Pay Back Period

What is the Payback Period?

Corporate finance is all about capital budgeting. One of the most important concepts every corporate financial analyst must learn is how to value different investments or operational projects. The analyst must find a reliable way to determine the most profitable project or investment to undertake. One way corporate financial analysts do this is with the payback period.

The payback period refers to the length of time it takes to recover the cost of an investment.

The desirability of an investment is directly related to its payback period. Shorter paybacks mean more attractive investments. Investors and managers use the payback period to make quick judgments on their investments. The concept of the payback period is generally used in financial and capital budgeting. But it has also been used to determine the cost savings of energy efficiency technology. As an example it can be used by homeowners and businesses to calculate the return on the energy efficient technologies such as solar panels and insulation, as well as maintenance and upgrades.

The payback period, though, disregards the time value of money. It is determined by counting the number of years it takes to recover the funds invested. For example, if it takes five years to recover the cost of the investment, the payback period is five years.

While payback periods are useful in financial and capital budgeting, it has applications in other industries. Some analysts favor the payback method for its simplicity. Others like to use it as an additional point of reference in a capital budgeting decision framework. The payback period does not account for what happens after payback, ignoring the overall profitability of an investment.

Payback Period Formula – Even Cash Flow:

When net annual cash inflow is even (i.e., same cash flow every period), the payback period of the project can be computed by applying the simple formula given below:

$$\text{Payback period} = \frac{\text{Investment required}}{\text{Net annual cash inflow*}}$$

*The denominator of the formula becomes incremental cash flow if an old asset (e.g., machine or equipment) is replaced by a new one.

The payback period is the cost of the investment divided by the annual cash flow. The shorter the payback, the more desirable the investment. Conversely, the longer the payback, the less desirable it is.

Example

The ABC company is planning to purchase a machine known as machine X. Machine X would cost $25,000 and would have a useful life of 10 years with zero salvage value. The expected annual cash inflow of the machine is $10,000. Compute payback period of machine X and conclude whether or not the machine would be purchased if the maximum desired payback period of ABC company is 3 years.

Solution

Since the annual cash inflow is even in this project, we can simply divide the initial investment by the annual cash inflow to compute the payback period. It is shown below:

Payback period = $25,000/$10,000

= 2.5 years

According to payback period analysis, the purchase of machine X is desirable because its payback period is 2.5 years which is shorter than the maximum payback period of the company.

Example

Due to increased demand, the management of XYZ Beverage Company is considering to purchase a new equipment to increase the production and revenues. The useful life of the equipment is 10 years and the company's maximum desired payback period is 4 years. The inflow and outflow of cash associated with the new equipment is given below:

Initial cost of equipment: $37,500

Annual cash inflows:

Sales: $75,000

Annual cash Outflows:

Cost of ingredients: $45,000

Salaries expenses: $13,500

Maintenance expenses: $1,500

Should XYZ Beverage Company purchase the new equipment? Use payback method for your answer.

Solution:

Step 1:

In order to compute the payback period of the equipment, we need to work out the net annual cash inflow by deducting the total of cash outflow from the total of cash inflow associated with the equipment.

Computation of net annual cash inflow:

$75,000 – ($45,000 + $13,500 + $1,500)
= $15,000

Step 2:

Now, the amount of investment required to purchase the equipment would be divided by the amount of net annual cash inflow (computed in step 1) to find the payback period of the equipment.

= $37,500/$15,000

=2.5 years

According to payback method, the equipment should be purchased because the payback period of the equipment is 2.5 years which is shorter than the maximum desired payback period of 4 years.

Comparison of two or more alternative projects

Where funds are limited and several alternative projects are being considered, the project with the shortest payback period is preferred. It is explained with the help of the following example:

Example:

The management of ABC company wants to reduce its labor cost by installing a new machine. Two types of machines are available in the market – machine X and machine Y. Machine X would cost $18,000 where as machine Y would cost $15,000. Both the machines can reduce annual labor cost by $3,000. Which is the best machine to purchase according to payback method?

Solution:

Payback period of machine X**:** $18,000/$3,000 = 6 years

Payback period of machine y: $15,000/$3,000 = 5 years

According to payback method, machine Y is more desirable than machine X because it has a shorter payback period than machine X.

Payback Method with Uneven Cash Flow:

In the above examples we have assumed that the projects generate even cash inflow but many projects usually generate uneven cash flow. When projects

generate inconsistent or uneven cash inflow (different cash inflow in different periods), the simple formula given above cannot be used to compute payback period. In such situations, we need to compute the cumulative cash inflow and then apply the following formula:

$$\text{Payback period} = \text{Years before full recovery} + \frac{\text{Unrecovered cost at start of the year}}{\text{Cash flow during the year}}$$

Example

An investment of $200,000 is expected to generate the following cash inflows in six years:

Year 1: $70,000

Year 2: $60,000

Year 3: $55,000

Year 4: $40,000

Year 5: $30,000

Year 6**:** $25,000

Compute payback period of the investment. Should the investment be made if management wants to recover the initial investment in 3 years or less?

