Topics in Corporate Finance

Chapter 2: Valuing Real Assets

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Investment decisions

- Valuing risk-free and risky real assets:
  - Factories, machines,…but also intangibles: patents,…
  - What to value? cash flows!
  - Methods
    - Discounted cash flows (DCF)
    - Internal rate of return (IRR)
    - Payback method

Valuing real assets

- Should we invest?
  - For example, in buying a fridge or an office building
- First, how can we evaluate these “projects”?
  - Net Present Value: value today net of investment costs
- Then, the answer is easy…
  - Positive → Undertake it!! Negative → Don’t!

Present and Future Value

- A pound today is worth more than one tomorrow! Why?

- If the interest is 10% a year…
  - Investing 28 million today gives 30,8 million year
  - The future value (in a year) of 28 million is 30.8 million
  - The present value of 30.8 million in a year is 28 million

More generally

- Future Value: Amount to which an investment will grow after earning interest

$$FV = £x \times (1+r)^t$$

- Present Value: Value today of a future (expected) cash flow.

$$PV = \frac{1}{(1 + r)^t} \times C_t$$

- Discount Factor: Present value of a £1 future (expected) payment
- Discount Rate, hurdle rate or (opportunity) cost of capital
  - Interest rate used to compute present values of future cash flows
  - Best available expected return offered in the market on an investment of comparable risk and term to the cash flow being discounted (methods: CAPM, APT,…see asset pricing module, next term)

Example

- A fertilizer company can create a new environmentally friendly fertilizer at a large savings over the company's existing fertilizer

Step 1: Forecast cash flows

- The fertilizer will require a new factory that can be built at a cost of £81.6 million
- Estimated revenues on new fertilizer £28 million after the first year, and lasting four years

Step 2: Estimate opportunity cost of capital

- Project's cost of capital is 10%

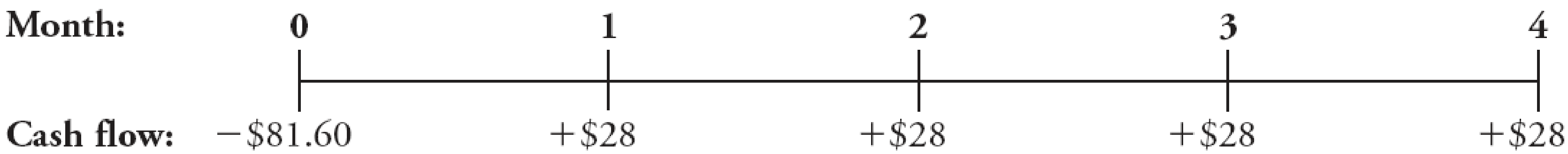
Step 3: Discount future cash flows

- ***See next slide***

Step 4: Go ahead if PV of payoff exceeds investment

Computing NPV

- Timeline with estimated returns:



- Cash flows: immediate £81.6 million "outflow" and an "annuity" "inflow" of £28 million per year for 4 years
- Therefore, given a discount rate r, the NPV is:

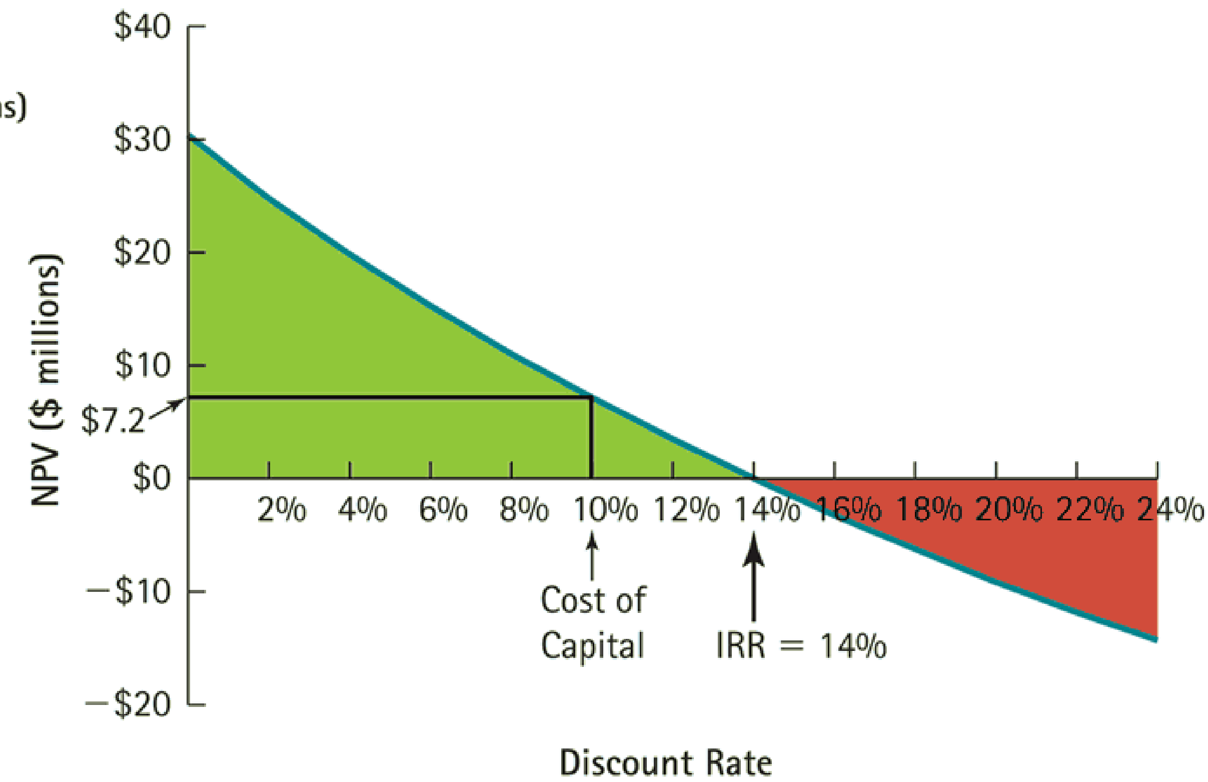
$$NPV = -81.6 + \frac{28}{1+r} + \frac{28}{(1+r)^2} + \frac{28}{(1+r)^3} + \frac{28}{(1+r)^4}$$

- Substituting r=0.1, the **NPV** is £7.2 million>0, hence invest!!

Panel (a)

Discount Rate	NPV ($ millions)
0%	$30.4
2%	$25.0
4%	$20.0
6%	$15.4
8%	$11.1
10%	$7.2
12%	$3.4
14%	$0.0
16%	−$3.3
18%	−$6.3
20%	−$9.1
22%	−$11.8
24%	−$14.3

Panel (b)



More generally…

- Net present value or "discounted cash flow":

$$\text{NPV} = \text{C}_0 + \frac{C_1}{1+r_1} + \frac{C_2}{(1+r_2)^2} + \frac{C_3}{(1+r_3)^3} + ... + \frac{C_T}{(1+r_T)^T}$$

- Where sometimes we denote

$$\text{NPV} = \text{C}_0 + PV \text{ where PV} = \frac{C_1}{1+r_1} + \frac{C_2}{(1+r_2)^2} + \frac{C_3}{(1+r_3)^3} + ... + \frac{C_T}{(1+r_T)^T}$$

- Back to the example:
  - If cash flows are certain, should r_2 be higher than r_1?
  - What if the fertilizer cash flows have higher risk (same expected value)?
  - What would the NPV if the fertilizer cash flows last forever?

