WHAT IS CAPITAL BUDGETING?

Capital budgeting is a required managerial tool. One duty of a financial manager is to choose investments with satisfactory cash flows and rates of return. Therefore, a financial manager must be able to decide whether an investment is worth undertaking and be able to choose intelligently between two or more alternatives. To do this, a sound procedure to evaluate, compare, and select projects is needed. This procedure is called capital budgeting.

I. CAPITAL IS A LIMITED RESOURCE

In the form of either debt or equity, capital is a very limited resource. There is a limit to the volume of credit that the banking system can create in the economy. Commercial banks and other lending institutions have limited deposits from which they can lend money to individuals, corporations, and governments. In addition, the Federal Reserve System requires each bank to maintain part of its deposits as reserves. Having limited resources to lend, lending institutions are selective in extending loans to their customers. But even if a bank were to extend unlimited loans to a company, the management of that company would need to consider the impact that increasing loans would have on the overall cost of financing.

In reality, any firm has limited borrowing resources that should be allocated among the best investment alternatives. One might argue that a company can issue an almost unlimited amount of common stock to raise capital. Increasing the number of shares of company stock, however, will serve only to distribute the same amount of equity among a greater number of shareholders. In other words, as the number of shares of a company increases, the company ownership of the individual stockholder may proportionally decrease.

The argument that capital is a limited resource is true of any form of capital, whether debt or equity (short-term or long-term, common stock) or retained earnings, accounts payable or notes payable, and so on. Even the best-known firm in an industry or a community can increase its borrowing up to a certain limit. Once this point has been reached, the firm will either be denied more credit or be charged a higher interest rate, making borrowing a less desirable way to raise capital.

Faced with limited sources of capital, management should carefully decide whether a particular project is economically acceptable. In the case of more than one project, management must identify the projects that will contribute most to profits and, consequently, to the value (or wealth) of the firm. This, in essence, is the basis of capital budgeting.

YOU SHOULD REMEMBER

Capital budgeting is investment decision-making as to whether a project is worth undertaking. Capital budgeting is basically concerned with the justification of capital expenditures.

Current expenditures are short-term and are completely written off in the same year that expenses occur. Capital expenditures are long-term and are amortized over a period of years are required by the IRS.
II. Basic Steps of Capital Budgeting

1. Estimate the cash flows

2. Assess the riskiness of the cash flows.

3. Determine the appropriate discount rate.

4. Find the PV of the expected cash flows.

5. Accept the project if PV of inflows > costs.
   IRR > Hurdle Rate and/or
   payback < policy

Definitions:
Independent versus mutually exclusive projects.
Normal versus non-normal projects.

### Basic Data

<table>
<thead>
<tr>
<th>Year</th>
<th>Project L</th>
<th>Project S</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>($100)</td>
<td>($100)</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>70</td>
</tr>
<tr>
<td>2</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>20</td>
</tr>
</tbody>
</table>

III. Evaluation Techniques

A. Payback period
B. Net present value (NPV)
C. Internal rate of return (IRR)
D. Modified internal rate of return (MIRR)
E. Profitability index
A. PAYBACK PERIOD
Payback period = Expected number of years required to recover a project’s cost.

<table>
<thead>
<tr>
<th>Year</th>
<th>Project L</th>
<th>Project S</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>($100)</td>
<td>($100)</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>(90)</td>
</tr>
<tr>
<td>2</td>
<td>60</td>
<td>(30)</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>50</td>
</tr>
</tbody>
</table>

Payback sub L = 2 + $30/$80 years
= 2.4 years.
Payback sub S = 1.6 years.

Weaknesses of Payback:
1. Ignores the time value of money. This weakness is eliminated with the discounted payback method.
2. Ignores cash flows occurring after the payback period.

B. NET PRESENT VALUE

\[
NPV = \sum_{t=0}^{n} \frac{CF_t}{(1 + k)^t}
\]

Project L:

\[
0 \quad 1\quad 2 \quad 3
\]

\[
\begin{array}{cccccc}
\text{Year} & \text{Project L} & \text{Project S} \\
0 & ($100) & ($100) \\
1 & 10 & (90) \\
2 & 60 & (30) \\
3 & 80 & 50 \\
\end{array}
\]

NPV sub L = $18.79
NPV sub S = $19.98

If the projects are independent, accept both.
If the projects are mutually exclusive, accept Project S since NPV sub S > NPV sub L.
Note: NPV declines as k increases, and NPV rises as k decreases.

