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THE CAPITAL INVESTMENT DECISION:
THEORY VERSUS PRACTICE

By

Richard W. Bender

B.S., University of Illinois, 1969

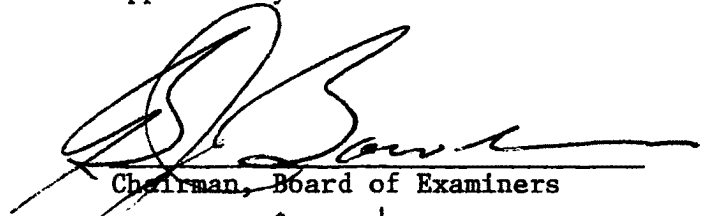
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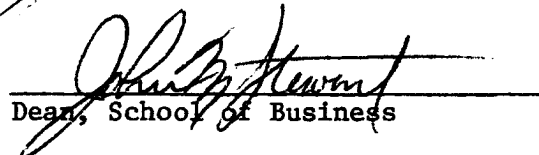
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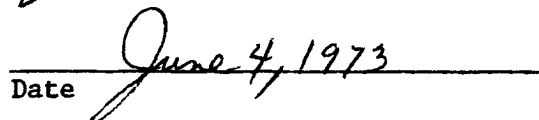
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CHAPTER I

INTRODUCTION

The typical businessman faces many problems during the normal operation of the firm. These problems run from personnel to financial management. Making capital expenditure decisions is the main problem in the finance area. The method or methods used by small firms to reach a decision to accept or reject a capital expenditure is the topic of the paper.

Small sized business firms have been overlooked when studies of various business practices have been conducted. This reasoning has been justified on the grounds that large companies are the ones which contribute the most to the economy. This reasoning is acceptable to most people. To the small businessman however, this is of no help. Would the findings of studies done on large companies have any direct implications on his operations? Surely the small businessman would like to be able to apply the methods large corporations do, but he is uncertain whether the methods are applicable to him or not. A study of small businesses seems more appropriate in this case. Another business in a similar situation could then readily interpret the results as they apply to them. This is one of the reasons behind this study.

A capital expenditure decision is not one to be made lightly by any company. No matter the size of a company, a capital expenditure

has a number of important effects on it. In the case of a large corporation, the results of a bad capital expenditure decision may have from a little to a devastating impact on the company. The same holds true for the small firm. The final outcome from a bad decision depends upon how much the company has invested in the expenditure.

Every capital investment decision has long-run implications to a firm. A capital expenditure, investment, by a traditional accounting definition, is one from which the benefits are expected to extend for a period of more than one year. For the most part, these expenditures are for large amounts. The results from any capital investment decision, correctly or incorrectly made, has several effects on a firm. The firm's growth, earnings, and survival are some of the most evident.

Since capital expenditure decisions have such a major effect on a firm, the methods used to decide whether or not to invest in a particular project are of extreme importance. It is of utmost importance to a business to be using a "correct" technique to evaluate investments. This study was concerned with determining the capital budgeting techniques used by Montana firms.

The paper is divided into three main chapters. The various capital budgeting techniques a firm has available to it are analysed in Chapter II. The discounted cash flow and payback techniques are explained. Examples of each are presented along with the weak and strong points of each method.

The third chapter of the paper is a synopsis of various selected studies which have been done in the United States. The results obtained in these studies have been compared with the results obtained from this study.

The analysis of Montana firms is presented in the fourth chapter. The method used and the results of the study are summarized. A comparison of the results obtained in Montana with those obtained elsewhere are contained in the chapter.

CHAPTER II

CAPITAL BUDGETING TECHNIQUES

Basically capital budgeting techniques fall into two categories. The first category consists of those methods which are time-adjusted or discounted cash flow. These time-adjusted methods hereafter will be referred to as "theoretically" correct. The second category consists of those methods which are not time-adjusted, or payback methods.

An understanding of the basic technique behind various methods in each category is necessary to show the problems which arise in the use of a particular method. Once the problems become apparent the reasoning behind the selection of a specific method by a firm can be much clearer. Along with the criticisms or shortcomings of a particular method possible advantages also need to be considered.

Discounted Cash Flow (Time-Adjusted) Methods

A number of "theoretically" correct methods have been developed to determine whether a firm should invest in a project or not. The three most popular of these methods are the net present value, the internal rate of return or discounted rate of return method, and the profitability index.

In these methods an attempt is made to correct the criticisms of the payback method. The main criticisms of payback are these:

1. It fails to recognize the time value of money. A dollar received a year from now is not worth its full value today.
2. It fails to consider earnings received after payment for the project is completed.
3. It tends to emphasize liquidity rather than profitability as the goal of an investment project.

The discounted cash flow methods attempt to take all these considerations into account.

In the following explanations of each method, the firm making the investment decision is considered not to be experiencing any of the following: (1) rising cost of capital, (2) capital rationing, (3) widely different investment opportunities in the future. These considerations will be analyzed after the methods have been explained.

The investments considered in the explanation of the methods are assumed to have an average amount of risk. The problem of adjusting for risk and choosing between mutually exclusive investment will also be covered below.

Net Present Value

In the net present value method expected net cash flows received from an investment are discounted at the cost of capital in order to find their present value. The total cost of the project is subtracted from the sum of the discounted expected cash flow to give the net present value. It is given by the following formula:

$$NPV = \frac{R_1}{(1 + k_1)} + \frac{R_2}{(1 + k_2)^2} + \dots + \frac{R_n}{(1 + k_n)^n} - C$$

where R_t , $t = 1, 2, \dots, n$ is the expected net cash flow in year t , k_t , $t = 1, 2, \dots, n$ is the cost of capital in year t , and C being the total

cost of the project. When the cost of capital is a constant the formula can be reduced to the following:

$$NPV = \sum \frac{R_t}{(1 + k)^t} - C$$

An investment should be accepted if the net present value is greater than zero, and rejected if less than zero. This means that if the investment is expected to result in time-adjusted cash inflows greater than the cash outflow (the project returns more than it costs,) then it should be accepted.

The following is a problem illustrating how to determine the cash flows for an investment. The methods of discounting flows to find the net present value of the investment is shown.

