

ENGM 401 & 620 – X1

Fundamentals of Engineering Finance

Fall 2010

Lecture 28:

After Tax Cash Flow

A corporation's primary goal is to make money.

Government's primary role is to take a big chunk of that money and give it to others.

- Larry Ellison

M.G. Lipsett

Department of Mechanical Engineering

University of Alberta

http://www.ualberta.ca/~mlipsett/ENGM401_620/ENGM401_620.htm

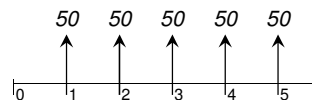


Department of Mechanical Engineering
Engineering Management Group



Inflation (Review)

- True or False: Inflation increases the actual value of a currency in the future for equivalent purchasing power.
- True or False: Tax is calculated before correcting for inflation.
- For this cash flow series, what is the NPV for $i = 5\%$ and $f = 2\%$?
 - a) \$216.47.
 - b) \$222.59.
 - c) \$228.99.
 - d) \$229.37.
 - e) \$235.67.



- You are in the country of Elbonia, which has 3650% inflation rate. If a cup of coffee cost ELB \$5 yesterday, how much will a cup of the same size cost you today?
 - a) \$4.90.
 - b) \$5.00.
 - c) \$5.10.
 - d) \$5.50.
 - e) \$10.00.



After-Tax Cash Flow (ATCF)

- Investment analysis should really be based on **incremental after-tax** cash flow
 - What **net** outflows (expenditures) and inflows (income) occur **because of the project**?
- Tax is complex. We consider only simple after-tax situations
- Recall that tax has its own method of depreciation, called CCA, and the undepreciated value is called UCC
 - CCA uses declining balance
 - Half-year rule: use one half of otherwise allowable CCA in year 1 (when assets purchased and used)
 - Available for use rule: don't include in CCA until actually used for production (unless you qualify for "major project" exemption)
- Assets are "pooled" into asset class accounts (each with its own rate, so each class gets tracked separately)
- Since declining balance is used, the cash flow effects of an asset essentially exist forever



Capital Cost Allowance Calculation (Review)

- When calculating capital cost allowance for year t (CCA_t) and the unclaimed capital allowance for year t (UCC_t), group assets by their taxation class and use the appropriate rate R for each class.
- The sum of transactions for year t is T_t (asset transaction is positive for purchase of an asset & negative for a sale).
- Calculation procedure:
 - Find T_t , the sum of the transactions for the current year t
 - If $T_t > 0$, then $T_t^* = 0.5 \times T_t$; otherwise $T_t^* = T_t$
- Calculate $CCA_t = R \times (UCC_{t-1} + T_t^*)$
- Calculate $UCC_t = UCC_{t-1} + T_t - CCA_t$



Review CCA

- You purchase \$246k worth of CCA Class 8 equipment (i.e., 20% CCA rate). What are its CCA and UCC over the next ten years?

| Year | $UCC_{t-1} + T_t^*$ | CCA (20%) | UCC_t |
|------|---------------------|-----------|---------|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |



Review CCA (2)

- You purchase \$246k worth of CCA Class 8 equipment (i.e., 20% CCA rate). What are its CCA and UCC over the next ten years?

| Year | $UCC_{t-1} + T_t^*$ | CCA (20%) | UCC_t |
|------|---------------------|-----------|-----------|
| 1 | \$123 000 | \$24 600 | \$221 400 |

$$UCC_0 = 0$$

$$T = \$246k$$

$$UCC_t = UCC_{t-1} + T - CCA$$

Half-year rule applies, so
 $T^* = \$123k$

Note that if you have multiple classes of equipment (which is typical), then you'll have separate CCA calculations but the sum of all of them will give you your total CCA to charge against income.



Review CCA (3)

- You purchase \$246k worth of CCA Class 8 equipment (i.e., 20% CCA rate). What are its CCA and UCC over the next ten years?

| Year | $UCC_{t-1} + T_t^*$ | CCA (20%) | UCC_t |
|------|---------------------|-----------|-----------|
| 1 | \$123 000 | \$24 600 | \$221 400 |
| 2 | \$221 400 | \$44 280 | \$177 120 |

For each class of asset,
UCC carries over to the next year
as the basis for the next year's CCA



Review CCA (4)

- You purchase \$246k worth of CCA Class 8 equipment (i.e., 20% CCA rate). What are its CCA and UCC over the next ten years?