Value of a "perpetuity"

The present value of a perpetuity (constant cash flows Cf and constant r):

Proof:

$$PV(\text{perp.}) = \sum_{t=1}^{\infty} \frac{Cf}{(1+r)^t} = \frac{Cf}{r}$$

$$V = \frac{CF}{(1+r)} + \frac{CF}{(1+r)^2} + \frac{CF}{(1+r)^3} + \ldots$$

$$(1+r)V = CF + \frac{CF}{(1+r)} + \frac{CF}{(1+r)^2} + \ldots$$

subtract the first equation from the second

$$\text{rV} = CF \quad \text{(or)} \quad \text{V} = \frac{CF}{\text{r}}$$

Project Selection

1. If only one from a set of positive NPV projects can be selected, we should select that with the largest NPV
2. When resources are limited, the profitability index (PI) helps selecting among various project combinations and alternatives:
   - PI = PV / $-C_0$
   - If resources are unlimited, we should select projects with PI>1
   - If resources are limited and projects are scalable then PI is useful
   - Example: Two scalable projects and GBP 10,000

Project	C_0	C_1	C_2	$NPV\ @10\%$	PI
A	-1	$+22$	-12.1		
B	-5	$+44$	-24.2		

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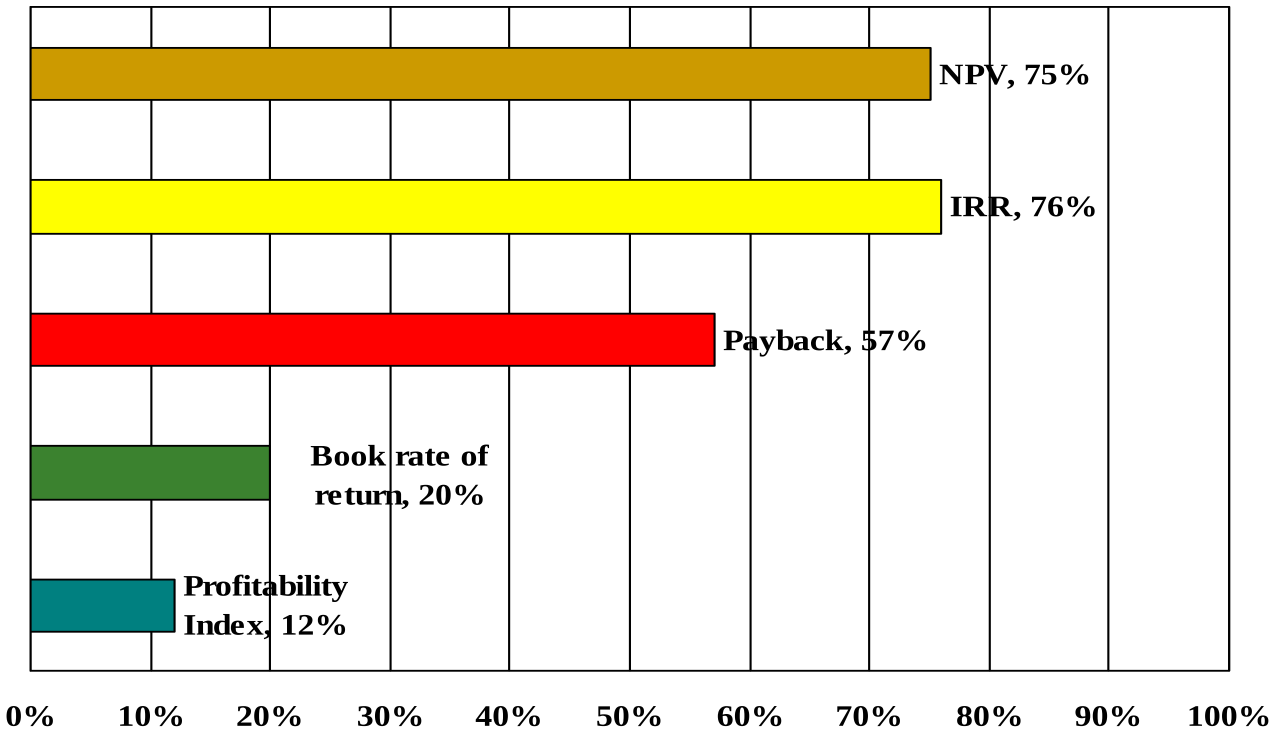
Project	C_0	C_1	C_2	$NPV@10\%$	PI
A	-1	$+22$	-12.1	9	9
B	-5	$+44$	-24.2	15	3

But, are there other criteria?