The XYZ Company has just become aware of a new investment opportunity from one of its managers. The proposed new investment involves purchasing a new piece of equipment for \$20,000. The equipment is expected to last only five years. The company already owns a piece of equipment which it bought five years ago at \$10,000 which does a similar job. The old equipment can be sold for \$2,000 but it is also expected that it would be serviceable for another five years.

The management calculated that sales would increase by \$4,000 per year and costs would decrease by \$2,000 per year if the new equipment were purchased. They also assumed that they would need an additional \$1,000 in working capital if the new equipment were to be purchased because of increased inventory that would need to be held. The company used straight-line depreciation, had a cost of capital of 10 per cent and a tax rate of 50 per cent. Would this be a profitable investment for the company?

The cash outflows which the new investment would involve were analyzed first. The new equipment would cost \$20,000 and the additional working capital required was \$1,000. The sale of the old equipment would result in a decrease in the cost by \$2,000, and a loss on the sale of \$3,000. A tax savings of \$1,500 would result for the firm. The net cash outflow thus would be \$17,500.

The cash inflows were examined next. The estimated variable cost savings of \$2,000 per year and sales increase of \$4,000 per year total to \$6,000 per year, which becomes \$3,000 per year after taxes. Since the firm uses straight-line depreciation on the new equipment, \$2,000 per year after taxes is returned. Since the company would then sell the old equipment it would lose \$500 per year depreciation on it. Lastly, the firm will recover the additional working capital of \$1,000 in 5 years when the new equipment wears out (Table 1).

The method itself is not difficult to apply. Only a few basic concepts must be learned.¹ It is the estimation of changes in savings and sales, the economic life of equipment, salvage values and the discount rate to use (cost of capital) which make the method hard to apply. These problems are the major criticisms of the net present value method.²

¹The method used to discount cash flows can be found in the following sources: Fred J. Weston and Eugene F. Brigham, Managerial Finance (3rd ed.; New York: Holt, Rinehart and Winston, Inc., 1971) pp. 143-60; William W. Haynes, Managerial Economics: Analysis and Cases (Rev. ed.; Austin, Texas: Business Publications, Inc., 1969), pp. 510-11; Ezra Solomon, "The Arithmetic of Capital-Budgeting Decisions," Journal of Business, XXIX (April, 1956).

²Frank Schwab, Jr., "Capital Expenditure Evaluations," The Controller (August, 1958), p. 365.

TABLE 1
DETERMINATION OF NET PRESENT VALUE OF
A PROPOSED INVESTMENT

	Before Tax	After Tax	Year	10% Present Value Factor	Present Value
Outflows:					
New Equipment	\$20,000	\$20,000	0	1.00	\$20,000
Sale of Old Equipment	(2,000)	(2,000)	0	1.00	(2,000)
Tax Loss	(3,000)	(1,500)	0	1.00	(1,500)
Additional Working Capital	1,000	1,000	0	1.00	<u>1,000</u>
					\$17,500
Inflows:					
Cost Savings	\$ 2,000	\$ 1,000	1-5	3.89	\$ 3,890
Sales Increases	4,000	2,000	1-5	3.89	7,790
Depreciation on New Equipment	4,000	2,000	1-5	3.89	7,790
Depreciation on Old Equipment	(1,000)	(500)	1-5	3.89	(1,945)
Return of Working Capital	1,000	1,000	5	.621	<u>621</u>
					\$18,126

Source: Adapted from Fred J. Weston and Eugene F. Brigham, Managerial Finance (3rd ed.; New York: Holt, Rinehart and Winston, Inc., 1971), p. 191.

Internal Rate of Return

The internal rate of return method is similar to the net present value method. The objective is to find the interest rate at which the net cash inflows and outflows should be discounted so that they are equal. In other words, the internal rate of return is the interest rate which equates the present value of inflows to that of the outflows. The formula for calculating it is as follows:

$$C = \sum \frac{R_t}{(1 + r)^t}$$

The procedure for calculating the internal rate of return is similar to that for calculating the net present value. The difference arises in that one must arrive at the answer by trial and error.³ A process of elimination type method must be set up to discover an interest rate which equates the present value of inflows to outflows. The interest rate, of course, is given in the net present value method. The criterion for accepting a project is that the internal rate of return be greater than the cost of capital.

³One difference which can arise in the internal rate of return methods is that multiple solutions can result. For further explanations of the reasons behind this see: Eugene F. Brigham, "Differences Between Discounted Cash Flow Capital Budgeting Techniques," Readings in Managerial Finance, ed. by Eugene F. Brigham, (New York: Holt, Rinehart and Winston, 1971), pp. 55-56.

Profitability Index

The profitability index, benefit/cost ratio, or the excess present value index⁴ is calculated by the following formula:

$$PI = \frac{\frac{R_t}{(1+k)^t}}{\text{Present Value of Costs}}$$

The calculation once again is similar to those for net present value. The only difference is in dividing by the present value of costs instead of subtracting them. The amount returned per dollar invested is indicated by the profitability index. Thus, any investment which has a profitability index greater than 1 should be accepted.

Which Discounted Cash Flow Method to Use

The three discounted cash flow methods discussed above normally result in the same "accept" or "reject" decision. For independent investment the three methods always make the same accept-reject decisions. It is when mutually exclusive investments are considered that they may make different decisions.⁵ The exceptions have received considerable

⁴Some of the works in this area include: Robert N. Anthony, Managerial Accounting (Homewood, Illinois: Richard D. Irwin, Inc., 1960), pp. 554-55; Carl L. Moore and Robert K. Laedicke, Managerial Accounting (Cincinnati: South-Western Publishing Co., 1963), p. 524; James C. Van Horne, Financial Management and Policy (Englewood Cliffs, N. J.: Prentice-Hall, 1968), Chapter 3.

⁵J. J. Lorie and L. J. Savage, "Three Problems in Capital Rationing," Journal of Business, XXVIII (Oct. 1955), 238.

attention.⁶ Other problems arise if a firm is experiencing any of the following: (1) rising cost of capital, (2) capital rationing, or (3) widely different expected investment opportunities.

