9

Lecture 9a
Selection of a Minimum Attractive Rate of Return

Who Owns the Diamonds, Gold, Oil, and Gas?

Who Owns the Diamonds, Gold, Oil, and Gas?, cont'd

- The rights to work on land surface are called *surface rights*. The rights to explore and extract resources below surface are called *mineral rights*. The *royalty* is the mineral-rights owner's share of production or revenues.
- Until the early 1900s, surface rights and mineral rights came with the purchase of land. Since then, however, mineral rights have belonged to the government (in Canada) and cannot be bought by individuals or companies. (These rights are, however, separable and purchaseable in several US states.)

Who Owns the Diamonds, Gold, Oil, and Gas?, cont'd

- In Alberta, the mineral rights were transferred to the provincial government by the *Natural Resources Transfer Act* in 1930.
- In 2007 there was public pressure in Alberta for the government to raise the royalty rates it charged the oil and gas developers.

Who Owns the Diamonds, Gold, Oil, and Gas?, cont'd

- On 18 September 2007, a review panel published its report, entitled *Our Fair Share*, which recommended to raise the royalty rate to a level that was about in the middle of what other countries charge.
- The response was a savage attack by industry on the panel.
- On 25 October 2007, the Alberta government announced a revision to its royalty.
- The new rate was not as low as the oil companies wanted, but not as high as the panel had recommended.

Connection: how do we value resources that are public goods?

Learning Objectives

- Select a firm's MARR by using the opportunity cost method of analyzing investments
- Adjust the firm's MARR to account for risk and uncertainty
- Use spreadsheets to develop cumulative investments and the opportunity cost of capital

Investment Opportunities

- A firm may have a broader range of investment opportunities than are available to an individual.
- Consider the available investment opportunities for a particular firm as outlined in Table 9-1.

Investment Opportunities, cont'd

Table 9-1 A Firm's Available Investment Opportunities

Project Number	Project	Cost ($000)	Estimated Rate of Return (%)
	Investment Related to Current Operations		
1	New equipment to reduce labour costs	150	30
2	Other new equipment to reduce labour costs	50	45
3	Overhaul particular machine to reduce material costs	50	38
4	New test equipment to reduce defective products produced	100	40
	New Operations		
5	Manufacture parts that previously had been purchased	200	35
6	Further processing of products previously sold in semi-finished form	100	28
7	Further processing of other products	200	18
	New Production Facilities		
8	Relocate production to new plants	250	25
	External Investments		
9	Investment in a different industry	300	20
10	Other investment in a different industry	300	10
11	Overseas investment	400	15
12	Purchase of treasury bills	Unlimited	8

Investment Opportunities

- A firm may have a broader range of investment opportunities than are available to an individual.
- Consider the available investment opportunities for a particular firm as outlined in Table 9-1.
- The cumulative investment required for all projects at or above a given rate of return is given in Figure 9-2.

Investment Opportunities, cont'd

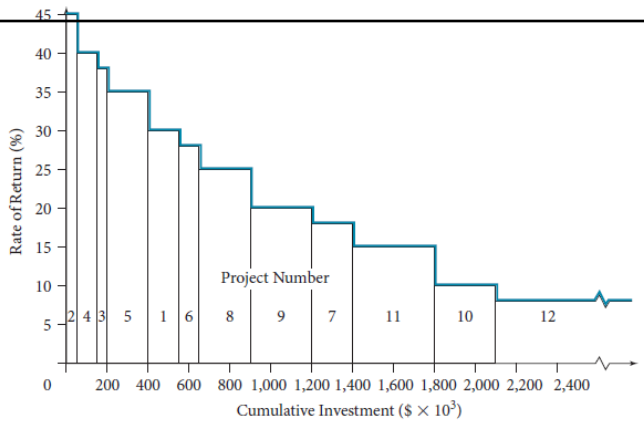

FIGURE 9-2 Cumulative investment required for all projects at or above a given rate of return.

Opportunity Cost

- Two independent aspects of investing:
  - Source of money available for projects
  - Firm's investment opportunities
- Investments need to be selected.
  - You want to ensure that all the selected projects are better than the best rejected project.
  - Best rejected project is called the:

Opportunity cost = Net cost (or benefit) of best opportunity foregone
= Net cost (or benefit) of next-best opportunity
= Rate of return on the best rejected project

Opportunity Cost, cont'd

EXAMPLE 9-2

Consider the situation represented by Table 9-1 and Figure 9-2. For a capital expenditure budget of $1.2 million ($1.2 × 10^6), what is the opportunity cost?

