Chapter 8: Fundamentals of Capital Budgeting

Big Picture: To value a project, we must first estimate its cash flows.

Note: 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

I. Unlevered Net Income

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
=> see my website for Excel worksheets I have created for the example in the book

B. Calculating by hand:

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

where:

UNI = incremental unlevered net income
=> counting only incremental operating cash flows, but no financing cash flows

EBIT = incremental earnings before interest and taxes
τ_c = firm's marginal corporate tax rate
R = incremental revenues
E = incremental expenses (or costs)
D = incremental depreciation

C. Review of How to Identify Incremental Earnings (and Cash Flows)

1. General Principles

Basic question: How do the earnings (and cash flows) for the entire firm differ with the project verses 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: 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. 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

MACRS Depreciation:

Keys:
1) multiply cost of project by % listed in MACRS table
2) Year 0 = year asset first put into use (To minimize confusion, I will use the authors' modification of the IRS' table)
3) the following table is in Appendix A of the book

	Depreciation Rate for Recovery Period					
Year	3 Years	5 Years	7 Years	10 Years	15 Years	20 Years
0	33.33	20.00	14.29	10.00	5.00	3.750
1	44.45	32.00	24.49	18.00	9.50	7.219
2	14.81	19.20	17.49	14.40	8.55	6.677
3	7.41	11.52	12.49	11.52	7.70	6.177
4		11.52	8.93	9.22	6.93	5.713
5		5.76	8.92	7.37	6.23	5.285
6			8.93	6.55	5.90	4.888
7			4.46	6.55	5.90	4.522
8				6.56	5.91	4.462
9				6.55	5.90	4.461
10				3.28	5.91	4.462
11					5.90	4.461
12					5.91	4.462
13					5.90	4.461
14					5.91	4.462
15					2.95	4.461
16						4.462
17						4.461
18						4.462
19						4.461
20						2.231

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
=> called an opportunity cost

II. Free Cash Flow

A. Calculating Free Cash Flow

Key

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

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

where:

CE = incremental capital expenditures
ΔNWC = change in net working capital associated with project
NWC = *CA* – *CL* = *C* + *I* + *AR* –*AP* (8.3)
CA = incremental current assets
CL = incremental current liabilities
C = incremental cash
I = incremental inventory
AR = incremental accounts receivable
AP = incremental accounts payable

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

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

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

III. 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 21%.

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

UNI_1 = $23,700 = **(110,000 – (30,000+50,000) – 0)(1 – .21)**
UNI_2 = $39,500 = **(150,000 – (30,000+70,000) – 0)(1 – .21)**

FCF_1 = 23,700
FCF_2 = 39,500

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 21%.

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

$NWC = C + I + AR - AP$

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

$UNI_1 = (110{,}000 - (30{,}000+50{,}000) - 0)(1 - .21) = \$23{,}700$
$UNI_2 = (150{,}000 - (30{,}000+70{,}000) - 0)(1 - .21) = \$39{,}500$

Note: holding cash doesn't affect UNI

$NWC_1 = 1000 =$ **1000 + 0 + 0 – 0**
$NWC_2 = 1500 =$ **1500 + 0 + 0 – 0**
$NWC_3 = 0$

$\Delta NWC_1 = 1000 =$ **1000 – 0**
$\Delta NWC_2 = 500 =$ **1500 – 1000**
$\Delta NWC_3 = -1500 =$ **0 – 1500**

$FCF_1 = 22{,}700 =$ **23,700 – 1000**
$FCF_2 = 39{,}000 =$ **39,500 – 500**
$FCF_3 = 1500 =$ **0 – (–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 21%.