When a firm is not experiencing any of these three characteristics, the net present value method is the best to use. The reason behind this is due to the assumptions associated with each method. The net present value method assumes cash returns to be reinvested at the cost of capital k , whereas internal rate return assumes a reinvestment rate of r . Projects are ranked in the net present value method by amount of return instead of rate of return. The value of the returns to the firm are maximized. The same argument can be applied to the profitability index. Since the firm is interested in maximizing its returns, not returns per dollar invested, the net present value method is superior to the profitability index.⁷

The method a firm should use when it does experience one of the three mentioned characteristics, cannot be stated flatly. Which investments should be accepted under these conditions can only be told by using a programming technique.⁸ The "best" method to use is recommended in consideration of the following problems.

Now what happens if a firm experiences capital rationing? For some reason the firm can not invest in all the projects known to be

⁶See Ezra Solomon, The Theory of Financial Management (New York: Columbia University Press, 1963), pp. 134-35.

⁷This is used when capital rationing is not imposed.

⁸Present value has already been found for the return per dollar invested.

profitable to it. Which method should be used under this circumstance?

The method which should be selected depends upon how severe the capital rationing is. If only a minor cutback is forecasted, then once again the net present value method will yield satisfactory results. However, when a large number of projects will have to be abandoned because of the rationing, internal rate return or profitability index methods will rank the projects better than the net present value method. The reason for this is due, once again, to the assumptions made in each method.

When capital rationing is imposed, the firm wants to select those projects yielding the highest reinvestment rate possible. Thus, the internal rate of return method yields a better result than net present value due to the assumption behind each. (See Figure 1-1.)

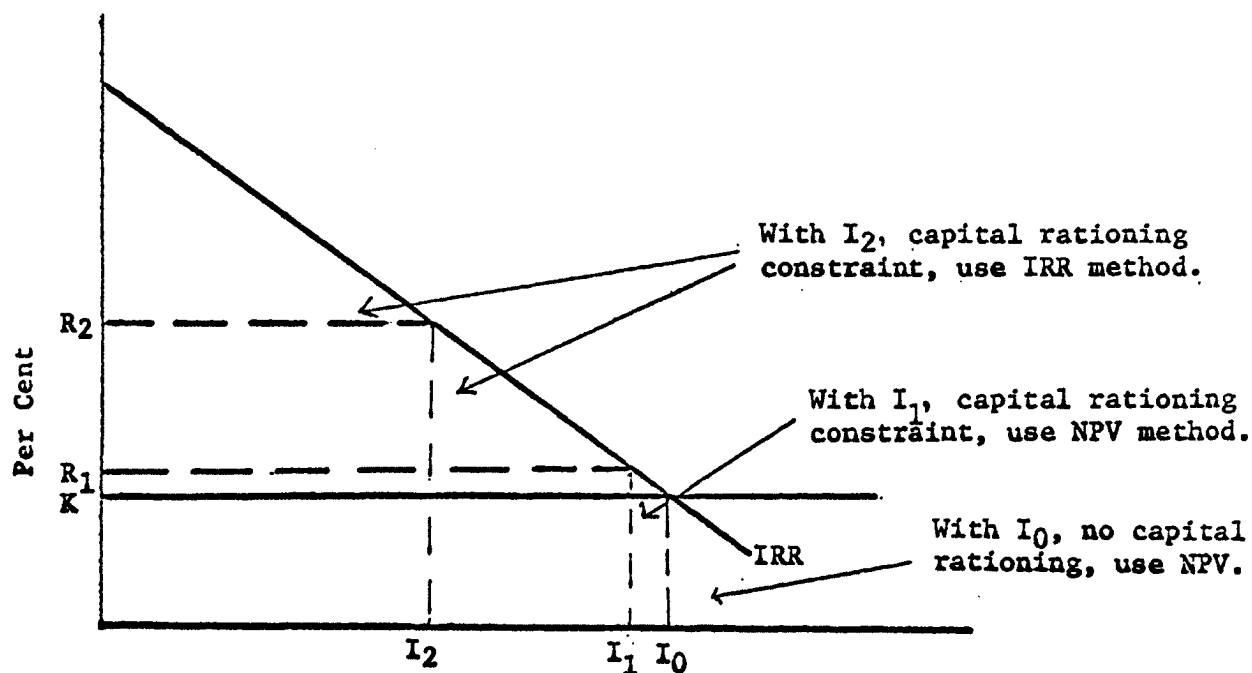


Fig. 1-1--Investment

The profitability index is a good method to use when capital rationing is imposed. Because this method takes into account the return which can be earned per dollar invested, it is superior to using the net present value method. The situation is illustrated by an example. A firm has \$300,000 to make investments with this year. Given the following list of costs, net present values, and profitability indexes associated with each investment, which investment should the firm accept to maximize its returns?

TABLE 2
PROFITABILITY INDEXES ASSOCIATED WITH INVESTMENTS

Project	Cost	NPV	PI
A	\$200,000	\$300,000	1.50
B	100,000	200,000	2.00
C	75,000	150,000	2.00
D	65,000	110,000	1.69
E	55,000	75,000	1.36
F	50,000	175,000	3.50
G	45,000	60,000	1.33
H	10,000	30,000	3.00

If the firm picked the investments with the highest net present value it would not maximize its return. Under these conditions it would select projects A and B which result in a net present value of \$500,000.

The correct method to use in this case would be to rank the projects by their profitability index and select them until the firm had spent its \$300,000. In this case the firm would choose projects H, F, B, C and D. The return from these projects, \$665,000, is much more than the returns which would result from choosing the projects according to net present value.

Another possible problem a firm could face is a rising cost of capital. Generally, the method to use depends upon how rapidly the cost of capital is increasing when the last investment's return equals the increased cost of capital. (See Figure 1-2.) If the cost of capital is rapidly increasing then the internal rate return or profitability index would rank investment better, otherwise use net present value.⁹

When a firm faces vastly different investment opportunities each year the "appropriate" method to use depends, once again, on how rapidly the cost of capital is increasing. (See Figure 1-2.) A further complication can be thrown in if the firm's cost of capital also changes.

