Lecture 5

Alternative Investment Rules

Some Alternative Investment Rules

Why Use Net Present Value?

The Payback Period Rule

The Discounted Payback Period Rule

The Average Accounting Return

The Internal Rate of Return

Problems with the IRR Approach

The Profitability Index

The Practice of Capital Budgeting

Why Use Net Present Value?

□ Accepting positive NPV projects benefits shareholders.

✓ NPV uses cash flows

✓ NPV uses all the cash flows of the project

✓ NPV discounts the cash flows properly

The Net Present Value (NPV) Rule

- Net Present Value (NPV) =

    Total PV of future CF's + Initial Investment

- Estimating NPV:
    - 1. Estimate future cash flows: how much? and when?
    - 2. Estimate discount rate
    - 3. Estimate initial costs

- Minimum Acceptance Criteria: Accept if NPV > 0
- Ranking Criteria: Choose the highest NPV

Good Attributes of the NPV Rule

- 1. Uses cash flows
- 2. Uses ALL cash flows of the project
- 3. Discounts ALL cash flows properly

- Reinvestment assumption: the NPV rule assumes that all cash flows can be reinvested at the discount rate.

The Payback Period Rule

- How long does it take the project to "pay back" its initial investment?

- Payback Period = number of years to recover initial costs

- Minimum Acceptance Criteria:
  - set by management

- Ranking Criteria:
  - set by management

The Payback Period Rule (continued)

- Disadvantages:
  - Ignores the time value of money
  - Ignores cash flows after the payback period
  - Biased against long-term projects
  - Requires an arbitrary acceptance criteria
  - A project accepted based on the payback criteria may not have a positive NPV
- Advantages:
  - Easy to understand
  - Biased toward liquidity

The Discounted Payback Period Rule

- How long does it take the project to "pay back" its initial investment taking the time value of money into account?

- By the time you have discounted the cash flows, you might as well calculate the NPV.

The Average Accounting Return Rule

$$AAR = \frac{\text{Average Net Income}}{\text{Average Book Value of Investent}}$$

- ☐ Another attractive but fatally flawed approach.
- ☐ Ranking Criteria and Minimum Acceptance Criteria set by management
- ☐ Disadvantages:
  - ☐ Ignores the time value of money
  - ☐ Uses an arbitrary benchmark cutoff rate
  - ☐ Based on book values, not cash flows and market values
- ☐ Advantages:
 - ☐ The accounting information is usually available
  - ☐ Easy to calculate

6.5 The Internal Rate of Return (IRR) Rule

- IRR: the discount that sets NPV to zero
- Minimum Acceptance Criteria:
  - Accept if the IRR exceeds the required return.
- Ranking Criteria:
  - Select alternative with the highest IRR
- Reinvestment assumption:
  - All future cash flows assumed reinvested at the IRR.
- Disadvantages:
  - Does not distinguish between investing and borrowing.
  - IRR may not exist or there may be multiple IRR
  - Problems with mutually exclusive investments
- Advantages:
  - Easy to understand and communicate

The Internal Rate of Return: Example

Consider the following project:

$$\begin{array}{cccc} & \$50 & \$100 & \$150 \\ | & | & | & | \\ 0 & 1 & 2 & 3 \end{array}$$

