained in the solutions manual which is available from the publisher to instructors who adopt the text. Many problems have been relocated so that there is a closer relationship between the contents of a chapter and

the problems that follow it. The solutions manual contains problem locator tables that enable one to determine the present location of every problem that appeared in the Fifth Edition, and the source of every problem appearing in the present edition.

We have attempted to present intuitive solutions in the early chapters. An understanding of this basic material will avoid certain types of errors in evaluating investments. Even though it will not give exact answers to the types of complex problems that require more sophisticated mathematics, it will help improve decision making.

Preface to the First Edition

Businessmen and economists have been concerned with the problem of how financial resources available to a firm should be allocated to the many possible investment projects. Should a new plant be built? Equipment replaced? Bonds refunded? A new product introduced? These are all to some extent capital budgeting decisions to which there are theoretically sound solutions. The purpose of this book is to express the solution of the economist in the language of the business manager.

Decades ago, economists such as Böhm-Bawerk, Wicksell, and Irving Fisher laid the theoretical foundation for a sound economic approach to capital budgeting. In recent years the technical literature has contained articles (such as those by Dean, Solomon, Lorie, Savage, and Hirshleifer) that have significantly increased our understanding of what is required for sound capital budgeting decisions. However, these works have not been directed toward business managers and, until recently, the work of these men has had no perceptible influence on the way businessmen actually made capital investment decisions. Businessmen have tended to make capital budgeting decisions using their intuition, rules of thumb, or investment criteria with faulty theoretical foundations and thus have been likely to give incorrect answers in a large percentage of the decisions.

The purpose of this book is to present for an audience that may be completely unfamiliar with the technical literature on economic theory or capital budgeting a clear conception of how to evaluate investment proposals.

The authors are convinced that the "present-value" method is superior to other methods of evaluating the economic worth of investments that have been discussed in the business literature. They recognize that considerations other than that of economic worth are also important in making investment decisions. The early pages of the book show that "cash payback" and "return on investment" may give incorrect results. The "yield" or "investor's method" is shown to be inferior to the present-value method, especially where there are several alternative investments available. The explanation of the reasons for the inferiority of yield to present value is particularly timely, since popular business magazines have

carried many articles praising the yield method without mentioning its important drawbacks.

The first four chapters present an over-all picture of the method of analysis advocated in this book that would be a suitable introduction for management at any level who need to be informed about the ideas involved in evaluating capital investments, but who are not directly involved in preparing investment evaluations. The remainder of the book elaborates on the basic description of the first four chapters and gives material that will assist a person in actually preparing the analysis of investments.

Book one is divided into two parts, enabling us to establish those conditions in which the suggested decision rules are relatively effective and those in which their effectiveness is limited. In Part I we treat decisions under certainty in a perfect capital market. Although these assumptions are not descriptive of the world, they do enable us to suggest solutions for some types of problems and to introduce the basic concepts of time discounting. In Part II we introduce imperfect capital markets and uncertainty, under which conditions the suggested solutions of Part I must be adjusted. We find under uncertainty that it is necessary to consider many attributes of the investment rather than only one. The more nearly unique the investment, the less reliable are the conventional guides for action that use the cost of capital as a hurdle rate.

We wish to thank the many persons in government, academic, and business areas, as well as our colleagues Jerry Hass, Vithala Rao, and John McClain, who have raised questions and made suggestions that have advanced our thinking.

Ithaca, New York

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SEYMOUR SMIDT

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PART ONE

Sirs:
The Indian who sold Manhattan for $24.00 was a sharp salesman. If he had put his $24 away at 6% compounded semiannually, it would now be $9.5 billion and could buy most of the now-improved land back.

—S. Branch Walker, Stamford, Conn., Life, Aug. 31, 1959.

In the first seven chapters of this book we present a theoretically correct and easily applied approach to decisions involving benefits and outlays through time, that is, capital budgeting decisions. Essentially, the procedure consists of a choice of a rate of discount representing the time value of money, and the application of this rate of discount to future cash flows to compute their net present values. The sum of all the present values associated with an investment (including immediate outlays) is the net present value of the investment.

In the first seven chapters it is assumed that the cash flows associated with an investment are known with certainty, that there are markets to borrow or lend funds at the rate of interest used in the time discounting, and that there are no constraints preventing the firm from using these markets. The objective of the discounting process is to take the time value of money into consideration, but it includes no adjustment for risk.

