Chapter 8: Fundamentals of Capital Budgeting

Key: most managers estimate a project’s cash flows in two steps:

1) Impact of the project on the firm’s incremental earnings
2) Use incremental earnings to determine the project’s incremental cash flows
3) Incremental: change as a result of the investment decision

8.1 Forecasting Earnings

Basic Question: How do firm’s unlevered earnings change as result of an investment decision?

A. Excel

=> for real projects, difficult to do by hand => use Excel

B. Calculating by hand:

\[ UNI = EBIT \times (1 - \tau_c) = (R - E - D)(1 - \tau_c) \]  

(8.2)

where:

\[ UNI = \text{incremental unlevered net income} \]
\[ \Rightarrow \text{counting only incremental operating cash flows, but no financing cash flows} \]

\[ EBIT = \text{incremental earnings before interest and taxes} \]
\[ \tau_c = \text{firm’s marginal corporate tax rate} \]
\[ R = \text{incremental revenues} \]
\[ E = \text{incremental expenses (or costs)} \]

Note: Book uses costs, I will use “expenses” so can have an “E” instead of a “C” in the equation. Will use “C” for cash in new working capital in section 8.2

\[ D = \text{incremental depreciation} \]

C. Identifying Incremental Earnings

1. General Principles

Basic question: How do the earnings (and cash flows) for the entire firm differ with the project verses without the project?

\[ \Rightarrow \text{count anything that changes for the firm} \]
=> count nothing that remains the same

Example of costs that often don’t change with new project: fixed overhead expenses

=> don’t count previous or committed spending unless can get some back if don’t proceed
=> part can’t get back is called sunk costs
  Ex. money already spent to research and develop a product
  Ex. completed feasibility studies
  Ex. money spent on a partially completed building that can be sold

2. Specific Issues

a. Sales and Expenses
=> count changes in sales or expenses that result from the project
=> count changes in sales or expenses elsewhere in the firm if it undertakes the project
=> called project externalities or cannibalization
  Ex. sales from new project replace existing sales
  Ex. no longer paying overtime at an existing facility

=> don’t count any interest expense
=> accepting/rejecting the project is a separate decision from how the firm will finance the project

=> taxes are an expense
=> relevant tax rate: firm’s marginal corporate tax rate

b. Fixed assets

1) Fixed assets that acquire because undertake project

a) cash outflow when pay to build or acquire
b) reduction in taxes because of depreciation in years after the acquisition
=> treat as a cash inflow since reduces outflow
Note: depreciation does not directly impact cash flow but indirectly through taxes
=> can use straight line or accelerated (MACRS) depreciation
Note: firms often report a different depreciation for taxes and accounting statements
=> use depreciation expense calculated for taxes (because of tax effect on cash flows).
MACRS Depreciation:

Keys:

1) multiply cost of project by % listed in MACRS table
2) Year 1 = year asset first put into use
3) the following table is in the appendix to chapter 8 of book

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2) Fixed assets that able to sell because invest in the project
   a) after-tax cash flow from sale
   b) loss of tax shield would have realized if had kept asset

3) Use of existing assets

   => cost equals value of its best alternative use (such as sale or rental)
   => called an opportunity cost

Concept Check: 2, 3

8.2 Determining Free Cash Flow and NPV

A. Calculating Free Cash Flow

Keys:

1) start with incremental unlevered net income
2) back out non-cash items in UNI
3) add cash items not in UNI
\[ FCF = UNI + D - CE - \Delta NWC \]  \hspace{1cm} (8.5a)

where:

- \( CE \) = incremental capital expenditures
- \( \Delta NWC \) = change in net working capital associated with project
  \( \Delta NWC_t = NWC_t - NWC_{t-1} \)  \hspace{1cm} (8.4)

\[ NWC = CA - CL = C + AR + I - AP \]  \hspace{1cm} (8.3)

