FACT SHEET

L-1091

INVESTMENT ANALYSIS--CAPITAL BUDGETING METHODS

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As business managers and owners sign purchase contracts for new equipment they often ask themselves, "Is this the best use I can make of my capital?" Two types of analysis that can assist in answering this question are discussed in this fact sheet. They are the *payback* and the *net present value* capital budgeting techniques. Both methods have strengths and shortcomings, but when used appropriately they can help managers improve investment decisions.

Steps in Capital Budgeting

Both capital budgeting techniques have the following requirements:

Step 1. *Identify the feasible alternatives.* Management is always concerned about finding new investments to modernize, expand or increase the profitability of the firm. Capital budgeting methods can be used to evaluate the following type investments: (a) maintenance and/or replacement of capital equipment, (b) adoption of new cost-reducing technology and (c) adding new enterprises or product lines.

Step 2. *Calculate the net cash investment for each alternative.* Total cash expenditures for an alternative may be more or less than the contractual cost of a piece of machinery or equipment. Installation costs, costs of additional storage facilities or other remodeling costs may be necessary to make a new piece of equipment functional. On the other hand, there may be some items currently in use that can be sold when a new process is undertaken. The net price received from these items should be subtracted from the cash outlay to determine the net cash investment. Also, there may be tax credits that will effectively reduce the net cash investment.

Step 3. *Estimate the net annual cash inflows for each alternative.* The most difficult step in evaluating any investment is to accurately predict the net cash differences that will result from the change. Annual net cash inflows are obtained by first estimating the annual sales or income that will result. From this, subtract the annual cash operating expenses needed to generate that level of sale, to obtain the return on the total project. *Do not subtract interest and depreciation!* Interest and depreciation expenses are taken into consideration in the capital budgeting methods of analysis and should not be subtracted at this point, even if money is borrowed for the project.[1]

Now the investment can be evaluated by either of the capital budgeting techniques.

Payback Method

The payback method of capital budgeting estimates the number of years that it takes to recover the net cash investment. The general formula for the payback period is:

$$\text{Payback period} = \frac{\text{Net cash investment}}{\text{Average annual cash inflows}}$$

For example, if a $20,000 net cash investment returned an additional annual net cash inflow of $5,300 per year, the payback period (in years) would be

$$\frac{\$20,000}{\$\ 5,300} = 3.77$$

For some investments the future net cash inflows change over time. For example, consider an investment having a net cash outflow of $16,000 and expected net cash inflows of $4,000 for three years which then drop to $2,500 for three years. Payback periods for this type investment are determined by the countdown method until the net cash flow is recovered.

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[1]The methods in this fact sheet are to determine the profitability of the asset in question—not its financing plan or tax benefits. If different financing plans are available for assets under consideration or tax consequences will benefit one investment alternative more than another, the capital budgeting technique can be expanded to take these items into consideration.

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	Net cash inflow	Remaining investment
Initial investment	0	$16,000
Year 1	$4,000	12,000
Year 2	4,000	8,000
Year 3	4,000	4,000
Year 4	2,500	1,500
Year 5	2,500*	0
Year 6	2,500	0

*Need $1,500/$2,500 or 3/5 of year to recover the last $1,500.

Payback period = 4 3/5 years.

The payback method is one of the simplest methods of capital budgeting. It has a high value for firms with a low liquidity position that must have a fast cash recovery. It is also useful for comparing assets for which future cash inflows are quite uncertain. This technique infers that the faster an asset returns the invested capital, the less "risky" the asset is considered.

Net Present Value Method

Many managers prefer the net present value method of capital budgeting because it takes into consideration the *time value* of the returns. In this method the *present value of the net cash inflows* is subtracted from the net cash investment. If the present value of the net cash inflows is greater than the net cash investment, the investment alternative in question will be "profitable." A present value factor adjusts the future net cash inflows downward. It does this because of the idea that the money could be invested in another interest-paying way. The factor indicates how much money would have to be invested for a *given time* at a *selected interest rate* to equal a net cash inflow at a future time.

For example, if a person could invest money now at 8 percent interest compounded annually, how much would have to be invested today to have $1.00 in five years? Table 1, a present value table, gives us a present value factor of .6806 at the 8 percent interest rate and 5-year time period. This means that 68.06 cents invested now at 8 percent interest compounded annually will be worth $1.00 in five years. The following calculations show this.