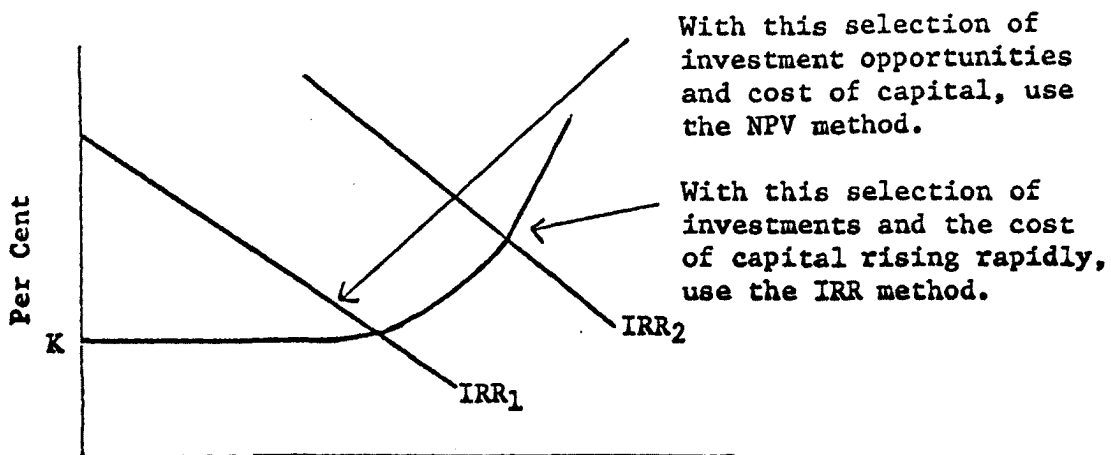


Fig. 1-2--Investment

Mutually Exclusive Investments

In some cases the three methods can make different accept-reject decisions for mutually exclusive investments. This result can occur because either the projects have different cash flows, or involve substantially different costs. The method which should be used makes the accept-reject decision depend upon whether the firm has any of the characteristics, use the method suggested in the above discussion, otherwise use the net present value method.

Non-Discounted Cash Flow Methods

Payback

The payback method is probably the most widely used method to determine if an investment should be accepted. Payback is a member of the second category of capital budgeting techniques, those which are not time-adjusted. The simplicity of the method probably has contributed substantially to its popularity.

The payback method involves calculating the number of years that are required to recover the initial investment required for a project. The net returns used in recovering the investment are before depreciation but after taxes. The following problem gives the correct calculation procedure for determining the payback period.

A new machine costing \$12,000 is expected to result in a \$5,000 per year saving and have a four year life. No additional sales are expected. Assuming a tax rate of 50 per cent, what is the payback period?

Savings	\$5,000
Less Depreciation	<u>3,000</u>
Operating Income	\$2,000
Less Taxes	<u>1,000</u>
Net Income	\$1,000
Plus Depreciation	<u>3,000</u>
Cash Flow	\$4,000

$$\frac{\text{Initial Cost}}{\text{Cash Flow Per Year}} = \frac{\$12,000}{\$4,000} = 3 \text{ years}$$

Whether a firm would accept or reject this project depends on its (subjectively determined) payback period. But how does a firm decide what the maximum payback period is? The discounted cash flow methods have a starting point, the cost of capital, above which investments should be considered for acceptance.¹⁰ No such starting point exists for payback in setting a standard. As Istvan said:¹¹

The lower limit is set by proclamation as three years, or two years, or what have you, based solely on the subjective reasoning of some past or present officer of the firm.

Thus, the establishment of a maximum payback period as a standard is an arbitrary process and becomes very questionable. Green points out another problem which results from this. He states: "Arbitrary payback requirements may also result in poorly timed capital replacement decisions."¹²

¹⁰The investments considered are of average risk, thus the cost of capital would be the appropriate discount rate to use. Evaluating investments with more risk will be covered below.

¹¹Donald F. Istvan, The Capital-Expenditure Decision-Making Process in Forty-Eight Large Corporations (unpublished Ph.D dissertation, Indiana University, 1959), p. 169.

¹²Robert T. Green, An Evaluation of the Capital Budgeting Techniques of Selected Utah Firms (unpublished MBA Thesis, University of Utah, 1964), p. 38.

Green exemplifies his point with this example:¹³

For example, a company requiring an arbitrary payback of two years on all replacement expenditures would refuse to accept the following investment till the present machine has been retained a number of years past its economic life. Suppose a \$10,000 investment would promise to develop a \$3,000 operating advantage for six years, thus developing a true rate of return of 20%. This company would not accept the investment until the savings resulting from replacing the relatively deteriorated old machine equal \$5,000, thus passing up a valuable saving in the meantime.

Payback fails to consider the profitability of a project since it is only concerned with the recovery of the initial investment. It is only after the initial investment has been recovered that a project becomes profitable for a firm. By ignoring the net returns after the payback period, a firm has no way of knowing just how profitable a project actually is. The result of using payback to govern the selection of investment opportunities means sacrificing profitability for liquidity.

Another criticism of payback is that it does not take the time value of money into account. With all the valid criticisms of payback presented, why do the majority of firms still use it?

Part of the answer probably lies in the fact that most small businessmen do not know how to use the "theoretically" correct methods. Another part is probably due to the amount of money a small business can afford to spend on getting the data needed to use these "better" methods. For the most part, a small business can not afford to make a concerted effort to determine such things as cost savings, sales increases, equipment life, and salvage values. The cost to the small

¹³Ibid.

business surely seems to outweigh the benefit it could derive from such an undertaking. The uncertainty of estimates made of sales and cost by the small firm, lead it to use payback. A final reason for the use of payback is its ease of calculation.

Return on Original Investment

A return is calculated in this method by taking the income after taxes and depreciation, then dividing by the total investment. Since depreciation provides a way to recover the original investment, one may feel that this method is correct.¹⁴ However, this is not the case.

There are two reasons why this method fails to provide guidance, first, the method is concerned with income instead of cash flow, and second, because it is not adjusted for time.¹⁵ It can be calculated by using the following formula:

$$\text{Return on Original Investment} = \frac{\text{Average Annual Income}}{\text{Original Investment}}$$

Return on Average Investment

The return on average investments, commonly known as accounting rate of returns or financial statement method, is calculated very similarly to the return on original investment. The only difference is in dividing by the average investment. This method is thus subject to

¹⁴For more in this area see Robert N. Anthony, Managerial Accounting (4th ed.; Homewood, Ill.: Richard D. Irwin, Inc., 1970), p. 632.

