Valuation
Free Cash Flows

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Finance Theory II
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Valuation Tools

- A key task of managers is to undertake valuation exercises in order to allocate capital between mutually exclusive projects:
  - Is project A better than doing nothing?
  - Is project A better than project B?
  - Is the project’s version A than its modified version A’?

- The process of valuation and ultimately of capital budgeting generally involves many factors, some formal, some not (experience, hard-to-formalize information, politics, etc.).

- We will focus on financial tools for valuation.
Valuation Tools (cont.)

- These tools provide managers with numerical techniques to “keep score” and assist in the decision-making process.

- They build on modern finance theory and deal with cash flows, time, and risk.

- All rely on (often highly) simplified models of the business:
  - Technical limitations (less now with computers)
  - Versatility
  - Understandable and discussible
How to Value a Project/Firm?

- **Calculate NPV**
  - Estimate the expected cash-flows
  - Estimate the appropriate discount rate for each cash flow
  - Calculate NPV

- **Look up the price of a comparable project**

- **Use alternative criteria (e.g., IRR, payback method)**
  - You need to be an educated user of these
Comparables method

- Suppose you want to value a private company going public
  - EBITDA = $100 million
  - For a similar public company P/E = 10
  - You value the IPO company at $1,000 million

- What are the implicit assumptions?
  - Suppose that $P = \frac{E}{(r - g)}$
  - Then, $P/E = \frac{1}{(r - g)}$
  - Thus, we assume that
    - Earnings are expected to grow in perpetuity at a constant rate
    - Growth rates and discount rates are the same for both firms
Internal Rate of Return (IRR)

- **One-period project**
  - Investment = 100 at time 0   Payoff = 150 at time 1
  - Rate of return = $\frac{150}{100} - 1 = 50\%$
  - NPV = $-100 + \frac{150}{\text{discount rate}} = 0$
  - Discount rate = $\frac{150}{100} = 50\%$
  - Rate of return is the discount rate that makes NPV = 0

- **Multiple period projects**
  - IRR is the discount rate that makes NPV = 0
  - $\text{NPV} = I_0 + \frac{C_1}{1 + \text{IRR}} + \frac{C_2}{(1 + \text{IRR})^2} + ... + \frac{C_T}{(1 + \text{IRR})^T} = 0$

Basic rule: Choose projects with IRR > opportunity costs of capital
Internal Rate of Return (IRR), cont.

- Suppose you choose among two mutually exclusive projects
  - E.g., alternative ways to use a particular piece of land
    - Project 1: cash flows -10 +20 IRR=100%
    - Project 2: cash flows: -20 +35 IRR=75%
  - Which project would you choose? (costs of capital = 10%)
    - Project 2 because it has a higher NPV

- Other pitfalls (BM, Chapter 5)
  - E.g., multiple IRR, lending vs. borrowing.

- Bottom line
  - NPV is easier to use than IRR
  - If used properly, IRR should give you the same answer as NPV
1. Calculating Cash Flows
The Free Cash Flow (FCF) Approach

- **FCF**: The expected after tax cash flows of an *all equity firm*
  - These cash flows ignore the tax savings the firm gets from debt financing (the deductibility of interest expense)

- **Plan of Attack:**
  - Step 1: Estimating the Free Cash Flows
  - Step 2: Account for the effect of financing on value

- **Preview: Two ways to account for tax shield:**
  - Adjust the discount rate (WACC method).
  - Adjust the cash-flow estimate (APV method).
Count *all* incremental, *after-tax* cash flows allowing for reasonable *inflation*.

**All:**
- Don’t just look at operating profits in the out years.
- If project requires follow-on CAPX or additional working capital, take these into account.

