## Calculation Example: Project Valuation

Question: You've estimated the costs and benefits of producing a product. Should you proceed with the project? What's the Net Present Value of the cash flows?

| Project Data |  |
| :--- | ---: |
| Project life | 10 yrs |
| Initial investment in factory that lasts for 10 yrs | $\$ 10 \mathrm{~m}$ |
| Depreciation of factory per year | $\$ 1 \mathrm{~m}$ |
| Expected sale price of factory at end of project | $\$ 1.7 \mathrm{~m}$ |
| Unit sales per year | 0.9 m |
| Sale price per unit | $\$ 10$ |
| Variable cost per unit | $\$ 6$ |
| Fixed costs per year, paid at the end of each year | $\$ 1.5 \mathrm{~m}$ |
| Interest expense per year | 0 |
| Tax rate | $30 \%$ |
| Discount rate | $10 \%$ |

Notes:

- An inventory (current assets) purchase of $\$ 0.1 \mathrm{~m}$ will occur at the very start of the first year ( $\mathrm{t}=0$ ), and inventories will be kept at that level for the life of the project. At the very end of the project ( $\mathrm{t}=10$ ), all inventories will be sold. Assume that as inventory is sold every year, it will be replaced with new stock so inventories will always remain at the same constant level. The project will not affect the firm's other current assets and liabilities.
- The factory that the project will use is temporarily empty, but in the past the business owner next door has rented it from you. This year he offered you $\$ 0.5 \mathrm{~m} / \mathrm{yr}$ to use it as a warehouse. This year, your grandma also made an offer! She offered you $\$ 100 / \mathrm{yr}$ to use it as a car park for her friends.
- All cash flows occur at the start or end of the year as appropriate, not in the middle or throughout the year.
- All rates and cash flows are real. The inflation rate is 3\% pa.
- All rates are given as effective annual rates.


## Formulas:

$\mathrm{NI}=($ Rev - COGS $-\mathrm{FC}-$ Depr $-\operatorname{IntExp}) .\left(1-\mathrm{t}_{\mathrm{c}}\right)$, or alternatively
$N I=(Q \cdot(P-V C)-F C-$ Depr $-\operatorname{IntExp}) .\left(1-t_{c}\right)$
$\Delta \mathrm{NOWC}=\Delta \mathrm{CA}-\Delta$ ExcessCash $-\Delta \mathrm{CL}$
FFCF $=$ NI + Depr - CapEx $-\Delta$ NOWC $+\operatorname{IntExp}$
NPV $=$ Net Present Value of FFCF

## Answer:

The opportunity cost of renting the factory to the next door business owner should be included. Note that only the highest opportunity cost is included. Your grandmas' offer is not included since you can't rent the factory to her and the next door business owner at the same time, so we only include the higher opportunity cost.

Note that if we did rent the factory, then the $\$ 0.5 \mathrm{~m}$ would have been added to revenue and thus would be taxed. Therefore, the opportunity cost should be the after-tax amount, not the whole $\$ 0.5 \mathrm{~m}$. There are two ways to include the opportunity cost. We can subtract the after-tax cost $\left(0.5 \mathrm{~m} \times\left(1-t_{c}\right)\right)$ from yearly FFCF or we can subtract it from revenues in the net income (NI) equation which achieves the same effect. Here we subtract the $\$ 0.5 \mathrm{~m}$
opportunity cost in the net income equation by adding it to fixed costs (FC) per year.

$$
\begin{aligned}
\mathrm{NI} & =(\mathrm{Q}(\mathrm{P}-\mathrm{VC}) \quad-\quad \mathrm{FC} \quad-\text { Depr }-\operatorname{IntExp})\left(1-\mathrm{t}_{\mathrm{c}}\right) \\
& =(0.9 \mathrm{~m}(10-6)-(1.5 \mathrm{~m}+0.5 \mathrm{~m})-1 \mathrm{~m}-0)(1-0.3) \\
& =\$ 0.42 \mathrm{~m}
\end{aligned}
$$

This net income will be received at the end of each year for the next ten years. Some adjustments are needed to get FFCF:

FFCF $=$ NI + Depr - CapEx $-\Delta$ NOWC $+\operatorname{IntExp}$
Capital expenditure (CapEx) is only incurred at the very beginning which is the 'Initial investment in factory', and at the end when the factory is sold. There is no yearly capital expenditure.