Solution:

Because the cash inflow is uneven, the payback period formula cannot be used to compute the payback period. We can compute the payback period by computing the cumulative net cash flow as follows:

Initial investment: $200,000

Year	Cash inflow	Cumulative cash inflow
1	$ 70,000	$ 70,000
2	60,000	130,000
3	55,000	185,000
4	40,000	225,000
5	30,000	255,000
6	25,000	280,000

Payback period = 3 + (15,000*/40,000)

= 3 + 0.375

= 3.375 Years

*Unrecovered investment at start of 4th year:

= Initial cost – Cumulative cash inflow at the end of 3rd year

= $200,000 – $185,000

= $15,000

The payback period for this project is 3.375 years which is longer than the maximum desired payback period of the management (3 years). The investment in this project is therefore not desirable.

Advantages and disadvantages of payback method

Advantages:

1. The payback period is useful from a risk analysis perspective, since it gives a quick picture of the length of time that the initial investment will be at risk. If you were to analyze a prospective investment using the payback method, you would tend to accept those investments having rapid payback periods and reject those having longer ones. It tends to be more useful in industries where investments become obsolete very quickly, and where a full return of the initial investment is therefore a serious concern.
2. An investment project with a short payback period promises the quick inflow of cash. It is therefore, a useful capital budgeting method for cash poor firms.
3. A project with short payback period can improve the liquidity position of the business quickly. The payback period is important for the firms for which liquidity is very important.

Disadvantages:

1. It does not consider the useful life of the assets and inflow of cash after payback period. For example, If two projects, project A and project B require an initial investment of $5,000. Project A generates an annual cash inflow of $1,000 for 5 years whereas project B generates a cash inflow of $1,000 for 7 years. It is clear that the project B is more profitable than project A. But according to payback method, both the projects are equally desirable because both have a payback period of 5 years ($5,000/$1,000).

   If an asset's useful life expires immediately after it pays back the initial investment, then there is no opportunity to generate additional cash flows. The payback method does not incorporate any assumption regarding asset life span.

2. Additional cash flows. The concept does not consider the presence of any additional cash flows that may arise from an investment in the periods after full payback has been achieved.

3.Cash flow complexity. The formula is too simplistic to account for the multitude of cash flows that actually arise with a capital investment. For example, cash investments may be required at several stages, such as cash outlays for periodic upgrades. Also, cash outflows may change significantly over time, varying with customer demand and the amount of competition.

4.Profitability. The payback method focuses solely upon the time required to pay back the initial investment; it does not track the ultimate profitability of a project at all. Thus, the method may indicate that a project having a short payback but with no overall profitability is a better investment than a project requiring a long-term payback but having substantial long-term profitability.

5.Time value of money. The method does not take into account the time value of money, where cash generated in later periods is worth less than cash earned in the current period. A variation on the payback period formula, known as the discounted payback formula, eliminates this concern by incorporating the time value of money into the calculation. Other capital budgeting analysis methods that include the time value of money are the net present value method and the internal rate of return.

6.Individual asset orientation. Many fixed asset purchases are designed to improve the efficiency of a single operation, which is completely useless if there is a process bottleneck located downstream from that operation that restricts the ability of the business to generate more output. The payback period formula does not account for the output of the entire system, only a specific operation. Thus, its use is more at the tactical level than at the strategic level.

Discounted payback method

The discounted payback period is a capital budgeting procedure used to determine the profitability of a project. A discounted payback period gives the number of years it takes to break even from undertaking the initial expenditure, by discounting future cash flows and recognizing the time value of money. The metric is used to evaluate the feasibility and profitability of a given project.

The more simplified payback period formula, which simply divides the total cash outlay for the project by the average annual cash flows, doesn't provide as accurate of an answer to the question of whether or not to take on a project because it assumes only one, upfront investment, and does not factor in the time value of money.

To begin, the periodic cash flows of a project must be estimated and shown by period in a table or spreadsheet. These cash flows are then reduced by their present value factor to reflect the discounting process. This can be done using the present value function and a table in a spreadsheet program.

A general rule to consider when using the discounted payback period is to accept projects that have a payback period that is shorter than the target timeframe. A company can compare its required break-even date for a project to the point at which the project will break even according to the discounted cash flows used in the discounted payback period analysis, to approve or reject the project.

The discounted payback method tells companies about the time period in which the initially invested funds to start a project would be recovered by the discounted value of total cash inflow. Additionally, it indicates towards the potential profitability of a certain business venture. For example, if a project indicates that the funds or initial investment will never be recovered by the discounted value of related cash inflow, it means the project would not be profitable and the company should refrain from investing in it.

