Chapter 9 – Making Capital Investment Decisions

Introduction

The cash flows that should be included in a capital budgeting analysis are those that will only occur if the project is accepted. These cash flows are called incremental cash flows. The stand-alone principle allows us to analyze each project in isolation from the firm simply by focusing on incremental cash flows.

Cash flow estimation is the most important step in the capital budgeting. It is also the most difficult. In large firms, many departments are involved:

- Marketing
- Engineering
- Operations
- Accounting
- Personnel

Because of its difficulty, forecast errors can be large thus making poor projects can appear to be good and good project appear poor. It does not matter what type of analytical technique is used, if the cash flows contain large errors, poor decisions can be made.

The role of financial staffs in the forecasting process

Coordinating the efforts of the other departments

Ensuring all participants use a consistent set of economic assumptions

Assure there are no biases inherent in the forecast

Too estimate cash flows; we must identify the relevant cash flows. We want to use cash flows not accounting income.

The incremental cash flows, for project evaluation, consist of any and all changes in a firm’s future cash flows that are a direct consequence of taking the project.

Sunk Costs

Opportunity Costs

- Turning a building we own into a condo complex. The opportunity costs would be the market value of the building.
Externalities or Side effects

    Erosion: Opening a new branch for a bank.
    Synergy

Shipping and Installation Costs

Changes in Net Working Capital

    Normally, a new project will require some investment in new inventory and accounts like that. This increases net working capital and should be considered in the analysis.

Financing Costs

    Not considered in cash flows.

Other Issues

    When the flows actually occur
    After-tax cash flows
A company is considering a new project that will last for five years. The equipment necessary for production will cost $400,000 and will be depreciated on a straight-line basis to a zero salvage value. The project will generate sales of $300,000 per year. Variable costs are 40 percent of sales and fixed costs are $30,000. The project will require an initial investment of $50,000 in net working capital. The tax rate is 30 percent and the required return is 12 percent. What is the payback period, NPV, and IRR?

**Initial Investment**

| Equip: | -400,000 |
| ↑ NWC | -50,000 |

Net Investment (CF$_0$) = -$450,000

**OCF**

| Sales | $300,000 |
| VC | 120,000 |
| FC | 30,000 |
| Dep | 80,000 |
| EBT | $70,000 |
| Tax | 21,000 |
| NI | $49,000 |

Remember:

\[
OCF = EBIT + Dep - Taxes
\]

Another way:

\[
OCF = NI + Dep
\]

**Non-OCF or Terminal Year CF**

| After-Tax Salvage Value | 0 |
| Return of NWC | 50,000 |
| Non-OCF | 50,000 |

**NPV/IRR Calculation**

\[
\begin{align*}
CF_0 & = -450,000 \\
CF_1 & = 129,000 \\
CF_2 & = 129,000 + 50,000 = 179,000 \\
\end{align*}
\]

| I | 12% |
| CPT NPV | \$43,387.47 |
| CPT IRR | 15.65% |
| Payback | 3.49 years |
Here is another way to approach this problem. It is called the Tax Shield approach and is used to calculate the OCF.

\[ \text{OCF} = [\text{Sales} - \text{Costs}] (1 - T_C) + \text{Depreciation}(T_C) \]

\[ \text{OCF} = [(P)Q - (VC)Q - FC] (1 - T_C) + \text{Depreciation}(T_C) \]

**Initial Investment**

| Equip: | -400,000 |
| ↑ NWC | -50,000 |

Net Investment (CF₀) -$450,000

**OCF**

\[ \text{OCF} = [\text{Sales} - \text{Costs}] (1 - T_C) + \text{Depreciation}(T_C) \]

\[ \text{OCF}_{1-5} = (300,000 - (0.40)(300,000) - 30,000)(1 - 0.30) + (80,000)(0.30) \]

\[ \text{OCF}_{1-5} = 129,000 \]

**Non-OCF or Terminal Year CF**

| After-Tax Salvage Value | 0 |
| Return of NWC | 50,000 |

Non-OCF 50,000

**NPV/IRR Calculation**

| CF₀ | -450,000 |
| CF₁ | 129,000 | F₁ 4 |
| CF₂ | 129,000 + 50,000 = 179,000 | F₂ 1 |

I 12%

CPT NPV $43,387.47

CPT IRR 15.65%

Payback 3.49 years
Aunt Sally’s Sauces is considering expansion into a new line of all natural tomato sauces. Sally paid $50,000 for a marketing study that determined sales for the product will be $650,000 per year for five years. Equipment will cost $500,000 and will be depreciated on a straight-line manner to zero over the five-year life of the project. The equipment will have a salvage value of $50,000 in five years. Annual fixed costs are projected at $80,000 per year and variable costs are 60 percent of sales. Net working capital in the amount of $75,000 is needed at the beginning of the project. The tax rate is 40 percent and the required return is 15 percent. What is the payback period, NPV, and IRR?