| Year | $UCC_{t-1} + T_t^*$ | CCA (20%) | UCC_t |
|------|---------------------|-----------|-----------|
| 1 | \$123 000 | \$24 600 | \$221 400 |
| 2 | \$221 400 | \$44 280 | \$177 120 |
| 3 | \$177 120 | \$35 424 | \$141 696 |
| 4 | \$141 696 | \$28 339 | \$113 357 |
| 5 | \$113 357 | \$22 671 | \$90 685 |
| 6 | \$90 685 | \$18 137 | \$72 548 |
| 7 | \$72 548 | \$14 510 | \$58 039 |
| 8 | \$58 039 | \$11 608 | \$46 431 |
| 9 | \$46 431 | \$9 286 | \$37 145 |
| 10 | \$37 145 | \$7 429 | \$29 716 |

UCC just carries over in subsequent years (unless new assets purchased in that class, in which case half-year rule applies again)



Calculating (Simplified) After-Tax Cash Flow

- **Pre-tax net income** is calculated as revenues minus cash expenses (normal business operations)
 - Note that some expenses (e.g., meal and entertainment expenses) recognized by a business are not recognized by the Canada Revenue Agency, but for investment analysis this can be ignored
- Capital Cost Allowance (CCA) is deducted (**up to** the limit of net income from **all** sources) to get the **taxable income**
 - Taxes for *incremental* cash flow (part of a company) may be negative
 - but only to the extent that other sources of income exist from which to deduct taxes (an advantage for a larger company)
- Tax rate is applied to taxable income to calculate tax
- Tax is deducted from taxable income to yield after-tax income
 Because interest is a taxable expense, the cost of interest is subtracted from income before debt service (that's the interest portion only, not any principal repayment, which is paid out of after - tax income).



After Tax Cash Flow Example 1

- You purchase \$246k worth of CCA Class 8 equipment and expect net cash flows of \$35k in year 1, increasing by \$10k per year for 10 years total. What are the after-tax cash flows (marginal tax rate of 35%, CCA rate 20%)?

| Year | Pre-tax Cash Flow | CCA | Taxable Income | Taxes Payable | After-Tax Cash Flow |
|------|-------------------|-----|----------------|---------------|---------------------|
| 0 | \$ -246,000 | - | - | - | \$ -246,000 |
| 1 | \$ 35,000 | | | | |
| 2 | \$ 45,000 | | | | |
| 3 | \$ 55,000 | | | | |
| 4 | \$ 65,000 | | | | |
| 5 | \$ 75,000 | | | | |
| 6 | \$ 85,000 | | | | |
| 7 | \$ 95,000 | | | | |
| 8 | \$ 105,000 | | | | |
| 9 | \$ 115,000 | | | | |
| 10 | \$ 125,000 | | | | |



Tax Calculations: First Year of Production

- When can we start claiming CCA? Year 1 (available for use rule)
- $UCC_0 + T^* = \$0 + 0.5 \times \$246k = \$123,000$ (half-year rule applies)
- $CCA_1 = R \times (UCC_0 + T^*) = .20 \times \$123,000 = \$24,600$
- Taxable Income = (Before Tax Cash Flow) – CCA
= $\$35,000 - \$24,600 = \$10,400$
- Tax = Tax Rate x Taxable Income = $0.35 \times \$10,400 = \$3,640$
- After Tax Cash Flow = (Before Tax Cash Flow) – Tax
= $\$35,000 - \$3,640 = \$31,360$
- UCC then becomes $UCC_1 = UCC_0 + T - CCA_1$ (not T^*)
= $\$246,000 - \$24,600 = \$221,400$

| Year | Pre-Tax Cash Flow | CCA | Taxable Income | Taxes Payable | After-Tax Cash Flow |
|------|-------------------|-----------|----------------|---------------|---------------------|
| 0 | \$ -246,000 | - | - | - | \$ -246,000 |
| 1 | \$ 35,000 | \$ 24,600 | \$ 10,400 | \$ 3,640 | \$ 31,360 |



Before Tax Cash Flow & After Tax Cash Flow

- Years 2 through 10 use the same calculation procedure.
 - If additional assets were purchased & available for use, the half-year rule would apply again in the year of purchase.
- The after-tax cash flows (future values) are:

$R = 20\%$

| Year | Pre-tax Cash Flow | CCA | Taxable Income | Taxes Payable | After-Tax Cash Flow |
|------|-------------------|-----------|----------------|---------------|---------------------|
| 0 | \$ -246,000 | - | - | - | \$ -246,000 |
| 1 | \$ 35,000 | \$ 24,600 | \$ 10,400 | \$ 3,640 | \$ 31,360 |
| 2 | \$ 45,000 | \$ 44,280 | \$ 720 | \$ 252 | \$ 44,748 |
| 3 | \$ 55,000 | \$ 35,424 | \$ 19,576 | \$ 6,852 | \$ 48,148 |
| 4 | \$ 65,000 | \$ 28,339 | \$ 36,661 | \$ 12,831 | \$ 52,169 |
| 5 | \$ 75,000 | \$ 22,671 | \$ 52,329 | \$ 18,315 | \$ 56,685 |
| 6 | \$ 85,000 | \$ 18,137 | \$ 66,863 | \$ 23,402 | \$ 61,598 |
| 7 | \$ 95,000 | \$ 14,510 | \$ 80,490 | \$ 28,172 | \$ 66,828 |
| 8 | \$ 105,000 | \$ 11,608 | \$ 93,392 | \$ 32,687 | \$ 72,313 |
| 9 | \$ 115,000 | \$ 9,286 | \$ 105,714 | \$ 37,000 | \$ 78,000 |
| 10 | \$ 125,000 | \$ 7,429 | \$ 117,571 | \$ 41,150 | \$ 83,850 |

UCC

\$221 400

\$177 120

\$141 696

\$113 357

\$90 685

\$72 548

\$58 039

\$46 431

\$37 145

\$29 716



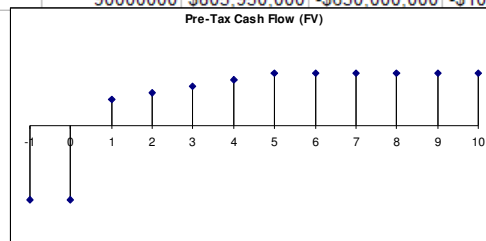
After-Tax Cash Flow In-Class Example 2

- A new microchip foundry has a capital cost of \$200M. Prepare incremental after-tax cash flows for the next 10 years, under the following operating scenario:
 - Design throughput is nominally 90 million units per year
 - 1st year production is at 80%, increasing by 5% per year until it reaches 100% in 5th year and every year thereafter
 - Revenues are \$9 per chip that is sold. There is a 0.5% reject rate.
 - Variable operating costs are \$7 per unit produced (including rejects).
 - Fixed operating costs are \$105 million per year.
 - Your marginal corporate tax rate is 40%; CCA rate is 30%.
- What is the project's NPV (at MARR of 14%)?
- What is IRR?



Before Tax Cash Flow

| Year n | Capital Costs | Production (units) | Gross Revenue | Variable Operating Costs | Fixed Operating Costs | Pre-Tax Cash Flow |
|--------|----------------|----------------------------------|---------------|--------------------------|-----------------------|-------------------|
| -1 | -\$100,000,000 | | | | | -\$100,000,000 |
| 0 | -\$100,000,000 | (@\$9/unit but 0.5% reject rate) | | (@\$7/unit produced) | | -\$100,000,000 |
| 1 | | 72000000 | \$644,760,000 | -\$504,000,000 | -\$105,000,000 | \$35,760,000 |
| 2 | | 76500000 | \$685,057,500 | -\$535,500,000 | -\$105,000,000 | \$44,557,500 |
| 3 | | 81000000 | \$725,355,000 | -\$567,000,000 | -\$105,000,000 | \$53,355,000 |
| 4 | | 85500000 | \$765,652,500 | -\$598,500,000 | -\$105,000,000 | \$62,152,500 |
| 5 | | 90000000 | \$805,950,000 | -\$630,000,000 | -\$105,000,000 | \$70,950,000 |
| 6 | | 90000000 | \$805,950,000 | -\$630,000,000 | -\$105,000,000 | \$70,950,000 |
| 7 | | 90000000 | \$805,950,000 | -\$630,000,000 | -\$105,000,000 | \$70,950,000 |
| 8 | | 90000000 | \$805,950,000 | -\$630,000,000 | -\$105,000,000 | \$70,950,000 |
| 9 | | 90000000 | \$805,950,000 | -\$630,000,000 | -\$105,000,000 | \$70,950,000 |
| 10 | | 90000000 | \$805,950,000 | -\$630,000,000 | -\$105,000,000 | \$70,950,000 |





Tax Calculations: First Year of Production

- Why is the first year of the project -1??
 - This allows us to consider present values in terms of the year that production begins as year 1.
- When can we start claiming CCA?
 - In the first year of production: year 1. UCC is \$200M because none of the capital costs have been claimed yet (so half-year rule applies).
- $UCC_0 + T^* = 0.5 \times \$200M = \$100M$
- $CCA_1 = R \times (UCC_0 + T^*) = .30 \times \$100M = \$30M$
 - Which is subtracted from Before Tax Cash Flow for year 1
- Taxable Income = (Before Tax Cash Flow) – CCA
- Tax = (Tax Rate) x (Taxable Income)
- After Tax Cash Flow = (Before Tax Cash Flow) – Tax