- \( CA \) = incremental current assets
- \( CL \) = incremental current liabilities
- \( C \) = incremental cash
- \( AR \) = incremental accounts receivable
- \( I \) = incremental inventory
- \( AP \) = incremental accounts payable

\[ FCF = (R - E - D) \times (1 - \tau_c) + D - CE - \Delta NWC \]  \hspace{1cm} (8.5b)

\[ FCF = (R - E) \times (1 - \tau_c) - CE - \Delta NWC + \tau_c \times D \]  \hspace{1cm} (8.6)

B. Notes

1. Depreciation (D)
   
   => add back to FCF since subtracted from UNI but doesn’t involve a cash outlay

2. Capital Expenditures (CE)
   
   => incremental capital spending creates an outflow of cash that isn’t counted in UNI
   
   Note: cost is recognized in UNI over the life of the asset through depreciation
   
   => incremental asset sales are entered as a negative CE
   => creates a cash inflow
   => must also consider tax implications of any asset sales

3. Change in Net Working Capital (\( \Delta NWC \))
   
   1) sales on credit generate revenue but no cash flow
   2) the collection of receivables generates a cash inflow but no revenue
   3) the sale of inventory generates an expense but no cash outflow
   4) the purchase of inventory generates a cash outflow but no expense
   
   => subtracting the change in net working capital adjusts for these issues
Notes on changes in net working capital:

1. recovery of net working capital
   => Changes in net working capital are usually reversed at the end of the project

   Ex. Cash put into cash registers is no longer needed when close a store

2. taxability
   => changes in net working capital are not taxable

   => buying inventory doesn’t create taxable income, selling inventory for a profit does

C. Examples.

Example 1:

Assume you are trying to decide whether to rent a building for $30,000 a year for the next 2 years (payments are due at the end of the year). A year from today you plan to purchase inventory for $50,000 that you will sell immediately for $110,000. Two years from today you plan to purchase inventory for $70,000 that you will sell immediately for $150,000. Calculate the store’s incremental unlevered net income and free cash flow for each year of operation if the corporate tax rate is 35%.

\[
\begin{align*}
\text{UNI}_1 &= (110,000 - (30,000 + 50,000) - 0)(1 - 0.35) = $19,500 \\
\text{UNI}_2 &= (150,000 - (30,000 + 70,000) - 0)(1 - 0.35) = $32,500 \\
\text{FCF}_1 &= 19,500 + 0 - 0 = 19,500 \\
\text{FCF}_2 &= 32,500 + 0 - 0 = 32,500
\end{align*}
\]

Notes:

1) FCF = UNI since no depreciation, capital expenditures or changes in net working capital
2) Will build on this example. New information in later examples will be underlined.
Example 2:

Assume you are trying to decide whether to rent a building for $30,000 a year for the next 2 years (payments are due at the end of the year). A year from today you plan to purchase inventory for $50,000 that you will sell immediately for $110,000. Two years from today you plan to purchase inventory for $70,000 that you will sell immediately for $150,000. Assume also that need to hold cash balances (to facilitate operations) of $1000 a year from today and $1500 two years from today. Calculate the store’s incremental unlevered net income and free cash flow for each year of operation if the corporate tax rate is 35%. Note: You would probably take the cash out of the store when you close your doors two years from today...but I am assuming you leave it to better demonstrate changes in net working capital.

\[ UNI = EBIT \times (1 - \tau_c) = (R - E - D)(1 - \tau_c) \]

\[ NWC = C + AR + I - AP \]

\[ FCF = UNI + D - CE - \Delta NWC \]

UNI₁ = (110,000 – (30,000+50,000) – 0)(1 – .35) = $19,500
UNI₂ = (150,000 – (30,000+70,000) – 0)(1 – .35) = $32,500

Note: holding cash doesn’t affect UNI

Net Working Capital:

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<tr>
<td>Inventory</td>
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<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A/P</td>
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FCF₁ = 19,500 – 1000 = 18,500
FCF₂ = 32,500 – 500 = 32,000
FCF₃ = 0 – (–1500) = 1500

Key: don’t have access to all of the cash flows generated by sales since must hold some cash at the store.
Example 3:

Assume you are trying to decide whether to rent a building for $30,000 a year for the next 2 years (payments are due at the end of the year). A year from today you plan to purchase inventory for $50,000 that you will sell immediately for $110,000. Two years from today you plan to purchase inventory for $70,000 that you will sell immediately for $150,000. Seventy-five percent of sales will be on credit that you will collect one year after the sale. Assume also that need to hold cash balances (to facilitate operations) of $1000 a year from today and $1500 two years from today. Calculate the store’s incremental unlevered net income and free cash flow for each year of operation if the corporate tax rate is 35%.

\[
UNI = EBIT \times (1 - \tau_c) = (R - E - D)(1 - \tau_c)
\]

\[
NWC = C + AR + I - AP
\]

\[
FCF = UNI + D - CE - \Delta NWC
\]

\[
UNI_1 = (110,000 - (30,000+50,000) - 0)(1 - .35) = $19,500
\]

\[
UNI_2 = (150,000 - (30,000+70,000) - 0)(1 - .35) = $32,500
\]

Note: doesn’t change for Examples 1, 2, or 3

Net Working Capital:

\[
AR_1 = .75(110,000) = 82,500
\]

\[
AR_2 = .75(150,000) = 112,500
\]

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\[
FCF_1 = 19,500 - 83,500 = -64,000
\]

\[
FCF_2 = 32,500 - 30,500 = 2,000
\]

\[
FCF_3 = 0 - (-114,000) = 114,000
\]

Keys:

=> sales on credit generate revenue but not cash flow
=> collections of receivables generate cash flows but not revenues
=> UNI overstates early cash flow and understates late cash flow
Example 4:

Assume you are trying to decide whether to rent a building for $30,000 a year for the next 2 years (payments are due at the end of the year). Today you plan to purchase inventory for $50,000 that you will sell a year from today for $110,000. A year from today you plan to purchase inventory for $70,000 that you will sell two years from today for $150,000. Sixty percent of all inventory purchases will be on credit due one year after you buy it. Seventy-five percent of sales will be on credit that you will collect one year after the sale. Assume also that need to hold cash balances (to facilitate operations) of $1000 a year from today and $1500 two years from today. Calculate the store’s incremental unlevered net income and free cash flow for each year of operation if the corporate tax rate is 35%.

\[
UNI = EBIT \times (1 - \tau_c) = (R - E - D)(1 - \tau_c)
\]
\[
NWC = C + AR + I - AP
\]
\[
FCF = UNI + D - CE - \Delta NWC
\]

\[
UNI_1 = (110,000 - (30,000+50,000) - 0)(1 - .35) = $19,500
\]
\[
UNI_2 = (150,000 - (30,000+70,000) - 0)(1 - .35) = $32,500
\]

Note: doesn’t change from previous examples

Net Working Capital:

\[
AP_0 = .6(50,000) = 30,000
\]
\[
AP_1 = .6(70,000) = 42,000
\]

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\[
FCF_0 = 0 - 20,000 = - 20,000
\]
\[
FCF_1 = 19,500 - 91,500 = - 72,000
\]
\[
FCF_2 = 32,500 - 2,500 = 30,000
\]
\[
FCF_3 = 0 - (-114,000) = 114,000
\]

Keys:

=> purchases on credit offset to some extent the differences between UNI and Cash Flow associated with buying inventory
Example 5:

Assume you are trying to decide whether to buy a building for $250,000. You expect to sell it in two years for $225,000. In the mean time you will depreciate it using the 3-year MACRS class. Today you plan to purchase inventory for $50,000 that you will sell a year from today for $110,000. A year from today you plan to purchase inventory for $70,000 that you will sell two years from today for $150,000. Sixty percent of all inventory purchases will be on credit due one year after you buy it. Seventy-five percent of sales will be on credit that you will collect one year after the sale. Assume also that need to hold cash balances (to facilitate operations) of $1000 a year from today and $1500 two years from today. Calculate the store’s incremental unlevered net income and free cash flow for each year of operation if the corporate tax rate is 35%.

