Chapter 2:
Capital Budgeting Decisions

Strategic Planning
"Top Down"

Capital Budgeting

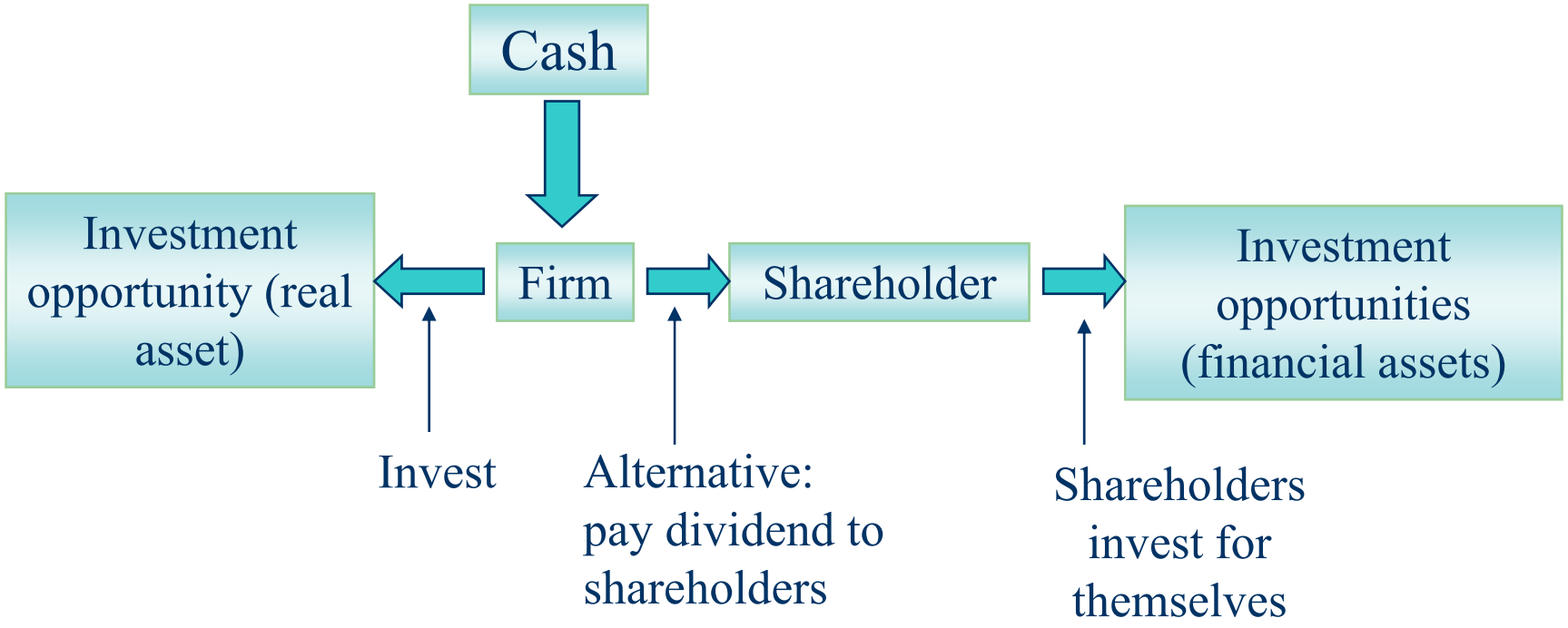
Project Creation
"Bottom Up"

Chapter 2: Capital Budgeting Decisions (CF Chap. 6 & 7)

Recommended homework: Read CF Chapters 6 & 7 and practice end-of chapter exercises + exercises on the internet site of the course.

1. Introduction

- The main task of a financial manager is to ensure that the firm creates value
- The main channel for value creation is to invest in fixed asset
- Investing in fixed asset corresponds to a capital budgeting decision
- In this chapter, we are going to learn how to analyze investment project:
  - What are the relevant CFs for valuing an investment project?
  - Which decision rule ensures value creation.



1. Introduction

Fundamental Principles of Project Evaluation:

- **Relevant cash flows:**
  The (incremental) cash flows that are a direct consequence of taking up the project

- **The relevant CFs are calculated using an incremental form:**
  Are only considered the **changes** in the firm's future cash flows resulting of the difference between CFs induced by the acceptance and the refusal of the project!

- **Project evaluation:**
  By application of one or more capital budgeting decision rules to estimated **relevant project cash flows** in order to make an accurate and consistent investment decision.

1.1. The Discount Rate

Definition: The discount rate is equivalent to an opportunity cost rate

Components of this rate: (cf. Finance 2)

Risk-free rate

+ Risk premium that depends on:

- Risk of the investment project
- Sector Return
- Inflation:

$$1+r=\frac{1+i}{1+\pi}\approx(1+i)(1-\pi)\approx 1+(i-\pi)$$

$$\Rightarrow r\approx i-\pi$$

with :

$r=$ real rate of return

$i=$ nominal rate of return

$\pi=$ inflation rate

This part will be covered in the Finance 2 part of the Finance course. For that matter, it's the main objective of the Finance 2 lectures.