Beginning of year	Investment	8 percent interest earned (end of year)	Value of investment (end of year)
0	$0.6806	$0.0544	$0.7350
1	0.7350	0.0588	0.7938
2	0.7938	0.0635	0.8573
3	0.8573	0.0686	0.9259
4	0.9259	0.0741	1.000

Table 1

Present Value of $1

$(1 + r)^{-n}$

Year (n)	6%	8%	10%	12%	15%	20%	25%
1	0.9434	0.9259	0.9091	0.8929	0.8696	0.8333	0.8000
2	0.8900	0.8573	0.8264	0.7972	0.7561	0.6944	0.6400
3	0.8396	0.7938	0.7513	0.7118	0.6575	0.5787	0.5120
4	0.7921	0.7350	0.6830	0.6355	0.5718	0.4823	0.4096
5	0.7473	0.6806	0.6209	0.5674	0.4972	0.4019	0.3277
6	0.7050	0.6302	0.5645	0.5066	0.4323	0.3349	0.2621
7	0.6651	0.5835	0.5132	0.4523	0.3759	0.2791	0.2097
8	0.6274	0.5403	0.4665	0.4039	0.3269	0.2326	0.1678
9	0.5919	0.5002	0.4241	0.3606	0.2843	0.1938	0.1342
10	0.5584	0.4632	0.3855	0.3220	0.2472	0.1615	0.1074
11	0.5268	0.4289	0.3505	0.2875	0.2149	0.1346	0.0859
12	0.4970	0.3971	0.3186	0.2567	0.1869	0.1122	0.0687
13	0.4688	0.3677	0.2897	0.2292	0.1625	0.0935	0.0550
14	0.4423	0.3405	0.2633	0.2046	0.1413	0.0779	0.0440
15	0.4173	0.3152	0.2394	0.1827	0.1229	0.0649	0.0352
16	0.3936	0.2919	0.2176	0.1631	0.1069	0.0541	0.0281
17	0.3714	0.2703	0.1978	0.1456	0.0929	0.0451	0.0225
18	0.3503	0.2502	0.1799	0.1300	0.0808	0.0376	0.0180
19	0.3305	0.2317	0.1635	0.1161	0.0703	0.0313	0.0144
20	0.3118	0.2145	0.1486	0.1037	0.0611	0.0261	0.0115

Note that the value of the investment at the end of each year corresponds to the number on the present value table.

As an example, if a $20,000 investment generated the additional net cash inflow of $5,300 per year for 5 years, would the investment be profitable if the firm manager required an 8 percent return on the investment? This investment would be analyzed as follows:

Cash outflows $20,000

Cash inflows

Year	Amount	Present value factor 8 percent	Net present value
1	$5,300	0.9259	$4,907.27
2	5,300	0.8573	4,543.69
3	5,300	0.7938	4,207.14
4	5,300	0.7350	3,895.50
5	5,300	0.6806	3,607.18

Total net present value of cash inflows = $21,160.78

Return to investment = $ 1,160.78 profit

In this example, the firm would receive total net present value cash inflows of $21,160.78 or $1,160.78 above the 8 percent return required on the investment.

If the manager required a 12 percent return on the investment, the following calculations would apply:

Cash outflows $20,000

Cash inflows

Year	Amount	Present value factor 12 percent	Net present value
1	$5,300	0.8929	$4,732.37
2	5,300	0.7972	4,225.16
3	5,300	0.7118	3,772.54
4	5,300	0.6355	3,368.15
5	5,300	0.5674	3,007.22

Total net present value of cash inflows = $19,105.44

Return to investment = loss of $ 894.56

The above calculations indicate that the proposed investment would not be profitable for a firm that required a 12 percent return on its capital. The current $20,000 investment would generate only total net present value cash inflows of $19,105.44, $894.56 short of a 12 percent return.

Selection of Discount Rate

In the examples above, arbitrary discount rates of 8 and 12 percent were used by the author. It can be seen that different discount rates may result in different answers to investment questions. Although discount rate selection is entirely a management decision, several factors should be considered.

