Issues in Capital Budgeting

What is Capital Budgeting?
- The process of making and managing expenditures on long-lived assets.
- Allocating available capital amongst investment opportunities.

What are the issues?
- What cash flows do we use while evaluating projects?
    - Incremental cash flows
        - Sunk costs
        - Opportunity costs
        - Externalities / side-effects / cannibalization
    - Tax effects
    - Inflation effects
    - Effect of working capital on cash flows
    - Leverage effects
- How do we evaluate project cash flows?
    - Mutually exclusive projects with unequal lives
    - Replacement and expansion decisions
    - Capital rationing
    - Project synergies
    - Project timing

First Principles of Cash Flow Estimation

- Cash Flows should be *Incremental.*

An incremental cash flow includes any cash inflow or outflow that is a direct or indirect consequence of taking a project (can be directly or indirectly traced to the project).

What will happen to this item of cash flow if this project is not taken?
- If the cash flow will remain unaffected, it is not incremental, so ignore it.
- If the cash flow will change, the amount of change should become a part of the analysis.

Example: A firm has already spent $2 million on market research for a new product introduction. Should it charge this expense to the project while evaluating it?
(check if this cash flow is incremental, as per the rule above!)

Sunk costs: Any expense that has been incurred already, and cannot be recovered if the project is not taken, is a sunk cost (usually R&D, test market expenses, etc.).

Always ignore sunk costs in project analysis.

Question: Would your analysis of test market expenses change if the research could be sold to a competitor?

- Sunk costs are not recoverable, so they should not be charged to the project.
- This may differ from the accounting treatment of sunk costs – but remember, we need to deal with real cash flows, not (fictional?) accounting numbers.

Example: In the previous test market case, if an additional $6 mil. needs to be spent to introduce the product in the market, and the present value of the expected cash flows from the project is $7 mil., should we accept the project?

Who eventually pays for these sunk costs, if they are to be ignored in project analysis?

- A firm does need to cover its sunk costs over time, or it will cease to exist!
- To be successful, firms' *cumulated* NPV of accepted projects must exceed the *cumulated* sunk costs on both accepted and rejected projects.
- Need long-term, firmwide benchmarking.

Opportunity Costs

- An opportunity cost arises when a project uses a resource that may already have been paid for by the firm.
- When a resource that is already owned by a firm is being considered for use in a project, this resource has to be priced on its next best alternative use, which may be
  - a sale of the asset, in which case the opportunity cost is the expected proceeds from the sale, net of any capital gains taxes.
  - renting or leasing the asset out, in which case the opportunity cost is the expected present value of the after-tax rental or lease revenues.
  - use elsewhere in the business, in which case the opportunity cost is the cost of replacing it.

Example: The Euro-Disney theme park in Bangkok, modeled after the one near Paris. Assume that Disney already owns the land in Bangkok, on which the theme park is to be built. This land was acquired several years ago for $5 mil. for a hotel that was never built. The land can be currently sold for $40 mil. (assume capital gains are taxed at 20%). In assessing the theme park, you would:
- Ignore the cost of the land, since Disney already owns it
- Use the value of the land at which it was bought ($5 m.)
- Use the market value of the land ($40 m.)
- Other

Externalities / Side-effects

- Most projects considered by any business create side costs and benefits for that business.
- The side costs include the costs created by the use of resources that the business already owns (*opportunity costs*) and lost revenues for other projects that the firms may have (*erosion*).
- The benefits that may not be captured in the traditional capital budgeting analysis include project synergies (where cash flow benefits may accrue to other projects) and options embedded in projects (including options to delay, expand or abandon a project).
- The returns on a project should incorporate these costs and benefits.

Example: (**Excess Capacity**)

Aracruz is setting up a new paper plant, with an annual capacity of 750,000 tons. It will use its existing distribution system to service the production out of the new plant. The new plant manager argues that there is no cost associated with using this system, since it has been paid for already and cannot be sold or leased to a competitor (and thus has no competing current use). Do you agree?