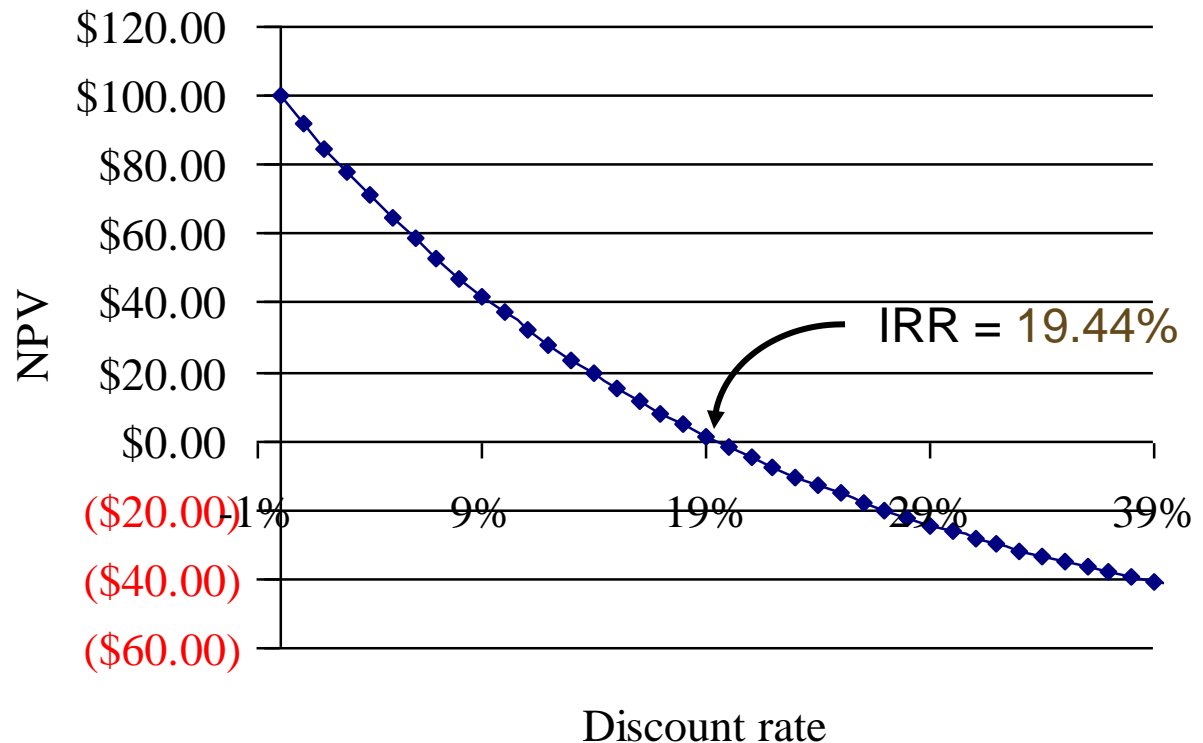-$200
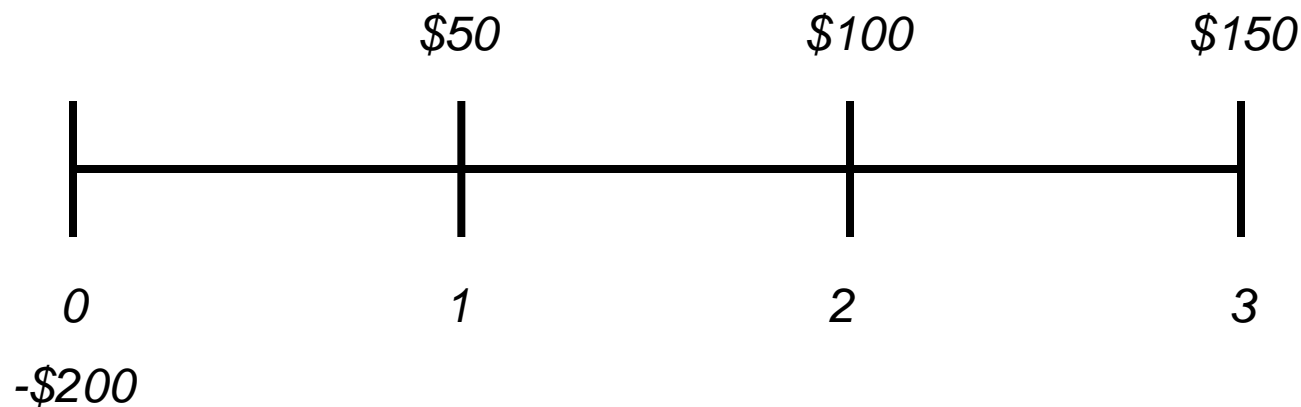
The internal rate of return for this project is 19.44%

$$NPV = 0 = \frac{\$50}{(1+IRR)} + \frac{\$100}{(1+IRR)^2} + \frac{\$150}{(1+IRR)^3}$$

The NPV Payoff Profile for This Example

If we graph NPV versus discount rate, we can see the IRR as the x-axis intercept.

