Chapter 7, Capital Budgeting and NPV

You are responsible for reading the examples in sections 7.2 and 7.3 of RWJ.

NPV and Capital Budgeting

In Chapters 4 – 6 we saw the basics of *capital budgeting* (using NPV, etc.).

In this chapter we will systematically determine what cash flows should be included.

Incremental Cash Flows

In calculating the NPV of a project, only incremental cash flows should be used.

1.) Sunk Costs

- NOT incremental cash flows.
- It is a cost that has already occurred, regardless of whether the decision to accept a project will be made.

Real life examples of Sunk Cost

- Your studies—your decision should be made on future events, not the past
- Investing—decisions about a stock/bond should be made with current information.
  - Example: If you thought a stock was a good buy at $40, and it drops to $30 after you bought it. Should you sell? Buy?
- Poker—you shouldn't think of the money already in the pot as yours, it's the pots' money, regardless of how much you've put in.

Incremental Cash Flows II

2.) Opportunity Costs

- Incremental cash flows.
- For example, if a firm uses an existing asset for a new project, then it foregoes ***other opportunities*** for using the asset.

3.) Taxes

- Incremental cash flows.
- Income before taxes – Taxes = Net Income

Real life opportunity costs:

- You probably subconsciously consider opportunity costs already
- Time
  - Playing on an intramural team
  - Studying
  - Partying
- Money
  - Anything you buy

Incremental Cash Flows III

4.) <u>Side Effects</u>

How does one project affect other projects?

- Erosion
- Synergy

Incremental Cash Flows IV

5.) Depreciation

- Depreciation expenses are subtracted from pre-tax income, thus lowering the tax bill.
- This creates a tax shield.

Another item: Net Working Capital

An investment in NWC can arise through several sources—inventory purchases, credit sales, or cash kept as a buffer against unforeseen costs.

Eventually the level of NWC will return to zero at the end of the project.

Operating Cash flow definitions

Operating Cash Flow after Taxes

= Revenues – Expenses – Taxes

Taxes= T_C [Revenues – Expenses - Depreciation]

(Where T_C = Corporate Tax Rate)

OCF = Revenues – Expenses

– T_C [Revenues-Expenses – Depreciation]

OCF = Revenues (1-T_C) – Expenses (1-T_C) +D T_C

Operating Cash Flows (T_C=34%)

If revenues increase by \$1, after tax cash-flow increases by \$1 $(1-T_C)$= 66 cents.

If expenses increase by \$1, after tax cash-flow decreases by \$1 $(1-T_C)$ = 66 cents.

For each \$1 of depreciation allowances, OCF increases by \$1 (T_C) = 34 cents.

Depreciation Tax Shield =

(Depreciation Allowance) x (Corporate Tax Rate)

Example: Deciduous Inc.

Deciduous Inc is deciding whether or not to enter the aluminum siding business. Projected sales, total NWC and capital investments are on the right. Variable costs are 60% of sales, and fixed costs are negligible. The $20,000 in production equipment will be depreciated on a straight-line basis over a five year period. The equipment will be worth $10,000 in six years.

Year	Sales	NWC	Inv.
0	$0	$400	$20,000
1	5,000	500	0
2	6,000	500	0
3	9,000	700	0
4-6	10,000	700	0

The required rate of return is 10% and the firm's tax rate is 34%. Should Deciduous embark on this new line of business?

Inflation

Valuation of long term projects demands an explicit treatment of inflation. Projected cash flows as well as the cost of capital need to be adjusted to reflect expected inflation.

Notation:

- r_n: Nominal interest rate
- r_r: Real interest rate
- i_e: Expected inflation rate

Definitions and Algebra

Definition:

$$(1+r_n)=(1+r_r)(1+i_e)$$

Simplifying?

$$(1+r_n)=1+r_r+i_e+r_r i_e$$

$$r_n=r_r+i_e+r_r i_e$$

A good approximation for the above is

$$r_n \cong r_r+i_e$$

Or,

$$r_r \cong r_n-i_e$$

Interest Rate Example

<u>Example</u>: r_n=10%, i_e=4%

$$r_r = \frac{(1+0.1)}{(1+0.04)} - 1 = 5.8\%$$

$$r_r \cong 0.1 - 0.04 = 6\%$$

So the approximation is valid, at least for small interest rates and inflation

Nominal Versus Real Interest Rates and Cash Flows?

Cash flows and interest rates can be used in either nominal or real (i.e., inflation-adjusted) terms. However, one has to be consistent.

Nominal cash flows discounted at the *nominal interest rate*.

Or

Real cash flows discounted at the *real interest rate*.

Projects with unequal lives

Suppose a firm chooses between two machines of unequal lives. The machines perform the same function, so only one will be purchased. How should we decide between the two machines?

In this case, if you use NPV ignores the fact that you need to buy a new machine sooner in one case than the other!

Example

Two machines have the following investment and maintenance expenses during their lives:

	0	1	2	3	4
Machine A	-500	-120	-120	-120	
Machine B	-600	-100	-100	-100	-100

PV(A) = -$798.42 > PV(B) = -$916.99.

Seems like one should choose the 1st machine, since the PV of its expenses is lower than for the 2nd machine….

….This may be wrong!

Replacement Chains

Calculate PV (costs) for the same time horizon.

In this example, Machine A has a lifetime of 3 years, and Machine B has a lifetime of 4 years.

If we repeat the analysis over a period of 12 years, A would have 4 replacement cycles and B would have 3.

- This is tedious! If we were added a machine with a 5 year lifetime, our chain would be 60 years long.

EAC: Equivalent Annual Cost Method

Idea: Amortize the cash flows to get a per-year cost for each piece of equipment. This gives the Equivalent Annual Cost of each machine.

This results in a annual payment on the Machine A of $321.05. The Machine B costs $289.28 per year.

Thus, Machine B should be the one purchased.