

## Chapter 8: Fundamentals of Capital Budgeting

Note: Read the chapter then look at the following.

Fundamental question: How do we determine the cash flows we need to calculate the net present value of a project?

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

Notes:

- 1) incremental = change as a result of the investment decision
- 2) revenues and expenses occur throughout the year, but we will treat them as if they come at end of the year

=> this is a standard assumption used by the text

### 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

Note: don't hardcode (enter numbers) directly into formulas. Have your formulas refer to the section of your spreadsheet where you input the numbers (the text makes this point on p. 245).

## B. Calculating by hand:

$$UNI = EBIT \times (1 - \tau_c) = (R - E - D)(1 - \tau_c) \quad (8.2)$$

where:

$UNI$  = incremental unlevered net income

=> counting only incremental operating cash flows, but no financing cash flows

$EBIT$  = incremental earnings before interest and taxes

$\tau_c$  = firm's marginal corporate tax rate

$R$  = incremental revenues

$E$  = 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

$D$  = 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 versus without the project?

=> 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. Revenues and Costs

- => count changes in revenues or expenses that result from the project
- => count changes in revenues 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 for tax payments
  - Note: depreciation does not directly impact cash flow but indirectly through taxes
  - => can use straight line or accelerated (MACRS) depreciation
    - Note: firms often use a different depreciation method for taxes and accounting statements
    - => use depreciation expense calculated for taxes (because of tax effect on cash flows).

## MACRS Depreciation:

=&gt; From appendix

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 Chapter 8 Appendix

MACRS Depreciation Rate for Recovery Period						
Year	3 years	5 years	7 years	10 years	15 years	20 years
1	33.33	20.00	14.29	10.00	5.00	3.750
2	44.45	32.00	24.49	18.00	9.50	7.219
3	14.81	19.20	17.49	14.40	8.55	6.677
4	7.41	11.52	12.49	11.52	7.70	6.177
5		11.52	8.93	9.22	6.93	5.713
6		5.76	8.92	7.37	6.23	5.285
7			8.93	6.55	5.90	4.888
8			4.46	6.55	5.90	4.522
9				6.56	5.91	4.462
10				6.55	5.90	4.461
11				3.28	5.91	4.462
12					5.90	4.461
13					5.91	4.462
14					5.90	4.461
15					5.91	4.462
16					2.95	4.461
17						4.462
18						4.461
19						4.462
20						4.461
21						2.231

2) Fixed assets that able to sell because invest in the project

- a) count after-tax cash flow from sale
- b) count 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 from Earnings

Keys:

- 1) start with incremental unlevered net income
- 2) back out non-cash items in UNI
- 3) add cash items not in UNI

$$FCF = UNI + D - CE - \Delta NWC \quad (8.5a)$$

where:

$CE$  = incremental after-tax capital expenditures

$\Delta NWC$  = change in net working capital associated with project

$$\Delta NWC_t = NWC_t - NWC_{t-1} \quad (8.4)$$

$$NWC = CA - CL = C + AR + I - AP \quad (8.3)$$

$CA$  = incremental current assets

$CL$  = incremental current liabilities

$C$  = incremental cash

$AR$  = incremental accounts receivable

$I$  = incremental inventory

$AP$  = incremental accounts payable

$$FCF = (R - E - D) \times (1 - \tau_c) + D - CE - \Delta NWC \quad (8.5b)$$

$$FCF = (R - E) \times (1 - \tau_c) - CE - \Delta NWC + \tau_c \times D \quad (8.6)$$

Note:  $\tau_c \times D$  is the depreciation tax shield

=> reduction in taxes that stem from deducting depreciation for tax purposes

=> depreciation increases cash flows because reduce tax payments

## 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

=> positive impact through equations as subtract a negative CE

=> 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

## D. Calculating NPV

$$PV(FCF_t) = \frac{FCF_t}{(1+r)^t} = FCF_t \times \frac{1}{(1+r)^t} \quad (8.7)$$

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 compare the NPVs of alternatives.

However, can also decide by calculating the NPV of the difference in cash flows.

Example from text (p. 247):

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

$$\begin{aligned} \text{Yr 0} &= -3000 = -3000 - 0 \\ \text{Yr 1} &= -117 = -5067 - (-4950) \\ \text{Yr 2 - 4} &= +900 = -5700 - (-6600) \\ \text{Yr 5} &= +1017 = -633 - (-1650) \end{aligned}$$

$$\text{NPV (differences)} = -3000 - \frac{117}{1.12} + \frac{900}{.12} \left( 1 - \left( \frac{1}{1.12} \right)^3 \right) \left( \frac{1}{1.12} \right) + \frac{1017}{(1.12)^5} = -597$$

Note: Same result as text

$$\text{Difference in text} = -20,107 - (-19,510) = -597$$

#### [Video Solution](#)

Concept Check: all

### 8.4 Further Adjustments to Free Cash Flow

#### 1. Other non-cash items

=> should back out (from UNI) any other non-cash items

#### 2. Timing of Cash Flows

=> cash flows likely spread throughout year instead of at end of year  
=> might increase accuracy if estimate cash flows over smaller time periods

#### 3. Accelerated Depreciation

Key issue: accelerated depreciation allows earlier recognition of depreciation

=> get cash flows from tax shield earlier  
=> present value of tax shield higher

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 recognize depreciation for the first time in year 1.