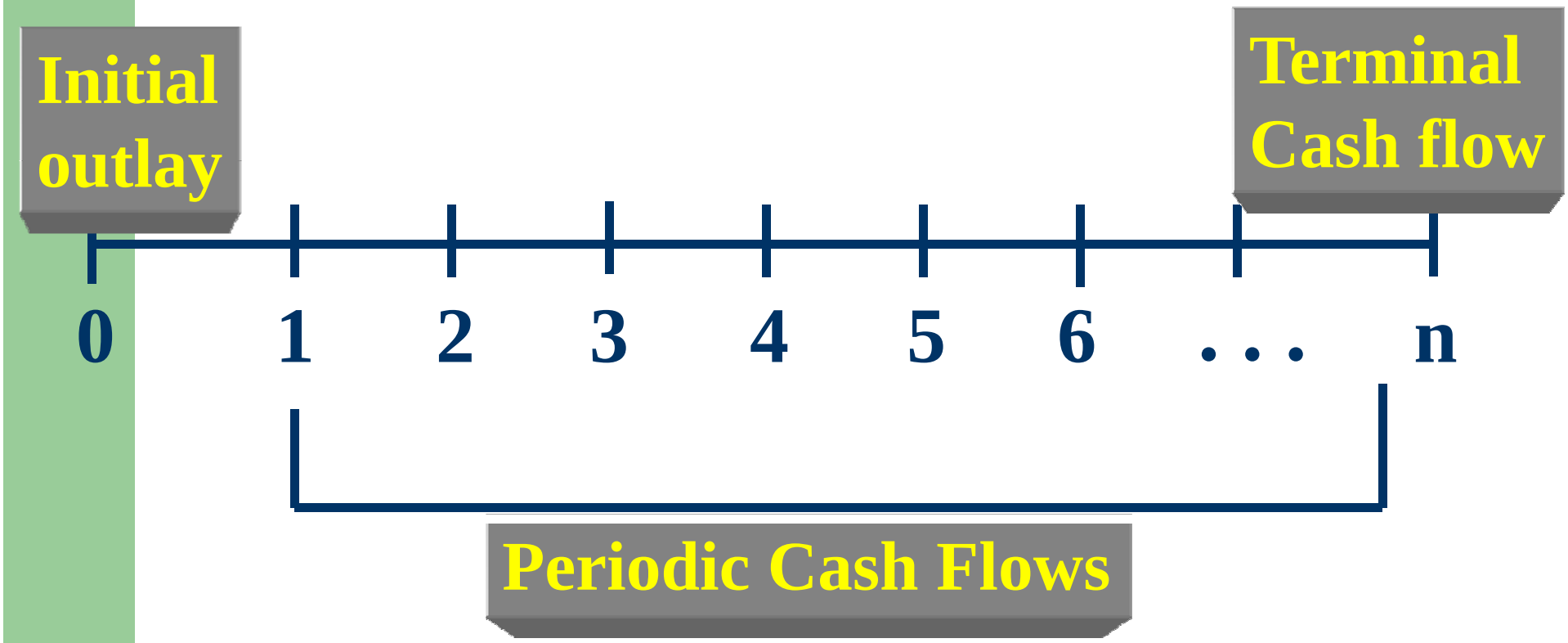
1.2. The Different forms of Investment Decisions

- Cost-Cutting Projects
- Replacing an asset
- Expansion Investment
- Strategic Investment

1.3. Capital Budgeting Stages

1) Evaluate Cash Flows:

- Initial outlay
- Periodic CFs: **Incremental** (or differential) Cash Flows over the life of the project => Determination of the Free Cash Flows (FCF) of the project
- Terminal Cash Flows



1.3. Capital Budgeting Stages

2) Evaluate the risk of the project:

Not done in this course (See Finance 2)
From now on, we'll assume that the risk of the project is the same as the risk of the overall firm and corresponds to the firm's cost of capital. Finance 2 will give you all the necessary tools for computing the Weighted Average Cost of Capital (WACC) of the firm.
In our course, the WACC, namely the discount rate, is always given in applications.

3) Accept or Reject the Project:

Application of one or more capital budgeting rule (like Project's NPV, or Project's IRR) and make a decision.

2. Relevant and Incremental Cash Flows

What are the Relevant CFs?

Decision Rule: You should always ask yourself "Will this cash flow occur ONLY if we accept the project?". If the answer is "yes", it should be included in the analysis. If the answer is "no", it should not be included in the analysis because it will occur anyway.

What are the Incremental CFs?

Computing Rule: The way the CFs are evaluated in Capital Budgeting Decisions obeys the following computing rule: you calculate Incremental CFs, or in other words, you calculate the difference between CFs induced by the project if it is taken up and CFs if the project is rejected.

2. Relevant and Incremental Cash Flows

What are the Relevant CFs?

- Sunk costs (A cost that has already been incurred and cannot be removed)

No

- Opportunity costs (Any cash flows foregone by taking one course of action rather than another)

Yes

- Side Effects or Externalities (New project revenues gained at the expense of existing products/services)

Yes

- Net working capital Investment

Yes

- Financing costs

No

-Overhead Costs induced by the project

Yes

2. Relevant and Incremental Cash Flows

What about Inflation?

- Be consistent in how you handle inflation!!
- Use nominal interest rates to discount nominal cash flows.
- Use real interest rates to discount real cash flows.
- You will get the same results, whether you use nominal or real figures

2.1. The Initial Outlay

•The initial outlay is the total up-front cost of the investment

•The initial outlay can consist of many components (all the following ones are negative):

- The cost of the investment
- Setup costs
- Training costs
- Any initial increase in net working capital

💣Don't forget the possible opportunity cost here and the induced tax effects.

