

# **Valuation**

## **Free Cash Flows**

Katharina Lewellen  
Finance Theory II  
April 2, 2003

# 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 =  $-100 + 150/\text{discount rate} = 0$

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

$$\text{NPV} = I_0 + \frac{C_1}{1 + \text{IRR}} + \frac{C_2}{(1 + \text{IRR})^2} + \dots + \frac{C_T}{(1 + \text{IRR})^T} = 0$$

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:  $PV = \$100 \cdot (1.06) / 1.08 = 98.2$

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

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

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

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

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

**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:**  $FCF = EBIT \cdot (1-t) + \text{Depreciation} - \text{CAPX} - \text{Change in NWC}$

$EBIT = 1,200 - 850 - 35 = 315$ ;  $\text{Ch. NWC} = (60+60-25) - (50+50-20) = 15$

$FCF = 315 \cdot (1-.38) + 35 - 40 - 15 = 175.3$

# 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
<b>CAPX</b>	20	0	0	0	0	0	0	0	0	0	0
<b>RW Inc. decrease</b>	0	2	2	2	2	2	2	2	2	2	2



# 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.  
$$D = (20 - 0) / 5 = \$4M$$
- Salvage value \$5M is fully taxable since book value is zero.

Year	0	1	2	3	4	5	6	7	8	9	10
<b>CAPX</b>	20	0	0	0	0	0	0	0	0	0	0
<b>Depreciation</b>	0	4	4	4	4	4	0	0	0	0	0
<b>Salvage Value</b>	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	<b>20.0</b>	-	-	-	-	-	-	-	-	-	-
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
<b>Incr. profit</b>	-	<b>39.6</b>	<b>39.6</b>	<b>39.6</b>	<b>39.6</b>	<b>39.6</b>	<b>39.6</b>	<b>39.6</b>	<b>39.6</b>	<b>39.6</b>	<b>44.6</b>
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
<b>Incr. taxes (36%)</b>	-	<b>12.8</b>	<b>12.8</b>	<b>12.8</b>	<b>12.8</b>	<b>12.8</b>	<b>14.3</b>	<b>14.3</b>	<b>14.3</b>	<b>14.3</b>	<b>16.1</b>
<b>Incremental CF</b>	<b>-20.0</b>	<b>26.8</b>	<b>26.8</b>	<b>26.8</b>	<b>26.8</b>	<b>26.8</b>	<b>25.3</b>	<b>25.3</b>	<b>25.3</b>	<b>25.3</b>	<b>28.5</b>

**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):**

$$\begin{aligned}\text{CF} &= \text{Incr. Profit} - \text{Taxes} - \text{CAPX} \\ &= \text{Incr. Profit} - t * (\text{Incr. Profit} - \text{Depr.}) - \text{CAPX} \\ &= (1 - t) * \text{Incr. Profit} + t * \text{Depr.} - \text{CAPX}\end{aligned}$$

**Example:** We could have computed the CF in year 1 as  
 $(1 - 36\%) * 39.6 + 36\% * 4 - 0 = \$26.8\text{M}$

# 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.

$$\text{Working Capital} = \text{Inventory} + \text{A/R} - \text{A/P}$$

## TW Example (cont.)

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

## Putting It All Together

$$\text{FCF} = (1 - t) * \text{Incr. Profit} + t * \text{Depr.} - \text{CAPX} - \Delta\text{NWC}$$

This can also be rewritten as

$$\text{FCF} = (1 - t) * \text{EBIT} + \text{Depr.} - \text{CAPX} - \Delta\text{NWC}$$



# 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.

$$\text{NPV} = \text{CF}_0 + \frac{\text{E}[\text{CF}_1]}{(1+r)} + \frac{\text{E}[\text{CF}_2]}{(1+r)^2} + \frac{\text{E}[\text{CF}_3]}{(1+r)^3} + \frac{\text{E}[\text{CF}_4]}{(1+r)^4} + \dots$$