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

$NWC = C + I + AR - AP$

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

$UNI_1 = (110{,}000 - (30{,}000+50{,}000) - 0)(1 - .21) = \$23{,}700$

$UNI_2 = (150{,}000 - (30{,}000+70{,}000) - 0)(1 - .21) = \$39{,}500$

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

$NWC_0 = 0$

$NWC_1 = 83{,}500 =$ **1000 + 0 + 82,500 – 0**

Note: $AR_1 = 82{,}500 = .75 \times 110{,}000$

$NWC_2 = 114{,}000 =$ **1500 + 0 + 112,500 – 0**

Note: $AR_2 = 112{,}500 = .75 \times 150{,}000$

$NWC_3 = 0$

$\Delta NWC_1 = 83{,}500 =$ **83,500 – 0**

$\Delta NWC_2 = 30{,}500 =$ **114,000 – 83,500**

$\Delta NWC_3 = -114{,}000 =$ **0 – 114,000**

$FCF_1 = -59{,}800 =$ **23,700 – 83,500**

$FCF_2 = 9{,}000 =$ **39,500 – 30,500**

$FCF_3 = 114{,}000 =$ **0 – (–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 21%.

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

UNI_1 = (110,000 – (30,000+50,000) – 0)(1 – .21) = $23,700
UNI_2 = (150,000 – (30,000+70,000) – 0)(1 – .21) = $39,500

Note: doesn't change from previous examples

NWC_0 = 20,000 = **0 + 50,000 + 0 – 30,000**
Note: AP_0 = 30,000 = .6(50,000)

NWC_1 = 111,500 = **1000 + 70,000 + 82,500 – 42,000**
Note: AP_1 = 42,000 = – .6(70,000)

NWC_2 = 114,000 = **1500 + 0 + 112,500 – 0**

NWC_3 = 0

ΔNWC_0 = 20,000 = **20,000 – 0**
ΔNWC_1 = 91,500 = **111,500 – 20,000**
ΔNWC_2 = 2,500 = **114,000 – 111,500**
ΔNWC_3**=** – 114,000 = **0 – 114,000**

FCF_0 = – 20,000 = **0 – 20,000**
FCF_1 = – 67,800 = **23,700 – 91,500**
FCF_2 = 37,000 = **39,500 – 2,500**
FCF_3 = 114,000 = **0 – (–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. While you own the building, you will depreciate it using the 3-year MACRS class. You will put the building into use a year from today and thus recognize depreciation for the first time a year from today. 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%.

D_1 = 83,325 = **.3333(250,000)**
D_2 = 111,125 = **.4445(250,000)**

UNI_1 = – $18,426.75 = **(110,000 – 50,000 – 83,325)(1 – .21)**
UNI_2 = – $24,588.75 = **(150,000 – 70,000 – 111,125)(1 – .21)**

Note: NWC and ΔNWC is the same as Example 4

NWC_0 = 20,000 = 0 + 50,000 + 0 – 30,000
NWC_1 = 111,500 = 1000 + 70,000 + 82,500 – 42,000
NWC_2 = 114,000 = 1500 + 112,500 + 0 – 0
NWC_3 = 0

ΔNWC_0 = 20,000 – 0 = 20,000;
ΔNWC_1 = 111,500 – 20,000 = 91,500;
ΔNWC_2 = 114,000 – 111,500 = 2,500;
ΔNWC_3 = 0 – 114,000 = – 114,000

FCF_0 = – 270,000 = **0 + 0 – 250,000 – 20,000**
$FCF = UNI + D - CE - \Delta NWC$

FCF_1= – 26,601.75 = **– 18,426.75 + 83,325 – 0 – 91,500**

Proceeds from sale of building:

Book $value_2$ = 55,550 = **250,000 – 83,325 – 111,125**
After-tax proceeds = 189,415.50 = **225,000 – (225,000 – 55,550)(.21)**
CE_2 = -189,415.50

FCF_2 = 273,451.74 = **– $24,588.75 + 111,125 – (–189,415.50) – 2,500**
FCF_3 = 114,000 = **0 – (–114,000)**

IV. Break-even Analysis, Sensitivity Analysis, and Scenario Analysis

Break-even: level of some input that makes NPV = 0
Sensitivity analysis: examines impact on NPV of changing one input variable
Scenario analysis: examines impact on NPV of changing multiple related input variables

Key: Use goal seek and data tables in Excel