¹⁵For reasons why cash flow should be used see Harold Bierman, Jr., and Seymour Smidt, The Capital Budgeting Decision, (3rd ed.; New York: The Macmillan Co., 1971), pp. 108-09.

the same criticisms as the previous method. It can be calculated from the following:

$$\text{Return on Average Reinvestment} = \frac{\text{Average Annual Income}}{\text{Average Investment}}$$

Other Methods

Payback Reciprocal

The payback reciprocal is simply the inverse of the payback period. It is given by:

$$\text{Payback Reciprocal} = \frac{\text{Annual Cash Flow}}{\text{Cost of Investment}}$$

The payback reciprocal is an excellent estimate of the discounted rate of return for a project with constant returns and a long life, otherwise it is a poor measure.¹⁶

MAPI

George Terborgh developed this method for the Machinery and Allied Products Institute. The method compares investing in a project with not investing in it for a year. It is primarily designed for making replacement decisions. The method takes deterioration and obsolescence of a machine into account.

This method is not a "short cut" method to use. It is based on some highly sophisticated reasoning, but is available in a simplified form.¹⁷

¹⁶Martin B. Solomon, Jr., Investment Decisions in Small Business (Lexington, Ky.: University of Kentucky Press, 1963), pp. 34-35 and p. 43.

¹⁷George Terborgh, Business Investment Policy (Washington, D.C.: Machinery and Allied Products Institute and Council for Technological Advancement, 1958).

Adjustment for Risk

The theoretical methods assume that all the facts which need to be known can be found. Moreover, it is required that these facts be known with certainty in order to perform the calculation. Where these facts are estimated under conditions of uncertainty, the theoretical methods imply greater accuracy than is warranted. Few business decisions are made under conditions of certainty. The "theoretically" correct methods attempt to correct for the deficiency resulting from uncertainty, in several ways.

Risk Adjusted Discount Factor

One method involves using a risk adjusted discount factor. The risk adjusted discount factor consists of a risk free interest rate plus some "appropriate" extra interest rate added on commensurate with the risk involved. Thus, a project which had a high degree of uncertainty would require a high discount rate. The problem here is determining the "appropriate" interest rate to add on. Once again, management must make an arbitrary judgment on the rate to use.

Certainty Equivalents

Using certainty equivalents is a second method of adjusting for risk.¹⁸ The only difference between this method and the non-risk adjusted technique is the addition of a term in the calculation of the present value of returns and the use of a risk free interest rate to

¹⁸Adapted from Weston, p. 225.

discount the cash flows. The present value of returns section of the equation may be expressed:

$$PV = \sum \frac{\alpha R_t}{(1 + i)^t}$$

The certainty equivalence factor is α_t . It may be represented by the equation:

$$\alpha_t = \frac{C_t}{R_t} = \frac{\text{Certain Cash Flow}}{\text{Risky Cash Flow}}$$

Risk and the risk free interest rate are separated by this method. The compounding effect of time is thus eliminated from the risk element by so doing. This is appropriate since risk probably does not increase as time passes.

One can apply this method by asking two questions, first, how much money would one want today instead of a "certain" sum received during some future period (that is, the risk free interest rate), and second, for the project one is investigating, how much return in a given year must one make in order to give up a "certain" sum that same year? For instance, by saying one requires \$150 return for giving up a "certain" sum of \$100 for the next year, one has taken the risk associated with the project and quantified it. Thus, the certainty equivalent for next year is two-thirds. One would conduct the same process for every year for which returns are expected for the project. Then one would simply plug the values into the equation to find whether the project would be accepted or not.

Risk Profits

David Hertz offered a third way to adjust for risk.¹⁹ His method involved developing a risk profile for an investment through the use of computer simulation. The method developed has not been presented here although it probably is the best available. Members of the small business community do not have the knowledge or the financial ability to perform a computer-oriented type of analysis.

Judgment

One last method can be used to adjust for risk. This method once again involves using pure judgment. If a risky project seemed to hold a better than average possibility for making a good return, management's judgment may indicate acceptance but that is all. Payback can be used to evaluate a risky project also. The calculations are the same but the payback period is shortened according to the risk involved. Those projects with the highest degree of risk thus would have the shortest payback period.

Summary

Each method discussed has its good points as well as its disadvantages. The main criticism of the non-adjusted techniques is that time must be incorporated into calculating the actual profitability of

¹⁹David B. Hertz, "Risk Analysis in Capital Investment," in Readings in Managerial Finance, ed. by Eugene F. Brigham (New York: Holt, Rinehart and Winston, Inc., 1971), pp. 64-82.

a project. The virtue of non-adjusted techniques lies in their simplicity of calculation. The main criticism and virtue of time-adjusted techniques is just the opposite of this.

A business firm should consider these points when selecting the method it decides to use. Before a firm can consider these points, it must be aware of the various methods available to it. The management of a small firm may not be aware of discounted cash flow methods, however, determining if they are is important.

The various methods of making investment decisions have been presented with their respective advantages and disadvantages. The methods used by various size firms is the next study question. The findings are presented in the next chapter.

CHAPTER III

CAPITAL BUDGETING STUDIES

As stated previously, most of the studies done on making capital expenditure decisions have been conducted with large corporations. Studies done of large firms include those by George A. Christy, Robert T. Green, The National Association of Accountants, Machinery and Allied Products Institute, James C. T. Mao, and Robert Eisner.¹ Martin B. Solomon, Jr. and Robert M. Soldofsky have conducted two of the studies of capital expenditure decisions by smaller firms.² The results obtained and the conclusions made in a number of these studies are worth review.

¹George A. Christy, Capital Budgeting: Current Practice and Their Efficiency (Eugene, Oregon: University of Oregon, 1966); "Return on Capital as a Guide to Managerial Decisions," Research Report No. 35. (New York: National Association of Accountants, Dec., 1959); Equipment Replacement Depreciation--A Survey of Policies and Practices (Washington, D.C.: Machinery & Allied Products Institute, 1956); Green, Current Practices; James, C. T. Mao, "Survey of Capital Budgeting: Theory and Practice," Journal of Finance (May 1970), pp. 349-60; Robert Eisner, "Determinants of Capital Expenditures, An Interview Study," in Studies in Business Expectations and Planning (Illinois University Bureau of Economic and Business Research: University of Illinois, 1956).

