Investment Appraisal

Chapter 3

Investments: Spot and Derivative Markets

Compounding vs. Discounting

- Invest sum over years, how much will it be worth?
- Terminal Value after *n* years @ *r* :
  - $TV_n = P(1+r)^n$ if $r_1 = r_2 = \ldots = r_n$
  - $1000\,(1.1)^2 = 1210$
- Offer a final sum in *n* years, how much should I get now?
- Discounted Present Value:
  - $DPV = \frac{TV_n}{(1+r)^n} = \frac{1210}{1.1^2} = 1000$
- Discounting is the inverse or mirror image of compounding.

Investment Appraisal (a.k.a. Capital Budgeting)

- Central concepts:
  - Capital cost (KC)
  - Opportunity cost of capital *(*typically *r)*
  - Net Present Value (NPV)
  - Internal Rate of Return (IIR)
  - In principle equivalent concepts, but one may be more informative than another, depending on the context used.

A Project Proposal

- Cash Flow:
  - $CF_1 = 1100$ and $CF_2 = 1210$
- KC = 2100
- $R = 10\%$

- Should you invest?
- 2310 > 2100

NPV

- $$DPV_{CF} = \frac{CF_1}{(1+r)} + \frac{CF_2}{(1+r)^2} = \frac{1100}{1.1} + \frac{1210}{(1.1)^2} = 2000$$
- KC = 2100
- DPV – KC < 0
- Do not invest, because opportunity cost of capital not compensated for.
- Equivalently,
  - Place KC in bank for 2 years: TV_{KC} = 2541
  - Terminal Value of Project: 2420
  - Why?

IRR

- IRR is that rate of interest that equates an initial outlay with the DPV of an income stream.

$$2000 = \frac{1100}{1+y} + \frac{1210}{(1+y)^2}$$

- y = ?
- Implicit assumptions:
  - y is an *average* growth rate.
  - All payments received before the terminal investment are re-invested at y. Why?

Different CF Profiles

- {-,-,…,+,+,…} NPV>KC or $y > r$ → Invest
- {+,+,…,-,-,…} NPV>KC or $y < r$ → Invest
- {-,+,-,...} NPV>KC → Invest. IRR ambiguous.

Mutually Exclusive Projects

- *Scale/Timing* Problem: $\{CF_t, CF_{t+1}\}$
  - Project A: {-10, +15} with r = 10% → IRR = 50%, NPV = 3.64
  - Project B: {-80, +110} & r = 10% → IRR = 37.5, NPV = 20.
  - Use NPV or adjust IRR:
  - *Incremental CF*: $CF_B - CF_A$ →= {-70, 95}
  - *Incremental IRR:* $$0 = -70 + \frac{105}{(1 + IncIRR)}$$
    → *35.7% > r*
  - *Incremental NPV* $$-70 + \frac{95}{1.1} = 16.36 > 0$$

Real vs. Nominal

$$(1+r_n) = (1+r_r)(1+\pi)$$

- Nominal CF discounted at nominal rate
- Real CF discounted at real rate
- Assume π = 5%, r_r = 3% & get €100 in a year:

  100/1.0815 = 100/(1.05*1.03) = 92.464

  100/1.05 = 95.238

  95.238/1.03 = 92.464

Timing of Capital Expenditures

- The timing of the initiation of a project can be crucial. But when is a good time?
- Delays imply lose out on revenue but save on interest payments.
- If we know the CFs (and *r*) with certainty we can work out the NPV of the project at different start dates.
- Take care express the NPVs for different start dates in present value terms (i.e. NPV_1 is discounted for one period, NPV_2 for two periods…).
- Choose Project with highest NPV.
- Intuitive delay if growth in NPV > r

Uncertainty & Risk

- Cash Flows (& *r*) tend to vary over time.
- Use probability distributions to account for this: use *expected* CF
- E.g., a *good* and a *bad* state of the economy $\{V_G, V_B\} = \{100, 40\}$ & $\{\mathrm{Pr}_G = 0.75, \mathrm{Pr}_B = 0.25\}$:

$$V^e = 0.75*100 + 0.25*40 = 85$$

$$\Rightarrow \text{NPV} = -\text{KC} + V^e/(1+r)$$

- Decision Trees:
  - How many contingencies?
  - Exponential increase in complexity over time.
- Liquidation Value
- Real Options Theory, Sensitivity Analysis, Scenario Analysis
- Discount Factor:
  - ‘Safe’ Rate? Projections of yield curve.
  - Risk Premium? (, e.g. CAPM, WACC)
- Capital Rationing → NPV fails, so use Profitability Index to rank projects:

$$PI = \frac{DPV\left(CF\right)}{KC}$$

Other Decision Rules

- Payback Period:
  - Number of years it takes for CF to exceed KC.
  - Problem is CF not discounted.
  - Unsophisticated (and therefore useful) *Rule of Thumb* often used alongside NPV.
  - More frequently used in small firms and Europe according to CEO survey.
- Return on Capital Employed (ROC)

  [Return on Investment (ROI), Accounting Rate of Return (ARR)]:
  - ‘Profits’/KC
  - What profits to use? Current, average past, projections…
  - Investment may take place over several periods.

Financing & Investment Decisions

- The financing and investment decisions are treated separately → A project's PV is calculated independent of debt considerations.
- Many possible sources of finance → Weighted Average Cost of Capital. Consider a ***D***ebt & ***E***quity financed firm for example:

$$1 + r_{WACC} = \left(\frac{D}{D+E} \right)(1 + r_D) + \left(\frac{E}{D+E} \right)(1 + r_E)$$

- Does bankruptcy risk increase WACC? Chapter 11 Modigliani & Miller 'Irrelevance of Funding Theorem'.

Some Practical Considerations

- EBITD = Revenue – Inputs Costs
- Depreciation (price, scrap value, lifetime)
- Tax $T = t(R\text{-}C\text{-}D)$
- Post tax CF:

$$CF_{Post\ Tax} = (R\text{-}C)(1\text{-}t)+tD$$

- tD is the depreciation tax shield

Working Capital

- Predictions on CF & KC tend to be smoothed out, WC is to account for the leads and lags.
- WC = Inventory + accounts receivable – accounts payable
- Change in WC = Change in inventory + change in accounts receivable – change in accounts payable

- Opportunity Cost
- Sunk Costs

M&A

$$Gain = NPV_{A+B} - \left(NPV_A + NPV_B \right) - tc$$

- Success? Mixed assessment & difficult to assess NPV_{A+B}.
- Synergies? Economies of scale related cost sharing, market power, customer base, …
- Are these beneficial to society?
- Discount Rate?
  - Horizontal (similar industry & rate) vs. Vertical (prob. differ) Merger
- Shareholder Maximisation vs. Empire Building
- Free Cash-Flow Hypothesis: M. C. Jensen, 'The Performance of Mutual Funds in the Period 1945-1964' *Journal of Finance*, 1968, *23*, 389—416.
- Should invest in all own projects with NPV > 0, then release excess cash to shareholders to invest as they want. M&A only if gains accrue from joining itself.