Survey Data on CFO Use of Investment Evaluation Techniques



SOURCE: Graham and Harvey, "The Theory and Practice of Finance: Evidence from the Field," Journal of Financial Economics 61 (2001), pp. 187-243.

Rate of Return Rule

- Accept investments that offer (internal) rates of return in excess of their opportunity cost of capital

<u>Example</u>

A project generates £420000 in a year but requires an investment of 370000 today, and the foregone investment opportunity is 12%. Should we take it?

$$\text{Return} = \frac{\text{profit}}{\text{investment}} = \frac{420{,}000 - 370{,}000}{370{,}000} = .135 \text{ or } 13.5\%$$

More generally

- The rate of return of a cash flow stream is the interest rate y that makes the NPV of a project equal to 0:

$$0 = C_0 + \frac{C_1}{1+y} + \frac{C_2}{(1+y)^2} + \frac{C_3}{(1+y)^3} + \ldots + + \frac{C_T}{(1+y)^T}$$

- ***Fertilizer example:***

$$NPV = -81 + \frac{28}{(1+IRR)^1} + \frac{28}{(1+IRR)^2} + \frac{28}{(1+IRR)^3} + \frac{28}{(1+IRR)^4} = 0$$

$$IRR = 14\%$$

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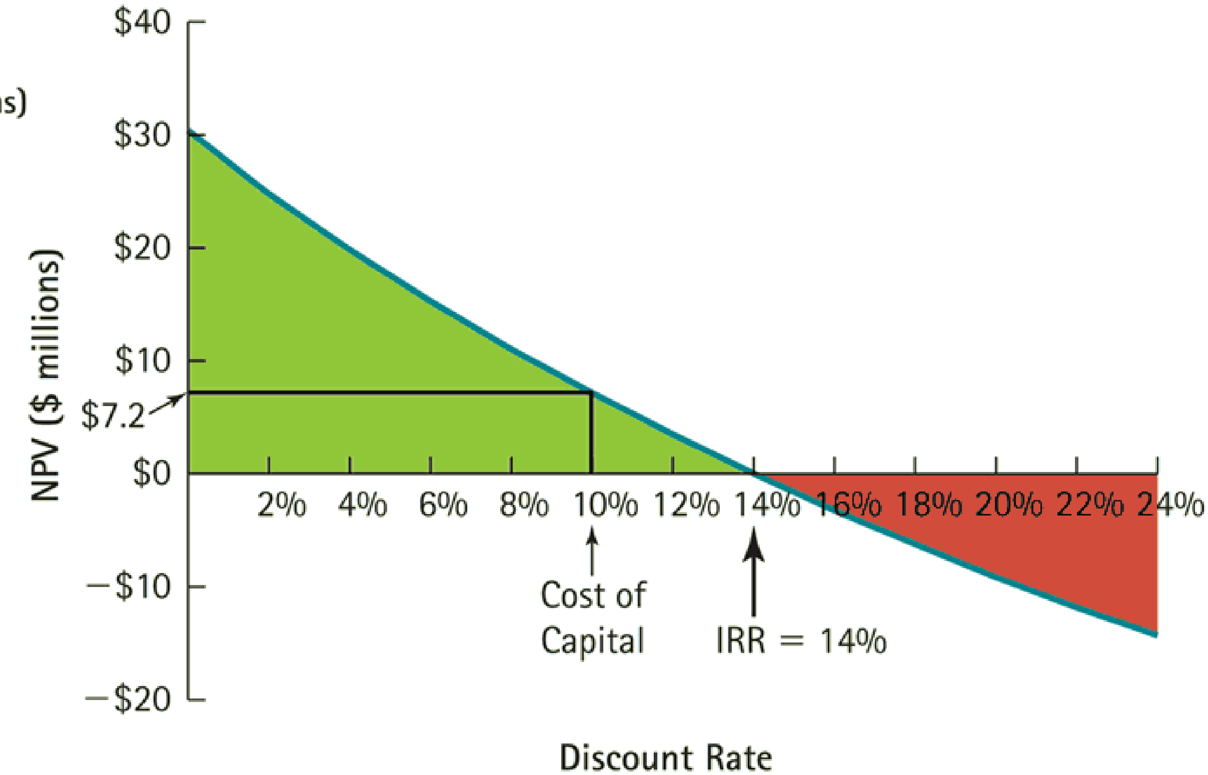
Panel (b)



