Chapter 7: Investment Decision Rules

Fundamental question: What criteria should firms use when deciding which long-term
   investment opportunities to undertake?

   Key => a number of investment decision rules exist
       => examine each and why inferior to NPV

Note: Projects may be either mutually exclusive or stand-alone

   Mutually exclusive => can accept only one
   Stand-alone => taking project does not constrain ability to undertake others

7.1 NPV and Stand-Alone Projects

   A. Applying the NPV Rule

      1. NPV (net present value): present value of all cash flows (positive and negative)

      2. Criteria:

         Key => NPV measures value of project
             => **if undertake project, value of firm changes by NPV of project**.

         Stand-alone => accept project if **NPV $\geq$ 0**
         Mutually Exclusive => accept project with **highest NPV $\geq$ 0**

      3. Advantages of NPV

         (1) Based on cash flow
         (2) **Considers all cash flows**
         (3) **Incorporates the time value of money**
         (4) **Incorporates risk of cash flows (through cost of capital)**

B. The NPV Profile and Internal Rate of Return (IRR)

   NPV profile: graph of project's NPV as function of interest (or discount) rate

   Ex. Assume a project generates the following cash flows. Sketch an NPV profile of the
      project and identify the IRR (where NPV = 0).

Year	Cash flows
0	– 10,000
1	+ 2000
2	+2500
3	+1000
4	+4000
5	+5000
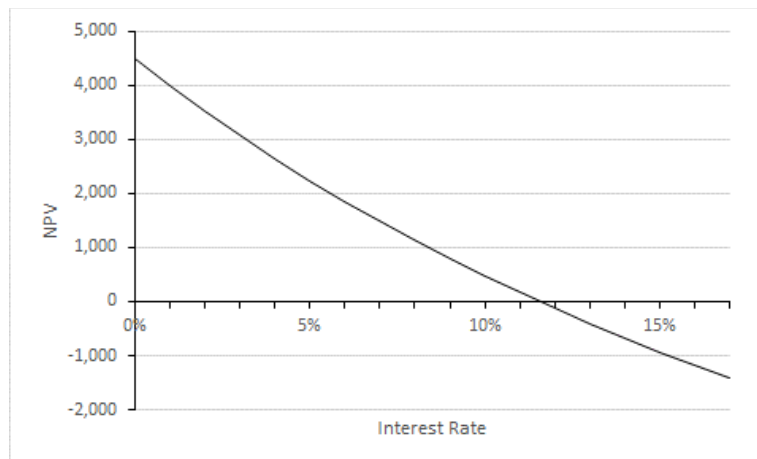
   IRR = 11.55%

   Note: I recommend Excel for building an NPV profile

C. Alternative Rules Verses the NPV Rule

   Key issues:

      => growth of use of NPV rule by firms
      => **other rules lead to loss of wealth if reject positive NPV projects or accept
         negative NPV projects**

7.2 The Internal Rate of Return Rule

Internal Rate of Return(IRR) : interest rate that causes net present value of cash flows to equal zero.

A. Applying the IRR Rule

1. Solving for IRR:

    a. **Use Excel or financial calculator**

    b. Trial and Error by Hand (Not recommended)

        Steps

            1) try a rate
            2) if NPV = 0, done
            3) if NPV ≠ 0, try again

        Note: NPV profile will help if using trial and error

2. Criteria:

    Stand-alone: accept project if **IRR ≥ cost of capital**
    Mutually Exclusive: accept project with **highest IRR ≥ cost of capital**

B. Pitfall #1: Delayed Investments

Key => If project is more like borrowing than lending, should reverse the criteria
=> if project is more like borrowing than lending, accept project with lowest IRR as long as less than cost of capital.

Keys

1] lending => early cash outflows followed by cash inflows
=> **want highest return possible**
2] borrowing => early cash inflows followed by cash outflows
=> **want lowest possible return (interest rate)**

Ex. Assume a project has a cost of capital of 15% and the generates the following cash flows.

Year	Cash flows
0	+15,000
1	-6000
2	-6000
3	-6000

IRR = 9.7%. NPV = 1300.65
=> NPV is positive if IRR < cost of capital

NPV profile: IRR = rate where graph of NPV crosses 0
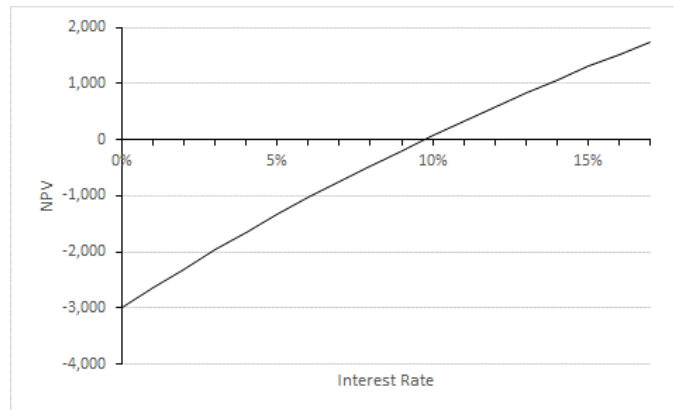
Note: Not always easy to tell if project is more like borrowing or lending

