Capital Budgeting, Part II

Lakehead University

Making Capital Investment Decisions

1. Project Cash Flows
2. Incremental Cash Flows
3. Basic Capital Budgeting
4. Capital Cost Allowance
5. The Tax Shield Approach
6. Special Cases
The Capital Budgeting Decision Process

Relevant cash flows for a project are those who increase the overall value of the firm. Relevant cash flows are called incremental cash flows.

Stand-alone principle: Once the project’s effects on a firm’s actual cash flows have been determined, it may be simpler to quantify the incremental cash flows and to consider the project as a minifirm.

Incremental Cash Flows

- **Sunk costs** incurred before evaluation are not considered.
- **Opportunity costs** have to be considered.
- **Side effects** have to be considered.
- **Net working capital** changes have to be considered.
- **Financing costs** are not considered.
- **Government interventions**, such as CCA, have to be considered.
A firm believes it can sell 500 cans of chicken soup per year at $4.30 per can. Each can costs $2.50 to produce.

Fixed costs are $200 per year and the tax rate is 40%.

The project has a three-year life.

Investments are:

- $900 in equipment, which will depreciate to zero in a straight line over the project life ($300 per year).
- $200 in net working capital, which will be recovered at the end of the project.

The pro forma income statements are

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>2,150</td>
<td>2,150</td>
<td>2,150</td>
</tr>
<tr>
<td>COGS</td>
<td>(1,250)</td>
<td>(1,250)</td>
<td>(1,250)</td>
</tr>
<tr>
<td>Fixed costs</td>
<td>(200)</td>
<td>(200)</td>
<td>(200)</td>
</tr>
<tr>
<td>Depreciation</td>
<td>(300)</td>
<td>(300)</td>
<td>(300)</td>
</tr>
<tr>
<td>EBIT</td>
<td>400</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Taxes</td>
<td>(160)</td>
<td>(160)</td>
<td>(160)</td>
</tr>
<tr>
<td>Net income</td>
<td>240</td>
<td>240</td>
<td>240</td>
</tr>
</tbody>
</table>
As we have seen earlier,

$$CF(A) = OCF - \Delta NWC - NCS,$$

where

- $CF(A)$  $\equiv$  Cash flow from assets;
- $OCF$  $\equiv$  Operating cash flow;
- $\Delta NWC$  $\equiv$  Additions to net working capital;
- $NCS$  $\equiv$  Net capital spending.
In the present example,

\[
OCF = EBIT + \text{Depreciation} - \text{Taxes} \\
= 400 + 300 - 160 \\
= 540
\]

in years 1, 2 and 3.

Additions to net working capital (ΔNWC) and net capital spending (NCS) are as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔNWC</td>
<td>200</td>
<td>0</td>
<td>0</td>
<td>-200</td>
</tr>
<tr>
<td>NCS</td>
<td>900</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Basic Capital Budgeting

Notes:

- Net working capital is recovered at the end of the project. That is, the value of these assets is transferred to the parent company or converted to cash.

- Fixed assets could have been sold at market value in year 3. This is not the case here since we have assumed straight-line depreciation to zero.

Cash flow (from assets) is then:

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCF</td>
<td>0</td>
<td>540</td>
<td>540</td>
<td>540</td>
</tr>
<tr>
<td>ΔNWC</td>
<td>(200)</td>
<td>0</td>
<td>0</td>
<td>200</td>
</tr>
<tr>
<td>NCS</td>
<td>(900)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cash flow</td>
<td>(1,100)</td>
<td>540</td>
<td>540</td>
<td>740</td>
</tr>
</tbody>
</table>
Basic Capital Budgeting

Using a discount of 10%, the net present value of this project is then

\[
NPV = -1,100 + \frac{540}{1.1} + \frac{540}{(1.1)^2} + \frac{740}{(1.1)^3} = $393.
\]

Net present value is positive but we may want to have a look at the other measures.

Payback period = 2.02 years,

Discounted payback period = 2.29 years.

\[
PI = \frac{\frac{540}{1.1} + \frac{540}{(1.1)^2} + \frac{740}{(1.1)^3}}{1,100} = 1.36
\]

\[
AAR = \frac{240}{\frac{900}{2} + \frac{200}{4}} = 0.46
\]

\[
IRR = 28.26\%.
\]
Basic Capital Budgeting

Notes

- Investment in NWC may vary over time.
- Capital cost allowance should be used instead of accounting depreciation.