💣 The after-tax salvage value of the old project (replacement project) (+ sign)

2.2 The Free Cash Flows

• **First, calculate the (annual) Operating Cash Flows** (CFs from Operation) and then adjust them to calculate the Free Cash Flows.

• **The annual Operating Cash Flows are the incremental CFs coming from the course of the project. They are computing, as usual, using incremental** (differential) **terms** (CFs if the investment project is considered **Minus** CFs if the investment project is not chosen)

• **Tips: build the pro forma financial statement of the project and focus on cash flows:**

OCF = Operating Cash Flows ; S = sales or turnover ; C = operating costs ; D = depreciation; EBIT = Earnings Before Taxes and Interests ; τ = corporate tax rate.

=>

$$\mathbf{OCF = S - C- (S -C - D)* \tau = (S - C – D)+D - (S -C - D)* \tau = EBIT*(1- \tau)+D}$$

$$\mathbf{FCF\ (Free\text{-}Cash\ Flows) = OCF - Capital\ Expenditures\ (CapEx) - \Delta NWC}$$

2.3 The Terminal Cash Flows

• The Terminal Cash Flows consist of those cash flows that are unique to the last year of the project's life span:

+ After-tax salvage value of the investment project

+ Recovery of the after-tax opportunity cost (💣)

- After-tax salvage value of the old project (case of a replacement project) (💣)

+ Recapture of all increase in net working capital (💣)

2.4. How to calculate Tax Effects

- Considering capital budgeting decisions, tax effects occur in 2 different ways:
  - Tax effect on the opportunity cost
  - Tax effects on the salvage value of any company's proprieties.

- The tax effects might be either a positive CF or negative CF (whether the Market Value is less (larger) than the Book Value).

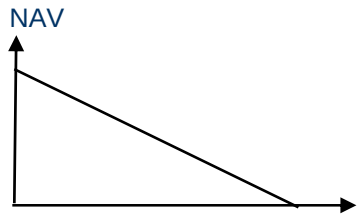
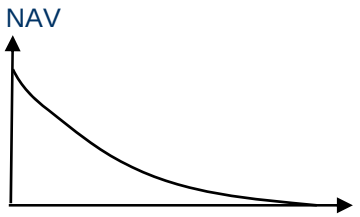
- How to calculate the tax effect?

  (Market Value – Book Value)*Tax Rate

- How to calculate the after-tax value of an asset?

  Market Value - (Market Value – Book Value)*Tax Rate

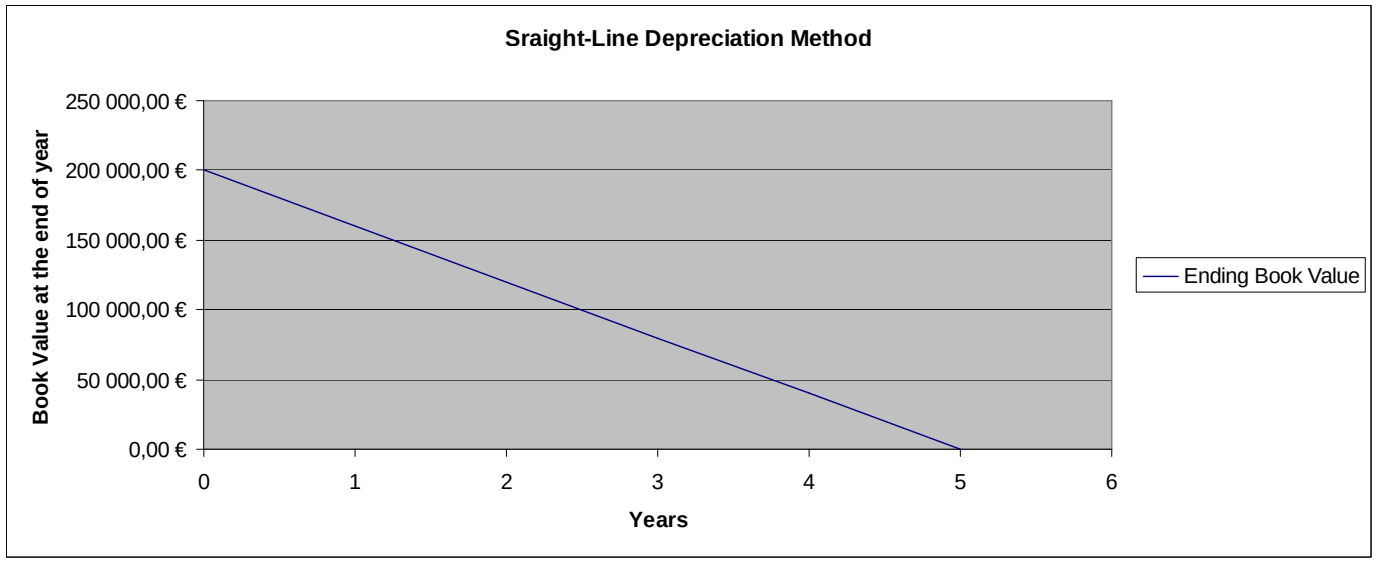
2.5. Depreciation Rules in France

	Straight-Line Depreciation	Declining Balance
Application	All investment goods with a life time > 1 year and Price > 500 Euros	
Application Case	All investment Projects	(Transport, Secutity, Transformation) and related types of good
Depreciation Rate	Fixed Depreciation amount / Net accounting Value	Initial straight-line rate * coefficient (1.25 for 3 or 4 years investment; 1.75 for 5 and 6 years investment; 2.25 for 7-year and more investment). When this rate falls below the corresponding straight-line rate, use the corresponding straight-line rate
Annual Depreciation	Investment amount / life time of the project	Depreciation Rate * Net Accounting Value
Net Accounting Value		