- ❑ Yes
- ❑ No

Framework for estimating the cost of excess capacity:
- If I do not take this project, when will I run out of capacity?
- If I take this project, when will I run out of capacity?
- When I run out of capacity, what will I do?
  - cut back on production: then the cost is the PV of after-tax cash flows from lost sales.
  - buy new capacity: then the cost is the difference in PV between earlier and later investment.

Costs for other projects:
- Projects often create side-costs for other projects. The key question that has to be asked then is; is this an incremental cost, as a result of the project, or would it have occurred anyway?
- If it is an incremental cost, it should be considered in project analysis. If it would have occurred anyway, it should be ignored.

What about **allocated costs**?

A cost that cannot be directly traced to business units in a firm. It is charged to business units based on other observable measures.

- For investment analysis, they must be viewed in terms of whether they create incremental cash flows.
- Ignore if the allocated cost exists even without the project.

Example: A retail firm with 5 stores wants to open a 6th store. The general and administrative (G&A) costs are currently $600,000, and would increase to $660,000 if the 6th store is opened. Then, the allocated cost to the project (of opening the 6th store) should be:

- one-sixth of total G&A costs, i.e. $110,000
- the additional G&A costs, i.e. $60,000 (after taxes)
- zero, as it is an overhead expense
- other

Then who pays for the overheads?

- Assuming that overhead costs serve a purpose, which otherwise would have to be borne by each project individually, one could argue that firms should estimate a fixed charge for these costs that every project must bear.
- Treat them like sunk costs, and make sure that *cumulatively* (across all projects), these costs are covered.

Product and Project Cannibalization: A Real Cost?

These are sales generated by one product, which come at the expense of other products manufactured by the same firm.

Assume that in the Disney theme park example, 20% of the revenues at the Bangkok Disney park are expected to come from people who would have gone to Disneyland in Anaheim, California. In doing the analysis of the park, would you
- look at only incremental revenues (i.e., 80% of the total revenue)
- look at total revenues at the park
- choose an intermediate number

Would your answer be different if you were analyzing whether to introduce a new show on the Disney cable channel on Saturday mornings that is expected to attract 20% of its viewers from ABC (which is also owned by Disney)?
- Yes
- No

Suppose a competitor can also introduce a new show similar to Disney's show, and would get the same viewers. Would your answer be any different *now*?
- Yes
- No

Project Synergies

- A project may provide benefits for other projects within the firm. If this is the case, these benefits have to be valued and shown in the initial project analysis.
- Consider, for instance, a typical Disney movie. Assume that it costs $50 million to produce and promote. This movie, in addition to theatrical revenues, also produces revenues from
    - the sale of merchandise (stuffed toys, plastic figures, clothes, etc.)
    - increased attendance at theme parks
    - stage shows (see "Beauty and the Beast" and "The Lion King")
    - television series based upon the movie

Tax Effects

Basic Principle: All investment analysis should be done in after-tax terms. All items that affect taxes, even non-cash items such as depreciation, should be considered.

- The correct tax rate to use in estimating tax liability is the marginal tax rate for the firm.
- For projects with incomes in different tax regimes (e.g., in different countries), use the weighted average marginal tax rate.
- If the profits from a project can be offset against losses from the other businesses of the firm, the resulting "tax shield" should be credited to the project.
- Non-cash charges (depreciation, amortizations, etc.):
  - Reduce taxable income, hence reduce taxes.
  - Do not generate a cash outflow.
  - Hence, must be added back to get net cash flows.
  - Tax benefit of depreciation
    -         =   depreciation X marginal tax rate
  - Switching depreciation methods can lead to changes in the NPV of the project.

Example.

Inflation Effects

Both the cash flows and the discount rate should either be in *nominal* terms, or *real* terms (i.e. adjusted for expected inflation).

$$\text{Real Cash Flow}_t = \frac{\text{Nominal Cash Flow}_t}{(1 + \text{Expected Inflation Rate})^t}$$

Nominal Discount Rate

$= (1 + \text{Real Discount Rate})(1 + \text{Expected Inflation Rate}) - 1$

Hence:
- If cash flows are nominal, the discount rate should be nominal.
- If cash flows are real, the discount rate should be real.

