Capital Budgeting

Virtually all 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 flow affected by the project.

   - In a replacement decision cost of ownership on the existing machine and cost of ownership on the new machine can be compared to estimate incremental cash flows.
   - 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 net present value 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.

**Process of Project Evaluation**

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.
Below are some useful information/formats for various cash flow estimations and examples:

### Relevant Cash Flow
- Indirect cost
  - Relationship might not be clear but it should be estimated
- Indirect benefits
  - Needs to be estimated
  - Claims by supplier of capital
  - Cost is usually taken care of in the discount rate
  - Interest Expense
  - Cost is usually taken care of in the discount rate
  - Opportunity cost
  - Next best course of action not taken - could be very important

### Irrelevant Cash Flow
- Sunk cost
  - These are past costs and are therefore irrelevant
  - Make the best use of the capacity put in place by past decisions
- Pure joint costs
  - They are common costs that do not change as a result of an action and are therefore irrelevant.
- Wealth-maximization with pure point costs
  - Compute the NPV of each investment, excluding pure joint costs.
    - Investments with negative NPVs are not considered in the next step
  - Compute the NPV of the combined investment including pure joint costs
  - If the combined investment has positive NPV, then all investments should be taken. If the combined investment has negative NPV, then focus on lowering joint costs, seeking other alternatives or shutting down.
Estimating Cash Flows From a Project

1. Estimating the Income Statement
   - Estimate the relevant revenues and expenses
   - Assemble into an income statement

2. Estimating the Balance Sheet
   - Determine the balance sheet accounts that are impacted
   - Estimate the initial size of the investment
   - Determine the size and growth during operations

3. Rolling the Income Statement and Balance Sheet into a Cash Flow Statement
   - Calculate depreciation
   - Estimate the life of the project
   - Determine terminal values for fixed assets
   - Determine disposal values for working capital
   - Construct the cash flow statement

   - Accounts Receivable
     - typically occur in year 0
     - typically increases with increase in sales
     - credit losses are fully deductible
     - often liquidated at a loss

   - Inventory
     - typically occur in year 0
     - typically increases with increase in sales
     - inventory losses are fully deductible
     - often liquidated at a loss

   - Cash Balances
     - typically occur in year 0
- typically increases with increase in sales
- liquidated at full value

- Accounts Payable
  - usually associated with the purchase of inventory
  - typically occur in year 0
  - typically increases with increase in sales
  - are a source of cash (positive number)
  - often liquidated at full value

- Accrued Expenses
  - associated with employees and others
  - typically occur in year 0
  - typically increases with increase in sales
  - credit losses are fully deductible
  - often liquidated at a loss

- Land
  - cannot be depreciated
  - typically occur in year 0
  - only increases with additional acquisitions
  - may be 1250 gain or loss on disposal
  - disposal gain and losses are fully taxable

- Buildings
  - either classified as residential or commercial
  - residential depreciated over 27.5 years
  - commercial depreciated over 39 years
  - must use mid-month convention
  - typically occur in year 0
  - often liquidated with a 1250 gain or loss
  - disposal gain and losses are fully taxable
• Equipment
  ▪ are grouped into one of 6 asset classifications - 3,5,7,10,15,20 year lives
  ▪ find the class, use the table rates
  ▪ typically occur in year 0
  ▪ often liquidated with a 1245 gain or loss
  ▪ disposal gain and losses are fully taxable

• Calculation of disposition stage gain or loss and cash flow (Fixed Assets)
  ▪ original purchase price - depreciation taken = remaining basis
  ▪ selling price - remaining basis = taxable gain or loss
  ▪ taxable gain or loss * tax rate = taxes owed or tax refund
  ▪ cash selling price - taxes owed or + tax refund = disposition stage cash flow

• Calculation of disposition stage gain or loss and cash flow (Working Capital)
  ▪ liquidation value – accumulated value = taxable gain or loss
  ▪ taxable gain or loss * tax rate = taxes owed or tax refund
  ▪ liquidation value - taxes owed or + tax refund = disposition stage cash flow

4. Making the Decision

• Calculate the net present value and other criteria. If you need additional help please see presentation files on Chapter 8 and 9 from FINC 340 Financial Management

• Criteria:
  • Payback
  • Discounted Payback
  • Net Present Value (NPV)

\[ NPV = \sum_{t=1}^{n} \frac{FCF_t}{(1+k)^t} - IO \]

• where, FCF is the Free Cash Flow, k is the required return, and t is the time subscript
• Decision Rule:
  - If NPV is positive, accept
  - If NPV is negative, reject

• Profitability Index (PI)

\[ NPV = \sum_{i=1}^{n} \frac{FCF_i}{(1+k)^j} - IO \]

\[ PI = \frac{\sum_{i=1}^{n} FCF_i}{IO} \]

• Decision Rule:
  - If PI is greater than or equal to 1, accept
  - If PI is less than 1, reject

• Internal Rate of Return (IRR)

\[ IRR: \sum_{i=1}^{n} \frac{FCF_i}{(1+IRR)^j} = IO \]

or \[ NPV = \sum_{i=1}^{n} \frac{FCF_i}{(1+IRR)^j} - IO = 0 \]