2.5. Depreciation Rules in France

Straight-Line Depreciation Method (200 000 Euros ; 5 years)

Year	Beginning Book Value	Annual Depreciation	Depreciation Rate	Accumulated Depreciation	Ending Book Value
0					200 000,00 €
1	200 000,00 €	40 000,00 €	20,00%	40 000,00 €	160 000,00 €
2	160 000,00 €	40 000,00 €	25,00%	80 000,00 €	120 000,00 €
3	120 000,00 €	40 000,00 €	33,33%	120 000,00 €	80 000,00 €
4	80 000,00 €	40 000,00 €	50,00%	160 000,00 €	40 000,00 €
5	40 000,00 €	40 000,00 €	100,00%	200 000,00 €	0,00 €

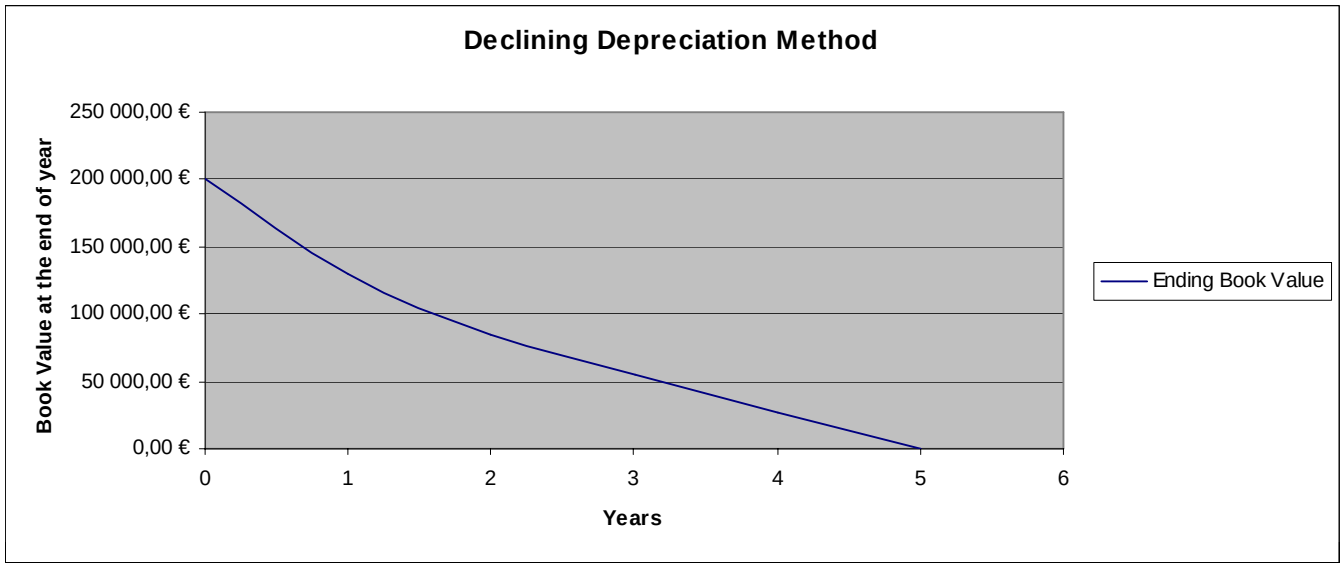


See depreciation.xls on the internet site of the course

2.5. Depreciation Rules in France

Declining Depreciation Method (200 000 Euros ; 5 years)

Year	Beginning Book Value	Depreciation Rate	Annual Depreciation	Accumulated Depreciation	Ending Book Value
0					200 000,00 €
1	200 000,00 €	35,00%	70 000,00 €	70 000,00 €	130 000,00 €
2	130 000,00 €	35,00%	45 500,00 €	115 500,00 €	84 500,00 €
3	84 500,00 €	35,00%	29 575,00 €	145 075,00 €	54 925,00 €
4	54 925,00 €	50,00%	27 462,50 €	172 537,50 €	27 462,50 €
5	27 462,50 €	100,00%	27 462,50 €	200 000,00 €	0,00 €



See depreciation.xls on the internet site of the course

2.6. A note on Depreciation in the US

- **Depreciation is not a cash expense, but it allows a cut in the taxable income.**
  ⇒ relevant cash flow.
  => Tax Shield = depreciation amount * tax rate

- **Possible Methods for Depreciation:**
  - Straight-line Method
  - Double Declining Method (similar to the declining Method in France (see 2.5.))
  - MACRS

- Modified Accelerated cost recovery system (MACRS): a depreciation method under US tax law allowing for the accelerated write-off of property under various classification.

Class	Examples
3-year	Equipment used in research
5-year	Autos, computers
7-year	Most industrial equipment
…..	….