Capital Cost Allowance

Suppose Dormont, Inc., has a 5-year project where sales are expected to be as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Sales (in $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>480</td>
</tr>
<tr>
<td>2</td>
<td>660</td>
</tr>
<tr>
<td>3</td>
<td>810</td>
</tr>
<tr>
<td>4</td>
<td>750</td>
</tr>
<tr>
<td>5</td>
<td>720</td>
</tr>
</tbody>
</table>
The equipment purchased at the beginning of the project costs $500, and the CCA rate associate with it is 20%. This gives

<table>
<thead>
<tr>
<th>Year</th>
<th>Beg. UCC</th>
<th>CCA</th>
<th>End. UCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>500</td>
<td>50</td>
<td>450</td>
</tr>
<tr>
<td>2</td>
<td>450</td>
<td>90</td>
<td>360</td>
</tr>
<tr>
<td>3</td>
<td>360</td>
<td>72</td>
<td>288</td>
</tr>
<tr>
<td>4</td>
<td>288</td>
<td>58</td>
<td>230</td>
</tr>
<tr>
<td>5</td>
<td>230</td>
<td>46</td>
<td>184</td>
</tr>
</tbody>
</table>

Suppose also that

- variable costs are 1/3 of sales;
- fixed costs are $20 per year;
- tax rate is 36%;
- net working capital is $60 at time 0 and 20% of sales thereafter.
- salvage value of fixed assets is $180.
Dormont’s pro forma income statements are

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>480</td>
<td>660</td>
<td>810</td>
<td>750</td>
<td>720</td>
</tr>
<tr>
<td>Var. costs</td>
<td>(160)</td>
<td>(220)</td>
<td>(270)</td>
<td>(250)</td>
<td>(240)</td>
</tr>
<tr>
<td>Fixed costs</td>
<td>(20)</td>
<td>(20)</td>
<td>(20)</td>
<td>(20)</td>
<td>(20)</td>
</tr>
<tr>
<td>Depreciation (CCA)</td>
<td>(50)</td>
<td>(90)</td>
<td>(72)</td>
<td>(58)</td>
<td>(46)</td>
</tr>
<tr>
<td>EBIT</td>
<td>250</td>
<td>330</td>
<td>448</td>
<td>422</td>
<td>414</td>
</tr>
<tr>
<td>Taxes</td>
<td>(90)</td>
<td>(119)</td>
<td>(161)</td>
<td>(152)</td>
<td>(149)</td>
</tr>
<tr>
<td>Net income</td>
<td>160</td>
<td>211</td>
<td>287</td>
<td>270</td>
<td>265</td>
</tr>
</tbody>
</table>

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With respect to assets, we have

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net working capital</td>
<td>60</td>
<td>96</td>
<td>132</td>
<td>162</td>
<td>150</td>
<td>144</td>
</tr>
<tr>
<td>(a) Change in NWC</td>
<td>60</td>
<td>36</td>
<td>36</td>
<td>30</td>
<td>(12)</td>
<td>(6)</td>
</tr>
<tr>
<td>(b) NWC recovery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>144</td>
</tr>
<tr>
<td>ΔNWC ((a)-(b))</td>
<td>60</td>
<td>36</td>
<td>36</td>
<td>30</td>
<td>(12)</td>
<td>(150)</td>
</tr>
<tr>
<td>Net capital spending</td>
<td>500</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(180)</td>
</tr>
</tbody>
</table>
Capital Cost Allowance

Operating cash flows are

<table>
<thead>
<tr>
<th>Year</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>EBIT</td>
<td>0</td>
<td>250</td>
<td>330</td>
<td>448</td>
<td>422</td>
<td>414</td>
</tr>
<tr>
<td>CCA</td>
<td>0</td>
<td>50</td>
<td>90</td>
<td>72</td>
<td>58</td>
<td>46</td>
</tr>
<tr>
<td>Taxes</td>
<td>(0)</td>
<td>(90)</td>
<td>(119)</td>
<td>(161)</td>
<td>(152)</td>
<td>(149)</td>
</tr>
<tr>
<td>OCF</td>
<td>0</td>
<td>210</td>
<td>301</td>
<td>359</td>
<td>328</td>
<td>311</td>
</tr>
</tbody>
</table>