C. INTERNAL RATE OF RETURN

\[ \text{IRR} : \sum_{t=0}^{n} \frac{CF_t}{(1 + IRR)^t} = 0 = \text{NPV} \]

Project L:

\[ \begin{array}{cccc}
0 & 1 & 2 & 3 \\
-100.00 & 10 & 60 & 80 \\
8.47 & 18.1\% & 18.1\% & 18.1\% \\
43.02 & 18.1\% & 18.1\% & 18.1\% \\
48.57 & 18.1\% & 18.1\% & 18.1\% \\
\hline
0.06 \approx 0 \\
\end{array} \]

\[ \text{IRR}_L = 18.1\% \]
\[ \text{IRR}_S = 23.6\% \]

If the projects are independent, accept both because IRR > k.

If the projects are mutually exclusive, accept Project S since IRR_S > IRR_L.

Note: IRR is independent of the cost of capital.

<table>
<thead>
<tr>
<th>k</th>
<th>NPV_L</th>
<th>NPV_S</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>$50</td>
<td>$40</td>
</tr>
<tr>
<td>5%</td>
<td>33</td>
<td>29</td>
</tr>
<tr>
<td>10</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>15</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>20</td>
<td>(4)</td>
<td>5</td>
</tr>
</tbody>
</table>

Crossover Point = 8.7%
1. ADVANTAGES AND DISADVANTAGES OF IRR AND NPV

A number of surveys have shown that, in practice, the IRR method is more popular than the NPV approach. The reason may be that the IRR is straightforward, but it uses cash flows and recognizes the time value of money, like the NPV. In other words, while the IRR method is easy and understandable, it does not have the drawbacks of the ARR and the payback period, both of which ignore the time value of money.

The main problem with the IRR method is that it often gives unrealistic rates of return. Suppose the cutoff rate is 11% and the IRR is calculated as 40%. Does this mean that the management should immediately accept the project because its IRR is 40%? The answer is no! An IRR of 40% assumes that a firm has the opportunity to reinvest future cash flows at 40%. If past experience and the economy indicate that 40% is an unrealistic rate for future reinvestments, an IRR of 40% is suspect. Simply speaking, an IRR of 40% is too good to be true! So unless the calculated IRR is a reasonable rate for reinvestment of future cash flows, it should not be used as a yardstick to accept or reject a project.

Another problem with the IRR method is that it may give different rates of return. Suppose there are two discount rates (two IRRs) that make the present value equal to the initial investment. In this case, which rate should be used for comparison with the cutoff rate? The purpose of this question is not to resolve the cases where there are different IRRs. The purpose is to let you know that the IRR method, despite its popularity in the business world, entails more problems than a practitioner may think.

2. WHY THE NPV AND IRR SOMETIMES SELECT DIFFERENT PROJECTS

When comparing two projects, the use of the NPV and the IRR methods may give different results. A project selected according to the NPV may be rejected if the IRR method is used.

Suppose there are two alternative projects, X and Y. The initial investment in each project is $2,500. Project X will provide annual cash flows of $500 for the next 10 years. Project Y has annual cash flows of $100, $200, $300, $400, $500, $600, $700, $800, $900, and $1,000 in the same period. Using the trial and error method explained before, you find that the IRR of Project X is 17% and the IRR of Project Y is around 13%. If you use the IRR, Project X should be preferred because its IRR is 4% more than the IRR of Project Y. But what happens to your decision if the NPV method is used? The answer is that the decision will change depending on the discount rate you use. For instance, at a 5% discount rate, Project Y has a higher NPV than X does. But at a discount rate of 8%, Project X is preferred because of a higher NPV.

The purpose of this numerical example is to illustrate an important distinction: The use of the IRR always leads to the selection of the same project, whereas project selection using the NPV method depends on the discount rate chosen.
• **PROJECT SIZE AND LIFE**

There are reasons why the NPV and the IRR are sometimes in conflict: the size and life of the project being studied are the most common ones. A 10-year project with an initial investment of $100,000 can hardly be compared with a small 3-year project costing $10,000. Actually, the large project could be thought of as ten small projects. So if you insist on using the IRR and the NPV methods to compare a big, long-term project with a small, short-term project, don’t be surprised if you get different selection results. (See the equivalent annual annuity discussed later for a good way to compare projects with unequal lives.)