2.6. A note on Depreciation in the US

Tax Depreciation Schedules by Recovery-Period Class

Year(s)	3-Year	5-Year	7-Year	10-Year	15-Year	20-Year
1	33.33	20.00	14.29	10.00	5.00	3.75
2	44.45	32.00	24.49	18.00	9.50	7.22
3	14.81	19.20	17.49	14.40	8.55	6.68
4	7.41	11.52	12.49	11.52	7.70	6.18
5		11.52	8.93	9.22	6.93	5.71
6		5.76	8.93	7.37	6.23	5.28
7			8.93	6.55	5.90	4.89
8			4.45	6.55	5.90	4.52
9				6.55	5.90	4.46
10				6.55	5.90	4.46
11				3.29	5.90	4.46
12					5.90	4.46
13					5.90	4.46
14					5.90	4.46
15					5.90	4.46
16					2.99	4.46
17–20						4.46
21						2.25

2.7. Review of concepts: The Baldwin Company Case

This example involves the Baldwin Company and colored bowling balls. The Baldwin company, originally established in 1965 to make footballs, is now a leading producer of tennis balls, baseballs, footballs and golf balls. In 2002 W.C. Meadows, vice president of the Baldwin Company, identified another segment of the sports ball market that looked promising and that he felt was not adequately served by large manufacturers. That market was for brightly colored bowling balls, and he believed a large number of bowlers valued appearance and style above performance. He also believed that it would be difficult for competitors to take advantage of the opportunity because of both Baldwin's cost advantages and its highly developed marketing skills. As a result, in late 2003 the Baldwin Company investigated the marketing potential of brightly colored bowling balls. Baldwin sent a questionnaire to consumers in 3 markets: Philadelphia, Los Angeles and New Haven. The results of these questionnaires were much better than expected and supported the conclusion that the brightly colored bowling ball could achieve a 10 to 15 percent share of the market. Of course, some people at Baldwin complained about the cost of the test marketing, which was $25,000. In any case, the Baldwin Company is now considering investing in a machine to produce bowling balls. The bowling balls would be manufactured in a building owned by the firm and located near Los Angeles. This building, which is vacant, and the land can be sold for $150,000. Working with his staff, Meadows is preparing an analysis of the proposed new product. He summarized his assumptions as follows:

2.7. Review of concepts: The Baldwin Company Case

- Costs of test marketing: $25,000.
- Value of the proposed factory site (which we own): Current Market Value= $150,000 ; Current Book Value=$100,000 ; Estimated Market Value in 5 years = $150,000
- Cost of bowling ball machine: $100,000 (depreciated adopting a French-declining balance rule) Salvage Value after 5 years: $30,000
- Production (in units) by year during 5-year life of the machine: 5,000 ; 8,000 ; 12,000 ; 10,000 ; 6,000.
- Price of the balls during first year is $20; price increases 2% per year thereafter.
- Production costs during first year are $10 per unit and increase 10% per year thereafter.
- Working Capital: initially $10,000 (it changes with sales).
- Tax Rate is 35%.

Question: What are the Relevant Cash Flows?

Solution details are given in baldwin.xls on the internet site

2.7. Review of concepts: The Baldwin Company Case

The Worksheet for Relevant Cash Flows of the Baldwin Company

Overall Projected CFs year by year

	Year					
	0	1	2	3	4	5
1. Capital spending	(100 000) $					19 500 $
2. Opportunity Cost	(132 500) $					132 500 $
3. Change in NWC	(10 000) $	- $	(6 320) $	(8 650) $	3 745 $	21 224 $
4. Operating CFs	- $	46 500 $	57 280 $	72 962 $	55 222 $	31 110 $
5. Project CFs	(242 500) $	46 500 $	50 960 $	64 313 $	58 967 $	204 334 $

3. Most Popular Investment Criteria

• There are several investment decision criteria

• We consider only the 3 most popular ones:
  - Discounted Payback Period
  - Net Present Value (NPV)
  - Internal Rate of Return (IRR)

• We review each investment criterion using **a very simple case study**:
  - Consider a discount rate of 10% (r=10%)
  - **Movie:** $1 million to build a mega-movie-theater. You plan to operate this theater for four years earning $350,000 each year

• All these criteria have been also used for solving exercises in 4 (See the internet site).

3.1. The Discounted Payback Period

Discounted Payback period:

The amount of time (*i.e.* number of years) until discounted net cash flows exceed the initial outlay.

Decision rule:

An investment is acceptable if its calculated discounted payback is less than some pre-specified number of years (Set by management before any project evaluation)

Application to our case: (see Investment_Rules.xls, first sheet)

Time	*Cash Flows*	*Discounted CF*	*Cumulative DCF*
0	(1 000 000)	(1 000 000)	(1 000 000)
1	350 000	318 182	(681 818)
2	350 000	289 256	(392 562)
3	350 000	262 960	(129 602)
4	350 000	239 055	109 453

DPB ≈

3 years and 7 months

3.1. The Discounted Payback Period

Discounted Payback Period Rule

Advantages	Disadvantages
Includes time value of money	May reject positive NPV investments
Easy to understand	Requires an arbitrary cutoff point
Does not accept negative estimated NPV	Ignores cash flows beyond the cutoff date
Biased towards liquidity	Biased against long-term project (such as R&D)
	Just as complex as NPV!

3.2. Net Present Value

definition:

Present value of future cash flows discounted at the opportunity cost of capital minus (net of) the initial investment.