IRR and NPV

- Computing the **IRR** is useful if estimate of cost of capital is imprecise
- **IRR rule** same criteria as NPV rule if NPV is decreasing wrt discount rate
- However, the **IRR rule** has some pitfalls:
  - If NPV increases (e.g. borrowing money), we should therefore ask for an IRR lower than the opportunity cost of capital
  - There might be several IRRs or none
  - Ignores magnitude and cannot select among different projects
  - Even more problematic if we discount rates are not stable over time (with which one do we compare?)

Payback

- The payback period of a project is the number of years it takes before the cumulative forecasted cash flow equals the initial outlay.
- The payback rule says only accept projects that “payback” in the desired time frame.
- This method is flawed, primarily because it ignores later year cash flows and the the present value of future cash flows
- Therefore it biases decisions towards accepting projects paying early

Payback

Example

Examine the three projects and note the mistake we would make if we insisted on only taking projects with a payback period of 2 years or less.

Project	C_0	C_1	C_2	C_3	Payback Period	NPV@ 10%
A	- 2000	500	500	5000	3	+ 2,624
B	- 2000	500	1800	0	2	- 58
C	- 2000	1800	500	0	2	+ 50

Reading

"How CFOs make capital budgeting and capital structure decisions", Journal of Applied Corporate Finance (2002)

Appendix

Compounding

Most interest rates are stated in annual terms. This does not, however, mean that interest is paid only once a year. Many securities pay interest semi-annually (e.g. Corporate Bonds), monthly (some savings accounts), daily, or even continually.

If the compounding frequency is not annual, then the stated interest rate is not equal to the actual return you are earning (effective annual yield). If the compounding frequency increases, so does the effective annual yield.

An example:

What is the future value of £1 in 5 years if r is 6% under:

1) annual compounding

$$FV = 1 \times (1.06)^{5} = 1.338$$

2) Semi-annual compounding (3% every six months)

$$FV = 1 \times (1.03)^{5 \times 2} = 1.344$$

3) Monthly compounding (0.5% per month)

$$FV = 1 \times (1.005)^{5 \times 12} = 1.349$$

In general, the future and present values of 1 dollar ***T*** years from now at a compounding frequency of ***m*** times per year are given by:

$$FV = \$1 \times \left(1 + \frac{r}{m}\right)^{m \times T} \qquad PV = \frac{\$1}{\left(1 + \frac{r}{m}\right)^{m \times T}}$$

Note: For continuous compounding, these expressions approach:

$$FV = \lim_{m \to \infty} \left(\$1 \times \left(1 + \frac{r}{m}\right)^{m \times T} \right) = e^{r \times T} \qquad PV = \lim_{m \to \infty} \left(\frac{\$1}{\left(1 + \frac{r}{m}\right)^{m \times T}} \right) = e^{-r \times T}$$

where e = 2.718 is the base of the natural logarithm

Consequently, we can convert r (stated by banks) to the effective annual yield.