Initial Investment

- Equip:
  - ↑ NWC

Net Investment (CF₀)

**OCF**

\[
OCF = [(PQ - (VC)Q - FC)(1 - T_C) + Depreciation(T_C)]
\]

\[
OCF₁⁻₅ =
\]

\[
OCF₁⁻₅ =
\]

Non-OCF or Terminal Year CF

- After-Tax Salvage Value
- SV - (SV - BV)T_C =
- Return of NWC
- Non-OCF

NPV/IRR Calculation

\[
\begin{align*}
CF₀ & \\
CF₁ & F₁ 4 \\
CF₂ & F₂ 1 \\
I & 15\% \\
CPT & NPV \\
CPT & IRR \\
Payback &
\end{align*}
\]
Replacement Analysis

A firm is considering an investment in a new machine with a price of $23 million to replace its existing machine. The current machine has a book value of $6 million, and a market value of $10.5 million. The new machine is expected to have a four-year life, and the old machine has four years left in which it can be used. If the firm replaces the old machine with the new machine, it expects to save $5 million in operating costs each year over the next four years. Both machines will have no salvage value in four years. If the firm purchases the new machine, it will also need an investment of $400,000 in net working capital. The required return on the investment is 10 percent, and the tax rate is 40 percent. What is the NPV and IRR of the decision to replace the old machine?

**Initial Investment**

<table>
<thead>
<tr>
<th></th>
<th>Buy new machine</th>
<th>Keep old machine</th>
<th>Incremental analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase new machine</td>
<td>−$23,000,000</td>
<td>−$23,000,000</td>
<td></td>
</tr>
<tr>
<td>Net working capital</td>
<td>−400,000</td>
<td>−400,000</td>
<td></td>
</tr>
<tr>
<td>Sell (buy) old machine</td>
<td>−$10,500,000</td>
<td>10,500,000</td>
<td></td>
</tr>
<tr>
<td>Taxes on old machine</td>
<td>1,800,000</td>
<td>−1,800,000</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>−$23,400,000</td>
<td>−$8,700,000</td>
<td>−$14,700,000</td>
</tr>
</tbody>
</table>

or

New Equip:

Old Equip_{AT}:

\[ SV - (SV - BV)T_C = \]

↑ NWC

Net Investment (CF₀)

**OCF**

<table>
<thead>
<tr>
<th></th>
<th>Buy new machine</th>
<th>Keep old machine</th>
<th>Incremental analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating expense</td>
<td>$5,000,000</td>
<td>$5,000,000</td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>5,750,000</td>
<td>$1,500,000</td>
<td>4,250,000</td>
</tr>
<tr>
<td>EBT</td>
<td>−$750,000</td>
<td>−$1,500,000</td>
<td>$750,000</td>
</tr>
<tr>
<td>Taxes</td>
<td>−300,000</td>
<td>−600,000</td>
<td>300,000</td>
</tr>
<tr>
<td>Net income</td>
<td>−$450,000</td>
<td>−$900,000</td>
<td>$450,000</td>
</tr>
<tr>
<td>OCF</td>
<td>$5,300,000</td>
<td>$600,000</td>
<td>$4,700,000</td>
</tr>
</tbody>
</table>

or

\[ OCF = [Sales - Costs](1 - T_C) + Depreciation(T_C) \]

\[ OCF_{1-4} = \]

\[ OCF_{1-4} = \]
Non-OCF or Terminal Year CF

After-Tax Salvage Value

Return of NWC

Non-OCF

NPV/IRR Calculation

<table>
<thead>
<tr>
<th>Year</th>
<th>Buy new machine Cash flow</th>
<th>Keep old machine Cash flow</th>
<th>Incremental analysis Cash flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-$23,400,000</td>
<td>-$8,700,000</td>
<td>-$14,700,000</td>
</tr>
<tr>
<td>1</td>
<td>5,300,000</td>
<td>600,000</td>
<td>4,700,000</td>
</tr>
<tr>
<td>2</td>
<td>5,300,000</td>
<td>600,000</td>
<td>4,700,000</td>
</tr>
<tr>
<td>3</td>
<td>5,300,000</td>
<td>600,000</td>
<td>4,700,000</td>
</tr>
<tr>
<td>4</td>
<td>5,700,000</td>
<td>600,000</td>
<td>5,100,000</td>
</tr>
</tbody>
</table>

