Capital Budgeting/ time value of money

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What is Capital Budgeting?

- Making of decisions about capital expenditure
  - capital investment today, backed by cashflows over a period of time.
  - capital acquisition today, followed by cashflows in future
- **Capital budgeting vs. Budgeting for revenue expenses**
  - Outflows/inflows scattered over time – not possible to simply compare nominal values of the inflows/outflows. Apply discounted cashflow (DCF) techniques.
  - Cash inflows and outflows happen at the same time- easy to compare inflows/outflows.

Time Value of Money Analysis

- All financial transactions that involve a period of time are designed to produce a rate of return to the investor, and a cost to the investee.
- Whether the rate of return is contractually fixed or not depends on the type of investment.
  - ownership or equity type investments do not carry fixed rate of return. debt type contracts carry fixed rate of return.
- Why does money have to have a rate of return?
  - One common reason is inflation.

Simple and compound interest

- **Simple Interest-** Interest continues to accrue over a period of time at a given rate.
  - **SI = P(r)(n)**

    Where, P = Principal invested today
    SI = Simple Interest
    r = Rate of interest
    n = time period
- **Compounding of interest-** compensation for the investor not actually receiving interest periodically
  - **$A = P(1+r)^n$**

    CI = A – P

  Where, A = Amount, i.e principal + interest
  P = Principal invested today
  CI = Compound Interest
  r = Rate of interest
  n = Time period

Compounding Principles

- Compounded value depends on
  - rate of compounding
  - frequency of compounding
- **Continuous compounding**
  - $FV = PV.e^{rn}$
  - $CI = FV - PV$
    - Where, e = exponential
      n = tenure

Future value of money and present value of money

- **Future Value-** value that money will acquire in future, if compounded at a given rate of return.
  - $FV = PV (1+r)^n$

    Where, FV = Future Value of money
    PV = Present Value of money
    r = interest rate (assumed/ actual)
    n = time period
- **Present Value-** value of money that is expected in future, today.
  - $PV = FV/ (1+r)^n$

Discounting and Discounted value

- As we compute the value of present money in future, we are compounding it. As we compute the value of future money at present, we are *discounting* it.
  - Generalized formula for discounting on continuous discounting basis:
    - $PV = FV / e^{rn}$

      - Where, r = discounting rate

        n = years

Internal/ Implicit rate of return (IRR)

- The word internal or implicit is only to state that on the face of it, the rate was not explicit.
  - IRR is the rate where NPV = 0
    - $NPV = 0 = CF0 - (CF1/(1+r)^1 + CF2/(1+r)^2 + ... + CFn/(1+r)^n)$
    - $Or;\ CF0 = (CF1/(1+r)^1 + CF2/(1+r)^2 + ... + CFn/(1+r)^n)$

      - Where, IRR = Internal Rate of Return
      - NPV = Net Present Value
      - CF = Cash Flows

Quick notable points about IRRs

- Is IRR the same as rate of interest?
  - If transaction is a loan, such rate is rate of interest. If transaction is not a loan, it is not appropriate to use the word “rate of interest”. IRR is more generic.
- In loan transactions, there is no need to compute IRRs?
  - No need to compute IRR if rate of interest in a loan is explicit, and there are no other significant cash inflows or outflows than payment of interest or principal.
- There is a common notion that the computation of IRR is based on an assumption that every cashflow is reinvested, and reinvested at the same rate as the IRR. Do you agree?
  - No basis for this notion. This is indeed a misnotion.

Net present values

- If we consider a series of cashflows, and compute present values of all the cashflows at a particular discounting rate, and then sum up the present values, the result is called *net present value*.
  - NPV = $CF0 - (CF1/(1+r)^1 + CF2/(1+r)^2 + \ldots + CFn/(1+r)^n)$
    - Where r is the discounting rate for computing the NPV.

What does the NPV imply?

- NPV is not necessarily the profit – NPV is a measure of net value of a deal.
  - If the discounting rate is the cost of funds, then NPV captures the monetary value of the profit, measured upfront.
  - several choices for discounting rates – we may use opportunity cost, risk free rate, etc.

Factors on which NPV would depend:

- **Factors**
  - IRR inherent in the cashflows
  - Discounting rate
  - Objective of the analysis
  - Consistency of comparison
  - Risk free and risk adjusted discounting rates
  - Pre-tax and post-tax discounting rates
  - Size of investment
  - Tenure of investment
  - Structure of repayment
- **Is NPV a tool of comparison?**
  - Stand-alone NPV does not say much. NPV has to be used in conjunction with something like IRR or duration to make it analytically important.