Capital Cost Allowance

Cash flows are

<table>
<thead>
<tr>
<th>Year</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>OCF</td>
<td>0</td>
<td>210</td>
<td>301</td>
<td>359</td>
<td>328</td>
<td>311</td>
</tr>
<tr>
<td>ΔNWC</td>
<td>60</td>
<td>36</td>
<td>36</td>
<td>30</td>
<td>−12</td>
<td>−150</td>
</tr>
<tr>
<td>NCS</td>
<td>500</td>
<td></td>
<td></td>
<td></td>
<td>−180</td>
<td></td>
</tr>
<tr>
<td>CF</td>
<td>−560</td>
<td>174</td>
<td>265</td>
<td>329</td>
<td>340</td>
<td>641</td>
</tr>
</tbody>
</table>
At a discount rate of 15%, the net present value of this project is

\[
\text{NPV} = -560 + \frac{175}{1.15} + \frac{265}{(1.15)^2} + \frac{329}{(1.15)^3} + \frac{340}{(1.15)^4} + \frac{641}{(1.15)^5}
\]

\[= \$521.\]

The IRR is 42% and the payback period is 2.37 years.

Are we missing something?

Regarding CCA, what happens when an asset is sold?

When the asset is sold for less than its UCC, the difference depreciates forever (if the asset pool is not terminated).

When the asset is sold for more than its UCC, the difference is subtracted from the value of the asset pool.

In the Brutus example, the assets are sold for less than the UCC, and thus there will be further tax savings coming from the project.
In the Dormont example, the equipment’s UCC after 5 years is expected to be $184 but the market value is expected to be $180. The difference, $184 - 180 = 4$, is then expected to depreciate forever, thus inducing tax savings into perpetuity.

Let $T_c$ denote the firm’s tax rate (36% in this case) and let $d$ denote the CCA rate (20% in this case). The tax savings arising from year 6 on are then

$$T_c \times d \times 4 \quad \text{in year 6},$$
$$T_c \times d \times (1 - d)4 \quad \text{in year 7},$$
$$T_c \times d \times (1 - d)^24 \quad \text{in year 8},$$
$$T_c \times d \times (1 - d)^34 \quad \text{in year 9},$$
$$\vdots$$
As of year 5, the present value of this perpetuity is

\[
PV_5 = \frac{4dT_c}{1+r} + \frac{(1-d)4dT_c}{(1+r)^2} + \frac{(1-d)^24dT_c}{(1+r)^3} + \frac{(1-d)^34dT_c}{(1+r)^4} + \ldots
\]

\[
= 4dT_c \left( \frac{1}{1+r} + \frac{1-d}{(1+r)^2} + \frac{(1-d)^2}{(1+r)^3} + \ldots \right)
\]

\[
= 4dT_c \times \frac{1}{r - (-d)} = \frac{4dT_c}{r + d},
\]

and thus the project’s NPV should also include

\[
\frac{4dT_c}{(r+d)(1+r)^5} = \frac{4 \times 0.36 \times 0.20}{(0.15 + 0.20)(1.15)^5} = $0.41.
\]
Let

\[ S \equiv \text{Sales}, \]
\[ C \equiv \text{Operating costs}, \]
\[ D \equiv \text{Depreciation for tax purposes}, \]
\[ T_c \equiv \text{Corporate tax rate}. \]

Then

\[ \text{EBIT} = S - C - D \quad \text{and} \quad \text{Taxes} = T_c(S - C - D). \]

Therefore,

\[ \text{OCF} = \text{EBIT} + D - T_c(S - C - D) \]
\[ = S - C - D + D - T_c(S - C - D) \]
\[ = (1 - T_c)(S - C) + T_cD. \]

This way of calculating operating cash flow is called the tax shield approach.
The Tax Shield Approach

Each year, cash flow from assets is

\[
\text{CF} = \text{OCF} - \Delta \text{NWC} - \text{NCS} \\
= (1 - T_c)(S - C) + T_c D - \Delta \text{NWC} - \text{NCS} \\
= (1 - T_c)(S - C) - \Delta \text{NWC} - \text{NCS} + T_c D.
\]

The problem can be simplified by treating depreciation separately from OCF. That is, NPV can be calculated as

\[
\text{NPV} = \text{PV of } (1 - T_c)(S - C) - \text{PV of } \Delta \text{NWC} - \text{PV of NCS} \\
+ \text{PV of CCA tax shield}.
\]

What is the PV of the CCA tax shield (PV of CCATS)?