If done consistently, the NPV will be identical under both approaches, so use the approach that is simpler.

Example.

- *How would you deal with hyperinflation?*
- *How does inflation affect stock prices?*

Net Working Capital

Changes is working capital (from one period to another) affect cash flows, though they do not affect accounting income.

- Working capital is the difference between current assets and current liabilities.
- Intuitively, money invested in working capital cannot be used elsewhere, hence is a drain on cash flows.
- *Changes* in working capital from one period to another reflect
  - additional cash infusion (if working capital increases, more money gets tied up in day-to-day operations).
  - cash generation (if working capital decreases, money gets released from day-to-day operations).
- Hence, working capital requirements of the project must be analyzed and factored in the cash flows.
- There are three implications of factoring working capital in to cash flows:
  - At the start of the project, some start-up working capital is required, called the *initial working capital investment*; it is a cash *outflow*.
  - During the project life, working capital changes can result in cash *inflows or outflows*.
  - At the end of the project's life, the entire working capital investment must be evaluated for potential *salvage value*, creating a cash *inflow* at the end of the project life.

Leverage Effects

Cash flows and discount rates must be matched up in terms of the investor group being analyzed – If the discount rate is the cost of equity, the cash flow has to be the cash flow to equity investors; if the discount rate is the cost of capital, the cash flow has to be the cash flow to the firm.

So, two approaches:
The Equity Approach
- Estimate cash flows associated with debt financing (interest and principal payments); subtract these from project cash flows, to calculate residual cash flows left over for equity investors.
- This cash flow must be discounted at a return that reflects the expectations of the equity investor (the cost of equity).
- The resulting PV should be compared to the *equity* investment in the project, to compute *equity* NPV.

The Project Approach
- Estimate total project cash flows, *not* subtracting debt payments, to calculate the cumulated cash flows to both equity investors and lenders.
- Discount these cash flows at the weighted average cost of capital, which is the weighted average of the return the equity investors demand and the after-tax cost of borrowing.
- Compare PV to *total* investment, to get *project* NPV.

Projects with Unequal Lives

Longer term projects are likely to have larger NPVs, even if they are less "attractive". How do we adjust for different lives of projects?

Example: Consider two projects (r=12%):
- Project A, 5-yr (-1000, 400, 400, 400, 400, 400)
- Project B, 10-yr (-1500, 350, 350, ……, 350)

NPV_A = \$442, while NPV_B = \$478.
- Is the second project better?
- This analysis fails to factor in the addition NPV that the firm could make from years 6-10 in the 5-yr project.
- Firm must consider the fact that it will get a chance to invest again *sooner* with a shorter term project.

Two ways of adjusting for unequal lives:
- Project replication
- Equivalent annuities

Project Replication

Assume that the projects can be replicated until they have the same lives (also called *matching cycles*).

Example: Do the 5-yr project twice, then compare it to the 10-yr project. Now they have equal lives!

This way, NPV_{A+A} = \$693. Now A becomes more attractive!

Criticism:
- Very tedious to use when the number of projects increases and the lives do not neatly fit into multiples of each other.
- E.g., using this approach, to compare three projects of 7-yr, 9-yr and 13-yr horizons, the analyst would have to replicate these projects to 819 years to arrive at an equal life on all three projects!
- Theoretically, it is very difficult to argue that a firm's project choice will essentially remain unchanged over time.

Equivalent Annuities

The NPV of projects can be converted into *an equivalent annuity*, which can be considered as an annualized NPV. Since the NPV is annualized, it can be legitimately compared across projects with different lives.

$$\text{Equivalent Annuity} = \frac{\text{NPV}}{\text{PVIFA(r,n)}}$$

[Use the same project's discount rate (r) and maturity (n)]

Example: Home Depot is considering three storage options (assume 12.5% cost of capital):

Option	Initial Investment	Annual Cost	Project Life
Build own storage	$10 mil.	$0.5 mil.	Infinite
Rent storage	$2 mil.	$1.5 mil.	12 yrs
third-party storage	-	$2.0 mil.	1 yr

Which option should Home Depot pick?