- 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

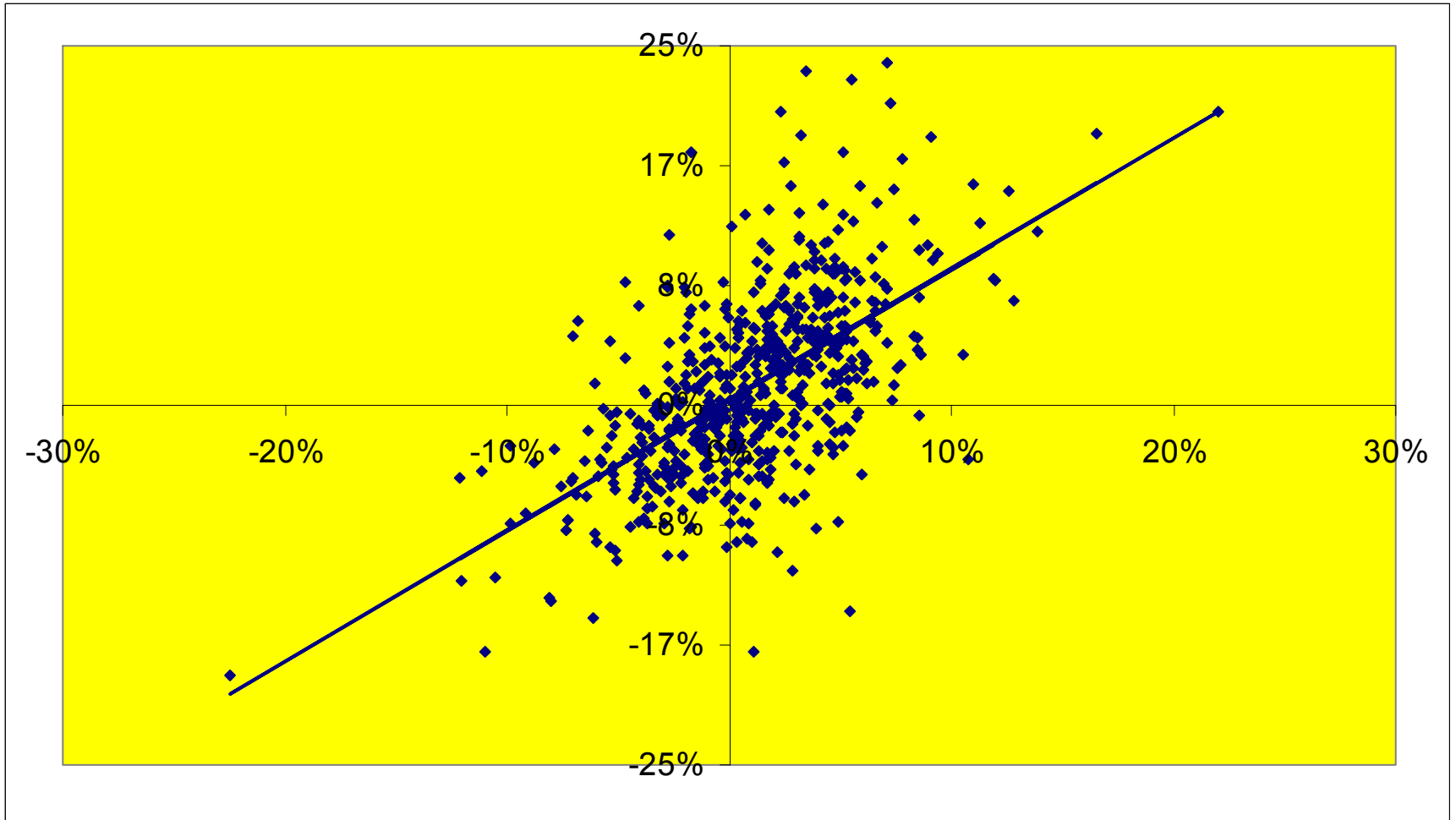
# What is the appropriate discount rate for a project?

- 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

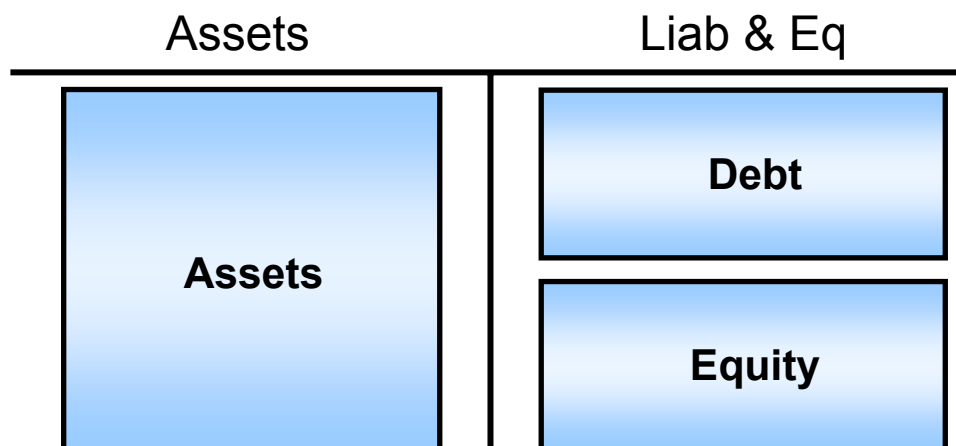
- **What does ‘comparable risk’ mean?**
  - CAPM: risk =  $\beta$
- **How does risk translate into a discount rate?**
  - CAPM:  $E[r_E] = r_f + \beta_E E[R_M - r_f]$
- **Practical issues**
  - Estimating betas
  - Estimating the market risk premium
  - Leverage

# Beta = regression slope



# Leverage, returns, and risk

Firm is a portfolio of debt and equity



Therefore ...

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

# 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)