Benefit Cost Ratio (BCR)

A benefit-cost ratio (BCR) is a ratio used in a cost-benefit analysis to summarize the overall relationship between the relative costs and benefits of a proposed project. BCR can be expressed in monetary or qualitative terms. If a project has a BCR greater than 1.0, the project is expected to deliver a positive net present value to a firm and its investors.

Key Takeaways

- A benefit-cost ratio (BCR) is an indicator showing the relationship between the relative costs and benefits of a proposed project, expressed in monetary or qualitative terms.
- If a project has a BCR greater than 1.0, the project is expected to deliver a positive net present value to a firm and its investors.
- If a project's BCR is less than 1.0, the project's costs outweigh the benefits, and it should not be considered.

What Does the BCR Tell You?

- If a project has a BCR that is greater than 1.0, the project is expected to deliver a positive net present value (NPV) and will have an internal rate of return (IRR) (used in capital budgeting to estimate the profitability of potential investments) above the discount rate (the minimum interest rate). This suggests that the NPV of the project's cash flows outweighs the NPV of the costs, and the project should be considered.

- If the BCR is equal to 1.0, the ratio indicates that the NPV of expected profits equals the costs. If a project's BCR is less than 1.0, the project's costs outweigh the benefits, and it should not be considered.

Limitations of BCR

The primary limitation of the BCR is that it reduces a project to a simple number when the success or failure of an investment or expansion relies on many factors and can be undermined by unforeseen events. Simply following a rule that above 1.0 means success and below 1.0 spells failure is misleading and can provide a false sense of comfort with a project. The BCR must be used as a tool in conjunction with other types of analysis to make a well-informed decision.

Formulae for Calculation BCR

Conventional B–C ratio with PW:

$$\text{B–C} = \frac{\text{PW(benefits of the proposed project)}}{\text{PW(total costs of the proposed project)}} = \frac{\text{PW}(B)}{I - \text{PW(MV)} + \text{PW(O\&M)}} \quad (1$$

where PW(·) = present worth of (·);
B = benefits of the proposed project;
I = initial investment in the proposed project;
MV = market value at the end of useful life;
O&M = operating and maintenance costs of the proposed project.

Modified B–C ratio with PW:

$$\text{B–C} = \frac{\text{PW}(B) - \text{PW(O\&M)}}{I - \text{PW(MV)}}. \quad (1$$

Conventional B–C ratio with AW:

$$\text{B–C} = \frac{\text{AW(benefits of the proposed project)}}{\text{AW(total costs of the proposed project)}} = \frac{\text{AW}(B)}{\text{CR} + \text{AW(O\&M)}}, \quad (1$$

where AW(·) = annual worth of (·);
B = benefits of the proposed project;
CR = capital-recovery amount (i.e., the equivalent annual cost of the initial investment, I, including an allowance for market, or salvage value, if any);
O&M = operating and maintenance costs of the proposed project.

Modified B–C ratio with AW:

$$\text{B–C} = \frac{\text{AW}(B) - \text{AW(O\&M)}}{\text{CR}}. \quad (1$$

Example:

The city of Columbia is considering extending the runways of its municipal airport so that commercial jets can use the facility. The land necessary for the runway extension is currently a farmland that can be purchased for $350,000. Construction costs for the runway extension are projected to be $600,000, and the additional annual maintenance costs for the extension are estimated to be $22,500. If the runways are extended, a small terminal will be constructed at a cost of $250,000. The annual operating and maintenance costs for the terminal are estimated at $75,000. Finally, the projected increase in flights will require the addition of two air traffic controllers at an annual cost of $100,000. Annual benefits of the runway extension have been estimated as follows:

$325,000 Rental receipts from airlines leasing space at the facility

$65,000 Airport tax charged to passengers

$50,000 Convenience benefit for residents of Columbia

$50,000 Additional tourism dollars for Columbia

Apply the B–C ratio method with a study period of 20 years and a MARR of 10% per year to determine whether the runways at Columbia Municipal Airport should be extended.

Conventional B–C: *Equation (10-1)*	B–C = PW(*B*)/[*I* − PW(MV) + PW(O&M)] B–C = $490,000 (*P*/*A*, 10%, 20)/[$1,200,000 + $197,500 (*P*/*A*, 10%, 20)] **B–C = 1.448 > 1; extend runways.**
Modified B–C: *Equation (10-2)*	B–C = [PW(*B*) − PW(O&M)]/[*I* − PW(MV)] B–C = [$490,000 (*P*/*A*, 10%, 20) − $197,500 (*P*/*A*, 10%, 20)]/$1,200,000 **B–C = 2.075 > 1; extend runways.**
Conventional B–C: *Equation (10-3)*	B–C = AW(*B*)/[CR + AW(O&M)] B–C = $490,000/[$1,200,000 (*A*/*P*, 10%, 20) + $197,500] **B–C = 1.448 > 1; extend runways.**
Modified B–C: *Equation (10-4)*	B–C = [AW(*B*) − AW(O&M)]/CR B–C = [$490,000 − $197,500]/[$1,200,000 (*A*/*P*, 10%, 20)] **B–C = 2.075 > 1; extend runways.**

Internal Rate of Return

The internal rate of return is a measure of an investment’s rate of return. The term internal refers to the fact that the calculation excludes external factors, such as the risk-free rate, inflation, the cost of capital, or various financial risks. It is also called the discounted cash flow rate of return.