Opportunity Cost, cont'd

EXAMPLE 9-2

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SOLUTION

From Figure 9
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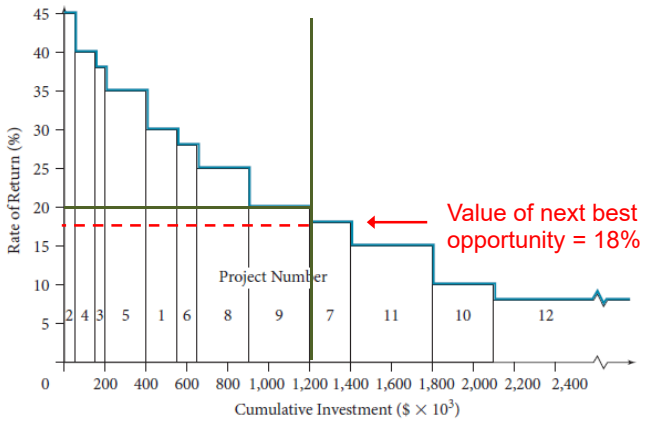

FIGURE 9-2 Cumulative investment required for all projects at or above a given rate of return.

Opportunity Cost, cont'd

EXAMPLE 9-2

Consider the situation represented by Table 9-1 and Figure 9-2. For a capital expenditure budget of $1.2 million ($1.2 × 10^6), what is the opportunity cost?

SOLUTION

From Figure 9-2 we see that the eight projects with a rate of return of 20% or more require a cumulative investment of $1.2(× 10^6). We would take on these projects and reject the other four (Projects 7, 11, 10, and 12) with rates of return of 18% or less. The best rejected project is Project 7, and it has an 18% rate of return. Thus the opportunity cost is 18%.

Opportunity Cost, cont'd

EXAMPLE 9-3

Nine independent projects are being considered. Figure 9-3 is based on the following data.

Project	Cost (thousands)	Uniform Annual Benefit (thousands)	Useful Life (years)	Salvage Value (thousands)	Computed Rate of Return
1	$100	$23.85	10	$ 0	20%
2	200	39.85	10	0	15
3	50	34.72	2	0	25
4	100	20.00	6	100	20
5	100	20.00	10	100	20
6	100	18.00	10	100	18
7	300	94.64	4	0	10
8	300	47.40	10	100	12
9	50	7.00	10	50	14

If a capital budget of $650,000 is available, what is the opportunity cost of capital? With this model, which projects should be selected?

Turn to Excel example

Opportunity Cost, cont'd

SOLUTION

Looking at the nine projects, we see that some are expected to produce a larger rate of return than others. It is natural that if we are to choose from among them, we will pick those with a higher rate of return. When the projects are arrayed by rate of return, as in Figure 9-3, Project 2 is the last one funded. Thus the opportunity cost of capital is 14% from Project 9, the highest ranked unfunded project. Projects 3, 1, 4, 5, 6, and 2 are the best options.

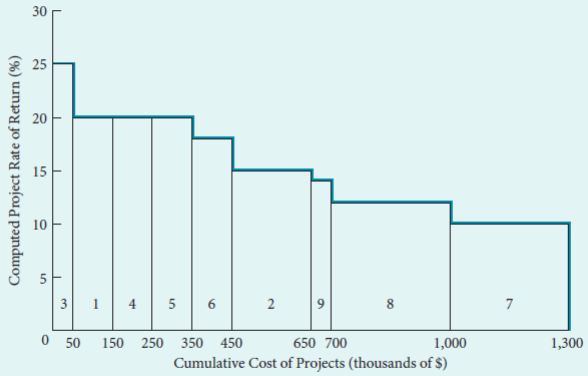

FIGURE 9-3 Cumulative cost of projects versus rate of return.

Choosing a Minimum Attractive Rate of Return

- Minimum Attractive Rate of Return (MARR)
  - A lower boundary for MARR must be the cost of the money borrowed to invest in a project.
  - MARR should not be less than the rate of return on the best opportunity foregone. This sounds simple (we just saw how it works), but it's messier than that, because the next best opportunity might not show up until the future.
  - Sometimes it's not that easy for a firm to borrow more money, because firms don't want to rely overly heavily on debt. They also raise money by selling stock shares. And usually do both. A firm that is short on capital will probably, therefore, set a higher MARR than the minimum.
  - An MARR must also reflect stockholder expectations of dividends and profits.
  - So broader concerns, and the desire to wait for other potentially better opportunities, may cause the firm to require a MARR that is higher than the minimum level based on borrowing rate.

Adjusting MARR to Account for Risk and Uncertainty

- **Uncertainty** describes the condition when the probabilities are *not* known.
- Thus, if the probabilities of future outcomes are known, we have *risk*, and if the probabilities are unknown, we have uncertainty.