The following example illustrates how a discounted payback method differs from a traditional or simple payback method.

Example

An opportunity arises for a company which requires an initial investment of $800,000 now. The management’s discount rate is 12%.

The amount of cash inflows expected from the new opportunity are:

- Year-1 cash Inflow: $250,000
- Year-2 cash Inflow: $400,000
- Year-3 cash Inflow: $300,000

- Year-4 cash Inflow: $450,000

Compute the simple and discounted payback periods of the new investment opportunity. Is this investment opportunity acceptable under two methods if the maximum desired payback period of the management is 3 years?

Solution

1. Simple payback period

The simple payback method dos not take into account the present value of cash flows.

Initial investment: $800,000

Year	Cash inflow	Cumulative cash inflow
1	$ 250,000	$ 250,000
2	400,000	650,000
3	300,000	950,000
4	450,000	1,400,000

Simple payback period =

Years before full recovery + (Unrecovered cost at start of the year/Cash flow during the year)
= 2 + *150,000/300,000
2.5 years

*$800,000 – $650,000

We see that in year 3, the investment is not just recovered but the remaining cash inflow is surplus. The initial investment of the company would be recovered in 2.5 years. So the project is acceptable according to simple payback period method because the recovery period under this method (2.5 years) is less than the maximum desired payback period of the management (3 years).

2. Discounted payback period

The discounted payback method takes into account the present value of cash flows.

Initial investment: $800,000				
Year	Cash inflow	Present value factor (12%)	Present value of cash inflows	Cumulative cash inflow
1	$ 250,000	*0.893	$ 223,250	$ 223,250
2	400,000	0.797	318,800	542,050
3	300,000	0.712	213,600	755,650
4	450,000	0.636	286,200	1,041,850

***Present value factor at 12%:** (1/1.12)^1 = 0.893; (1/1.12)^2 = 0.797; (1/1.12)^3 = 0.712; (1/1.12)^4 = 0.636

The rest of the computations are similar to simple payback period

Discounted payback period = Years before full recovery + (Unrecovered cost at start of the year/Cash flow during the year)
3 + *44,350/286,200
3.15 years

*$800,000 – $755,650

We observe that the outcome with discounted payback method is less favorable than with the simple payback method and according to this method the initial investment would be recovered in 3.15 years.

The project is not acceptable according to discounted payback period method because the recovery period under this method (3.15 years) is more than the maximum desired payback period of the management (3 years).

Advantages and disadvantages of discounted payback method

Advantages:

- It takes into account the time value of money by deflating the cash flows using cost of capital of the company.
- The concept backing the method is easy to understand.

Disadvantages:

- Both simple and discounted payback method do not take into account the full life of the project. The overall benefit and profitability of a project cannot be measured under these methods because any cash flows beyond the payback period is ignored.
- It may become a relative measure. In some situations, the discounted payback period of the project may be longer than the maximum desired payback period of the management but other measures like accounting rate of return (ARR) and internal rate of return (IRR) etc. may favor the project.
- The accuracy of the output only depends upon the accuracy of the input provided, like the accuracy of figures of cash flows, the estimation of the timing of cash flows which affects their present values, and the accuracy of the discount rate to be used etc.

Accounting Rate of Return (Average Rate of Return)

The Average Rate of Return or ARR, measures the profitability of the investments on the basis of the information taken from the financial statements rather than the cash flows. It is also called as Accounting Rate of Return. The term "average rate of return" refers to the percentage rate of return that is expected on an investment or asset vis-à-vis the initial investment cost or average investment over the life of the project. The ratio does not take into account the concept of time value of money. ARR calculates the return, generated from net income of the proposed capital investment.

How to Calculate the Accounting Rate of Return – ARR

1. Calculate the annual net profit from the investment, which could include revenue minus any annual costs or expenses of implementing the project or investment.

2. If the investment is a fixed asset such as property, plant, or equipment, subtract any depreciation expense from the annual revenue to achieve the annual net profit.
3. Divide the annual net profit by the initial cost of the asset, or investment. The result of the calculation will yield a decimal. Multiply the result by 100 to show the percentage return as a whole number.

The formula for calculating the average rate of return is:

Average Rate of Return = Average Income / Average Investment over the life of the project*100

Accept-Reject Criteria: The projects having the rate of return higher than the minimum desired returns are accepted. When comparing investments, the higher the ARR, the more attractive the investment. More than half of large firms calculate ARR when appraising projects.

The formula for average rate of return is also derived by dividing the average annual net earnings after taxes or return on the investment by the original investment or the average investment during the life of the project and then expressed in terms of percentage.

