Ministry of Higher Education and Scientific Research

Al-Mustaqbal University College

Chemical Engineering and Petroleum Industries Department

Chemical Engineering Economics
Fourth Stage
Lecture No.9

Ass. Lec. Zahraa Abdulelah Hadi

Economic Evaluation of Projects

A proposed investment must be evaluated for its economic feasibility. When a new technical project is proposed, a design study must be carried out. The design study produces specifications from which cost estimates can be made. These cost estimates, in turn, become the data for evaluating the economic consequences of the project. Principles and methods for carrying out economic evaluations are introduced. Such economic evaluations provide information that is essential, although not necessarily sufficient, for making decisions about how to use these limited resources.

Profitability Standards

In the process of making an investment decision, the profit anticipated from an investment must be judged relative to some profitability standard. A profitability standard is a quantitative measure of profit with respect to the investment required to generate that profit.

Profit is the goal of any investment, but maximizing profit is an inadequate profitability standard. The profit must be judged relative to the investment.

For example,

suppose two equally sound investment opportunities are available. One of these requires a $ 100,000 capital investment and will yield a profit of $ 10,000 per year, while the second requires $1 million of capital investment and will yield a profit of $25,000 per year. While the second investment provides a greater yearly profit than the first, the annual rate of return on that investment is only ($25,000/$l, 000,000) (100), or 2.5 percent, while it is 10 percent for the first investment. If one had $1 million to invest and there were no alternative uses for these funds, then one might select the second investment.

However, because there are numerous reliable alternatives, such as bonds, that will yield annual returns greater than 2.5 percent, the second investment is not attractive. In this case, it would be advisable to invest $100,000 in the first alternative, assuming that it is not significantly more risky than the second alternative, and invest the remaining $900,000 in other reliable alternatives that provide higher annual returns.

Cost of Capital

The cost of capital based upon corporate experience is often used as a basic profitability standard. Cost of capital is the amount paid for the use of capital from such sources as bonds common and preferred stock, and loans.

The cost of capital after income taxes is found by weighting the cost of each of these outside sources according to its fraction of the total capital from these sources.

Method for Calculating Profitability

1. Methods that Do Not Consider the Time Value of Money
   - Rate of return on investment,
   - Payback period
   - Net return
2. Methods that Consider the Time Value of Money
   - The discounted cash flow rate of return
   - Net present worth

Table 8-2 Use of profitability measures†

Evaluation method	Percentage use	
	Small companies	Large companies
Payback period	43	52
Return on investment	22	34
Net present worth	16	80
Discounted cash flw rate of return	11	78

†E. J. Farragher, R. T. Kleiman, and A. P. Sahu, *Eng. Econ.*, **44**(2): 137 (1999).

Return on Investment (ROI) This profitability measure is defined as the ratio of profit to investment. Although any of several measures of profit and investment can be used, the most common are net profit and total capital investment. This can be expressed as

$$\text{ROI} = \frac{N_p}{\mathcal{T}} \qquad (8\text{-}1a)$$

$$\text{ROI} = \frac{(1/N)\sum_{j=1}^{N}(N_{p,j})}{\sum_{j=-b}^{N}(\mathcal{T}_j)} \qquad (8\text{-}1b)$$

where N is the evaluation period, $N_{p,j}$ the net profit in year j, -b the year in which the first investment is made in the project with respect to zero as the startup time, and $\mathcal{T}_j$ the total capital investment in year j. Note that for $j > 0$, that is, anytime after the original investment, $\mathcal{T}_j$ may often be zero or at most

small compared to the original investment, and the denominator can be replaced by the initial total capital investment to simplify Eq. (8-1b) to

$$\text{ROI} = \frac{(1/N)\sum_{j=1}^{N}(N_{p,j})}{\mathcal{F}} = \frac{N_{p,\text{ave}}}{\mathcal{F}} \qquad (8\text{-}1c)$$

where $N_{b.ave}$ is the average value of net profit per year over the evaluation period.

Minimum acceptable Rate of Return

The symbol m_{ar} will be used for the minimum acceptable annual rate of return, and it is used as a fraction per year but often expressed as a percentage per year.

Table 8-1 Suggested values for risk and minimum acceptable return on investment

Investment description	Level of risk	Minimum acceptable return m_{ar} (after income taxes), percent/year
Basis: Safe corporate investment opportunities or cost of capital	Safe	4–8
New capacity with established corporate market position	Low	8–16
New product entering into established market, or new process technology	Medium	16–24
New product or process in a new application	High	24–32
Everything new, high R&D and marketing effort	Very high	32–48+