1. What is the firm's *opportunity cost*? That is: How much can the firm receive from an alternative investment? In the example above, 8 percent was chosen because a firm can obtain this return in a relatively secure corporate bond. The 12 percent rate was chosen because it would give some adjustment for risk in the investment in question.
2. What is the firm's *cost of capital*? Capital costs can vary with the interest charge for loan funds, tax deductibility of capital costs and the source of equity capital.
3. What is the firm's *planning horizon*? Economic outlook for some firms' products may be extremely stable, so that a low interest rate could be selected for proposed purchases. On the other hand, a manager may want to select a relatively high interest rate when making an investment that will increase production for a volatile market.
4. What is the *technological stability* of the assets? Some production processes use the same types of assets for many years, but new technology is developed rapidly for other processes. The more unstable the technological process, the higher the interest rate should be.

Discount rates for evaluating investment alternatives of major U.S. firms vary from 8 percent for some well-capitalized firms in stable industries to 33 percent for less well-financed firms in unstable industries. In the past, several major firms have used rules of thumb such as prime rate + 5 percent, double corporate bond rate or an arbitrarily selected rate such as 20 percent for investment analyses. Again, remember that the interest rate is a managerial decision and represents the rate of return that management requires on capital investments. Table 1, the present value table, shows the present value factors for seven interest rates for 20 years.

Summary

Capital budgeting methods are useful in determining the investment resulting in the *best* use of capital. The payback method is a simple tool to identify how fast an investment is recovered. The net present value method can be used to determine if a prospective investment will earn a sufficient amount on the capital to justify the investment.

Capital budgeting methods, when used in conjunction with enterprise budgeting and break-even analysis, can give management valuable assistance in making investment decisions.

Example Problem

A farmer is considering buying an irrigation system for a pecan grove. There are two alternatives that he would like to consider. Alternative 1 will require a net cash outlay of $34,350 and will generate returns of $6,000 per year for 10 years. Alternative 2 requires an outlay of $50,000 but will generate returns of $10,000 for the first 4 years, then $8,000 per year for 3 years, and then $3,000 per year for 3 years. What is the payback period for each investment? If the farmer's discount rate is 10 percent, which alternative would be most profitable?

PAYBACK METHOD

Solution to Alternative 1

Net cash outflow	$34,350
Average net cash inflows	$ 6,000

$$\text{Payback period} = \frac{\text{Net cash outflow}}{\text{Annual average cash inflows}}$$

$$= \frac{\$34{,}350}{\$\ 6{,}000} = 5.73 \text{ years}$$

Solution to Alternative 2

Net cash outflow $50,000

Net cash inflows

Year	Amount
1	$10,000
2	10,000
3	10,000
4	10,000
5	8,000
6	8,000
7	8,000
8	3,000
9	3,000
10	3,000

Payback period = 5.25 years

(This is a nonconventional problem, so a countdown method must be used.)

NET PRESENT VALUE METHOD

Solution to Alternative 1

Net cash outflow $34,350

Net cash inflows

Year	Cash inflow	Present value of cash inflows 10 percent	Net present value
1	$6,000	0.9091	$5,454.60
2	6,000	0.8264	4,958.40
3	6,000	0.7513	4,507.80
4	6,000	0.6830	4,098.00
5	6,000	0.6209	3,725.40
6	6,000	0.5645	3,387.00
7	6,000	0.5132	3,079.20
8	6,000	0.4665	2,799.00
9	6,000	0.4241	2,554.60
10	6,000	0.3855	2,313.00

Total net present value = $36,877.00

Investment profits

$36,877.00 − $34,350.00 = $ 2,527.00

Solution to Alternative 2

Net cash outflow $50,000

Net cash inflows

Year	Cash inflow	Present value of cash inflows 10 percent	Net present value
1	$10,000	0.9091	$9,091.00
2	10,000	0.8264	8,264.00
3	10,000	0.7513	7,513.00
4	10,000	0.6830	6,830.00
5	8,000	0.6209	4,967.20
6	8,000	0.5654	4,516.00
7	8,000	0.5132	4,105.60
8	3,000	0.4665	1,399.50
9	3,000	0.4241	1,272.30
10	3,000	0.3855	1,165.50

Total net present value = $49,124.10

Investment loss = $ 875.90

This Fact Sheet is one in a series on investment analysis. Others in the series include *Investment Analysis—Partial Budget Method* (L-1092, Texas Agricultural Extension Service) and *Investment Analysis—Break-Even Method* (L-1093, Texas Agricultural Extension Service).

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