Discount Rate	NPV
0%	$100.00
4%	$71.04
8%	$47.32
12%	$27.79
16%	$11.65
20%	($1.74)
24%	($12.88)
28%	($22.17)
32%	($29.93)
36%	($36.43)
40%	($41.86)

IRR = 19.44%

Discount rate

6.6 Problems with the IRR Approach

- Multiple IRRs.

- Are We Borrowing or Lending?

- The Scale Problem.

- The Timing Problem.

Multiple IRRs

$200 $800

Which one should
we use?

|---|---|---|---|
| 0 | 1 | 2 | 3 |

-$200   - $800

NPV

$100.00

100% = IRR₂

$50.00

$0.00

-50%   0%   50%   100%   150%   200%

($50.00)

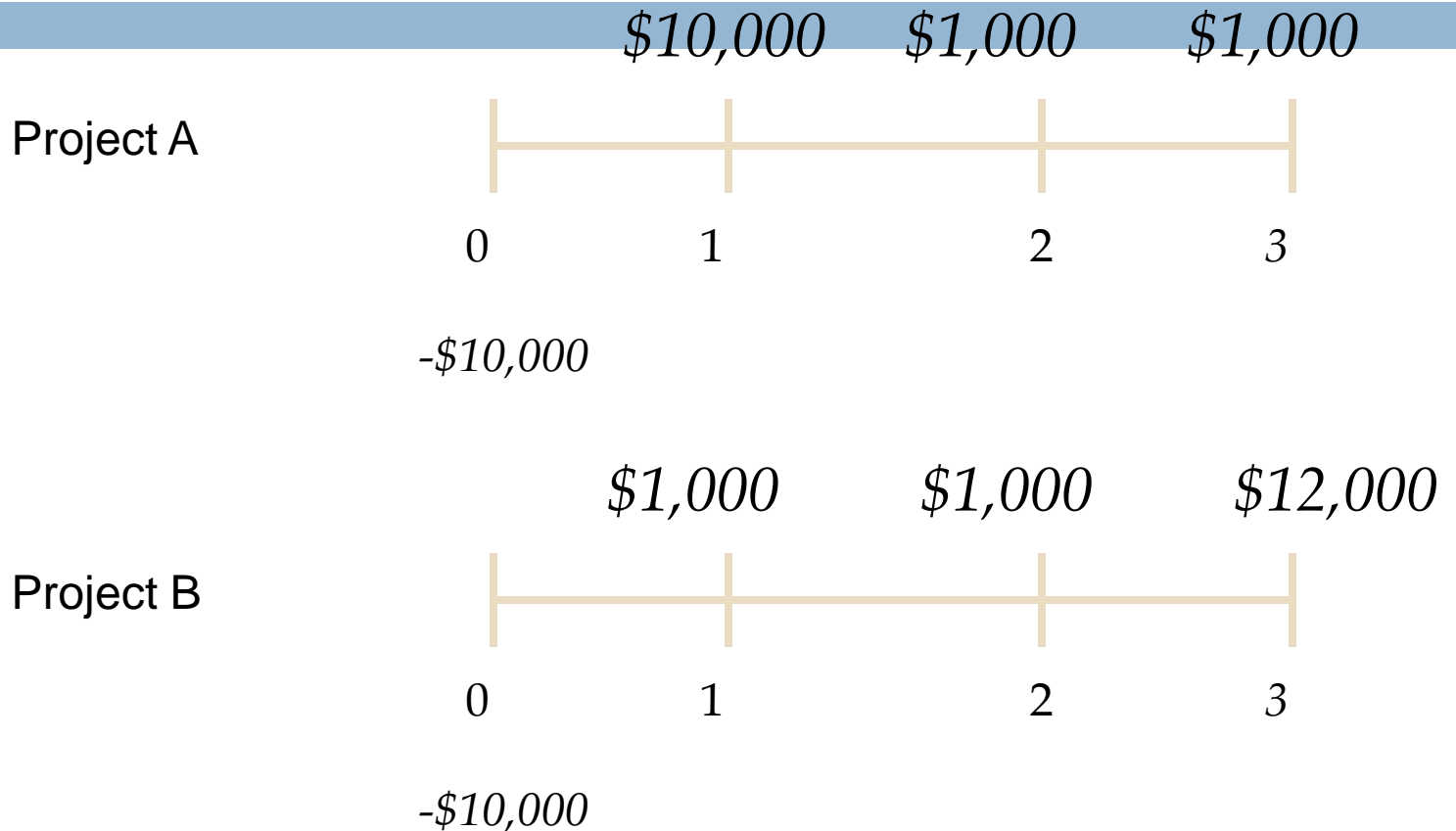**0% = IRR₁**

Discount rate

($100.00)