²Martin Solomon, Investment Decisions; Robert M. Soldofsky, "Capital Budgeting Practices in Small Manufacturing Companies," in Studies in the Factor Markets for Small Business Firms, ed. Dudley G. Luckett (Ames, Iowa: Iowa State University, 1963), pp. 46-94.

Major Studies

George A. Christy Studies

Christy used the firms listed in Standard and Poor's 500 as his population.³ None of these firms are small in size. A total sample size of 108 firms was selected from Standard and Poor's list.

He found that payback was the most commonly used method for determining capital expenditure decisions. Approximately one-half of the firms used payback either alone or in conjunction with another method. The return on average investment method placed second behind payback. Discounted cash flow methods came in last with 13.9 per cent of the firms using it alone or in combination with another method.

Since discounted cash flow methods are the most "theoretically" correct and accurate methods to use, one would expect that firms employing these techniques would experience the best earnings performance. This, however, was not found. No link between the capital expenditure decision method used and earnings performance could be stated from the study. One of the suggested reasons for this result was that Christy chose firms in "dynamic" industries.⁴ These were the industries which had the most growth potential. A second possible reason for the result could be due to the economic conditions which existed in the country at the time of the study. The questionnaire was sent out in 1964 and earnings trends were based on the period from 1959-1963. The expansion of

³Christy, Capital Budgeting.

⁴Ibid., p. 6.

the economy during the early sixties could have had a direct effect on the profitability of any investment. Thus, no matter what method was used during that period of time, favorable earnings could have resulted from an expansion of the general economy.

Donald F. Istvan Study

Istvan's study of 48 large corporations was made in 1957.⁵ One hundred and forty-seven personal interviews with executives of these firms, chosen from Fortune, were made. The firms he used accounted for approximately 25 per cent of the total capital expenditures which were made in the entire United States in 1957 according to data taken from the Department of Commerce. The firms studied had total assets of about \$76 billion.

Once again, the results of the study indicated that payback was used by more than 70 per cent of the firms, either as a primary or a secondary technique. Only five firms used a discounted cash flow technique to evaluate capital investments. Another nine firms used a discounting technique to evaluate large expansion projects.

It was found that a number of firms calculated the payback period incorrectly. Thirteen of the firms using payback, incorrectly considered the effect of income taxes. The reasoning behind the use of payback was stated as:

. . .refined techniques were not needed in their firms because those presently used are productive of sufficiently adequate results, and that replacement by a more complicated system would

⁵Donald F. Istvan, The Capital-Expenditure Decision-Making Process.

do nothing more than increase the administrative costs of the program without proportionally increasing profits.⁶

Robert M. Soldofsky's Study

Soldofsky conducted a study of small manufacturing firms in Iowa under the auspices of the Small Business Administration.⁷ His study included 123 firms selected from the Census of Iowa Manufacturers. The interview study was conducted during 1961.

Seventy-one firms used payback as the method to evaluate investments. Fifty-one firms had no criterion by which to evaluate an investment. Five firms used the rate of return method, but the rate was not time adjusted. Once again, it was found that the correct payback calculation was made by only ten per cent of the firms making it. The reason payback was used so extensively by these firms was their emphasis on cash.⁸

Martin Solomon's Study

Solomon's study consisted of forty small firms.⁹ The firms were either single proprietorships or family-owned. He found payback to be very popular with the firms he studied. He suggested the reason behind the use of payback being partly due to the uncertainty involved with making investment decisions.

⁶Ibid., p. 181.

⁷Soldofsky, "Capital Budgeting Practices."

⁸Ibid., p. 93.

⁹Solomon, Investment Decisions.

Solomon suggested that the cost of additional information, training, and the time to accomplish these things make the theoretical methods uneconomical for the small business firm. Thus, the use of a short cut method is a necessity for the small firm.

Other Studies

Robert T. Green Study

Green's study was done of large firms.¹⁰ He found payback to be used by a majority of the firms. He suggested that the firms were not acquainted with modern capital expenditure decision processes or distrusted the techniques as a substitute for judgment.

The National Association of Accounts Study

This study was of 44 large companies.¹¹ The study revealed that 42 of the firms used return on average investment or the accounting rate of return. A number of firms also were formed to use some discounted rate of return method.

MAPI Study

This study indicated paybacks. The widespread use of paybacks was indicated by this study and it was also found the MAPI method was the next most often used.¹² The results of this study as well as the previous study, would indicate a possible bias in the selection of the firms.

¹⁰Green, Current Practices.

¹¹"Return on Capital."

¹²Equipment Replacement.

James C. T. Mao's Study

Mao surveyed 8 medium to large sized companies.¹³ He found payback used by the companies as a tool to measure the risk involved with a project.

Robert Eisner's Study

This study was conducted on 14 large manufacturing corporations.¹⁴ It was found that most of the firms used some sort of payback criterion. Further, Eisner found payback to be used more for equipment than plant decisions. He stated:¹⁵

. . . major expenditures such as those involved in large expansion programs were apparently predicted on management judgment much more than on the accountant's calculations.

Walter W. Heller's Study

Most of the firms Heller studied used payback.¹⁶ Some of the firms indicated a resistance to using "fancy formulas" to base their decisions on, reasoning that "judgment" is better. Heller also suggested that as the size and separation of ownership and management increased, the use of better capital budgeting techniques also increased. This would help to explain why small firms do not use advanced methods.

¹³Mao, "Theory and Practice."

¹⁴Eisner, Interview Study.

¹⁵Ibid., p. 30.

¹⁶Walter W. Heller, "The Anatomy of Investment Decisions," Harvard Business Review, pp. 95-103.

Summary

Payback was named by all but one of the studies presented, as the principal technique used by all sizes of firms. Few firms used any sort of discounted cash flow technique in the studies cited. This being the case, the Montana study was based on the assumption that most of the firms use payback, if they use any method at all.

The results obtained from a study done in Montana are analyzed in the next chapter.