We advocate the use of the net present value method to evaluate investments, both because of its simplicity and its theoretical soundness.

CHAPTER 1

Capital Budgeting

The New York Times on January 17, 1964, reported the following exchange between Alfred P. Sloan, former Chairman of General Motors, and a reporter:

One questioner asked Mr. Sloan if he had made any mistakes in 40 years as a top executive of General Motors and added: "Think of one." "I don't want to keep you up all night." Mr. Sloan snapped. "The executive who makes an average of 50–50 is doing pretty good."

The controller points to the ancient, gray, six-story structure and says with pride, "This is one reason we can keep our costs down. Our plant is fully depreciated, so we don't have the large depreciation charges our competitors have."

Another company in the same industry sells a relatively new plant because it is not large enough for a three-shift operation. Rather than operate what is considered to be an inefficient production line (the production line had been completely overhauled within the last twelve months), a new plant is being constructed in another state.

The investment philosophies of the two companies making these decisions were vastly different. One was reluctant to invest money in plant and equipment. The other wanted to operate only the latest in plant and equipment. Which of the two companies was right? Maybe each company was following a policy that was correct for it, or perhaps they were both making faulty decisions. We cannot decide here because the necessary facts are not available to us. But the facts should be available to the responsible executives in both these companies, and these facts should be arranged in a useful manner and then interpreted correctly.

Consider the statement of a steel company executive that Japanese steelmakers were lucky in having their obsolete plants destroyed in World War II. It enabled them to start fresh with efficient plants and equipment. Were the Japanese really "lucky" to have had their productive capacity destroyed? We think not. Good decision making is more effective (and humane) than bombs.

Investment decisions may be tactical or strategic. A tactical investment decision generally involves a relatively small amount of funds and does not constitute a major departure from what the firm has been doing in the past. The consideration of a new machine tool by Ford Motor Company is a tactical decision, as is a buy or lease decision made by Mobil Oil Company.

Strategic investment decisions involve large sums of money and may also result in a major departure from what the company has been doing in the past. Acceptance of a strategic investment will involve a significant change in the company's expected profits and in the risks to which these profits will be subject. These changes are likely to lead stockholders and creditors to revise their evaluation of the company. If a private corporation undertook the development of a supersonic commercial transport (costing over $4 billion), this would be a strategic decision. If the company failed in its attempt to develop the commercial plane, the very existence of the company would be jeopardized. Frequently strategic decisions are based on intuition rather than on detailed quantitative analysis.

The future success of a business depends on the investment decisions made today. That business managers are generally aware of this is indicated by the requirement that important investment decisions must be approved by the chief operating executive or the board of directors. In spite of this fact, the procedures used to help management make investment decisions are often inadequate and misleading. Few manufacturing concerns would sign a long-term contract for supplies of an important raw material without carefully investigating the various sources of supply and considering the relative advantages of each in terms of price, service, and quality. Yet occasionally management groups approve investments without a careful consideration of available alternatives. Even when there is an investigation of alternatives, the information obtained sometimes does not lead to effective decisions, because managements may not organize the information in a way that will help them make better decisions.

Business organizations are continually faced with the problem of deciding whether the commitments of resources — time or money — are worthwhile in terms of the expected benefits. If the benefits are likely to accrue reasonably soon after the expenditure is made, and if both the expenditure and the benefits can be measured in dollars, the solution to such a problem is relatively simple. If the expected benefits are likely to accrue over several years, the solution is more complex.

We shall use the term *investment* to refer to commitments of resources made in the hope of realizing benefits that are expected to occur over a reasonably long period of time in the future. Capital budgeting is a many-sided activity that includes searching for new and more profitable investment proposals, investigating engineering and marketing considerations to predict the consequences of accepting the investment, and making economic analyses to determine the profit potential of each investment proposal. The primary purpose of this book is to help business management analyze the profit potential of investments in plant and equipment, marketing programs, research projects, and the like.

The Role of Strategy in Investment Decision-Making

The investment strategy of a firm is a statement of the formal criteria it applies in searching for and evaluating investment opportunities. Strategic planning guides the search for projects by identifying promising product lines or geographic areas