Decision rule:

- Accept the project if its NPV >0
- Reject it if its NPV < 0
- Indifference if NPV=0

$$NPV = \sum_{t=0}^{N} \frac{CF_t}{(1+r)^t}$$

Application to our case: (see Investment_Rules.xls, second sheet)

Yes because
NPV > 0

Time	*Cash Flows*	*Discounted CF*
0	(1 000 000)	(1 000 000)
1	350 000	318 182
2	350 000	289 256
3	350 000	262 960
4	350 000	239 055
Sum		***109 453***

3.2. Net Present Value

Advantage of this Rule:
if NPV > 0, firms increase shareholder's wealth by undertaking the project

Intuition:
Would alternative use of capital give better returns?
The NPV is the change in the firm's value due to this project
<=> It is also the change in total shareholder's wealth due to the project.

That's because both should be using the same discount rate (if we consider a debt-free firm as an approximation).

Think of NPV as a proxy for the analysis of investments done by market analysts (See next chapter)

3.3. The Internal Rate of Return

Internal rate of return (IRR):

The discount rate that makes the NPV of an investment equals to zero (=project's expected rate of return on its investment)

$$\sum_{t=1}^{N} \frac{CF_t}{(1+IRR)^t} - I_0 = 0$$

Decision Rule:

An investment is acceptable if its IRR exceeds the cost of capital (required rate of return). It should be rejected otherwise.

Intuition is that when IRR > *r*, our money grows faster in this project than in our best alternative (opportunity cost.)

This looks different from the NPV rule, but it should give the same decisions (see NPV_IRR.xls):

- IRR > *r* means that NPV > 0
- Don't Confuse IRR and *r !*

The IRR is specific to the project ; *r* depends on what you have to give up.

3.3. The Internal Rate of Return

Application to our case: (see Investment_Rules.xls, third sheet)

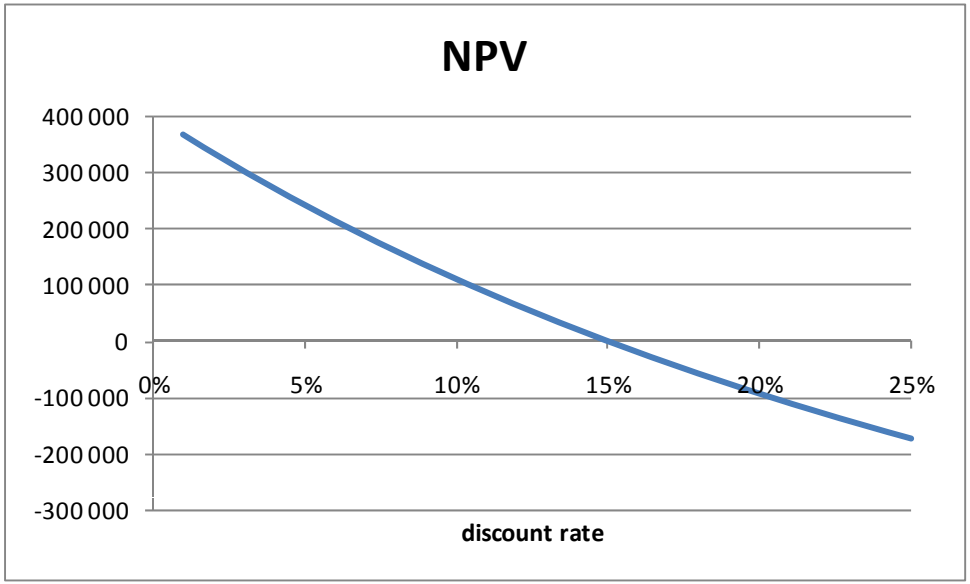
IRR such as :

$$-1000 + 350\left(1 - \frac{1}{(1+IRR)^4}\right)/IRR = 0$$

$$\Leftrightarrow IRR = 14{,}96\%$$

How do we solve this equation for IRR?

- use a computer (Goal Seek or IRR(TRI) on EXCEL) or a financial calculator
- guess & iterate by hand



3.4. Internal Rate of Return *vs* NPV

IRR and NPV decision rules will lead to identical decisions if:

- project cash flows are *'conventional' (only one sign change)*
- projects under consideration have the same life time

Problems with the use of IRR occur when:

- cash flows are non-conventional: (see NC_IRR.xls)

The NPV graph's may intersect the NPV = 0 axis several times!
For this to happen, the CFs must change sign multiple times. (e.g. decommissioning costs, multi-stage project.)
Solution: Must use NPV rule instead

- Projects are mutually exclusive: (see MI_IRR.xls)

The project with the highest IRR may not be the one that increases the value of the firm the most. This only really matters if projects are mutually exclusive.
The problem is that IRR ignores project size and duration:

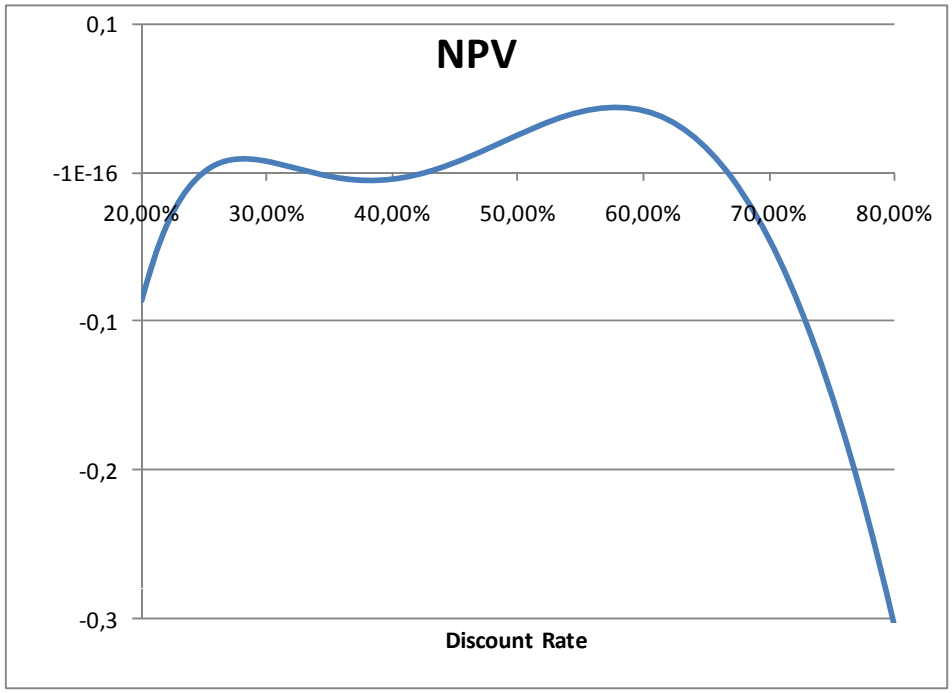
for a given IRR, a big / long-lived project has a bigger NPV

Solution: Use NPV. (sound familiar?)

3.4. Internal Rate of Return *vs* NPV

Example of Non Conventional Cash Flows: (see NC_IRR.xls)

Year	Cash Flow
0	- 252
1	1431
2	- 3035
3	2850
4	- 1000



3.4. Internal Rate of Return *vs* NPV

Examples of Mutually Exclusive Investments:

• Example1:

Choose one of these two riskless investments:

- Invest $1,000 today, get $4,000 in one year (IRR=300%)
- Invest $1,000,000 today, get $1,500,000 in one year (IRR=50%)

IRR ranks the first higher than the second, but fails to take account of size. We'd rather make $500,000 than $3,000 in profit next year.

Example 2:

Given $1 million to invest and a 7.5% discount rate, which riskless investment would you prefer?

- one which pays $2 million after 1 year (IRR=100%)
- one which pays $300,000 per year, forever (IRR=30%)

We know how to calculate the present value these two cash-flows:

The first is worth $2,000,000 / 1.075 = $1,860,465

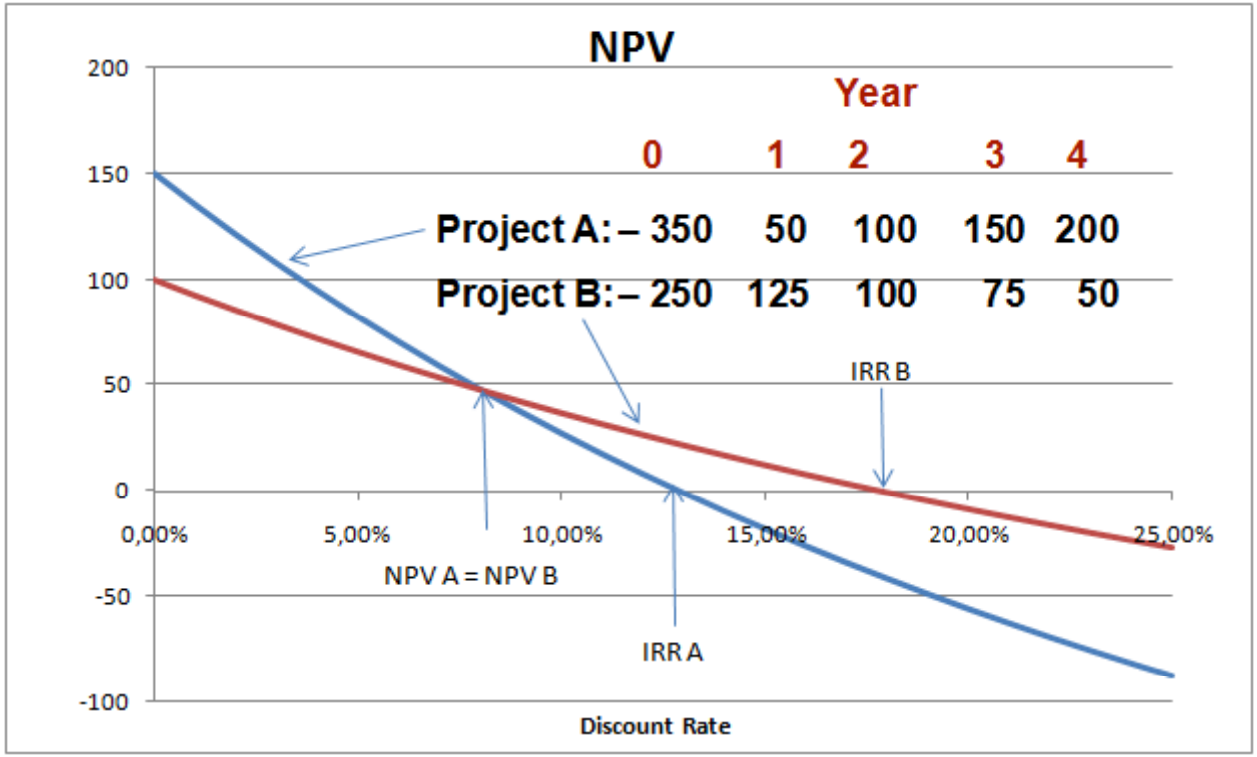
The second is worth $300,000 / 0.075 = $4,000,000

3.4. Internal Rate of Return *vs* NPV

Mutually Exclusive Investments Decision Rule:

Assume Two mutually exclusive investment projects (A and B) with cash flows as follow: (see MI_IRR.xls)

Solution: Compute NPV(A-B)=0 and compare with the discount rate (the rate of return required by investors)



4. Application Exercises
Application # 1: Evaluating Cost-Cutting Proposals

Example:

Pizza Hut is deciding whether to invest or not in an online-ordering system that will require $5 million in new computer equipment (salvage value of 0 after 5 years) but will reduce their labor costs from $7 million per year to $5.5 million per year for the next 5 years. The required discount rate is 10% and the company's tax rate is 25%. Use a straight-line method for depreciation.