**After-tax:** The rest goes to the IRS.

**Be consistent in your treatment of inflation:**
- Discount nominal cash flows at nominal discount rates.
- Reasons:
  - Nominal rates reflect inflation in overall economy, but inflation in cash flows may be different.
  - In fact, some items in cash flows, e.g., depreciation, may have no inflation.
Treatment of Inflation - Example

- T-Bill rate (nominal) = 8%
- Expected inflation rate = 6%
- Expected real rate = $1.08/1.06 = 1.9$

- Sales of widgets next year = $100 measured in today’s dollars
- You expect that the price of the widgets will go up by 6%
- What’s the PV of the widgets?
  
  nominal cash flows: \[ PV = \frac{100 \times 1.06}{1.08} = 98.2 \]
  
  real cash flows: \[ PV = \frac{100}{1.08/1.06} = 98.2 \]
Equivalent Expressions for Free Cash Flows (see Finance Theory I)

FCF = (1 – t) \times EBIT + \text{Depreciation} - \text{CAPX} - \text{Change in NWC}

FCF = (1 – t) \times EBITD + t \times \text{Depreciation} - \text{CAPX} - \text{Change in NWC}

FCF = (1 – t) \times EBIT - \text{Change in Net Assets}

\textbf{Note:}
EBIT = \text{Earnings before interest and taxes}
EBITD = \text{Earnings before interest and taxes and depreciation} = EBIT + \text{Depreciation}
Change in NWC is sometimes called Investment in NWC.
Example of Free Cash Flow Calculation

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In 1999: FCF = EBIT*(1-t) + Depreciation - CAPX - Change in NWC
EBIT = 1,200 - 850 - 35 = 315; Ch. NWC = (60+60-25) - (50+50-20) = 15
FCF = 315 * (1-.38) + 35 - 40 - 15 = 175.3
Beware!

- **Note:**
  - We ignored interest payments
  - We computed taxes on EBIT

- Do not take the effect of financing (e.g., interest) into account at this stage.

- Remember our plan:
  - First, determine the expected cash-flows as if the project were 100% equity financed.
  - Later, we will adjust for financing.

- If you count financing costs in cash-flow, you count them twice.
TW Example

- XYZ, a profitable widget producer ($100M annual after-tax profit) contemplates introducing new Turbo Widgets (TWs), developed in its labs at an R&D cost of $1M over the past 3 years.

- New plant to produce TW would
  - cost $20M today
  - last 10 years with salvage value of $5M
  - be depreciated to $0 over 5 years using straight-line

- TWs need painting: Use 40% of the capacity of a painting machine
  - currently owned and used by XYZ at 30% capacity
  - with maintenance costs of $100,000 (regardless of capacity used)

- Annual
  - operating costs: $400,000
  - operating income generated: $42M
  - operating income of regular widgets would decrease by $2M

- Working capital (WC): $2M needed over the life of the project

- Corporate tax rate 36%
TW Example (cont.)

- Ignore the $100M after-tax profit and focus on incremental cash-flows
- R&D cost of $1M over the past three years: Sunk cost ==> Ignore it
- The plant’s $20M cost: It’s a CAPX ==> Count it
- Machine’s $100K maintenance cost: Not incremental ==> Ignore it
  - Incurred with or without TW production
  - True even if accounting charges TW production a fraction of these

- Op. income of regular widgets decrease by $2M due to cannibalization
  - Would not occur without TW production
  - It is an opportunity cost ==> Count it

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Use Incremental Cash Flows

- Compare firm value with and without the project
  \[ V(\text{project}) = V(\text{firm w/ project}) - V(\text{firm w/o project}) \]

- Use only cash flows (in and out) attributable to the project
  - **Sunk costs should be ignored**
    - They are spent w/ or w/o the project (bygones are bygones).
  - **Opportunity costs should be accounted for**
    - A project might exclude good alternatives (e.g., use of land).
  - **Accounting illusions should be avoided**
    - e.g. the project might be “charged” for a fraction of expenses that would be incurred anyway.
Use After-tax Cash Flows

- These are what you have left after paying capital suppliers
- Make sure to count the benefits of expensing, depreciation, etc.
- CAPX and Depreciation:
  - CAPX are not directly subtracted from taxable income
  - Instead, a fraction of CAPX (depreciation) is subtracted over a number of years
TW Example (cont.)