Average Rate of Return = Average Annual Net Earnings After Taxes / Initial investment * 100%

Or

Average Rate of Return = Average annual net earnings after taxes / Average investment over the life of the project * 100%

$$\text{Accounting/Simple rate of return} = \frac{\text{Incremental accounting income}}{\text{Initial investment}}$$

In the above formula, the incremental net operating income is equal to incremental revenues to be generated by the asset less incremental operating expenses. The incremental operating expenses also include depreciation of the asset.

The denominator in the formula is the amount of investment initially required to purchase the asset. If an old asset is replaced with a new one, the amount of initial investment would be reduced by any proceeds realized from the sale of old equipment.

Example:

The ABC Clothing Factory wants to replace an old machine with a new one. The old machine can be sold to a small factory for $10,000. The new machine would increase annual revenue by $150,000 and annual operating expenses by $60,000. Annual depreciation is $30000. The new machine would cost $360,000. The estimated useful life of the machine is 12 years.

Compute accounting rate of return (ARR) of the machine using above information.

Should ABC Clothing Factory purchase the machine if management wants an accounting rate of return of 15% on all capital investments?

Solution:

Computation of accounting rate of return:

= $60,000* / $350,000**

= 17.14%

*Incremental net operating income:

Incremental revenues – Incremental expenses including depreciation

$150,000 – ($60,000 cash operating expenses + $30,000 depreciation)

$150,000 – $90,000

$60,000

** The amount of initial investment has been reduced by net realizable value of the old machine ($360,000 – $10,000).

Conclusion:

According to accounting rate of return method, the ABC Clothing Factory should purchase the machine because its estimated accounting rate of return is 17.4% which is greater than the management's desired rate of return of 15%.

Cost reduction projects:

The accounting rate of return method is equally beneficial to evaluate cost reduction projects. The accounting rate of return of the assets that are purchased with a view to reduce business costs is computed using the following formula:

$$\text{Accounting/Simple rate of return} = \frac{\text{Net cost savings}}{\text{Initial investment}}$$

Example:

The ABC company is considering to purchase an equipment costing $45,000 to be used in packing department. It would reduce annual labor cost by $12,000. The useful life of the equipment would be 15 years with no salvage value. The operating expenses would be $3,000 per year.

Required: Compute accounting rate of return/simple rate of return of the equipment.

Solution:

= $9,000* / $45,000

= 20%

*Net cost savings:

$12,000 – ($3,000 cash operating expenses)

$9000

Comparison of different alternatives:

If several investments are proposed and the management have to choose the best due to limited funds, the proposal with the highest accounting rate of return is preferred.

It is important to understand the concept of the average rate of return as it is used by investors to make decisions based on the likely amount of return expected from an investment. Based on this, an investor can decide whether to enter into an investment or not. Further, investors use this return for ranking the assets and eventually make the investment as per the ranking and include them in the portfolio.

In cases of projects, an investor uses the metric to check whether or not the average rate of return is higher than the required rate of return, which is a positive signal for the investment. Again, for mutually exclusive projects, an investor accepts the one with the highest return. In short, the higher the return, the better is the asset.

The accounting rate of return is a capital budgeting metric useful for a quick calculation of an investment's profitability. ARR is used mainly as a general comparison between multiple projects to determine the expected rate of return from each project.

ARR can be used when deciding on an investment or an acquisition. It factors in any possible annual expenses or depreciation expense that's associated with the project. Depreciation is an accounting process whereby the cost of a fixed asset is spread out, or expensed, annually during the useful life of the asset.

Depreciation is a helpful accounting convention that allows companies not to have to expense the entire cost of a large purchase in year one, thus allowing the company to earn a profit from the asset right away, even in its first year of service. In the ARR calculation, depreciation expense and any annual costs must be subtracted from annual revenue to yield the net annual profit.

However, ARR does not differentiate between investments that yield different cash flows over the lifetime of the project.

If you have already studied other capital budgeting methods (net present value method, internal rate of return method and payback method), you may have noticed that all these methods focus on cash flows. But accounting rate of return (ARR) method uses expected net operating income to be generated by the investment proposal rather than focusing on cash flows to evaluate an investment proposal.

Advantages and disadvantages:

Advantages:

1. Accounting rate of return is simple and straightforward to compute.

2. It focuses on accounting net operating income. Creditors and investors use accounting net operating income to evaluate the performance of management.

Disadvantages:

1.Accounting rate of return method does not take into account the time value of money. Under this method a dollar in hand and a dollar to be received in future are considered of equal value.

2.The accounting rate of return does not consider the increased risk of long-term projects and the increased uncertainty associated with long periods.

3.Cash is very important for every business. If an investment quickly generates cash inflow, the company can invest in other profitable projects. But accounting rate of return method focus on accounting net operating income rather than cash flow.

4.The accounting rate of return does not remain constant over useful life for many projects. A project may, therefore, look desirable in one period but undesirable in another period.