($150.00)
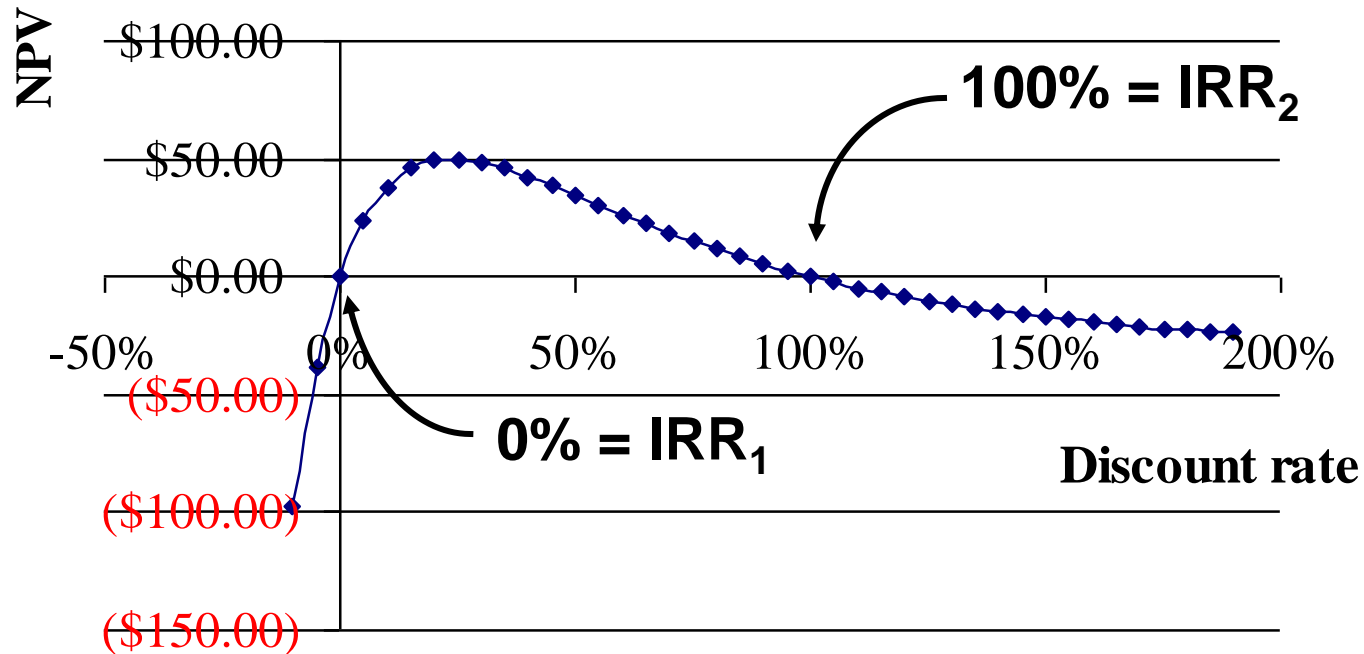
The Scale Problem

Would you rather make 100% or 50% on your investments?
