Valuation
Free Cash Flows

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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 $P = E / (r – g)$
  - Then, $P/E = 1 / (r – g)$
  - 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 = 150/100 – 1 = 50%

    NPV = -100 + 150/discount rate = 0

    Discount rate = 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

$$NPV = I_o + \frac{C_1}{1+IRR} + \frac{C_2}{(1+IRR)^2} + \ldots + \frac{C_T}{(1+IRR)^T} = 0$$

Basic rule: Chose 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 = $100*(1.06)/1.08 = 98.2

real cash flows: PV = $100/(1.08/1.06) = 98.2

Equivalent Expressions for Free Cash Flows (see Finance Theory I)

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

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

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

Note:

EBIT = Earnings before interest and taxes

EBITD = Earnings before interest and taxes and depreciation = EBIT + Depreciation

Change in NWC is sometimes called Investment in NWC.

Example of Free Cash Flow Calculation

	1998	1999
Sales	1,000	1,200
Cost of Goods Sold	700	850
Depreciation	30	35
Interest Expense	40	50
Taxes (38%)	80	90
Profit After taxes	150	175
Capital Expenditures	40	40
Accounts Receivable	50	60
Inventories	50	60
Accounts Payable	20	25

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

Year	0	1	2	3	4	5	6	7	8	9	10
CAPX	20	0	0	0	0	0	0	0	0	0	0
RW Inc. decrease	0	2	2	2	2	2	2	2	2	2	2

Use Incremental Cash Flows

- Compare firm value with and without the project

  V(project) = V(firm w/ project) - V(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.

$$D = (20 - 0) / 5 = \$4M$$

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

Year	0	1	2	3	4	5	6	7	8	9	10
CAPX	20	0	0	0	0	0	0	0	0	0	0
Depreciation	0	4	4	4	4	4	0	0	0	0	0
Salvage Value	0	0	0	0	0	0	0	0	0	0	5

TW Example (cont.)

Year	0	1	2	3	4	5	6	7	8	9	10
CAPX	**20.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Income	-	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0
RW Inc. decr.	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Incr. income	-	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Incr. cost	-	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Salvage value	-	-	-	-	-	-	-	-	-	-	5.0
Incr. profit	**-**	**39.6**	**39.6**	**39.6**	**39.6**	**39.6**	**39.6**	**39.6**	**39.6**	**39.6**	**44.6**
Depreciation	-	4.0	4.0	4.0	4.0	4.0	-	-	-	-	-
EBIT	-	35.6	35.6	35.6	35.6	35.6	39.6	39.6	39.6	39.6	44.6
Incr. taxes (36%)	**-**	**12.8**	**12.8**	**12.8**	**12.8**	**12.8**	**14.3**	**14.3**	**14.3**	**14.3**	**16.1**
Incremental CF	**-20.0**	**26.8**	**26.8**	**26.8**	**26.8**	**26.8**	**25.3**	**25.3**	**25.3**	**25.3**	**28.5**

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 = Incr. Profit – Taxes – CAPX

= Incr. Profit – t * (Incr. Profit – Depr.) – CAPX

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

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

(1 - 36%) * 39.6 + 36% * 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

  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.

Working Capital = Inventory + A/R - A/P

TW Example (cont.)

Year	0	1	2	3	4	5	6	7	8	9	10
CAPX	20.0	-	-	-	-	-	-	-	-	-	-
Incr. profit	-	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	44.6
Incr. taxes (36%)	-	12.8	12.8	12.8	12.8	12.8	14.3	14.3	14.3	14.3	16.1
NWC	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	-
Change in NWC	2.0	-	-	-	-	-	-	-	-	-	-2.0
Total	**-22.0**	**26.8**	**26.8**	**26.8**	**26.8**	**26.8**	**25.3**	**25.3**	**25.3**	**25.3**	**30.5**

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.