Use of discounting rate in NPV computation

- What discounting rate to use for discounting the cashflows?
  - No uniform answer to this question. The analyst must understand the purpose of the analysis and the nature of NPV.
  - NPV is the present value of difference between the discounting rate and the rate of inherent in the cashflows (assuming the cashflows have a rate of return inherent).

Appropriate Discounting Rates to be used (contd..)

- While analyzing cashflow of Project A, in which I would invest. I have the opportunity of investing in Project B that would give me a rate of return of 10%.
  - 10% discounting rate (being opportunity rate or opportunity cost) used for Project A
- While analyzing cashflows of both Project A and Project B, and funding of the 2 projects is to come from a certain combination of debt and equity,
  - weighted cost of capital of the sources of funding
- Project A and B above will be funded from the internal resources of the company.
  - weighted average cost of capital
- If the cashflows in question are the residual cashflow from a project, net of interest and financing costs,
  - return on equity (ROE) or return on economic capital (ROCE)

Appropriate Discounting Rates to be used

- If cashflows being discounted are post-tax cashflows,
  - post-tax discounting rate (for eg., post-tax cost of capital)
- If cashflows are pre-tax cashflows,
  - pre-tax discounting rate
- If the riskiness of the cashflows has already been captured by computing the expected value of the cashflows,
  - risk-free discounting rate.
- Discounting rate does not have to be static – it may be a variable discounting rate.
  - For eg, if the rate of return on risk free securities is used as the discounting rate, it is well known that the rate is not the same for different tenures.
    - Hence, cashflows occurring at different points of time may be discounted at different discounting rates.

Incorporating riskiness of cashflows

- The uncertainty of future cashflows in dealt with in one of the two ways in time value of money analysis:
  - Risk adjusted discounting rate
    - Use of beta of the cashflows
    - Use of return on equity, or weighted average cost of capital
  - Use of expected values

Decision tree Analysis

- Another way of incorporating and evaluating different scenarios
- Suppose, there are two or more scenarios at the inception, and each scenario in turn leads to two or more scenarios, leading to a kind of a tree with branching, splitting into sub-branches, and so on.
  - To evaluate the decision tree, we first evaluate the branches on the right-hand side and compute the value of each branch.
    - Then, we come to the *nodes* where these ultimate branches began, and compute the value at each node.

Measures of risk: measures of dispersion

- Here, we measure the dispersion from the average.
  - Say, two projects might both have expected value of $ 1000, but the underlying volatility, that is, the dispersion of values away from the mean, may greatly differ.
    - Hence, the riskiness of the two projects may be widely different. Expected value does not give sufficient information about the risk.
- Several measures used to measure the risk:
  - Expected value
  - Range
  - Mean absolute deviation (MAD)
  - Standard deviation (s)
  - Variance (s^2)
  - Coefficient of variance
  - Semi-variance

Assessing risk by simulation

- Where a project or investment has different outcomes or scenarios, a simulation run tries to simulate the reality about the outcomes of the project.
  - The reality is uncertain, and uncertainty is best captured by random numbers.

Capital rationing

- If we assume that there is a capital constraint, and if the firm may invest in several competing projects, not all of which may be *mutually exclusive*,
  - then, choose such combination as maximizes the NPV to the firm.
- Criteria for choosing projects is the *profitability index*, that is, the NPV of the project divided by its capital outlay, or the NPV per dollar of capital outlay.
  - To be more precise, one must say, profitability index, divided by duration, should be the decision criteria.

Inflation-adjusted cashflows (contd..)

- Discounting rate or rate of return includes an element of inflation too.
  - Impact of inflation is already taken care of in the discounted vales.
- Inflation has common impact on both the required rate of return, and on the projected cashflows, and hence, tends to cancel out itself.

Inflation-adjusted cashflows

- If future cashflows have been projected under assumption of price fixity, inflation-adjusted cashflows, and inflation-adjusted discounting rate, may not exactly neutralize- Important to incorporate the impact of inflation.
  - Expected cashflows which are inflation-indexed be revised upwards by incorporating inflation rate.
  - Cashflows that are not affected by inflation taken without incorporating the impact of inflation.
  - Now, there are two approaches:
    - Discounting rate may not be inflation-adjusted rate.
      - Inflation-deflated cashflows are discounted by usual discounting rates to obtain the present value.
    - If discounting rate already captures the impact of inflation-
      - Inflation-adjusted cashflows are discounted at that rate.