Let

\[
\begin{align*}
A & \equiv \text{value of assets initially purchased}, \\
S & \equiv \text{salvage value of these assets at the end of the project}, \\
T_c & \equiv \text{Corporate tax rate}, \\
d & \equiv \text{CCA rate}, \\
k & \equiv \text{discount rate}, \\
n & \equiv \text{asset life}.
\end{align*}
\]
The Tax Shield Approach

PV of CCATS

As we have seen in Chapter 2, CCA depreciation is

\[ 0.5dA \] in year 1,
\[ 0.5d(1 - d)A + 0.5dA \] in year 2,
\[ 0.5d(1 - d)^2A + 0.5d(1 - d)A \] in year 3,
\[ \vdots \]
The Tax Shield Approach

**PV of CCATS**

If these assets are never sold, the present value of the tax shield is

\[
\text{PVCCATS} = \frac{0.5T_c dA}{k + d} + \frac{0.5T_c dA}{(1 + k)(k + d)}
\]

\[
= \frac{0.5T_c dA}{k + d} \times \left( 1 + \frac{1}{1 + k} \right)
\]

\[
= \frac{0.5T_c dA}{k + d} \times \left( \frac{1 + k + 1}{1 + k} \right)
\]

\[
= \frac{0.5T_c dA}{k + d} \times \left( \frac{2 + k}{1 + k} \right) = \frac{T_c dA}{k + d} \times \frac{1 + 0.5k}{1 + k}
\]

The Tax Shield Approach

**PV of CCATS**

When the assets are sold, their market value \((S)\) is subtracted from the asset pool. That is, \(S\) won’t depreciate forever.

As of time \(n\), the present value of the tax savings attributed to \(S\) is

\[
\frac{T_c dS}{k + d}
\]

and thus

\[
\text{PVCCATS} = \frac{T_c dA(1 + 0.5k)}{(k + d)(1 + k)} - \frac{T_c dS}{(k + d)(1 + k)^n}.
\]
The Tax Shield Approach

Back to the Dormont example:

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1 − Tc)(S − C)</td>
<td>0</td>
<td>192</td>
<td>269</td>
<td>333</td>
<td>307</td>
<td>294</td>
</tr>
<tr>
<td>ΔNWC</td>
<td>60</td>
<td>36</td>
<td>36</td>
<td>30</td>
<td>−12</td>
<td>−150</td>
</tr>
<tr>
<td>NCS</td>
<td>500</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>−180</td>
</tr>
</tbody>
</table>

The Tax Shield Approach

\[
\text{PV of } (1 − Tc)(S − C) = 0 + \frac{192}{(1.15)^1} + \frac{269}{(1.15)^2} + \frac{333}{(1.15)^3} + \frac{307}{(1.15)^4} + \frac{294}{(1.15)^5} = 911
\]

\[
\text{PV of } ΔNWC = 60 + \frac{36}{(1.15)^1} + \frac{36}{(1.15)^2} + \frac{30}{(1.15)^3} + \frac{−12}{(1.15)^4} + \frac{−150}{(1.15)^5} = 57
\]

\[
\text{PV of NCS} = 500 + \frac{0}{(1.15)^1} + \frac{0}{(1.15)^2} + \frac{0}{(1.15)^3} + \frac{−180}{(1.15)^5} = 411
\]
The Tax Shield Approach

and

\[
\text{PVCCATS} = \frac{T_c dA (1 + 0.5k)}{(k + d)(1+k)} - \frac{T_c dS}{(k + d)(1+k)^n}
\]

\[
= \frac{0.36 \times 0.20 \times 500 \times 1.075}{0.35 \times 1.15} - \frac{0.36 \times 0.20 \times 180}{0.35(1.15)^5}
\]

\[
= 78.
\]

Therefore,

\[
\text{NPV} = 911 - 57 - 411 + 78 = $521.
\]

Evaluating Cost-Cutting Proposals

A firm is considering the purchase of a $300,000 computer-based inventory management system that would save the firm $130,000 in pretax income each year. With the help of this system, managing inventories more efficiently is expected to reduce net working capital by $40,000. The system has a CCA rate of 30% and is expected to last 4 years, at the end of which its salvage value is expected to be $30,000. The relevant tax rate is 36% and the required rate of return is 15%.

What is the NPV of this project?
Evaluating Cost-Cutting Proposals

We have seen that

\[ \text{NPV} = \text{PV}\left[(1 - T_c)(R - C)\right] - \text{PV}[\Delta\text{NWC}] - \text{PV}[\text{NCS}] + \text{PVCCATS}, \]

where

\[ \text{PVCCATS} = \frac{T_c dA(1 + 0.5k)}{(k + d)(1 + k)} - \frac{T_c dS}{(k + d)(1 + k)^n}. \]

Note: \( R \) stands for sales (revenues) and \( S \) stands for salvage value.