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

- 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

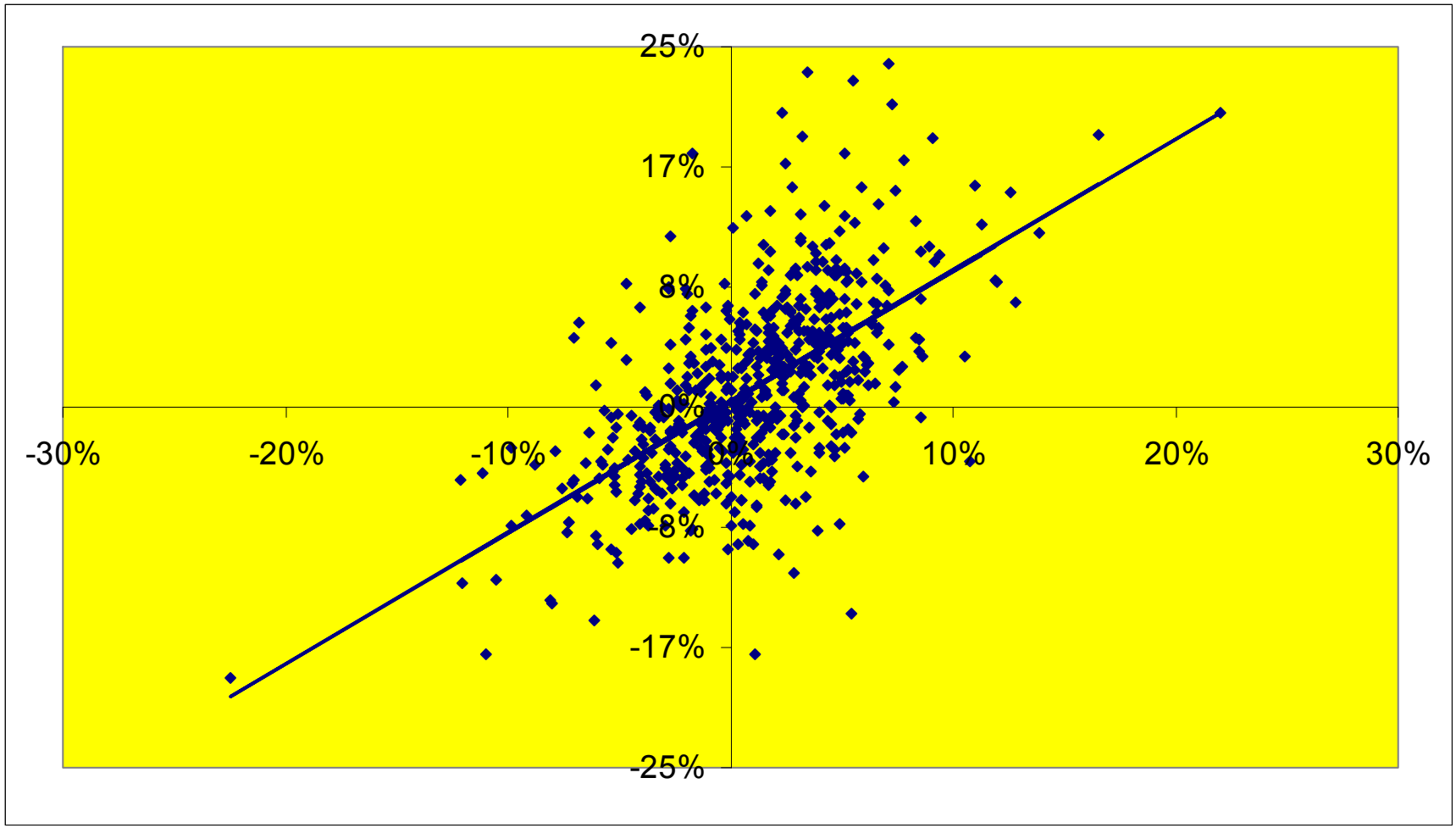
What is the appropriate discount rate for a project?

- **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

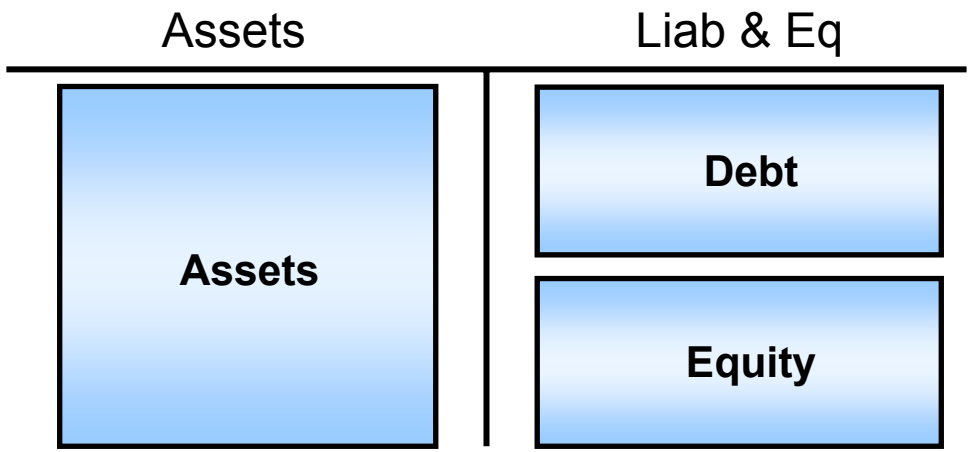
- **What does 'comparable risk' mean?**
  - CAPM: risk = β
- **How does risk translate into a discount rate?**
  - CAPM: $E[r_E] = r_f + \beta_E E[R_M - r_f]$
- **Practical issues**
  - Estimating betas
  - Estimating the market risk premium
  - Leverage

Beta = regression slope



Leverage, returns, and risk

Firm is a portfolio of debt and equity



Therefore …

$$r_A = \frac{D}{A} r_D + \frac{E}{A} r_E \qquad \text{and} \qquad \beta_A = \frac{D}{A} \beta_D + \frac{E}{A} \beta_E$$

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)