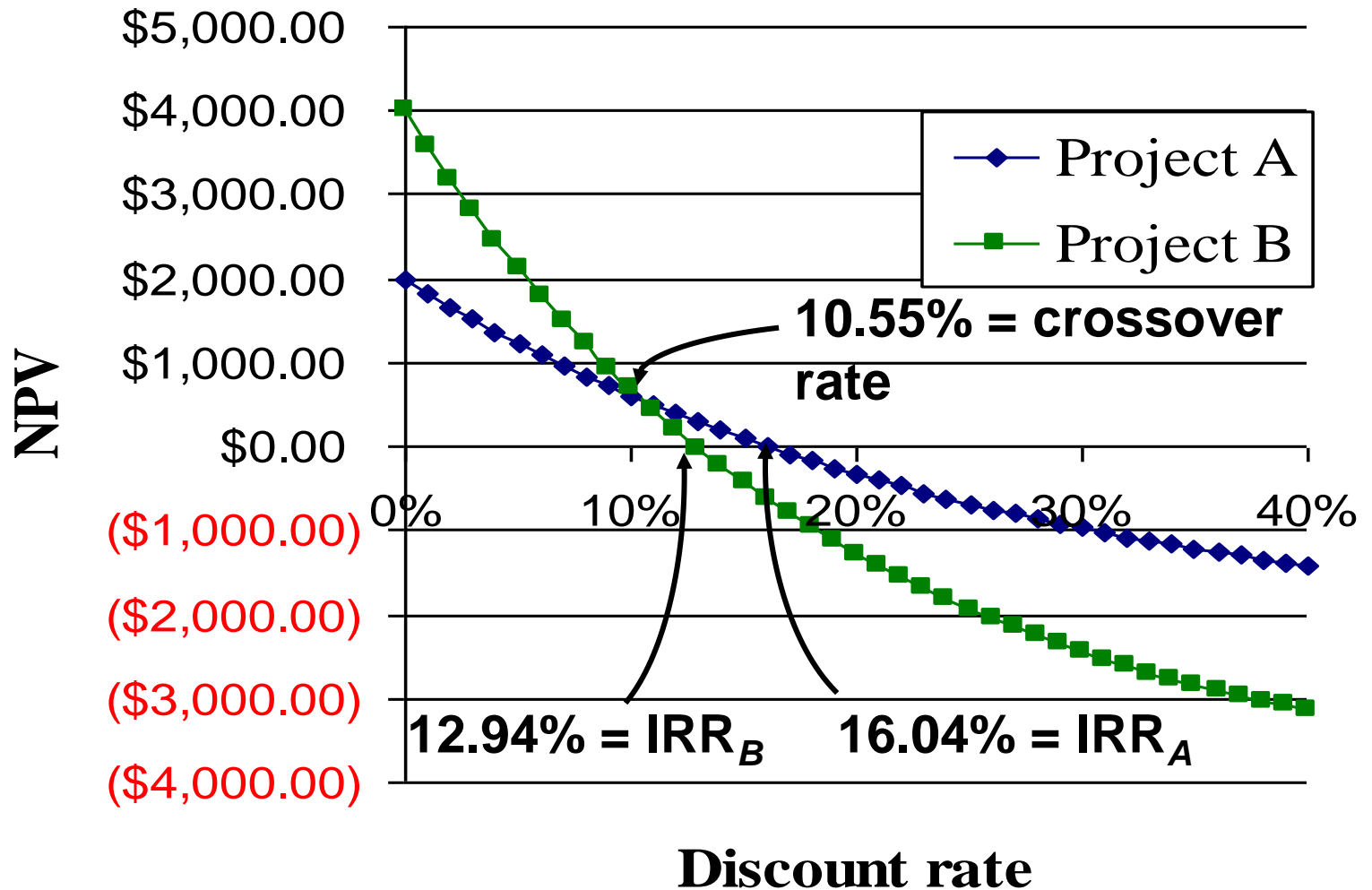
What if the 100% return is on a $1 investment while the 50% return is on a $1,000 investment?