Option	NPV	Equivalent Annual Cost
Build own storage	$14.00 mil.	$1.75 mil.
Rent storage	$11.08 mil.	$1.83 mil.
third-party storage	$2.00 mil.	$2.00 mil

Replacement Decisions

When should you replace an existing asset with a newer one that performs the same functions?

- Replacing old equipment with new involves a net cash *outflow* (usually, unless the old one has antique value!).
- There will be cash *inflows* during the life of the new machine, either due to lower operation costs and/or higher revenues (why else would you replace it?). These are augmented by tax benefits from higher depreciation.
- The salvage value at the end of the life of the new equipment will be the differential salvage value, i.e., the excess of the salvage value on the new equipment over the salvage value that would have been obtained if the old equipment had been kept for the entire period and not replaced at the beginning.

Example: Suppose a mail-order company is considering replacing an old packaging system with a new one. The old system has a book value of $50,000 and a remaining life of 10 yrs and could be sold for $15,000 (net of capital gains taxes) right now. The new machine costs $150,000 and has a depreciable life of 10 yrs, annual operating costs $40,000 lower than the old machine. Assuming straight line depreciation, 40% tax rate, and no salvage value on either machine at the end of 10 years, should the company replace the old packaging system?

Net initial investment in new machine

$$= \quad -150{,}000 + 15{,}000$$
$$= \quad \$135{,}000$$

Depreciation on the old system $= \$5{,}000$

Depreciation on the new system $= \$15{,}000$

Annual tax savings from additional depreciation on new machine $= \quad (15{,}000 - 5{,}000) \times 0.4$
$$= \quad \$4{,}000$$

Annual after-tax savings in operating costs

$$= \quad 40{,}000\,(1 - 0.4)$$
$$= \quad \$24{,}000$$

Assuming a 12% cost of capital for the company,

NPV of the replacement decision

$$= \quad -135{,}000 + 28{,}000\,(PVIFA_{12\%,10})$$
$$= \quad \$23{,}206$$

The decision: Replace it!

Timing Decision

This is the decision of when to act on or take a project.

Examples:
- The owner of a product patent may have to decide when to introduce the product.
- The owner of a lumbar tract may have to decide when to harvest the trees for lumbar.

In timing decisions, there is generally both a cost and a benefit to waiting:
- By waiting, the firm may be able to get better information on the market, or get a higher price for the product, or may have time to improve the product.
- The disadvantages of waiting:
  - the time value of waiting an extra period,
  - the risk of a competitor entering the market first,
  - costs may increase over time.

If the benefits of waiting exceed the cost, it pays to wait.

Another interpretation of the timing decision:
- The optimal time to take the action is the one that maximizes the NPV.

Example: Suppose you own land with trees for lumber. It costs $1 mil. to clear the land. Lumber harvested right now yields $1.1 mil. These costs are expected to grow at 3% per year over time. Your cost of capital is 10%. Assume the trees become more valuable over time, with their values growing as shown below:

Year	Growth Rate	Lumber Value	Harvesting Cost	NPV
0		$1,100,000	$1,000,000	$100,000
1	10	1,210,000	1,030,000	163,636
2	9	1,318,900	1,060,900	213,223
3	8	1,424,412	1,092,727	249,200
4	7	1,524,121	1,125,509	272,257
5	6	1,615,568	1,159,274	283,323
6	*5*	*1,696,346*	*1,194,052*	*283,532*
7	4	1,746,200	1,229,874	274,194
8	3	1,817,126	1,266,770	256,745
9	2	1,853,469	1,304,773	232,701
10	1	1,872,004	1,343,916	203,600
11	1	1,890,724	1,384,234	177,522
12	1	1,909,631	1,425,761	154,176

The NPV is maximized if the lumbar is harvested in the sixth year!