Minimum Attractive Rate of Return (MARR)

An organization's minimum attractive rate of return (MARR) is just that, the lowest internal rate of return the organization would consider to be a good investment. The MARR is a statement that an organization is confident it can achieve at least that rate of return

Another way of looking at the MARR is that it represents the organization's opportunity cost for investments. By choosing to invest in some activity, the organization is explicitly deciding to not invest that same money somewhere else. If the organization is already confident it can get some known rate.

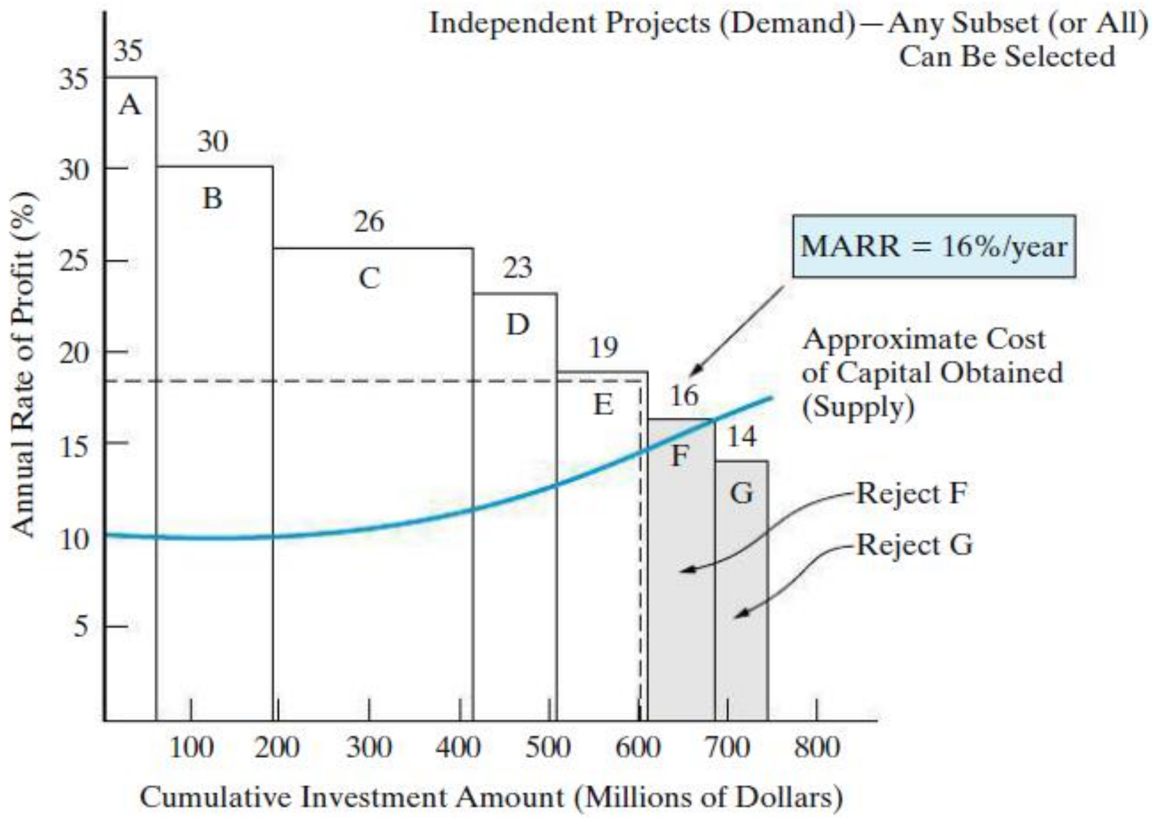

Fig: 01

A simple example of capital rationing is given in Figure1, where the cumulative investment requirements of seven acceptable projects are plotted against the prospective annual rate of profit of each. Figure 1 shows a limit of $600 million on available capital. In view of this limitation, the last funded project would be E, with a prospective rate of profit of 19% per year, and the best rejected project is F. In this case, the MARR by the opportunity cost principle would be 16%

per year. By not being able to invest in project F, the firm would presumably be forfeiting the chance to realize a 16% annual return. As the amount of investment capital and opportunities available change over time, the firm's MARR will also change.*