We can then use the effective annual yield in order to compare interest rates that are paid with differing compounding frequencies.

$$1 + \text{Effective Annual Yield} = \left(1+\frac{r}{m}\right)^{m}$$

again, for continuous compounding, this rate approaches

Effective Annual Yield = $e^{r} - 1$

(Note: For a given r, a higher compounding frequency [i.e. more frequent interest payments] leads to a higher future value of an investment and a lower present value of future cash flows)

IMPORTANT: Unless otherwise specified, the interest rate (r) is the annually compounded annual interest rate.

I.e. if I tell you the interest rate is 4%, that means that after 1 year, the investor will have £1.04 for every £1 invested.

Inflation: We have treated all cash flows as nominal cash flows.

Real cash flows are adjusted for inflation and thus comparable across time in terms of their purchasing power.

One nominal dollar in 1995 is worth less (in terms of purchasing power) than one nominal dollar in 1980.

One real, inflation adjusted dollar in 1995 is worth the same (in terms of purchasing power) as a real dollar in 1980.

Interest rates also appear in real and nominal terms. The quoted interest is always nominal.

Always discount nominal cash flows with the nominal rate and real cash flows with the real rate.

If you earn a 6% nominal rate (r) on your investment of £100 and 3% of that return is "eaten up" by inflation (i), then your real return (ρ) is computed as:

$$£100 \times (1+\rho) = \frac{\$100 \times (1+r)}{(1+i)} = \$100 \times \frac{1.06}{1.03}$$

or $\rho = 2.91\%$

More Generally: $(1+r) = (1+\rho) \times (1+i)$

Suppose you receive a nominal cash flow of £50 next year (i = 4%, r = 12%)

$$PV = \frac{\$50}{1.12} = £44.64$$

Suppose you receive a real cash flow of £48.08 next year (equivalent to a £50 nominal cash flow)

compute the real interest rate: $1+\rho = 1.12/1.04 = 1.0769$

$$PV = \frac{\$48.08}{1.0769} = £44.64$$

Either way is correct. Most of the time calculating everything in nominal terms is easier. That does not mean that we are ignoring inflation, because inflation cancels out from using nominal cash flows and nominal interest rates.

Cash Flow Calculations

It would be nice if we could get cash flow forecasts directly.

Unfortunately, we often get numbers *filtered* through the Generally Accepted Accounting Principles (GAAP) or some other non-cash based format.

Even innocent projections by project managers often are about project specific incomes and expenses which, after running through firm wide tax effects and other distortions, are different from actual cash flows.

The specifics are for an accounting class. We will only cover the very basic ideas and adopt a 'cookie cutter' approach.

Review:

	Revenues
-	Costs
=	Operating Income (EBITDA)
-	Non-Cash Expenses (NCE)
=	EBIT (Operating Profit)
-	Interest Expenses
=	Pretax Income
-	Taxes
=	Net Income
-	Dividends
=	Addition to Retained Earnings

Also:

EBIT × (1-t) = **NOPAT**

Current Assets - Current Liabilities = **Working Capital**

Current Assets are things like inventories, accounts receivables, etc.

Current Liabilities are things like Accounts Payable

NCE are items like depreciation and ammortization

Free Cash Flow Calculations

Let Cf_t denote the **net** cash flow at time t.

Cf_t = Cash Inflow at t - Cash Outflow at t

Cf_t = NOPAT + Non-Cash Expenses (NCE)
- net capital outlays - increase in working capital

= EBITDA $\times$ (1 – t) + NCE $\times$ t
- net capital outlays - increase in working capital

= NI + NCE + Interest x (1-t)
- net capital outlays - increase in working capital

IMPORTANT:

- NEVER include financing cash flows (discounting takes care of the cost of capital)
- The ‘Statement of Cash Flows’ **does** often include financing cash flows (hence, use with caution!)
- Do not include sunk costs.
- Often it is easier to estimate *incremental* cash flows.
- Include the true opportunity costs of using existing assets. Treat these as cash outflows if the project under consideration eliminates other profitable uses of the assets
- Do not allocate a share of the general overhead based on an arbitrary measure, such as sales or labor hours, just because the accountants do it. The ‘real’ costs are relevant.