- UCC then becomes $UCC_1 = UCC_0 + T - CCA_1$ (not T^*)



Tax Calculations for After Tax Cash Flow (FV)

| Year n | Pre-Tax Cash Flow | CCA | UCCt | Taxable Income | Tax | After-Tax Cash Flow FV |
|--------|-------------------|--------------|---------------|----------------|--------------|------------------------|
| -1 | -\$100,000,000 | | \$100,000,000 | | | -\$100,000,000 |
| 0 | -\$100,000,000 | | \$200,000,000 | | | -\$100,000,000 |
| 1 | \$35,760,000 | \$30,000,000 | \$170,000,000 | \$5,760,000 | \$2,246,400 | \$33,513,600 |
| 2 | \$44,557,500 | \$51,000,000 | \$119,000,000 | -\$6,442,500 | -\$2,512,575 | \$47,070,075 |
| 3 | \$53,355,000 | \$35,700,000 | \$83,300,000 | \$17,655,000 | \$6,885,450 | \$46,469,550 |
| 4 | \$62,152,500 | \$24,990,000 | \$58,310,000 | \$37,162,500 | \$14,493,375 | \$47,659,125 |
| 5 | \$70,950,000 | \$17,493,000 | \$40,817,000 | \$53,457,000 | \$20,848,230 | \$50,101,770 |
| 6 | \$70,950,000 | \$12,245,100 | \$28,571,900 | \$58,704,900 | \$22,894,911 | \$48,055,089 |
| 7 | \$70,950,000 | \$8,571,570 | \$20,000,330 | \$62,378,430 | \$24,327,588 | \$46,622,412 |
| 8 | \$70,950,000 | \$6,000,099 | \$14,000,231 | \$64,949,901 | \$25,330,461 | \$45,619,539 |
| 9 | \$70,950,000 | \$4,200,069 | \$9,800,162 | \$66,749,931 | \$26,032,473 | \$44,917,527 |
| 10 | \$70,950,000 | \$2,940,049 | \$6,860,113 | \$68,009,951 | \$26,523,881 | \$44,426,119 |

For CCA, use half-year rule in year 1 (the first year available, in this case)

$$UCC_0 + T^* = 0.5 \times \$200M = \$100M$$

$$CCA_1 = R \times (UCC_0 + T^*) = .30 \times \$100M = \$30M$$

$$\text{Taxable Income} = (\text{Before Tax Cash Flow}) - CCA$$

$$\text{Tax} = (\text{Tax rate}) \times (\text{Taxable Income})$$

$$\text{After Tax Cash Flow} = (\text{Before Tax Cash Flow}) - \text{Tax}$$

$$UCC_1 = UCC_0 + T - CCA_1$$



What About Salvage Value?

- Because CCA is calculated using declining balance (i.e., it carries on forever), disposal of assets is not straightforward
 - A **disposal tax effect** (DTE) accounts for the fact that salvage value provides a loss or a gain
- DTE in year t is equivalent to the difference between the salvage value and the UCC_t book value multiplied by the tax rate TR :

$$DTE = (BookValue - SalvageValue) \times TR$$
- **Example:** If you dispose of the previous \$246k asset for \$20k in year 10, what is the after tax cash flow that year?



Salvage Value: Two Other Cases

- If you sell an asset for greater than its UCC value:
- DTE is negative (salvage value is larger than book value), meaning the tax effect is an increase in taxes (i.e., DTE reduces ATCF)
- If you sell an asset for greater than its purchase price (Basis Value), then DTE is negative, and equal to the sum of two tax effects:

$$\text{Tax On Recapture} = (BookValue - BasisValue) \times TR$$

$$\text{Capital Gains Tax} = (BasisValue - Salvage Value) \times TR / 2$$

$$DTE = \text{Tax On Recapture} + \text{Capital Gains Tax}$$



Salvage Value: Example

- If you dispose of the previous \$246k asset for \$300k in year 10, what is the after tax cash flow that year?

Tax on Recapture =

Capital Gains Tax =

DTE =

ATCF_{year10} =



Summary

- Tax will be part of the costs in a cash flow series
- An investment opportunity needs to include tax to show the value correctly
- Before-tax future cash flows may be adjusted for inflation, to reflect the effect of inflation, before calculating after-tax cash flow
- Salvage value also has tax implications

- Tax scenarios in this course are greatly simplified, which is useful for assessing technology investments; but you should consult a professional for specific situations in the real world !!