Adjusting MARR to Account for Risk and Uncertainty, cont'd

- In projects accompanied by normal risk and uncertainty, the MARR is used without adjustment.
- For projects with greater than average risk or uncertainty, most firms increase the MARR to determine the validity of an alternative.
- Companies under a normal level of risk have typical MARR rates of 12%–15%.
- Much higher rates are common for different industries, such as technology start-ups short of capital or petroleum, where the risks maybe much higher.
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Adjusting MARR to Account for Risk and Uncertainty, cont'd

Table 9-2 Example of Risk-Adjusted Interest MARR Values in Manufacturing

Rate (%)	Applies to:
6	Equipment replacement
8	New equipment
10	New product in normal market
12	New product in related market
16	New product in new market
20	New product in foreign market

Opportunity Cost, cont'd

Let's revisit one aspect of this one more time:

- This method:

- This approach is common:
- May not work well when:

- <return to Excel examples, Ch4 ppt ex 4>

Selecting the Best Projects:
Project Prioritization under Capital Budget Constraints

- Firms do not have access to unlimited funding to invest in projects.
  - E.g., Suppose 20 projects exceed the MARR and there is limited funding so not all projects with be funded.
- Some firms rank projects (that exceed the MARR) based on the "biggest bang for the buck", measured by:
  - Net Present Worth/Present worth of (capital) cost

  Notice:

- However, it is more common for firms to rank projects based on rate of return.

Selecting the Best Projects:
Capital Budgeting

- The amount of an investment can also change ranking.
  - E.g., Suppose there are six possible projects.
  - There is enough money for funding only the top two projects because one of the projects is very expensive.

  OR
  - There is enough money for funding four projects in some other order (1, 2, 3, 5, and 6 for example).

Capital Budgeting, or
Selecting the Best Projects, cont'd

EXAMPLE 9-4

Rank the following nine independent projects in their order of desirability, based on a 14.5% minimum attractive rate of return. (To facilitate matters, the necessary computations are included in the tabulation.)

Project	Cost (thousands)	Uniform Annual Benefit (thousands)	Useful Life (years)	Salvage Value (thousands)	Computed Rate of Return	Computed NPW at 14.5% (thousands)	Computed NPW/PW of Cost
1	$100	$23.85	10	$ 0	20%	$22.01	0.2201
2	200	39.85	10	0	15	3.87	0.0194
3	50	34.72	2	0	25	6.81	0.1362
4	100	20.00	6	100	20	21.10	0.2110
5	100	20.00	10	100	20	28.14	0.2814
6	100	18.00	10	100	18	17.91	0.1791
7	300	94.64	4	0	10	−27.05	−0.0902
8	300	47.40	10	100	12	−31.69	−0.1056
9	50	7.00	10	50	14	−1.28	−0.0256

Capital Budgeting, or Selecting the Best Projects, cont'd

EXAMPLE 9-4

Rank the following nine independent projects in their order of desirability, based on a 14.5% minimum attractive rate of return. (To facilitate matters, the necessary computations are included in the tabulation.)

Project	Cost (thousands)	Uniform Annual Benefit (thousands)	Useful Life (years)	Salvage Value (thousands)	Computed Rate of Return	Computed NPW at 14.5% (thousands)	Computed NPW/PW of Cost
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2	200	39.85	10	0	15	3.87	0.0194
3	50	34.72	2	0	25	6.81	0.1362
4	100	20.00	6	100	20	21.10	0.2110
5	100	20.00	10	100	20	28.14	0.2814
6	100	18.00	10	100	18	17.91	0.1791
7	300	94.64	4	0	10	−27.05	−0.0902
8	300	47.40	10	100	12	−31.69	−0.1056
9	50	7.00	10	50	14	−1.28	−0.0256

Rank by these measures

Capital Budgeting, or Selecting the Best Projects, cont'd

SOLUTION

Ranked by NPW/PW of cost, the projects are listed as follows:

Project	NPW/PW of Cost	Rate of Return
5	0.2814	20%
1	0.2201	20
4	0.2110	20
6	0.1791	18
3	0.1362	25
2	0.0194	15
9	−0.0256	14
7	−0.0902	10
8	−0.1056	12

Projects meeting MARR

Notice that methods lead to different prioritization

With a 14.5% MARR, Projects 1 to 6 are recommended for funding and 7 to 9 are not. However, they are ranked in a different order by the present worth index and by the rate-of-return approaches. For example, Project 3 has the highest ranking for the rate of return and is fifth by the present worth index.