C. Pitfall #2: Multiple IRRs

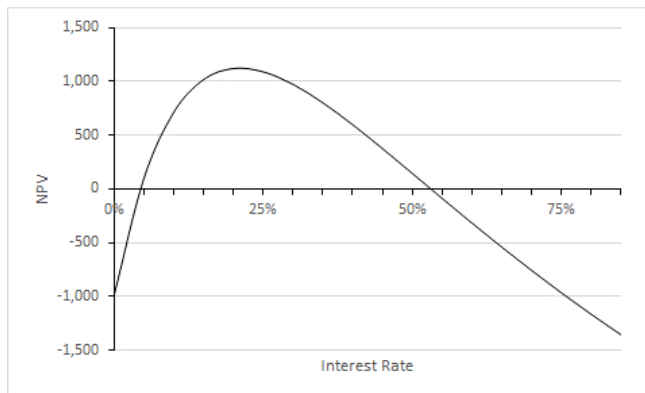**Key => can have as many IRRs as changes in sign of cash flows**

Notes:

    1) unclear which IRR should base decision on
    2) unclear what decision rule should be

Ex. Multiple IRR

Year	Cash flows
0	-7000
1	8000
2	2000
3	4000
4	12,000
5	-20,000

NPV profile: NPV = 0 in two places (two rates)

IRR = 4.5% and 53%

D. Pitfall #3: Nonexistent IRR

Ex.

Year	Cash flows
0	-9000
1	8000
2	2000
3	4000
4	12,000
5	-20,000

NPV profile: never crosses 0

No IRR => NPV negative at all discount rates.
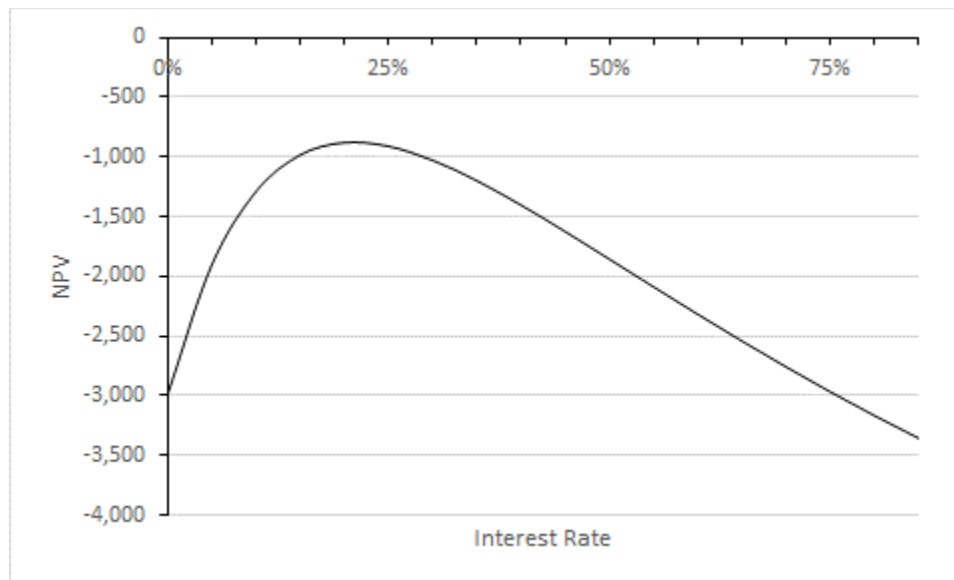
Note: There are additional problems with IRR

1) **IRR unaffected by scale of project**

Ex. Would you rather invest $1 and get back $1.50 in one year (50% IRR) or invest $1,000,000 and get back $1,200,000 in one year (20% IRR)?

2) => NPV of projects dominated by long-term cash flows fall faster as increase discount rate than projects dominated by short-term cash flows
=> **long-term projects may have lower IRR other things equal**.

3) Difficult to compare projects if **different cost of capital (because of different risk)**

7.3 Payback Rule

Payback rule: number of years to pay back the initial investment

Criteria:

Stand-alone: accept project if payback ≤ prespecified period
Mutually exclusive: accept project with shortest payback ≤ prespecified period

Payback rule pitfalls:
(1) **ignores cost of capital and time value of money**
(2) **ignores cash flows after the payback**
(3) **ad hoc criterion**
(4) **ignores scale of project**

Note: used because of simplicity

7.4 Choosing Between Projects

A. NPV Rule and Mutually Exclusive Investments

=> already discussed

B. IRR Rule and Mutually Exclusive Investments

=> already discussed

1. Differences in Scale

2. Differences in Timing

3. Differences in Risk

C. The Incremental IRR

Incremental IRR: IRR of incremental cash flows if replace one project with another

Incremental IRR Pitfalls: many of the same pitfalls as IRR: might not have outflows
followed by infolows, possible that no incremental IRR, possible that multiple
incremental IRR, does not indicate whether either project has positive NPV, unclear
how to compare projects with different risk

7.5 Project Selection with Resource Constraints

Key issue: **how choose project if there is a fixed supply of some resource used by projects**

A. Evaluating Projects with Different Resource Constraints

Key issue: set of projects that maximize total NPV without using more than supply of resource

B. Profitability Index

1. Definition: $PI = \frac{NPV}{RC}$ (7.2)

Where: RC = resource consumed

=> **NPV per resource consumed**

2. Criteria: Accept projects from high to low PI as long as ≥ 0

C. Shortcomings of Profitability Index

1. Might not give best set of projects if **resource not completely consumed**
2. Can't be used if more than one resource constraint
3. Difficult to use if multi-period constraints
Note: Linear or integer programming is an alternative