• **DIFFERENT CASH FLOWS**

Furthermore, even two projects of the same length may have different patterns of cash flow. The cash flow of one project may continuously increase over time, while the cash flows of the other project may increase, decrease, stop, or become negative. These two projects have completely different forms of cash flow, and if the discount rate is changed when using the NPV approach, the result will probably be different orders of ranking. For example, at 10% the NPV of Project A may be higher than that of Project B. As soon as you change the discount rate to 15%, Project B may be more attractive.

• **WHEN ARE THE NPV AND IRR RELIABLE?**

Generally speaking, you can use and rely on both the NPV and the IRR if two conditions are met. First, if projects are compared using the NPV, a discount rate that fairly reflects the risk of each project should be chosen. There is no problem if two projects are discounted at two different rates because one project is riskier than the other. Remember that the result of the NPV is as reliable as the discount rate that is chosen. If the discount rate is unrealistic, the decision to accept or reject the project is baseless and unreliable. Second, if the IRR method is used, the project must not be accepted only because its IRR is very high. Management must ask whether such an impressive IRR is possible to maintain. In other words, management should look into past records, and existing and future business, to see whether an opportunity to reinvest cash flows at such a high IRR really exists. If the firm is convinced that such an IRR is realistic, the project is acceptable. Otherwise, the project must be reevaluated by the NPV method, using a more realistic discount rate.

D.

**YOU SHOULD REMEMBER**

The internal rate of return (IRR) is a popular method in capital budgeting. The IRR is a discount rate that makes the present value of estimated cash flows equal to the initial investment. However, when using the IRR, you should make sure that the calculated IRR is not very different from a realistic reinvestment rate.
Modified IRR (MIRR)

The MIRR is similar to the IRR, but is theoretically superior in that it overcomes two weaknesses of the IRR. The MIRR correctly assumes reinvestment at the project’s cost of capital and avoids the problem of multiple IRRs. However, please note that the MIRR is not used as widely as the IRR in practice.

There are 3 basic steps of the MIRR:
(1) Estimate all cash flows as in IRR.
(2) Calculate the future value of all cash inflows at the last year of the project’s life.
(3) Determine the discount rate that causes the future value of all cash inflows determined in step 2, to be equal to the firm’s investment at time zero. This discount rate is known as the MIRR.

Project L:

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>-100.00</td>
<td>10</td>
<td>60</td>
<td>80.00</td>
</tr>
</tbody>
</table>

MIRR = 16.5%

$158.10 = TV of inflows

PV costs = \( \frac{TV}{(1 + MIRR)^n} \)

MIRR\(_L\) = 16.5%.

MIRR is better than IRR because
1. MIRR correctly assumes reinvestment at project’s cost of capital.
2. MIRR avoids the problem of multiple IRRs.
E. PROFITABILITY INDEX (PI)

The profitability index, or PI, method compares the present value of future cash inflows with the initial investment on a relative basis. Therefore, the PI is the ratio of the present value of cash flows (PVCF) to the initial investment of the project.

\[ PI = \frac{PVCF}{Initial\ \text{investment}} \]

In this method, a project with a PI greater than 1 is accepted, but a project is rejected when its PI is less than 1. Note that the PI method is closely related to the NPV approach. In fact, if the net present value of a project is positive, the PI will be greater than 1. On the other hand, if the net present value is negative, the project will have a PI of less than 1. The same conclusion is reached, therefore, whether the net present value or the PI is used. In other words, if the present value of cash flows exceeds the initial investment, there is a positive net present value and a PI greater than 1, indicating that the project is acceptable.

PI is also known as a benefit/cash ratio.