• Decision Rule:
  - If IRR is greater than or equal to the required rate of return, accept
  - If IRR is less than the required rate of return, reject

• Problems with IRR
  - Non-conventional cash flows (more than one sign change in cash flows) – Multiple IRRs
  - Conflicting project ranking
  - Reinvestment rate for cash flows is assumed to be IRR itself

• Modified Internal Rate of Return (MIRR) – this is a remedy for reinvestment rate assumption of IRR

• Determination of MIRR:
  - Calculate the PV of the cash outflows (PVCOF) using the required rate of return – this is usually the investment amount
• Calculate the FV of the cash inflows (FVCIF) at the last year of the project’s time line using the required rate of return. This is also called the terminal value (TV)

• MIRR is the growth rate of money from initial investment to terminal value over the life of the investment or

<table>
<thead>
<tr>
<th>N</th>
<th>I/Y</th>
<th>P/Y</th>
<th>PV</th>
<th>PMT</th>
<th>FV</th>
<th>MODE</th>
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</thead>
<tbody>
<tr>
<td>Project Life</td>
<td>MIRR</td>
<td>1</td>
<td>-Investment (PVCOF)</td>
<td>0</td>
<td>Terminal Value (FVCIF)</td>
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</table>

5. Project ranking issues:
• The NPV decision may not agree with IRR or PI
• Three project ranking problems:
  • Mutually exclusive projects of unequal size (the size disparity problem) – difference in initial investment
  • The time disparity problem with mutually exclusive projects – difference in cash flow amount and timing
  • Mutually exclusive investments with unequal lives – discussed in detail below.

6. Investing Decision when projects are mutually exclusive with unequal lives:
• There are two alternative methods:
  • Equivalent Annual Annuity (EAA) and Replacement Chains
  • Equivalent Annual Annuity Assumptions:
    • Projects are repeated indefinitely
    • Projects costs do not change over time
  • Calculation of Equivalent Annuity:
    • Determine the NPV of each project
    • Spread the NPV over the life of the project as an annuity (EAA), where N = project life, I/Y = required return, PV = - NPV from previous step, and FV = 0
    • Select the largest EAA project
• Replacement Chains:
  • Determine the common ending period for projects
  • Estimate cash flows from each project over that time period
  • Compute NPVs and select the largest NPV project

• Solutions for the following projects are available in an Excel file.

<table>
<thead>
<tr>
<th>Years</th>
<th>CF T</th>
<th>CF U</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-$50,000</td>
<td>-$65,000</td>
</tr>
<tr>
<td>1</td>
<td>$25,000</td>
<td>$25,000</td>
</tr>
<tr>
<td>2</td>
<td>$25,000</td>
<td>$25,000</td>
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<tr>
<td>3</td>
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<td>$25,000</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>$25,000</td>
</tr>
</tbody>
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7. Double Declining Depreciation Method:

\[ \text{DDB} = \frac{2 \times \text{Cost} \times \text{Salvage}}{\text{Life} + 1} \times \text{Period} \times \frac{\text{Cost} - \text{Salvage}}{\text{Life}} \]

Salvage is the salvage value at the end of the life of the asset.
Life is the number of years over which the asset is depreciated.
8. Inflation adjustment:

In general, nominal cash flows should be discounted at the nominal rate and real cash flow should be discounted at the real rate. Nominal cash flows are inflated by the amount of the inflation and therefore require a discount rate that has inflation risk premium built on it. If cash flows are not adjusted for inflation then the rate should not have a premium for the inflation but depreciation expense should be deflated to reflect the loss of purchasing power of tax savings associated with depreciation.

Example:

**Colin Corporation**

Colin Corporation, a large manufacturer of aircraft components, is trying to determine whether an investment in a new machine to replace an existing one has to be made. The new machine can be purchased for $380,000 and additional installation cost of $20,000 is required. The new machine has 5 years of tax life and it will be depreciated under straight-line depreciation. The present (old) machine was purchased for $240,000 three years ago and it is depreciated based on 5 years of tax life. The firm has found a buyer who is willing to pay $280,000 for the old machine. The usable life of new machine and remaining life of old machine is 5 years. Relevant tax rate is 40%. If firm proceeds with the new machine there will be $17,000 investment in net working capital. New machine will be sold for $50,000 when project is over in 5 years. Following table provides revenues and expenses for proposed and current machines. Given 11% discount rate, identify relevant cash flows and find NPV of this project.
<table>
<thead>
<tr>
<th>Years</th>
<th>Proposed Machine</th>
<th>Present Machine</th>
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<tbody>
<tr>
<td></td>
<td>Revenue</td>
<td>Expenses</td>
</tr>
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<td>$2,520,000</td>
<td>$2,300,000</td>
</tr>
<tr>
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</tr>
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<tr>
<td>5</td>
<td>$2,520,000</td>
<td>$2,300,000</td>
</tr>
</tbody>
</table>

Solution of this example is provided in Excel file at the link labeled “Capital Budgeting.”
In that file there is also a full Free Cash Flow estimate for a project whose assumptions are not provided.
Please do not try to fit the cases into the example solutions. Start from scratch.