## Pay-back Period

Payback period is measured in years and shows how long the project takes to 'pay itself off'. In other words, how many years it is expected to take to re-coup the cost of the project and break even.

Projects with shorter payback periods are preferred.
Sometimes managers use a decision rule that any project with a payback period above a threshold number of years should be rejected.

## Pay-back Period: Pros and Cons

The advantage of the payback period approach is that it is intuitive, simple to understand and simple to calculate.

The disadvantages are that it:

- Doesn't explicitly take the time value of money or risk into account.
- Provides no indication about how much more the firm will be worth if the project is accepted.
- Ignores all cash flows after the payback period.
- Suffers from the same scale effect problems as IRR when ranking mutually exclusive projects.


## Calculation Example: Pay-back Period

Question: A mining firm's potential new gold mine has the following after-tax cash flows:

-     - $\$ 9 \mathrm{~m}$ to buy extra machinery needed to excavate the mine which will be delivered and paid for immediately ( $\mathrm{t}=0$ ).
- \$6m in one year ( $\mathrm{t}=1$ ) from gold sales.
- $\$ 5 \mathrm{~m}$ in two years $(\mathrm{t}=2)$ from gold sales.

Question: What is the payback period, assuming that the cash flows are received (or paid) in full at the given time?

Answer: The $\$ 9 \mathrm{~m}$ cost will be paid back at $\mathrm{t}=2$ since the cumulative cash flow at $\mathrm{t}=2$ will be positive ( $>0$ ). Note that present values are not calculated, we just sum up the cash flows as if we're accountants:

$$
\begin{aligned}
C_{\text {cumulative }, t=0 \rightarrow 2} & =C_{0}+C_{1}+C_{2} \\
& =-9 m+6 m+5 m \\
& =2 m \\
& >0
\end{aligned}
$$

Question: What is the payback period, assuming that all cash flows are received smoothly over the year before the given time (but assume that the negative cash flow at the start is paid in full at $\mathrm{t}=0$ )?

So the $\$ 6 \mathrm{~m}$ at time 1 is actually earned smoothly from $\mathrm{t}=0$ to $\mathrm{t}=1$.

Answer: Make a new column that sums the current and past cash flows at each time, called 'Cumulative cash flows':

Payback Period Calculation

| Time <br> $(y r s)$ | Cash <br> flow $(\$ \mathrm{~m})$ | Cumulative <br> cash flow $(\$ \mathrm{~m})$ |
| :---: | :---: | :---: |
| 0 | -9 | -9 |
| 1 | 6 | -3 |
| 2 | 5 | 2 |

The payback period clearly occurs sometime during the second year (between $\mathrm{t}=1$ and 2 ).

The payback period is the time at which the first positive cumulative cash flow occurs, less the positive cumulative cash flow divided by the single cash flow in that period:

$$
\begin{aligned}
\mathrm{T}_{\text {pay back }} & =\left(\begin{array}{c}
\text { Time of } \\
\text { first positive } \\
\text { cumulative } \\
\text { cash flow }
\end{array}\right)-\frac{\left(\begin{array}{c}
\text { first positive } \\
\text { cumulative } \\
\text { cash flow }
\end{array}\right)}{\binom{\text { cash flow }}{\text { in that year }}} \\
& =2-\frac{(-9+6+5)}{5} \\
& =2-\frac{2}{5} \\
& =1.6 y r s
\end{aligned}
$$