Project L

\[
\begin{array}{c|c|c|c|c}
0 & 10\% & 1 & 2 & 3 \\
-100.00 & 10 & 60 & 80 \\
PV_1 & 9.09 & & & \\
PV_2 & 49.59 & & & \\
PV_3 & 60.11 & & & \\
\hline
& & & 118.79 & \\
\end{array}
\]

\[ PI = \frac{\text{PV of cash flows}}{\text{initial cost}} \]

\[ = \frac{118.79}{100} = 1.19 \]

Accept project if PI > 1.0
Reject if PI < 1.0
F. EQUIVALENT ANNUAL ANNUITY

What do you do when project lives vary significantly? An easy and intuitively appealing approach is to compare the “equivalent annual annuity” among all the projects. The equivalent annuity is the level annual payment across a project’s specific life that has a present value equal to that of another cash-flow stream. Projects of equal size but different life can be ranked directly by their equivalent annuity. This approach is also known as equivalent annual cost, equivalent annual cash flow, or simply equivalent annuity approach. The equivalent annual annuity is solved for by this equation:

Equivalent Annuity = PV(Cash Flows) / (present value factor of n-year annuity)
IV. PROJECT DECISION ANALYSIS

A. MAKING GO/NO-GO PROJECT DECISION
(Suggestions by R. Bruner)

Virtually all general managers face capital-budgeting decisions in the course of their careers. The most common of these is the simple “yes” versus “no” choice about a capital investment. The following are some general guidelines to orient the decision maker in these situations.

1. Focus on cash flows, not profits. One wants to get as close as possible to the economic reality of the project. Accounting profits contain many kinds of economic fiction. Flows of cash, on the other hand, are economic facts.

2. Focus on incremental cash flows. The point of the whole analytical exercise is to judge whether the firm will be better off or worse off if it undertakes the project. Thus one wants to focus on the changes in cash flows effected by the project. The analysis may require some careful thought: a project decision identified as a simple go/no-go question may hide a subtle substitution or choice among alternatives. For instance, a proposal to invest in an automated machine should trigger many questions: Will the machine expand capacity (and thus permit us to exploit demand beyond our current limits)? Will the machine reduce costs (at the current level of demand) and thus permit us to operate more efficiently than before we had the machine? Will the machine create other benefits (e.g., higher quality, more operational flexibility)? The key economic question asked of project proposals should be, “How will things change (i.e., be better or worse) if we undertake the project?”

3. Account for time. Time is money. We prefer to receive cash sooner rather than later. Use NPV as the technique to summarize the quantitative attractiveness of the project. Quite simply, NPV can be interpreted as the amount by which the market value of the firm’s equity will change as a result of undertaking the project.

4. Account for risk. Not all projects present the same level of risk. One wants to be compensated with a higher return for taking more risk. The way to control for variations in risk from project to project is to use a discount rate to value a flow of cash that is consistent with the risk of that flow.

These 4 precepts summarize a great amount of economic theory that has stood the test of time. Organizations using these precepts make better investment decisions than organizations that do not use these precepts.
B. THE PROCESS OF PROJECT EVALUATION

(Suggestions by R. Bruner)

1. Carefully estimate expected future cash flows.

2. Select a discount rate consistent with the risk of those future cash flows.

3. Compute a “base-case” NPV.

4. Identify risks and uncertainties. Run a sensitivity analysis.
   
   Identify “key value drivers”.
   Identify break-even assumptions.
   Estimate scenario values.
   Bound the range of value.

5. Identify qualitative issues.

   Flexibility
   Quality
   Know-how
   Learning

6. Decide
C. CAPITAL RATIONING  
(Suggestions by R. Bruner)

• Exists whenever enterprises cannot, or choose not to, accept all value-creating investment projects. Possible causes:
  ■ Banks and investors say “NO”
  ■ Managerial conservatism

• Analysis is required. One must consider sets of projects, or “bundles”, rather than individual projects. The goal should be to identify the value-maximizing bundle of projects.
• The danger is that the capital-rationing constraint heightens the influence of nonfinancial considerations, such as the following:
  ■ Competition among alternative strategies
  ■ Corporate politics
  ■ Bargaining games and psychology

The outcome could be a sub-optimal capital budget, or, worse, one that destroys value!

• Some remedies are the following:
  ■ Relax and eliminate the budget constraint.
  ■ Manage the process rather than the outcomes.
  ■ Develop a corporate culture committed to value creation.

Reference: http://www.exinfm.com/training/s_course_desc.html