CHAPTER IV

THE MONTANA STUDY

The businesses surveyed in Montana were arbitrarily divided into three different groups. The groups consisted of firms with (1) over one million dollars in assets, (2) between one million and one-half million dollars, and (3) under one-half million dollars in assets. The purpose of this grouping was to compare whether firms with larger asset bases use the theoretically correct methods in evaluating investments, while the smaller firms use an easier but perhaps less correct method.

The Method of Study

The study was conducted by sending out questionnaires to randomly selected firms, within the three groups previously mentioned, in Montana. The list of firms was taken from Dun and Bradstreet Middle Market Directory 1972, Dun and Bradstreet Million Dollar Directory 1972, and various city directories.¹

A total of 48 questionnaires was sent to Group I type firms, (assets under one-half million dollars.) Of this total 13 were returned

¹Dun and Bradstreet Middle Market Directory 1972 (New York: Dun and Bradstreet, Inc., 1971), and Dun and Bradstreet Million Dollar Directory 1972 (New York: Dun and Bradstreet, Inc., 1971).

of which 6 were unanswered and one partially completed. Questionnaires were sent to 106 Group II firms, (assets between one and one-half million dollars.) Twenty-two questionnaires were returned from this group of which 8 were unanswered. The Group III firms (assets over one million dollars) were sent 53 questionnaires, 23 replies were received of which 4 were unanswered.

The replies received were a result of sending the selected firms the questionnaires one time. No attempt was made to solicit an answer from a firm which did not reply to the initial questionnaire.

The Results of the Survey

The replies to the questionnaires are summarized below. A sample of the questionnaire which was sent to the firms is contained in Appendix A.

When asked if a set procedure was followed in evaluating capital investments, the respondents answered as follows:

Group	I	II	III
Yes	1	6	10
No	5	8	9

No firm conclusions can be drawn from the results obtained, but it does appear that the larger firms are more likely to have set routines than the smaller firms.

More than twice as many firms indicated they used a payback method versus another method in evaluating investments.

The replies received by the different groups to the question of whether the firm required a piece of equipment to pay for itself during some time period is shown below.

Group	I	II	III
Yes	2	11	15
No	4	3	4

Of the four firms in Group I which indicated they did not use payback, none indicated they used any method to evaluate investments other than "judgment." The three firms which answered "no" in Group II indicated they used criterion such as quality of service, industry trends, or community welfare in making their decision. Two of the four firms indicating they did not use payback in Group III, evaluated investments using a discounted cash flow method. The other two indicated current business operations determined what the outcome would be.

When asked if the firm used any other technique for evaluating investments, the firms replied as follows:

Group	I	II	III
Yes	0	11	13
No	6	2	4
No Answer	0	1	2

Most of the firms answering "yes" to this question interpreted it to ask if they used any other considerations in determining whether or not to invest. They indicated other considerations such as: goodwill,

service to customers, production factors, impact on business image, investment credit, Montana Clean Air Act, and various other things. Only two of the respondents, both in Group III, indicated they also used a discounted cash flow method.

A total of eight respondents said they were familiar with discounted cash flow techniques but only five indicated they used it in making a decision. The groups answered the question, "Are you familiar with discounted cash flow techniques?" as follows:

Group	I	II	III
Yes	0	2	6
No	6	12	11
No Answer	0	0	2

To the question of whether they used a discounted cash flow method for decision making, the firms replied:

Group	I	II	III
Yes	0	0	5
No	6	12	11
No Answer	0	2	3

Not a single firm in Group I was familiar with discounted cash flow methods. As suspected, the larger firms of Group III were the most familiar with the techniques and actually applied them in practice.

Almost every firm indicated that it found its technique for evaluating investments was yielding satisfactory results. Only two firms, both in Group II, indicated any dissatisfaction with the method

they used. Both of these firms had no set procedure for evaluating investments, and both claimed to use payback as a measuring device. When presented with a hypothetical investment decision, both firms incorrectly applied the payback calculation; if they had done so correctly their decision would have been to accept the investment rather than reject, based on their stated payback period.

The firms were also asked to rate their earnings trend. Here are the results:

Group	I	II	III
Steadily Rising	2	9	8
Predominantly Rising	2	3	6
Level	2	2	5
Predominantly Declining	0	0	0
Steadily Declining	0	0	0

No firm indicated a decline in earnings trend. This might help to explain why most of the firms found their method for evaluating investments yielding satisfactory results. A further look into the type of investments the firms usually make may also show why the firms find their methods acceptable.

The firms, when asked what best described the type of investment their firm usually made, replied as listed below:

Group	I	II	III
Replacement	2	8	10
Adding Capacity	3	8	11

Group	I	II	III
Adding New Products	1	0	4
No Answer	0	1	0

The large majority of the investment decisions by the firms either were replacement or adding to capacity.² This result also partially explains why the firms are satisfied with their evaluation techniques, given that they have some knowledge of the market they serve, as to its strength, etc. If their market is strong, a replacement or adding to capacity decision becomes much easier and could be made without much harm to the firm. This being the case, the firms could not help but like their methods' results and also helps explain the upward earnings trend.

The size of the firms also seemed to indicate its relative position as to making investments which involved more risk than normal. The Group I firms would not consider making such an investment. Only two of the firms in Group II said they would weight their decision on the returns which could develop. Eight firms in Group III took into consideration returns when evaluating risky investments. The relationship between making a risky investment and firm size could be due to a number of factors. Some of the possible reasons could be (1) the firm can not afford for any investment to go bad, (2) the smaller firms' managers do not know how to take risk into account, or (3) the relative relationship of the person making the decision to how much he has

²The apparent difference in the total for the number of firms in this question's answer is due to multiple answers received from some firms.

invested in the company, that is whose money is exposed, his or someone else's. Any one of these reasons or a number of others could influence the outcome. The tendency for the larger firms to take more risk and evaluate it better is to be expected, since they can afford to take more risk and should have better trained managers.

Summary

The overall results of the survey were as generally expected. Very few firms had any knowledge of discounted cash flow methods to evaluate capital investments by. The firms that did know of these methods were the larger sized ones. The smaller firms responding to the questionnaire indicated that they had no idea what discounted cash flow techniques were.