Should Pizza Hut buy the computer equipment?

Solution technique: Similar to the Baldwin Case. Focus on **incremental** cash flows.

See Piz_Hut.xls on the internet site.

4. Application Exercises
Application # 2: Replacing an asset

Example:

A university student painter is considering the purchase of a new air compressor and paint gun to replace an old paint sprayer. These two new items cost $7000 and have a useful life of three years (use a straight-line depreciation method over 3 years). After 3 years, it is projected that these items will be sold for $600. The old paint sprayer bought two years ago for $1000 (4 years straight-line depreciation) can be sold now for $200 and could be scrapped for $150 in three years. The Entrepreneurial student believes that his operating revenues will increase each year by $6000 per year with respect to that of the old equipment over the next 3 years. The tax rate is 22% and the discount rate is 18%.
Should the purchase be made?

Solution technique: Similar to the Baldwin Case. Focus on **incremental** cash flows. Beware of the salvage value of the two machines and their unequal life span. Draw a time line.
See Univ.xls on the internet site.

4. Application Exercises
Application # 3: Exam type of exercise

http://www.esc-toulouse.net/projets/nalpas/fin1/

Chapter Summary

- You know how to detect a relevant cash-flow for capital budgeting decisions.
- You know how to apply one or more investment decision criterion to select good investment projects.
- The main messages of this chapter are:
  - Separate your analysis in 3 stages (initial outlay, Free Cash Flows and Terminal Cash Flows)
  - Cash Flows are considered using an incremental analysis basis.
  - Don’t forget to handle opportunity costs, induced tax effects and changes in net working capital.
  - In case of conflict between the NPV and the IRR criteria, use the NPV because of its direct link with the value creation.

Appendices of Chapter 2

Mutually Exclusive Investments with Unequal Lives (1/3)

- Suppose your firm is planning to expand and we have to select 1 of 2 machines.
- They differ in terms of economic life and capacity.
- How do we decide which machine to select?

The after-tax cash flows are:

Year	Machine 1	Machine 2
0	(45,000)	(45,000)
1	20,000	12,000
2	20,000	12,000
3	20,000	12,000
4		12,000
5		12,000
6		12,000

Assume a discount rate of 14%.

(See EAA.xls on the Internet site)

Mutually Exclusive Investments with Unequal Lives (2/3)

First Step: Calculate NPVs

NPV1 = $1,433

NPV2 = $1,664

So, does this mean that #2 is better?

No! The two NPVs can't be directly compared!

Step 2: Equivalent Annual Annuity (EAA) method

- If we assume that each project will be replaced an infinite number of times in the future, we can convert each NPV to an annuity.
- The projects' EAAs can be compared to determine which is the best project!
- EAA: Calculate the equivalent annuity over the project's life.

EAA with your calculator:

Simply "spread the NPV over the life of the project":

Machine 1: PV = 1433, N = 3, i = 14,

$EAA_1 = 617.08 \Leftrightarrow$ $EAA_1\left(1-\frac{1}{(1+0.14)^3}\right)/0.14 = 1433$

Machine 2: PV = 1664, N = 6, i = 14,

$EAA_2 = 427.91 \Leftrightarrow$ $EAA_2\left(1-\frac{1}{(1+0.14)^5}\right)/0.14 = 1664$

Mutually Exclusive Investments with Unequal Lives (3/3)

Step 3: Compare EAAs

$EAA_1 = \$617$

$EAA_2 = \$428$

This tells us that:

NPV1 => annuity of $617 per year.

NPV2 => annuity of $428 per year.

So, we've reduced a problem with different time horizons to a couple of annuities.

Decision Rule: Select the highest EAA.

Here, we should choose machine #1.

Setting a bid price

Example:

Consider a project to supply 40 million postage stamps to Canada Post each year for the next five years. You have an idle parcel of land available (bought $750,000 five years ago; if the land were sold today, it would net you $850,000. In five years, you can expect to sell it for $1,000,000). You will need to install $2.6 million in new manufacturing plant and equipment to actually produce the stamps; this plant and equipment will be depreciated straight-line to zero over the project's five years life. The equipment can be sold for $380,000 at the end of the project. You will also need $600,000 in initial net working capital for the project, and an additional investment of $50,000 in every year thereafter. Your production costs are 1.8 cents per stamp (increasing at 2% per year), and you have fixed costs of $600,000 per year. If your tax rate is 34% and your required discount rate on this project is 15%, **what is the lowest bid price you could submit on the contract**?

Solution technique: Focus on **incremental** cash flows and Set the price of the stamps such as NPV = 0

See Post_Can.xls

More complicated case studies

See your booklet

End of Chapter 2