#### 4. Liquidation or Salvage Value

$$G = SP - BV \quad (8.8)$$

where:

G = gain

SP = sales price

BV = book value

$$BV = PP - AD \quad (8.9)$$

where:

PP = purchase price

AD = accumulated depreciation

$$ATCF = SP - \tau_c \times G \quad (8.10)$$

where:

ATCF = after-tax cash flow from asset sale

#### 5. Terminal or Continuation Value

Key issue: often assume cash flows grow at some constant rate forever beyond horizon over which forecast cash flows.

#### 6. Tax Carryforwards and Carrybacks

Key issue: can carryback losses to offset profits for previous two years and/or can carryforward losses to offset profits for following 20 years.

#### A. Examples

Note: In the following examples, we start with the simplest case in which free cash flow equals unlevered net income. Each subsequent example builds on the previous example by adding (or changing) an assumption. The new assumptions are underlined in each example.



## 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%.

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

$$NWC = C + AR + I - AP$$

$$FCF = UNI + D - CE - \Delta NWC$$

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

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

$$FCF_1 = 19,500$$

$$FCF_2 = 32,500$$

[Video Solution](#)

## 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.

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

$$NWC = C + AR + I - AP$$

$$FCF = UNI + D - CE - \Delta NWC$$

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

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

Note: holding cash doesn't affect UNI

Net Working Capital:

	t = 0	t = 1	t = 2	t = 3
Cash	0	1000	1500	0
A/R	-	-	-	-
Inventory	-	-	-	-
A/P	-	-	-	-
NWC	0	1000	1500	0
$\Delta NWC$	0	1000	500	-1500

$$FCF_1 = 19,500 - 1000 = 18,500$$

$$FCF_2 = 32,500 - 500 = 32,000$$

$$FCF_3 = 0 - (-1500) = 1500$$

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

[Video Solution](#)

## 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 from Examples 1, 2, or 3

Net Working Capital:

$$AR_1 = .75(110,000) = 82,500$$

$$AR_2 = .75(150,000) = 112,500$$

	t = 0	t = 1	t = 2	t = 3
Cash	0	1000	1500	0
A/R	0	82,500	112,500	0
Inventory	-	-	-	-
A/P	-	-	-	-
NWC	0	83,500	114,000	0
$\Delta NWC$	0	83,500	30,500	-114,000

$$FCF_1 = 19,500 - 83,500 = -64,000$$

$$FCF_2 = 32,500 - 30,500 = 2,000$$

$$FCF_3 = 0 - (-114,000) = 114,000$$

[Video Solution](#)

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:

$$AP_0 = .6(50,000) = 30,000$$

$$AP_1 = .6(70,000) = 42,000$$

	t = 0	t = 1	t = 2	t = 3
Cash	0	1000	1500	0
A/R	0	82,500	112,500	0
Inventory	50,000	70,000	0	0
A/P	30,000	42,000	0	0
NWC	20,000	111,500	114,000	0
$\Delta NWC$	20,000	91,500	2500	-114,000

$$FCF_0 = 0 - 20,000 = -20,000$$

$$FCF_1 = 19,500 - 91,500 = -72,000$$

$$FCF_2 = 32,500 - 2,500 = 30,000$$

$$FCF_3 = 0 - (-114,000) = 114,000$$

[Video Solution](#)

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%.

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

$$NWC = C + AR + I - AP$$

$$FCF = UNI + D - CE - \Delta NWC$$

$$D_1 = .3333(250,000) = 83,325$$

$$D_2 = .4445(250,000) = 111,125$$

Proceeds from sale of building:

$$\text{Book value}_2 = 250,000 - 83,325 - 111,125 = 55,550$$

$$\text{Gain} = 225,000 - 55,550 = 169,450$$

$$\text{After-tax proceeds} = 225,000 - 169,450(.35) = 225,000 - 59,307.50 = 165,692.50$$

$$CE_2 = -165,692.50$$

[Video Solution \(Part a\)](#)

Net Working Capital:

	t = 0	t = 1	t = 2	t = 3
Cash	0	1000	1500	0
A/R	0	82,500	112,500	0
Inventory	50,000	70,000	0	0
A/P	30,000	42,000	0	0
NWC	20,000	111,500	114,000	0
$\Delta NWC$	20,000	91,500	2500	-114,000

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

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

$$FCF_0 = 0 + 0 - 250,000 - 20,000 = -270,000$$

$$FCF_1 = -15,161.25 + 83,325 - 0 - 91,500 = -23,336.25$$

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

$$FCF_3 = 0 - (-114,000) = 114,000$$

[Video Solution \(Part b\)](#)

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 one input variable that makes  $NPV = 0$

Sensitivity analysis: examines impact on NPV of changing one input variable

Key concern: identify 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

=> covered earlier in notes