The increase in net operating working capital ( $\triangle \mathrm{NOWC}$ ) will be $\$ 0.1 \mathrm{~m}$ at $\mathrm{t}=0$ and then a decrease (negative increase) at $\mathrm{t}=10$.

$$
\begin{aligned}
& \mathrm{FFCF}_{\mathrm{t}=0}=\mathrm{NI}+\text { Depr }- \text { CapEx }-\Delta \mathrm{NOWC}+\operatorname{IntExp} \\
& =0+0-10 \mathrm{~m}-0.1 \mathrm{~m}+0 \\
& =-10.1 \mathrm{~m} \\
& \text { FFCF }_{\mathrm{t}=1,2, \ldots 9}=\mathrm{NI}+\text { Depr }- \text { CapEx }-\Delta \mathrm{NOWC}+\operatorname{IntExp} \\
& =0.42 \mathrm{~m}+1 \mathrm{~m}-0 \quad-0 \quad+0 \\
& =1.42 \mathrm{~m} \text { each year }
\end{aligned}
$$

The factory is expected to be sold at $\mathrm{t}=10$ which will have an impact on CapEx. A complicating factor is capital gains tax (CGT).

Note that selling a capital asset is a positive cash flow which is negative CapEx expenditure.

$$
\begin{aligned}
\text { CapEx } & =-\left(\mathrm{P}_{\mathrm{mkt}}-\text { CGT }\right) \\
& =-\left(\mathrm{P}_{\mathrm{mkt}}-\left(\mathrm{P}_{\mathrm{mkt}}-\mathrm{P}_{\mathrm{book}}\right) \cdot \mathrm{t}_{\mathrm{c}}\right) \\
& =-(1.7 \mathrm{~m}-(1.7 \mathrm{~m}-0) \times 0.3) \\
& =-1.19 \mathrm{~m}
\end{aligned}
$$

$\mathrm{P}_{\mathrm{mkt}}$ is the market sale price of the factory.
$\mathrm{P}_{\text {book }}$ is the book price of the factory according to the govt tax office.

The increase in NOWC at $\mathrm{t}=10$ will be negative since NOWC will fall when the inventory is sold. So $\Delta \mathrm{NOWC}_{10}=-0.1 \mathrm{~m}$
These figures should be added to the FFCF equation at $\mathrm{t}=10$.

$$
\begin{aligned}
\mathrm{FFCF}_{\mathrm{t}=10} & =\mathrm{NI} \quad+\text { Depr }- \text { CapEx }-\Delta \mathrm{NOWC}+\text { IntExp } \\
& =0.42 \mathrm{~m}+1 \mathrm{~m}-(-1.19 \mathrm{~m})-(-0.1 \mathrm{~m})+0 \\
& =2.71 \mathrm{~m}
\end{aligned}
$$

Since all cash flows are real, and the discount rate is also real, there is no need to convert rates using the Fisher equation and inflation. If the cash flows and discount rate was nominal, that would also be fine, no need to convert rates or cash flows. We can go ahead and discount cash flows to find the NPV of the project.

$$
\begin{aligned}
\mathrm{NPV} & =\operatorname{PV}\left(\mathrm{FFCF}_{\mathrm{t}=0}\right)+\mathrm{PV}\left(\mathrm{FFCF}_{\mathrm{t}=1,2, \ldots .9}\right)+\mathrm{PV}\left(\mathrm{FFCF}_{\mathrm{t}=10}\right) \\
& =\mathrm{FFCF}_{\mathrm{t}=0}+\mathrm{FFCF}_{\mathrm{t}=1,2, \ldots .9} \times \frac{1}{\mathrm{r}}\left(1-\frac{1}{(1+\mathrm{r})^{\mathrm{T}}}\right)+\frac{\mathrm{FFCF}_{\mathrm{t}=10}}{(1+\mathrm{r})^{\mathrm{T}}} \\
& =-10.1 \mathrm{~m}+1.42 \mathrm{~m} \times \frac{1}{0.1}\left(1-\frac{1}{(1+0.1)^{9}}\right)+\frac{2.71 \mathrm{~m}}{(1+0.1)^{10}} \\
& =-10.1 \mathrm{~m}+8.1778 \mathrm{~m}+1.0448 \mathrm{~m} \\
& =-0.8774 \mathrm{~m}
\end{aligned}
$$

Since the NPV is negative, reject the project.
This is an interesting result because the net income is positive every year so an accountant might think that this is a good project, but clearly it is not.

## Questions: Capital budgeting and business project valuation

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