NPV | -$6,326,507.75 | -$6,798,080.73 | $471,572.98

IRR | -3.09% | -37.07% | 11.46%

or

\[
\begin{align*}
CF_0 \\
CF_1 & \quad F_1 \quad 3 \\
CF_2 & \quad F_2 \quad 1 \\
I & \quad 10\% \\
\text{CPT} & \quad \text{NPV} \\
\text{CPT} & \quad \text{IRR}
\end{align*}
\]
Expansion Project using MACRS Depreciation

A company is considering a new project that will generate sales of $1.6 million, $2 million, $1.9 million, and $1.4 million over the next four years. The variable costs are 30 percent of sales and fixed costs are $400,000. The equipment necessary for the project costs $1.5 million and will be depreciated on a 3-year MACRS schedule. The equipment will be worth $100,000 in four years. The project will require an immediate investment in net working capital of $350,000. The tax rate is 40 percent and the required return is 11 percent. What is the payback period, NPV, and IRR?

Initial Investment

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Depreciation Calculations</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑ NWC</td>
<td>Year</td>
</tr>
<tr>
<td>Net Investment (CF₀)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

OCF

\[
OCF = [(PQ - (VC)Q - FC)(1 - TC) + Depreciation(TC)]
\]

\[
OCF₁ = (1,600,000 - (0.30)(1,600,000) - 400,000)(1 - 0.40) + (499,950)(0.40) = 631,980
\]

\[
OCF₂ =
\]

\[
OCF₃ =
\]

\[
OCF₄ =
\]

Non-OCF or Terminal Year CF

\[
\text{After-Tax Salvage Value} = \ SV - (SV - BV)T_C
\]

\[
\text{Return of NWC} =
\]

\[
\text{Non-OCF}
\]
NPV/IRR Calculation

\[\begin{array}{l}
\text{CF}_0 \\
\text{CF}_1 & F_1 \ 1 \\
\text{CF}_2 & F_2 \ 1 \\
\text{CF}_3 & F_3 \ 1 \\
\text{CF}_4 & F_4 \ 1 \\
\end{array}\]

I \ 11\%

CPT NPV

CPT IRR
Replacement Project using MACRS Depreciation

<table>
<thead>
<tr>
<th>Original Machine</th>
<th>New Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchased 5 years ago</td>
<td>5-year life</td>
</tr>
<tr>
<td>Initial cost</td>
<td>100,000</td>
</tr>
<tr>
<td>Annual depreciation</td>
<td>9,000</td>
</tr>
<tr>
<td>Book Value today</td>
<td>55,000</td>
</tr>
<tr>
<td>Salvage today</td>
<td>65,000</td>
</tr>
<tr>
<td>Salvage in 5 years</td>
<td>10,000</td>
</tr>
</tbody>
</table>

Required return = 10%
Tax rate = 40%

Initial Investment

<table>
<thead>
<tr>
<th>Equip (New)</th>
<th>Equip (Old)_{AT}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Investment (CF\text{0})</td>
<td></td>
</tr>
</tbody>
</table>

OCF

\begin{align*}
OCF_1 &= (0 - (-50,000))(1 - 0.40) + [(0.33)(150,000) - 9,000](0.40) = 46,200 \\
OCF_2 &= 30,000 + [(0.45)(150,000) - 9,000](0.40) = 53,400 \\
OCF_3 &= 30,000 + [(0.15)(150,000) - 9,000](0.40) = 35,400 \\
OCF_4 &= 30,000 + [(0.07)(150,000) - 9,000](0.40) = 30,600 \\
OCF_5 &= 30,000 + (-9,000)(0.40) = 26,400 \\
\end{align*}

Non-OCF or Terminal Year CF

\begin{align*}
SV_{Old} &= -10,000 \\
\text{Total:} &= -10,000
\end{align*}
**NPV Calculation**

<table>
<thead>
<tr>
<th>CF</th>
<th>F</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF₀</td>
<td>-89,000</td>
<td></td>
</tr>
<tr>
<td>CF₁</td>
<td>46,200</td>
<td>F₁ 1</td>
</tr>
<tr>
<td>CF₂</td>
<td>53,400</td>
<td>F₂ 1</td>
</tr>
<tr>
<td>CF₃</td>
<td>35,400</td>
<td>F₃ 1</td>
</tr>
<tr>
<td>CF₄</td>
<td>30,600</td>
<td>F₄ 1</td>
</tr>
<tr>
<td>CF₅</td>
<td>26,400 – 10,000 = 16,400</td>
<td>F₅ 1</td>
</tr>
</tbody>
</table>

I 10%

CPT NPV

CPT IRR
Strategic Options

Option to expand

Option to wait

Option to abandon

Strategic options – Sticking our toe in the water