\[
UNI = EBIT \times (1 - \tau_c) = (R - E - D)(1 - \tau_c)
\]

\[
NWC = C + AR + I - AP
\]

\[
FCF = UNI + D - CE - \Delta NWC
\]

\[
D_1 = .3333 (250,000) = 83,325
\]

\[
D_2 = .4445 (250,000) = 111,125
\]

\[
UNI_1 = (110,000 - 50,000 - 83,325)(1 - .35) = -$15,161.25
\]

\[
UNI_2 = (150,000 - 70,000 - 111,125)(1 - .35) = - $20,231.25
\]

Net Working Capital:

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\[
FCF_0 = 0 + 0 - 250,000 - 20,000 = -270,000
\]

\[
FCF_1 = -15,161.25 + 83,325 - 0 - 91,500 = -23,336.25
\]

Proceeds from sale of building:

\[
Book\ value_2 = 250,000 - 83,325 - 111,125 = 55,550
\]

\[
Gain = 225,000 - 55,550 = 169,450
\]

\[
After-tax\ proceeds = 225,000 - 169,450(.35) = 225,000 - 59,307.5 = 165,692.50
\]

\[
CE_2 = -165,692.50
\]

\[
FCF_2 = -20,231.25 + 111,125 - (-165,692.50) - 2,500 = 254,086.25
\]

\[
FCF_3 = 0 - (-114,000) = 114,000
\]
D. Calculating NPV

\[ PV(FCF_t) = \frac{FCF_t}{(1+r)^t} = FCF_t \times \frac{1}{(1+r)^t} \]  

(8.7)

Note: We really don’t need this equation. It is essentially (4.2)

8.3 Choosing Among Alternatives

A. Evaluating Manufacturing Alternatives

Note: To decide between alternatives, can calculate NPV of difference in cash flows.

Example from Table 8.6 in text (all numbers in thousands):

Differences in Cash Flows (Outsourced– In-House):

- Yr 0 = +4000 = 0 – (–4000)
- Yr 1 = –183 = (–7150) – (–6967)
- Yr 2 to 4 = –1200 = (–8800) – (–7600)
- Yr 5 = –1017 = (–1650) – (–633)

NPV (differences) = 4000 − \frac{183}{1.12} - \frac{1200}{1.12} \left(1 - \left(\frac{1}{1.12}\right)^3\right) \left(\frac{1}{1.12}\right) - \frac{1017}{(1.12)^5} = +686

=> save PV of costs of 686,000 if outsource instead of assemble in-house

Note: Same result as text that prefer outsourcing with lower PV(costs):
- Outsourced: –26,192
- In-house: –26,878
- Difference (Outsourced – In-House): +686 = (–26,192) – (–26,878)

Concept Check: all

8.4 Further Adjustments to Free Cash Flow

1. Other non-cash items

2. Timing of Cash Flows
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3. Accelerated Depreciation

Note on Example 8.5: Firms can start depreciating the asset as soon as it is put into use. Unless stated otherwise, I will assume that if we build or acquire an asset today, it will be put into use at some point during the first year and so is depreciated for the first time in year 1.

4. Liquidation or Salvage Value

\[ G = SP - BV \]  
\[ (8.8) \]

where:
- \( G \) = gain
- \( SP \) = sales price
- \( BV \) = book value

\[ BV = PP - AD \]  
\[ (8.9) \]

where:
- \( PP \) = purchase price
- \( AD \) = accumulated depreciation

\[ ATCF = SP - \tau_c \times G \]  
\[ (8.10) \]

where:
- \( ATCF \) = after-tax cash flow
- \( SP \) = sales price
- \( \tau_c \) = corporate tax rate

5. Terminal or Continuation Value

6. Tax Carryforwards and Carrybacks

Concept Check: all
8.5 Analyzing the Project

Key to all of section 8.5: Using goal seek and data tables in Excel.

Break-even: level of some input that makes NPV = 0
Sensitivity analysis: examines impact on NPV of changing one input variable
  Key concern: which worse-case assumptions lead to a negative NPV

Scenario analysis: examines impact on NPV of changing multiple related input variables

Concept Check: all

Chapter 8 Appendix: MACRS Depreciation