- Depreciation:
  - Straight line depreciation: Flat annual depreciation
  - Accelerated depreciation: Decreasing

- $20M CAPX is depreciated linearly over 5 years, down to zero.
  \[ D = \frac{(20 - 0)}{5} = $4M \]

- Salvage value $5M is fully taxable since book value is zero.

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**Note:** We do as if entire EBIT is taxable ==> We ignore (for now) the fact that interest payments are not taxable.
So far (but we’re not done yet):

\[ CF = \text{Incr. Profit} - \text{Taxes} - \text{CAPX} \]

\[ = \text{Incr. Profit} - t \times (\text{Incr. Profit} - \text{Depr.}) - \text{CAPX} \]

\[ = (1 - t) \times \text{Incr. Profit} + t \times \text{Depr.} - \text{CAPX} \]

**Example:** We could have computed the CF in year 1 as

\[ (1 - 36\%) \times 39.6 + 36\% \times 4 - 0 = $26.8M \]
Changes in (Net) Working Capital

Remark 1:
- Many projects need some capital to be tied up (working capital) which constitutes an opportunity cost.
- We need the Change in Working Capital implied by the project.

Remark 2:
- Accounting measure of earnings
  \[
  \text{Sales - Cost of Goods Sold}
  \]
- Income and expense are reported when a sale is declared.
  - COGS in 2000 includes the costs of items sold in 2000 even if the cost was incurred in 1999 or hasn’t been incurred yet.
  - Sales in 2000 include the income from items sold in 2000 even if the payment has not been received yet.

\[
\text{Working Capital} = \text{Inventory} + \text{A/R} - \text{A/P}
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Putting It All Together

FCF = (1 – t) * Incr. Profit + t * Depr. – CAPX – ΔNWC

This can also be rewritten as

FCF = (1 – t) * EBIT + Depr. – CAPX – ΔNWC
Finding the Value of the Cash Flows

- **Decision Rule**
  - Accept any project with positive NPV. The NPV tells you how much value the project creates.

\[
\text{NPV} = CF_0 + \frac{E[CF_1]}{(1+r)} + \frac{E[CF_2]}{(1+r)^2} + \frac{E[CF_3]}{(1+r)^3} + \frac{E[CF_4]}{(1+r)^4} + \ldots
\]

- We know how to find the expected *free cash flows*

- We need to find the appropriate *discount rate* for a project

- We need to account for the tax benefits of interest payments
  - Ignore this for now, and assume that the project is 100% equity financed
What is the appropriate discount rate for a project?

- The discount rate is the *opportunity cost of capital for the project*.

- It answers the question: What rate can investors earn on an investments with *comparable risk*?

- What does comparable risk mean?
Using the CAPM

- What does ‘comparable risk’ mean?
  - CAPM: risk = $\beta$

- How does risk translate into a discount rate?
  - CAPM: $E[r_E] = r_f + \beta E[R_M - r_f]$

- Practical issues
  - Estimating betas
  - Estimating the market risk premium
  - Leverage
Beta = regression slope
Leverage, returns, and risk

Firm is a portfolio of debt and equity

Therefore ...

\[ r_A = \frac{D}{A} r_D + \frac{E}{A} r_E \]

and

\[ \beta_A = \frac{D}{A} \beta_D + \frac{E}{A} \beta_E \]
Estimating Betas

- **Equity Beta**
  - Simply regress past stock returns on the market return

- **Asset Beta**
  - For an all-equity firm, equity beta = asset beta
  - How about levered firms?
  - Hint:
    - You can view the firm as a portfolio of debt and equity
    - Recall: portfolio beta = weighted average of individual asset betas
    - Question: What are the appropriate weights?
    - You can assume that debt is risk-free or that debt beta is between 0.1 and 0.3 (based on empirical studies)