The system will save the firm $130,000 before tax annually over four years. These savings can be viewed as an annuity making four payments of \((1 - 0.36) \times 130,000\), and thus

\[ \text{PV}\left[(1 - T_c)(R - C)\right] = \frac{(1 - 0.36) \times 130,000}{0.15} \left(1 - \left(\frac{1}{1.15}\right)^4\right) \]

\[ = \$237,534. \]
Evaluating Cost-Cutting Proposals

NWC decreases by $40,000 at time 0 and increases back to its original level after 4 years, so

$$\text{PV} [\Delta \text{NWC}] = -40,000 + \frac{40,000}{(1.15)^4} = -$17,130.$$ 

In the case of net capital spending, we have

$$\text{PV} [\text{NCS}] = 300,000 - \frac{30,000}{(1.15)^4} = $282,847.$$ 

The present value of the CCA tax shield is

$$\text{PV}_{\text{CCA}\, \text{TS}} = 0.36 \times 0.30 \times 300,000 \times 1.075 \times \frac{0.45}{1.15} - 0.36 \times 0.30 \times 30,000 \times \frac{0.45}{(1.15)^4} = $63,188,$$

and thus

$$\text{NPV} = \text{PV} [(1 - T_c)(R - C)] - \text{PV} [\Delta \text{NWC}] - \text{PV} [\text{NCS}] + \text{PV}_{\text{CCA}\, \text{TS}}$$

$$= 237,534 - (-17,130) - 282,847 + 63,188$$

$$= $35,004.$$
Evaluating Cost-Cutting Proposals

Note that

\[
P(V[(1 - T_c)(R - C)] - PV[\Delta NWC] - PV[NCS])
= 237,534 - (-17,130) - 282,847
= -28,183,
\]

and thus NPV is positive because of the CCA tax shield.

Replacing an Asset

When evaluating a proposition to replace an asset, calculations involve net acquisitions and net dispositions. That is, opportunity costs related to asset purchases, asset sales and CCA tax shield have to be considered.
Replacing an Asset

Net Capital Spending

Assuming the old asset would have been sold at the same time as the replacing asset, let

\[ A_r \equiv \text{today’s cost of the replacing asset}, \]
\[ S_r \equiv \text{salvage value of the replacing asset after } n \text{ years} \]
\[ A_o \equiv \text{today’s cost of the original asset}, \]
\[ S_o \equiv \text{salvage value of the original asset after } n \text{ years.} \]

PVCCATS

Regarding the CCA tax shield, its present value is

\[
\text{PVCCATS} = \frac{T_c d (A_r - A_o) (1 + 0.5k)}{(k+d)(1+k)} - \frac{T_c d (S_r - S_o)}{(k+d)(1+k)^n}.
\]
Replacing an Asset: An Example

Theatreplex Oleum is considering replacing a projector system in one of its cinemas. The new projector will significantly improve sound and image quality, thus increasing pre-tax operating income by $60,000 annually due to greater attendance.

The new projector costs $300,000 and is expected to last 15 years, time at which its salvage value is expected to be $30,000. The actual projector can be sold now for $20,000 and would have had a salvage value of $2,000 after 15 years.

The CCA rate is 25%, the required rate of return is 15% and the tax rate is 36%. What is the NPV of this project?

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Let’s first calculate the present value of the increase in the number of tickets sold, which can be seen as an annuity paying

\[(1 - 0.36) \times 60,000 = 38,400\]

per year for 15 years.

With a discount rate of 15%, the present value of this annuity is

\[
\frac{38,400}{0.15} \left(1 - \left(\frac{1}{1.15}\right)^{15}\right) = 224,539.
\]
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There is no change in net working capital,

\[ PV(NCS) = 300,000 - 20,000 - \frac{30,000 - 2,000}{(1.15)^{15}} = $276,559, \]

and

\[ PVCCATS = \frac{0.36 \times 0.25 \times 280,000 \times (1.075)}{0.40 \times 1.15} - \frac{0.36 \times 0.25 \times 28,000}{0.40 \times (1.15)^{15}} = $58,117. \]

The net present of this operation is then

\[ NPV = PV[(1 - T_c)(R - C)] - PV[\Delta NWC] - PV[NCS] + PVCCATS \]

\[ = 224,539 - 0 - 276,559 + 58,117 \]

\[ = $6,097. \]

Again, NPV is positive because of the CCA tax shield.