The Timing Problem

$10,000 $1,000 $1,000

Project A

0   1   2   3

-$10,000

$1,000 $1,000 $12,000

Project B

0   1   2   3

-$10,000

The preferred project in this case depends on the discount rate, not the IRR.
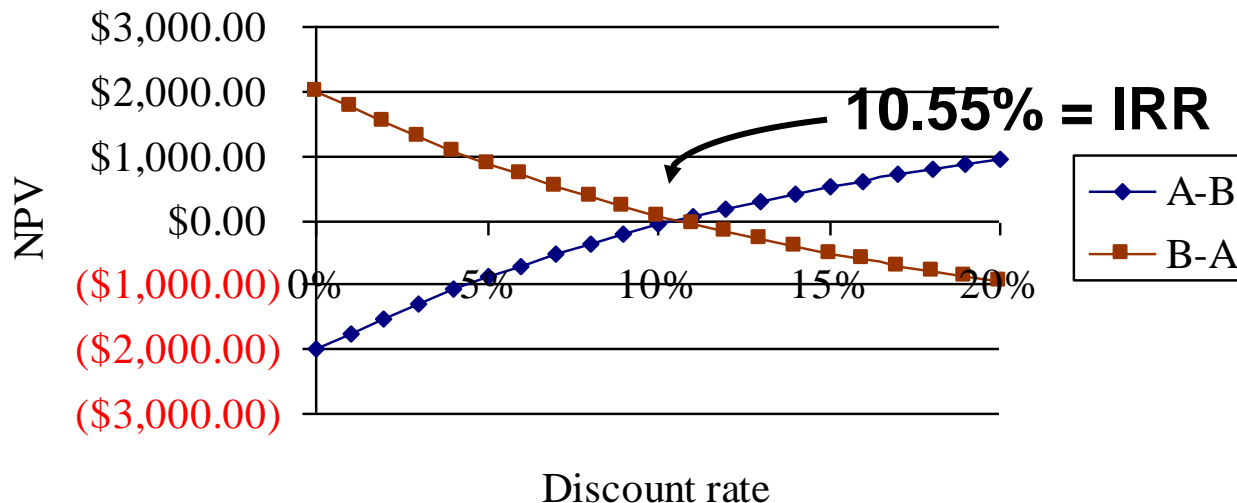
The Timing Problem

Calculating the Crossover Rate

Compute the IRR for either project "A-B" or "B-A"

Year	Project A	Project B	Project A-B	Project B-A
0	($10,000)	($10,000)	$0	$0
1	$10,000	$1,000	$9,000	($9,000)
2	$1,000	$1,000	$0	$0
3	$1,000	$12,000	($11,000)	$11,000

10.55% = IRR

Mutually Exclusive vs. Independent Project

- Mutually Exclusive Projects: only ONE of several potential projects can be chosen, e.g. acquiring an accounting system.

  - RANK all alternatives and select the best one.

- Independent Projects: accepting or rejecting one project does not affect the decision of the other projects.

  - Must exceed a MINIMUM acceptance criteria.

The Profitability Index (PI) Rule

$$PI = \frac{\text{Total PV of Future Cash Flows}}{\text{Initial Investent}}$$

- Minimum Acceptance Criteria:
  - Accept if PI > 1
- Ranking Criteria:
  - Select alternative with highest PI
- Disadvantages:
  - Problems with mutually exclusive investments
- Advantages:
  - May be useful when available investment funds are limited
  - Easy to understand and communicate
  - Correct decision when evaluating independent projects

The Practice of Capital Budgeting

- Varies by industry:
  - Some firms use payback, others use accounting rate of return.
- The most frequently used technique for large corporations is IRR or NPV.

Example of Investment Rules

Compute the IRR, NPV, PI, and payback period for the following two projects. Assume the required return is 10%.

Year	Project A	Project B
0	-$200	-$150
1	$200	$50
2	$800	$100
3	-$800	$150

Example of Investment Rules

	Project A	Project B
CF_0	-$200.00	-$150.00
PV_0 of CF_{1-3}	$241.92	$240.80
NPV =	$41.92	$90.80
IRR =	0%, 100%	36.19%
PI =	1.2096	1.6053

Example of Investment Rules

Payback Period:

	Project A			*Project B*	
Time	CF	Cum. CF		CF	Cum. CF
0	-200	-200		-150	-150
1	200	0		50	-100
2	800	800		100	0
3	-800	0		150	150

Payback period for project B = 2 years.

Payback period for project A = 1 or 3 years?

Relationship Between NPV and IRR

Discount rate	NPV for A	NPV for B
-10%	-87.52	234.77
0%	0.00	150.00
20%	59.26	47.92
40%	59.48	-8.60
60%	42.19	-43.07
80%	20.85	-65.64
100%	0.00	-81.25
120%	-18.93	-92.52

NPV Profiles