Payback was found to be the method most widely used by the firms studied. This result coincides with the results obtained from the studies cited earlier. Other points brought up by these earlier studies also came to light in this study. Heller's point concerning the size and separation of ownership and management with respect to the type of capital budgeting techniques used by a firm also seems to be supported by this study. The small closely held firms used the more primitive methods such as "judgment" in evaluating investments, while the larger firms tended toward using a more sophisticated approach.

There should be little doubt that any size firm would be better off using a discounted cash flow method to evaluate investments. No firm knowingly likes to evaluate a capital expenditure decision incorrectly! The problem seems to lie in the firms simply not being aware

of the methods available to them. One might say that as long as the firms are happy with the way they make their decisions now, why bother to change? This question misses the point that the firms could make a better decision using a discounted cash flow method.

CHAPTER V

CONCLUSIONS

The majority of capital budgeting studies have reached the conclusion that payback is the method often selected by companies in making investment decisions. Various reasons were presented as to why payback was selected over other methods. The most widely given reason is its ease of calculation. Some studies, however, indicated that even the payback calculation was performed incorrectly by those firms using it. An attempt to determine whether the conclusions from the Montana Study could be generalized as to the way firms evaluated their capital expenditure decisions.

The Montana Study consisted of surveying three different groups of firms. The firms were grouped as to their relative asset size. The conclusions reached from the study corresponded quite well to what was found in earlier research. Payback was the method most widely used. Discounted cash flow type methods were found to be used by only a few large sized firms. Smaller firms did not know of the method, let alone use it. A large majority of the small firms did not even use payback, but relied on managerial "judgment."

The method of evaluating capital investments did not seem to bear any relationship as to a firm's earnings or growth. This conclusion had been reached in earlier studies. The fact that the firms were

mainly concerned with conducting their day to day business was indicated by various comments that were written on the questionnaire. The size and separation of ownership compared with capital budgeting technique used also seemed to hold for the firms in Montana as elsewhere in the nation.

The fact that the study was conducted in Montana appeared to have little effect on the results. It is believed that the same would have been obtained elsewhere. The results of the study revealed that small businesses are still relatively naive as to the methods they have available to them. The small sized firms simply do not understand the importance of making capital budgeting decisions correctly. Since they are mostly concerned with their current business, they fail to plan appropriately for the future. True, the small firm has a "feel" for what would happen if a capital investment went bad or turned out well, but they fail to quantify this result. This failure to evaluate capital investments properly can do nothing but hurt these firms.

APPENDIX A

QUESTIONNAIRE

1. Does your firm have a set procedure for evaluating investment decisions?

YES ___ NO ___

2. Do you use "judgment" as a criterion for accepting or rejecting an investment?

YES ___ NO ___

3. Does your firm require that the cost of a piece of equipment be recovered during some maximum period of time? (A payback period)

YES ___ NO ___

If yes, what is this maximum time period? ___ years
How did your firm arrive at this length of time? Please explain.

4. Evaluate the following capital expenditure problem given below in words or figures. Include the final decision you would make as a result of your evaluation.

An investment will cost \$12,000 and have an expected life of 5 years. It is estimated that at the end of these 5 years the investment will have a salvage value of \$2,000. The annual savings from the investment is estimated at \$3,000 before taxes. (Assume your firm has a 50% tax rate)

5. Does your firm use any other evaluation technique to decide whether or not to make an investment?

YES ___ NO ___

If yes, please explain what it is.

6. If an investment opportunity called for your firm taking a lot of risk, (that is, the possible yearly returns on the investment could vary a considerable amount), how would you adjust for this in your decision to accept or reject a project?

7. Have you found your firm's techniques for evaluating investments yielding satisfactory results?

YES ___ NO ___

The payback method of selection of investments is subject to a few criticisms, but does have a number of things in its favor. Discounted cash flow methods have been developed to make up for the weak points of the payback calculation.

8. Are you familiar with any of the discounted flow techniques?

YES ___ NO ___

If yes, which ones?

9. Does your firm use any of these methods to evaluate investments?

YES ___ NO ___

If yes, why do you use them?

10. Does your firm have a problem finding sufficient investment opportunities?

YES ___ NO ___

11. Do you find estimating the costs of an investment the hardest part in making your decision?

YES ___ NO ___

12. Do you find estimating returns (sales and/or savings) from an investment hard?
YES ___ NO ___
13. Which of the following do you find has the most uncertainty involved when making your estimates?
Costs ___ Returns ___
What degree of uncertainty is involved? High ___, Moderate ___, or Low ___.
14. Which of the following best describes the pattern of yearly returns your firm normally expects to receive from an investment?
Level ___ Steadily rising ___ Steadily declining ___
15. Which of the following best describes the type of investments your firm makes most often? Replacement ___, Adding on capacity to existing operations ___, Adding on different product lines ___.
Other (explain) _____
16. Do you find yourself concerned mostly with managing existing operations?
YES ___ NO ___
17. What percentage of your time do you spend on current operations?
___%
18. Do you believe you spend as much time as you should seeking new investment opportunities?
YES ___ NO ___
If not, is it because you are tied up with managing existing operations?
YES ___ NO ___
If so, what percentage of your time do you spend looking? ___%
19. Which of the following best describes your firm's earnings trend? Steadily rising ___, predominantly rising ___, level ___, predominantly declining ___, or steadily declining ___.
20. The cost of debt (credit) is the interest rate one must pay. In this light, since you do not have to pay dividends, does your firm consider its stockholders' equity interest-free debt?
YES ___ NO ___
21. Does your firm's cash position have any effect on whether it invests in a certain item?
YES ___ NO ___

22. If your firm does not have sufficient cash on hand to pay for an investment, which has been determined to be a favorable opportunity, would it borrow or sell stock?

YES ___ NO ___

If yes, which one? _____

23. Does the availability of acceptable investment opportunities affect your firm's dividend policy?

YES ___ NO ___

24. Please fill in the following:

Number of employees you have _____.

Total assets of your firm _____.

Net worth (stockholders' equity) _____.

Firm's main business _____.

25. Please fill in the following:

(Name)

(Position)

(Company)

If you would like a copy of the findings of this survey, please fill in the following:

(Address)

Please return this Questionnaire to:

Richard W. Bender
P. O. Box 1327
Great Falls, Montana 59403

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